

# Canadian Water Regulations Applicable to Hydraulic Fracturing Operations



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Published March 2016



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# S O U R C I N G

# IMPORTANT TERMINOLOGY

## BRITISH COLUMBIA

Drinking Water (Potable)	Total Dissolved Solids (TDS) less than 500mg/L
Agricultural Standards (Non - saline)	Total Dissolved Solids (TDS) less than 4000mg/L
Sea Water	Water with TDS range from 30,000 - 40,000mg/L
Formation Water	(NE BC) Water with TDS range of 20,000-200,000mg/L

## ALBERTA

Drinking Water (Potable)	Water used for drinking, cooking, dishwashing or other domestic purposes requiring water that is suitable for human consumption
Ground Water (Non - saline)	Groundwater having TDS less than or equal to 4000mg/L
Ground Water (Saline)	Water from wells greater than 150 meters deep (TDS greater than 4000mg/L)
Surface Water	Surface water means all water on the ground surface, whether in liquid or solid state

## SASKATCHEWAN

Drinking Water (Potable)	Total Dissolved Solids (TDS) less than 1500mg/L
Agricultural Standards (Non - saline)	Total Dissolved Solids (TDS) less than 4000mg/L
Canadian Council of Ministers of the Environment	The primary minister-led intergovernmental forum for collective action on environmental issues of national and international concern

## MANITOBA

### Water

All water on or below the surface of the ground. Refer to Canadian drinking water standards along with Manitoba bacteriological, microbial, chemical and physical standards

## NEW BRUNSWICK

### Clean Water Act

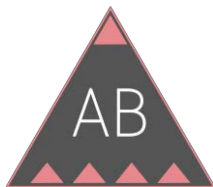
The Clean Water Act refers to six water classes: Outstanding Naturals Class, AP Class, AL Class, A Class, B Class, C Class

# PROVINCIAL SPECIFICATIONS & REGULATIONS

## SURFACE WATER



The Ministry of Forests, Lands and Natural Resources (FLNR) are responsible for longer term licences for the use of surface water. Details are contained in Section 8 of the Water Act for Permits. Permits are awarded for 24-month periods.



The quantities of surface water available and rates of diversion for licensing may be limited by requirements to meet water conservation objectives, aquatic ecosystem protection, environmental and in-stream flows, trans-boundary apportionment agreements, allocations granted to previous licences, or other factors per the Water Conservation and Allocation Policy for Oilfield Injection from Water for Life (2006). In addition, the Environment and Parks' *Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams* provides a technique for calculating environmental flow requirements in the absence of site-specific assessments or recommendations.



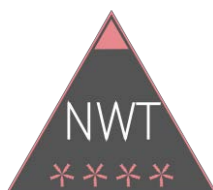
The use of surface water requires approval and is managed by the Water Security Agency Act. Their policy states that "any use that will consume greater than 5 cubic dm (4 acre-feet) of ground water will require an approval." To obtain requirements for the acquisition of an approval click [here](#).



Licensing is managed through the Water Rights Act for usage exceeding 25,000 litres/day.



Defined by the various water class systems and managed by the New Brunswick Energy & Utilities Board for Oil and Gas Fracturing.



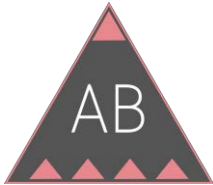
Licensing and managing of surface water is done by: Mackenzie Valley Resource Management Act (MVRMA), Northwest Territories Water Regulations, Northwest Territories Waters Act, Sahtu Land Use Plan, DFO (Fisheries and Oceans Canada) 2010. GNWT Environmental Protection Act, GNWT Spill Contingency Planning and Reporting Regulations.

# GROUND WATER

The application for saline water usage will initiate a comprehensive environmental assessment. Water sources, as well as injection and disposal wells, are governed by the BC Oil and Gas Commission (BCOGC). The publication Water Source, Injection and Disposal Service Wells Summary Information (2014) provides guidance for understanding subsurface water management as it applies to Oil and Gas. Legislation includes the Drilling and Production Regulation, and the Oil and Gas Activities Act General Regulation. Groundwater withdrawals of greater than 75 litres/second require that an environmental assessment be performed.



Groundwater quantity limitations and evaluations requirements are described in the Environment and Parks' Guide to Groundwater Authorization (2011). Additional site-specific requirements may be prescribed during licence application and review.



All ground water use except domestic requires an approval. The Water Security Agency Act manages groundwater. The Approval Process includes obtaining: 1) Groundwater Investigation Permit  
2) Approval to Construct and Operate Works and Water Rights Licence to Use Ground Water.



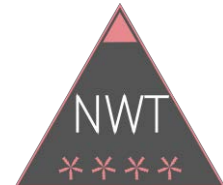
See Surface Water Description.



See Surface Water Description.



See Surface Water Description.





## PIPELINES & TRUCKING



**Pipelines:** Requirements for water transport are managed by the BC Oil and Gas Commission.

**Trucking:** There are no specific regulations pertaining to the transportation of fresh water. Brackish or saline water requires proper labeling, proper Transportation of Dangerous Goods (TDG) and truck dockets. (Federal)



**Pipelines:** Alberta has requirements for pipelines that originate and terminate within the province. Alberta regulates pipelines (including water) through the Pipeline Act and Pipeline Rules. Directive 56, Section 6 (Pipelines) require an applicant to submit 'Substance Detail' information (sec. 6.12.2, pg. 6-53) including the 'substance' and 'Code'; Table 6.6 identifies 'produced water' and 'potable water, surface water' as substances with this own substance category and code. A license under the Pipeline Rules is exempt if it is for surface water or non-saline groundwater meeting the exemption requirements specified in s.3(3)(d) of the pipeline rules. Bulletin 2014-38 provides greater detail on the exemption.

**Trucking:** No applicable information for trucking.



**Pipelines:** For information on Pipelines as it applies to water transport, see the Guide to Waterworks Design from the Water Security Agency (Saskatchewan Ministry of Environment): A Guide to Waterworks Design Section 2.5 Supply Pipelines.

**Trucking:** No applicable information for trucking.



**Pipelines:** Trans-jurisdiction large pipelines may be regulated by the National Energy Board (NEB) or the Government of Northwest Territories (GNWT) Department of Industry, Tourism and Investment (ITI) and Office of the Regulator of Oil and Gas (OROGO).

**Trucking:** Regulations for trucking address the proper manifesting, reporting of spills, etc. on roadways. These regulations are contained in:

- Transportation of Dangerous Goods Act
- Northwest Territories Water Regulations
- Northwest Territories Waters Act
- GNWT Environmental Protection Act
- GNWT Spill Contingency Planning and Reporting Regulations

NOTE: Barging is also a mode of transport and is addressed and managed by marine legislation

## LICENSING APPLICATIONS

	Relevant Information
BC	<p>See section on Surface Water/Groundwater for information on Licensing Applications.</p> <p>Water approvals contain: minimum flow requirements, maximum drawdown on natural water bodies, maximum daily allowable withdrawal, and water withdrawal during low flow conditions, which is prohibited.</p>
AB	<p>See section on Surface Water/Groundwater for information on Licensing Applications. The Water Act, Alberta's legislation that supports and promotes the conservation and management of Crown owned water regulates the diversion of water from surface water bodies and groundwater sources. A Water Act licence application review by regulatory staff of the Alberta Energy Regulator determines whether water diversion impacts on the environment, or other water users, are in accordance with the Act and associated regulations and policies. This review ensures the sustainable use of water resources, protection of aquatic ecosystems and water availability to other users.</p> <p>A temporary diversion licence (TDL) may be issued for short-term water uses up to one-year duration. TDLs are submitted to the online Water Act temporary diversion license Electronic Review System (WATERS).</p>
SK	<p>The right to use ground and surface water is vested in the Crown and is administered by the <u>Water Security Agency</u>. A Temporary Water Rights Licence is required for industries using water for temporary processing operations including: mineral exploration and mining, oil exploration and recovery, manufacturing, gravel washing, road construction, hydraulic pressure testing, thermal power generation, and other purposes that the Water Security Agency may designate. For exemptions, guidelines and fees, click <a href="#">here</a>.</p>

MB	<p>Managed by: <u>Public Registry for Environmental Approvals</u>. The Water Stewardship Division issues water approvals. A <u>Water Rights Licence</u> is required for use of surface water and groundwater if use exceeds 25,000 litres per day and can be issued for up to 20 years.</p>
NB	<p>Managed by the Government of New Brunswick. For a Water Supply Source Assessment Permit click <a href="#">here</a>.</p>
NWT	<p>In the Sahtu region, water is regulated by :</p> <ul style="list-style-type: none"> <li>• Territorial jurisdiction, which includes the Sahtu Land and Water Board (SLWB) and Environment and Natural Resources (ENR)</li> <li>• Federal jurisdiction, which includes the Department of Fisheries and Oceans (DFO).</li> </ul> <p>The applicable regulatory framework for definitions, usage, reporting, volumes, and licensing, etc., is contained in the lists above. Individual water licences are issued by the SLWB, which defines terms and conditions around water use, withdrawal, volumes, and reporting, etc.</p>

# CONTAINMENT

## BRITISH COLUMBIA

BC Oil and Gas Commission (OGC):  
Facility Application Storage Manual,  
Appendix E.

Containment is also governed by drilling and production regulations.

## ALBERTA

AER Directive 55 and its associated documents (Addendum to 55 and Report 2009A) identify requirements for storage of materials produced, generated (including oilfield waste such as flow back) or used by the upstream petroleum industry. Directive 55 Table 1 provides a summary of the requirements applicable to oilfield material storage. Directive 55 excludes fresh water storage.

AER Directive 55 Addendum provides requirements for above ground synthetically-lined wall storage systems, updates to liner requirements, and diking requirements for single-walled above ground storage tanks.

AER Directive 58 specifies management of oilfield waste (including recycle, reuse and/or disposal).

Surface water and non-saline groundwater storage require an approval under the Water Act. Saline water storage requires an approval under the Environmental Protection and Enhancement Act for saline water having greater than 5000 mg/L chlorides.

**SASKATCHEWAN**

Refer to: Waterworks Design Standard from the Water Security Agency (Saskatchewan Ministry of Environment) - Section 4: Treated Water Storage.

**NEW BRUNSWICK**

Managed by the Government of New Brunswick. Water Supply Source Assessment Permit.

**MANITOBA**

Managed by: Public Registry for Environmental Approvals and Water Stewardship Division - A Water Rights Licence is required for use of surface water and groundwater if use exceeds 25,000 litres per day and can be issued for up to 20 years.

**NORTHWEST TERRITORIES**

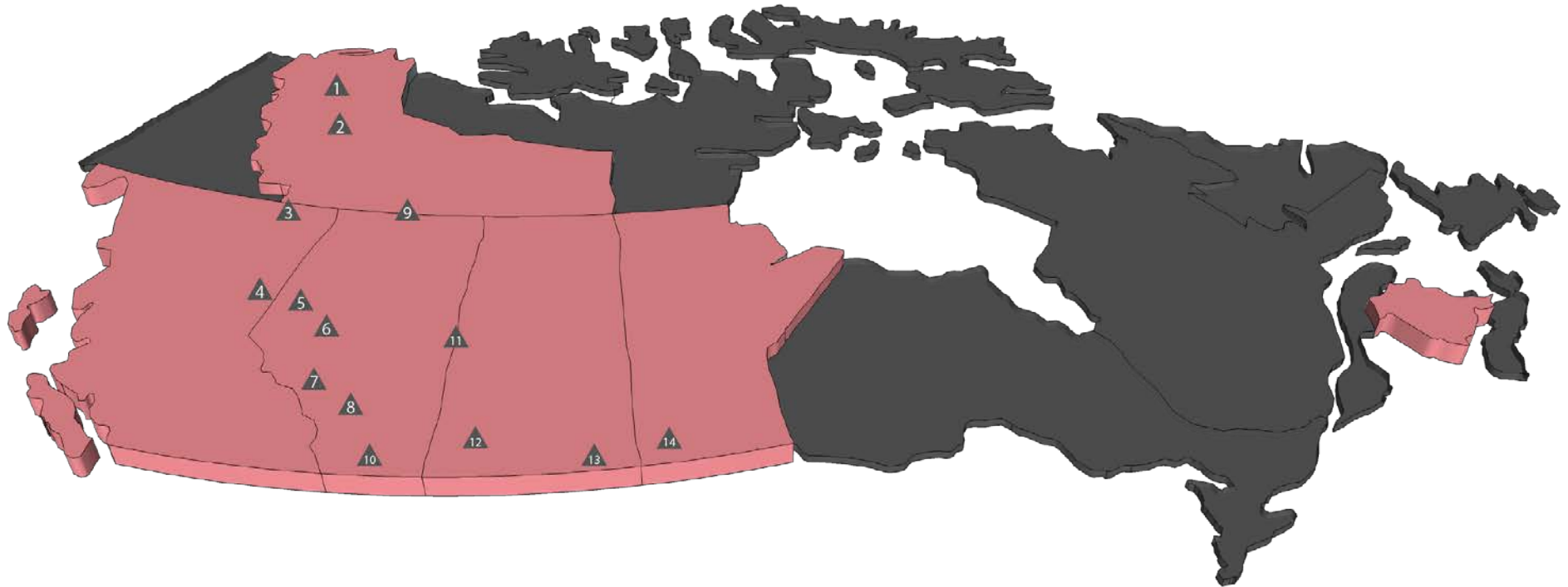
Oil and Gas regulations are outcome-based and therefore require proponents to define their risk management and operational controls. These control commitments are then written into Terms and Conditions of Land Use Permits or Water Licences issued by SLWB. Applicable legislation would include regulatory outcomes, reporting requirements and registrations, if required.

# U S A G E

# NATIONAL WATER APPLICATION MAP

## Types of Fracturing Systems:

- Slickwater
- Linear Gels
- Crosslink Fluids
- Viscoelastic Fluids



### British Columbia (Horn River)

Volume Usage:  
2,500m<sup>3</sup> – 5,000m<sup>3</sup>/stage

Ranging from:  
10,000m<sup>3</sup> - >100,000m<sup>3</sup>/well

### Alberta Volume Usage:

Upper limits can be as  
much as 70,000m<sup>3</sup> for  
total water volumes of  
fracturing.

Typical volumes:  
10,000m<sup>3</sup> - 20,000m<sup>3</sup>

### Saskatchewan

Volume Usage:  
Upper limits can be up to  
10,000m<sup>3</sup>

Typical water volumes:  
100m<sup>3</sup> - 5,000m<sup>3</sup>

- 1 - Central MacKenzie Valley
- 2 - Canol Shale
- 3 - Horn River
- 4 - Montney
- 5 - Peace River
- 6 - Duvernay
- 7 - Deep Basin
- 8 - Cardium
- 9 - Slave Point
- 10 - Alberta Bakken
- 11 - Viking
- 12 - Shaunavon
- 13 - Saskatchewan Bakken
- 14 - Manitoba Bakken

# D I S P O S A L



# PROVINCIAL SPECIFICATIONS & REGULATION

## WATER GUIDELINES

BRITISH COLUMBIA	ALBERTA
<ul style="list-style-type: none"><li>^ <u>Ministry of Environment</u></li><li>^ <u>BC Oil &amp; Gas Commission</u></li><li>^ <u>The Oil &amp; Gas Activities Act</u></li></ul>	<ul style="list-style-type: none"><li>△ <u>Alberta Energy Regulator</u></li><li>△ Environmental Protection and Enhancement Act (EPEA)</li><li>△ Directive 58: Oilfield Waste Management Requirements for the Upstream Petroleum Industry</li><li>△ Directive 47: Waste Reporting Requirements for Oilfield Waste Management Facilities</li><li>△ Directive 59: Well Drilling and Completion Data Filing Requirements</li><li>△ Directive 65: Resources Applications for Oil and Gas Reservoirs</li><li>△ Directive 51: Injection and Disposal Wells – Well Classifications, Completions, Logging, and Testing Requirements</li></ul>
SASKATCHEWAN	MANITOBA
<ul style="list-style-type: none"><li>^ <u>Waste Management Guidelines (SPIGEC 1996)</u></li><li>^ <u>Saskatchewan Hydraulic Fracturing Fluids and Propping Agents Containment and Disposal Guidelines</u></li><li>^ <u>Water Security Agency Regulations</u></li></ul>	<ul style="list-style-type: none"><li>^ <u>Water Protection Act</u></li><li>^ <u>Manitoba Water Quality Standards, Objectives and Guidelines</u></li></ul>

## NEW BRUNSWICK

- ^ Clean Environment Act
- ^ Clean Air Act
- ^ Clean Water Act
- ^ There exists an Appeal Regulation that allows an individual to appeal the Minister's decision within 15 days of the initial judgement. The appellant must submit to the Minister a document outlining the reasons for the appeal and any supporting documents within 30 days of making the appeal.

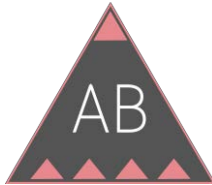
## NORTHWEST TERRITORIES

- ^ Sahtu region water is regulated by: Territorial jurisdiction including Sahtu Land and Water Board (SLWB) and Environment and Natural Resources (ENR)
- ^ Department of Fisheries and Oceans (DFO)
- ^ Applicable regulatory framework for definitions, usage, licensing, reporting etc. are found in:
  - Mackenzie Valley Resource Management Act (MVRMA)
  - Northwest Territories Water Regulations
  - Northwest Territories Waters Act Sahtu Land Use Plan
  - DFO (Fisheries and Oceans Canada) (2010) DFO Protocol for Winter Water Withdrawal from Ice-covered water bodies in the Northwest Territories and Nunavut
  - GNWT Environmental Protection Act
  - GNWT Spill Contingency Planning and Reporting Regulations

## SURFACE WATER



Surface discharge of produced water is not allowed in BC. Produced water and fracture return water are not introduced into surface waters such as lakes and streams, and are not introduced into near surface aquifers that are used for potable water supply.



In Alberta, no fluids used or produced in oil and gas operations (even those that have been treated) may be released to surface water bodies. Certain fluids may be released to land surface under specific, controlled circumstances (e.g., water-based drilling fluid may sometimes be released after testing – see AER Directive 50 for more information). Management of oilfield waste is outlined in AER Directive 58.



Any temporary or permanent diversion or alteration of flow paths of surface or ground waters requires approval from Saskatchewan Water. Managed by: The Water Security Agency Act

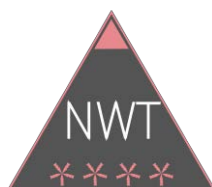
\*See section on Sourcing for Surface Water Approval process Surface Water Discharge Criteria (Appendix 3)



Managed by the Surface Water Management Section of the Water Stewardship Division of The Manitoba Water Quality Standards. Includes lakes, bogs, sloughs, marshes, rivers and wetlands, watercourse and all visible above ground water, including ice and snow.



Managed by the Clean Water Act, New Brunswick.



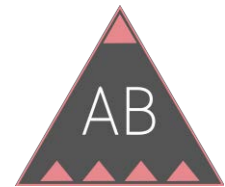
Managed by: Mackenzie Valley Resource Management Act (MVRMA), Northwest Territories Water Regulations, Northwest Territories Waters Act, Sahtu Land Use Plan, DFO (Fisheries and Oceans Canada), 2010. DFO Protocol for winter water withdrawal from ice-covered water bodies in the Northwest Territories and Nunavut. GNWT Environmental Protection Act. GNWT Spill Contingency Planning and Reporting Regulations.

## GROUND WATER

All fracture return water (the water that returns to the surface after hydraulic fracturing for an unconventional gas development) is both recycled and used for further hydraulic fracturing, or is disposed of by injection into deep subsurface formations, through a water disposal well. Similarly, produced water is also used, either for further resource extraction, such as re-injection into oil and gas pools to produce oil and natural gas, or is disposed of by injection through a water disposal well.



Fluids and waters used or produced in oil and gas operations may be reused in oil and gas operations, or they must be disposed of to the deep subsurface, either into depleted oil and gas reservoirs, or deep saline groundwater zones below the Base of Groundwater Protection (i.e., in zones with TDS greater than 4,000 mg/L). AER Directive 51 outlines requirements for such operations. Management of oilfield waste is outlined in AER Directive 58.



Any temporary or permanent diversion or alteration of flow paths of surface or groundwater requires approval from Saskatchewan Water. Managed by: The Water Security Agency Act.



\*See section on Sourcing for Ground Water Approval process

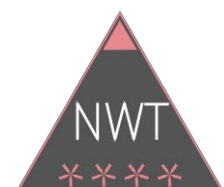
The Groundwater Management Program provides monitoring and ground water data compilation for the province. The Section advises on ground water resource management and protection, and carries out studies which enhance knowledge of groundwater resources in the province. The Program also provides maps and reports, which describe local and regional resources and quality, and identifies areas where quality problems may or may not occur. Groundwater and Water Well Act.



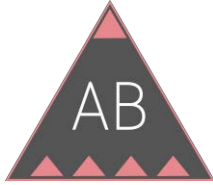
See Surface Water Description.



See Surface Water Description.



## PIPELINES & TRUCKING\*



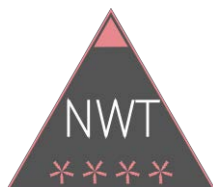
**Pipelines:** Originating and terminating within Alberta provincial boundaries are governed by the Pipeline Act, administered by the AER. All pipeline licences, including all water lines, are applied for and approved under Directive 56: Energy Development Applications and Schedules. Section 6 of D-56 governs pipelines. Temporary surface water pipelines conveying surface and non-saline groundwater are exempt from requiring a pipeline licence and may use a surface pipeline as outlined in AER Bulletin 2014-38.

**Trucking:** Directive 58: Oilfield Waste Management Requirements for the Upstream Petroleum Industry. See 'Section 8 - Manifesting' of Directive 58 for trucking requirements.



**Pipelines:** Wholly within Saskatchewan boundaries are under the jurisdiction of Saskatchewan Environment and Resource Management and Saskatchewan Energy and Mines. Pipelines require Saskatchewan Environment and Resource Management approvals and Saskatchewan Energy and Mines approvals; this includes any lines carrying oil, natural gas, fuel gas, oil well effluent, salt water, freshwater and natural gas liquids.

**Trucking:** Requirements see Waste Management Guidelines, Section 7.



**Pipelines:** ENR would be the likely regulator but no "Best Practice" or regulation may be applicable. Trans-jurisdiction large pipelines may be regulated by NEB or GNWT ITI, Office of the Regulator of Oil and Gas.

**Trucking:** Regulations address proper manifesting, reporting of spills, etc. on roadways. Managed by:

- Transportation of Dangerous Goods Act
- Northwest Territories Water Regulations
- Northwest Territories Waters Act
- GNWT Environmental Protection Act
- GNWT Spill Contingency Planning and Reporting Regulations

\*NOTE: Barging is also a mode of transport and will be dealt by marine legislation

\*Note that Provinces not listed do not have applicable regulations in place.

# LICENSING APPLICATIONS

Relevant Information	
BC	<p>The Commission publishes a "Drilling Hazard Map" to alert operators of injection and disposal well locations. This is a safety measure that facilitates information sharing between all operators in the province and increases awareness around drilling that may be through a formation with higher than expected pressure.</p>
AB	<p>Application for a well licence before drilling; <u>Directive 56: Energy Development Applications and Schedules.</u></p> <p><u>Application for water disposal must be made under Directive 65: Resources Application for Oil and Gas Reservoirs and Directive 51: Injection and Disposal Wells – Well Classifications, Completions, Logging and Testing Requirements.</u></p> <p>Application for water management hubs that contain recycled fluids must be made under EPEA Water Act, Directive 58 and/or Dam Safety.</p> <p>Application for facilities associated with a disposal well may require a waste management approval under AER Directive 58.</p> <p>The Directive 56 application for a well licence must be previously approved before the Directive 51 and Directive 65 applications are submitted and reviewed simultaneously</p> <p>For any pipeline, including water, a licence must be applied for and approved under Section 6 of Directive 56: Energy Development Applications and Schedules. There may be excess unused source water remaining after completion of the hydraulic fracturing operation. This water may be transported using a temporary surface pipeline provided that it meets the exemption requirements in the Pipeline Rules and as outlined in Bulletin 2014 - 38</p>
SK	<p>Table 4-4: Summary of Approvals Permits, and Licences Potentially Required for <u>Oil and Gas Development in Saskatchewan.</u></p>

MB	<p>Managed by Water Use Licensing and Manitoba Conservation and Water Stewardship.</p> <p>Green Manitoba is developing a water recycling strategy</p>
NB	<p>Managed by the Clean Water Act, New Brunswick</p>
NWT	<p>In the Sahtu region, water is regulated by:</p> <p>Territorial jurisdiction, which includes the Sahtu Land and Water Board (SLWB) and Environment and Natural Resources (ENR)</p> <p>Federal jurisdiction, which includes the Department of Fisheries and Oceans (DFO). The applicable regulatory framework for definitions, usage, reporting, volumes, and licensing, etc., is contained in the lists above. Individual water licences are issued by the SLWB, which defines terms and conditions around water use, withdrawal, volumes, and reporting, etc.</p>

## AVAILABLE TECHNOLOGIES\*

<p style="text-align: center;"><b>BRITISH COLUMBIA</b></p> <p>There are specific requirements for lined earthen excavations. All lined earthen excavations must be constructed with a primary containment device, a secondary containment device, a leak detection system between the primary and secondary containment devices, adequate fencing to prevent wildlife access and unauthorized dumping, and signage at the access point identifying the operator and location. Stringent inspection, monitoring and record keeping practices are also in place.</p>	<p style="text-align: center;"><b>ALBERTA</b></p> <p>To reduce the demand for fresh water in oil and gas production, the Canadian oil and gas industry has adopted alternatives or innovative practices, including: recycling and reusing almost all of the water used in conventional oil recovery; recycling about 90% of the water used in oil sand projects; using brackish ground water that is not suitable for drinking or agriculture; enhancing the recovery of oil from older wells using carbon dioxide, instead of water; and using combustion instead of steam to liquefy bitumen in the oil sands (Canadian Association of Petroleum Producers 2008).</p>
<p style="text-align: center;"><b>SASKATCHEWAN</b></p> <p><u>State of the Watershed Report (2010).</u></p>	<p style="text-align: center;"><b>MANITOBA</b></p> <p>Managed by Water Use Licensing and Manitoba Conservation and Water Stewardship.</p> <p>Green Manitoba is developing a water recycling <u>strategy</u>.</p>

\*Note that Provinces not listed have no information in place at this time.



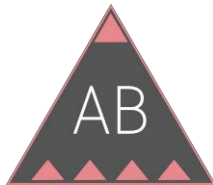
# R E P O R T I N G

# PROVINCIAL REPORTING STRUCTURES



Water used during hydraulic fracturing operations is captured in the fracture fluid file submission on [fracfocus.ca](http://fracfocus.ca). There are currently no water sourcing reporting requirements for BC.

Water reporting for hydraulic fracturing operations is regulated by the Alberta Energy Regulator (AER) in Directive 59: Well Drilling and Completion Data Filing Requirements. Information on fracture fluid composition must be submitted to the AER; if water is used in the carrier fluid, the licensee must also report details on the source(s) of that water to the AER. Licensees must submit fracture fluid composition and fracture fluid water source data for each well undergoing hydraulic fracturing operations within 30 calendar days from the conclusion of an operation. Water volumes used in hydraulic fracturing operations are available to the public through the FracFocus.ca website.



Water licences and TDLs issued for hydraulic fracturing purposes (surface and non-saline groundwater) have monitoring requirements as a condition of the licence. In terms of reporting requirements, they are applied based on the source and volume required.

Water source submissions requirements include:

- △Type of water (surface water, groundwater, municipal water, waste water, recycled fracturing water, etc.);
- △Volume, location and timing of water sourcing activities; and,
- △Various water source administrative information depending on the type of water (see AER Dir. 59 for more details.)

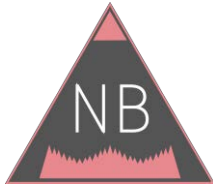
AER Directive 47 provides the reporting requirements for oilfield wastes management facilities; also includes some documentation requirements for recycled fluids.



Reporting is managed by [Government of Saskatchewan](http://Government of Saskatchewan).



Reporting is managed by the Government of Manitoba.



Reporting is managed by the New Brunswick Energy and Utilities Board and the Government of New Brunswick.



Reporting is managed by the National Energy Board.

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# WATER QUALITY OF FRACTURING FLUID

## SLICK WATER

	Range	Problems	Remedial Options
Temperature (Celsius)	3-40	Temperature for safe handling of fluid at surface. Lower temperatures may cause freezing problems.	Use a hydration unit for mixing of water and friction reducer.
pH	5-8	pH < 5 may cause prolonged hydration. pH > 8 may result in inadequate gelling.	NaOH or NaCl
Chloride (mg/L)	<90,000	High chloride concentration inhibits hydration. Greater amounts of friction reducer may be required.	Mechanical vapour recompression, ionization, reverse osmosis, electrocoagulation.
Hardness (mg/L Calcium Carbonate)	<15,000	Divalent cations inhibit hydration.	Flocculation and coagulation, ion exchange,
Concentration Factor for Residual Additive Ingredients	2	Friction reducer impact on formation.	Breaker
Suspended Solids (mg/L)	50 (<100 um)	Possible damage to reservoir.	Settling or filtration

	Range	Problems	Remedial Options
Temperature (Celsius)	15-40	Lower temperatures may prolong the hydration of gel polymers.	Passive cooling in tanks or ponds. Heat exchanger.
pH	6-8	pH < 6 may cause prolonged hydration of gel. pH > 8 may result in inadequate gelling.	NaOH or NaCl
Chloride (mg/L)	<50,000	High chloride concentration destabilizes the fluid and causes dehydration.	Mechanical vapour recompression, ionization, reverse osmosis, electrocoagulation
Iron (mg/L)	<25	Iron degrades and breaks polymers in gels, causing premature breaking and crosslinking.	Iron sequestration, oxidation.
Sodium (mg/L)	<1000	Excess sodium destabilizes the fluid.	Ion exchange, mechanical vapour recompression, reverse osmosis.
Bacteria (CFU)	0	The presence of bacteria degrade the gel viscosity.	Biocide, ozone.
Concentration Factor for Residual Additive Ingredients	2	Polymer impact on formation and fresh water.	Breaker
Suspended Solids	50 (<100 um)	Possible damage to reservoir.	Settling or filtration

## CROSSLINK FLUIDS

	Range	Problems	Remedial Options
Temperature (Celsius)	15-40	Temperature range for safe handling of fluid at surface and hydration of gel.	Passive cooling in tanks or ponds. Heat exchanger.
pH	6-8	pH < 6 may cause prolonged hydration of gel. pH > 8 may result in inadequate gelling.	NaOH or NaCl
Chloride (mg/L)	<30,000	High Cl <sup>-</sup> concentration destabilizes the fluid and creates problems with crosslinking.	Mechanical vapour recompression, ionization, reverse osmosis, electrocoagulation.
Iron (mg/L)	<25	Iron degrades and breaks polymers in gels, causing premature breaking. Iron can also create premature crosslinking.	Iron sequestration, oxidation.
Alkalinity (mg/L Calcium Carbonate)	<600	Acts as a pH buffer, so high concentrations of crosslinking activator may be needed.	Ionization, mechanical vapour recompression, scale inhibitor.
Sodium (mg/L)	<1000	Excess sodium destabilizes the fluid.	Ion exchange, mechanical vapour recompression, reverse osmosis.
Silica (mg/L)	<35	Excess silica may inhibit the crosslinking of polymer gels.	N/A
Bacteria (CFU)	0	The presence of bacteria degrade the gel viscosity.	Biocide, ozone.

	Range	Problems	Remedial Options
Concentration Factor for Residual Additive Ingredients	2	Polymer impact on formation and fresh water.	Breaker
	Field Tests Required	Buffers impact on control of crosslinking.	Disposal of flowback or physical/ chemical water treatment for dissolved solids.
Suspended Solids	50 (<100 um)	Possible damage to reservoir.	Settling or filtration.

## VISCOELASTIC FLUIDS

	Range	Problems	Remedial Options
Temperature (Celsius)	20-40	Temperature range for safe handling of fluid at surface.	Passive cooling in tanks or ponds. Heat exchanger.
pH	5-12	Values outside this range can effect properties of surfactants. Testing required.	N/A
Chloride (mg/L)	<33,000	Being outside this range could affect the fluid quality and performance of standard chemistry. Alternative blends can be tested above this concentration.	Blending, mechanical vapour recompression, reverse osmosis, ionization, electrocoagulation.
Suspended Solids (mg/L)	50 (<100um)	Possible damage to reservoir.	Settling or filtration.



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# SOURCING

## IMPORTANT TERMINOLOGY

Drinking Water (Potable)	Water from a municipal water source.
Groundwater (Non - saline)	any water that is obtained from a subsurface water-bearing aquifer (TDS<4000 mg/L) (TDS <4000 mg/L) from water wells greater than or less than 150 m.
Groundwater (Saline)	any water that is obtained from a subsurface water-bearing aquifer (TDS>4000 mg/L).
Surface Water	Surface water is any water that is obtained from sources, such as lakes, rivers, and reservoirs that are open to the atmosphere.

## WATER REGULATIONS

	Regulation
Surface Water	<p>Surface water is defined as water collecting on the ground or in a stream, river, lake or wetland. This water is managed by the <u>Environment Canada Federal Water Policy - Canada Water Act</u> (contains provisions for formal consultation and agreements with the provinces).</p> <p>The <u>Indian Oil and Gas Act</u> specifies that Canada's Governor in Council "...may make regulations... for carrying out the purposes of the Indian Oil and Gas Act and for the exploitation of oil and gas in Indian Lands." Prior to oil and gas activities, an environmental review is conducted. When hydraulic fracturing is proposed, the IOGC ensures companies conduct baseline water testing for water wells located within 500 meters of any oil or gas well prior to drilling. All oil and gas applications, regardless of whether hydraulic fracturing is proposed, must demonstrate that the environment will be protected.</p>

	Regulation
Groundwater	Groundwater is managed by the province, not the federal government, and is defined as water found underground in the cracks and spaces in soil, sand and rock. The <u>National Pollutant Release Inventory (NPRI) Oil and Gas Sector</u> will be developing procedures for reporting chemicals injected into ground water for fracturing purposes per petition 317.
Trucking	All transported volumes must receive approval from the Indian Oil and Gas Commission (IOGC) prior to transporting any water sourced on Indian Lands.
Pipeline	All transported volumes must receive approval from the Indian Oil and Gas Commission (IOGC) prior to transporting any water sourced on Indian Lands.
Licensing Applications	Groundwater licensing is managed by provincial bodies except on Indian land. The Indian Oil and Gas Act specifies that Canada's Governor in Council "...may make regulations... for carrying out the purposes of the Indian Oil and Gas Act and for the exploitation of oil and gas on Indian Lands". Prior to commencing oil and gas activities, an environmental review is conducted; when hydraulic fracturing is proposed, IOGC ensures companies conduct baseline water testing for water wells located within 500 meters of any oil or gas well prior to drilling. As well, all applications, regardless of whether hydraulic fracturing is proposed, must demonstrate that the environment will be protected.
Containment	Storage requirements are managed by the province in which storage is taking place. All proposed storage on First Nations Lands must be approved by the IOGC.

# USAGE

The Federal Government and Environmental Protection Agency govern activities on First Nation Lands.

The Federal Government is ultimately responsible for environmental protection on reserve lands as well as the health of First Nations citizens living on reserve. Thus, IOGC is responsible for safeguarding both the environment on reserve, as well as protecting First Nations citizens from adverse effects of oil and gas activities on reserve lands. To effectively fulfill federal government responsibilities, IOGC ensures that:

- Prior to oil and gas activities taking place, an environmental review is conducted. When hydraulic fracturing is proposed, IOGC ensures that companies conduct baseline water testing for water wells located within 500 meters of any oil or gas well prior to drilling. All applications, regardless of whether hydraulic fracturing is proposed, must demonstrate that the environment will be protected.
- During oil and gas activities on reserve, IOGC monitors environmental performance through auditing and inspections, and all aspects of oil and gas production.
- New Indian Oil and Gas Regulations currently under development will provide IOGC with the necessary tools to require, at any time, operators to correct any impacts of an oil and gas activity. In February 2014 IOGC introduced Phase I Regulations and provided them to oil and gas First Nations and the Joint Technical Committee (JTC) for their review and feedback. Although individual First Nations did not provide feedback, the input received from the JTC resulted in a new set of regulatory drafting instructions that are now applied to guide the development of the second Consultation Draft, Phase I Regulations. The expected completion date for this second draft is February 2015. Going forward from this timeframe to May 2015, the second Consultation Draft will be used to consult with First Nations, Industry and oil and gas producing provinces. Three major oil and gas producing First Nations – Frog Lake First Nation, Loon River Cree Nation, and White Bear First Nation – will be conducting independent reviews of the second Consultation Draft. These First Nations are expected to obtain independent legal and technical advice on the second Consultation Draft, which will form an important part of Canada's duty to consult. The results will be shared with all producing First Nations and those with oil or gas potential. All First Nations will be given an opportunity to become fully engaged on the new regulations prior to implementation.
- The department approved a phased approach for regulation development that allows for minimal delay for the 2009 Act to become law. This approach ensures that First Nations will benefit sooner from the improvements embodied within the IOGA, 2009, which provides new authority for IOGC in the following areas: 1) audit companies working on First Nation lands; 2) determine and advise industry of longer records retention time for auditing purposes; 3) deal more effectively with surface and sub-surface trespass; 4) protect First Nation sites of cultural importance; 5) order companies to take remedial action under certain circumstances; and, 6) issue fines and penalties for offences under the Act or regulations. The phased approach calls for updates to the Indian Oil and Gas Regulations, 1995 – to make them compatible with the IOGA, 2009 – including new regulations in the areas of: 1) Drainage and Compensatory Royalty; 2) Sub-surface Tenure; 3) First Nations' Audit (a component of Royalty Management); and, 4) reporting requirements to facilitate royalty verification. The remaining regulatory modules would become law once they are completed and, at the end of the process, IOGC will have jurisdiction to oversee and enforce a complete set of new, modern regulations. In consideration of the time required to accommodate input from stakeholders and the government's regulations review and approval process, it is projected that the 2009 Act and its regulations will come into force in April 2016.

# DISPOSAL

	Regulation
Water Guidelines	<u>Environment Canada</u> is the key federal environmental regulator. Other guidelines include: <u>Transport Canada Guidelines</u> and the <u>National Energy Board Guidelines</u>
Surface Water	The right to use surface water is vested in the Crown, and approvals are administered by provincial government regulators for water use, depending on the province in which the federal land is located.
Groundwater	The right to use groundwater is vested in the Crown, and approvals are administered by provincial government regulators for water use, depending on the province in which the federal land is located.
Trucking	Brackish/saline water requires proper labeling, proper TDG and truck dockets. For Transport Canada Guidelines, click <a href="#">here</a> .
Pipeline	Pipeline systems that cross provincial or international boundaries are regulated by the federal government, primarily under the authority of the National Energy Board (NEB). Refer to the <u>Pipeline Regulations: Canada Fact Sheet</u> for more information.
Licensing Applications	The right to use ground and surface water is vested in the Crown, and approvals are administered by provincial government regulators for water use, depending on the province in which the federal land is located.
Containment	Once fracture treatment is completed, fracture fluids are flowed back to the wellbore where they are recovered at the surface and stored for re-use or future disposal. Treatment and/or disposal of fracture fluids and produced formation waters is undertaken in accordance with regulations in each jurisdiction. Click <a href="#">here</a> for more information.
Available Technologies	To reduce the demand for fresh water in oil and gas production, the Canadian oil and gas industry has adopted alternatives or innovative practices, including: recycling and reusing almost all of the water used in conventional oil recovery; recycling about 90% of the water used in oil sand projects; using brackish ground water that is not suitable for drinking or agriculture; enhancing the recovery of oil from older wells using carbon dioxide, instead of water; and using combustion instead of steam to liquefy bitumen in the oil sands (Canadian Association of Petroleum Producers 2008).

# REPORTING

Indian Oil and Gas Canada (IOGC) is an organization committed to managing and regulating oil and gas resources on First Nation reserve lands. It is a special operating agency within Aboriginal Affairs and Northern Development Canada (AANDC).

The IOGC is responsible for oil and gas on First Nation reserve lands across Canada, but only a handful of reserves exist north of the 60th parallel. Therefore, practically all of IOGC's work is south of the 60th parallel, with most of that in the Western Canada Sedimentary Basin.

IOGC's general responsibilities are to:

- identify and evaluate oil and gas resource potential on Indian reserve lands,
- encourage companies to explore for, drill and produce these resources through leasing activity,
- ensure equitable production, fair prices and proper collection of royalties on behalf of First Nations,
- secure compliance with and administer the regulatory framework in a fair manner.

IOGC operates pursuant to the Indian Oil and Gas Act and Indian Oil and Gas Regulations, 1995, as well as other relevant legislation and guidelines (see Acts and Regulations). Oil and gas activity on First Nation reserve lands depends on agreements involving First Nation band councils, oil and gas companies, and Indian Oil and Gas Canada. The Government of Canada, in consultation with the oil and gas producing First Nations, has launched an initiative to amend the Indian Oil and Gas Act, 1974 and Indian Oil and Gas Regulations, 1995. The Indian Oil and Gas Act, 1974 and Indian Oil and Gas Regulations, 1995 are the legislative and regulatory instruments for the Government of Canada to manage oil and gas exploration and development on Indian reserve lands. This regime has remained virtually unchanged for the last 35 years. An Act to amend the Indian Oil and Gas Act was introduced on January 28, 2009 as Bill C-5 and received Royal Assent on May 14, 2009.

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CSUR wishes to thank the following staff from QuadRipple ([www.quadripple.ca](http://www.quadripple.ca)) for compiling this document:

- CEO, Husam Al-rameeni, EIT
- President, Steve Paolasini, EIT
- Content Management Intern, Priya Raina

About the designers of this package.



QuadRipple, based in Calgary, Alberta is the first marketing agency created by engineers to primarily service the technical and engineering industry. We like to call our strategy engineered marketing. Combining the analytical and technical skills of engineers with the creative passion of marketing enthusiasts, QuadRipple can accelerate sales and drive your product or service to the next level.

At QuadRipple, we work primarily with technical and engineering companies. It's the type of industry and the people we know best. After all, our entire team is comprised of young professionals from engineering backgrounds. We have mastered the notorious challenge of conveying technical concepts to non-technical minds and decision makers. We like to call this challenge "content-bridging". Your company should focus on doing what it does best while we make sure the market knows why you're the best.

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CSUR wishes to acknowledge the contributions of David Moore in the preparation of this document.