Comments on the Government Moratorium on Fracking in New Brunswick

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Submitted to the New Brunswick Commission on Hydraulic Fracturing
10 November, 2015
Executive Summary

The New Brunswick's Commission on Hydraulic Fracturing has solicited public comment on the conditions for lifting the moratorium on hydraulic fracturing in New Brunswick. I submit these comments to further enlighten the panel.

It has been reported that “The conditions to be met before the moratorium can be lifted are:

- There is a "social license" to proceed.
- There is clear information about the impacts of hydraulic fracturing on public health, the environment and water, enabling the government to develop a regulatory regime.
- Plans to mitigate impacts on public infrastructure and deal with issues such as waste water disposal are in place.
- The province has established a process that allows it to meet its duty to consult with First Nations.
- A "proper" royalty structure is developed, with a mechanism in place to ensure New Brunswickers the the maximum benefits from shale gas extraction.

This paper addresses the issue of “Social License”.

Every human endeavour involves some social and environmental risk, accompanied by concomitant social and economic benefits. The basic question is “Do the social and economic benefits of the endeavour justify acceptance of the social and environmental risks?” Acceptance of such risks by a thoroughly informed public is the essence of “Social License”.

In the study leading up to these comments, I reviewed documents and currently available data within the government domain, which provide the background information necessary to assess the economic feasibility of the shale gas industry in NB. I also reviewed documents and currently available data that identify tangible risks requiring immediate attention before the shale gas industry is allowed to proceed with exploration and development in NB.

I also reviewed the recommendations of the province’s Chief Medical Officer of Health (CMOH) concerning conditions that should be imposed on the shale gas industry before it is allowed to proceed with exploration and development in NB. I reviewed how well the province has been following those recommendations in some specific critical instances of shale gas activities. I also explored the implications of the CMOH recommendations should the moratorium be lifted.

Based on this review, I have concluded

- The shale gas industry in NB can project to have gas wells delivering less than 3Million cubic feet of gas per day (MMcfpd) at initial production (IP).
- At 3MMcfpd IP, the price of natural gas would have to reach $11/Mcf to be economically feasible, a price not forecast to be realized, short or long term.
- At the projected IP for NB wells, no shale gas well in NB has a positive Net Present Value (NPV), making investment in NB wells unlikely and the promised investment, employment and social benefits unlikely to be realized in the short or long term.
• **At zero net social and/or economic benefit there can be no acceptable level of social or environmental risk associated with this industry**

• Thermogenic methane has been found in domestic well water in the Elgin area indicating connections between deeply buried shale gas formations and surface aquifers. Whether these connections pre-existed, or resulted from, gas well drilling is indeterminate because the baseline data were not collected beforehand to pinpoint correlation.

• The problem of geologic connections of deep shale layers with near surface aquifers at Elgin is compounded by the many geologic fault lines in proximity to gas reserves in the area. The data indicate that strict adherence to the recommendations of the CMOH is absolutely mandatory for even the most exploratory of shale gas endeavours in this province.

• Until the implications all of these factors are transparently and objectively communicated to the public, and the public is given a chance to respond, it is impossible to maintain that this industry has a social license to proceed in NB.

Based on this review, I recommend that:

• the government communicate immediately to the public a more realistic appraisal of the economic feasibility of the shale gas industry in NB as documented in the CERI (2013) and JUPIA (2014) reports.

• the government immediately communicate its failure to implement the recommendations of the CMOH (2012) despite the identification of geologic connections of deep shale gas substrates with near surface groundwater in the Elgin area.

• the government immediately adopt all recommendations of CMOH (2012) as constraints on any and all exploratory and developmental shale gas activities in the province.

• the moratorium on fracking in NB be made extended indefinitely or be made permanent.

INTRODUCTION

The New Brunswick's Commission on Hydraulic Fracturing has solicited public comment on the conditions for lifting the moratorium on hydraulic fracturing in New Brunswick.

It has been reported that “The conditions to be met before the moratorium can be lifted are:

• **There is a "social license" to proceed.**

• **There is clear information about the impacts of hydraulic fracturing on public health, the environment and water, enabling the government to develop a regulatory regime.**

• **Plans to mitigate impacts on public infrastructure and deal with issues such as waste water disposal are in place.**

• **The province has established a process that allows it to meet its duty to consult with First Nations.**

• **A "proper" royalty structure is developed, with a mechanism in place to ensure New Brunswickers the the maximum benefits from shale gas extraction.**
While much can be said to address these conditions, these comments will be limited to the issue of “Social License”. One could argue that this issue was settled in the 2014 election, which was presented to the voters as a referendum on shale gas. However, the issue of social license goes beyond election campaigning. It is a waste of the public’s time, and the Commission’s time, and a waste of taxpayer money to be wallowing in issues inherently governed by subjective judgments. Given that every human endeavour involves some social and environmental risk, accompanied by concomitant social and economic benefit, in the final analysis, the basic question is “Do the potential social and economic benefits of the endeavour justify the acceptance of the social and environmental risks. Acceptance of such risks by a thoroughly informed public is the essence of “Social License”.

In the case of shale gas, the government is caught in a dilemma: “How can a government gauge acceptable risk if it does not know the extent of the resource?” If costly constraints for adequate protection of the public are imposed beforehand, the increased financial cost of exploration will preclude assessment of the resource. Unfortunately in NB there has been too much hyperbole about the potential resource to the exclusion of a frank discussion about the risks to the public involved with the exploration and developmental stages of this industry. The inflated predictions of the potential resource have prompted governments to skirt around the environmental and social risks in order to provide a more positive economic climate for exploration companies. This is unfortunate, wrongheaded and dangerous.

New Brunswick has an unfortunate history of pursuing dead end ventures with small hope of social or economic gain as exemplified by the Briklin and Atcon ventures as well as multiple dead end mining ventures. In retrospect, such economically challenged ventures warranted no level of acceptable risk. However, economic futility is not always self evident at the onset of a project. Fortunately, in the case of shale gas, the economic handwriting is clearly on the wall upfront and the message is grave.

The NB government already has in hand a variety of studies, reports and data that facilitate an assessment of the economic futility of the shale gas industry in NB (CERI, 2013; JUPIA, 2014). In addition, the government has in hand the internationally acclaimed report by its Chief Medical Officer of Health (CMOH), outlining recommendations for the conditions to be imposed on the shale gas industry before the industry is allowed to proceed with exploration and/or development activities in NB (CMOH, 2012). The government also has access to an empirical study of domestic well water in the relatively gas rich Elgin area of NB (Al et al, 2012). This study identifies existing social and environmental risks of shale gas exploration and development, as discussed below.

**ECONOMIC PROSPECTS**

I draw the commission’s attention to two related public documents on the economic prospects of shale gas in New Brunswick. The first is the report published by Canadian Energy Research Institute (CERI, 2013) titled “Potential Economic Impacts of Developing Québec’s Shale Gas”. The second report is JUPIA (2014) Potential New Brunswick Energy Infrastructure & Natural Resource Investment Review: Our Path to a Stronger New Brunswick“. Although the second of these documents purported to show the vast economic benefit of this industry, it actually confirmed the exact opposite; the industry cannot make a profit in New Brunswick and thus will never proceed as claimed and as I will document below.
A critical benchmark of economic feasibility is the notion of “Net Present Value” or NPV of a multi-year undertaking. This benchmark is used by investors as a guide to identifying investments compatible with their long-term investment goals. A positive NPV means the business will be profitable over its projected lifespan; a negative NPV reflects a money losing project. It is crucial to consider the sensitivity of the NPV of shale gas projects in NB to critical influencing factors, the most important of which is the price of natural gas on the open market. Of immediate relevance to this discussion of fracking and shale gas are Figures 1.17 to 1.19 of CERI (2013). CERI found that the break-even price (or price at NPV=0) of natural gas at initial well production (IP) rates of 10 million cubic feet per day (MMcfpd), 6MMcfpd and 2MMcfpd were respectively $4.15, $5.35 and $11.64 per 1000 cubic feet. (mcf). Interpolation of CERI’s data results in the NPV versus initial production graph shown in Figure 1.

![Graph showing NPV vs Initial Production for shale gas projects](image)

**Figure 1.** Required long-term well head price of gas for investors to break-even at a given rate of initial gas flow from shale gas wells in Quebec.

*Based on CERI. 2013. Potential Economic Impacts of Developing Québec’s Shale Gas. Canadian Energy Research Institute*

Below the break-even price a potential well represents a negative NPV to investors and is thus unattractive as an investment opportunity and unlikely to proceed. The 40 year history of the wellhead price of natural gas published by the U.S. Energy Information Administration (EIA, 2015) shows that historically, the wellhead price of natural gas has generally stayed below $5.00/mcf with an inflated price period 2000-2009, briefly peaking at $10.79/mcf in 2008-2009. Since 2009, natural gas has returned to its historic norm, currently sitting at US$2.39/mcf.
Figure 2. 42 year history of the wellhead price of Natural Gas as compiled by U.S. EIA.

Combining this information, it is evident that New Brunswick wells would require an initial production capacity of 6 to 10 MMcfpd in order to attract investment and show a profit that would warrant any level of acceptable social or environmental risk.

In JUPIA (2014) the author assumed an expected initial production capacity of 3MMcfpd for NB wells. At that initial production level, the wellhead price of natural gas would have to reach $10.00/mcf and stay there before a venture could break even in NB; clearly a losing proposition for the province and investors, and clearly unlikely to ever proceed.

REPORTED AND EMPIRICAL EVIDENCE

The empirical evidence suggests that the JUPIA (2014) prediction of 3 MMcfpd initial production for NB wells is overly optimistic.

A discussion of New Brunswick’s shale gas prospects begins with government and industry estimates of shale gas reserves in NB. The National Energy Board (NEB) provides these estimates for Canada.

<table>
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<th>Table 1: Comparison of Canadian Gas Shales</th>
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<td><strong>Depth (m)</strong></td>
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<td><strong>Thickness (m)</strong></td>
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<td><strong>Published estimate of natural gas (Tcf)</strong></td>
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<td><strong>Horizontal well cost, including fractures (Million $Cd)</strong></td>
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* Recoverable gas will be considerably less.
These numbers come from a variety of sources, including exploration companies that selectively release information to the public. The NEB has made no attempt to verify these numbers.

The NEB estimate of greater than 130Tcf of gas in the Horton Bluff deposit includes both New Brunswick and Nova Scotia.

In November, 2013, the New Brunswick’s energy minister of the time, Craig Leonard, stated that the province might have 80 trillion cubic feet of natural gas, 15 trillion of which could be
economically extracted with today’s technology. For perspective, consumption of natural gas in the US was about 24 trillion cubic feet in 2010.


Presumably, Leonard was basing his estimate on a governments published report stating:

- Shale resource estimate in Sussex-Elgin area is 67.3 Trillion cubic feet (“Tcf”)
- Shale resource estimate in Hillsborough area is 10.9 Tcf

http://www2.gnb.ca/content/gnb/en/corporate/promo/natural_gas_from_shale/fact_sheets/oil_natural_gas_innb.html

However, these estimates are refuted by the stark empirical evidence to the contrary. Corridor Resources has drilled and fracked 40 gas wells into the shallow sandstone formation of the McCully field in Southern NB, and at their peak, these wells were producing 11-million cubic feet a day (MMcf/d) of gas from 21 of them.


This would imply an average productive capacity of producing wells of 0.52MMcfpd, and 0.28MMcfpd per well for all drilled wells.

It is instructive to compare this productivity with the Montney Formation in B.C.- “The production of natural gas from horizontal shale gas wells in the Montney of northeast B.C. has risen from zero in 2005 to 10.7 million cubic metres per day (376 MMcfpd) and is expected to continue to rise. As of July 2009, 234 horizontal wells were producing from the Montney shale. Exploration companies have spent more than $2 billion since 2005 to acquire rights in the Montney Formation from the B.C. government.” (Source http://www.neb-one.gc.ca/clf-nsi/rngynfmtn/rngyrprt/ntrlgs/prmrndrstndngshlgs2009/prmrndrstndngshlgs2009nrgbrf-eng.html)

These figures imply an average productivity of 1.61 MMcf/d per well in the Montney Formation. This is at least 3 times the productivity of NB wells to date.

However, the NEB document paints an even dimmer prospect for the deeper NB shales. Quoting from the NEB document for the Horton Bluff Group, “While still in the early evaluation stage, two vertical wells drilled in New Brunswick have flowed 4,200 cubic metres per day (0.15 million cubic feet per day) after undergoing small fractures.” This gas return per well is 1/10 th that of the Montney Formation. The wells to which the NEB refers were drilled near Elgin, NB by APACHE in partnership with Corridor Resources. The Elgin area is projected to be the richest gas deposit in NB. Shortly after drilling these unproductive wells, Apache left the province and has not returned.

The best recorded return from NB wells was reported by the province’s own profile of the gas industry “As of 2009, total natural gas production from 26 wells in the McCully Field averaged about 600 thousand cubic metres per day (Smith, 2010). This averages out to 0.81 MMcf/d per well. This figure was compiled early in the history cycle of most of the 26 wells and does not
include the non-productive drilled wells. At a maximum productive capacity ½ that of the Montney Formation, NB shales cannot compete.

Some in government contend that shale gas presents an opportunity to pull the province out of its economic slump. However, available evidence does not support this contention.

- Until recently, shale gas development has proceeded unabated across North America. However, NB has had only two wells drilled since 2009, those being the two unproductive wells drilled at Elgin in 2011 as reported above by the NEB.
- No exploratory or commercial gas well was drilled in the province from 2012 to 2014, and none were scheduled for anytime in 2015 or beyond, prior to the current moratorium.
- Actual Leases for commercial oil and gas development in the province declined by 30% from 2010 to 2015, including holdings of Corridor Resources, PetroWorth and Windsor Energy. There were no takers for the expired leases prior to the moratorium. A similar decrease occurred in the areas under Licenses to Search (~29%). Source: Oil and Natural Gas Licenses/Leases, Dept of Energy and Mines. New Brunswick 2010 and 2013
- SWN, which held a License to Search, and not a Lease, did not identify a single gas reserve in 4 years of exploration, although it received two 1 year extensions to fulfill its financial obligations under its original license. The province has had several opportunities to place SWN in default, collect the amount remaining on the contract, and auction off the license area. They have not done so; there would be no takers for an uneconomic license.
- Twenty-nine existing gas wells owned by Corridor Resources have largely been depleted, and have produced little employment and minimal royalties. These wells also require multiple dangerous propane and hydraulic re-fracks to continue to limp along.
- All work carried out in 2014 in NB, occurred in tight sandstones and not in the deeper shales.

Given that the Marcellus shales are promising a glut of cheap gas across Northeast US and Eastern Canada, the province is facing an uphill battle to attract investors to low productivity wells. Keith Schaeffer, an Oil and Gas commentator had this to say in Feb. 2014: “This will mean that the Northeast United States will have gone in just a few years from being almost fully dependent on Canada for natural gas to having the ability to export natural gas to Canada–and fill all of eastern Canada’s needs.”


We may see a pipeline bringing cheap American Gas to Eastern Canadian consumers before any interest is shown in developing NB shales. In total, these observations suggest that if the gas exists at all in the Horton Bluff Deposit in NB, it is not eager to surface and extracting the gas economically and safely is likely a futile proposition for many years to come.

Also on the investment front, since July 2012, Corridor Resources has been attempting to divest itself of some of its interest in holdings in the Frederick Brook Shales including the areas around Elgin. The proposed divestiture does not include the McCully Field at Penobsquis. MacQuarrie-Tristone was contracted to find the partners. After 3 years, no partner has reportedly been found. I quote the report:
"Corridor Resources Inc. has engaged Macquarie Tristone to seek proposals for divesting a portion of its working interest in the Sussex/Elgin Frederick Brook Shale prospect in New Brunswick, Canada. This divestiture will be by means of a farm-out as part of Corridor’s corporate strategy to advance the development of the Frederick Brook Shale. Corridor holds an average 89% working interest and wishes to farm out a portion of five leases encompassing over 116,000 gross acres"

For the full document see: http://www.corridor.ca/documents/CorridorOverviewMemorandumUpdateFB.pdf

APACHE had a similar farm-in arrangement with Corridor from 2009 to 2011, but backed away from investing $100 Million to secure a 50% interest in the 116,000 acres after witnessing the poor economic return of the two Elgin wells of 2011.

The apparent lack of interest on the part of other industry players is telling. The province continues to rely on industry speculation instead of facing up to the reality that pinning its hopes on a non-existent or minimal gas resource is economic folly warranting no level of social or economic risk.

NEGLECT OF REGULATORY OBLIGATIONS

In 2012, the Office of the Chief Medical Officer of Health for New Brunswick, tabled its Recommendations Concerning Shale Gas Development in New Brunswick CMOH (2012). The CMOH made 30 recommendations for conditions to be applied to shale gas development in NB. To date, none of those recommendations have been meticulously applied to any shale gas endeavour in the province. The province has based this failure to properly regulate on the erroneous excuse that the CMOH recommendations only apply to commercial development of the industry, and not to exploration activities. The position of the government on this issue is deplorable, given that the risks associated with exploration are as real as those associated with commercial gas exploitation. It is especially abhorrent, given that the long-term economic benefits of the industry have been shown to be non-existent by the CERI (2013) report.

A concrete example of how this neglect of responsibilities under the public health act have put the New Brunswick public at risk is given by the 2013-2014 experience in Elgin. Geological Survey of Canada (GSC) Report “OF-7449” compiled by Al et al (2013) found thermogenic methane in water wells in proximity to Corridor Resources gas wells G-41, B-41 and O-59 at Elgin. Thermogenic methane has origins in "deeply buried organic-rich sedimentary rock – usually shale." (Al et al, 2013) One of the water wells found with thermogenic methane is approximately 500m from gas wells B-41 and G-41. In Corridor’s report for Phase III of the EIA of these wells (AMEC, 2014), Corridor failed to report this finding of thermogenic methane to the regulator, the NB Department of Environment (DELG). The regulator also failed to note, or to address the same issue. The methane findings of Al et al (2013) have not been part of any environmental study on shale gas to date, and the findings have not been communicated to the public by government.
The ramifications of this are profound. The existence of thermogenic methane in domestic well water indicates that pathways exist at Elgin for methane to migrate from deep shale deposits to near surface groundwater during fracking. However, because no baseline data on methane levels were collected on water wells in the Elgin area prior to the first deep well drilling in the area, it is impossible to determine if fracking caused the pathways or if the pathways pre-existed. In either case, the existence of the pathways should have immediately required baseline testing of all water wells in the Elgin area before any subsequent fracking operations or well drilling were permitted. However, Corridor was permitted to frack the three wells in question in 2014 without any pre-condition for baseline water well testing for methane.

This is the kind of abuse of the regulatory framework that exists. The homeowners of Elgin are caught in a dilemma. A home with a compromised well field potentially suffers a significant decrease in value. A homeowner with methane contaminated well water faces serious health risks. However, homeowners know that methane information threatens their financial security and are understandably reluctant to undergo testing. The government needs to get serious about protecting homeowner health and financial security before haphazardly permitting continued exploration. It is the government’s unwavering faith that gas company spin constitutes economic reality that threatens the future health and economic well-being of residents caught in the exploration web.

Given the CERI report, the government is closing its eyes to the economic futility of the shale gas endeavour. The Elgin experience is repeated in the Penobsquis area, where multiple accidents and violations of flood plain constraints have been allowed to go unaddressed.

Given that the Elgin methane pathways refute the gas industry contention that there can be no compromise of near surface groundwater by shale gas exploration and development, the matter of seismic faultlines is another major concern in the consideration of the possible impact of proposed fracking. Previously identified faultlines in the Elgin area are shown in red in figure 3 below. The government has failed to openly communicate to the public the existence and implications of these faultlines. This glaring discrepancy exists despite the fact that 38 seismic events of magnitude 2.2 to 3.8 in proximity to an existing fault zone in British Columbia have been definitively linked to fracking at nearby gas wells (BC Oil and Gas Commission. 2012) The B.C. wells were fracked at approximately the same depth as those being fracked at Elgin.
CONCLUSIONS

Based on this review, I have concluded

- The shale gas industry in NB can project to have gas wells delivering less than 3 Million cubic feet of gas per day (MMcfpd) at initial production (IP).
- At 3MMcfpd IP, the price of natural gas would have to reach $11/Mcf to be economically feasible, a price not forecast to be realized, short or long term.
- At the projected IP for NB wells, no shale gas well in NB has a positive Net Present Value (NPV), making investment in NB wells unlikely and the promised investment, employment and social benefits unlikely to be realized in the short or long term.
- **At zero net social and/or economic benefit there can be no acceptable level of social or environmental risk associated with this industry**

- Thermogenic methane has been found in domestic well water in the Elgin area indicating connections between deeply buried shale gas formations and surface aquifers. Whether these connections pre-existed, or resulted from, gas well drilling is indeterminate because the baseline data were not collected beforehand to pinpoint correlation.
- The problem of geologic connections of deep shale layers with near surface aquifers at Elgin is compounded by the many geologic fault lines in proximity to gas reserves in the
area. The data indicate that strict adherence to the recommendations of the CMOH is absolutely mandatory for even the most exploratory of shale gas endeavours in this province.

- Until the implications all of these factors are transparently and objectively communicated to the public, and the public is given a chance to respond, it is impossible to maintain that this industry has a social license to proceed in NB.

**RECOMMENDATIONS**

Based on this review, I recommend that:

- the government communicate immediately to the public a more realistic appraisal of the economic feasibility of the shale gas industry in NB as documented in the CERI (2013) and JUPIA (2014) reports.
- the government immediately communicate its failure to implement the recommendations of the CMOH (2012) despite the identification of geologic connections of deep shale gas substrates with near surface groundwater in the Elgin area.
- the government immediately adopt all recommendations of CMOH (2012) as constraints on any and all exploratory and developmental shale gas activities in the province.
- the moratorium on fracking in NB be made extended indefinitely or be made permanent

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