APPENDIX M
Review of Approaches to and Best Practices in the Regulation of Hydraulic Fracturing in Canada

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1.0 INTRODUCTION

This report was commissioned by the NLHFRP Water Quality Review Project at Memorial University on behalf of the Western NL Hydraulic Fracturing Panel. The terms of reference called for research on "approaches taken to the regulation of hydraulic fracturing in other jurisdictions, paying particular attention to the identification of regulatory best practices, with a view to coming to conclusions on what changes should be made in the law and regulatory practices of Newfoundland & Labrador as regards the activity of hydraulic fracturing". The areas of regulatory practice to be considered included regulations on:

> *... how wells are drilled, completed, stimulated, produced, suspended and abandoned in a manner that assures well bore integrity, considers the risk imposed by the unique reservoir characteristics of the play and the technologies being used (such as inter-wellbore communication).*

The areas of regulation to be researched included regulation on the approval process, filing requirements and design of hydraulic fracturing, including the chemicals used.

The specific research questions to be addressed were as follows:

1. What are the regulatory oversight mechanisms in other Canadian jurisdictions where hydraulic fracturing operations occur?

2. How does the current regulatory framework in Newfoundland & Labrador compare?

3. What are the best practices to ensure appropriate oversight for hydraulic fracturing operations?

4. Should there be ongoing environmental monitoring during and after hydraulic fracturing operations?

5. What actions/regulations/best practices will ensure appropriate regulatory oversight and responsibility?

This report provides answers to each of these questions. It uses the answer provided to the first question – on the regulatory oversight mechanisms used in other Canadian jurisdictions – as foundational to the answers given to the other four questions.

In answering the first question, this report relies primarily on understanding the regulatory oversight mechanisms used in Alberta and British Columbia, as well as those developed for use in New Brunswick. In each of these provinces hydraulic fracturing is used – or, in the case of New Brunswick, would be used – primarily to extract shale gas rather than the shale oil that would be extracted by hydraulic fracturing in western Newfoundland. These provinces can nevertheless be used as indicative of how hydraulic fracturing is regulated in Canada because hydraulic fracturing calls largely for the same kind of regulation whether it is used to extract shale gas or shale oil. Meanwhile, Alberta and British Columbia have the most developed and comprehensive regulatory frameworks for hydraulic fracturing in Canada. Alberta in particular is regarded as the leader in the regulation of hydraulic fracturing in Canada, in the sense that its approach frequently becomes the basis of the approach adopted by other provinces, even where other provinces go beyond Alberta's approach on specific aspects of the framework first developed in Alberta.

New Brunswick was included in the research despite the recent decision of New Brunswick to place a moratorium on hydraulic fracturing. The reason is that the province went through an extensive process of reviewing, updating and strengthening its regulation and regulatory system in anticipation of the use of hydraulic fracturing in shale gas development before it decided to adopt a moratorium on hydraulic fracturing. Its review and the revisions it made to its regulations illustrates the point made above – in broad terms, Canadian jurisdictions follow the lead of Alberta in the regulation of hydraulic fracturing. Despite being in abeyance, New Brunswick's framework for regulating hydraulic

fracturing is also of interest because it was deliberately developed to be the most demanding in the country. In very rough terms, New Brunswick's rules therefore provide a version of how hydraulic fracturing might be regulated if regulated using the same kind of rules – as well as other regulatory tools – as are used in other jurisdictions but with more control or restriction built into many of the rules.

In broad terms, the conclusion of this report is that hydraulic fracturing is regulated in jurisdictions in which it occurs under a comprehensive system of approvals-based regulation, often associated with command and control regulation.[1] It can only happen when approval has been received from the regulatory body by way of a permit, licence or approval that specifies the terms and conditions on which approval is granted. This is the command dimension. The control dimension of the regulatory approach is the various measures that are taken both by the regulated operator and the regulator to ensure the activity is conducted as approved.

The regulatory approach applied can also be characterized as detailed and comprehensive. The regulatory framework, viewed as a whole, generally consists of specific requirements that apply to the specific and discreet decisions and steps that must be taken in carrying out both hydraulic fracturing and the broader process of oil and gas development which Includes hydraulic fracturing. The objective is preventive, specifically, to prevent the kinds of harm – such as water contamination – that drilling wells and hydraulic fracturing can cause if they are not done properly. The regulatory framework appears generally comprehensive in this respect: it specifies requirements not just for some but on many if not most of the specific decisions and steps that must be taken in fracturing and in the drilling, construction and operation of hydrocarbon wells more generally. This perspective is strengthened when it is considered that many of the activities involved in hydraulic fracturing are regulated not only by oil and gas regulators but also by other regulators, such as those concerned with occupational health and safety.

A detailed and comprehensive regulatory approach for hydraulic fracturing within the broader context of oil and gas development is warranted for two reasons. First, if the risks inherent with these activities are not effectively controlled, significant harm could be caused to people, water, land, air and property. Second, the more specific and serious risks in question can be controlled by specific measures, many based on sound engineering principles, which can be specified with a reasonably high level of precision. There is in other words both the opportunity and the rationale for applying relatively tight and relatively prescriptive regulation that emphasizes prevention of known and generally well understood harms that improperly conducted fracturing can cause.

To characterize a regulatory framework as a relatively detailed and comprehensive command and control framework is not the same thing as saying it is an effective regulatory framework. Even where the regulated activity is amendable to this kind of regulation, a regulatory framework that uses command and control regulation can be a weak or strong regulatory framework, depending on whether it uses strong or weak commands and whether it utilizes strong or weak mechanisms of control.

Where command and control regulation is used in a field of regulation that is largely about the expertise and the technology to be applied to build and operate installations that must withstand known and predictable pressures, the effectiveness of even strong regulations can be undermined by a number of variables. One is incomplete knowledge or understanding or underestimation of the pressures. Another is the possibility of some unappreciated defect or weakness inherent in the expertise or technology or a mistake or defect in how it is applied in a specific case. Another is more diffuse – the unavoidable human element which may, for example, prevent a technology that is perfectly capable of achieving its purpose from being used properly or effectively, potentially in ways that defy detection or correction or make them difficult.

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[1] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (Oxford: Oxford University Press, 2012), 106-111. This approach could also be called ex ante regulation, meaning subject to prior approval, to distinguish it from a system of post hoc regulation, which consists largely of self-applying rules which apply to everyone who does activity within the scope of the rules.

The conclusion of this report is that the regulations in force in Alberta and British Columbia, as well as the regulatory framework prepared for implementation in New Brunswick, consist of generally strong commands – commands that can achieve their objective if they are followed – especially concerning the critical issue of well integrity and the role it plays in preventing contamination of water. The same is generally true of the regulations related to the prevention of contamination of water from the liquids, including liquid wastes, handled, used or stored above ground at well sites. This conclusion is based in part on the alignment between the content of the regulations on these critical risks and the conclusions of recent reports on the controls that should apply to hydraulic fracturing to ensure safety and environmental protection. It is however, subject to a number of important qualifications, the main one being that the same reports stress there are gaps in knowledge both of the risk of water contamination and of the effectiveness, especially in the longer term, of the mechanisms which regulation currently prescribes to control those risks.

It is harder to come to conclusions on the control aspect of regulation, absent a full audit of regulatory administration in Alberta and British Columbia. On paper, each appears to apply a rigorous system of control, judging from how their regulatory systems are designed and structured and the range of regulatory tools or mechanisms each utilizes. One aspect of this system are the requirements for checking, testing, monitoring and reporting to detect failures, including those related to the unavoidable human element referenced above. Another important aspect of the regulatory system of each province is the general responsibility placed on operators to identify, evaluate and control risks through the development of plans, programs, procedures and systems in specified operational areas, including hydraulic fracturing.

This being said, it is clear that regulation can only ensure hydraulic fracturing is conducted safely and without harming the environment if it is followed. Robust compliance monitoring and enforcement by a regulator that has the capacity and the will to do it are therefore essential ingredients of regulation's likely effectiveness. Whether or not this is happening in other jurisdictions is a question which cannot be answered based on the research carried out for this report. What can be said based on that research is that the logic of how hydraulic fracturing is regulated depends for its success on strong monitoring and enforcement by a strong and vigilant regulator. It is therefore important to stress that lack of faith in regulation to ensure hydraulic fracturing is safely conducted often rests on the view that the regulation of oil and gas activities is weak and inadequate where hydraulic fracturing is already allowed, including in Alberta. Specifically, lax permissive regulation is blamed on regulators being too close to industry at the expense of communities and the environment.[2] It is therefore critical that any jurisdiction taking regulatory guidance from Alberta and other provinces which have followed Alberta's lead on the content of regulations take effective measures to ensure that good regulations are not only adopted but implemented, followed and enforced.

This report concludes that the laws of Newfoundland & Labrador that would apply to hydraulic fracturing in that province provide a foundation for an approach to regulation which is broadly similar to how hydraulic fracturing is regulated in Alberta and British Columbia and to how it would be regulated in New Brunswick. One difference is that Newfoundland & Labrador does not currently have a set of detailed rules for hydraulic fracturing – or for drilling and completing oil and gas wells more generally – like the ones Alberta, British Columbia and New Brunswick have each adopted to elaborate on the more general regulatory requirements set out in their respective statutes and regulations. This would leave more discretion – and responsibility – with the regulator to determine the content of regulation by defining the terms and conditions attaching to each and every approval. Newfoundland & Labrador is considering the adoption of a Guidelines document to ensure this discretion is consistently exercised to require operators to comply with regulatory requirements that would be very similar to those in force in Alberta and British Columbia and which were approved for implementation in New Brunswick.

[2] Nickie Vlavianos, "The Legislative and Regulatory Framework for Oil Sands Development in Alberta: A Detailed Review and Analysis" (2007) Occasional Paper No. 21, Canadian Institute of Resources Law, 38; Cecilia A. Low, "Energy and Utility Regulation in Alberta: Like Oil and Water?" (2009), Canadian Institute of Resources Law, p. 38; and Nickie Vlavianos, "A Single Regulator for Oil and gas development in Alberta? A Critical Assessment of the Current Proposal" (2012) Canadian Institute of Resources Law, 6.

The regulatory approach which would apply under Newfoundland & Labrador's legislation also differs from that of Alberta and British Columbia – but is similar to that of New Brunswick – in leaving jurisdiction over environmental assessment in relation to hydraulic fracturing largely with the province's Minister of Environment. In contrast, in Alberta and British Columbia, jurisdiction for environmental assessment and environmental protection more generally as it relates to oil and gas activity has largely been transferred to the oil and gas regulators of those provinces. This is an aspect of a larger difference. In Newfoundland & Labrador, as in New Brunswick, the regulation of oil and gas activity, including hydraulic fracturing, is done by a government department. In Newfoundland & Labrador, the primary regulators for onshore fracturing would be the Minister of Natural Resources and the senior official in the Department's Energy Division. In contrast, in Alberta and in British Columbia, the regulator is an arms-length organization which has a more comprehensive regulatory mandate over oil and gas activity, including hydraulic fracturing.

In proposing best practices in regulatory oversight of hydraulic fracturing, this report considers best practices relating to the content of regulatory requirements and best practices relating to regulatory mechanisms, i.e., mechanisms used to achieve adherence to regulations and the achievement of regulatory objectives. It draws on the regulatory frameworks in place in Alberta and British Columbia and the one developed for implementation in New Brunswick, major reports on hydraulic fracturing which have considered how it should be regulated, the author's experience in administering and designing regulatory frameworks in multiple sectors and the literature on approaches to regulation and regulatory best practices. It also considers how regulatory best practices are called for and informed by the precautionary principle and how they in turn can help to ensure hydraulic fracturing is regulated on a precautionary basis that is proportionate to the risks requiring control and to the mechanisms available to industry and regulators for controlling those risks.[3]

On the content of regulation, this report discusses best practices in the following areas, among others: community engagement; participation in regulatory decision-making; mandatory risk and safety management systems; locational choices; establishing baseline information on environmental indicators; maintaining well integrity; spill prevention and the containment and disposal of wastes; maintaining surface and sub-surface integrity and stability; disclosing and reducing the use of chemicals; managing water use; and managing cumulative effects.

On best practices in regulatory mechanisms, this report considers issues such as: the importance of institutional arrangements that are conducive to effectiveness; options for ensuring focused attention on protecting the environment and human health; adding a regional layer of regulation to a system otherwise limited to regulating individual projects; the balance of prescriptive and performance-based regulations and between general rules and the terms and conditions attached to approvals; the importance of capacity; and the need for transparency and continuous improvement, including through regulation's active engagement with researchers to address critical knowledge gaps.

This report then considers the importance of environmental monitoring. Finally, it considers at a higher level the question of the actions, regulations and best practices that can be taken to ensure appropriate oversight and responsibility in the regulation of hydraulic fracturing. It suggests that the critical requirement is an integrated and comprehensive approach which will allow the best practices on content and mechanisms discussed in the earlier section to operate in mutually reinforcing ways.

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[3] In debates about hydraulic fracturing and other controversial industrial activities, the precautionary principle is often invoked by those who support a political or policy decision to prohibit fracturing or to place it under a moratorium until it is better understood. The impression can be created that the precautionary principle either requires a prohibition or a moratorium or is inapplicable or irrelevant. It is therefore important to emphasize that where the choice is made to address the concerns associated with hydraulic fracturing by allowing it to happen as a regulated activity, the precautionary principle continues to have relevance to how regulation is structured and carried out. In fact, the consistency of decisions at the political and policy level to allow hydraulic fracturing to proceed as a regulated activity with the precautionary principle may depend upon the extent to which the principle is built into the regulatory process.

2.0 WHAT ARE THE REGULATORY OVERSIGHT MECHANISMS IN OTHER CANADIAN JURISDICTIONS WHERE HYDRAULIC FRACTURING OPERATIONS OCCUR?

2.1 Summary

Hydraulic fracturing is subject to regulatory approval before it takes place. It can only happen in a well that has been drilled with regulatory approval. This approval deals not only with the drilling of the well and with hydraulic fracturing, but with the production of oil or gas after hydraulic fracturing, the closing (abandonment) of the well and the reclamation of the site after production has ended.

Wells can only be drilled in respect of oil or gas that has been leased from the Crown, the owner of oil, gas and other mineral resources. Leases are issued where exploration has determined the location of a quantity of oil or gas that can be economically recovered. Exploration requires regulatory approval before it is conducted.

Each approval in the sequence of approvals that leads to hydraulic fracturing depends on approval by the regulator of the applicant's plans for conducting the specific activity or phase of activity that is being approved. To varying degrees and in different combinations, the applicable regulations specify the required content of these plans, the issues they must address, the outcomes they must achieve and the measures that must be taken to ensure their implementation.

Regulations also specify how many aspects of approved activities must be conducted or carried out. This is particularly true of how the regulations address the drilling, completion and operation of wells. Again however, the extent to which regulations specify or prescribe how approved activities are to be conducted varies from activity to activity and jurisdiction to jurisdiction. In general however, where regulations do not prescribe the methods or technology to be used in carrying out an approved activity, they prescribe the outcomes that are to be achieved or avoided in the conduct of the activity. This means that in all jurisdictions, the regulatory oversight mechanism in place for hydraulic fracturing and the exploration and drilling which proceeds it as well as the production which follows it, is that all of these activities must be conducted in accordance with relatively comprehensive standards that have the force of law. For matters beyond the scope of legally enforceable regulatory requirements, regulators typically encourage the following of industry best practices.

Making exploration, drilling, fracturing and production subject to approval before they are conducted is intended to achieve many policy objectives. It is intended to ensure the rational, coherent and efficient development of oil and gas resources. It is also intended to ensure worker and public safety, protection for the environment, the quality of ground and surface water, the sustainable use of other resources, particularly water, and to minimize disruption and inconvenience for others, particularly those living or engaging in economic activities in proximity to oil or gas wells and hydraulic fracturing. An objective of growing importance in the regulation of hydraulic fracturing and associated exploration, drilling and production activities is to ensure that members of the public have meaningful opportunities to participate in and to have their concerns addressed in industry and regulatory decision-making.

The regulatory requirements that apply to exploration, drilling and hydraulic fracturing extend beyond those which relate specifically and exclusively to oil and gas activities. Subject to their own criteria of applicability, legislation and regulations pertaining to the environment, worker safety, public safety, highways, forestry, land use planning, nature conservation, as well as other matters, are all applicable to exploration, drilling and hydraulic fracturing. To the extent these generic laws are not applicable to exploration, drilling or hydraulic fracturing, it is because the issues they address are said to be addressed in the legislation and regulations that are specific to exploration, drilling and hydraulic fracturing. In many areas of overlap between the generic laws and regulations specific to oil and gas activities, the latter apply additional requirements to those which would be applicable under generic legislation and regulation.

Regulatory bodies are responsible for monitoring approved activities for the purpose of ensuring they are conducted

in compliance with regulatory requirements. Where non-compliance is detected or brought to the attention of the regulator responsible for the requirement that has not been met, the regulator has a range of enforcement tools at its disposal, including ordering rectification, issuing stop work orders, stipulating additional terms and conditions or monitoring measures, prosecution and revocation of the applicable regulatory approval.

2.2 Legislative and Institutional Framework of Regulatory Oversight

Regulation of hydraulic fracturing happens under legislation that applies to oil and gas exploration and development more generally. The legislation includes the enabling statutes or statutes passed by the legislature and regulations adopted under the enabling statute by the provincial cabinet. The statutes deal with two distinct areas of regulation: the development of the resource and the activities that are conducted to develop the resource. The regulation of the development of the resource includes the processes by which a company receives development rights over a resource within an area, typically an oil and gas licence or lease, the obligation to develop the resource once a licence or lease has been granted, and the royalties that must be paid to the Crown once oil or gas is produced. The regulation of oil and gas activities includes the conduct of exploration activities, the drilling and completion of wells, the operation of wells and the decommissioning of wells when production comes to an end.

On oil and gas activities, applicable statutes are very general. For the most part, they confer general regulatory powers, such as the power to approve activities for which approval is necessary, the power to conduct inspections and other enforcement activities, and the power to make regulations or regulations and rules. Statutes determine who the regulator of oil and gas activities will be. In British Columbia it is the BC Oil and Gas Commission and in Alberta it is the Alberta Energy regulator, formerly the Resources Energy Conservation Board. In New Brunswick and in most of Canada, it is the minister responsible for natural resources or more specifically, energy. In broad terms, where regulatory responsibility is delegated to a commission, there is a greater institutional separation between regulation and policy-making than there is in a system in which regulatory authority is assigned to a minister and therefore, in functional terms, to his or her officials.

Most of the substance of the rules applicable to oil and gas activity is contained in regulations or rules authorized by statute. The authority to make regulations, or rules where authority to make rules exists, is always defined in very broad terms. This is to ensure that no aspect of oil and gas activity is beyond the scope of regulatory control. In British Columbia, much of the authority to make the more detailed operational regulations is given to the Oil and Gas Commission while the authority to make regulations dealing with the administration of the Act and environmental protection is given to the provincial cabinet.[4] In Alberta, it is contained largely in the rule-making authority of the Alberta Energy Regulator.[5] In New Brunswick, where there is no Commission, the regulation-making authority is exercised by the provincial cabinet.[6] This difference in the allocation of the authority to establish regulatory requirements may be significant. For example, regulation or rule making may be less vulnerable to delay when in the hands of a specialized commission or board than when it must wait for its turn on a cabinet's agenda. The factors taken into account in regulation or rule-making may also be more exclusively technical and regulatory when regulation or rule-making authority is located outside of government.

In addition to being subject to regulations made specifically for oil and gas activities, shale oil and gas activities are subject to a wide-range of regulations that apply to industrial activity more generally. For example, specific activities carried out in the course of conducting the oil and gas activities approved by the oil and gas regulator may require an approval under environmental legislation. Discharges and emissions into the environment are subject to environmental laws where they cause an adverse environmental effect. Shale oil and gas activities must be conducted

4 *Oil and Gas Activities Act*, SBC 2008, c 36, ss. 99, 101, 103, 104, 111.

5 *Oil and Gas Conservation Act*, RSA 2000, c 0-6, s. 10.

6 *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, s. 59.

in compliance with health and safety laws and laws on handling and transportation of hazardous materials. Where they affect wildlife, they are subject to laws pertaining to the protection of wildlife. Unless exempted from them by legislation or a legislatively authorized order of the provincial government, shale oil and gas activities are subject to municipal laws, including municipal land use laws. Where they require an amount of water from a regulated water source large enough to trigger the requirement for an approval or licence, they must obtain that approval or licence.

2.3 Exploration

Hydraulic fracturing takes place in the production phase of shale oil and shale gas development. It is part of the process of completing the well so that oil or gas can be extracted from the subsurface reservoir into which it is released by the fracturing process. Despite this, it should be noted that by the time hydraulic fracturing occurs, several levels of approvals have been obtained, starting in the exploration phase of development. These requirements are briefly summarized in this section.

2.3.1 Approval Requirements

Exploration includes geological or geophysical exploration and exploratory drilling. Consistent with the approach taken across Canada, both kinds of exploration are regulated activities in Alberta, British Columbia and New Brunswick. They can only be lawfully conducted when conducted under the approvals specified in legislation and regulations.[7] They are otherwise prohibited.[8] Exploratory drilling requires an approval to drill a well, i.e., the same kind of approval that applies to the drilling of a production well.[9]

2.3.2 Where Can Exploration Be Conducted?

In general, exploration can be conducted within the area specified in the permit, licence or other approval under which exploration is to occur. The regulator's authority to include areas within the approvals it gives to conduct exploration is broad, reflecting two facts: first, the Crown owns the mineral resources under its own land as well as land owned by others, and second, entrepreneurially motivated exploration is how the location of the Crown's economically recoverable resources is discovered. Although exploration by law can only occur on private land with the agreement of the owner,[10] the holder of the approval to conduct exploration has the option of obtaining an order against the owner through mediation or adjudication where agreement cannot be reached.[11]

Provincial authority to authorize exploration, as well as the development that can follow exploration, only applies to provincial lands. The authority to approve exploration or subsequent development is subject to designations of an area under nature conservation legislation. For example, all extractive activities are prohibited in designated ecological reserves in British Columbia.[12] Provinces can also choose to put specified areas off limits to exploration on a case-by-case basis.[13] Provincial authority is also either subject to or exercised consistent with municipal land use planning by-laws.

The regulator's authority to authorize exploration (and other activities) can also be limited where it is not excluded

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7 *Oil and Gas Conservation Act*, RSA 2000, c O-6 s. 11; *Petroleum and Natural Gas Act*, RSBC 1996, c 361 s. 110; *Oil and Gas Activities Act*, SBC 2008, c 36 ss. 1, 21, 24; *Oil and Natural Gas Act*, SNB 1976, c 0-2.1 s. 4.

8 *Oil and Gas Conservation Act*, RSA 2000, c 0-6, s. 107; *Oil and Gas Activities Act*, SBC 2008, c 36, s. 21.

9 *Petroleum and Natural Gas Act*, RSBC 1996, c 361 s. 38; *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, s. 4.

10 *Exploration Regulation*, Alta Reg 284/2006, s. 8; *Surface Rights Act*, RSA 2000, c S-24, s. 1; *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, ss. 9, 10; *Surface Lease Regulation*, BC Reg 497/74; *Petroleum and Natural Gas Act*, RSBC 1996, c 361, s. 144.

11 *Petroleum and Natural Gas Act*, RSBC 1996, c 361, ss. 142,157-167; *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, ss. 157-167.

12 BC Parks, "Summary of Protected Areas Designations and Activities" (January 2015), online: www.env.gov.bc.ca/bcparks/aboutBCParks/summary-of-pa-designations&activities.pdf

13 Scott Simpson, "Klappen region permanently off-limits to gas exploration, BC announces" *The Vancouver Sun* (December 18, 2012).

to ensure it is exercised in ways that are consistent with other policy objectives. For example, in British Columbia, the operating area for a permit is not to include a forest area designated as an old growth management area unless a determination is made that it will not have a material adverse effect on the old seral stage forest representation within that area.[14] More generally, legislation intended to protect wildlife, species-at-risk, wetlands and water courses, apply to provincial permitting activities in the oil and gas industry as in other industries.

2.3.3 Regulation of Exploration Activities

If shale oil development expands in Newfoundland & Labrador, the scale of exploration for shale oil deposits can be expected to expand. It is therefore worth touching briefly on the regulations that apply to geological or geophysical exploration.

Regulation requires exploration to be conducted in compliance with a range of regulatory requirements and with the exploration plan or program that is required to be submitted with the application for the exploration permit, licence or approval.

In Alberta, for example, legislation specifies that exploration is only lawful if conducted in accordance with the approved exploration program. Under the Exploration Regulation, exploration is to be conducted in compliance with all applicable Exploration Directives issued by the Alberta Energy Regulator and directions from the Minister issued under the Mines and Minerals Act.[15] The regulations impose an obligation on holders of exploration licences and permits to ensure that exploration is conducted in accordance with the preliminary plan approved for the exploration program, the terms and conditions of the exploration approval, and any authorizations given by the Minister relating to activities on public land.[16]

Similarly, in British Columbia, persons holding a permit to conduct exploration must ensure exploration is carried out in accordance with the permit, the Act and regulations and any order issued to the person.[17] Under New Brunswick's legislation, a geophysical licence is subject to cancellation for non-compliance with a provision of the applicable Act or regulations and the holder of a licence to search is required to comply with the provisions of the Act, regulations and the terms and conditions of the licence.[18]

The result is that exploration is subject to a range of regulatory requirements addressing specific aspects of exploration work. Regulations require set-back distances to be maintained between the use of energy sources and specified structures. For example, in all three provinces, the use of a non-explosive energy source must be 50 metres and the use of an explosive energy source must be 180m, from any building or structure with a concrete base, residence, barn, concrete irrigation structure or water pipeline or concrete lined irrigation canal.[19] In Alberta, reduced set-back distances apply if the permit holder has the prior written consent of the owner of the structure. New Brunswick requires testing of water wells before and after seismic testing within a 200m radius.[20]

Under Alberta's Exploration Regulation, those conducting an exploration program must use the products listed as

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14 *Oil and Gas Activities Act*, SBC 2008, c 36, s. 7.
15 *Exploration Regulation*, Alta Reg 284/2006, ss. 3, 4.
16 *Exploration Regulation*, Alta Reg 284/2006, s. 32.
17 *Oil and Gas Activities Act*, SBC 2008, c 36, s. 26.
18 *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, ss. 15, 34.
19 Alberta Government, "Exploration Directive: Distance Requirements ED2006-15" (2013), Environment and Sustainable Resource Development, p. 2; Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), Appendix 1; *Geophysical Exploration Regulation*, BC Reg 280/2010, Schedule 1.
20 Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), p. 37.

approved by the Alberta Energy Regulator or by the Minister on application.[21] Alberta's regulations also prescribe obligations and prohibitions designed to ensure that drilling shot holes and test holes does not contaminate water or damage aquifers, as well as obligations and procedures to be followed where water is released and comes to the surface as a result of drilling a test or shot hole or detonation of a shot hole or where gas is encountered or subsidence occurs.[22] The regulations impose obligations relating to the clean-up and disposal of debris at the conclusion of an exploration program.[23] Alberta's regulations also specify requirements that apply to temporary and permanent abandonment of shot and test holes.[24] They impose limitations on the times at which specified activities can be carried on and the depth to which test or shot holes can be drilled in prescribed areas. Many of these rules have been largely adopted by New Brunswick.[25]

The rules and framework for exploration activities in British Columbia are broadly similar. The holders of exploration permits are subject to the same legislation and regulation that apply to the holders of permits for other kinds of oil and gas activities. They are therefore subject to the same general obligations and duties, some of which are quite sweeping, that apply to all oil and gas activities.[26]

The holders of exploration approvals are subject to broad record-keeping and reporting obligations, including progress reports and final reports on implementation of the approved exploration program and the results achieved. They are subject to a range of enforcement actions including: investigations, inspections and audits; stop work orders; orders to comply with an approval or legislation or to take action to address a risk to safety, the environment or mineral resources; cancellation of a licence or permit; administrative penalties; and prosecution.[27]

2.4 Drilling, Constructing and Completing Wells

2.4.1 Introduction

Regulation on the drilling, construction and completing of wells applies both to wells that are to be developed by hydraulic fracturing for the purpose of recovering shale oil or gas and to wells that will not be developed by hydraulic fracturing. In this respect, the regulations applicable to the activity of hydraulic fracturing are the regulations applicable to drilling, constructing and completing wells more generally.

2.4.2 The Requirement for a Well Licence

In Alberta, legislation states that only persons who have a licence can drill a well or undertake activities preparatory or incidental to the drilling of a well.[28] The requirement for a licence before any work on a well is commenced is reiterated and emphasized in Directive 056 of the Alberta Energy Regulator, which governs the process for applying for well licences, as well as pipeline and facility licences. It says "an applicant must obtain the appropriate ERCB (sic) licence(s) prior to commencing any site preparation, construction or operation". It also says a licence issued under the Directive "is a licence to construct and operate a surface facility, pipeline or well".[29]

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21 *Exploration Regulation*, Alta Reg 284/2006, s. 42.
22 *Exploration Regulation*, Alta Reg 284/2006, ss. 45, 46-48.
23 *Exploration Regulation*, Alta Reg 284/2006, ss. 57-58.
24 *Exploration Regulation*, Alta Reg 284/2006, ss. 50-52.
25 Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), pp. 1-2.
26 *Oil and Gas Activities Act*, SBC 2008, c 36, ss. 35, 36, 37 (See sections 35 (obligations carrying out oil and gas activities); 36 (environmental protection and management); and 37 (spillage)).
27 *Oil and Gas Activities Act*, SBC 2008, c 36, ss. 48-68; *Mines and Minerals Act*, RSA 2000, c M-17, ss.108.2, 108.3, 108.4, 109, 110, 112.
28 *Oil and Gas Conservation Act*, RSA 2000, c O-6, s. 11.
29 Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules", pp. 3-5.

Similarly, in British Columbia, holders of exploration permits must obtain a permit to drill an exploratory well before they do so and lease holders must obtain a permit to drill a production well before they commence work on a production well. In both cases the application is to the BC Oil and Gas Commission.[30] In New Brunswick, a well licence is required for exploratory drilling and for the drilling of a production well.[31]

2.4.3 Connection to Leasing of Mineral Rights (i.e. Tenure)

The regulation of well drilling and construction is connected to the legal framework by which the right to develop oil and gas reserves is assigned or allocated by the Crown. For example, to be eligible to apply for or to hold a well licence in Alberta, a person must be a working interest participant and have the right to produce the oil or gas from the well or the right to drill or operate the well for another authorized purpose, such as exploration.[32] In other words, the person, which will be a company, must have tenure in relation to the oil and gas reservoirs for which the well is to be drilled. The same is true in British Columbia and New Brunswick.[33]

This aspect of the regulation of shale oil and gas development is beyond the scope of this report, the focus of which is on the activities carried out by those who have tenure in respect of oil and gas resources to develop those resources, including by hydraulic fracturing. It is however worth noting the connection between these two domains of oil and gas regulation. One reason is that non-compliance with the regulations applying to the activities of developing the resource can lead, at least in law, to loss of the right to develop the resource.[34] A deeper connection may be the strong possibility that a decision to give a company the right to develop oil or gas reserves strongly influences or even determines the outcome of subsequent consideration of applications to drill and construct wells. This may have the effect of undermining the value to potentially affected persons and to the public more generally of the opportunities they are afforded to participate in regulatory processes relating to those applications. This effect has been noted in respect of the regulation of oil and gas regulation in Alberta as well as in the regulation of other natural resources industries.[35]

2.4.4 Application Process – Notification, Consultations, Hearings

Under Alberta's Directive 056, applications are processed as either routine or as non-routine applications.[36] This is determined by the answers applicants give to a consistent series of questions they are asked at the beginning of an online application process. A routine application is one in which all technical requirements are met and in which there are no outstanding concerns or objections to the application and affected landowners have agreed to have their compensation determined by adjudication after the completion of the mandatory participant involvement (consultation) process by the applicant. An application is processed as a non-routine application in four circumstances: where participant involvement (consultation) requirements have not been met; where there are outstanding concerns or objections after notification and consultation other than landowner compensation; where technical requirements are not met; or where a variance from regulatory requirements is requested or the use of unspecified methods, materials or processes is proposed.

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30 *Oil and Gas Activities Act*, SBC 2008, c 36, s. 21.

31 *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, s. 4.

32 *Oil and Gas Conservation Act*, RSA 2000, c O-6, s. 16.

33 *Petroleum and Natural Gas Act*, RSBC 1996, c 361, s. 110; *Oil and Natural Gas Act*, SNB 1976, c 0-2.1, ss. 4, 16, 29; *Oil and Gas Activities Act*, SBC 2008, c 36, s. 24.

34 *Mines and Minerals Act*, RSA 2000, c M-17; s. 110; *Oil and Gas Conservation Act*, RSA 2000, c O-6, s. 25.

35 Nickie Vlavianos, "A Single Regulator for Oil and gas development in Alberta? A Critical Assessment of the Current Proposal" (2012) Canadian Institute of Resources Law, 6; Meinhard Doelle and William Lahey, A New Regulatory Framework for Low Impact/High Value Aquaculture in Nova Scotia – The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia (2014), online: novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf.

36 Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules", pp. 3-11.

The Regulator may also designate applications as non-routine for various reasons, such as the application proposes activity in a sensitive environmental area or the first petroleum or industrial activity in an area. Non-routine applications receive additional regulatory scrutiny and can be set down for a public hearing. The Regulator can also decide to require an environmental assessment where "the complexity and scale of a proposed project, technology [or] resource allocation creates uncertainty about the environmental effects, or result in the potential for adverse environmental effects", using its authority under the Environmental Protection Act.[37] Otherwise, the process for determining applications is based largely on the scrutiny of the documents and information filed in support or against the application. In certain circumstances, those opposed to a decision on an application have the opportunity to appeal.[38]

Applicants are required to show they have provided notification to those they are required by the regulations to notify and conducted consultations with those entitled by the regulations to be consulted.[39] For those entitled to consultation, applicants must confirm non-objection or submit their application as non-routine. Entitlement to notification or consultation depends on proximity to the well and the well's categorization in the regulations.[40]

Applicants are required to submit the survey plans required by regulation.[41] Among many other matters, these survey plans must show the relation of the proposed well to surface improvements, water wells within 200m, other petroleum wells and coal mines and the distances to the nearest dwelling, building used by the public, place of business or other surface development where members of the public may gather.

In British Columbia, the applicant for a permit to drill a well is required to have given notice to landowners on which they propose to conduct their activities that advises the landowners of the opportunity they have to make submissions to the Commission.[42] They are also required to give notice to land owners within prescribed notification distances and notice and an invitation to consult if the land holder has a residence or a structure used to shelter livestock within prescribed consultation distances.[43] Notice or notice and an invitation to consult must also be given to others, including municipalities (depending on proximity of the proposed exploration to municipally-owned structures, community watersheds or municipally designated areas) and First Nations (depending on proximity of the exploration activity to the First Nation's Indian Reserve).

Applicants are required to file a written report with their application on the results of their compliance with their obligations to provide notice and conduct consultations.[44] Whether those given notice or notice and the opportunity to consult have objections to the proposal that are not addressed by the applicant can have implications for the kind and scale of hearing that is held by the Commission, for the terms and conditions of any approval that is given and for whether an approval is given.

Applicants are also required to submit a "description of the proposed site of the oil and gas activity" and "the information, plans, application form and records required by the commission". The Commission is required to consider any submissions made by those other than the applicant and any environmental objectives that have been prescribed for the Commission by government. When it grants a permit, it must provide notice to owners of land within the "operating area" and advise them of rights of appeal to the Oil and Gas Tribunal.

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37 Alberta Energy Regulator, "Environmental Assessment", Data and Publications, online: www.aer.ca/data-and-publications/environmental-assessment

38 *Responsible Energy Development Act*, SA 2012, c R-17.3, s. 38.

39 Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules", pp. 2-1 to 2-11.

40 Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules", pp. 7-6 to 7-7, 7-4 to 7-5.

41 Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules", pp. 7-7 to 7-8.

42 *Oil and Gas Activities Act*, SBC 2008, c 36, s. 22.

43 *Oil and Gas Activities Act*, SBC 2008, c 36, s. 22; *Consultation and Notification Regulation*, BC Reg 279/2010.

44 *Oil and Gas Ac tivities Act*, SBC 2008, c 36, s. 24.

In New Brunswick, an environmental assessment is conducted by the Department of Environment and Local Government whereas in British Columbia and Alberta, review of the impact of a proposed well on the environment is integrated into the review of the application by the oil and gas regulator.[45] Companies can opt for a phased environment assessment in which each phase of a well's development is incrementally assessed and approved. For drilling to commence, the Department of Environment and Local Government must issue an approval to construct and operate with terms and conditions it considers necessary or justified for avoiding, reducing or mitigating adverse environmental impacts. These approvals require: a chemical and waste management plan; a water management plan; a containment system plan; a private water well pre- and post-activity sampling and analysis program; a rehabilitation plan; a noise assessment program; and quarterly reporting.

Applicants in New Brunswick are required to hold public information sessions.[46]

2.4.5 Spacing and Separation Distances[47]

Alberta no longer limits the number of wells to one per section because of the need for more concentrated development to enhance recovery in tight formations and to reduce the footprint of horizontal and multi-pad wells.[48] British Columbia follows the approach of generally limiting gas wells to one per section. The "target area" for gas wells in a "normal spacing area" must be 250m or some other appropriate distance from the sides of the spacing area.[49] "Other Than Normal" spacing orders are made where a different approach to spacing in the interests of resource recovery is found consistent with good engineering practice. Showing greater density is consistent with good engineering practice or entering into an approved Utilization Agreement with other licences, releases operators from the one well per section limitation.

In Alberta, wells must be at least 100m from water bodies or surface improvements – unless a shorter distance is specifically approved in a non-routine application – and at least 200m from the nearest dwelling. They must be drilled to have at least 50m vertical separation from the bottom of water wells. They cannot be drilled beyond a depth of 3600m without intermediate casing between the production casing and the surface casing first having been installed to ensure well control.

Separation distances required in British Columbia for dwellings, structures or public facilities are the same or similar. In British Columbia, wells are prohibited from within: 40 m of any right of way or easement of any road allowance or public utility or 100 m of a building, installation or works, place of public concourse, or national defence reserve.[50]

In New Brunswick, wider separation distances apply: 250m for dwellings (as opposed to 200m as it is in Alberta); and

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[45] Government of New Brunswick, "Exploring Natural Gas in New Brunswick", p. 16; *Environmental Assessment (Mandatory and Exempted Activities) Regulation*, Alta Reg 118/1993, Schedule 2; *Reviewable Projects Regulation*, BC Reg 370/2002, Table 8; Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, pp. 38-39, 43, 59-60. In contrast, the Alberta Energy Regulator administers the following regulations under Alberta's *Environmental Protection and Enhancement Act* (EPEA) relative to energy resource activities, all of which would otherwise be administered by the province's environment ministry: *Activities Designation Regulation*; *Administrative Penalty Regulation*; *Approvals and Registration Procedures Regulation*; *Conservation and Reclamation Regulation*; *Disclosure of Information Regulation*; *Environmental Protection and Enhancement (Miscellaneous) Regulation*; *Ozone Depleting Substances and Halocarbons Regulation*; *Remediation Certificate Regulation*; *Release Reporting Regulation*; *Substance Release Regulation*; *Waste Control Regulation*; *Wastewater and Storm Drainage Regulation*; and the *Wastewater and Storm Drainage (Ministerial) Regulation*. For the situation in British Columbia, see BC Oil & Gas Commission, Environmental Protection and Management Guideline – Version 2.1 (October, 2015), online: http://www.bcogc.ca/node/5899/download.

[46] Government of New Brunswick, "Exploring Natural Gas in New Brunswick", p. 19.

[47] This is an area of regulation in which there can be variation between how oil and gas developments are regulated.

[48] Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, p. 20.

[49] *Drilling and Production Regulation*, BC Reg 28/2010, s. 7.

[50] *Drilling and Production Regulation*, BC Reg 28/2010, s. 5.

500m for schools and hospitals (as compared to 100m).[51] There is a limit of one well per section unless the regulator approves more concentrated development to accommodate pad-based horizontal wells.[52]

2.4.6 Casing and Cementing

2.4.6.1 Introduction

The central concern of regulations on well drilling, construction and completion is to ensure well integrity is achieved and maintained. Well integrity refers to the dependability of a well in maintaining separation by an impermeable barrier between the hydrocarbon, formation waters, injected fluids (including hydraulic fracturing fluids), and waste water that will travel up and down the well and the groundwater and surface water surrounding the well. In the case of shale gas development, it has been said that the role of well integrity in preventing "immediate and longer-term leaks of gas and other fluids to groundwater or the surface is a cornerstone of environmental protection in any oil and gas drilling operation".[53] It is also said that well integrity is important to many of the issues to be managed in shale oil and gas development, including: groundwater and surface water impacts and protection; impacts on ecology and land; carbon footprint and climate change; health and community well-being; the possibility of operational mistakes/accidents; and public relations and communications.[54]

This explains the centrality of well integrity to the regulation of shale oil and gas development and hydraulic fracturing more particularly. At the centre of the regulations dealing directly with well integrity are those dealing with the casing and cementing elements of well construction. These are the requirements that relate to matters such as: the kinds and layers of casing that must be installed in different circumstances; the depth to which casing should be sunk; and the extent to which and the ways in which casing should be cemented to ensure its stability, impermeability and protection from the subsurface environment and pressures.

2.4.6.2 Alberta

Alberta's regulations require surface casing to be installed to the depth indicated by a prescribed calculation and to be installed in all cases to at least 25m below the deepest water well within a 200m radius.[55]

Casing and casing accessories must be made of materials ensuring the suitability of both "for the life of the well".[56] Casing has to be manufactured to minimum specifications and have performance properties that meet or exceed standards set by such organizations as the American Petroleum Institute and the National Association of Corrosion Engineers, subject to the determination of regulators that these standards provide the desired level of protection.[57] Casing safety factors have to be increased to required minimum design factors after consideration of anticipated casing wear.[58] Notification of any leak or failure must be given to the regulator immediately on detection.[59] Essentially,

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[51] Government of New Brunswick, "Exploring Natural Gas in New Brunswick", p. 16.
[52] Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, p. 47.
[53] Council of Canadian Academies, "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", p. 55.
[54] Council of Canadian Academies, "Environmental Impacts of Shale Has Extraction in Canada: The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction", p. 192.
[55] Council of Canadian Academies, "Environmental Impacts of Shale Has Extraction in Canada: The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction", p. 4.
[56] Alberta Energy Regulator, "Directive 010: Minimum Casing Design Requirements", pp. 4-5, 6-8.
[57] Alberta Energy Regulator, "Directive 010: Minimum Casing Design Requirements", p. 2.
[58] Alberta Energy Regulator, "Directive 010: Minimum Casing Design Requirements", p. 7.
[59] Alberta Energy Regulator, "Directive 010: Minimum Casing Design Requirements", s. 1.7; *Oil and Gas Conservation Rules*, Alta Reg 151/1971, s. 12.141;

this is regulation based on performance standards, albeit within narrow parameters, not regulation which prescribes the technology, materials and methods to be used. This characterization is reinforced by the option that applicants have to use an independent engineered design option that determines the loads and capabilities of casing strings in more detail than is required by the methods otherwise required by the regulations.[60]

Surface casing, liners and conductor pipe, where required, must be cemented full length.[61] Where less than 180m of surface casing has been run or casing is not set more than 25m below any aquifer with useable water, the casing string next to the surface casing and intermediate and production casing must also be cemented full length. Casing is required to be centralized in the hole. Intermediate and production casing must be centralized at top and bottom of productive formations and at 50m intervals to the required cement top. Fillers or additives that reduce compressive strength are prohibited from use in cement. Cement is required to have a compressive strength of 3500 kPa in 48 hours.

The hole diameter must be at least 100mm larger than the diameter of the pipe. The volume of cement used has to be 20% greater than the cement required by hole-size measurements. Pumping cement down the annulus requires prior regulatory approval. Flow returns must be visually monitored during cementing. If cement returns are not obtained at surface or if required cement tops are not obtained, a cement-top locating log and remedial cementing program must be submitted to the regulator for approval. Full details of the cementing operation have to be recorded and submitted to the regulator. Logs must be taken within the surface casing interval to ensure well integrity. Before completion, abandonment or suspension of drilling, logs measuring the integrity of the well from bottom of the well to the base of the surface casing must be taken. Drilling has to stop where the cement job fails to retain its integrity.

2.4.6.3 British Columbia

British Columbia's regulations on casing and cementing are very similar.[62] Surface casing must be set in a formation and at a depth as to permit blowout prevention equipment to be sufficiently anchored. The well must be constructed to ensure control of the well pressures which are to be expected – and which the licensee is required to expect – at the site, given its characteristics. Surface casing must be cemented to the surface; the next casing string must be cemented for its full length if it is not set below the bottom of all porous strata containing usable groundwater or at least 600m. More generally, hydraulic isolation must be maintained between porous zones at the well site. For deeper wells, surface and production casing is required but intermediate casing, as in Alberta, is only required where it is determined to be functionally required to ensure well integrity.

Evaluation of cementing integrity is required if cement does not return to the surface during cementing. If this happens, bond logging is required to evaluate the cement and to locate its top. Remediation is required as necessary. Cementing information on all wells is submitted to the regulator and reviewed by the regulator's drilling engineer.

2.4.6.4 New Brunswick

New Brunswick's regulations on casing and cementing build on, and are very similar to, those of Alberta and British

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[60] Alberta Energy Regulator, "Directive 010: Minimum Casing Design Requirements", pp. 10-11.

[61] Alberta Energy Regulator, "Directive 009: Casing Cementing Minimum Requirements", pp. 3-7; Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, 12-15.

[62] *Drilling and Production Regulation*, BC Reg 28/2010, s. 18; Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, 12-15.

Columbia.[63] In fact, New Brunswick has adopted the Directives of Alberta's Energy Regulator on the drilling and completion of wells.

The approach taken to determining the required depth of casing, borrowed largely from Alberta, results in casing which is 50 to 80m below the maximum depth of potable water. Intermediate casing is not generally required but can be required to address particular geological formations, such as salt zones. Information on cementing must be included in applications and included in daily reports to the regulator so that the process can be monitored as it occurs. Samples of cement are required to ensure quality. Logging and remedial action as necessary is required if no cement returns to the surface.

One difference is that New Brunswick would require two layers of steel in wells drilled in a new setting.[64]

2.4.7 BOP Systems and Other Equipment and Procedures

Beyond casing design, depth and cementing, regulations deal with many other aspects of the equipment that must be used and the procedures followed in the drilling of wells to ensure well integrity is achieved and maintained. Like the content of regulations on casing and cementing, regulations on other aspects of well integrity and control are very detailed and specific and on many points, relatively prescriptive.

Alberta's Directive 036, "Blowout Prevention Requirements and Procedures"[65] requires the installation and maintenance of BOP equipment "adequate to shut off a flow at the wellhead … in accordance with the well classification and specification as outlined in this directive". The Directive proceeds to lay out a long list of specific standards for the design, fabrication, installation and/or use of specific kinds of equipment, material or processes, including pipe rams, casing rams, ram locking devices, double drilling, flange and clamp-type connections, casing bowls, and Kelly locks.[66] This directive also outlines the inspection normally conducted by the Regulator after the licensee has set surface casing and drilled out the shoe, specifying it should be conducted without prior notice "whenever possible".

British Columbia's regulations on the wider aspects of drilling and well construction are similar to those of Alberta.[67] As in Alberta, regulations in British Columbia are specific and prescriptive as to the BOP system that must be installed. They set standards for many of the specific kinds of equipment, procedures, plans and measures which licensees must use, develop and implement to prevent leakage, escape and spillage of oil and other substances, as well as other kinds of adverse events, and to bring such events under control if they occur.

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[63] Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), pp. 2-6; Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, pp. 41-42.

[64] Government of New Brunswick, "Exploring Natural Gas in New Brunswick" p. 16; Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), p. 5.

[65] Alberta Energy Regulator, "Directive 036: Drilling Blowout Prevention Requirements and Procedures."

[66] The Directive itemizes the components of a BPO system in considerable detail. For example, it requires wells to include a "bleed-off system", and "kill system", and specifies the "minimum requirements", "requirements", "specifications" or "minimum conditions" their respective components must meet. The Directive also requires a "BOP Control System" – and blowout prevention equipment more generally – and the components and procedures it must include and the tests it must pass. The Directive prescribes requirements for "Mud Tanks and Fluid Volume Monitoring Systems", "Well-Site Supervision and Certification", "Well Control, Crew Training and Tripping", "Electrical and Flame-Type Equipment" on site, "Casing Inspection", "Well-Site Records and reporting", "Well-Site Fluids and Environment" and the spacing to be maintained between various kinds of equipment and equipment and the well.

[67] *Drilling and Production Regulation*, BC Reg 28/2010, s. 8 (notification to the Commission of staging in the drilling process), ss. 9-14 (Blowout Prevention), ss. 20-25 (procedures); BC Oil and Gas Commission, "Well Drilling Guideline" (2015) (addressing reporting on drilling, drilling practices and procedures and drilling blowout prevention systems); BC Oil and Gas Commission, "Well Completion, Maintenance and Abandonment Guideline" (2015), (addressing well equipment, well servicing operations, well servicing equipment and procedures, environmental considerations, data submission and compliance).

New Brunswick's "Rules for Industry" says New Brunswick will enhance existing requirements for blowout prevention and control measures "by adopting and imposing procedures for drilling and well servicing such as those set out in the latest version of Alberta ... Directive 036, Drilling Blowout Prevention Requirements, and Directive 037, Service Rig Inspection Manual".[68]

2.4.8 Hydraulic Fracturing

Whether or not hydraulic fracturing is to occur is decided in approving or refusing approval of a well licence. In other words, there generally is no separate process for approving hydraulic fracturing.[69] The requirements in areas such as separation distances, casing and cementing and blowout protection systems discussed above apply to wells that are hydraulically fractured as to other wells. An application for a licence to drill a well is however subject to specific regulatory requirements addressing the issues specifically associated with hydraulic fracturing.

2.4.8.1 Geological Assessments

Geologic assessments are encouraged but not generally required where fracturing is planned.[70] Alberta requires an assessment where fracturing is to be conducted within 100m of groundwater. British Columbia and Alberta require one where fracturing is proposed in a well that is 600m or less from the surface. In both provinces, the assessment is part of a larger risk assessment that must be conducted where "shallow fracturing" is proposed. In New Brunswick, an assessment of the geological formation's ability to prevent fluid migration and groundwater would be required for all well's to be fractured.[71]

In all provinces, specific assessments addressing specific risks, such as that of simulated seismicity or inter-wellbore communication, will be required where conditions show they are warranted. Additional or more extensive assessments may also be required for projects within regions or locales where conditions are known to generally justify additional precautions.

2.4.8.2 Pressure Testing

Pressure testing would be required before hydraulic fracturing in New Brunswick. It is not generally required in Alberta or British Columbia but is generally done as a best practice.

2.4.8.3 Locational Limitations and Restrictions

For fracturing within 600m of the surface, British Columbia and Alberta require water well owners within 200m to be notified and, subject to their agreement, to have their wells tested before and after fracturing.[72] In Alberta, fracturing cannot be initiated within the zone that is 200m horizontal distance from a water well and 100m below the bottom of that well.[73] In New Brunswick, no fracturing would be allowed within 600m of the surface and testing before and after all fracturing would be required on all water wells within 500m of the well pad from which fracturing is conducted.[74]

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[68] Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), p. 14.

[69] In N.B., the fracturing stage of well development may be subject to a distinct phase in New Brunswick's phased environmental impact assessment process.

[70] Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, pp. 17-20, 45-47.

[71] Government of New Brunswick, "Exploring Natural Gas in New Brunswick", p. 16.

[72] Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, p. 15.

[73] Alberta Energy Regulator, "Directive 083: Hydraulic Fracturing – Subsurface Integrity", p. 9.

[74] Government of New Brunswick, "Exploring Natural Gas in New Brunswick", p. 16.

2.4.8.4 Subsurface and Surface Integrity; Inter-wellbore Communication

Alberta requires precautions to be taken to ensure that fracturing does not jeopardize subsurface integrity. Licensees must use either a single- or dual-barrier system for containing and isolating fracturing fluids within the well, or obtain the regulator's approval of an alternative barrier system.[75] Where the single-barrier option is taken, additional operational precautions must be taken to ensure fracturing fluids are kept within the well. Regulations also require risk assessment and mitigation to prevent fracturing from causing a "well-control event at an offset well" or an adverse effect to an aquifer.[76] To prevent the risk of surface damage from fracturing, it is prohibited within 100 vertical m of the top of the bedrock surface.[77]

2.4.8.5 Induced Seismicity

In Alberta, the risk that hydraulic fracturing can induce seismicity is addressed primarily through the terms and conditions attached to the approval to drill and complete a well. The regulator has issued orders of more general application for regions identifying as subject to a higher risk.[78] One such order requires assessments of the potential for induced seismicity before fracturing; readiness to implement a response plan should the risk materialize; compliance with a "traffic light" system under which the response is calibrated to the magnitude of the seismic event; and monitoring for seismic activity in the vicinity of hydraulic fracturing operations. Response plans must be activated and the event reported to the regulator where an event with magnitude 2.0 ML or greater occurs. Operations must be suspended until the regulator agrees to their continuation where an event of 4.0 ML or greater occurs. The regulator also monitors seismic activity with a network of monitoring stations across the province.

In British Columbia, seismic events occurring during fracturing within 3 km of a drilling pad must be reported to the commission if the event has a magnitude of 4.0 or greater or if ground movement is felt by any person.[79] If the well is identified as the source of the event, fracturing must be suspended until operational changes satisfactory to the regulator are taken to reduce or eliminate additional events. Regulation to prevent induced seismicity is done through permit conditions. A recent report recognizes the opportunity to improve transparency, consistency of application and enforcement of requirements by moving them into regulations.[80] After recent events and resulting studies, seismic monitoring capability has been "greatly increased";[81] applicants are required to perform geologic and seismic assessment of pre-existing faults; and the relationship between fracturing parameters and seismicity, and other questions, have been subjected to further study.[82]

New Brunswick's rules[83] require an assessment prior to fracturing for the potential for seismic activity at the surface outside of what would be expected from well stimulation if more than 1000 cubic meters of base fluid are to be injected at any stage of the fracturing process. Where the potential is indicated, operators would be required to: appropriately adjust the placement of the wellbore and design; prepare a response plan; conduct site-specific monitoring during fracturing; and take appropriate action if seismic activity exceeds pre-determined levels.

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75 Alberta Energy Regulator, "Directive 083: Hydraulic Fracturing – Subsurface Integrity", p. 4-6.
76 Alberta Energy Regulator, "Directive 083: Hydraulic Fracturing – Subsurface Integrity", p.7-9.
77 Alberta Energy Regulator, "Directive 083: Hydraulic Fracturing – Subsurface Integrity", p. 10.
78 Alberta Energy Regulator, "Subsurface Order No. 2: Monitoring and Reporting of Seismicity in the Vicinity of Hydraulic Fracturing Operations in the Duverney Zone, Fox Creek Alberta" (2015).
79 *Drilling and Production Regulation*, BC Reg 282/2010.
80 EY, "Review of British Columbia's Hydraulic Fracturing Regulatory Framework" (2015), p. 20. Online: www.bcogc.ca/node/12471/download
81 EY, "Review of British Columbia's Hydraulic Fracturing Regulatory Framework" (2015), p. 17. Online: www.bcogc.ca/node/12471/download
82 BC Oil and Gas Commission, "Investigation of Observed Seismicity in the Horn River Basin" (2012), pp. 26-27.
83 Government of New Brunswick, "Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), p. 36.

2.4.8.6 Water Use

The withdrawal of water for use in fracturing – and in drilling – is subject to approval either by the ministry having general authority over water or by the oil and gas regulator.[84] New Brunswick would specify the preferred sources for water to be used in fracturing fluid, in descending order, as follows: recycled wastewater; ocean water; non-potable groundwater; captured run-off water or rainwater; lakes or watercourses; and potable groundwater. Withdrawal greater than 50 m^3/day or intake within 30m of a watercourse or wetland would trigger an environmental assessment. The assessment would consider the sustainability of withdrawal and impact on adjacent users.

In Alberta, use of freshwater requires an approval unless it is sourced on Crown land and the amount sourced is less than 5,000 m^3. Restrictions can be applied to protect holders of senior water rights, instream flow needs or the aquatic environment.

In British Columbia, groundwater withdrawal rates exceeding 75 L/s are subject to environmental assessment. Assessments must consider impact on riparian owners, fish, recreational use, other users, shoreline habitat and include First Nation consultations. Water approvals specify maximum flow requirements, maximum drawdown, maximum daily allowable withdrawal, and give the regulator the ability to reduce or suspend withdrawal in response to low flow conditions.

2.4.8.7 Fracture Fluid

In Alberta, British Columbia and New Brunswick, regulations require disclosure to the regulator of the composition of fracturing fluid. In Alberta and British Columbia, the licensee must report the components (the carrier fluid, proppant and additives) of the fracturing fluid and the ingredients for each component.[85] The licensee must report the chemical family name for trade secret ingredients and the ingredient name for others. For both, it must report the maximum concentration of the ingredient in the component and in the hydraulic fluid. It can be required to submit further information, including the name of ingredients reported as trade secrets, by the regulator. In both provinces, the information submitted to the regulator – with the exception of the information withheld as a trade secret – is also made available to the public through the Fracfocus.ca website. The approach under New Brunswick regulations is more stringent: the name of all ingredients must be reported and posted on the website.

2.4.8.8 Storage of Flowback Fluids

The storage and disposal of flowback fluids is subject to detailed regulation.[86] Storage is required to be temporary storage – 90 days or less in British Columbia and generally no more than 90 days in Alberta. Storage areas and devices are required to be properly sited – for example, accessible to emergency services, outside of floodplains, and not within 100m of the boundary of a water body or (in British Columbia) 200m of a water supply well. In general terms, regulation requires primary containment, secondary containment, leak detection systems and a comprehensive plan for containment of operational releases and spills. Releases and spills are to be tracked and recorded and their sources systematically eliminated.

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[84] Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, pp. 21-23, 48-50.

[85] Alberta Energy Regulator, "Directive 059: Well Drilling and Completion Data Filing Requirements", pp. 24-31; *Drilling and Production Regulation*, BC Reg 28/2010 s. 37; *Oil and Gas Activities Act General Regulations*, BC 274/2010 s.17.1; Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, pp. 19, 46; *Explore in NB*, supra note 42 at 16.

[86] References for this and the following paragraph are: Paul Precht & Don Dempster, "Final Report – Jurisdictional Review of Hydraulic Fracturing Regulation" (2012), Nova Scotia Department of Energy and Nova Scotia Environment, pp. 23-31, 50-56; Alberta Energy Regulator, "Directive 051: Injection and Disposal Wells – Well Classifications, Completions, Logging and Testing Requirements"; Alberta Energy Regulator, "Directive 055: Storage Requirements for the Upstream Petroleum Industry"; Government of New Brunswick, "Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), pp. 16-22.

In Alberta, regulatory requirements vary for storage devices of different sizes, designs and materials. An aboveground tank with a capacity of 5 m^3 or more is subject to more requirements than one with a capacity under 5 m^3. Both must be made from, or externally coated with, weather-resistant material, but larger tanks are required to be: "designed, fabricated, tested and installed to applicable engineering, manufacturing and regulatory standards"; equipped with more extensive spill control devices; used with loading and unloading areas designed to contain spills and leaks; and installed on sites that are appropriately contoured to prevent the collection of surface water around the "secondary containment system". Single-walled tanks are subject to additional requirements, including a secondary containment system consisting of an impervious liner and dike and graded to a sump or low-lying area within the dyke. The performance requirements for dikes, impervious liners and leak detection systems are specified.

In British Columbia, fracture fluid returns can only be stored in closed-top tanks while slickwater fracture fluids returns may be stored in open top tanks or lined earthen excavations. Similar to Alberta, open-top tanks larger than 45.4 m^3 require dyking or berming to prevent migration off site. With the exception of very small tanks, smaller tanks must have secondary containment or be double walled. Tanks must have no less than 1m of freeboard at all times and be inspected monthly for leakage and damage. Primary containment can be an impermeable synthetic liner if certified by an engineer.

Earthen excavations – which may be used for slickwater flowback in British Columbia – must be sloped to place the low end down gradient of the directional flow of groundwater; constructed with primary and secondary containment devices of impervious synthetic liners which are protected against damage during operations; and equipped with leak detection devices. The design must be certified by an engineer. There must be 1m of freeboard, signage and fencing and netting to protect wildlife and waterfowl. A contingency plan for collection and containment of spills during loading and unloading is required. Alberta's regulations also contain detailed requirements on construction, secondary containment and leak detection for lined earthen excavations that are very similar to those of British Columbia.

Following the British Columbia approach, New Brunswick would require enclosed tanks for flowback water and produced water supported by secondary containment. "Pits" would not be allowed.

2.4.8.9 Treatment and Disposal of Flowback Fluids

Alberta and British Columbia both allow and encourage recycling of treated flowback fluids. Treatment must occur at a licensed waste treatment facility. Disposal is by deep-well injection. Licensed disposal wells must be used and operated in compliance with detailed regulations, such as those found in Alberta's Directive 51 on Injection and Disposal Wells. These apply varying requirements depending on well classification which is based on the fluids the well is designed to handle. They specify casing and cementing requirements to ensure the hydraulic isolation of the well and the isolation of usable groundwater from injected fluids. They require the disposal by injection of certain fluids to be approved, logging to confirm hydraulic isolation and casing integrity, initial pressure testing and continuous wellbore and formation monitoring to ensure ongoing integrity.

Deep-well injection does not happen in New Brunswick due to the limited pore space typical of the province's geology and the concern that injection could induce seismicity. Recycling is the preferred method of management, subject to feasibility.

2.5 Production and Operations

2.5.1 Air Emissions[87]

Regulations on air emissions from oil and gas wells apply to wells that are completed using hydraulic fracturing. In Alberta, the applicable directive deals with flaring and venting of solution gas and with temporary and well test flaring, venting and incineration. It does not prohibit venting but says it is not considered an acceptable alternative to flaring.[88] The directive defines the yearly limit for the volume of "solution gas" that can be flared.[89] It requires operations to be managed to control non-routine flaring, incineration and venting of solution gas that is normally conserved.[90] It requires operators to obtain a permit for planned non-routine flaring or incineration if the volume of gas emitted exceeds a "volume allowance threshold".[91]

Operators are required to implement options for eliminating or reducing flaring, venting or incinerating where a prescribed evaluation establishes economic feasibility and public or safety concerns or environmental impacts.[92] There is an overriding concern to see gas captured and used or marketed where this is feasible and economic. Where flaring, venting or incineration is required or justified, the regulations require it to be done for solution gas in accordance with prescribed performance and venting and fugitive emissions requirements. They require temporary or well testing flaring or incineration to be done in accordance with prescribed performance and public consultation requirements, as determined in accordance with the directive on consultation requirements. The flaring, incineration or venting of solution gas is also subject to these public consultation requirements.[93]

The performance requirements define the required components, procedures, operating efficiency, functionality and performance characteristics of the "flare and incineration systems" that can be used to flare or incinerate gas.[94] The system must be designed or reviewed by an engineer. It must be designed, maintained and operated in compliance with Alberta's Ambient Air Quality Objectives. It must, for example, operate within the prescribed time and temperature parameters to ensure combustion of heavier gases and meet prescribed stack design requirements. It must address all outcomes that mandatory modelling predicts would be in excess of the Ambient Air Quality Objectives.

Under the venting and fugitive emissions management provisions of the directive,[95] non-conserved gas must be burned if volume and flow rates support stable combustion. There are limitations on venting of gas containing odorous compounds or benzene.

Alberta requires the volume of gas flared, incinerated or vented to be measured and reported to the regulator.[96] Alberta's rules are detailed but they leave the choice of technology largely to operators.

British Columbia's requirements are very similar to those of Alberta.[97] New Brunswick adopts a less prescriptive but

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87 This is an area of regulation in which there can be differences in how oil and gas wells are regulated.
88 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 9, 22.
89 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 9.
90 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 17.
91 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 22, 26.
92 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 10, 22-23.
93 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 17.
94 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 50-70.
95 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 71-75.
96 Alberta Energy Regulator, "Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting", 78; Alberta Energy Regulator, "Directive 017: Measurement Requirements for Oil and Gas Operations"; Alberta Energy Regulator, "Directive 007: Volumetric and Infrastructure Requirements."
97 BC Oil and Gas Commission, "Flaring and Venting Reduction Guideline, Version 4.4" (2015).

broader approach in its "Rules for Industry".[98] The Rules say that "the operator of an oil or gas facility will be given an emission limit (under the Clean Air Act) and must decide how best to achieve it". Sources would include all emitting sources on site, not only the well. Operators are required to conduct screening level emission modelling or more sophisticated modelling where warranted by the number or scale of sources under their control. Periodic, site-specific air quality monitoring at source may be required. Ambient air quality monitoring may be required at "sensitive locations" or where necessary to determine cumulative effects. Operators are required to implement a fugitive emissions management and greenhouse gas reduction plan which, for example, considers alternatives to diesel fuel for compressors and ensures that flaring and venting do not occur when a field is served by a gas collection system. Greenhouse gas emissions must be reported annually.

2.5.2 Noise Pollution

Well operators are responsible for noise control. The requirements are virtually identical in Alberta, British Columbia and New Brunswick.[99] In Alberta, the permissible sound level, measured at the point of the receptor, is set at 5 decibels above the night-time ambient sound in rural areas during summer months. The permitted sound level must be met at the closest dwelling or at 1.5 kilometers from the fence line of the site if there are no closer dwellings. The noise level permitted during daytime is 10 decibels higher than the permissible or basic sound level. Further adjustments from the basic sound level are permitted during winter months, when the permitted sound level can be higher. There can also be temporary adjustments while noise generating activities associated with temporary activities are under way, provided notice is given to the impacted residents. A Noise Impact Assessment must be carried out before construction starts or operations commence to identify the measures that may be required to ensure work at the well will meet the permissible sound level with a suitable measure of safety. A Noise Management Plan is required. Enforcement is limited to the investigation of complaints.

2.5.3 Operator Responsibilities to Develop and Implement Plans, Programs and Systems

The regulation of shale oil and gas activities requires operators to adopt and implement a wide range of plans, programs and systems to manage a wide range of issues. In effect, these plans, programs and systems supplement the specific requirements set out in regulations. Compliance with them becomes part of the terms and conditions under which shale oil and gas activities are authorized to proceed. Many of these plans, programs and systems are specifically subject to regulatory approval. Others are approved in a more general sense: the applicant for licence can be required, for example, to submit their plans, programs or systems in specified areas of management or confirm they have the required plans, programs or systems in place. Whether or not required plans, programs or systems are in place and functioning properly can also be addressed when audits, inspections or investigations are conducted.

The responsibility for development and implementation of plans, programs and systems to the satisfaction of the regulator can be thought of as an area of regulated (or enforced) self-regulation.[100] The regulated operator writes the rules that the regulator then requires the operator to comply with,

The substance of the plans, programs and systems that licensed operators are required to develop and implement must be consistent with the regulations, except to the extent variation is explicitly authorized and any procedure specified for the approval of variation is followed. Compliance with regulations includes compliance with the codes,

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[98] Government of New Brunswick, "Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), 73-74.

[99] Alberta Energy Regulator, "Directive 038: Noise Control", pp. 3-4, 5, 7-10, 12-17; BC Oil and Gas Commission, "British Columbia Noise Control Best Practices Guidelines", (2009); Government of New Brunswick, "Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), 31-32.

[100] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy and Practice* (Oxford: Oxford University Press, 2012), 146-157.

standards, protocols or best management practices, including those developed by organizations such as the American Petroleum Institute, the Petroleum Technology Alliance of Canada, safety standards associations or the associations that set practice standards for engineering, geoscience or other fields of technical knowledge, that are incorporated into the regulations. Otherwise, operators should follow such codes, standards and protocols, or have a good reason for not doing so, both because this will help to ensure the effectiveness of their plans, programs and systems and also because these codes, standards, protocols and best management practices are likely to be an important reference for regulators.

In Alberta, British Columbia and New Brunswick, the list of plans, programs and systems that licensed operators are required to have in place is long and varied but similar. The list can include plans, programs or systems in the following areas: general safety of the site; resource development; drilling; casing; cementing; hydraulic fracturing; testing, for example, of well integrity; noise management; consultations; leak and spill detection; spill containment; run off prevention; emissions control and reduction; prevention and extinguishment of fires and prevention of blowouts; wildlife protection; waste prevention, storage, treatment and disposal; site security; water use and conservation; employee and contractor training; emergency preparedness and response; pollution prevention and environmental protection; monitoring; decommissioning and well abandonment; and site reclamation and restoration.

In combination and in conjunction with the operation of regulatory requirements, the plans, programs and systems licensed operators are required to adopt can and should be more than the sum of the parts. They should function together to form a comprehensive risk management system. It has been suggested that the National Energy Board's filing requirements for onshore drilling involving hydraulic fracturing identifies the general areas that such a system must cover. Under these requirements, applicants must submit plans on safety, risk assessment and risk management, environmental protection, waste management and spill contingency.[101]

2.6 Decommissioning and Site Reclamation

When production from a well comes to an end, the well must be abandoned in accordance with applicable regulatory requirements.[102] Notification of abandonment must be given to the regulator. The source, if any, of detectable flows of gas between the surface and production casing of the well, or of loss of pressure integrity between the intermediate and production casing, must be identified and remedied to prevent gas from migrating and escaping from these parts of the well after the plugging of the production casing. Cement bond logs, temperature logs and noise logs may be used to identify the location at which gas is moving. Cement is squeezed into the casing above these locations to prevent gas from moving up the casing. The success of these remediation efforts must be reported to the regulator before plugging can proceed.

Downhole abandonment then proceeds. Prescribed criteria and methods are applied to identify the zones above which seals or plugs should be placed in the production casing. Each plug consists of a metal or polymer bridge plug over a mechanical seal topped with enough cement to seal the 30 to 50 metres of the casing above the bridge plug. A number of these three-part seals will be placed along the production casing to ensure redundancy and prevent a vertically continuous path up the wellbore. Logs confirming the effectiveness of the plugging process must be submitted to the regulator.

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[101] Council of Canadian Academies, "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" pp. 203-205.

[102] *Drilling and Production Regulation*, BC Reg 28/2010, ss. 26-28; Alberta Energy Regulator, "Directive 020: Well Abandonment." (Both British Columbia and New Brunswick have adopted Directive 020: see BC Oil and Gas Commission, "Well Completion, Maintenance and Abandonment Guideline", p. 21, Government of New Brunswick, "Responsible Environmental Management and Natural Gas Activities in New Brunswick – Rules for Industry" (2013), p. 14. The description of the process provided here is informed by Maurice B. Dusseault, "Chapter 7: Well Integrity" (2014) in David Wheeler, et al., "Report of the Nova Scotia Independent Review on Hydraulic Fracturing", 193-220.

Surface abandonment then takes place. The surface, intermediate and production casings are cut off at least 1m below the final contour elevation. They are then capped with a steel plate which is designed and installed to prevent access while preventing build-up of pressure within the casings. The completion of surface abandonment must be reported to the regulator.

The licensee is required to remove surface equipment, cement pads and produced liquids from the site, usually within 12 months. General site reclamation is also the responsibility of the licensee. In Alberta and New Brunswick, it is conducted under environmental legislation. The basic requirement is to reclaim the site to its pre-development capability. This includes replacing or decompacting soil, redistributing stockpiled soils, re-vegetating the site, removing wetland and watercourse crossing structures, restoring drainage patterns and stabilizing slopes. In the case of wells on private land, it can also include addressing the requirements of the lease.

2.7 Monitoring, Oversight and Enforcement

Regulators of shale oil and gas development have broad powers of oversight. They are given clear and general authority to use a range of oversight, compliance and enforcement tools.[103] For example, under Alberta's legislation, the regulator: has access at all reasonable times to all wells, equipment, plant, and records; is entitled to enter on and inspect any well or place used or occupied in connection with a well or that is used for the storage or disposal of any substance to an underground formation; can inspect all books, documents, records, plant and equipment; and is entitled to take samples or particulars.[104] These powers of oversight are in addition to the power of the Minister under the Mines and Minerals Act to conduct investigations and inspections of any well used in recovery of a mineral or in connection with injection into a subsurface reservoir for storage or sequestration.[105]

Any contravention of the legislation, regulations, rules, orders, directives or the terms and conditions of a licence, permit, approval or authorization is an offence, which can be prosecuted.[106] There is also provision for administrative penalties, i.e. fines imposed by the regulator without prosecution. The regulator or Minister is entitled to recover the cost of taking control of an operation to take the actions which the operator has refused or proved unable to take.

Monitoring is enabled and facilitated by obligations imposed on operators to give the regulator notice when they reach a specified stage of an approved activity or before they proceed with an approved activity. For example, the regulator must be notified before a well is capped. It is also enabled by the wide-ranging and detailed obligation of licensed operators to regularly file information with the regulator.[107] Broadly, these obligations fall into two categories: information, such as drilling data, which must be regularly filed with the regulator and information which must be filed or submitted when a specified event occurs. An electronic filing or submission system permits this filing to happen

[103] The regulator's compliance and enforcement powers include the authority to: cancel a licence or approval or suspend a licence or approval for indefinite period for contravention of the legislation, the regulations, rules or an order or direction of the regulator with respect to a well; order the suspension or abandonment of a well or authorize another person to suspend or abandon a well; to take any means that appear to be necessary to prevent or control flow or escape of oil, gas, water or any substance from a well or underground formation that a well enters is not prevented or controlled; order a well to be shut down or for approved methods to be adopted and remedial measures taken before operations proceed or hold an inquiry where it determines that a licensee, approval holder, contractor or operator of a well has contravened or failed to comply with this Act, the regulations, or rules or orders of regulator or that a method or practice is being employed that is improper, hazardous, inadequate or defective; do whatever the regulator considers necessary because of a failure to comply with an order, direction or requirement; give directions to take steps it considers necessary or to enter to take those steps necessary to contain and clean up an escaped substance, such as oil, crude bitumen or water; take any steps it considers necessary for the purposes of enforcing an order it has made, including forcibly or otherwise entering on and seizing control of a well and discontinuing all production and plugging the well. *Oil and Gas Conservation Act*, RSA 2000, c O-6, ss. 27-28; s. 41; s. 44; s. 100; s. 104; s. 105.

[104] *Oil and Gas Conservation Act*, RSA 2000, c O-6, s. 96.

[105] *Mines and Minerals Act*, RSA 2000, c M-17, s. 52.

[106] *Oil and Gas Conservation Act*, RSA 2000, c O-6, s. 108.

[107] Alberta Energy Regulator, "Directive 059: Well Drilling and Completion Data Filing Requirements." (For example)

in real time and presumably at less expense to both operator and regulator. This keeps the regulator informed of the status of operations so that it can quickly intervene where information suggests intervention is warranted. Auditing and inspection to ensure compliance by operators with their filing and submission responsibilities is critical in such a system. The regulator's capacity to actively monitor the submitted data is also critical.

Whether enforcement action is to be taken – and the kind of enforcement action required - is left to the discretion of the regulator. Decision-making on enforcement is guided by policies that emphasize factors such as: the seriousness of the non-compliance with applicable regulations; precautions the licensee did or did not take to avoid the breach of regulations; the harm caused or that could have been caused by the non-compliance with regulatory requirements; foreseeability of the non-compliance; and the compliance record of the regulated entity.[108]

In general, regulators in the industry emphasize prevention and correction of non-compliance rather than penalization for non-compliance. One example are the incentives created for voluntary disclosure of non-compliance.[109] The heavy reliance on what Alberta calls directives and British Columbia calls guidelines, is also illustrative of this approach. Each of these documents covers the responsibilities of the licensed operators in different stages or aspects of their operations. They combine the substance of the requirements that are typically found in different laws or sections of laws, the enforceable rules or directives made by the regulator, and guidance on best practices. The clear purpose is to help operators to know and understand their obligations by putting those obligations together in a package that relates more directly to the activities to which they apply than the scattered requirements found in legislation, regulations and rules typically are. New Brunswick has followed this approach with its "Rule for Industry" document, although this document covers many topics and is therefore more general in some areas and lacks the legal enforceability of Alberta's directives.

Automated application systems are another part of the emphasis on compliance. In Alberta, applicants for approvals apply online using a system that requires each part of the application to be correctly completed before the applicant is allowed to proceed further with the application.[110] The system differentiates routine applications that are unlikely to require individualized attention from the regulator from non-routine applications that will. Presumably, this system expedites the approval process while standardizing it, thereby reducing subjectivity and inconsistency, and focusing the attention of applicants on their regulatory responsibilities. A compliance auditing process is used to ensure that accurate information is being submitted and properly processed by the system.

In addition to their monitoring of submitted data, regulators use inspections and investigations to ensure compliance is being achieved on the ground and to identify and require correction of situations of non-compliance.[111] The applicable policies indicate that unannounced inspections are carried out. For some operators, the effectiveness of these relatively soft measures may depend on whether the regulator is viewed as prepared to take stronger measures. The regulatory framework also includes a complaint process.[112] Experience under many regulatory systems in many industries and jurisdictions show that the seriousness with which complaints from citizens are handled can be critical to overall public confidence in the regulatory system.

2.8 Regionalized Performance-Based Regulation

Alberta and British Columbia are both in the process of changing their regulatory approach to hydraulic fracturing. In Alberta, there are two principles to this new approach: first, regulation will become more risk-based and less

[108] Alberta Energy Regulator, "Directive 019: Compliance Assurance."
[109] Alberta Energy Regulator, "Directive 019: Compliance Assurance"; Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules."
[110] Alberta Energy Regulator, "Directive 056: Energy Development Applications and Schedules."
[111] Alberta Energy Regulator, "Directive 019: Compliance Assurance."
[112] BC Oil and Gas Commission, "Defining: Compliance and Enforcement", online: www.bcogc.ca/node/11461/download

prescriptive and second, regulation will be "play-focused", meaning it will be more focused on the regulation of the development of a shale hydrocarbon resource within a geological formation and less focused on the regulation of specific projects.[113]

The regulator's role would evolve from up-front authorization of individual projects and activities to approving and monitoring the implementation by collaborating operators of a "play development plan". Instead of ensuring compliance with specific rules, the plan would be expected to meet the regulatory outcomes established by the regulator. These would be set in an order for the "play" issued by the regulator. They would be broad. For example, outcomes on water management would be to "maintain a sustainable level of nonsaline water use" and "maintain quality of surface water and nonsaline groundwater". The order from the regulator would also identify how general regulatory requirements would be customized for activities in the play. General requirements could be relaxed, modified or increased and new play-specific requirements could be added on subjects such as subsurface reservoir development, production controls, flaring limits, geohazard assessment, technology-specific design or operation and data requirements and reporting. In the absence of modification, general regulatory requirements would continue to apply within the play.

The play development plan designed to meet the regulatory outcomes would be developed by all the operators having an approved interest in the play's development working collaboratively. They would be expected to develop the plan with public input and to include in the plan processes for continuing engagement and relationships with the community. Where a play development plan was not achievable, individual or cooperating operators would be required to develop a project plan to address the regulatory outcomes expected for the region within the scope of their activities. Again, public engagement would be required. The regulator would have the option of seeking further public input in deciding whether to approve either kind of plan.

This approach advances a number of interrelated regulatory strategies. It supports customization of regulatory requirements to the locale, in much the same way as environmental regulation can be customized for a watershed, while regulatory outcomes are held constant from one watershed to the next. It expands the scope of community participation at the more strategic planning stage of the regulatory process. A third idea is to make operators responsible for achieving general outcomes that can only be achieved through combined efforts, while keeping specific regulatory requirements in place to guard against localized non-compliance and free-ridership. This will require operators to share infrastructure and to reduce the industry's overall footprint, thus limiting the demands which the physical growth of the industry can have on public infrastructure (like roads), other resources (like water), communities and the landscape more generally. It will require regional multi-operator approaches to water utilization, potentially reducing the pressure which hydraulic fracturing places on water resources and waste management, insuring more consistent use of best technology and practices. Theoretically, industry as a whole becomes responsible for avoiding adverse cumulative effects. Operators become more directly accountable to each other, in addition to being accountable to the regulator and the public.

This approach is both needed and possible because of the technology of hydraulic fracturing. A well pad for horizontal drilling activities has a larger footprint than a conventional well used for vertical drilling. On the other hand, it can be the platform for drilling of multiple wells. If used as such, it reduces the need for additional pads.

To facilitate this transition in regulatory approach, Alberta's regulator is substituting pad approvals for well approvals in plays that are governed by a play development plan or project plan. It is bundling a number of the specific approvals that in the traditional system were required in addition to a well approval with the new pad approval. The pad approval thereby provides a more comprehensive approval for the range of activities that are carried out across the full life cycle of a play's development. Single-well pads would then be discouraged.

[113] Energy Resources Conservation Board, "A Discussion Paper: Regulating Unconventional Oil & Gas in Alberta", online: www.aer.ca/documents/projects/URF/URF_DiscussionPaper_20121217.pdf.

3.0 HOW DOES THE CURRENT FRAMEWORK IN NEWFOUNDLAND & LABRADOR COMPARE?

The framework which the legislation and regulations of Newfoundland & Labrador create for the regulation of onshore oil and gas activity, including hydraulic fracturing, are broadly similar to those of Alberta, British Columbia and New Brunswick. However, it is much less detailed than the laws of other provinces, particularly Alberta.

3.1 Legislative and Institutional Context

As in New Brunswick but unlike in Alberta and British Columbia, government is the direct regulator of oil and gas activities. For most purposes relating to the operational aspects of oil and gas activities, this would be the Deputy Minister of the Department of Natural Resources, or his or her designate.[114] The Minister also plays a direct role however, due to the overlap that exists in Newfoundland & Labradors' legislation on rights in oil and gas reserves and the regulatory requirements applicable to development of those reserves.

In Newfoundland & Labrador, there is the possibility of onshore hydraulic fracturing extending into the offshore and into the jurisdiction of the Canada-Newfoundland & Labrador Offshore Petroleum Board. In that scenario, hydraulic fracturing would be within the jurisdiction of an independent regulatory body that operates at arms-length from government.

The legislation of Newfoundland & Labrador does not specifically address hydraulic fracturing. While this is also generally true of the legislation of Alberta, British Columbia and New Brunswick, the difference is that all of these provinces have developed and adopted specific regulatory rules pertaining to hydraulic fracturing, as reviewed above, dealing with issues or topics such as subsurface integrity, water use, pressure testing, locational limitations and handling, storage, disposal and disclosure of fracture fluids. Newfoundland & Labrador does not currently have either a series of regulatory documents comparable to the directives of Alberta or the guidelines of British Columbia or a single compendium of regulatory rules comparable to New Brunswick's "Rules for Industry" document.

This picture is however, incomplete. Like New Brunswick, Newfoundland & Labrador's legislative framework gives environmental regulators a larger direct role in the regulation of oil and gas activities on matters such as emissions. Second, the Petroleum and Natural Gas Act would, when proclaimed, give the provincial cabinet broad regulation-making powers which would authorize regulations on many of the regulatory issues not explicitly addressed in the Act.[115] This seems to be consistent with a general drafting theory of leaving issues that in other jurisdictions are addressed in statute to be addressed in regulations.

Third, a draft guideline document has been prepared that would, somewhat like the Rules for Industry document developed in New Brunswick, bring existing regulatory requirements together in one document while filling the holes that may currently exist in Newfoundland & Labrador's existing legislation.[116] Consistent with the approach previously taken by New Brunswick, this document builds on the regulations in place in Alberta and British Columbia, as well as New Brunswick's work. One of its strengths is showing how regulatory requirements under a number of statutes, including the Petroleum and Natural Gas Act, the Environment Act and the Water Resources Act, can be brought together to create an integrated regulatory framework.

It is also relevant that Newfoundland & Labrador's legislation appears to envisage a regulatory approach that, in comparison to that of Alberta or British Columbia, relies to a greater extent on regulation through the terms and conditions attached to specific approvals. Alberta and British Columbia have in comparison incorporated more of their

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[114] *Petroleum Regulations*, CNLR 1151/96, s. 2.

[115] *Petroleum and Natural Gas Act*, RSNL 1990, c P-10, s. 9. (The regulation-making authority provided, while extensive, is not as extensive or as detailed as the rule-making authority given to Alberta's regulator.)

[116] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3."

regulatory requirements into rules of general application. The Newfoundland & Labrador approach is more similar to that of New Brunswick in this respect. This is discussed further below.

3.2 Exploration and the Connection to Tenure Over Hydrocarbon Resources

Engaging in oil and gas activities requires prior regulatory approval.[117] Exploration is defined to exclude the drilling of wells, except stratigraphic wells.[118] Exploration requires an exploration permit or licence. With a licence, a person acquires the non-exclusive right to conduct exploration surveys.[119] With an exploration permit, a person acquires the non-exclusive right to an exploration licence and the exclusive rights to drill and test for petroleum in the permit area and to convert the permit to a lease for all or part of the area, provided the proposed lease covers a petroleum pool for which a development plan has been approved.[120]

Similar to other provinces, the opportunity to acquire an exploration permit depends on having the rights in the resources to which the permit relates.[121] As a result, the authority of regulators to enforce regulations includes the authority to revoke the right to the resource.[122]

Newfoundland & Labrador appears to also have mandatory separation distances for seismic exploration involving energy sources that are similar to those in place in other provinces.[123] Holders of exploration permits cannot drill closer than 500m of the boundary of the permit area.[124]

3.3 Drilling, Constructing and Completing Wells

3.3.1 Development Plan Approval

The holder of an exploration permit who wishes to convert the permit into a lease (and a lessee who wishes to expand their operations into an area of their lease not already approved for development) must submit a development plan for the approval of the Minister of Natural Resources under the Petroleum Regulations.[125] The submitted development plan must include a "detailed description of the proposed method for petroleum recovery"[126], which would include the plan to utilize hydraulic fracturing.[127] The submitted plan must also include "an environmental impact statement, where required by the Environmental Assessment Act" (now the Environmental Protection Act) and "a description of the proposed mitigative measures designed to reduce the impact of the proposed development on the environment".[128]

The Minister is required to give the public notice of the application and has a discretion to initiate public briefings or

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[117] *Petroleum and Natural Gas Act*, RSNL 1990, c P-10, s. 8.
[118] *Petroleum Regulations*, CNLR 1151/96, s. 2.
[119] *Petroleum Regulations*, CNLR 1151/96, s. 10.
[120] *Petroleum Regulations*, CNLR 1151/96, s. 24.
[121] *Petroleum Regulations*, CNLR 1151/96, ss. 17-23.
[122] *Petroleum Regulations*, CNLR 1151/96, s. 61 and s. 71.
[123] For example, energy sources cannot be used within 180 metres of a dwelling, barn, cemetery or building with a concrete base, or water well: Government of Newfoundland & Labrador, "Newfoundland & Labrador Exploration Survey Regulations" (Draft – June 25, 1997), Schedule A.
[124] *Petroleum Regulations*, CNLR 1151/96, s. 24(5).
[125] *Petroleum Regulations*, CNLR 1151/96, s. 32.
[126] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 72.
[127] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 72.
[128] *Petroleum Regulations*, CNLR 1151/96, s. 33.

hearings on the plan, as well as on exploration licences, permits and leases.[129] Public meetings can also be required through the environmental assessment process, now conducted under the Environmental Protection Act and the Environmental Assessment Regulations, if the Minister of Environment and Conservation orders an environmental impact statement.[130] An environmental impact statement must be completed according to guidelines approved by the Minister of Environment after the public has had the opportunity to make submissions on them.[131] The proponent is then required to meet with the public in preparing its impact statement.[132] The cabinet may order a public hearing, "where there is strong public interest in an undertaking for which an Environmental Impact Statement is required".[133]

In making a decision on a development plan, the Minister of Natural Resources must consider a range of considerations including: the safety of the proposed technology; the sufficiency of the completed environmental, social and economic impact studies; and if the development would result in sufficient employment and industrial benefits.[134]

With an approved development plan, a permit can be converted to a lease for the pools of petroleum within the approved plan. The lessee acquires the right to develop the petroleum in the lease area "in accordance with the regulations", subject to a duty to execute and carry out the approved development plan.[135]

This approach puts environmental protection concerns, as well as economic and social impacts, towards the front-end of the regulatory process. Instead of putting the leasing process ahead of the regulatory assessment of the adequacy of the proponent's plans for developing the resource, it integrates that assessment into the decision on whether or not the proponent gets a lease.

The onus is placed on the proponent to show how it will ensure safe, environmentally responsible and economically beneficial development of the resource. Where the Minister determines that the proposed approach meets regulatory requirements, including in the area of environmental protection, it becomes the approach the proponent will be obligated to implement and follow, subject to changes or additions required by the Minister. This could allow for beneficial customization of regulatory requirements to environmental and social context, provided consistent environmental standards on outcomes are maintained.

The development plan approval process also ensures the public receives notice of development towards the front-end of the regulatory process when decisions of a more strategic nature are being made. It also creates the opportunity for front-end consultations with the public, either through a decision of the Minister of Natural Resources that there will be a public briefing or hearing, or a decision by the Minister of Environment and Conservation to require an environmental impact statement.[136] The draft Guidelines that have been prepared to supplement the legislation state that the two ministers and their departments would coordinate their respective processes and avoid duplication. Given the broad goals for stakeholder consultations set out in those Guidelines, as well as the

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[129] *Petroleum Regulations*, CNLR 1151/96, ss. 7, 34.

[130] *Environmental Assessment Regulations*, 2003, NLR 54/03, s. 32; Government of Newfoundland & Labrador, "Guide to the *Environmental Protection Act*", Department of Environment, pp. 12-15. (Under the Environmental Protection Act, an "undertaking that will be engaged in crude, natural gas or petroleum production facilities shall be registered" for environmental assessment. The Minister of Environment can "release" a registered undertaking or order the preparation of an Environmental Preview Report or an Environmental Impact Statement, or both in sequence, prior to the release of the undertaking. Authorizations under other acts are not to be issued until an undertaking has been released or exempted from environmental assessment.)

[131] *Environmental Protection Act*, SNL 2002, c E-14.2, s. 59.

[132] *Environmental Protection Act*, SNL 2002, c E-14.2, s. 58.

[133] *Environmental Protection Act*, SNL 2002, c E-14.2, s. 63.

[134] *Petroleum Regulations*, CNLR 1151/96, s. 35.

[135] *Petroleum Regulations*, CNLR 1151/96, ss. 41-42.

[136] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 12-16.

public interest that is likely to exist in any shale oil development, public consultations under one legislative regime or the other would appear probable. Since the processes of each department require direct government involvement, government will have the opportunity to ensure consultations are conducted objectively. It is also positive that all of the consultation options provided for in legislation appear to call for communal rather than individualized consultations.

3.3.2 Drilling Approval Requirements and Process

To drill a well, a permit or lease holder must obtain a drilling program approval (DPA) and an authority to drill a well (ADW).[137] The DPA is authority to conduct the approved drilling program and the ADW is authority to drill a well, on the approved terms and conditions.[138]

In applying for DPA, an applicant has to submit information on the environmental and geologic conditions within which the program will be executed, details on the equipment to be used, the relationship between the drill rig and other equipment that will be used and the prevailing environmental conditions and, if requested, the effect that the drilling program is expected to have on the natural environment.[139]

An application for an ADW must include information on geographic coordinates, proposed depth, casing and cementing, and elevation of the ground surface at the wellhead and the rotary table or drill floor.[140] In addition, they must provide a "well prognosis" including information on matters such as: how the plan for drilling the well overcomes meteorological conditions; the prevailing environmental conditions of the well; the equipment, procedures and resources to be used to protect the natural environment; the detailed geological prognosis of the location of the well; the subsurface conditions anticipated; and the details of the proposed casing program.[141]

Unlike in Alberta and British Columbia, there is currently no legislated requirement for notification to be given and consultations offered to those within a specified proximity to the proposed well. Notice will however already have been given in the Development Plan stage of the process, where a public meeting, opportunity to submit comments or a hearing, or some combination of all three, will also usually have occurred. In addition, the draft Guidelines say that applicants for a DPA or an ADW may be required to meet with local residents or participate in public hearings.[142] They also say that operators will be required to notify residents within 1.8 km, or as otherwise determined by the regulator, of a site where hydraulic fracturing is proposed to occur. The "timing, content and nature of notification will be in accordance with directions from the Director". Additionally, they say that operators will be required to have comprehensive stakeholder engagement plans that show how the public, landowners and local authorities will be engaged in each stage of development, including hydraulic fracturing.[143]

3.3.3 Approval of Onshore to Offshore Drilling

Where wells are drilled onshore to target an offshore reservoir, they will have to be approved by the Canada-Newfoundland Labrador Offshore Petroleum Board as well as the Department of Natural Resources.[144] The Board

[137] *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 5, 12, 24, 32.
[138] *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 12, 32.
[139] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 8.
[140] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 29.
[141] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 30.
[142] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 17.
[143] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 12.
[144] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 19.

requires a project environmental assessment for each project within its jurisdiction. The legislative framework exists for the Board and Newfoundland & Labrador to conduct a joint environmental assessment.

3.3.4 Spacing and Separation Distances

A well cannot be drilled within 100m of a surface improvement – which includes a dwelling – unless the regulator agrees it can be conducted without damaging the improvement.[145] A well within 100m of the normal high water mark of a body of water can only be drilled with approval of the operator's plan to prevent pollution of the water by the relevant regulatory body.[146]

3.3.5 Well Integrity, including Casing and Cementing Requirements

The Petroleum Drilling Regulations impose the general obligation on operators to conduct drilling in a manner that maintains full control of the well at all times.[147] They deal extensively and in detail with casing and cementing, well control equipment, drilling operations and procedures, and well termination and abandonment procedures, along with other topics. On each of these topics, the content of the regulations is broadly consistent with the regulations in place in other jurisdictions, although the requirements in some respects are stated more generally. For example, on casing depth, the regulations say, "The setting depth of a casing string shall be based on relevant geological and engineering data". Again, this reflects Newfoundland & Labrador's greater reliance on the terms and conditions of approval as the regulatory mechanism. Applicants for an ADW are required to include a well prognosis describing the geological conditions in which the well will be drilled and the casing program, cementing program, blowout preventer system, drilling plan and fluid system to be used to ensure well integrity is established and maintained in those conditions.[148] On approval by the regulator, these become, with the requirements set out in legislation, the operator's obligations.

The regulations require installation of casing that is designed to meet the stresses and other pressures that are known or that may reasonably be expected.[149] They prescribe the formula to be used in designing casing; the minimum design factors to be used for casing components (surface, intermediate, conductor and production casing and liners); and the assumptions to be used relative to the stresses the casing must be designed to withstand.[150] The regulations also specify key elements of a casing program for "normal pressure conditions", including "surface casing in a competent formation at a depth of not less than 150 metres and not more than 4 times the depth of the previous conductor casing or 500 metres, whichever is greater".[151]

The regulations define the amount of cement to be used (either 30% or 10% more than the estimated annular volume needed) and the measures to be taken where indications of cement failure are detected.[152] They say that cement and cementing procedures used are to prevent the movement of fluids, provide support for the casing and retard corrosion.[153] The extent (or length) of cementing required for conductor, surface and intermediate casing are specified.[154]

Under draft Guidelines, surface casing would have to be set in accordance with Alberta's Directive 008: Surface Casing Depth Requirements and cementing would have to comply with Alberta's Directive 009: Casing Cementing

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[145] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 28.
[146] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 31.
[147] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 17.
[148] *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 29, 32.
[149] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 37.
[150] *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 37-40.
[151] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 43.
[152] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 45.
[153] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 46.
[154] *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 47-48.

Requirements. These Guidelines also say the regulator will require operators to reduce the risk of fracturing fluid, drilling fluids, and hydrocarbons from reaching water wells or the surface to a "low as reasonably practical standard.[155] Earlier in the document, it is stated this standard applies to a risk that is tolerable where the cost of further reduction in the risk would be "grossly disproportionate to the benefit gained" or if the costs of reduction of the risk "would exceed the improvement gained". It will be important to explain how the application of this approach to risk reduction aligns with the requirement in the regulations that drilling is to be conducted in a manner that maintains full control of the well at all times and the expectation articulated in the Guidelines that community engagement assure communities their concerns are being addressed.

3.3.6 BOP Systems and Other Well Completion and Operational Requirements

The content of the regulation on well control equipment and on drilling operations and procedures are more extensive and detailed.[156] Again, they appear to broadly cover the same ground as the regulations of other jurisdictions on these matters. For example, the provisions on well control equipment deal with blowout preventer system requirements and where they should be installed, diverter systems, safety valves and their location, choke manifolds, flow lines and pressure tests of casing and preventers. However, the regulations in these areas seem to cover these topics at a more general level where they overlap with the regulations of other jurisdictions. They also seem not to deal with some matters that the regulations of other jurisdictions deal with. For example, Alberta's regulations seem to deal with many more of the specific components of blowout systems than do those of Newfoundland & Labrador. Again, however, this does not mean that these matters are not regulated in Newfoundland & Labrador but rather that they are regulated in the terms and conditions of regulatory approvals.

3.3.7 Hydraulic Fracturing

As in other jurisdictions, there is no separate process for approval of hydraulic fracturing. Instead, the plan to use hydraulic fracturing is evaluated within the context of the various approvals that are required to drill and operate a well. This starts with the approval of a Development Plan, as noted above.

3.3.7.1 Geological Assessment

The application for an ADW must include a well prognosis, including a geological prognosis. Under draft Guidelines, this prognosis will be expected to address a number of risks and associated regulatory requirements, including the potential for anomalous or induced seismicity.

The draft Guidelines propose that applicants will be required to complete a geological containment assessment on the ability of the zone between the resource-bearing strata and the base of a non-saline aquifer to act as a confining layer that will prevent vertical migration of fracturing fluid, formation water, hydrocarbons or other potential contaminants to the strata containing non-saline water.[157] The hydraulic fracturing program is to reflect the results of this assessment. Applicants will also be required to complete a groundwater risk assessment and again, to propose a fracturing program that reflects the results of that assessment.

3.3.7.2 Locational Limitations and Restrictions

Under draft Guidelines, the regulator would not approve hydraulic fracturing within 250m of a surface improvement

[155] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 40.
[156] *Petroleum Drilling Regulations*, CNLR 1150/96, Parts IV, V.
[157] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", 49-50.

without being satisfied that it can be done without damaging or threatening the structure.[158] No wells or well pads using fracturing would be approved within: 500m of schools, hospitals or nursing homes; 250m of a dwelling or public area such as a playground or protected area; or 100m of any other kind of permanent building. No hydraulic fracturing would be approved within 250m of: a watercourse or wetland; wellhead of any domestic or public water well; or a surface drinking water source. There would be discretion to increase or reduce these setbacks, with reductions requiring agreement on acceptable mitigative alternatives. Later in the Guidelines, it is stated that hydraulic fracturing will not be approved within a zone that extends 250m horizontally from a water well and 100m vertically from the bottom of the well.[159] It also stated that fracturing will not be permitted within 100m of the BGWP (Base of Groundwater Protection) or where the FPZ (Fracture Process Zone) is within 100m of the BGWP.

The draft Guidelines also deal with restrictions on shallow hydraulic fracturing: they say hydraulic fracturing will not be allowed within 100 vertical m of the top of the bedrock surface.[160] This is the same limitation applied in Alberta.

3.3.7.3 Subsurface Integrity

Under draft Guidelines, hydraulically fractured wells would be required by the regulator to comply with Alberta's Directive 083: Hydraulic Fracturing – Subsurface Integrity.[161] Where single rather than dual barrier systems are used, the regulator would require additional measures to be taken to ensure the adequacy of the system, including a number borrowed from Alberta. One would be that fracturing fluids capable of harming ground water would not be used unless the surface casing is set to the base of groundwater protection.[162]

3.3.7.4 Inter-wellbore Communication

Under draft Guidelines, operators will be required to have a qualified professional assess the risk of inter-wellbore communication between their well and any well within the fracture planning zoned.[163] It will be a requirement to complete the assessment to the standard developed by Enform, the safety association for the upstream oil and gas industry in western Canada. If the assessment shows potential for impact on an offset well, fracturing will not be permitted until the fracturing program is modified to eliminate or acceptably reduce the risk of that happening. The regulator will require a well control plan for each at-risk offset well and communication and cooperation between owners of subject and at-risk offset wells to prevent inter-wellbore communication and to develop and implement well control plans.

3.3.7.5 Induced Seismicity

An applicant for an ADW is required to submit a well prognosis including detailed information on the geological prognosis. Under draft Guidelines, the regulator will require operators to assess the potential for anomalous or induced seismicity as part of the geological prognosis. Where the assessment identifies the potential for either, the regulator will require: the potential to be addressed in the wellbore placement and drilling design; personnel

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[158] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 21, 24.
[159] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", 50.
[160] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 48-49.
[161] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 44.
[162] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 45-46.
[163] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 47-48.

preparedness and monitoring procedures, including measures to ensure on site personnel can recognize seismicity detectable at the surface; suspension of operations when unusual conditions are experienced or suspected; and appropriate monitoring, including use of Natural Resources Canada data and surface monitoring at and near operations. Where monitoring detects anomalous or induced seismicity, higher mitigation measures would be activated, including: increased monitoring; changing operating conditions; suspending operations or proceeding with additional caution; conducting engineered trials designed by third party experts to identify appropriate operating adjustments, and reporting and discussing occurrences with the regulator.

3.3.7.6 Water Use

Water use is regulated under the Water Resources Act.[164] It authorizes a licence to divert or use water for industrial purposes and a priority list of users that puts uses such as hydraulic fracturing (and other industrial and commercial and institutional uses) after domestic, municipal and agricultural uses. Under draft Guidelines, a licence will require a water management plan showing the rate of proposed withdrawals will not exceed sustainable limits and will not cause: depletion of non-saline groundwater; progressive lowering of groundwater; degradation of water quality; or reduction in surface water that adversely affects wetlands, aquatic habitat or ecosystems or other water users.[165] Operators will be expected to recycle and reuse flowback (or produced water or treated/recycled waste water from municipal or industrial sources) unless they establish they are not feasible in the context. Where they do so, they will be expected to use ocean water, non-potable groundwater, captured water or water from lakes or watercourses, in that order. Use of water from lakes or watercourses will be subject to a showing that the in-stream flow would not be adversely affected.

Operators would also be expected to demonstrate conformity with water use best practices formulated by the Canadian Association of Petroleum Producers, which generally seem similar but less detailed than the requirements under the Water Resources Act.

3.3.7.7 Fracture Fluids

Current legislation does not deal expressly with the use of chemicals in fracturing fluid or with the responsibility of operators to inform the regulator or the public on the chemicals that are used. Legislation does provide authority that can be used at the Development Plan stage and at the well drilling approval stage to make the composition of fracturing fluids subject to approval and specification in the terms and conditions of approval.[166] This authority could also be used to make approval subject to informing the regulator and the public of the information on composition other jurisdictions require operators to disclose to regulators and to the public.

Draft Guidelines indicate that this authority will be used in this way. Proponents will be required to provide information on fracturing fluids – and fracturing plans more generally – in their environmental impact statement and detailed information on fracturing fluids to the regulator at least 30 days before hydraulic fracturing occurs.[167] They will also be required to provide the results of a risk assessment outlining the operation controls that will be taken to manage risks associated with the use of the fluids they propose to use. If approved by the regulator, these control measures will be a term and condition of the permission to conduct hydraulic fracturing. A standard term and condition will require a report to the regulator within 30 days of the completion of fracturing on the composition of the fluids used,

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[164] *Water Resources Act*, SNL 2002, c W-4.01

[165] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 33-37.

[166] *Petroleum Regulations*, CNLR 1151/96, ss. 33 and 35; *Environmental Protection Act*, SNL 2002, c E-14.2, s. 67; *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 29, 32.

[167] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 52-55.

including the name of each chemical ingredient and the concentration of each ingredient as a percentage of the additive component of the fluids and of the total volume of fluids. The report is then to be released to the public using the website – www.fracfous.ca – used by other Canadian jurisdictions. It is to be prepared in accordance with the Guidelines issued by the British Columbia Oil and Gas Commission with the result that a more general name for an additive can be substituted for its specific name where the specific name is trade secret protected.

This approach will put Newfoundland & Labrador in line with other jurisdictions, particularly British Columbia and New Brunswick, both of which require the fullest level of disclosure on fracturing fluid composition. Given the importance attached to this topic and the intention to take a consistent general approach, Newfoundland & Labrador might consider putting its disclosure requirements into a general regulation, rather than relying on the terms and conditions of specific approvals. Newfoundland & Labrador's legislation provides very broad confidentiality protection to trade secrets and it will be important to ensure these do not prevent implementation of the plan to make disclosure of information on the composition of fracturing fluid mandatory on the same basis as it is in, for example, British Columbia.

3.3.7.8 Storage, Treatment and Disposal of Flowback Fluids and Produced Water

Legislation currently requires storage in "suitable" tanks and transportation in suitable containers. Under draft Guidelines, the regulator will use its authority to specify the terms and conditions on which a well can be drilled to require compliance with more specific requirements broadly similar to those in place in other jurisdictions, and specifically, with the more stringent requirements applied in British Columbia and New Brunswick.[168] For example, use of pits or underground tanks will not be approved. Flowback and produced water must be transported to storage tanks by pipe. Storage tanks must be covered, water-tight tanks with secondary containment constructed of heat and corrosion-resistant materials suitable for anticipated pressures and the physical and chemical properties of fluids. They must be engineer inspected. Storage on site will be limited to short-term storage. Flowback and produced water must be treated and reused except where reuse is not feasible, in which case they must be disposed of at a waste water treatment plant capable of providing effective treatment.

3.4 Production and Operations

3.4.1 Air Emissions

The authority to approve Development Plans and the approvals needed to drill a well on terms and conditions can both be used to approve on terms and conditions which achieve regulatory objectives in protecting air quality.[169] Emissions are subject to the Air Pollution Control Regulations and the ambient air quality standards they prescribe.[170]

Draft Guidelines indicate that Newfoundland & Labrador will be following the approach followed in Alberta, where operators are required to, in sequence, eliminate flaring, incinerating and venting where feasible; to reduce where reduction is feasible; and to ensure flaring, incinerating and venting meet applicable performance standards.[171] Emission inventories, emission dispersion modelling and, in some cases, ambient air quality monitoring will be required. With the exception of non-combustible inert gases, venting will be generally prohibited subject to the authority of the regulator to allow it in specified circumstances. Plans for preventing and reducing fugitive emissions and reducing greenhouse gas emissions will be required.

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[168] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 65.

[169] *Petroleum Regulations*, CNLR 1151/96, s. 33; *Petroleum Drilling Regulations*, CNLR 1150/96, ss. 29, 30, 32.

[170] *Air Pollution Control Regulations*, 2004, NLR 39/04, Schedule A.

[171] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 56-60.

3.4.2 Noise Pollution

Noise levels are regulated under the Occupational Health and Safety Act, applying threshold limits set by American Conference of Governmental Industrial Hygienists.

3.4.3 Operator Responsibilities for Plans, Programs and Systems

The legislative framework requires applicants for approval of a Development Plan and for the approvals needed to drill and complete a well to submit a comprehensive set of plans for their proposed development and proposed wells. Obviously, these include the Development Plan itself as well as an environmental impact statement (where required under the Environmental Protection Act), as well as a range of more targeted and specific plans or programs in areas such as drilling, casing, cementing, emergency preparedness, decommissioning, and so on. There is a general onus on the proponent at the Development Plan stage of the process to show how safety and the environment will be protected. Where development and drilling and completion of wells are each approved, these plans and programs become the substance of the terms and conditions on which the operator is required to conduct its operations. In addition, the regulators have continuing authority after approval has been given to require additional plans, programs of systems to be developed or implemented to address issues not adequately addressed by terms and conditions of approval or by general regulatory requirements.

The Draft Guidelines builds on this legislative framework, itemizing many of the plans, programs and systems which will be required once the Guidelines are implemented. Most broadly, operators will be required to adopt, under the "as low as reasonably practical" principle of risk management, "a systematic approach to the identification of hazards and the application of quality engineered solutions and systems to develop the most effective techniques and approaches to best address those hazards". They will be required to have a "comprehensive stakeholder engagement plan that addresses how they will involve the public, landowners and local authorities at each stage of the play development, including hydraulic fracturing operations". They will also be required to have a water management plan, groundwater monitoring program, fugitive emissions and greenhouse gas reduction plans, waste management plan, spill containment plan, emergency readiness plans and plans to address the assessed and evaluated risk in areas such as inter-wellbore communication, induced seismicity and geological containment.

3.5 Decommissioning and Site Reclamation

The provisions of the Drilling Regulations on well termination and abandonment are broadly similar to those found in the regulations and rules that have been adopted in other jurisdictions. As on other regulatory topics, they may leave more of the details to be determined in the terms and conditions of each approval, and therefore to the termination program or plan which the operator is required to submit to the regulator for approval. But the regulations indicate that the scope of regulatory requirements required by the regulations and the approved terms and conditions is in combination comparable to what is required in other jurisdictions. As in other jurisdictions, Newfoundland & Labrador's version of these requirements specifies the application of the engineering principles, technology, materials and precautions that are generally required in other jurisdictions.

The Drilling Regulations contains basic requirements on site restoration.[172] Restoration is dealt with more extensively in the Development Plan approval process and under the Environmental Protection Act.

[172] *Petroleum Drilling Regulations*, CNLR 1150/96 s. 117.

3.6 Monitoring, Oversight, Enforcement

3.6.1 Data and Information Submission

Holders of a licence, permit or lease are all subject to the same broadly framed duty to submit data and information to the regulator during operations and at the end of their licence, permit or lease.[173] Further reporting requirements apply to holders of a DPA and ADW for matters such as: a summary of all significant events; reports on lithology of formation drilled and the reservoir fluids encountered; summaries of the results of deviations and directional surveys taken; and accident reports.[174] A final well report is also required for each well.[175] Existing Guidelines indicate that the data and information which must be submitted is information about drilling operations (elevation, depth, hole size and depth, casing and cementing record, drilling fluid, fluid disposal, plugging, etc.); geology (drill cuttings, lithology, stratigraphic column); and well evaluation (downhole logs, synthetic seismograms, vertical seismic profiles).[176] With the exception of the "well history" which permit and lease holders must submit, all of the data and information that must be submitted is, subject to limited exceptions, to be held as confidential information by the regulator.[177]

Draft Guidelines indicate that the approval authority of regulators is being used or will be used to broaden reporting obligations in the area of safety and environmental protection, including in areas such as water testing, groundwater and other environmental monitoring and risk assessment in areas such as induced seismicity, inter-wellbore communication and geological containment.

3.6.2 Inspection and Enforcement Powers

A licence, exploration permit and a lease, in addition to the terms and conditions on which each is issued, are subject to the Act and regulations under which they are issued.[178] All are subject to a duty to comply with applicable legislation and duties to allow their operations to be inspected and to cooperate with inspectors.[179] All are subject to the power of the Minister to take "all necessary measures", including ordering a permanent or temporary halt of operations, where, for example, damage is being caused or likely to be caused to the environment or where there is a failure to comply with the legislation or terms and conditions of the applicable authorization.[180] With approval of the cabinet, a Minister can cancel a licence, permit or lease for non-compliance with the legislation or terms and conditions in the licence, permit or lease where there is a failure to take appropriate remedial action after notice is given that such action is required.[181] An ADW can be withdrawn if a drill fails to perform as stated in the DPA or if environmental conditions prove more severe.[182] "Interest holders" can also be prosecuted under provisions of the Petroleum and Natural Gas Act that creates general offences, including failing to comply with a requirement imposed upon him or her by the legislation or an order made under the legislation.[183] The maximum penalty on conviction is $1,000 for every day during which a contravention continues or imprisonment not exceeding 12 months.[184]

Although these are broad powers, they are not as detailed or specific as they might be, particularly in comparison to

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[173] Petroleum Regulations, CNLR 1151/96, s. 52.
[174] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 148.
[175] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 151.
[176] Government of Newfoundland & Labrador, "Guideline: Regulatory Requirements for Final Well Reports Onshore to Offshore Wells", Department of Natural Resources.
[177] *Petroleum Drilling Regulations*, CNLR 1150/96, s. 153; *Petroleum Regulations*, CNLR 1151/96, s. 53.
[178] *Petroleum Regulations*, CNLR 1151/96, s. 4.
[179] *Petroleum Regulations*, CNLR 1151/96, ss. 47, 48, 66.
[180] *Petroleum Regulations*, CNLR 1151/96, s. 49.
[181] *Petroleum Regulations*, CNLR 1151/96, s. 71.
[182] *Petroleum Regulations*, CNLR 1151/96, s. 33.
[183] *Petroleum and Natural Gas Act*, RSNL 1990, c P-10, s. 28.
[184] *Petroleum and Natural Gas Act*, RSNL 1990, c P-10, s. 28.

those of Alberta, summarized above. For example, the ministerial power to take all necessary measures may include the power to assume control of an operation where that is the appropriate regulatory intervention but this would be clearer if stated explicitly. One other difference between these provisions and those found in Alberta and British Columbia is that they place enforcement power mainly or exclusively in the hands of political actors, usually a Minister and sometimes the cabinet. In contrast, officials directly involved in the regulatory process also have enforcement powers in Alberta and British Columbia. This may or may not be relevant to the basis on which enforcement decisions are taken and to the frequency with which enforcement powers are exercised.

4.0 WHAT ARE THE BEST PRACTICES TO ENSURE APPROPRIATE OVERSIGHT FOR HYDRAULIC FRACTURING OPERATIONS?

This report has described how hydraulic fracturing and associated oil and gas activities more generally are regulated in Canada, as indicated by how they are regulated in Alberta and British Columbia and how it would be regulated in New Brunswick if New Brunswick proceeded with shale gas development. It has compared the approach of these provinces to the legislative and regulatory framework in Newfoundland & Labrador, as it is currently structured and as it would be operated under draft Guidelines which would be followed by regulators in exercising the broad authority they are given by legislation to specify the terms and conditions under which oil and gas development, including hydraulic fracturing, would be allowed to proceed. My conclusion is that the regulatory framework in place in Newfoundland & Labrador is broadly comparable to that which is already operational in Alberta and British Columbia and that has been developed for New Brunswick. This comparability would increase with adoption and implementation of the guidelines that have been proposed for Newfoundland & Labrador's regulators.[185]

It cannot be assumed that current approaches to regulation of hydraulic fracturing are best practices simply because they are current or followed in multiple jurisdictions. At the same time, the approach followed in Alberta and British Columbia reflects the extensive experience of both in the regulation of hydraulic fracturing. The scale of their respective regulatory systems is broadly proportionate to the scale of their respective industries. In broad terms, their regulation of the industry has been largely successful in controlling the risks most frequently associated with hydraulic fracturing. In addition, core elements of their largely common approach to regulation are identified as best practices in regulation by a number of the reports that have recently been written on hydraulic fracturing. The same can be said of some of the most significant changes taking place in how Alberta and British Columbia regulate hydraulic fracturing.

This discussion of regulatory best practices builds upon several of these recent reports and the earlier discussion of the regulations of Alberta, British Columbia, New Brunswick and Newfoundland & Labrador.[186] In drawing on the regulatory framework which New Brunswick has developed, it also indirectly draws on the extensive and recent work carried out in that province to develop a regulatory framework that would function at or above the Canadian standard. The discussion also draws on earlier work on the elements of "good regulation" in another sector[187], on a recent

[185] If these guidelines are adopted, they would guide regulators in how they exercise the broad regulatory discretion they have under applicable legislation to decide the procedural and substantive content of regulation project-by-project. If the guidelines were consistently followed, it appears they would result in a level and scope of regulatory control that would be broadly comparable to that which is applied to hydraulic fracturing in jurisdictions which rely to a greater degree on general rules to define the content of regulations and less on regulatory discretion.

[186] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012); Council of Canadian Academies, "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"; David Wheeler et al., "Report of the Nova Scotia Independent Panel on Hydraulic Fracturing" (2014).

[187] Meinhard Doelle and William Lahey, *A New Regulatory Framework for Low Impact/High Value Aquaculture in Nova Scotia – The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia* (2014), online: novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf.

review of the regulation of hydraulic fracturing completed in British Columbia,[188] and on other work on regulation of hydraulic fracturing completed for the Western NL Hydraulic Fracturing Panel.[189]

In very broad terms, regulatory practices can be viewed as related to the content of regulation or about the regulatory mechanisms that should be used to ensure adherence with the content of regulations.

Because the focus of this report is regulatory practices, it does not discuss the consultations relative to hydraulic fracturing that would be required with First Nations. The requirement for these consultations, and their required scope and content, is not a regulatory practice but a matter of compliance with the Constitution and respect for the aboriginal and treaty rights of the First Nations in question.[190] The interests of First Nations communities which give rise to the duty to consult must also be accommodated to the extent required by the applicable duty to accommodate. The duty to consult and accommodate can be discharged within the regulatory process.[191]

4.1 Best Practices in Regulatory Content

4.1.1 Community Engagement

Multiple reports have concluded that the development of hydrocarbon resources in shale formations needs to happen with full engagement of the community.[192] For this to happen, engagement needs to start as early as possible in the development process so that members of the community can learn about the development, get answers to their questions and have input when their input can still have influence on the path that development will take. Ideally, this would mean engagement that starts in the exploration phase of development and not in the well drilling phase of development to avoid or minimize the possibility that the community will feel it is only being engaged after the dye has been cast.

Whenever it starts, effective engagement requires engagement that is sustained over the entire life of each project or of the broader development within which specific projects take place. Perhaps most importantly, it requires engagement that goes beyond obligatory consultations and that instead aims to achieve and sustain a deeply rooted social licence, what the Nova Scotia report on hydraulic fracturing calls the "permission to proceed".

An important aspect of this kind of engagement is that it must go beyond the objective of reducing impacts, as important as that is. Engagement must also seek alignment with community values and identification and maximization of the benefits to the community that development can bring. Successful engagement with the community which is asked to host oil and gas development can help to ensure that the community's values, expectations, concerns and priorities, including those relating to economic development, are built into projects which are then put forward for regulatory approval. It can also give proponents access to community knowledge of local conditions that can be used to improve projects in ways that reduce or avoid later conflict. In these ways, community engagement can facilitate regulatory efficiency and predictability and reduce the risk of conflict with the community when a project obtains regulatory approval.

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[188] EY, "Review of British Columbia's Hydraulic Fracturing Regulatory Framework" (2015), p. 20. Online: www.bcogc.ca/node/12471/download.

[189] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 1".

[190] *Haida Nation v. British Columbia* (Minister of Forests) 2004 SCC 73.

[191] *Taku River Tingit First Nation v. British Columbia (Project Assessment Director)* 2004 SCC 74; *Beckman v. Little Salmon/Carmacks First Nation*, 2010 SCC 53.

[192] Council of Canadian Academies, "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" pp. 208-211; Constance MacIntosh, "Chapter 9: Regulatory Issues" (2014), in David Wheeler, et al., "Report of the Nova Scotia Independent Panel on Hydraulic Fracturing" pp. 273-275; International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), p. 43.

This kind of engagement probably cannot be prescribed by regulations the way regulations in Alberta and British Columbia impose obligations on applicants for approvals to give notice and offer consultations to those owning land within a prescribed radius and to others who are deemed to be entitled to individualized notice and consultations. To do so may well result in consultations to meet regulatory objectives rather than engagement to meet the larger objective of social licence. Nevertheless, regulation can and should require proponents to have and implement a stakeholder or community engagement plan that is capable of achieving the larger goals of community engagement. Regulation should also require regulators to evaluate the success of community engagement efforts both when approvals are pending and after approvals have been given. These evaluations should be taken into account in a number of regulatory decisions, including: whether the proponent or operator should be required to do more; what process the regulator will use in deciding an application; and the application of regulatory requirements related to the results of engagement with the community.

However community engagement is required by and used in regulation, deep and sustained engagement by proponents and operators with the community is foundational to building the precautionary principle, which can also be called the precautionary approach, into the regulatory process.[193] The core idea of the principle is that potentially serious risks[194] should be proportionally managed or controlled if they can be reasonably anticipated even if they cannot be scientifically confirmed or validated. This can only be done if such risks are proactively identified and if their nature, extent and basis is openly and thoroughly explored. Successful community engagement from the front-end of project development is one of the ways of making sure this happens

Canadian regulators are moving in this direction. Requiring or at least enabling broader and more proactive engagement with the community is part of the rationale for the move towards regionally-scaled regulation in Alberta and British Columbia. Draft Guidelines for the conduct of regulation in Newfoundland & Labrador would require proponents to develop and implement a sustained stakeholder engagement plan along the lines described here and called for in a number of reports. The province's current legislative framework, which requires a broader Development Plan to be approved through a process that can include environmental assessment before the approval of individual wells, also lends itself well to this approach.

4.1.2 Participation in Regulatory Decision-Making

In some of the reports that have considered the regulation of hydraulic fracturing, there is an ambiguity as to whether the enhanced community engagement that is called for is separate from or happens within or includes the regulatory decision-making process. Canadian regulatory frameworks are not perfectly clear on this either, partly because of the broad procedural discretion they typically give to regulators to decide the process they will use to decide specific applications.

The independence of the regulator and of the formal regulatory process is very important to the credibility and legitimacy of both. Too much involvement of the regulator in the proponent's efforts to engage with the community

[193] Nicolas de Sadeleer, "Chapter 3: The Precautionary Principle", *Environmental Principles: From Political Slogans to Legal Rules* (Oxford: Oxford University Press, 2002), pp. 194-195.

[194] In the classic formulation, the principle applies where there is a reasonable basis for the occurrence of harm that would be "serious or irreversible". For example, in the decision of the Supreme Court of Canada in *114957 Canada Ltée (Spraytech, Société d'arrosage) v. Hudson* (2001) SCC 40, the *Bergin Ministerial Declaration on Sustainable Development* (1990) was quoted as follows, at para. 31: "In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation". In the *Rio Declaration* of 1992, the broad reference to "measures" was replaced by a reference to "cost-effective measures", as follows: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".

could compromise the regulator's ability to evaluate those efforts. It could also compromise the acceptability of the decisions the regulator must ultimately make on plans or projects put before it for approval as well as the objectivity of its regulation of approved projects and the trust and confidence which the community will place in the regulator's oversight of development.

Regulation should therefore ensure that it provides opportunities to those potentially affected by proposed development to participate in the regulator's decision-making process that are separate from and additional to the opportunities for engagement provided by proponents. Regulation in Canada generally does this, in the sense that it provides the oil and gas regulator the authority to hold a hearing where the regulator determines a hearing is warranted. In Newfoundland & Labrador and in New Brunswick, the opportunity to participate in decision-making can also come through the separate environmental assessment process.

Alberta bases the decision on whether a hearing is called for on whether an application is routine or non-routine, based on criteria specified in advance. This may bring some certainty and predictability to the regulator's procedural decision-making for the benefit of industry and stakeholders. It is also positive that one of the criteria for determining whether an application is routine or non-routine is the existence or non-existence of objections to the project among those who the regulations define as those entitled to notification and consultation or at least to notification. It is however important to note that the Alberta process has been criticized by those who point out very few hearings are held relative to the number of applications considered and approved and by those who argue that when hearings are conducted, the line between those who can participate because they are deemed to be directly affected and those who cannot is drawn too restrictively. These criticisms may or may not be valid but even if they are, a system which distinguishes with reference to predefined criteria between cases that do and cases that do not warrant a formal oral hearing and between those who do and do not have a sufficient interest to participate as parties or intervenors in hearings which are held, is consistent both with good regulatory practice and administrative law. The criteria must, of course, be principled and defensible and they must be rationally, consistently and fairly applied.[195]

The requirement that proponents must notify certain people and to offer consultations to a sub-set of them is itself a best-practice. Newfoundland & Labrador is proposing to adopt the notification aspect of this approach, possibly because of the assumption that consultations will be addressed in the broader community engagement process that proponents will be required to initiate and sustain. Either version of the approach helps to ensure that people most likely to be affected by a project are notified of their opportunity to participate in the regulator's decision-making process. Under the Alberta and British Columbia approach, they may also be assured of being individually consulted within any broader engagement that may also occur.

A regulatory process that is open by inviting and enabling participation from potentially affected members of the public is more likely to operate in accordance with the precautionary principle. It gives those likely to be affected by risks which arguably fall within the scope of the principle – serious risks which have a reasonable basis in fact but which are not scientifically validated – the opportunity to put their concerns about those risks before the regulator. It also places an onus on the regulator to either explain why those risks will not be addressed or show how they have been or will be anticipated and addressed in ways that are proportionate to the likelihood of their occurrence and to the harm which may flow from them.

[195] In Alberta, the criteria for determining participation status are whether the persons seeking status are "directly and adversely affected" or have "rights" that are being affected. Under the *National Energy Board Act*, the person seeking to participate must satisfy the Board they are "directly affected" or that they have "relevant information or expertise" to offer. Useful sources in this area include: David J. Mullan, "Regulators and the Courts: A Ten Year Perspective" (2013), 1 *Energy Regulation Quarterly* 13; David J. Mullan, "2014 Developments in Administrative Law Relevant to Energy Law and Regulation" (2015) 3 *Energy Regulation Quarterly* 17; *Kelly v. Alberta (Energy Resources Conservation Board)*, 2011 ABCA 325, 515 AR 201; and *Forest Ethics Advocacy Association v. National Energy Board*, 2014 FCA 245.

4.1.3 Mandatory Risk and Safety Management Systems

A consistent theme in the reports is that hydraulic fracturing must be done within operations that are managed under a rigorous and comprehensive risk and safety management system.[196] Typically, it is stated that one of the responsibilities of such a system is to ensure compliance with regulatory requirements, reflecting the assumption that the system has to be more comprehensive than what is required by regulation. This makes sense given that critical elements of comprehensive and rigorous risk and safety systems are not easily prescribed by regulation. For example, a risk and safety management culture is a foundational element of such systems. The development and implementation of a comprehensive and rigorous risk and safety management system can however, be a condition of regulatory approval, even though all the specific elements of such a system cannot be prescribed or prescribed in detail.

Regulation in all jurisdictions already does this to varying degrees. The regulation of hydraulic fracturing by the National Energy Board largely consists of a requirement for creation and implementation of plans addressing the major areas covered in most risk and safety management systems. Other jurisdictions require a range of plans or systems to be created and implemented to manage specific risks or risks associated with specific stages or aspects of operation. These plans and systems become part of a company's overall risk and safety management system.

Under the regulatory guidelines which have been prepared for consideration by Newfoundland & Labrador, it would follow this approach on a broad scale. Under those guidelines, operators would be required to "adopt a systemic approach to the identification of hazards and the application of quality engineered solutions and systems to develop the most effective techniques and approaches to best address those hazards".[197] This would be in addition to or include the obligation of operators to have plans to address specific risks, such as discharge of contaminants from stored wastes, and compliance with specific regulatory requirements, like the required depth of casing or extent of cementing.

It is understood that third party evaluation is an essential element of risk and safety management systems. Regulation typically mandates such evaluation, while itself functioning as an evaluation process on two levels: in monitoring the functioning and implementation of the system it requires operators to develop and apply and in monitoring the success of the system in ensuring that regulated activity is conducted in compliance with more specific regulatory requirements.

Risk and safety management systems must be designed and operated to be dynamic. They must incorporate improvements as experience improves understanding of the risks and how they can be most effectively controlled or avoided both on an industry-wide scale and in each operator's specific context. An adaptive management approach seeks to optimize this process of continuous improvement by making learning and the application of learning explicit objectives of risk and safety management. In simple terms, it calls for a cyclical improvement process under which actions based on evidence and experience to achieve risk management objectives are monitored and evaluated against pre-determined metrics and in which objectives and the methods used to accomplish objectives are then revised in light of the monitoring and evaluation.[198] It is recognized this approach depends upon continuous engagement with stakeholders, industry-wide networks through which learnings are shared and robust two-way relationships between industry and researchers.

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[196] Council of Canadian Academies, "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", pp. 195-202; Ian Mauro, "Chapter 8: Public Participation in the Assessment of Risk" and Constance MacIntosh, "Chapter 9: Regulatory Issues" (2014), in David Wheeler et al., "Report of the Nova Scotia Independent Panel on Hydraulic Fracturing", p. 266.

[197] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", p. 10

[198] Rist, L., A. Felton, L. Samuelson, C. Sandström and O. Rosvall. 2013. "A new paradigm for adaptive management" Ecology and Society 18(4):63.

One of the questions that arises in implementing risk management systems is the standard to be applied in evaluating their success in abating specific risks. The Guidelines prepared for Newfoundland & Labrador recommend a "low as reasonably practicable standard" under which risks would be categorized as high (unacceptable except in extraordinary circumstances); medium (tolerable if further reduction of the risk is either impracticable; possible only at a cost that is grossly disproportionate to the improvement gained; or if cost of reduction would exceed improvement) or low (acceptable without further measures other than normal precautions).[199] As noted in the Guidelines, this is the approach taken in some other high-risk industries. It is an approach which must be applied dynamically as research, experience and technological development improves understanding of the nature and severity of risks and of the importance, feasibility and effectiveness of mitigation options.

Several questions can be asked about how this standard will be applied. One is how it will address situations in which the cost and benefit of further mitigation of a tolerable risk accrue to different people or values. The point here is that a risk which is low from the point-of-view of those responsible for it may not be low from the point-of-view of those who may be exposed to it. Also, to the extent this approach results in some specific risks being unmanaged, questions can be asked about the cumulative effect of this on the assumed assimilative capacity of the receiving environment. The point here is that a risk which is low and therefore acceptable when viewed in isolation may not be low when viewed on a cumulative basis, particularly on an industry-wide or regional scale. Such impacts may require attention and a level of additional control that operates above the level of each individual operator.

Also, the consistency of the "low as reasonably practicable" standard with the precautionary principle and with the emphasis the draft Guidelines themselves place on the obligation of operators to address community concerns, should be considered.[200] In assuming that all risks can be categorized as high, medium or low, the standard might be interpreted as limiting the scope of risk management to risks that are sufficiently understood to be amendable to this kind of quantification and categorization. In contrast, the precautionary principle says, in effect, that a risk cannot be ignored simply because it has not been fully validated or confirmed scientifically. It calls, in other words, for action in relation to at least some of the risks on which there is scientific uncertainty as well as on risks which are certain by scientific standards.

The difficulty in applying the precautionary principle becomes two-fold: identifying the potential risks which fall within the scope of the principle and determining the actions which satisfy the principle in relation to those risks, given their uncertainty. On both issues, neither the various formulations of the principle or the extensive literature on it provide definitive answers.

It can however be said with some confidence that the principle applies to concerns about serious harms: in the classic formulation of the principle, it applies where there is a concern about harm that could be "serious or irreversible".[201] Likewise, it is reasonably clear the principle applies to risks (or harms) which should or can be reasonably anticipated,

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[199] Paul Precht and Don Dempster, "Newfoundland & Labrador Basis for Development of Guidance Related to Hydraulic Fracturing: Part 3", pp. 10-11.

[200] Nicolas de Sadeleer, "Chapter 3: The Precautionary Principle", *Environmental Principles: From Political Slogans to Legal Rules* (Oxford: Oxford University Press, 2002), pp. 91-226.

[201] In the classic formulation, the principle applies where there is a reasonable basis for the occurrence of harm that would be "serious or irreversible". For example, in the decision of the Supreme Court of Canada in *114957 Canada Ltée (Spraytech, Société d'arrosage) v. Hudson (2001) SCC 40*, the Bergin Ministerial Declaration on Sustainable Development (1990) was quoted as follows, at para. 31: "In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation". In the *Rio Declaration* of 1992, the broad reference to "measures" was replaced by a reference to "cost-effective measures", as follows: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".

meaning there is some objective basis for them in what is known or can be reasonably extrapolated from what is known.[202] It has likewise been persuasively argued that the principle calls for action that is proportionate both to the potential of the event, impact or consequence upon which the principle is invoked and to the nature and magnitude of the harm which can reasonably be anticipated from those events, impacts or consequences.[203]

In some contexts, these parameters may justify a ban on certain activities or their exclusion from certain locations or kinds of locations. In other scenarios, they may warrant limitations on the scale of development or the application of additional controls or safeguards to those which would be called for if decision-making was limited to the control of scientifically-validated risks. In all contexts, proportionality requires consideration not only of the harms which are said to trigger the principle's application (and the value of preventing those harms) but also the impact which the protective measures which are proposed would have on the interests of those who would be affected by the measures.[204] At the same time, the principle has to be applied in accordance with its purpose, which is to prevent – not to minimize or ameliorate – environmental degradation. Where it applies, it reverses the onus in regulatory decision-making.[205] Refusal to allow an activity to occur and regulatory control of how it is allowed to occur ceases to require proven scientific justification. Instead, regulatory approval requires demonstration that the activity can be conducted safely.

If it is not the intention of the approach to risk management proposed in the Guidelines to authorize operators to ignore risks which an approach based on the precautionary principle would address, this should be clarified. On the other hand, if the intent is to exclude the operation of the precautionary principle, that approach should be reconsidered both because a precautionary approach is objectively warranted in the regulation of hydraulic fracturing and because public trust and confidence in the regulation of hydraulic fracturing probably requires regulation to be suitably precautionary. An additional consideration is that an approach to risk management which is mandated by regulators and which is limited to the management of known risks may limit the statutory authority of regulators to apply the precautionary principle to the exercise of their regulatory discretion.

4.1.4 Emergency Response Plans and Readiness

As stated by the International Energy Agency, "Operators and local emergency services should have robust plans

[202] For example, see Nicolas de Sadeleer, "Chapter 3: The Precautionary Principle", *Environmental Principles: From Political Slogans to Legal Rules*, where it is argued the principle is "triggered" by risks falling between those which are "certain" and those which are "residual" (pp. 156-157). The author explains, at page 159: "The occurrence of such risks remain controversial at the scientific level, but it is not unreasonable to anticipate their occurrence on the basis of certain data, even if those data have not yet been fully validated. In other words, strong presumption should be sufficient basis for an appeal to precaution, whereas simple intuition excludes it use. The application of the principle should depend on minimal evidence of the probability of a risk; failing this, scientific uncertainty – which serves to advance knowledge – would be transformed into a sterile debate and would eventually serve to discredit research. The precautionary measure must therefore be linked to a minimum of knowledge: that is to say, to scientific grounds with a demonstrated degree of consistency". Later, the author says, at page 160: "The principle may consequently apply to all post-industrial risks for which a cause-and-effect relationship is not clearly established but where there is a 'reasonable scientific plausibility' that this relationship exists".

[203] Nicolas de Sadeleer, "Chapter 3: The Precautionary Principle", *Environmental Principles: From Political Slogans to Legal Rules*, pp. 167-174. Under this approach, proportionality leads the decision-maker "to evaluate the need for and usefulness of proposed measures by considering how they will affect the interests of the various parties influenced by a decision". A proposed precautionary measure "will be deemed disproportionate and should be abandoned if it brings into question in an inappropriate manner interests that are worthy of legal protection". Assessing proportionality therefore requires consideration of "non-targeted risks that might arise: to refuse to run a risk is often to accept other, opposite risks". However, just as the risks which trigger application of the principle cannot be too speculative, nor should be those which are considered for the purpose of gauging the proportionality of a proposed precautionary measure.

[204] Nicolas de Sadeleer, "Chapter 3: The Precautionary Principle", *Environmental Principles: From Political Slogans to Legal Rules*, 171.

[205] Nicolas de Sadeleer, "Chapter 3: The Precautionary Principle", *Environmental Principles: From Political Slogans to Legal Rules*, pp. 202-[203] De Sadeleer puts it this way: "This is quite simply a new paradigm: previously the polluter benefited from scientific doubt; henceforth doubt will work to the benefit of the environment".

and procedures in place to respond quickly and effectively to any accident, including appropriate training and equipment".[206] Regulation should require these plans and procedures to be in place. The broader role of government may be to ensure that "local emergency services" have the capacity to play their necessary role in emergency preparedness and response.

4.1.5 Locational Choices

The choice of location for a well or well pad to be completed by hydraulic fracturing is important from at least two perspectives. It is important to the potential for adverse impact on communities, land use patterns, homes and other surface structures, domestic water wells, other economic sectors, recreational activities, conservation areas, heritage sites, surface waters, ecology or other values. It is also important to the crucial matters of well integrity and geological containment.

One of the primary regulatory responses is to specify the distances between wells (or well sites), buildings and water bodies that must be maintained, or maintained unless a variance is approved by the regulator or agreed to by the potentially affected people. These set-backs are undoubtedly important to the people they benefit. It has however been pointed out that these "set-backs" lack scientific basis.[207] In addition, their role in prohibiting development immediately beside surface features should not be allowed to obscure the implicit permission they give to development that could still be relatively close to many surface features.[208]

The more fundamental regulatory response is for more proactive decision-making in identifying the areas in which development will be allowed or encouraged and the areas in which it will be restricted or prohibited because of either suitability or lack of suitability from resource, social and environmental perspectives. Currently, these decisions are made not only in the regulation of oil and gas activities but also in a range of other regulatory fields (such as land use planning, wilderness conservation, wildlife management, forestry, water resource management, mining, and environment). Shifting of the focus of the regulation of hydraulic fracturing to the regional-scale may provide opportunities for a more strategic and organized approach to ensuring the industry only develops where development makes the best locational sense. Strategic environmental assessment could also play a role in this respect.[209] So could broader and more comprehensive processes of integrated land use planning.

The locational aspect of geological risk is currently addressed primarily by requiring proponents to identify, evaluate and address the geological conditions of their proposed site in their plan of development, including well design, casing, cementing and fracturing program. Where geological knowledge or experience indicates the need for additional precautions in certain regions, regulators should make those precautions - or alternatives of equal effectiveness – a term of approval.

More generally, there is a need for more clarity on the criteria, factors and standards to be applied in identifying localities in which hydraulic fracturing will be permitted and those in which it will be limited or prohibited. For example, it has been suggested that aquifer vulnerability assessments or mapping should be conducted to identify areas where

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[206] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), p. 48.

[207] Council of Canadian Academies, "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", pp. 147- 186, 195. The same report, at page 175, raises questions about the adequacy of the vertical separation distances which must be maintained between top of the fracture zone and bottom of the fresh groundwater zone.

[208] Pennsylvania has adopted a more protective approach, under which the operator is presumed liable if damage occurs to a property within 760 metres from the well; Council of Canadian Academies, "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", 174.

[209] David P. Lawrence, *Impact Assessment: Practical Solutions to Recurrent Problems and Contemporary Challenges*, 2nd ed. (Hoboken, NJ: Wiley, 2013), 36-43 and 46-49.

aquifer vulnerability should mean no development, higher levels of precaution or prioritization for monitoring.[210] Similarly, processes of geological assessment and mapping should be used to proactively identify and characterize "risky geology" to ensure such geology is either avoided or addressed on a precautionary basis in the nature and scale of development that is allowed to occur and in the terms and conditions on which it is approved and monitored. These would be examples of a precautionary approach to the regulation and conduct of hydraulic fracturing.

4.1.6 Mandatory Establishment of Baselines for Key Environmental Indicators

The reports universally say that baseline environmental conditions should be established before hydraulic fracturing begins. Regulations in the four jurisdictions considered for this report either require or are currently poised to require this for water wells within a specified distance of hydraulic fracturing. Hydrogeological wells drilled to monitor groundwater should be drilled before oil or gas wells are drilled. The establishment of the baseline for broader environmental conditions is being required as part of the plans that must be approved relative to the development of plays. The establishment of baseline environmental conditions would be required under the Guidelines that have been prepared for Newfoundland & Labrador.

Requiring baseline conditions to be established is essential to making mandatory environmental monitoring, discussed below, meaningful.[211] It has also been pointed out that it is foundational to making engagement with the community deeper, more trustful and evidence-based. For this reason, it is important that the baseline for general environmental conditions be not only established but shared with all stakeholders. It is also important that baseline conditions be established through a process that is transparent, independent and objective.

4.1.7 Well Integrity; Spill Prevention and Containment; Disposal of Associated Wastes

There is general agreement that well integrity is critical to controlling many of the possible sources of water contamination that generate much of the legitimate concern about hydraulic fracturing. There is also wide agreement on the measures to be taken to achieve and maintain well integrity and on the testing that should be done to confirm the effectiveness of these measures. In Alberta, British Columbia, New Brunswick and Newfoundland & Labrador, these wide agreements are reflected in regulations that are robust and directive in specifying the measures to be taken in constructing and completing wells to ensure their integrity. The regulations also specify the testing that is to be done to ensure well integrity has been achieved and is maintained. More specifically, within a general duty to achieve well integrity, the regulations prescribe how wells are to be constructed and completed in considerable detail.

Similarly, the regulations detail the responsibilities of operators in preventing and containing spills and leaks from wells and in safely disposing of associated wastes in some detail. Again, the detail applies within the context of a general responsibility to prevent, contain and dispose safely. But the detail provides significant guidance as to what is and is not acceptable in spill prevention, containment and disposal.

Regulation on these topics should continue to be robust and directive. Operators should be under a general overarching duty to achieve and maintain well integrity and to cease operations and take immediate corrective action when it is lost, as well as a general duty to prevent and contain and to safely dispose of waste from spills and leaks. Within these general and overarching duties however, the specific measures to be taken to ensure well integrity and to prevent and contain spills and leaks and to safely dispose of the associated wastes should be prescribed to the extent they are amendable to prescription.

The importance of prescriptive preventative regulation on well integrity and spill prevention and containment to

[210] Council of Canadian Academies, "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", 172-175.
[211] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), 43.

effective regulation of hydraulic fracturing is recognized in various reports on hydraulic fracturing and its regulation. For example, the International Energy Agency calls for "robust rules on well design, construction, cementing and integrity testing as part of a general performance standard that gas bearing formations must be completely isolated from other strata penetrated by the well, in particular fresh water aquifers".[212] It also calls for "appropriate minimum depth limitations on hydraulic fracturing to underpin public confidence that this operation takes place well away from the water table". Also, it calls for "both stringent regulations and a strong performance commitment from companies" to prevent and contain spills and leaks and to ensure safe disposal of waste fluids and solids.

A precautionary approach is also called for in this area of regulation. With respect to the risks of water contamination which are understood, it calls for regulation which builds ample safety margins into requirements on drilling, casing and cementing, avoidance and containment of spills, management and disposal of wastes, monitoring and emergency response. For risks which are not fully understood, such as the effectiveness in the longer term of the measures currently being taken and required by regulations to ensure well integrity, a precautionary approach calls for active work to improve understanding of the risk and options for reducing or mitigating it, including through research and technological development. In the meantime, it may call for additional limits on the scale or location of development or for additional safeguards against the possibility that safeguards which are currently thought adequate prove to be inadequate. It also reinforces the rationale for a comprehensive system of environmental monitoring which is designed to survive the coming and going of specific operators or companies or the industry as a whole.

4.1.8 Subsurface and Surface Integrity, Inter-wellbore Communication and Induced Seismicity

Some jurisdictions require dual-barrier containment systems to keep fracturing fluids within the well, while others permit single-barrier systems provided additional operational precautions to the satisfaction of the regulator are taken to provide at least the same level of containment assurance. Fracturing is prohibited above a specified geological depth to prevent surface disturbance.

The approach taken to both the potential for inter-wellbore communication and the possibility for induced seismicity is similar: assessment of the risk and proportionate adjustments to operational plans for wellbore placement, drilling and fracturing. Third party involvement can be required. Well control plans must be ready for each potentially affected off-set well. Monitoring is required and training and other measures undertaken to ensure personnel are prepared to respond to either kind of event. Where anomalous or induced seismicity above a specified threshold is detected, it must in Alberta and British Columbia be reported to regulators and operations must be suspended until further control measures are implemented. Requirements in New Brunswick and proposed for Newfoundland & Labrador are similar but defined more generally.

The risk of seismicity from fracturing is said to be small but its reality has been proven and acknowledged by regulators.[213] The regulatory approaches being taken do not give a clear impression of the existence of a best practice. Until further research allows better definition of this risk, best practice may be: recognizing its reality increasing monitoring of seismic conditions in the region in which fracturing is proposed or conducted; requiring it to be mitigated in accordance with a precautionary approach; and supporting the research needed to allow the risk to be better understood and evaluated.

[212] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), p. 45.

[213] Council of Canadian Academies, "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", 129-133; BC Oil & gas Commission, "Investigation of Observed Seismicity in the Horn River Basin" (2012), 12, 26.

4.1.9 Minimizing, Handling, Storing and Disposing of Flowback Fluids, Produced Water and Other Liquid Wastes

Regulation should impose a general responsibility on operators to minimize liquid waste and to ensure that the handling, storage and disposal of it is safely done. Within that general responsibility, regulation should require the utilization of a comprehensive system of waste management that provides a very high level of protection against contamination of water or other harm to the environment or safety. Regulation should prohibit methods, equipment and materials that carry unacceptable risks (such as open pits) and prescribe the use of methods, equipment and materials that provide high and effective control of risks (such as corrosion resistant covered tanks). This approach is justified because the potential for water contamination which generates many of the legitimate concerns about hydraulic fracturing could be caused by the improper or inadequate handling, storage or disposal of liquid wastes. It is also justified by the fact that methods for the handling, storage and disposal of fluids and liquid wastes that provide a high level of protection against these risks can be prescribed and enforced.

This is an area of regulation where the content of regulation should remain relatively prescriptive, as it already is, particularly in British Columbia, and as it would be under the framework developed in New Brunswick. It is another area of regulation where regulation needs to be precautionary in addition to being strongly preventive in accordance with current knowledge and technology.

4.1.10 Mandatory Disclosure and Reduced Use of Chemicals in Fracturing Fluids

Operators are required to disclose to regulators and the public the volume of fracturing fluids used, the additives and chemical ingredients used in the fluid and the concentration of each ingredient as a percentage of the additive component of the fluids and of the total volume of fluids in British Columbia and Alberta. New Brunswick would impose the same requirement and it is being proposed for adoption in Newfoundland & Labrador.

This requirement has been endorsed in the reports. In the view of the International Energy Agency, it is connected to the broader themes of public engagement, measurement and disclosure, as follows: "Reluctance to disclose the chemicals used in the hydraulic fracturing process and the volumes involved, though understandable in terms of commercial competition, can quickly breed mistrust among local citizens and environmental groups".[214] The Canadian Association of Petroleum Producers also regards this disclosure as a best practice, whether or not it is regulated.

Operators are also being encouraged but not required by regulators to reduce their use of chemical additives. Reduced use is also supported by the Canadian Association of Petroleum Producers. Disclosure may encourage reduction. Regulation could however be more ambitious in this area by requiring operators, individually or collectively, to have a plan for reducing use of chemicals or by making approvals subject to progressively demanding reduction requirements.

4.1.11 Water Use and Management

Regulators are taking a broadly consistent set of measures to both ensure that the need for significant volumes of water in hydraulic fracturing does not threaten the sustainability of water sources and to assure society that this is so.[215] These measures include requiring progressive improvement in efficiency of water use and therefore in the amount of water needed; making water recycling mandatory when it is feasible; requiring the use of saline or non-potable water sources when needs cannot be met by recycling; making sure that hydraulic fracturing gives priority to other uses; requiring studies to confirm that the withdrawals made for fracturing do not threaten the sustainability of

[214] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), p. 46.
[215] Graham Gagnon, "Chapter 6: Impacts on Water", in D. Wheeler et al., "Report of the Nova Scotia Independent Panel on Hydraulic Fracturing", 167-191.

the bodies of water or groundwater sources from which withdrawals are made; requiring tracking, documentation and disclosure on the volumes of water withdrawn from specific sources and used in fracturing; and monitoring the status of the water sources from which water is drawn.

A similar bundle of measures is called for in the reports. They appear to represent regulatory best practice.

4.1.12 Air Emissions

Regulation should prohibit venting except in exceptional circumstances with a view to its elimination. It should require flaring to be kept to a minimum, the prevention of fugitive gases and continuous progress in reducing all emissions during well completion, including of greenhouse gases. It should require operators to minimize and reduce emissions from vehicles, drilling rigs, pumps and compressors.

Currently, the regulations on air emissions could be characterized, especially in comparison to those addressing the risk of water contamination, as permissive. It has been argued that the issue of air emissions from unconventional well development has received inadequate attention in discussions of the regulation of hydraulic fracturing, perhaps in part because of the focus on risks to water.[216] It has also been argued that a comprehensive regulatory scheme should be more aggressive than current schemes are in reducing these emissions, especially in light of research suggesting methane emissions are much higher from unconventional wells than from conventional wells. This report endorse that view. Reducing air emissions on an aggressive scale would be consistent with a precautionary approach to regulation given the adverse impact on both a local and wider scale which higher emissions may have on a cumulative basis, particularly as the industry grows, both on their own and in combination with emission from other sources.

4.1.13 Decommissioning, Well Abandonment and Reclamation

It is critical that wells be abandoned and capped in strict accordance with the knowledge, materials, equipment and procedures that are state of the art. The state of the art is what regulation should make mandatory. This is another context in which prescriptive regulation should be retained and enforced.

This is an area of oil and gas activity in which questions about the will and capacity of regulation to confront and prevent bad and irresponsible industrial practices can be very legitimately asked. For example, Alberta faces a serious issue in remediating the many orphan wells that are a legacy of the industry's activity in that province. Newfoundland & Labrador has the opportunity to learn from this experience by insisting upon strict compliance with demanding regulations on decommissioning, well abandonment and reclamation. Regulation should require site reclamation to the highest international standards.

Orphan sites simply cannot be allowed to come into existence. Ultimately, the government has to be positioned to carry out decommissioning, well abandonment and reclamation where operators fail to meet their obligations. Regulation should ensure that government`s responsibilities are fully funded by industry, not taxpayers. But to ensure that government is not called upon to clean up after industry in the first place, the regulatory framework should make it clear that new licences will not be issued where existing licences have resulted in wells that have not been properly decommissioned, abandoned and reclaimed.

As already noted, there are unanswered questions about the long-term durability of abandoned wells, particularly concerning the stability of cement.[217] Regulation must therefore ensure long-term stability is adequately monitored and

[216] J. Gerken "What the frack shale we do? A proposed environmental regulatory scheme for hydraulic fracturing" (2013) 41 Capital University Law Review, 81.

[217] Council of Canadian Academies, "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", 193.

that the capacity to repair wells is maintained and ready for deployment. The monitoring should be done transparently and to a standard that allows the data to be used in the research that is needed to answer the questions that are currently unanswered. As noted above, these measures are called for by a precautionary approach to regulation.

4.1.14 Cumulative Effects

The minimization of adverse cumulative effects should be a primary objective of regulation and more broadly, of the policy objectives of industry and government. Requiring industry to take a collaborative approach to development by moving the focus of regulation to the regional or play level, as discussed above, can help to prevent overbuilding of infrastructure. It should therefore help to reduce cumulative impacts while helping to ensure that infrastructure is built to and utilized in accordance with consistently high standards.

The avoidance of adverse cumulative effects may however also require controls on the pace and scale of development, whether it is done through approval of multi-well pads or individual wells.

Cumulative effects have to be tracked, monitored and controlled. This is one of the important rationales for making environmental monitoring mandatory, as discussed below. As the industry grows, evidence of adverse cumulative effect should become an important factor in regulatory decision-making, including on applications for the go-ahead on expansions or new projects.

The risk that hydraulic fracturing will lead to adverse cumulative effects that will not be adequately controlled under a traditional regulatory focus on individual operators is an example of the kind of risk that falls within the scope of the precautionary principle. Active and effective minimization or prevention where prevention is possible of such effects would align the regulation of hydraulic fracturing in Newfoundland & Labrador with the precautionary principle. It would help to ensure that the province avoids what is commonly said to be one of the main deficiencies of how the oil and gas industry has been regulated elsewhere, which is inattention to prevention, minimization and remediation of cumulative effects.

4.2 Best Practice in Regulatory Mechanisms

4.2.1 The Importance of Conducive Institutional Arrangements

The regulation of hydraulic fracturing is largely done by an arms-length commission in Alberta and British Columbia. In New Brunswick, the responsibility would lie primarily with two government departments. In Newfoundland & Labrador, both models are in place: for fracturing which takes place onshore, regulatory authority is shared by the departments of natural resources and environment whereas for fracturing offshore, jurisdiction lays with the Canada Newfoundland & Labrador Offshore Petroleum Board (CNLOPB).

The arms-length commission model and the government department model can also be combined. Until the recent establishment of the Alberta Energy Regulator, the regulation of oil and gas activities was the mandate of the Alberta Energy and Conservation Board while environmental regulation, now delegated to the Alberta Energy Regulator which replaced the AECB, was the responsibility of Alberta's ministry of the environment. In the arms-length commission model as it has generally been applied, administration of the tenure rights system for oil and gas resources has remained with the government department responsible for energy or natural resources more generally.

It is not possible to say one model or the other is a regulatory best practice. But given that Alberta and British Columbia are the jurisdictions from which other jurisdictions largely take their lead in the regulation of hydraulic fracturing, what they gain from having delegated the responsibility largely to independent commissions requires consideration. This is also appropriate given Newfoundland & Labrador's own experience, through the CNLOPB, with both the arms-length commission (or board) model and the government model.

It is generally thought that an independent commission model supports institutional regulatory expertise by ensuring regulatory specialization and engagement in regulatory work of specialists who might be less likely to work in, or be retained by, a government department. This model is intended to ensure regulatory decisions are made for regulatory reasons, rather than for broader policy or political reasons. In part, it may do this by creating organizational separation between the responsibility of the regulator for regulatory administration and the responsibility of a minister and a department for overall policy and the management of the economic component of oil and gas development. A further possibility is that a commission model lends itself to the consolidation or centralization of regulatory responsibilities that would otherwise be applied to the industry by a number of different government departments. It might in this way reduce the risk of regulatory fragmentation, which can be bad for industry and regulation's effectiveness.

The commission model may also allow for more timely rule-making, at least if the commission is given authority not only to apply rules but also to make rules that would otherwise be made as regulations by either a minister or cabinet. This is the model in Alberta, where the Alberta Energy Commission, like the AERCB before it, has independent rule-making authority which would not typically be given to a division of a government department. It has used that authority to issue the series of directives that are fundamental to how hydraulic fracturing is regulated in Alberta and very important to how it is regulated across the country. Assuming a commission is properly resourced, its rule-making may have the potential to be more timely and responsive to regulatory conditions than rule-making by government because of the commission's specialization and its ability to dedicate its resources to rule-making when it determines rule-making is a priority. In contrast, a government regulator may face competition from other divisions or departments for government's rule-making resources, including space on a minister's or government's law and policy-making agenda.

Regulation by government departments may also be more susceptible to politicization, largely because of the absence of institutional separation between regulators who work in government departments and their political masters. If this happens, political rather than strictly regulatory considerations can become the basis on which regulatory discretion is exercised. Regulatory effectiveness, consistency, certainty, predictability, and fairness can all suffer.

The arms-length commission model may however, have its own inherent weaknesses in comparison to the government department model. For example, it may be more susceptible to regulatory capture due to its strong association with the regulated industry and membership of regulators and those in the industry in the same professional communities. As noted earlier, this has been one of the criticisms levelled against the Alberta Energy Regulator and its predecessors. The arms-length commission model may also limit or complicate the democratic accountability of regulatory decision-making. It may also limit or prevent alignment between regulation for which the commission is responsible and regulation left in the hands of government departments and between regulation and government policy more generally. This can constrain regulation's effectiveness and result in regulatory tools being used to accomplish objectives that would be better pursued by other means. It can result in regulation and decision-making on policy working at cross-purposes. These questions about the commission model may conversely be areas of comparative strength for the government department model.

A separate but related question is whether the mandates for regulation of oil and gas activities and environmental regulation should be combined or kept separate, recognizing that they must unavoidably overlap and function in alignment whether they are formally combined or kept separate. This is an issue that must be addressed whether responsibility for oil and gas regulation is kept within government or delegated to an arms-length commission. In the version of the arms-length commission model now in place in Alberta and British Columbia, the commission has been delegated responsibility for environmental regulation as well as oil and gas regulation. In general terms, this is also true of the CNLOPB and under the National Energy Board.

The rationales are to better integrate environmental protection into oil and gas regulation, regulatory streamlining, and to reduce or avoid regulatory fragmentation and conflict. For some, including Alberta's recently elected government, this raises concerns about the rigour with which environmental regulation will be conducted given the

commission's strong association with the industry.[218] The implications arising from this concern are serious given that the rationale for much of oil and gas regulation is environmental protection. In fact, it is probable that the protection of the environment in the oil and gas context depends more on how oil and gas regulation is conducted than it does on how more general environmental regulations are applied to oil and gas activities. Another concern with consolidating responsibility for administration of oil and gas and environmental regulation as a means of aligning them is that it may cause inconsistency between environmental regulation of oil and gas activities and other industries and thereby reduce the overall effectiveness of environmental regulation in meetings its distinct objectives.

The best practice is to design and implement an institutional model which creates the combination of institutional conditions likely to be most conducive to regulatory effectiveness. Consideration should be given to the contributions that institutional choices in different jurisdictions have made to regulatory effectiveness for the purpose not only of choosing between the models in place elsewhere but also to consider how the strengths of different models can be combined in a model that will work in and for Newfoundland & Labrador. Given its experience with the commission model for the regulation of offshore oil and gas development and the government model for the onshore industry, Newfoundland & Labrador is well-positioned to carry out that analysis and to develop an approach that combines the strengths of both models while minimizing their respective relative weaknesses.

An additional factor in the context of western Newfoundland is that wells drilled onshore may extend under the ocean floor and therefore into the jurisdiction of the CNLOPB. Where this occurs, the drilling of the well and the fracturing conducted in it will be partly under the jurisdiction of two onshore regulators – the Departments of Natural Resources and Environment – and partly under the jurisdiction of the CNLOPB. This could make the integrated and seamless regulation that effective regulation of fracturing clearly requires more difficult to accomplish. It could result in jurisdictional uncertainty and arguments, regulatory gaps, regulatory duplication and overlap, and conflicting direction to operators. More generally, it could result in a regulatory system which is less efficient and less effective than a regulatory system under a single regulatory authority, at least for the oil and gas component of regulation, would be.

These consequences could be mitigated or avoided entirely by effective collaboration between onshore regulators and the CNLOPB and by the adoption of mechanisms for collaboration such as harmonization of regulatory requirements and co-regulation through a collaboratively administered "single-window" approval processes. These approaches may however be second-best solutions to consolidation of regulatory authority in a single regulatory body.

For constitutional and intergovernmental reasons, it would probably not be possible to do this by expanding the authority of onshore regulators to the offshore. The only option for doing it may therefore be to expand the authority of the CNLOPB to the onshore. This would bring the regulatory experience and expertise of the Board to bear on the regulation of onshore hydraulic fracturing and thereby help to ensure it was knowledgeably regulated from its very beginning. To the extent the Board has earned the trust and confidence of the public, it would contribute to public trust and confidence in how onshore development will be regulated. This approach may also have the advantage of eliminating or at least softening the jurisdictional boundary which will otherwise apply to hydraulic fracturing which occurs in whole or in part under the ocean floor from wells which are drilled onshore.

Multiple questions would have to be answered to determine the value and feasibility of this option. For example, the CNLOPB may have to address a range of issues in regulating onshore that it does not have to address in regulating offshore – the risk of water contamination and the potential conflicts with other onshore activities come immediately to mind. To the extent the issues to be addressed are the same or similar, their context in the onshore could be significantly different to their context in the offshore in ways which would require a different approach to the one the Board applies or follows in the offshore.

[218] Alan I. Ross and Michael Massicotte, "A divided Alberta energy regulator" *Financial Post* July 3, 2015.

The CNLOPB is jointly established and mandated by Newfoundland & Labrador and Canada. Federal agreement and collaboration would presumably be required for it to accept a mandate to regulate within what clearly is the jurisdiction of Newfoundland & Labrador. Conversely, Newfoundland & Labrador would have to be open to delegating its regulatory jurisdiction to a body which is as much as federal as a provincial agency. Questions such as the additional resourcing the Board would require for its onshore work and whether its membership and staff would be the same for onshore as for offshore work, would have to be worked out. To take full advantage of the option, the onshore and offshore rules would have to be harmonized. While this is something Newfoundland & Labrador may desire in any event, it could amount to giving the federal government a say, if only indirectly, in the rules Newfoundland & Labrador chooses to adopt within its own exclusive jurisdiction.

Another issue would be the scope of the CNLOPB's onshore mandate – specifically, would it be limited to the issues otherwise within the mandate of the Department of Natural Resources or would it include some or all of the issues otherwise under the authority of the Department of Environment and Conservation. As explained above, onshore, the Department of Environment and Conservation has jurisdiction over environmental assessment in relation to oil and gas wells, contrary to the situation in Alberta and British Columbia where that authority has been delegated to the oil and gas regulator. The situation in the offshore is similar to that in Alberta and British Columbia – the CNLOPB has jurisdiction over environmental assessment as well as over the regulation of oil and gas activities.

Accordingly, if the CNLOPB was to be given an onshore role, a decision would have to be made on whether it would be given the more limited jurisdiction of the Department of Natural Resources or a broader mandate that would include environmental assessment. The former option would limit the extent to which regulatory consolidation was achieved by expanding the Board's role to the onshore. It would however, also maintain the separation between oil and gas regulation and environmental assessment that could be one of the strengths of Newfoundland & Labrador's legislative framework. In contrast, the latter option, under which environmental assessment authority and responsibility for oil and gas regulation would be consolidated, would maximize the benefits to be gained by consolidating regulatory authority for onshore and offshore development in the CNLOPB.

4.2.2 Emphasizing Environmental Protection and Human Health

The regulation of hydraulic fracturing is intended to protect the environment and human health. Where and how regulation happens may have a tendency to obscure this fundamental fact. It largely happens as part of oil and gas regulation, which is part of the oil and gas industry. It operates largely by regulating the technology and engineering of oil and gas development. Given this context and the industry orientation it may encourage, it is important that steps are taken to ensure a focus on protecting the environment and human health. For example, in Alberta and British Columbia, the mandate for environmental assessment is largely integrated into the mandate of the oil and gas regulators of those provinces. The rationale may partly be to limit the number of regulators involved in the regulatory process but presumably it is also to improve the effectiveness of regulation by integrating responsibility for environmental protection directly in to the regulation of oil and gas operations. In addition, in both provinces, legislation gives the minister of environment an oversight authority, an authority to give directions to the oil and gas regulator and the authority to intervene where he or she determines their intervention is called for. In contrast, the approach in New Brunswick and in Newfoundland & Labrador seems to be to ensure environment protection by leaving responsibility for environmental assessment and other aspects of environmental regulation with the minister of the environment.

Either way, it is critical that regulation is focused on its role in protecting the environment and human health. Institutional arrangements have an important role in maintaining this focus. However the role and authority of the minister and department of environment is defined, they should have the authority and responsibility to define the environmental protection objectives and standards within which the regulation of hydraulic fracturing happens. A similar arrangement between regulators of hydraulic fracturing and the public health system should be considered. Building health impact assessments into decision-making on hydraulic fracturing is another way to ensure regulation

is grounded in its role in protecting health.[219] In addition, the regulators of hydraulic fracturing should have their own relationships with the public, academia and environmental and public health organizations to ensure they are connected on a continuing basis with the priorities that these constituencies place on environmental protection and protection of human health.

4.2.3 Adding a Regional Layer to Regulation

The Reports endorse a more regionally scaled approach to regulation.[220] The move underway in both Alberta and British Columbia to regulation of plans for the development of a play have been specifically endorsed. A plan of development for all of the companies participating in an area's resource potential is put forward for regulatory approval. Approval depends on the plan's responsiveness to broadly defined regulatory objectives, and more specifically, to the regulatory objective of reducing the industry's footprint on the landscape, thus reducing its effect on communities. This means approval of well pads operators are expected to share, rather than the approval of individual wells. It means companies collaborating in building and using other infrastructure, to improve the efficiency of utilization and to reduce the amount of infrastructure, construction and servicing required. Opportunities are created for engagement with the community that come earlier and are broader than those typically associated with an approval process focused on individual wells.

This model is promising: it is responsive to concerns that a regulatory system focused on specific projects cannot easily address cumulative effects and to concerns that a project-by-project approach leads to unplanned development which accentuates the tension between communities and development. It is also positively responsive to the call for community engagement which starts early, when community input can be incorporated into how development is planned, when more adverse impact can be avoided and not simply mitigated. It may help to ensure that regulation is customized - within defined parameters - to its regional context in ways that reflect the variation between regions as to geological, environmental and socio-economic conditions.

This approach may or may not be immediately applicable in jurisdictions where the industry is relatively small. In the case of Newfoundland & Labrador, the need for approval of a Development Plan before an application can be made for approval of a well may provide an opportunity for a version of this approach to be applied within a regulatory process that may need to be more project-focused.

It should be noted that in Alberta, the regulator has stressed that although regulation in the regulation of plays will be more performance-based, it will be backstopped by the rules developed to regulate individual wells. This appears to mean that play development plans will not be allowed to derogate from the standards embodied in the existing regulatory system, including its prescriptive standards.

4.2.4 Prescriptive vs. Performance-Based Standards

The Reports call for performance-based regulation.[221] In contrast to prescriptive regulation, performance-based regulation directs regulatory efforts directly to achievement of the goals or outcomes of regulation instead of to

[219] Frank Atherton, "Chapter 4: The Protection of Public Health" and Shawn Dalton, "Chapter5: Socioeconomic and Social Ecological Impacts on Communities" in David Wheeler et al., "Report of the Nova Scotia Independent Panel on Hydraulic Fracturing", pp. 122-139 and pp. 140-159.

[220] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), p. 47; Council of Canadian Academies, "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", pp. 205-208; David Wheeler et al., "Report of the Nova Scotia Independent Panel on Hydraulic Fracturing" (2014), pp. 272-273.

[221] Council of Canadian Academies, "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", p. xix.

compliance with its rules.[222] The effect that regulation can have in imposing limits on the achievement of ultimate regulatory goals and outcomes may be less likely with performance-based regulation. Because it leaves more decision-making on the "how" of regulation to business, performance-based regulation can better accommodate the up-to-date expertise those in industry may have. It may also give companies more opportunity to integrate regulatory and business performance. For these reasons, performance-based regulation may better align regulation with the innovation that both business and regulation requires.

Canadian regulation of hydraulic fracturing already contains significant elements of performance-based regulation. It is moving more in that direction, particularly in association with regionally-scaled regulation of play development in place of an exclusive focus on each and every well. It is however, very important to recognize that prescriptive regulation is both suitable and called for in critical areas such as well integrity, which is widely acknowledged to be critical to regulation's overall effectiveness.

The importance of standards which are both prescriptive and relatively detailed in this and other aspects of regulation directly concerned with preventing the escape of contaminants into the environment is evident from a review of how hydraulic fracturing is currently regulated. It is also clear from the fact that the reports which call for or acknowledge the rationale for performance-based regulatory systems also emphasize the importance of rigorous and prescriptive standards for some issues. For example, in its "Golden Rules", the International Energy Agency says there should be "an appropriate balance between prescriptive regulation and performance based regulation in order to guarantee high operational standards while also promoting innovation and technological improvement".[223]

4.2.5 Regulation by General Rules vs. Terms and Conditions of Approval

Much of the substance of regulation will be found in the terms and conditions on which specific projects are approved in an approvals-based system. One of the primary rationales for such a system is to allow this to happen so that regulatory requirements can be suitably customized. This approach can also increase the system's flexibility, since it allows the substance of the law to be changed through individualized administrative decision-making.

There are risks in this approach being taken too far. It can lead to unwarranted variation in regulatory requirements and to inconsistency in how operators are dealt with. It can make it difficult for those in the industry and the public to know the substance of the law. This could reduce compliance and limit the public's ability to have informed opinions on how the industry is regulated and their interests protected. This can contribute to a lack of public confidence in the regulatory system. Too much reliance on "terms and conditions law-making" can limit democratic accountability by shifting law-making from political and policy-making levels to administrative levels of decision-making. It can accentuate the tendency, present in all regulation, for the regulatory process to be conducted as individualized bargaining, resulting in regulatory requirements being given a contractual connotation. Taken too far, this can become a barrier to making improvements to the regulatory system, as operators assert expectations based on "their" approval.

A range of measures are available for minimizing these risks. For example, all approvals and associated documents can be filed in a publicly accessible electronic registry. More generally, conducting the regulatory system on an open and transparent basis, important in any system of regulation, becomes particularly important in an approvals-based system which relies heavily on "terms and conditions law-making". Other best practices in regulation, such as deep and continuous engagement with the community and public, take on added importance in such a system.

Clear policies and guidelines can be developed and adopted establishing the parameters within which administrative

[222] Robert Baldwin, Martin Cave & Martin Lodge, *Understanding Regulation: Theory, Strategy and Practice* (Oxford: Oxford University Press, 2012), pp. 296-302.
[223] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), p. 48.

discretion should normally be exercised.[224] It is very important for this be done openly and transparently, so that everyone affected by or interested in decisions has the opportunity to know the guidance being given to decision-makers. Typically, these policies or guidelines establish the decision-making criteria administrators are to apply, the factors they are to consider and the objectives they are to advance. The draft guidelines for the regulation of hydraulic fracturing which have been proposed for Newfoundland & Labrador are guidelines of this sort. They should be analyzed to ensure they would not be vulnerable to challenge on the basis that they fetter administrative discretion; i.e., by binding regulators to use their discretion in certain ways rather than guiding them in how to exercise their powers in response to the merits of specific cases.[225]

Another step is to put generally applicable requirements into generally applicable law, whether in legislation (statute or regulations) or statutorily authorized rules. This directly addresses the problems that can arise in a system which is heavily weighted in favour of approval-specific standards. It may: minimize the risk of inconsistency; make the substance of the law more accessible; put distance between law-making on general questions and application of the law to specific cases; and help to ensure that the discretion to individualize general requirements which regulators should have is grounded on enabling legislation with real substance. It may also contribute to knowledge of the law by regulated actors, and thereby to compliance. It may also avoid questions about the enforceability of core regulatory requirements which could be raised where those requirements are found only in the terms and conditions of approvals.

4.2.6 Ensuring Regulatory Readiness and Capacity

Jurisdictions building a regulatory framework in anticipation of hydraulic fracturing or a significant increase in the extent of hydraulic fracturing, have to be sure they are prepared to effectively regulate the activity and the industry from the beginning of development. Some of the steps that can be taken to accomplish this include:

1. Building on the regulations – as well as the associated expertise and experience – of the jurisdictions that have the most experience in regulating hydraulic fracturing, including the parts of regulation dealing directly with well integrity, the process of hydraulic fracturing, oil and gas production, well site management, decommissioning, well abandonment and site reclamation and remediation. This is not to say that the regulatory frameworks of these jurisdictions should simply be adopted – there is too much variation in environmental, social-economic and geological conditions for this to be the right approach. In addition, the reports have called for adoption of regulatory practices that go beyond what any or most jurisdictions currently do. It is also clear that there are unanswered questions about the effectiveness of some of the regulatory requirements that are generally followed. These unknowns mean there are questions about the ultimate effectiveness of regulation even when it is carried out like it is carried out in what are currently the leading jurisdictions. There is however, a great deal which is known about how hydraulic fracturing should be regulated. This knowledge is to varying degrees incorporated into the regulation of jurisdictions in which hydraulic fracturing already happens on a significant scale. Jurisdictions new to the industry should therefore build upon the regulatory frameworks of these jurisdictions without limiting themselves to the level or kinds of regulatory control over the industry these jurisdictions have adopted and applied.

2. A relatively comprehensive regulatory framework such as that already in place in jurisdictions in which hydraulic fracturing already happens should be largely developed and operational before hydraulic fracturing is allowed on a significant scale in a jurisdiction that is new to hydraulic fracturing. The importance of compliance with the core requirements contained in the regulatory framework of jurisdictions in which hydraulic fracturing already occurs are too important to the successful control of the risks associated with hydraulic fracturing to permit fracturing to

[224] Unless these policies or guidelines are statutorily authorized to have binding effect, they cannot require administrators to reach specified decisions or prohibit them from making decisions they are authorized by their enabling legislation to make; See David Phillip Jones and Anne S. De Villars, *Principles of Administrative Law 5th ed.* (Toronto: Carswell, 2009), 197-202.

[225] If this vulnerability is found to exist, it can be remedied by adopting legislation which authorizes the passing of binding guidelines.

occur even on a small scale without such a framework being largely operational. This emphasizes the importance of basing the regulatory framework in jurisdictions new to hydraulic fracturing on the framework of jurisdictions that are experienced in regulating hydraulic fracturing at a significant scale.

3. The administration of the regulatory framework must be properly resourced. Resourcing must change and evolve in lock-step with changes in scale and complexity of the industry. At all stages of development, there must be enough staffing and other resources to ensure the regulatory process can apply the level of oversight to the process of hydraulic fracturing – and the larger process of oil and gas development within which fracturing occurs – that the effectiveness of the regulatory model presupposes. Moreover, the regulatory body must have, or have ready access to the expertise, equipment and systems needed to ensure administration of the regulatory framework is both effective and efficient. In other words, regulation needs the right kind of resources as well as the right amount of resources. As one example, the regulatory body requires as much expertise in the engineering and geophysics of drilling, constructing, fracturing and sealing a well as those tasked with conducting each of these activities in accordance with regulatory requirements. As another example, an automated application process such as that which exists in Alberta can expedite the approval process for compliant projects, thereby facilitating responsible development, but also ensure consistency in regulatory decision-making.

4. The pace and scale of development should be carefully managed. This is essential if cumulative effects are to be understood and if adverse cumulative effects are to be avoided or minimized and promptly identified and mitigated when they develop, including by halting development where that is necessary to prevent irrevocable harm. In a jurisdiction into which hydraulic fracturing is being introduced or expanded, a managed and precautionary approach to the growth and expansion of the industry allows for the interaction of the industry with the local environment and community to be closely monitored and evaluated as growth and development takes place. This would allow Newfoundland & Labrador to ensure development proceeds in accordance with the precautionary principle. It would also allow growth in regulatory capacity and expertise to occur in lockstep with the growth and development of the industry and to be informed by direct knowledge of how the industry is affecting and being affected by local conditions. In addition, a measured approach to the growth and development of the industry will help to prevent gaps between the scale of the industry and the capacity of the regulators to apply the level of oversight which is warranted given the scale of the industry.

5. A comprehensive program for monitoring the effects of shale oil development, including but not limited to environmental effects, should be in place when development commences. Such monitoring is an essential element of any regulatory system which aspires to be precautionary when a jurisdiction embarks on a new industry. Studies should be conducted to determine relevant baseline conditions in the geographic areas in which development will occur. The completion of these studies should be a precondition to the approval of projects. Monitoring of these conditions should be continuous throughout the life of approved projects, including after decommissioning. The scale of the monitoring should grow with the scale of development. Third party involvement in this monitoring should be required or at least encouraged. Opportunities to include the community in monitoring and evaluating the results of monitoring, including through organizational structures such as local environmental groups, should be explored, developed and utilized. Whether by this or other means, the monitoring process should be transparently and openly conducted.

6. Hydraulic fracturing should only proceed after it is known with certainty how the wastes created by hydraulic fracturing will be treated and managed by recycling, disposal or some combination of recycling and disposal. This will require a decision by the regulator – or by multiple regulators – as to how operators will be allowed to manage wastes. This decision has to consider not only preferred or ideal options but also options that are practically feasible and available in the location in which hydraulic fracturing is proposed. When the available options do not provide an acceptable level of protection for the environment, safety or health, fracturing should not be allowed. Regulators should be sure that potential operators will have the practical ability to dispose of or recycle wastes in the permitted manner before they approve fracturing or drilling with a view to fracturing.

4.2.7 Ensuring Effective Oversight and Compliance

Given the nature of the risks associated with hydraulic fracturing and the high level of public concern about those risks, it is clear that effective regulation in this field must ensure effective regulatory oversight of the industry and industry compliance with its regulatory responsibilities. As stressed by others, this means that regulation must include rigorous auditing, inspections, investigations, and enforcement. It needs to be equally stressed that a regulatory system based largely on prior approval (an ex ante system of regulation) as the regulation of hydraulic fracturing largely is, depends for its effectiveness on rigorous approval processes that prevent unacceptable risk from being created in the first place. Effective, diligent and vigilant monitoring of compliance with and enforcement of the terms and conditions on which approval is given is critically important. It ensures the requirement to obtain approval serves its purpose. It is however a complement to, not a substitute, for a rigorous approval process.

The regulation of hydraulic fracturing is not entirely approvals based: it also depends on industry's compliance with a large volume of general regulatory requirements which apply to all approved projects. This is necessary to ensure consistent treatment of issues warranting consistent treatment and also to maintain the manageability of the regulatory system. It is crucial however, that compliance with these general requirements, sometimes called ex post regulation, is subject to strong regulatory oversight. Otherwise, ex post regulation can easily become self-regulation to a degree which is unacceptable in this field of regulation due to the nature of the risks involved and the public concern that regulation be effective in controlling those risks.

On enforcement, it is imperative that serious breaches have serious consequences. Attention tends to focus on prosecution and financial penalization, which is important, but there needs to be realism about how much can be accomplished by that kind of penalization. Revocation of the authority to operate or denial of approval for additional activities are other options which legislation makes available to regulators but which regulators may not use when warranted.

There are many specific steps regulators can take to ensure effective compliance and oversight, including:

1. Communicating regulatory requirements in a style, format and medium that best facilitates understanding of the regulations by those most immediately responsible for compliance with them. Alberta's approach of "packaging" regulatory requirements into directives that address different stages or aspects of the work being regulated is one such approach. It presents regulatory requirements, including those set out in separate legislative provisions, in a format akin to a series of "how to" operating manuals. This shows the functional interconnectedness of regulatory requirements and the relationship between regulatory requirements and the distinct stages or aspects of oil and gas development, including fracturing. In contrast to the traditional approach under which regulatory requirements are stated or communicated only or primarily in traditional legislative documents, which works better for lawyers than for others, this packaging of what New Brunswick calls the "Rules for Industry" may work better for the non-lawyers who must follow and apply the rules, especially in an industry where the contents of the rules comes more from fields such as engineering and geoscience than it does from law. Along with Alberta and New Brunswick, British Columbia also uses this approach and Newfoundland & Labrador is moving in this direction.

2. Ensuring that regulators have relatively continuous and immediate access to the critical data on the status of work taking place under regulatory approvals at all stages of each well's life cycle, from initial drilling to abandonment and capping. For this to play the role that it is meant to play in regulatory oversight, information systems are needed and regulators must have the capacity needed to keep on top of the data that regulations typically require operators to submit to their regulators.

3. Working with communities, environmental organizations, representatives of other economic sectors, academia and civil society more generally to ensure not only that they have meaningful opportunities to hold industry and regulators accountable but also the capacity to do so. In addition to being built and supported

through the community engagement that should be expected of operators, this capacity can be strengthened by public education programs, the regulatory transparency discussed below, and the public disclosure of baseline environmental information and the results of environmental monitoring. It can also be supported and operationalized by creating forums in which the effectiveness of regulation can be openly discussed by regulators, industry and representatives of the general public and interested stakeholders. Through this kind of approach, the public or civil society can become an effective third corner in a regulatory triangle.[226]

4. Requiring the wide range of assessments, evaluations, audits, plans and systems which project proponents and operators are required to conduct or to have in place either to be conducted or created with independent experts or validated or certified by such experts. In Newfoundland & Labrador, these experts will often be regulated engineers or geoscientists by virtue of the scope of the definitions of engineering and geoscience contained in the Engineers and Geoscientists Act.[227] This will help to ensure that the three critical assumptions of regulation's reliance on third party experts holds true: that they are qualified, truly independent and accountable. Directly or indirectly, the regulatory system for hydraulic fracturing must ensure these assumptions hold true.

5. Performance against standards and the results of broader monitoring of impact, such as in the area of environmental monitoring, should be validated and certified by qualified and independent third parties. Again, the underlying assumptions of qualifications and of independence must hold true. For example, the International Energy Agency states: "Credible, third-party certification of industry performance can provide a powerful tool to earn and maintain public acceptance, as well as providing a powerful tool to assist companies to adhere to best practices. These independent assessments should come from institutions that enjoy public trust, whether academic or research institutes or independent regulatory bodies or certification bodies".[228]

4.2.8 Regulatory Transparency and Continuous Improvement

Good regulation is regulation conducted openly and transparently. In large measure, this is because regulation is a kind of public administration and openness and transparency are core values of public administration. The role they play in regulation is helping to ensure that regulators are accountable for protecting the people and things they are legislatively mandated to protect. Openness and transparency are important safeguards against regulatory capture. They have heightened importance when the industry being regulated is the subject of significant public concern about the capacity of regulation to control serious risks. Openness and transparency are also crucial to ensuring those regulated know what is expected of them and have ample opportunity to conduct themselves according. This enables the effective self-regulation on which all regulatory systems must significantly depend.

An important dimension of openness and transparency – as well as accountability – are the written reasons regulators give for their decisions, especially in contested approval matters. What is called for are substantive and not pro forma reasons that make "justification, transparency and intelligibility" hallmarks of the decision-making process.[229]

The regulation of hydraulic fracturing should be regularly evaluated. Ideally, this evaluation would be done arms-length from the regulators in an open and transparent process that seeks input from everyone with a direct interest in the effectiveness of regulations in achieving the outcomes regulation is designed to achieve.

Continuous regulatory improvement can also be supported by the comprehensive environmental monitoring discussed below.

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[226] Called "regulatory tripartism" in John Braithwaite and Ian Ayers, *Responsive Regulation*, (Oxford University Press, 1995)
[227] SNL 2008, c. E-12.1.
[228] International Energy Agency, "Golden Rules for a Golden Age of Gas" (2012), 48.
[229] *Dunsmuir v. New Brunswick* 2008 SCC 9, para. 47.

Continuous improvement requires improvement in the knowledge base for regulation and timely adoption and implementation of regulatory improvements in response to improvements in regulation's knowledge base. Regulators should actively seek opportunities to work with and support researchers in conducting the research that is needed to: improve understanding of the risks associated with hydraulic fracturing; evaluate the effectiveness of the measures that are currently taken to control those risks; and to develop better regulatory measures. The active engagement of regulators in the research and technological innovation enterprises can help to ensure both happen and are responsive to the needs of regulation and the challenges regulators face not only in general but also in the varied circumstances of their respective jurisdictions. The role regulators can play in demanding, enabling and contributing directly to improvements in the knowledge base for regulation can be seen as a requirement of the precautionary approach to regulation and as a vital step in making regulation precautionary.

5.0 SHOULD THERE BE ONGOING ENVIRONMENTAL MONITORING DURING AND AFTER HYDRAULIC FRACTURING OPERATIONS?

There is broad consensus that there should be ongoing environmental monitoring starting before development commences and continuing during drilling, fracturing and production and after well abandonment and decommissioning.[230] Environmental monitoring, broadly conceived, is one of the hallmarks of a precautionary approach to regulation.

Monitoring is critical to understanding the impacts the industry is or is not having and the effectiveness of regulation and best practices that go beyond regulatory requirements in preventing or minimizing adverse impacts. Monitoring is also critical to the availability of the data that research needs if it is to answer the unknowns that currently exist as to the effectiveness of industry practices and of the engineering, structural, managerial and operating requirements which regulation currently applies.

Monitoring is also critical to strengthening regulation. It provides information to regulators about both the compliance of licensed operators with regulatory requirements and about the adequacy and effectiveness of those requirements. It can help to ensure that interventions that are needed or warranted to protect safety or the environment are taken on a timely basis. Monitoring can function as an alarm system that can bring attention to systemic or cumulative problems that traditional monitoring of the regulatory compliance of individual operations may not reveal.

Monitoring also has an important role to play in reassuring the public of the industry's safety and responsibility and of regulation's adequacy and effectiveness. It may therefore be critical to the industry's ability to achieve and maintain social licence.

The report of the Canadian Council of Academies on the environmental impacts of shale gas development calls for monitoring of health and social impacts; gas emissions; seismic activity; surface water; and groundwater, as well as cumulative effects monitoring.[231] The rationale given for monitoring in these areas would apply to shale oil activities. This discussion focuses on the three areas of monitoring most directly related to specific environmental impacts: groundwater, surface water and gas emissions monitoring. Health and social impact monitoring can also be viewed as

[230] Council of Canadian Academies, "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", 147-175, citing a number of other reports to the same effect. The importance of environmental monitoring is also being raised in the regulation of other natural resource industries: see, for example, Meinhard Doelle and William Lahey, "A New Regulatory Framework for Low Impact/High Value Aquaculture in Nova Scotia – The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia" (2014), 49-51, online: novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf.

[231] Council of Canadian Academies, "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", 148-187.

part of environmental monitoring broadly conceived including in its concern with the connections between the health of ecosystems and human health and social well-being, for First Nations and other communities.

The challenge in establishing an effective system of groundwater monitoring are the important knowledge gaps as to how it should be done. For example, little work has been done on characterizing the groundwater system to allow monitoring devices "to be positioned where impacts are most likely to occur".[232] The knowledge gaps are particularly pronounced in monitoring potential impacts on groundwater from subsurface sources, given the limited knowledge of potential migration pathways and the broader geology, hydrogeology and hydrogeochemistry. Monitoring will also be complicated by the inability of conventional monitoring wells to monitor at the required depth; lack of information on the chemical composition of flowback water and its chemical properties; and the unavailability of simulators capable of modelling possible gas (or oil) flows, pathways and geochemical reactions. These challenges lead the authors of this report to state: "Modelling subsurface flow in shale gas environments is not yet practical, primarily due to lack of basic scientific data on the nature of fracture networks and a relatively poor understanding of fluid flow in low permeability rocks, especially under dynamic stresses and transient fluid conditions".[233]

These realities call for concerted effort on the research needed to make full-scale knowledge-based groundwater monitoring possible. In the meantime, performance monitoring is required for: gas leaks along the exterior of wells; contamination emanating from beneath the pad; migration of gas or saline fluids upward from the hydraulic fracturing zone; and leakage from on-site tanks.[234] Sentry monitoring (along potential migration pathways between sources and receptors) and receptor monitoring (of aquifers, surface waters, supply wells and springs) are other essential components of groundwater monitoring. Domestic well sampling can contribute to understanding of the groundwater system while also providing baseline information on drinking water that can be used to assess the impacts of development.

Monitoring for impacts on surface water is more straightforward, although this kind of monitoring has not been common. The issues include "changes in run-off or rainfall and snow melt, potentially resulting in floods, erosion, and water quality problems".[235] They necessitate "A substantial surface monitoring program".

As in Alberta, British Columbia and New Brunswick, gas emissions monitoring should include testing new wells for surface casing vent flow (gas emissions from the subsurface); periodic "bubble testing" during the life of the well; and retesting prior to abandonment.[236] Regulations should identify the thresholds for characterizing a leak as serious and prescribe the actions that should be taken where thresholds are crossed. Gas emission monitoring should also include testing to identify gas leaks in the "vadose zone" between ground surface and the water table.

On seismic monitoring, the Canadian Council of Academies recommends the approach taken by British Columbia, which starts with studies to determine background seismicity levels and includes a regional monitoring network in regions of where hydraulic fracturing is conducted to supplement the more general monitoring carried out by the Canadian National Seismograph Network. The report notes that this monitoring is additional to operator monitoring of the immediate impact of hydraulic fracturing.

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[232] Council of Canadian Academies, "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", 160.

[233] Council of Canadian Academies, "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", 167.

[234] This calls for the development of "monitoring devices that can be implanted along the surface casing and perhaps even along the conductor casing to detect gas leakage directly or measure indirect indicators such as fluid pressure or perhaps temperature"; Council of Canadian Academies, "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", 170.

[235] Council of Canadian Academies, "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", 157.

[236] Council of Canadian Academies, "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", 152-156.

For monitoring to be effective, it should be in place from the beginning of development. It should begin with the testing and studies required to establish baseline conditions before drilling and hydraulic fracturing begins. Without these elements, monitoring will be limited in its capacity to identify changes in the environment that may be a consequence of shale oil or shale gas development.

Monitoring should be continuous throughout and beyond the life of approved projects, adjusting in scale and method to the level of risk associated with each stage of the project. The importance of continuing monitoring after well decommissioning has been stressed by numerous reports, particularly in light of the unanswered questions about the long-term stability and durability of the cementing which the industry and regulators currently rely upon to ensure well integrity. It is not enough to hold licenced operators responsible for addressing problems after they have completed operations and decommissioned wells and to give government the legal authority and responsibility to intervene when a company is unable, unwilling or unavailable to discharge its responsibilities. The monitoring that is required to ensure the problems which trigger these responsibilities are detected when they occur, must also be in place.

Environmental monitoring may be related in several ways to the possibility of making shale "plays", as opposed to individual wells, the basic unit for regulation. First, the collaboration among operators that would be required under that approach to regulation would improve the feasibility for environmental monitoring on a broader and more comprehensive scale. The cost of a broader and more comprehensive approach to monitoring would presumably be a shared cost under the "play" or regional approach to regulation. Monitoring duplication could also be avoided or at least reduced. Monitoring of general environmental conditions could also be more effective and valuable if done on the regional scale associated with regulation of oil and gas plays. Monitoring on that scale is more likely to be monitoring on the scale required to produce information of value in understanding not just the stability or change in environmental conditions but the relationship of environmental conditions to the development of the industry.

The move to a regional approach to regulation may also increase the importance of the kind of environmental monitoring that a regional approach to regulation would enable. One of the objectives of this approach to regulation is to reduce the footprint and the environmental disruption caused by development by encouraging the industry to construct and share multi-well pads and associated infrastructure. This approach may however involve a trade-off: a reduction in the scale of surface disturbance and in the likelihood of operational failure but an increase in the harm that could be caused by an operational failure. To the extent this is accurate, it strengthens the importance of environmental monitoring as well as the other kinds of monitoring discussed above.

Third party involvement in monitoring should be required, supported and enabled. Opportunities to include the community in monitoring and evaluating the results of monitoring, including through organizational structures such as local environmental groups, should be explored, developed and utilized. Whether by this or other means, the monitoring process should be transparently and openly conducted. Disclosure of the results of monitoring should be a routine practice.

Monitoring should be conducted independently from government and industry. It should be conducted under a framework capable of producing output "that can withstand review and scrutiny by independent scientists".[237] The principles applied to develop the monitoring program for the Alberta oil sands, along with the province's governance structure for its monitoring program, have been identified as models for others to follow. Academia should be actively involved in the design, governance and evaluation of monitoring, including to ensure that monitoring produces the data needed for the research that will improve monitoring over time and the research that will more generally improve knowledge of how hydraulic fracturing interacts with its environment and of how these interactions can be effectively regulated.

[237] Council of Canadian Academies, "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", 176.

6.0 WHAT ACTIONS/REGULATIONS/BEST PRACTICES WILL ENSURE APPROPRIATE REGULATORY OVERSIGHT AND RESPONSIBILITY?

The regulatory oversight and responsibility that is "appropriate" can be defined and evaluated in different ways. If it is defined to mean the level of oversight and responsibility that will ensure nothing goes wrong, there is no combination of actions, regulations and best practices that could ensure appropriate regulatory oversight and responsibility. Hydraulic fracturing is the same as other regulated industrial activities in this respect. All industrial activities that are regulated are regulated because of their potential to cause harm. No regulatory system can be successful in preventing all harm within its sphere of operation.

In general terms, appropriate oversight and responsibility is oversight and responsibility that is proportionate to the potential harms that could occur as a result of hydraulic fracturing. Proportionality should be defined in a precautionary way, both because of the relevance of the precautionary principle to the question and because of the nature of the harms that could be caused by hydraulic fracturing if it is not conducted in a precautionary way. The other critical factor in evaluating the proportionality of regulation is the level of protection reasonably expected by the public and especially by those most likely to be adversely affected if potential harms are not prevented, minimized or mitigated.

In that context, the regulation of hydraulic fracturing must be comprehensive if it is to ensure appropriate oversight and responsibility of hydraulic fracturing. It should aim to understand and respond to all of the associated risks. It should apply and combine all of the elements of an effective regulatory system, each of which is mutually interdependent with the others. For example, although good standards are required, they will not accomplish what good standards can accomplish unless they are administered by regulators who have capacity proportionate to the scale and complexity of the regulatory mandate. Conversely, capacity cannot substitute for good standards and indeed, may well be wasted unless matched with good standards. Meanwhile, the effectiveness of both good standards and strong capacity depends on whether they are supported by other elements, such as the openness and transparency that requires accountability from both regulators and industry.

Regulation should, wherever possible, apply an approach which is like the multi-barrier approach that regulators often require of others. Under such an approach, regulation applies levels of defence against risks, especially serious risks, to prevent first line defences from failing and to prevent harm from occurring or to minimize its effect where they do fail, as they sometimes will.

To the extent applicable, front line defences in the regulation of hydraulic fracturing should require implementation of engineered solutions, such as those which currently apply to the design and construction of wells and the handling, storage and containment of chemicals and liquid wastes. Ultimately however, the objective of regulation should be not only to contain risks but to reduce or eliminate them by, for example, contributing to the reengineering of processes or the development and deployment of technology that reduces or eliminates the risks, such as the requirement for chemicals or other sources of potential harm. The shift of regulation of hydraulic fracturing to the regional scale is a broader example of regulation playing this role. The shift aims to reduce the incidence of a range of the industry's impacts on the landscape by essentially requiring it to use available technology to substitute collaborative business practices for individualistic ones.

For regulation to play this kind of role in the context of an industry with risks such as those posed by hydraulic fracturing, it must be rigorous without being rigid. It must be rigorous in achieving compliance with the regulatory requirements of today. It must at the same time support and enable the development and adoption of the better technologies or methods that could become the enhanced regulatory requirements of tomorrow. It should in fact seek to be one of the forces supporting and pushing the evolution of the industry towards higher performance in protecting the environment, safety and health and in addressing public concerns in each of these domains.

Regulation does this on an operational scale when, subject to clear conditions and strong accountability, it allows operators to discharge their responsibilities by applying alternative approaches, provided they are based on strong evidence and independent analysis, to those otherwise mandated by regulatory standards. It does it on a systemic scale when it incorporates improved ways of doing things into regulatory standards.

The broader influence of regulation depends upon many of the best practices mentioned earlier in this report and in other reports. For example, when regulation requires industry to establish and maintain robust relationships with host communities and when it gives civil society organizations and the public strong roles in the broader regulatory process, it gives communities and the public expanded opportunities to influence industry and regulation in the direction of better protection for what communities and the public value. Another example is the kind and scale of comprehensive environmental monitoring recommended earlier. If properly done, it will apply its own distinct pressure for improvement while supporting and reinforcing the capacity of community engagement and public participation to have a positive impact on industry and regulation. A third example is the role that regulation can play, on its own and with industry and other actors, in supporting and enabling the contribution the research community can make to understanding the risks that regulation must control and the methods regulation can use or require to make that control more effective.

On a final note, the importance of political will should be stressed. Although the focus of this report has, as requested, been on the substance of regulation and the mechanics of regulatory oversight, there can be little doubt that sustained political will in favour and support of strong and demanding regulation is absolutely vital to making that kind of regulation into sustained reality.