Submission to the Expert Panel on Hydraulic Fracturing in Nova Scotia

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Summary

Shale gas development using unconventional drilling and high-volume slick-water, hydraulic fracturing (hereafter UHF) will have negative impacts and poses potentially serious environment and public health risks. In return, it likely offers only modest and relatively short-lived economic benefits. Given the emerging knowledge about UHF's risk to the environment and public health plus continued uncertainties regarding the nature of these risks, the responsible position for the Wheeler Panel is to recommend a significant extension to the existing moratorium on this practice in Nova Scotia.

Economic Geology: Shale Gas is Not Conventional Gas

Shale gas as a resource in Nova Scotia is no substitute for Sable Island gas, yet it comes with far higher costs and risks.

That shale gas is fundamentally different than conventional gas may seem an obvious point to make, but I have found myself having to make it over-and-over again in my discussions with the media, government and wider public so as to keep various industry and others' claims of abundant jobs, resource royalties and economic benefits in sober perspective.

First, shale gas requires the drilling of a great many wells across extensive areas of landscape simply to get at all the shale rock, thus greatly magnifying in scale the sorts of impacts that would be associated with most conventional oil & gas (Dutzick *et al*., 2012; Riddlington and Rumpler, 2013). As such, significant shale gas development would industrialize substantial areas of Nova Scotia's rural environment.

Second, the UHF required specifically for shale oil & gas extraction uses huge quantities of water, sand and chemicals, creating a host of additional economic impacts and environmental and public health concerns not typically associated with conventional oil & gas (see below). For example, an estimated 1,000 truckloads of water and other materials are required per frack, which inflicts enormous damage on road and related infrastructure (Dutzik *et al*., 2012; Rogers, 2013a). The Province of Nova Scotia will carry most of the financial burden of road repair costs, which in the case of re-paving is usually in excess of $300,000 per km (Nova Scotia, 2014).

Third, shale oil & gas wells are typically depleted at rates much faster than conventional oil & gas wells. On this, the Geologist David Hughes' detailed report, "Drill Baby Drill" is essential reading (Hughes, 2013a, 2013b). Based on industry data from over 60,000 producing shale oil and gas wells, Hughes' analysis shows that shale oil & gas wells are typically depleted by 75-90% within just 2-3 years, with a minority of wells producing most of the total production within a given area. These findings reveal in sharp relief just how relatively little is to be gained in

exchange for the damage caused and risks inflicted by the drilling of a typical shale gas well. Because of such rapid well depletion rates, there are shale plays in the US that are much larger than exist in Nova Scotia and yet have already peaked in production and are now in cumulative decline only 6-7 years after commencement of the first wells being drilled (Bardi, 2013; Frosch, 2013; Heinberg, 2013; Hughes, 2013a; Rogers, 2013b). One consequence of this is that employment gains from shale gas development are typically far below industry projections (Lean, 2013; Mauro *et al*., 2013; Schwartz, 2013; Spencer *et al*., 2014). Another consequence is that resource royalties from most shale wells are likely to be modest, short-lived and quite possibly not even sufficient to offset the costs required to repair road damage caused by the industry (Rogers, 2012; 2013a).

Geography (of the Maritimes) Matters

There are solid arguments to be made against the deployment of UHF for shale gas under any circumstances. However, the Canadian Maritimes are particularly ill-suited for this kind of development because the geographic distribution of shale resource here coincides with populated, residential settlement throughout the region. This means that from the outset and thereafter industry will develop in close proximity to where many people live, whether in Nova Scotia's Annapolis Valley and greater Tatamagouche-New Glasgow area or in New Brunswick's greater Boctouche-Moncton-Sussex-Rothesay corridor.

Until recently, this kind of close contact between industry and people has not been the pattern of shale gas development in other regions (e.g., Northeastern BC, Texas, North Dakota). Shale oil & gas in North America developed first in un-populated or thinly-populated regions where its effects were experienced by relatively few residents (Law *et al*., 2014). Even with so few people directly affected, there have been many, albeit mostly anecdotal accounts of harms inflicted. But as the industry has moved into more heavily populated rural and suburban residential areas (e.g., Colorado, Pennsylvania), concerns have magnified and there has emerged an enormous and growing public opposition (Steinzor *et al*., 2012; Willow & Wylie, 2014).

There are now hundreds of local municipal and several State-level government moratoriums in-place or in the works across the United States, and there are numerous similar local government initiatives in New Brunswick. People in these places are deeply concerned about the risks of harm to their families and properties and are frightened by feelings of powerlessness in the face of an industry that can marshal nearly unlimited resources to advance its own interest in political environments defined by inadequate government oversight (Oswald & Bamberger, 2013; Willow & Wiley, 2014). As has been observed by numerous public health experts, including New Brunwsick's Chief Medical Officer, stress-related health problems in themselves can be severe in such situations and, while poorly understood, should be given serious consideration in policy deliberations relating to shale gas (Cleary, 2012; Oswald & Bamberger, 2013).

More generally, large numbers of Nova Scotians will be situated in close contact with and thus exposed directly (and indirectly) to the effects of shale gas development. For many of these residents, groundwater wells will be put at risk, air quality will be degraded, roads will become congested and wrecked by heavy truck traffic, property values will decline in value, and overall quality of life will be significantly compromised (Gopalakrishnan and Klaiber, 2013; Popkin *et*

al., 2013). These are not conjectures; they are certainties. The bio-physical foot-print of a significant shale gas industry in the landscape is enormous. Extensive areas of relatively pristine rural countryside will become industrialized and levels of air and water pollution will soar. Let me reiterate: *if a significant shale gas industry develops in Nova Scotia, there is no doubt that these effects will happen*. What is less certain is how these various effects will play-out from place-to-pace and the degree to which they will engender serious impacts on peoples' health and the environment.

Risk, Uncertainty and the Precautionary Principle

Over the roughly twenty-five years that I have studied environmental science and policy, there is probably no other issue that more forcefully calls for a precautionary approach to public policy decision-making than the prospects for development of a shale gas industry using UHF. The complex technical nature of hydraulic fracturing combined with explosive, largely unregulated[1] growth in its use has caught scientists, public health professionals and environmental policy experts completely off-guard. If there is one common theme that runs throughout the environmental science and public health literature on this topic, it is that we do not have anywhere close to sufficient information or understanding to properly assess the many and potentially serious risks associated with the development shale gas using UHF (CSSP, 2010; Colborn *et al*., 2011; Bamberger and Oswald, 2012; Cleary, 2012; Goldstein, 2012; Lustgarten *et al*., 2011; McKenzie *et al*., 2012; Steinzor *et al*., 2012; Vidic *et al*., 2013; Adgate *et al*., 2014; Brown *et al*., 2014; Law *et al*., 2014; Shonkoff *et al*., 2014).

We are only now starting to learn in a more rigorous, scientific manner about the myriad effects associated with shale gas development using UHF. Among the notable early findings include much higher than presumed climate warming effects associated with fugitive methane emissions (Howarth *et al.*, 2011; Alvarez *et al*., 2012; Tollefson, 2012, 2013; Miller *et al.*, 2013; Caulton *et al*., 2014); widespread contamination of surface and ground water (Entrekin *et al*., 2011; Osborn *et al*., 2011; Fontenot *et al*., 2013; Jackson *et al.*, 2013; Olmstead *et al*., 2013; Warner *et al.*, 2013); and sharply heightened exposure to a cocktail of air-borne pollutants that pose public health risks to populations both close to and quite distant from the location of actual drilling operations (Colborn *et al*., 2011; Colborn *et al*., 2014; Adgate *et al*., 2014; Shonkoff *et al.*, 2014). In short, the science that is finally now emerging countenances further caution, not confidence, in moving forward with this industry.

Given the emerging knowledge about UHF's risk to the environment and public health plus continued uncertainties regarding the nature of these risks, the responsible position for the Wheeler Panel is to recommend a significant extension to the existing moratorium on this practice in Nova Scotia.

Thank-you for your consideration.

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[1] Hydro-fracking of shale for oil and gas has been *largely unregulated* in the sense that it received special exemption under the United States Energy Act of 2005 from virtually all federal legal-regulatory oversight, including the Clean Water Act, Clean Air Act, and SUPERFUND (the so-called "Haliburton Loophole"). It is a widely-held view that State-level regulatory oversight of the shale gas industry is woefully inadequate.

Sincerely,

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Author's Biographical Notes and Qualifications

I am a graduate of Dalhousie University (MES, 1990), but also hold a B.Sc. from the University of British Columbia and a PhD in Ecology & Evolution from Rutgers, the State University of New Jersey. I lived for five years in Halifax (1987-92) and have lived and worked in Sackville, New Brunswick since the fall of 1999, where I have taught in the Department of Geography & Environment at Mount Allison University.

Over the past 15 years, I have distinguished myself as an internationally-recognized research scholar on the human dimensions of environment, having authored 30 peer-reviewed articles and co-edited two books. I am a four-time recipient of Mount Allison University's Paul Pare Award for faculty excellence and have established myself within the Maritimes as a leading advocate for wider public education and engagement on scientific issues, particularly as these relate to energy, climate change and the environment. I teach undergraduate courses on environmental policy and politics and am a frequent media commentator and public presenter on environmental issues.

I am keenly interested in the shale gas and hydraulic fracturing issue, having closely followed developments in the political-policy sphere and academic literature on the subject over the last three years, because development of this industry would likely affect my home Province of New Brunswick as much or more so than Nova Scotia. That said, there are many parallels between the two Provinces in terms of the issues and likely impacts.