

SHALE GAS DEVELOPMENT IN FORT NELSON FIRST NATION TERRITORY:

Potential Regional Impacts of the LNG Boom

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OVER THE PAST DECADE, abundant “unconventional” gas reserves throughout North America have become economically and technically viable through the combined use of two extraction technologies – horizontal drilling and hydraulic fracturing (or “fracking”) – and, as a result, production on the continent has boomed.¹ In 2012, the Government of British Columbia released a Natural Gas Strategy outlining its vision to dramatically increase provincial natural gas production and exports (BC Ministry of Energy and Mines 2012a). To escape the gas glut (and subsequent low prices) in North America, British Columbia is pursuing growing Asian markets. In order to be exported to Asia, the gas must be piped to the province’s west coast, liquefied (i.e., turned into “liquefied natural gas” – LNG – at coastal plants), and then shipped in tankers across the Pacific Ocean. In the BC Jobs Plan (Government of BC 2011), the Liberal government committed to having three LNG plants up and running by 2020. The year 2014 will be pivotal in British Columbia’s energy history as a number of proponents working towards a 2020 opening decide on final investments (Government of BC n.d.).

It is widely accepted that at most only a few of the more than twelve proposed LNG plants will ever be built. Even so, independent researchers have raised concerns about the potential implications of these developments for British Columbia’s efforts to reduce greenhouse gas (GHG) emissions (Jaccard and Griffin 2010; Stephenson, Doukas, and Shaw

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¹ Hydraulic fracturing injects large volumes of water mixed with sand and chemicals underground at high pressures to create fissures in the rock, allowing the trapped gas to flow into the well.

2012). What is less widely appreciated – and has not been adequately researched or assessed – is the issue of the upstream environmental impacts of the LNG industry (Council of Canadian Academies 2014). In British Columbia, the expansion of natural gas production for LNG exports means the development of unconventional gas reserves. For example, between 2005 and 2010, the percentage of wells in the Horn River Basin targeting shale gas jumped from 3.4 to 85.4 percent of all new wells drilled (BC Oil and Gas Commission 2010). Under the current environmental assessment regime, only those impacts associated with pipelines and gas processing plants are systematically assessed. However, First Nations in the shale gas plays that will feed the LNG industry are already experiencing a much wider range of effects. One of the nations most directly affected is the Fort Nelson First Nation (FNFN), whose territory includes three of the four major shale gas plays in British Columbia.²

This research, conducted with the Fort Nelson First Nation Lands Department, was prompted by concerns that the province has not meaningfully assessed the risks and impacts of an unconventional gas industry in FNFN territory. Nor is there adequate data or resources available for the nation to assess the risks on its own. In what follows, we tell the story of the rapid expansion of natural gas developments in the FNFN's territory through figures developed by the FNFN Lands Department. These figures reveal a race for industrial tenure, landscape disturbance on a massive scale, threats to wildlife, risks to water quality and quantity, and a high level of GHG emissions. After a short description of the treaty rights and land uses of the FNFN and the policy context of the BC natural gas industry, we present and describe these impact-related figures in turn, also referring to a wider literature on natural gas development in British Columbia and elsewhere. We aim to illustrate the scale and pace of industrial expansion and to identify a range of associated impacts. This investigation of potential impacts reveals an urgent need for a strategic assessment of the cumulative upstream effects of the LNG industry. Appeals for baseline studies and cumulative environmental assessments of the oil and gas industry in northeast British Columbia are widespread, coming from First Nations, researchers, and non-governmental organizations alike (West Coast Environmental

² The four major shale gas plays in British Columbia are the Liard Basin, the Horn River Basin, the Cordova Embayment, and the Montney Trend. The first three fall almost entirely within FNFN territory (see Figure 1); the majority of the Montney shale gas play, however, lies farther south. In this article, we focus largely on the plays within FNFN territory but also draw, where relevant, from research regarding shale gas developments in the Montney Trend.

Law 2004; Parfitt 2011; Campbell and Horne 2011; University of Victoria Environmental Law Centre 2013; Gale and Lowe 2013; Garvie and Shaw 2014 (this issue). Assessing, understanding, and mitigating cumulative effects is an essential precondition to the LNG industry proceeding in a way that protects the ecological and social resilience of the region, including the constitutionally protected treaty rights of the Treaty 8 First Nations on whose territory this development will proceed. An informed understanding of cumulative effects, in turn, should be the basis for any decision making around how the industry develops.

CRITICAL CONTEXT

Fort Nelson First Nation

The Fort Nelson First Nation is made up of fourteen extended families, whose traditional languages are Dene and Cree. The FNFN territories cover approximately seventy-two thousand square kilometres of northeast British Columbia. Since time immemorial, FNFN ancestors have lived and travelled throughout their traditional territories on seasonal rounds to hunt, fish, trap, and gather. Family groups travelled on their individual seasonal rounds between villages, fishing and hunting camps, and traplines by riverboat, dogteam, horseback, and foot. Families were dispersed among ten different village sites before moving to the main reserve six kilometres south of the town of Fort Nelson in the 1960s. Members of the FNFN continue to visit the village sites and actively hunt and trap in their family hunting grounds, but recent shale gas developments are making it increasingly difficult to do so. The FNFN's territory contains three large shale gas basins – the Liard Basin, the Horn River Basin, and the Cordova Embayment (see Figure 1) – within which extraction-related activities have rapidly expanded over the last ten years.

The FNFN has shared its territories with settlers and their industries for decades. Some families have supplemented their incomes by working with local guide outfitters and prospectors as well as in forestry and oil and gas extraction. The conventional oil and gas industry has been operating within FNFN territory since the 1940s, but the rise of unconventional gas has ushered in a new era of development. This shale gas era is placing immense pressure on existing regulation, and provincial oil and gas governance structures, to evolve with the changing character of the industry and to address novel environmental concerns (Stefik and Paulson 2010).

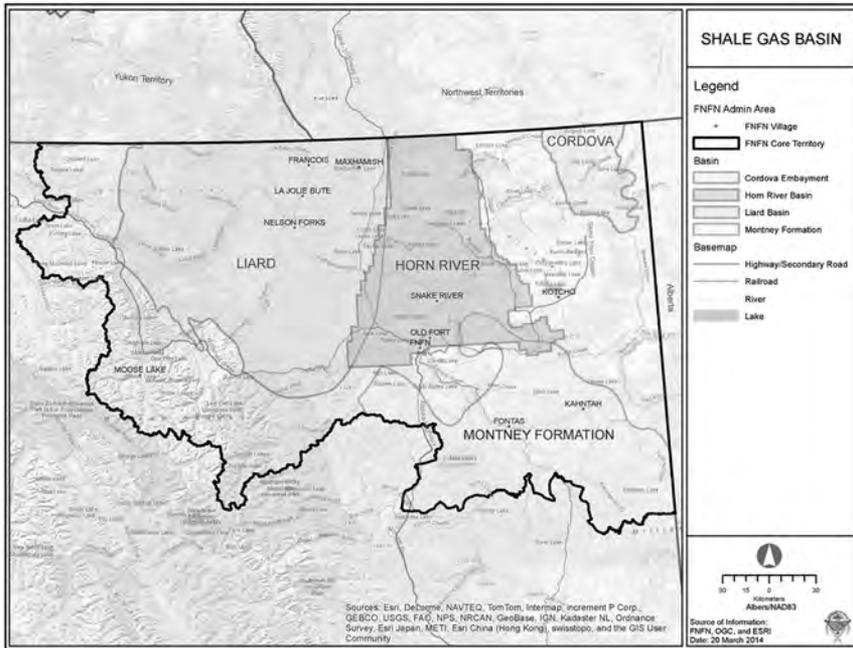


Figure 1. Shale gas basins in Fort Nelson First Nation's territory. *Source:* Fort Nelson First Nation Lands Department.

The FNFN understands its relationship to the Crown through Treaty 8. When the FNFN signed on to Treaty 8 in 1910, it agreed to share the land on the condition “that the treaty would not lead to any forced interference with their mode of life”; this included the right to “be as free to hunt and fish after the treaty as they would be if they had never entered into it” (Laird, Ross, and McKenna 1899). As unconventional gas development accelerates, the FNFN is concerned that these rights are not being respected and protected by government regulators (see Garvie and Shaw 2014). This concern was highlighted on 16 April 2014 when the province made the decision to exempt sweet gas plants from environmental assessment requirements without consulting with First Nations. After a quick and united response from BC First Nations, the province retracted the decision within twenty-four hours (CBC News 2014; Prystupa 2014). There is a growing demand from First Nations for collaborative, culturally and scientifically sound research to be gathered prior to any decisions being made on the future of the BC LNG industry (Garvie and Shaw 2014). As the FNFN chief Sharleen Gale and lands director Lana Lowe explain in a *Globe and Mail* opinion piece: “To truly have peace, we as a people must be able to share the wealth and protect

the integrity of our land. We need new mechanisms for decision-making and both the industry and government must be willing to change their ways” (Gale and Lowe 2013). Imminent decisions on how British Columbia’s LNG and shale gas industries advance have the potential to strongly influence the province’s relationship with First Nations.

The Rush for Tenure

Shale gas development is different from the conventional oil and gas development that has been occurring in FNFN territory since the 1940s in at least two ways: (1) it is happening at an increased pace and scale and (2) the use of hydraulic fracturing introduces new environmental concerns, especially regarding water. The sudden economic viability of shale gas extraction in North America due to a combination of new technologies and higher natural gas prices created a tenure buying frenzy in northern British Columbia between approximately 2005 and 2010. By the time FNFN members heard about shale gas and fracking at a town hall meeting hosted by an industry proponent in 2008, petroleum and natural gas tenure sales had already peaked in the Horn River Basin at \$1.1 billion (C. Adams 2011). Oil and gas company Devon Canada set a provincial record in August 2008 for the largest single bonus paid at a petroleum and natural gas rights disposition when it purchased a 5,789-hectare drilling licence in the Horn River Basin for \$75.8 million. By 2010, industry had bought up tenures covering over 75 percent of the Horn River Basin and had moved on to the Liard Basin, spending \$47 million and \$110 million on tenures in 2009 and 2010, respectively (ibid.). Despite lower natural gas prices, prolific production rates at test wells in the Liard are still anticipated to offset the higher production costs in the remote northeast area (Apache 2012). According to the Northern Rockies Regional Municipality (n.d.), at the end of 2012, the provincial government had accrued more than \$3.6 billion from land sales and royalties in the Horn River Basin and the Liard Basin. Figure 2 compares tenure holdings in FNFN territory in 2006 and 2013. The FNFN was not consulted on petroleum and natural gas tenure sales until June 2012, despite the implications of these sales for the future of FNFN territory and the ability to practice constitutionally protected treaty rights.

The tenure rush in British Columbia was followed by a relative lull in development as the economic recession slowed American markets and they became saturated with domestic shale gas, which was also being rapidly developed. US gas prices have remained below six dollars per million British thermal units (mmBtu) since 2009, after a 2008 peak of

is working to fill this critical gap, but, as stated previously, there are currently no regulatory requirements for industry to carry out baseline studies on its tenures. Without this information, the scope and scale of development impacts on First Nations territories and cultural practices cannot be fully understood as development progresses (Tollefson and Wipond 1998; Booth and Skelton 2011).

Once tenure has been acquired, all development – with the exception of projects that trigger an environmental assessment (i.e., pipelines and gas processing plants) – must be approved through the Oil and Gas Commission’s permitting process.⁴ As explained in Garvie and Shaw 2014, approval of developments proceeds on an individual, permit-by-permit basis. No long-term, landscape-scale plans are made available to the public or affected parties such as the FNFN.⁵ As a consequence, assembling a landscape-scale picture of present impacts, let alone potential future impacts, requires mapping hundreds of different permits individually. The FNFN’s Lands Department is currently undertaking this work. In what follows, we document the scale of development that has taken place to date on the tenures purchased in FNFN territory and explore some of the potential impacts of this development.

The Development Footprint

Figure 3 displays the cumulative oil and gas activities in the FNFN’s traditional territories as of March 2014. The solid patches are grids of seismic lines one to three metres in width, occurring approximately every 240 metres across the landscape. If all of the linear disturbance in the Liard, Horn River, and Cordova basins were laid end to end, it would wrap almost two times around the planet. In the most heavily affected areas of the FNFN’s territory, there are over 9.98 kilometres of linear disturbance per square kilometre.

Figure 4 illustrates what this level of disturbance looks like at Two Island Lake, an area of particular cultural importance to the FNFN (FNFN 2012a). A number of families continue to hunt, fish, trap, and gather in the area, despite industry’s extensive impacts on the landscape. Within the 100-square-kilometre area represented in Figure 4, there are 90 wells, 25 pipeline right-of-ways, 7 processing facilities, 114 water withdrawal points, and 2,385 kilometres of seismic lines. As of March 2014, there

⁴ For more information on responsibilities of the BC OGC, see <https://www.bcogc.ca/about-us>.

⁵ This lack of long-term, landscape-scale oversight is in contrast to industries with similar landscape-scale impacts such as forestry, where companies must have a Forest Stewardship Plan approved for their licence area before submitting site-specific permit applications (Forest and Range Practices Act SBC 2002 c. 69).

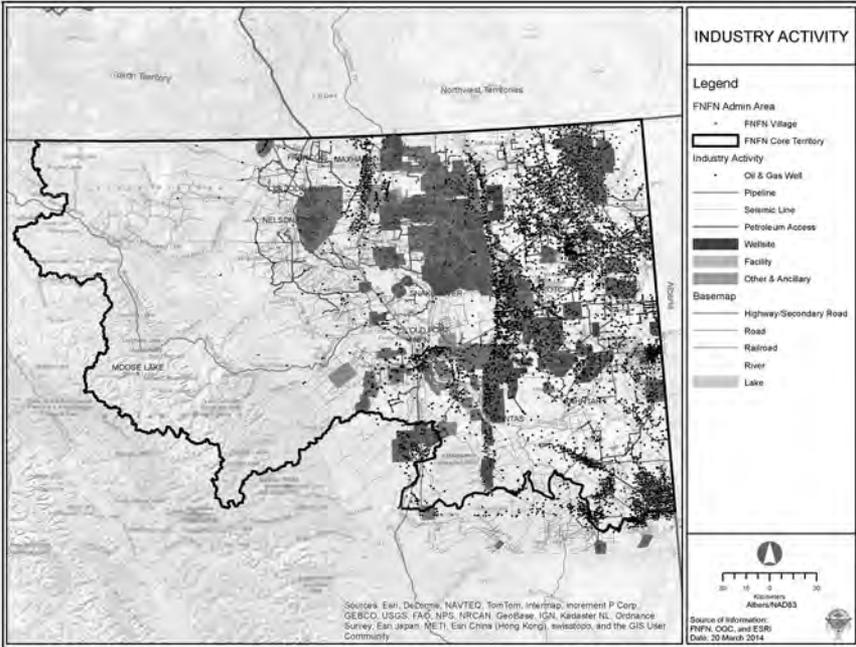


Figure 3. All oil and gas activity in FNFN territory as of March 2014. *Source:* Fort Nelson First Nation Lands Department.

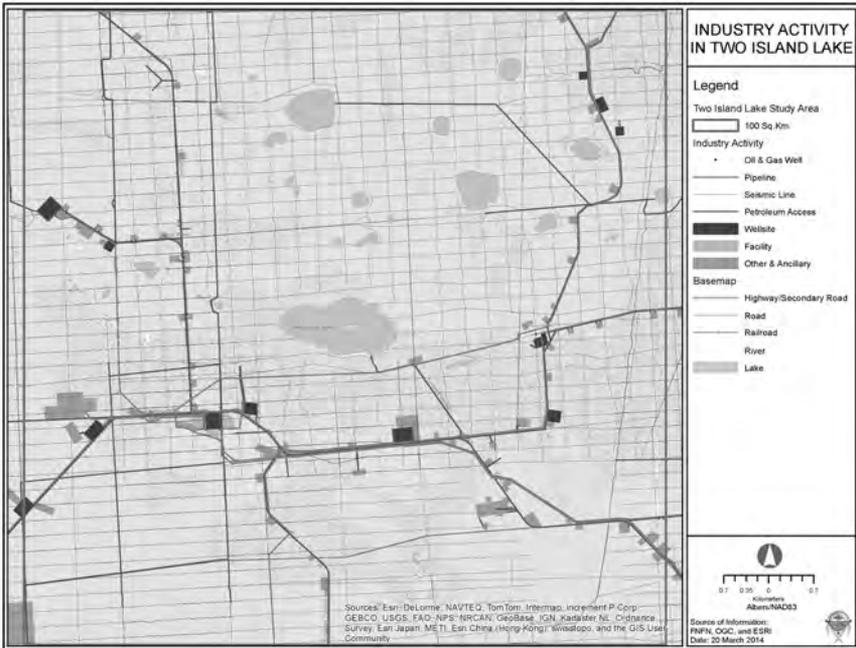


Figure 4. All oil and gas activity in a one-hundred-square-kilometre area around Two Island Lake as of March 2014. *Source:* Fort Nelson First Nation Lands Department.

has been no systematic assessment of the cumulative impacts of these developments on the wildlife and ecosystems of the northeast.

The pace and scale of development depicted in these figures have a wide array of potential impacts on the region that go almost entirely unstudied. In the following sections, we discuss the potential risks to wildlife, water, air, and human health based on northeast British Columbia's unique environmental and social characteristics and research conducted in other jurisdictions where shale gas development is taking place.

POTENTIAL IMPACTS

Threats to Wildlife

The development footprint in FNFN territory displayed in Figure 3 and Figure 4 also undeniably tells a story of changing wildlife habitat in northeast British Columbia. The impacts these changes are having on wildlife are unknown since the necessary research has not been conducted. Potential impacts, however, can be extrapolated not only from a number of studies on wildlife experiencing comparable levels of habitat disturbance from other industries but also from studies on livestock living in close proximity to conventional and unconventional oil and gas operations in other places. The threats to wildlife fall into two categories: (1) spatial changes to habitat (which alter predator-prey and wildlife-human interactions) and (2) degradation of habitat (which has impacts on wildlife health).

One of the few species that has been extensively researched in the northeast is the boreal woodland caribou; we use it here as an example of how the industrial footprint of unconventional gas development can have a variety of far-reaching effects on wildlife. The boreal woodland caribou appears on both provincial and federal "red lists" of endangered species. The FNFN territory contains five of the six boreal woodland caribou populations in the northeast. A 2009 government report identified oil and gas exploration as the greatest risk to northeast caribou populations (Goddard 2009). Seismic lines and roadways have been found to alter predator-prey relationships, resulting in increased caribou mortalities and decreasing populations (James and Stuart-Smith 2000; Latham et al. 2011). Additionally, noise and lighting from roadways, processing facilities, and well sites deter wildlife and alter habitat ranges (Dyer et al. 2001; Sorensen et al. 2008). Twelve of the fifteen core caribou habitat areas in northeast British Columbia have surpassed the

61 percent anthropogenic impact threshold (Theissen 2009), at which point a population becomes unsustainable (Sorensen et al. 2008). The preservation of remaining caribou habitat in the northeast is critical.

Similar studies have not been conducted on culturally significant species to the FNFN such as moose and beaver. However, it is well known that habitat fragmentation and degradation is associated with significant species loss (Fahrig 2003). Baseline studies are critical in order to determine how much development can take place before species loss begins. In the Peace-Moberly region of the northeast (south of FNFN territory) it is already too late: a study conducted in 2008 found that the cumulative effects of landscape change from industrial development (namely, conventional oil and gas development, mining, forestry, and agriculture) are synergistic, additive, and antagonistic in nature, and have reached a point at which they are threatening the ecological integrity of the area as a whole (Nitschke 2008). The alarming results of this study highlight the need for better industry regulation in FNFN territory to ensure that this region does not suffer the same fate.

Degraded habitats threaten wildlife health in numerous ways. If the land and waterways become contaminated, so, too, will the animals that are sustained by them. Studies have not been conducted in the northeast, but there are first-hand accounts from hunters about increasing rates of sick animals with tumours and failing organs. Outside British Columbia, where much shale gas development is occurring in more populated areas, the majority of research on fracking and animal health concerns livestock. In the United States, proximity to shale gas developments and exposure to frack fluids has been found to cause negative health effects in livestock, including increased mortality (Bamberger and Oswald 2012). In a 2014 article, Bamberger and Oswald draw connections between livestock health close to drilling operations and food safety in the United States. Additionally, studies conducted in conventional oil and gas fields in Alberta have found decreased fertility in cattle and increased calf mortality rates due to air pollution (Waldner 2008). In the BC context, these kinds of risks could have serious health implications for wildlife as well as for community members hunting and trapping these animals.

Northeast British Columbia is one of the few remaining places on earth that still has boreal forest able to support a wide array of large mammals, including grizzly bears, American black bears, wood bison, bighorn sheep, moose, caribou, and wolves (Laliberte and Ripple 2004). The forests, muskeg, and lakes of FNFN territory are home to over thirty endangered or vulnerable species, including woodland boreal caribou, wood bison, grizzly bear, wolverine, and fisher, as well as a number

of culturally significant species, such as freshwater whitefish and bull trout (BC Ministry of Environment n.d.). Members of the FNFN are already speaking out about changes to the landscape and the health and behaviour of the animals, but without baseline data and ongoing monitoring, provincial regulators and industry representatives often reject community members' concerns as anecdotal. Allowing an information and data vacuum to persist in northeast British Columbia facilitates uninformed industry growth and the marginalization of FNFN concerns.

Water Use and Contamination

Concerns about water use and contamination arise virtually everywhere the shale gas industry has expanded (Freyman 2014; International Energy Agency 2012), and northeast British Columbia is no exception (Parfitt 2011; Campbell and Horne 2011). Until recently, to support the rapid development of the industry, almost all water use has been facilitated by "Section 8" water permits. Section 8 water permits are for short-term water use access and are issued by the Oil and Gas Commission (OGC) according to section 8 of the BC Water Act. As of 2011, water permits are required for surface water removal from any surface water body, including borrow pits (a human-made pit created during the removal of construction materials). Up until April 2014, British Columbia was the only Canadian province that did not regulate groundwater use.⁶ Figure 5 displays all of the surface water diversion points approved under section 8 water permits in FNFN territory as of March 2014. These permits only represent a small fraction of water that would be required should LNG move forward at the pace anticipated by the provincial government.

In the shale gas industry water is primarily used for hydraulic fracturing. The amount of water required to frack a well varies dramatically, depending on the local geography. A report for the BC Ministry of Energy and Mines (MEM) found that, on average, 34,911 cubic metres of water are used per well in the Horn River Basin, while just 1,925 cubic metres are used per well in the Montney Trend (Johnson and Johnson 2012).⁷ Apache holds the record for the world's largest frack job at a pad

⁶ As of 29 April 2014, there is a new Water Sustainability Act in British Columbia. Of particular note is the introduction of groundwater regulation and environmental flow requirements. See Curran (2014) for a summary of the new legislation.

⁷ A BC OGC factsheet documents much higher averages: 77,000 cubic metres per well in the Horn River Basin and 7,000 to 10,000 cubic metres per well in the Montney Trend (BC OGC 2014b). The discrepancy between these two sets of numbers – which both come from official provincial documents – reveals the ongoing uncertainty of data regarding water use for hydraulic fracturing in British Columbia.

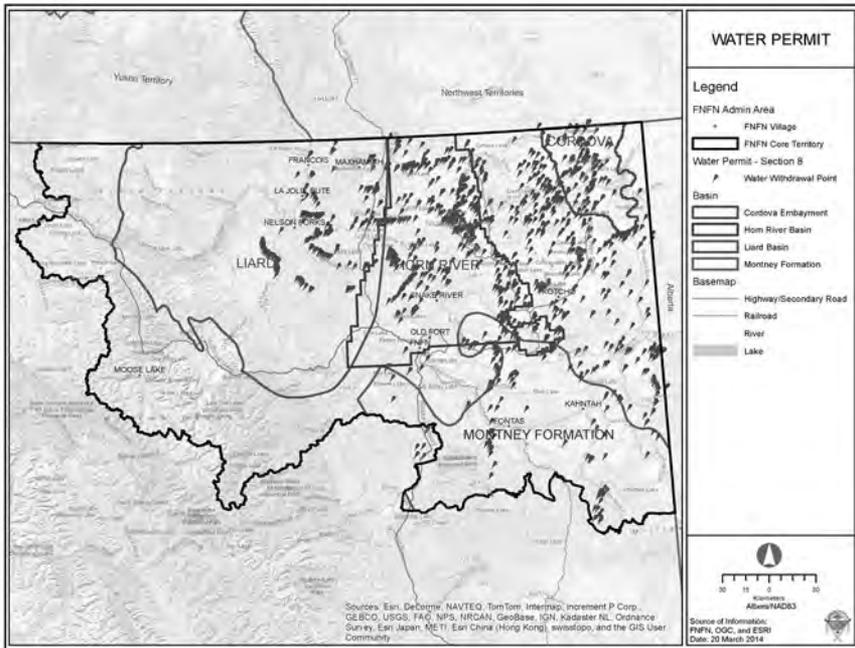


Figure 5. All of the water diversion points approved in FNFN territory through OGC-issued section 8 water permits as of March 2014. *Source:* Fort Nelson First Nation Lands Department.

with sixteen wells near Two Island Lake. It took 111 days to frack the sixteen wells a total of 274 times. In total, 980,420 cubic metres of water and 50,000 tons of sand were used during the operation (C. Adams 2011; Parfitt 2011). That volume of water is equivalent to 392 Olympic swimming pools' worth. Due to contamination, once water is used for fracking, it must be forever removed from the hydrologic cycle; in the absence of treatment facilities in the northeast, companies fulfill regulatory requirements by disposing of flowback in deep-injection wells.⁸

The vast majority of water being used by industry for fracking is surface water; just 7 percent comes from source wells, despite the fact that saline aquifers have been found beneath large areas of tenure (BC Oil and Gas Commission 2014a). While some companies are taking advantage of these sources, there are no regulatory requirements that ensure that non-potable sources are prioritized and that water recycling is carried out.

As the industry is becoming established, companies are moving towards long-term water licences. Nineteen water licences in the FNFN's

⁸ Flowback is a highly saline, toxic solution containing both the frack fluid chemicals injected into the well during the fracking operation and naturally occurring toxins from within the shale formation, such as radioactive barium and arsenic (Vengosh et al. 2014).

territories are currently awaiting government approval. The first licence granted has resulted in a lawsuit by the FNFN alleging inadequate consultation in the granting of the licence and significant flaws in the licence itself, particularly in terms of the lack of regulatory oversight. The FNFN had experience with this lack of government oversight and enforcement when, in the summer of 2012, during a one-in-thirty-year drought, 182,785 cubic metres of water were removed from North Tsea Lake after the lake's discharge dropped below the zero withdrawal limit (Chapman 2013). The use of multi-well pads (such as the one at North Tsea Lake) increases the intensity of water demand over short periods of time (Rivard et al. 2014). The impacts of these withdrawals on the surrounding ecosystem will never be fully understood because no baseline data exist. There continues to be no systematic monitoring of impacts, despite the unprecedented scale of withdrawals relative to the water body's size allowed under the licence.

The OGC is working reactively to fill the regulatory gaps created by the widespread introduction of hydraulic fracturing, which has brought with it unique governance challenges, including water use and contamination (Stefik and Paulson 2010). In a recent effort to deal with increased water use by the oil and gas industry, the OGC has developed a publicly available NorthEast Water Tool (NEWT) that assesses water availability based on estimates of monthly and annual water flows and existing water permits and licences. It is used as a "decision-support tool" for short-term water permits and long-term water licences (BC Oil and Gas Commission n.d.). Environmental flow needs are also estimated; however, considering the limited baseline data for the region the accuracy of these estimates is questionable. The longer the OGC waits before implementing rigorous data collection the less useful the information will be because ecosystems will already be in an altered state.

Water acquisition is only part of the controversy surrounding hydraulic fracturing; water contamination is also a significant concern. According to the US Environmental Protection Agency (EPA) (2012), there are five stages in the hydraulic fracturing water cycle that could lead to groundwater contamination: (1) water acquisition, (2) chemical mixing, (3) well injection, (4) flowback and produced water, and (5) waste water treatment and waste disposal. The real contamination effects of these five stages remain largely unknown. Whether or not hydraulic fracturing is responsible for drinking water well contamination in a number of jurisdictions across the United States is highly contested; a lack of pre-drilling data makes it difficult to identify fracking as the

sole potential cause of contamination (Vidic et al. 2013), but there are a number of studies that have found a correlation between a drinking well's proximity to a shale gas well and contaminants in the water. For example, Fontenot et al. (2013) found that wells within three kilometres of active gas wells in the Bennett Shale had higher levels of arsenic, selenium, strontium, and total dissolved solids. In the Marcellus Shale in the Appalachian Basin, household wells less than one kilometre from gas wells had concentrations six times higher of methane and concentrations twenty-three times higher of ethane (Jackson et al. 2013).

In 2013, the US EPA backed away from finishing an independent, peer-reviewed study on contaminated wells in Pavillion, Wyoming, after releasing a draft report linking the contamination to fracking in the area (Vidic et al. 2013). The EPA passed the study off to the state of Wyoming in June of that year. The state will be working with Encana, a company with operations in the region, to complete the research (Office of Governor Matt Mead 2013). This sequence of events raises alarms for a number of reasons, not least of which is industry's involvement in research in which it has a strong vested interest. Water studies currently being conducted in FNFN territory are also industry funded. The BC government has installed six groundwater monitoring wells in the Montney Play but has yet to install a test well in the Horn River Basin (Rivard et al. 2014).

The shale gas reservoirs in northeast British Columbia lie at much greater depths than do the deposits in the United States, where groundwater contamination has been reported. However, there are still potential pathways through which contaminants could travel to water bodies. In 2012, the BC OGC completed a study that found that seismic events in "the Horn River Basin between 2009 and 2011 were caused by fluid injection during hydraulic fracturing in proximity to pre-existing faults" (BC Oil and Gas Commission 2012). The seismic events studied did not result in any wellbore deformation on vertical well sections (*ibid.*), but seismicity may be a risk to well casings over time, creating vertical fluid and gas migration pathways. Unlike other provinces, British Columbia does not require well casing integrity tests prior to fracking (Rivard et al. 2014). While integrity tests are required for deep injection wells, a report released by the University of Victoria Environmental Law Centre still raises concerns about the potential for compromised well casings, especially considering that 60 percent of the oil and gas industry's

waste (including flowback and produced water) has been injected into wells that are more than forty-three years old (Carr-Wilson 2014).⁹

Researchers have also raised concerns over fracking's effect on the speed of advective transport rates. Myers (2012) found that advective transport rates of contaminants up into aquifers are dramatically increased after hydraulic fracturing; modelling of the Marcellus Shale indicates that contaminant transport that naturally takes up to tens of thousands of years may only take tens or hundreds of years after hydraulic fracturing occurs (ibid.). Independent hydrologists in British Columbia have also raised concerns about advective transport and compromised well casings over time, but supporting research has not yet been conducted.

In addition to the potential for groundwater contamination during fracking or disposal, there is also the potential for surface water contamination from spills and the improper treatment, storage, and disposal of frack fluids and flowback. Less rigorous regulatory standards for disposal and storage in some states have resulted in numerous incidences of aquatic species death in rivers (Vengosh et al. 2014) and livestock mortality (Bamberger and Oswald 2014). A study of forest health after direct exposure to frack fluids in West Virginia resulted in 56 percent tree mortality within two years (M.B. Adams 2011; see also Warner et al. 2013). Other threats to surface water and surrounding ecosystems include increased sedimentation from road and pipeline development and elevated traffic levels (Entrekin et al. 2011).

In sum, even at current levels of development, industry demand for water has been significant and poorly regulated. Even with massive recent increases in shale gas development, there is currently no independent, publicly available assessment of the implications of water use at this scale or of the dangers of contamination in the northeast.

Air Quality and GHG Emissions

The emissions from shale gas developments are also drastically under-researched: preliminary analyses of the impacts on local air quality and global GHG emissions have shown cause for concern and the need for extensive and more comprehensive studies. Recent and preliminary work in northeast British Columbia has shown that shale gas development may affect local air quality in ways that have impacts on human health. In June 2012, the Fraser Basin Council released Phase One of a human

⁹ See the University of Victoria Environmental Law Centre's report *Improving the Regulation of Fracking Wastewater Disposal in BC* for a list of fifteen recommendations to improve the safety of deep-injection wells in the oil and gas industry (Carr-Wilson 2014).

health risk assessment currently under way: *Identifying Health Concerns Relating to Oil and Gas Development in Northeast BC*. The BC Ministry of Health contracted the report after public concerns about oil and gas development began to grow with the industry's rapidly increasing activity (Fraser Basin Council 2012). The report documents numerous environmental pathways created by the oil and gas industry that could result in adverse human health effects: inhalation of "sour gas" (gas with a high hydrogen sulphide content), inhalation or ingestion of diesel dust from increased traffic and operating equipment, and the ingestion of contaminated wildlife and water (ibid., 25). Phase Two of the study is due later this year. Based on some of the concerns raised during Phase One, the Ministry of Health provided two additional air-monitoring sites in the South Peace (BC Ministry of Health 2012). In FNFN territory, however, there continue to be no provincial monitoring stations, despite rapid industrial growth in the Horn River Basin. Without air quality data, community concerns about risks to long-term health and ecological well-being remain unexplained and unaccounted for in scientific research and policy. This information gap raises serious concerns, particularly given what is known about the massive production of contaminants by the upstream oil and gas sector in Canada as a whole: in 2006, the sector accounted for 17 percent of sulphur oxide, 21 percent of nitrogen oxide, and 28 percent of volatile organic compounds in the country (Environment Canada 2013).

Numerous studies in the United States have linked air quality during well completion to human health effects. McKenzie et al. (2012) found that individuals living within 0.8 kilometres of a gas well completion are at a greater risk of contracting cancer from elevated benzene levels and that they also experience other subchronic health effects. An air quality study in Colorado conducted at wells during the initial drilling phase found non-methane hydrocarbons at levels beyond those that have been found to cause lower IQ scores in prenatally exposed children (Colborn et al. 2014). Adgate, Goldstein, and McKenzie (2014) argue that the research on populations living near unconventional gas developments has been scientifically limited in a number of ways (e.g., self-selected populations, small sample sizes, lack of consistently collected data) and that more substantive research on risks to human health risk assessments is needed.

The FNFN often hears the argument that local sacrifices will result in net benefits for the planet through reduced GHG emissions. In the fall of 2013, Premier Christy Clark declared that by developing shale

gas and LNG “we are doing the world a favour” (Canadian Press 2013). Not only is this ethically dubious, its validity has been questioned by several researchers. A number of studies indicate that emissions from shale gas over its full lifecycle are significantly higher than are the emissions from conventional gas (Jiang et al. 2011; Karion et al. 2013), and they are possibly as high as coal if carbon capture and storage (ccs) technologies and fugitive emission reduction measures are not adopted (Howarth, Santoro, and Ingraffea 2011).¹⁰ Recent studies by Alvarez et al. (2012) and Caulton et al. (2014) highlight the need to reduce methane leakages and to improve scientific estimation methods in order to maximize climate benefits of switching from coal to natural gas. Full lifecycle emission calculations are particularly pertinent for gas extracted from the Horn River Basin, where shale gas has a CO₂ content as high as 12 percent (versus the 2 percent of conventional natural gas), and companies are not required to use emission-reducing ccs.

While the FNFN is being asked to think globally, the government has not adopted the necessary industry regulations to make real progress towards realizing its claim that British Columbia will have the world’s cleanest LNG industry (Stephenson, Doukas, and Shaw 2012; Stephenson and Shaw 2013). Consideration of upstream impacts poses a clear challenge to the idea that LNG is “clean.” A 2013 report by Clean Energy Canada concludes: “Without policy leadership, LNG produced in British Columbia would emit more than three times the carbon pollution of that produced in current world-leading operations. The finding is based not only on the emissions of the proposed LNG plants, but on the carbon footprint of the commodity they would produce – from wellhead to waterline” (Glave and Moorhouse 2013, 4). While the government claims to be focused on making LNG production as “clean” as possible on the coast (BC Ministry of Energy and Mines 2012b), it is upstream in FNFN territory where the most emissions will be produced (Horne 2012), as is shown in Figure 6.¹¹ Processing plants in FNFN territory will create nearly five times the GHG emissions of the liquefaction process on the coast (*ibid.*).

¹⁰ See Cathles et al. (2012) for a critique of the assumptions and methods employed in the Howarth, Santoro, and Ingraffea (2011) study. Cathles et al. (2012) estimate that the shale gas’s GHG footprint is at most half that of coal.

¹¹ Initially, the government was committing to use hydropower to run the LNG plants on the coast but has since signalled that the liquefaction process will be powered by natural gas, which it has named a “clean energy” when being used to power LNG plants (Government of BC 2012).

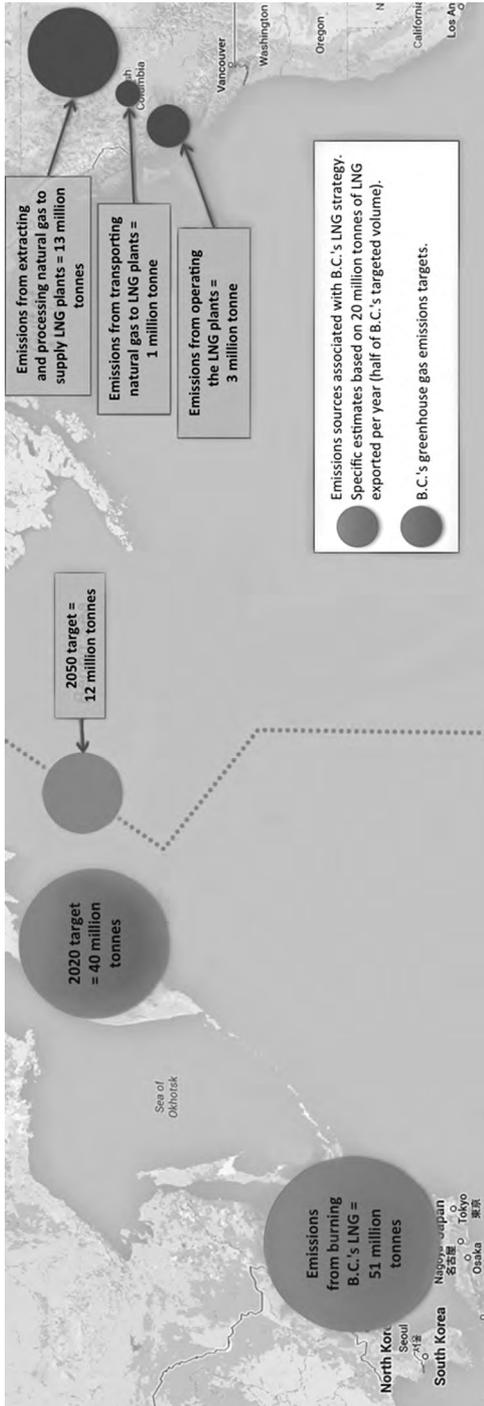


Figure 6. GHG emissions produced on the coast from LNG in contrast to GHG emissions produced in FNFN territory during shale gas extraction and processing. This figure first appeared in an article by Matt Horne from the Pembina Institute (Horne 2012).

DISCUSSION AND CONCLUSIONS

The nascent LNG industry in British Columbia is constantly in the news, but the direct connection between LNG and the industrial footprint of shale gas extraction in the northeast is rarely discussed. Despite aggressive provincial efforts to launch an LNG industry, there is no publicly available long-term development plan that connects LNG to shale gas development in the northeast and that considers the potential cumulative impacts to this region. We have sought here to illustrate the potential character of upstream impacts that are associated with unconventional gas extraction in the FNFN's traditional territory. Our analysis is preliminary; at this point, the research that would allow an assessment of these impacts and their potential trajectories under different scenarios of industrial development has simply not been done. But what our analysis makes clear is that more research is necessary before an informed decision on the pace and scale of shale gas development can be reached; impacts on ecosystems and on First Nations treaty rights must be better understood. Currently, all of the above-described development in FNFN territory is happening without systematic baseline studies, monitoring, or mitigation plans for cumulative impacts. We believe this is cause for alarm.

The FNFN territory contains three of British Columbia's four major basins and had experienced relatively limited industrial development before shale gas took off. The nation was in no way prepared for the rapid expansion in development. Nor, it appears, was the province: the industry has been launched in the absence of a regulatory framework capable of cumulative impact assessment or comprehensive monitoring that would enable the provincial government and industry to answer essential questions and concerns such as those raised by the FNFN. In the absence of independent scientific research, we cannot make the claim that the ecological integrity of the region is being compromised, but the impacts of large-scale oil and gas activity in northern Alberta – on ecosystems similar to those in northeast British Columbia – have been extensively researched. These studies document detrimental impacts to wildlife, biodiversity, and water (Kelly et al. 2009; Timoney and Lee 2009). Such changes, of course, have cascading impacts on the health and resilience of communities (Gosselin et al. 2010; Kelly et al. 2010; Tenenbaum 2009). In the context of British Columbia's northeast, numerous ENGOS and civil society groups have criticized the failure of oil and gas regulation to protect the environment (e.g., Campbell and Horne 2011; Parfitt 2011).

Crucially, the FNFN is reporting changes on the landscape and in the wildlife that are not being seriously investigated, let alone mitigated. From the FNFN's perspective, meaningful consultation on shale gas development is not taking place (Garvie and Shaw 2014). The FNFN – along with other Treaty 8 First Nations – has specific recommendations for the improvement of the consultative process (Garvie and Shaw, this issue). The FNFN has also clearly articulated its expectations of the research and regulatory changes that are necessary for shale gas development to take place within its territory. These expectations include but are not limited to (1) regional baseline studies before water licences are issued; (2) multi-year pre-development plans provided by both industry and government; (3) cumulative environmental assessment processes to ensure development is taking place sustainably; (4) the full protection of culturally significant land and water resources; and (5) third-party, independent monitoring and enforcement of all industry activities (FNFN 2012b). The potential impacts of shale gas development that we have explored in this article support these demands for informed decision making. Only when First Nations, provincial decision makers, and all British Columbians understand the potential impacts can the viability of an LNG industry be decided.

As the provincial government seeks to develop an LNG industry, it must build and mobilize an understanding of existing and potential impacts, both upstream and downstream, and create concrete plans to mitigate them. Currently, the FNFN is struggling to minimize the impacts within a system that is fundamentally unable to address concerns in anything more than a haphazard, superficial way (Garvie and Shaw 2014). Furthermore, the FNFN is but one example of numerous Indigenous and settler communities being affected by shale gas development and other regional transformations in both positive and negative ways. Treaty 8 communities in the Montney Trend are also experiencing unprecedented rates of shale gas development and in combination with numerous other energy industries, including mining developments, wind turbines, and the proposed Site C dam (Muir and Booth, 2011).

The challenge of launching the LNG industry in British Columbia is significant: gas markets are intensely competitive, a fact that puts tremendous pressure on governments to minimize the start-up and ongoing costs for the industry so companies can maximize economic benefits. Balancing this imperative with social, ecological, and governance needs is complex. However, protecting the environment – over both the short and long terms – is also crucial. When the industry is gone, British

Columbia will be left with its legacy: it is important for this legacy to be positive (Rondeau et al. 2013). Unfortunately, the provincial government's approach to developing the industry to date has been rushed and secretive. Consultations with affected communities or British Columbians have been extremely limited, hurried, and haphazard. In addition, there is no body of research identifying and assessing the social and environmental challenges the industry poses and considering how these could be mitigated; in fact, there is little indication the government is considering any of the industry's implications other than its potential to contribute to government coffers. This is a very risky way to proceed. If the province were to slow down, do the necessary research, and work to maximize the economic benefits over the long term, the environment could be better protected as well. Considering that the potential impacts of poorly regulated development are so profound, the FNFN and all British Columbians deserve a measured, well-researched approach.

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