

Jennifer J. West, M.Sc., P.Geo.
Geoscience Coordinator
Ecology Action Centre
2705 Fern Lane
Halifax NS, B3K 4L3

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To the Law Amendments Committee of the Nova Scotia Legislature,

In the current wording of Bill 6, section 11A – exemptions are stated for formations other than shale, and for purposes of testing and research:

"11A (1) In this Section and in clause 27(1)(ta), "high-volume hydraulic fracturing" means high-volume hydraulic fracturing as defined by the regulations.

*(2) No person shall engage in high-volume hydraulic fracturing **in shale formations** unless exempted by the regulations for the purpose of testing or research."* (emphasis added)

I wish to bring to the attention of the committee an opportunity to clarify and strengthen the wording of this section.

As written, the bill would affect a type of rock that is interbedded with many other rocks. *Interbedded* is defined as beds (layers) of rock lying between or alternating with (in a sequence of) beds of a different kind of rock. Exploration companies compile information about the rocks from surface to the target formation during exploratory drilling, and report to funders and government agents. The following excerpts are from "Elmworth Energy Corporation (Triangle Petroleum Corporation) NSDE Development Plan Application, Oil and Natural Gas Development Project, Windsor Block, dated June 2008" and show how common these alternating rock types are in the Kennetcook area:

*"The unconventional gas reservoirs within the Horton Bluff Formation are composed of **interbedded** mudstone, siltstone, and sandstones."*

*"Shale gas reservoirs are unconventional **sequences** that can best be described as low porosity low permeability, organic rich rock that relies on fracture stimulation to produce."*

*"At least four different **shale units** have been identified in the Kennetcook wells that have potential as unconventional gas reservoirs."*

*"Thickness of prospective **shale package** can exceed 200 metres"*

"It is possible that Elmworth may encounter traditional oil or natural gas reservoirs in the uphole Horton or Windsor groups, while drilling for gas in the Horton Bluff Formation." (emphasis added)

According to the Atlantic Geoscience Society¹ (emphasis added), "The Horton Bluff Formation is characterized by **interbedded shales, sandstones, and impure dolomitic carbonates** that probably represent paleosols. ...dominated by successive shallowing-upward **cycles** representing the filling of the lake following each subsidence episode. Although relatively undeformed (at least compared with later stops) the **succession** contains a number of soft-sediment features. Most notably, synsedimentary dykes are common, and frequently feed upward into conspicuously thickened, lenticular **units of overlying sandstone.**"

These quotes describe a local geology in the Kennetcook area that is comprised of complex repeating layers of shale, sandstone, and other rocks reflecting natural changing environments over geologic time. This pattern is common in geologic formation across Nova Scotia during the Carboniferous period, when many organic sediments were deposited and are now being explored for economic petroleum potential. Other examples include the Pictou Group ("sandstone, siltstone, shale, coal and conglomerate"²) and Windsor Group ("limestone, siltstone, gypsum, anhydrite, salt, sandstone"). In most cases, it would be impossible and economically infeasible to technically allow fracture stimulation of one bed and not another based on rock type.

I strongly recommend that Section 11A (2) be amended by replacing the words "in shale formations" with the words "in tight, non--- porous rock formations including shales, tight sands and coal."

Respectfully,

Jennifer West

¹ <http://www.ualberta.ca/~jwaldron/nsfieldtrip/HortonCheverie.htm>

² Geology Map of Nova Scotia, 1994.

Proposed amendments to Bill 6

1. Remove the words "high volume hydraulic fracturing" wherever it occurs and replace with the term "hydraulic fracturing." (defined below)
2. The definition of the term "hydraulic fracturing" should be included in the bill itself, not in regulations. A proposed definition is provided in point 3 below.
3. Amend Section 11A (1) to include a definition of hydraulic fracturing which incorporates the following specific criteria that characterize hydraulic fracturing for unconventional hydrocarbons and distinguish the type of hydraulic fracturing intended to be prohibited by this act from other types of hydraulic fracturing:
 - a) Involves the injection of fluids ("Fluid" means any material or substance which flows or moves whether in semi-solid, liquid, sludge, gas, or any other form or state.)¹
 - b) Pressure is "sufficient to create or enhance subsurface fractures", or "a force exceeding the parting pressure of the rock."
 - c) The result is to induce or enhance a network of fractures.
 - d) The purpose is to facilitate the release of any petroleum, natural gas or other hydrocarbons which will flow through these fractures.

Using these criteria, the section could be amended to read "In this Section 'hydraulic fracturing means "... the transmission of a carrier fluid to apply pressure and transport proppants to an underground geologic formation to create or enhance subsurface fractures and facilitate the release of any petroleum or natural gas, but does not include fracturing for the production of wells for potable water;"²

or

"Injecting fracturing fluids into the target formation at a force exceeding the parting pressure of the rock thus inducing a network of fractures through which oil or natural gas can flow to the wellbore."³

4. Section 11A (2) shall be amended by adding, after the words "unless exempted by the regulations for the purpose of testing or research" the following sentence: "Such exemption will only be permitted if the data and research results sought are not available, or cannot reasonably be obtained, from research and testing conducted in other jurisdictions."

¹ From Vermont Statute 152 prohibiting hydraulic fracturing

² Nova Scotia Importation of Hydraulic Fracturing Wastewater Prohibition Act

³ *Environmental Impacts of Shale Gas Extraction in Canada*, Council of Canadian Academies. Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction, 2014, p 224

5. Section 11B (2) should be amended by inserting an additional clause after “(d) environmental issues” which will read “climate impacts.”

6. Section 11B (2) should be amended by inserting additional clauses after “(f) regulatory effectiveness and efficiency” which will read:
 - Primary deference to the precautionary principle
 - Existence of adequate peer reviewed independent studies of the short, intermediate and long term impacts of hydraulic fracturing
 - Limitations in our knowledge of how to close down hydraulic fracturing sites and laterals in a manner that will preclude migration of contaminants, and the long-term implications
 - Readily available, adequate and affordable in the Province: facilities, equipment, techniques, experts and funding for baseline environmental and assessments, and baseline and on-going long term monitoring of all potential environmental and health impacts, that take into account all cumulative effects
 - Readily available, adequate and affordable in the Province: facilities, equipment, techniques, experts and personnel, that may be required to ensure the prompt removal of all pollutants that may be released into the environment, and otherwise restore adversely affected life and property.
 - Existence of adequate and readily accessible methodology for projecting the ultimate costs of: (i) investigating releases of contaminants, (ii) determining the extent of contamination, (iii) remediating contamination, (iv) monitoring contamination and remediation, and (v) paying for the replacement water sources, cancers, birth defects, loss of property values, loss of income and other consequences of contamination.
 - Legislative enactment of speedy, cost effective, affordable remedy for citizens, municipalities and the Province when damage or injury occurs or is likely to occur, that places the burden of proof and financial onus on polluters and those that engage them -- not citizens, imposes strict liability without fault for polluters and those that engage the polluters as contractors or otherwise, eliminates judicial barriers to class actions by Nova Scotians, and gives Nova Scotians the ability to assert claims that are based on violations of any law or regulation intended to be for the protection of the environment or health
 - Existence of whistle blowing legislation that protects whistleblowers and requires polluters and those that engage them, to provide compensation for those in the industry to report violations of applicable law, regulation and any release or discharge of any contaminant that is not expressly authorized by law or regulation
 - Requiring industry to provide secure liquid financial resources that will remain available to pay all reasonably foreseeable costs and losses

citizens, municipalities and the Province may incur including investigation, litigation, remediation, restoration, repair and replacement costs – despite bankruptcy, disposition of assets or adverse changes in financial condition of industry, surety companies, insurance companies and individual polluters and those that engage them

- Adoption of readily available sanctions with significant deterrent effect, that the Province, municipalities and members of the public may obtain if contamination occurs, from the polluters and those who engage the polluters
 - An effective means of ensuring that any community that might be affected by hydraulic fracturing, including First Nations have consented to the proposed hydraulic fracturing after being presented with all materials facts in the form of health and environmental assessments that are prepared with extensive public input, for each well and well pad but consider all cumulative impacts.
7. Section 11B should be amended by inserting, after Section 11B (2), a new clause 11B (3) which will read, “If the Minister reviews the prohibition, such review shall include a transparent process involving sufficient opportunity for broad public consultation and input from independent experts.”
8. Amend Section 11 to acknowledge the need for acquiring community consent before hydraulic fracturing for unconventional hydrocarbons may occur by adding Section 11 C, which will read:
- (a) “Municipalities have the right to ban or restrict hydraulic fracturing for unconventional gas, oil or other hydrocarbons.
 - (b) If a future legislature lifts the prohibition on hydraulic fracturing contained in this bill, before hydraulic fracturing is permitted proceed within any municipality, a local municipal referendum authorizing it would be required, after community members have been presented with all materials facts in the form of health and environmental assessments that are prepared with extensive public input, for each well and well pad but considering all cumulative impacts.
9. Amend Section 11A (2) by replacing the words “in shale formations” with the words “in tight, non-porous rock formations including shales, tight sands and coal.” Amend the explanatory note so that the wording is consistent.