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VIA EMAIL

August 1, 2013

The Honourable Leona Aglukkaq
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Dear Honourable Ministers:

Re: Request that Minister Polak order a Strategic Economic and Environmental Assessment of liquid natural gas (LNG) development in British Columbia, pursuant to Section 49 of the *Environmental Assessment Act*

Request that Minister Aglukkaq enter into an agreement with the government of British Columbia respecting the joint establishment of a committee to conduct a regional study of the effects of LNG development in northern British Columbia, pursuant to Section 74 of the *Canadian Environmental Assessment Act, 2012*

On behalf of Northwest Institute for Bioregional Research, we hereby request that you direct that a Strategic Economic and Environmental Assessment be conducted of proposed massive new LNG developments in British Columbia.[1]

Section 49 of the BC *Environmental Assessment Act* empowers the BC Minister of Environment to authorize a Strategic Environmental Assessment in the form of "an assessment of any policy, enactment, plan, practice or procedure of the government."[2]

Similarly, Minister Aglukkaq is authorized to enter into an agreement with the government of British Columbia to establish a committee to conduct such an assessment (regional study) under s.74 the *Canadian Environmental Assessment Act, 2012*. Such a regional study could also be used to fulfill the requirement to conduct Strategic Assessment pursuant to the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals.*[3]

Since environmental assessments normally examine economic impacts as well, this Strategic Assessment should examine both economic and environmental impacts of policies encouraging large-scale LNG development.

A Strategic Assessment (Regional Study) is necessary to:

- determine whether these developments are in the public interest; and
- if so, to identify ways to optimize benefits and minimize negative impacts.

An Assessment is required to ensure the best possible economic and environmental future for all British Columbians.

Contents

Background

Approximately one dozen new LNG projects are now proposed in BC – with liquefaction plants proposed for the coast, along with numerous pipelines to connect the Peace River Country with the Pacific. Thousands of new gas wells would be required in Northeast BC. A number of the largest energy companies in the world, including Chevron, Shell, PetroChina, Petronas, Apache and British Gas are scrambling to join the race to export LNG, with new development announcements almost weekly.

(See Appendix A for a short description of a number of the proposed LNG projects.)

Unfortunately, as you can see from Appendix A, each proposal is being developed and environmentally assessed in isolation from the other LNG proposals. Government – and the public – are responding *ad hoc* to each individual proposal as it is filed. No environmental assessments will be done on the thousands of gas wells. Assessments (of varying levels of rigour) will proceed on individual LNG and pipeline projects – but there is no comprehensive assessment of the overall development being proposed.

The risk is that current assessment processes will "miss the forest for the trees." Government – and the public – are considering individual pieces of overall LNG development, but no strategic assessment is being conducted on the big picture.

There are serious economic and environmental risks to this *ad hoc* development of LNG. As energy industry lawyer David Austin has noted:

> *We have to move away from a higgledy-piggledy planning approach to a modicum of planning so we don't trip over our own two feet. You can only have so many pipeline corridors across British Columbia; there's only so much water to produce the natural gas. The airshed in Kitimat can only take so much pollution. And you have to sort some of this out in advance... so you don't use up the Kitimat airshed for one LNG facility, thereby preventing the possible construction of two or three.*

For example, there is no overall strategy for reducing unnecessary duplication of infrastructure. Constructing a number of different pipeline corridors across the Province would put far more fish, grizzlies and caribou at risk than if a single common corridor was used. And the building of such redundant infrastructure could also risk the future of the industry itself.

We need look no further than Australia, where lack of up-front planning led to building redundant infrastructure that not only caused unnecessary environmental damage – but also threatens the economic viability of the industry itself.

We need to be smarter than that. Instead of simply reacting to a series of one-off LNG proposals, BC needs to step back, look at the big picture, and determine what all this massive development will mean for the Province. It's not enough to do individual environmental assessments on one project at a time. We need a Strategic Environmental and Economic Assessment to determine how to best provide jobs *and* protect nature.

Among other things, the Assessment could consider:

Economic Questions

- Is it likely that Asian gas prices will fall over the next decade and threaten the viability of a long-term LNG industry?
- Is rapid expansion of LNG development in BC truly economically sustainable in the long run? Or is it possible that some BC agreements are being used to better the negotiating position of corporations with other gas-producing countries?
- What fiscal and environmental liabilities could be created if the industry fails economically?
    - Should taxpayer-funded subsidies and special tax breaks for LNG companies be prohibited for this potentially lucrative – but high-risk – venture?
    - What environmental risks could be created if LNG companies fail?
    - Since taxpayers already face massive liabilities to clean up previous oil/gas operations, should industry guarantee that taxpayers won't pay to clean up contaminated sites if the LNG boom collapses?
- Can economic viability and environmental integrity be enhanced by rationalizing and integrating infrastructure?
    - Are there ways to develop LNG infrastructure efficiently, to reduce duplication and cost, and to thereby make our LNG more competitive internationally?
    - Should we allow numerous pipelines to cross the province by different routes – or establish a single pipeline corridor to reduce industry costs and environmental impacts?
    - Can redundant processing facilities be shared or rationalized, in order to enhance the net economic benefits to the Province?

- Could the new LNG export industry cause prices to soar for domestic consumers of natural gas? What other types of negative economic impacts could the industry cause?

Environmental Questions

- What impact will expansion of the LNG industry have on Greenhouse Gas Emissions and BC's commitment to reduce GHGs?
- What are the environmental costs of dramatically expanding the use of hydraulic fracturing (fracking) operations in the Northeast in order to produce the gas for the LNG industry? In particular, what would the cumulative impacts be?
- What are the environmental costs of running new pipelines across the Province and building new LNG plants and shipping facilities on the Coast?
- In light of high public concern about bitumen pipelines and tankers, should Government prohibit future conversion of gas pipelines to carry bitumen?

Such a strategic assessment could be far more efficient and timely than just doing assessments of individual projects. Advantages include:

- Since a Strategic Assessment focuses on a few key, high-level questions it will be a more efficient use of time and resources than the current *ad hoc*, project-level approach;
- A single Strategic Assessment avoids the complexity and duplication involved in conducting multiple project-specific environmental assessments on the same issues;
- Society should have a voice in early, high-level strategic discussions around LNG development. Assessments of individual projects are not the proper forum for discussing the broader issues about the establishment of an entire new industry that will change the face of British Columbia. Neither the public nor Government can meaningfully discuss the big issues if that discussion is spread across a dozen or more small assessments of local projects. A Strategic Assessment will enable meaningful public participation regarding the broader issues.
- Identifying a single transportation corridor and other integration of common infrastructure could make a future LNG industry more efficient and competitive internationally.

We will first discuss the economic questions, followed by questions related to the environment.

KEY ECONOMIC QUESTIONS

Any Environmental Assessment needs to consider economic and socio-economic impacts of development. Thus, an important component of a Strategic Assessment of LNG development would be a thorough review of critical economic questions. First of all the Assessment needs to determine whether – and to what extent – the evolving LNG industry is likely to be a long-term economic benefit to the Province. On the other hand, the Assessment should also consider whether LNG development may pose net economic costs to the Province.

Furthermore, if the industry is indeed likely to be of net benefit, the Assessment should determine what specific steps might be taken to enhance the economic benefits to the Province – and to create a more efficient, profitable and beneficial industry.

Among other things, a Strategic Assessment would address the following economic questions:

- Given market realities -- including projected increases in global LNG supply and the prospect that high Asian prices for LNG will decline -- is a major BC LNG industry likely to be a long-term economic success?
- Is it possible that some announced BC LNG developments may never proceed – but may simply be used by industry as bargaining chips to drive down prices, taxes and regulatory burdens in negotiations of new agreements with established LNG producers elsewhere?
- Are there ways to develop LNG infrastructure efficiently, to reduce duplication and cost, and to thereby make our LNG more competitive internationally?
- Given current economic circumstances, should the Province subsidize this industry or grant it special tax concessions?
- If the new LNG industry fails, what would be the fiscal and environmental impact on British Columbia?
- Could creation of this new industry cause the price of natural gas for British Columbians to soar, as has occurred in Australia?
- What kinds of potential negative economic impacts may the new industry create? What costs may be incurred by the wilderness tourism industry, the sports fishing industry, the commercial fishing industry and other sectors of the economy?

Is a major LNG industry likely to be a long-term economic success in British Columbia?

BC has some key advantages in developing an LNG industry. It has large quantities of natural gas, and an established gas industry. We have lower labour costs than producers in places like Australia, and lower shipping costs to Asian markets than most US (Gulf Coast) suppliers. Unlike the US, Canada does not have a strong lobby to retain natural gas for domestic manufacturing use.

On the other hand, BC has some disadvantages. For example, construction of liquefaction plants and other infrastructure in BC will cost far more than in the US, which has existing infrastructure.[4] Such costs will necessitate a substantial price for the BC product.

Nevertheless, LNG development appears to be entering a boom era in British Columbia. But the current rush is based on lucrative gas prices in Asia, which are more than triple the North American price. BC projects need such high price differentials to be profitable.[5] The critical question is whether those high Asian prices will actually continue. Gas prices are notoriously volatile. For example, in the last five years new fracking methods increased supply so much that North American gas prices plunged from over $12 to about $4 per MMBtu today.[6]

Today Asian prices remain relatively high – in the range of $14.50 per MMBtu,[7] compared to the North American price of about $3.75 to $4. However, Asian prices could easily collapse too. China has the world's largest reserves of shale gas and aggressive plans to develop them.[8] Russia, Qatar, Australia, and the US are in the process of dramatically increasing gas exports to Asia.[9] And Japan and Korea are developing technology to extract natural gas from vast seabed deposits. If just some of this comes on line, the price bubble could collapse.

At the very least, analysts expect to see a narrowing of the price differential between Asian and North American prices. Bloomberg estimates that the difference between U.S. and Asian gas is poised to drop by more than 60 percent by 2020.[10] Another analyst agrees, predicting that the price differential could shrink to about $6/mmBtu from about $15 today.[11]

Iain Grant, of Athabasca University poses the critical question about the boom in developing LNG for Asian markets:

> *"[s]hould we expect either the low Henry Hub [North American] prices or the high Japanese prices to last long enough to justify the massive effort that is underway to capitalize on it?"*[12]

The assumption that the current lucrative price differential will last is questionable, for the following reasons:

We may be rushing headlong into a global supply glut

Shale gas is not the only form of unconventional natural gas. Methane hydrates form an enormous gas resource on the ocean floor – estimated by some to contain more hydrocarbons than all the other sources (coal, oil, and gas) combined.[13] There are an estimated 40 trillion cubic feet of gas hydrates off the coast of Japan, which is close to commercializing this resource.[14] This year Japan successfully extracted natural gas from methane hydrates off its coast, and Japanese officials intend to establish methane hydrate production technologies for practical use by 2018.[15]

Japan, Taiwan, and South Korea are the traditional backbone of LNG exports. If Japan becomes less dependent on foreign natural gas – or, indeed, self-sufficient – global LNG prices will likely plummet.

Even without the development of methane hydrates, the global supply of LNG could overtake global demand before BC is able to get projects online. A leading international energy consulting group[16] projects that the global supply of LNG could overtake demand from large Asian importers (e.g. Japan, South Korea, China) as early as 2017.[17]

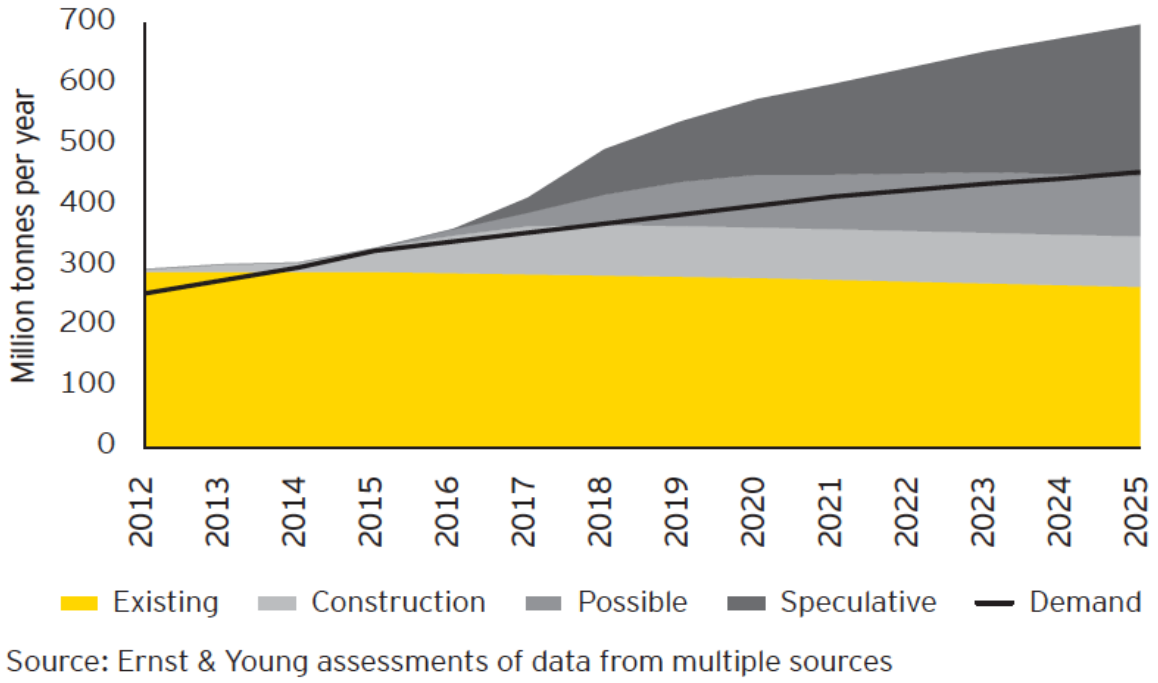
Even with the inclusion of incremental demand from potential new Asian markets such as Vietnam, Bangladesh and the Philippines, the global supply of LNG is expected to remain in surplus of global demand through 2020 and possibly even through 2025 as new supply projects emerge in North America and East Africa.[18]

This analysis is corroborated by a 2013 Ernst & Young analysis. Ernst & Young projects that global LNG supply provided by existing projects and projects currently under construction will overtake demand for the period between 2015 and 2017, and the market will only permit more supply-side growth after 2018.[19] If all the *possible* LNG projects are built – and BC's projects are surely in this category as we have yet to begin large-scale construction – then the global supply of LNG surpasses global demand around 2015 – and demand does not catch up again until 2025.[20] If, in addition, all the *speculative* projects are built, then global LNG supply remains far above demand from

2015 to 2025, and shows no sign of returning to equilibrium.[21] See Ernst & Young's graphic analysis in Figure 1.

From the point of view of *possible* BC projects, this analysis implies that BC-sourced LNG could be sold into a buyers' market until 2025. Such markets are characterized by fierce competition between sellers and falling prices.

Figure 1. Global LNG capacity and demand[22]



Source: Ernst & Young assessments of data from multiple sources

At this point, only one small BC project – Douglas Channel LNG/BC LNG Export Co-operative – is likely to be online before 2017.[23] The Province's LNG Strategy document aims to have another two LNG facilities operating by 2020.[24] And even this timeline could well be delayed by circumstances.

The point is not whether we will see a worst case scenario in which:

- global supply for LNG outstrips demand by 2017, when BC LNG begins to go online;
- Japan begins large-scale commercial production of methane hydrates by 2018; and

- BC experiences delays in construction such that our LNG projects come on-line only to find that there is no longer an international market for our product.

The point is that if even one of these risks materializes, we are unlikely to be able to participate successfully in the global LNG market. Thus, we could be left with the bill for extremely costly infrastructure and without customers – or have to grant costly subsidies, tax breaks and loosening of regulations to keep the industry alive.

[**Note:** Because of the high cost of building greenfield LNG projects in remote areas, analysts have pointed out that in order for Canadian LNG to be profitable, the contract price will likely have to be linked to the price of oil.[25] Yet this would require the survival of the "oil-indexed" LNG pricing system – which pegs the price of LNG to the price of oil so that the two prices rise and fall in tandem. However, the coming global oversupply of LNG could make the long-term survival of oil-indexed pricing highly questionable.

Indeed, the managing executive officer of the Japan Bank for International Cooperation has stated that "We [Japan] need some mechanism to make a real adjustment in the market formula… That means we need to decouple the oil price from the gas price." Peter Hughes, a U.K.-based energy analyst, expects oil-indexation to collapse in Asia as it has in Europe, leaving the market to determine the price of LNG.[26] (See Appendix B for a full discussion.)]

Given the above, why are so many LNG projects being announced? It may be that sophisticated Asian buyers are using the projects here to negotiate for better deals from cheaper sources, without necessarily intending to buy LNG from BC.

It is possible that experienced LNG buyers are using the option of imports from Canada and the USA to negotiate better terms in their existing contracts that are up for renewal. For instance, a top industry analyst has recently posed the possible situation: A Japanese buyer may be in the process of renewing a long-term contract with its longstanding Malaysian supplier in the next year or so. As part of their negotiation process, the Japanese buyer may emphasize the point that they have a memorandum of understanding or letter of intent with a BC project in order to improve their negotiation position with Malaysia LNG. In some instances a buyer may sign MOUs for this sole purpose, without having any real inclination to purchase LNG from the neophyte, high-cost North American project.[27] Having many sources of supply available may give purchasers leverage in negotiating reduced prices, increased subsidies, and loose environmental regulations.

Can We Control Costs Sufficiently to Be Competitive?

In addition to the uncertainties regarding LNG prices, BC will face uncertainties about whether it can keep its LNG *costs* down. The viability of the Australian LNG industry is threatened today because of its runaway costs, and BC must examine whether it may face similar challenges – and develop strategic responses to those challenges.

Australia has been at the vanguard of LNG development and exports. However, the boom in Australia has caused Australian LNG projects to become the most expensive in the world, plagued by cost overruns.[28] Pell-mell development like BC's has driven up industry's costs – and is making the Australian industry far less competitive. Indeed, higher prices are now costing Australia new LNG contracts. Korea recently cancelled $60 billion in Australian LNG development.[29]

Reasons for Australia's skyrocketing project construction costs include:

a) Shortages of skilled labour, experienced subcontractors, and specialist suppliers;
b) The strong Australian dollar;
c) Regulatory burdens;
d) The challenges of developing remote areas with limited existing infrastructure and access to equipment and skilled personnel; and
e) Unnecessary duplication of infrastructure.[30]

Many of these factors that drive Australia's costs to uncompetitive levels also apply to BC – leaving us at risk of becoming another producer with an uncompetitive cost structure.

For example, like Australia, BC faces a shortage of skilled labour in the oil and gas industry, one that is likely to be exacerbated as the oil patch moves to triple its current production by 2030.[31] The oil sands expansion will also increase competition between gas and oil sectors for experienced subcontractors and specialist suppliers. Like Australia, BC's natural gas reserves, proposed pipeline routes and liquefaction plants are also located in remote areas without existing infrastructure. In a further similarity to Australia, Canada has a strong dollar.

However, one key cost factor that we may be able to control is to avoid building redundant infrastructure. We can learn from the Australian experience:

Planning to Eliminate Redundant Infrastructure Costs

In Queensland, Australia, up-front planning to prevent redundant infrastructure didn't take place -- and that added enormous costs to LNG production. For example, three LNG plants were built in one location by three different companies – each with its own separate pipelines. This caused unnecessary environmental *and* economic damage.

As the *Financial Times* described it:

> *The result has been costly duplication of facilities and services...Analysts estimate BG (British Gas), Origin and Santos could have saved billions of dollars by merging two of the three ventures, all of which have experienced cost overruns and are forecast to deliver meagre returns to shareholders.*[32]

The Vice-President of Santos has admitted that they missed an opportunity when the companies decided not to get together to build one plant.[33]

If we want to avoid overbuilding expensive and redundant infrastructure, Canada should examine the measures taken by the State of Western Australia to prevent duplicating infrastructure. Midway through the 2000s, several multinational companies approached the State Government seeking to process natural gas from the Browse Basin in various separate onshore facilities. The State Government, however, "recognised that it was in the best interest of the pristine Kimberley environment to choose one location at which multiple companies could establish gas processing facilities."[34]

The State Government intended that the common-user infrastructure would reduce costs – and minimize impacts on the environment and on indigenous peoples.[35] As stated in the *Final Site Evaluation Report*:

> *The establishment of a single LNG processing precinct on the Kimberley coast is intended to provide the location and common-user infrastructure required to ensure the efficient development of the Browse Basin gas reserves,* ***the ability to prevent the costly duplication of ports, airports and accommodation, and a means to limit environmental and heritage impacts on the Kimberley.***[36]
>
> [emphasis added]

The vision was that the location chosen would allow different companies to share common-user facilities such as the port, roads, infrastructure corridors and workers' accommodation.[37] There was no requirement to share "process critical infrastructure,"

but an expectation that the overall footprint of the common-user precinct would be minimized.[38]

Clearly, there are pragmatic ways to develop LNG infrastructure efficiently, reduce duplication and cost, and make the industry more competitive. But – as Australia learned through costly experience – *ad hoc* and unplanned development is unlikely to achieve such efficiencies.

Instead of simply reacting to a series of one-off LNG proposals, BC needs to step back and take a hard look at the big picture. It's not enough to do individual environmental assessments on one project at a time. We need a Strategic Environmental and Economic Assessment to consider:

- Should we allow numerous pipelines to cross the province by different routes – or establish a single pipeline corridor? Restriction to a single corridor would reduce environmental impacts.
- Can redundant processing facilities be shared or rationalized?

Given economic circumstances, should the province subsidize this industry – or grant them special tax breaks?

As discussed, BC's LNG development is taking place in a rapidly changing global natural gas industry, where the market may well collapse before we can get to it. The financial risks are enormous. These financial risks matter to British Columbians because we may end up subsidizing the LNG industry through:

- tax breaks,
- subsidies, and
- Government clean-ups of the mess the industry may leave behind.

Subsidies to the oil and gas industry are common. An analysis of a recent study by the International Monetary Fund (IMF) reports that in Canada, the oil and gas sector received $26 billion on energy subsidies in 2011.[39] The Canadian government's revenues were $665 billion in that year. In other words, an amount equal to 4% of government revenues was expended on energy subsidies.[40]

There is a substantial policy question as to whether the Province should provide subsidies and other concessions to LNG development, which is a risky industry that may well fail. Yet the Province has already sought special tax treatment for provincial

LNG development. The Province recently supported the Canadian Association of Petroleum Producers (CAPP) in lobbying the federal government to give the industry a substantial tax write off for the construction of liquefaction plants.[41] Minister Coleman wrote to Minister Flaherty in December 2012, saying that the province needed this tax write off to out-compete other countries "in the global LNG race."[42]

CAPP and the Province sought to change the tax classification of liquefaction plants from "transmission plants" to "manufacturing plants" so that they could get a 30% declining balance as their annual capital cost allowance, rather than their current 8% declining balance.[43] This would amount to a very large subsidy for LNG plants, perhaps as much as $2 billion.[44] In the case of actual manufacturing plants, such as automobile plants, the rationale is that this generous write-off is compensated for through job creation.

However, according to one estimate, the LNG industry may create less than 1000 permanent jobs in BC.[45] [Last year the government commissioned a report that assumed that three LNG plants would be operational by 2020. This report projected 800 long term operational (i.e. permanent) jobs and 9,000 construction jobs.[46] Note, however, that the Petroleum Human Resources Council of Canada has just issued a far more optimistic job estimate, based on an assumption that five LNG plants will be operational by 2021.[47] This assumption is extraordinarily optimistic.[48]]

In March, Finance Minister Jim Flaherty rejected British Columbia's request for a subsidy.[49] Federal Heritage Minister James Moore of BC explained that the requested tax break was simply not affordable.[50] The provincial government would do well to follow the federal lead. As the Oxford Energy Group put it:

> *It is absolutely true that producers need to decide whether the price they will receive for producing and exporting their commodity will result in a profit which they believe reflects the value of their resource. What is not true is that producers should be guaranteed a return on their investment; in a market nobody is guaranteed a profit on their investment, they need to make judgements and take risks.*[51]

The Strategic Assessment needs to examine whether subsidies and special tax breaks are warranted for this industry, in the circumstances. *The Assessment needs to determine whether it is worthwhile for British Columbians to invest their tax dollars in LNG development.*

If it is determined that British Columbians should subsidize the industry, mechanisms should be considered to ensure that taxpayers enjoy a fair share of profits that may

result from tax investments – so that they are not just taking the risks, but also sharing in profits.

If the new LNG industry fails, who will pay for cleanups of abandoned sites?

In analyzing the economics of LNG development, the Strategic Assessment needs to consider the possibility that economic failure of the industry could saddle taxpayers with extensive clean up costs and other long-term liabilities for sites abandoned by bankrupt companies. We need to learn from experience – BC taxpayers already face approximately $650 million in such liabilities for abandoned resource sector projects, including many oil and gas sites.[52]

The Assessment needs to examine measures that could be taken to protect taxpayers from having to assume massive liabilities for cleanups. The form of adequate bonding and security for cleanup costs must be considered if development is to proceed.

Could the new industry negatively impact BC consumers - and other industries?

Finally, in considering economic issues, the Assessment should examine potential negative economic impacts on other sectors of society. For example, it is quite possible that development of this LNG export industry could cause massive price increases for British Columbia homeowners.

The Assessment must consider the potential impact that a sudden, large-scale increase in exports could have on the domestic price of natural gas – which could rise and seriously impact homeowners across the Province. In Australia, for example, natural gas prices for local users rose dramatically in regions that are pursuing LNG export – to a price four times that in the rest of the country.[53]

One NEB assessment questioned whether massive exports of LNG would similarly raise BC domestic prices towards the level of Asian prices.[54] However, the province's largest domestic natural gas distributor has acknowledged the possibility that exports could drive up natural gas prices for BC consumers. In letters to the National Energy Board in 2012, FortisBC warned that gas prices in BC could rise as in Australia. Fortis warned that exporting LNG raises "the potential for negative price impacts and increased transportation costs that could arise."[55] Fortis added: "There is currently considerable uncertainty how the proposed LNG export projects will impact the regional pricing of natural gas and the utilization of existing pipeline infrastructure in

BC, which could reduce liquidity and give rise to price disconnects at BC market hubs."[56]

This needs to be studied carefully – before millions of British Columbians are potentially affected.

In addition, the Assessment should examine potential negative economic impacts on other industries that rely on wilderness and an intact environment. For example, the Assessment must also consider LNG developments' potential negative impacts on the Wilderness Tourism industry, which employs 40,000 people and is worth $1.5 billion a year – and on the critical commercial and sport fishery, etc, as discussed in Appendix C.

Furthermore, the externalized impacts of greenhouse gas emissions could cost society many billions of dollars. This issue needs to be carefully examined.

KEY ENVIRONMENTAL QUESTIONS

Background

The development of numerous LNG projects will have broad-ranging cumulative impacts. Such development will require:

- Dramatic expansion of the gas extraction industry and fracking in Northeast British Columbia
- Construction of pipelines across the Province
- Construction of large industrial sites for liquefaction of the gas on the Coast
- Production and use of massive amounts of energy to power the liquefaction plants
- Construction of port facilities for shipping

Environmental concerns associated with the proposed projects include:

- Greenhouse Gas Emissions and the overall contribution of the projects to climate change
- Habitat fragmentation due to development of pipelines, roads, and transmission lines
- Disturbance of streams and fish habitat by pipelines, transmission lines, service roads, etc.

- Risks posed to threatened Grizzly populations by providing easier access to hunters
- Risks to caribou and other wildlife
- Environmental impacts of producing the massive amount of energy required to operate liquefaction plants
- Air and water quality issues, and related human health issues.

A Preliminary Point – The Need to Assess Overall Cumulative Impacts

A Strategic Environmental Assessment is necessary to get a true picture of the overall impacts of all of this development – development which the current hodgepodge of individual approval processes is unlikely to adequately assess. We need an overall assessment to capture such global impacts.

An SEA would allow for an assessment of the cumulative effects of all the proposed LNG projects. Individual, project-level environmental assessments (EAs) provide insufficient guidance on how to avoid overloading the environment.

This is so because an individual project may not do irreversible damage to a given environment -- but the combined effects of many projects could push the surrounding environment past a tipping point. Beyond the tipping point, irreversible damage is done and the land may be rendered incapable of supporting the ecosystem and lifestyle that once existed upon it.

The Forest Practices Board (FPB) has repeatedly warned against proceeding as though projects exist in isolation from one another and from past developments: As the Board has stated:

> *[A]ll effects are cumulative effects simply because all effects accumulate – through time and over space... The critically important point is the need to assess the aggregate stresses acting on environmental values.*[57]

The FPB identifies two important aspects of cumulative effects that are relevant in this case. First, "A series of individually insignificant effects can accumulate to result in a significant overall effect."[58] For example, an individual gas well project in the Northeast may have small impacts – but a thousand new gas wells can transform an ecosystem.

And second:

> *The cumulative effect of stressors on the environment may be more than the simple sum of the individual stressors. For example, a fish population may be able to cope with an industrial pollutant when there is plenty of water to dilute it and they may be able to cope with low water levels resulting from an industry that withdraws water, but the fish are unable to cope with the combined effects of both stresses.*[59]

For example, the Board concluded that the cumulative impacts of decades of industrial development and, potentially, climate change in the Peace Region already stress boreal caribou populations.[60] Adding further stressors in the form of well pads, pipelines, roads, or power lines will likely drive caribou populations closer to extinction.

A Strategic Assessment creates a mechanism to consider the effects of all the proposed LNG projects together, and also their interactions with pre-existing developments. This information is essential to responsible, long-term land-use planning in BC.

Greenhouse Gas Emissions – What Will the Overall Impact Be on Climate Change?

Boosting gas production could violate BC's legal commitments to reduce greenhouse gas emissions – perhaps unwise as climate change floods both Calgary and Toronto. Expanding LNG will increase BC's production of fossil fuels – and will thus add to the creation of GHGs.

However, although Government acknowledges that BC LNG may produce additional fossil fuels, it argues that the LNG will help replace the use of coal in China. Since coal produces higher end-use CO2 emissions than natural gas, Government argues that BC LNG may provide a net global benefit on greenhouse gases.

However, this claim is questionable, and needs to be carefully weighed by a Strategic Environmental Assessment. It will be more efficient to determine this critical issue in one strategic process, rather than deal with the issue piecemeal in a series of individual Environmental Assessments.

It is true that natural gas is the cleanest burning of the fossil fuels – at the end-use stage. However, there is evidence that the process of fracking shale gas may have an extraordinarily large GHG footprint because of methane release during production and other factors.

A peer reviewed study by Cornell University professors published in *Climatic Change* found that the lifecycle GHG footprint for shale gas is greater than that for conventional

gas or oil when viewed on any time horizon, but particularly so over 20 years. According to this study, the footprint of shale gas is at least 20% greater than *coal* – perhaps more than twice as great on the 20-year horizon and comparable when compared over 100 years.[61]

Industry and some academics challenged the Howarth study's findings, but the critics own research has been challenged as outdated.[62] And indeed, the first field-based, peer reviewed study of lifecycle GHG emissions from shale gas – led by researchers at the National Oceanic and Atmospheric Administration (NOAA)[63] – appears to support the approach of the Cornell study. The field-based study estimated that the natural-gas producers studied were losing about 4% of their gas to the atmosphere – not including additional losses in the pipeline and distribution system.[64] This is more than double the official inventory, but roughly in line with estimates made by the Cornell team. Last year the journal *Nature* stated that the NOAA investigation:

> *…has now produced the first hard evidence that the cleanest-burning fossil fuel might not be much better than coal when it comes to climate change.*[65]

Even if shale gas turns out to be cleaner than other fossil fuels, the argument that LNG will displace dirty coal in China is questionable. While it is true that unconventional natural gas from BC *may* be used in China to displace dirtier-burning coal, BC has no control over Chinese domestic energy policy. Further, given that China's coal market is seven times larger than the total global LNG market, the idea that BC LNG could make a significant dent in Chinese GHG emissions bears questioning.[66]

Indeed, Mark Jaccard, former head of the BC Utilities Commission, has said that the provincial LNG Strategy:

> *…is helping to destroy the planet… deluding voters into thinking that somehow natural gas will decrease greenhouse gas emissions in China. It won't.*[67]

Of course, even if there were a guarantee that Asian consumers would substitute natural gas for coal, it would not reduce global GHG emissions if the Cornell scientists are right about the massive GHG footprint of shale gas.

A Strategic Assessment should study the lifecycle GHG emissions of developing our shale gas for export, to determine what impact a vast expansion of the LNG fossil fuel industry is likely to have on climate change.[68]

Impacts of Pipeline Corridors

Proposed LNG development across BC and on the coast includes: transmission pipelines, compressor stations (typically installed at intervals of approximately 48 to 112 kms along the pipeline),[69] roads, processing plants, and shipping.

Impacts on Wilderness

The new pipelines and related roads will inevitably traverse currently undeveloped areas. Just as one example among many, the "latest proposed route for the Spectra pipeline traverses the Babine River watershed through unroaded wilderness"[70] north of lodges and guided steelhead fishing areas. The wilderness experience and the fish and wildlife populations are main tourist attractions in that area.

Impacts on Fish and Streams

The multiplicity of pipelines proposed by LNG developers will have to cross streams to carry their product from the gas fields to the coast. Given that the proposed Northern Gateway Pipeline would cross at least 785 BC waterways en route to the coast, and given the number of natural gas pipelines proposed, we can conservatively estimate that proposed LNG pipelines will involve several hundreds of stream crossings.[71] A number of these streams will be salmon-bearing.

Construction

Pipeline construction can cause short pulses of acute physical and water quality impacts.[72] The main physical impacts are sedimentation and increases in total suspended solids (TSS) due to trench excavation, disposal of fill, erosion and run-off from adjacent worksites. In addition, fluid discharge from trench dewatering and pipe testing contribute to sediment load. Stream cover and channel morphology changes due to pipeline construction can also have adverse environmental effects.[73]

Construction disturbs channel beds and banks, thus increasing the suspension and deposition of sediment.[74] Sediment is released particularly during road building and road washouts. Sediment and increased turbidity in streams compromises "the integrity of the physical and chemical nature of fish habitat."[75] It affects fish behavior and physiology: sediment can increase stress; cause gill damage; disturb growth; reduce feeding success; change social behaviour and movement; increase susceptibility to disease; degrade spawning habitat; impair egg and larvae development; and reduce fry emergence.[76] Sediment can restrict light penetration, thus reducing the number of plants and the amount of habitat available for insects that fish eat.[77] [78] Salmon are particularly

sensitive to sediment increases. Recurring stress on fish may also have cumulative effects on their health, survival and reproduction, the long-term effects of which are not certain.[79] The higher the sediment concentration and the longer the exposure, the more detrimental the impacts will be to fish populations.[80]

Once the pipeline construction is complete and the associated road network developed, fish are mainly impacted by:

- Increased access by human anglers; and
- Increases in stream temperature due to decreased stream shading.

Building roads and pipelines will require cutting down vegetation cover near rivers and streams. This, in turn, increases water temperatures.[81] Even small increases in water temperature can negatively affect fish. Exposure to temperatures of 22-24 Celsius degrees over a few days can be fatal to salmon, and death is almost certain within a few hours of exposure to temperatures above 24 Celsius degrees.[82]

Leaks

During the operation of gas pipelines, leaks are common.[83] Condensate (a liquid form of raw natural gas) can spill from pipelines into surface water. "Condensate contains a number of chemicals known to cause cancer, and many other severe illnesses".[84] Sour gas (described below) can leak from pipelines, causing health problems and forcing evacuations. For example, just last month sour gas was reported to have leaked from a pipeline in Alberta.[85]

Cumulative Effects

A single stream crossing properly constructed may not have substantial impacts on fish and their habitat.[86] However, cumulative effects may stem from the construction of multiple crossings of a river or stream system, or from frequent crossing construction within the same system. These effects join forces with cumulative effects from other stressors, including forestry, hydro-electricity, transportation, agriculture, mining, mountain pine beetle (which reduce tree cover), climate change, and other fossil fuel exploration. In some cases, "the capacity of the system to recover from impact may be exceeded."[87] A strategic assessment is the best tool available with which to assess the cumulative impacts of pipelines and other development on fish habitat.

Impacts on Grizzly Bears – A Particularly Important Issue

Pipelines and related road construction may be particularly harmful to grizzly bear populations, as the developments clear areas that attract the animals to forage and travel – and simultaneously provides hunters with vehicle access to the bears.

Grizzly bears are on Appendix II of the Convention on the International Trade in Endangered Species (CITES), and are listed by the World Conservation Union (IUCN).[88] Grizzlies are noted as being of special concern on both COSEWIC and *Species At Risk Act* lists.[89] British Columbia has around 15,000 grizzlies, the healthiest populations of which are located in the north central and northern regions of the province.

Grizzly bears require large areas of connected habitat to sustain populations long-term. Individual bears must be able to move freely among valued habitats, free of human-built obstructions. Areas with lower levels of human development foster more efficient use of high-quality habitat in grizzlies.[90]

Human-caused mortality is the top threat to grizzly bear populations.[91] Human-caused mortality arises from various factors including habitat loss and fragmentation,[92] hunting and poaching,[93] collisions on major roads, destruction of bears involved in human-bear conflicts, social disruption between bears when some begin avoiding habitat near new roads.[94] Noise during pipeline construction also poses the risk of scaring bears and making habitat unsuitable for bears, at least temporarily.[95]

A study in the Kakwa area showed that grizzlies used roads, road-pipeline combined right-of-ways, and pipelines significantly more than expected. The bears likely used the pipeline right-of-ways for both foraging and travel.[96]

Yet it is dangerous for bears to use such roads and right of ways. Studies show that most grizzlies are killed within 500 metres of a roadway, and that 89% of human-caused grizzly mortalities occur within 500 metres of a road on provincial lands.[97] While it may be possible to restrict or close human access to roads, attempts to do so are not always effective.[98]

Construction of new roads and motorized access routes also displaces grizzly bears from high-quality habitat. Human infrastructure may lead female grizzlies in particular to "underutilize productive habitat." Habitat fragmentation due to roadway expansion will "…impede the persistence or recovery of a grizzly bear population, because small isolated populations are more likely to become extinct or extirpated."[99] This is

problematic because grizzlies reproduce slowly, and can therefore withstand only a very low mortality rate.[100]

Impacts on Caribou

Development of a number of new cross-provincial pipelines and rapid expansion of natural gas extraction operations in the Northeast gas fields may also put endangered and threatened caribou at risk.

Based on government maps of caribou ranges[101] and a map of current LNG development proposals contained in a recent Fraser Institute Report,[102] it appears proposed gas pipeline development will impact caribou in BC.[103] Environment Canada has recommended assuming there will be impacts on caribou in disturbed areas plus a 500 metre buffer. That area would best represent "the combined effects of increased predation and avoidance on caribou population trends at the national scale."[104] However, the "effect of anthropogenic disturbance on boreal caribou can extend up to 14 kilometres."[105]

In north eastern BC, over 75% of boreal caribou range is already tenured and being developed for petroleum and natural gas. This level of activity is reported to exceed a disturbance threshold in 12 of 15 Core Habitat areas, a point at which "caribou populations achieve negative population growth."[106] One projection has suggested that if no management actions are taken, the current boreal caribou population will decline and have over a 60% probability of becoming extirpated in all but one range within 50 years.[107]

Caribou are of special concern to BC, specifically the endangered Woodland Caribou, Boreal population,[108] and the threatened South Peace Northern Caribou[109] and Southern Mountain Caribou.[110] Caribou are "integral to the culture, identity and survival" of several of BC's aboriginal communities.[111]

Caribou require large continuous tracts of rich, undisturbed habitat. "The primary threat to most boreal caribou local populations is unnaturally high predation rates as a result of human-caused and natural habitat loss, degradation, and fragmentation." [112] Habitat loss results when areas are permanently changed, *e.g.*, by well pad sites, cleared areas, etc. For example, caribou are known to avoid cleared well pads and roads.[113] Habitat degradation occurs when the habitat quality of an area is reduced, for example by seismic line development.

Habitat fragmentation occurs when linear development dissects habitat, for example through road and pipeline construction. Fragmentation changes the way caribou use the habitat or can result in a negative impact on the overall condition of a local population.[114]

Other potential impacts to caribou from LNG development include pollution, noise and light disturbance and vehicle collisions.[115] Many of the threats to caribou are related and may interact, "in which case they can have cumulative impacts that may not be evident when threats are examined individually."[116]

Other Potential Environmental Impacts on Northeastern BC

A Strategic Assessment must examine the widespread environmental impacts that expansion of natural gas production in Northeast BC will create in that Region. This gas producing region will face dramatic impacts from expansion of the industry – which could include over 6,000 new gas wells, along with necessary pipelines and other facilities.[117] Below are some of the key concerns:

Water Supply

Expanding gas extraction activities will likely impact the availability of clean water for human and habitat uses:

- Seismic exploration, drilling, road freezing, washing, extraction and processing of proppant sands, testing of pipelines and especially fracking, all require water. Each LNG well can use almost eight million gallons of water, and each well pad contains 10 to 16 wells.[118] Most of the water used for fracking flows back to the surface, but is not currently treated and cannot be returned to its source.[119]
- If a number of LNG plants are built, that will require the use of vast amounts of water in the gas fields. Encana, in response to a written request for information from the federal Select Standing Committee on Natural Resources, reported using 1,488,560 cubic metres of water at 14 gas wells all located on one pad and all fracked in late 2010 and early 2011. A total of 316 separate fracks were required to complete the job, meaning that each well required 106,325 cubic metres of water to frack. A recent National Bank information circular pegs the combined impact of 4 LNG projects in the province would be the drilling of another 6,500 gas wells. Assuming that the Encana experience is roughly indicative of what would occur moving forward, that means the industry will need to use and render toxic more than 691 million cubic metres of water.[120]

- Massive water withdrawals from north eastern BC's surface and groundwater resources could diminish drinking water and hydroelectricity sources. Watershed ecosystems could be disrupted, impacting wildlife habitat and humans who eat wildlife.[121]

Water Quality

Expanded natural gas extraction activities will likely impact water quality in the Northeast. For example, many studies have shown that contaminants used as part of gas extraction development can end up in drinking water and the environment, and can cause significant health effects:

- The chemicals injected into the ground during fracking can contaminate surface and groundwater drinking wells and habitat.[122] The chemicals include known carcinogens and regulated toxins.[123] Health effects associated with these chemicals include cancer; liver, kidney, brain, respiratory and skin disorders; and birth defects.[124]
- "Produced water" also returns to the surface with the flowback fracturing fluids. Produced water can contain high concentrations of salts, naturally occurring radioactive materials, arsenic, benzene and mercury.[125] In BC, this waste water is commonly disposed of by injection into former well sites or tailings ponds, which can lead to contamination of water sources.[126]
- Proximity to a gas well was a highly significant predictor of concentrations of "stray gases" including methane, ethane and propane found in the drinking water of 141 wells tested in northeastern Pennsylvania.[127] Residents in the United States where fracking occurs have reported methane concentrations so high they can light their tap water on fire, and it has exploded drinking water wells and entire houses.[128] "[N]aturally-occurring groundwater constituents, such as iron and manganese, ... may form particles in water wells that are released (resulting in change in color and increased turbidity of drinking water) as a result of vibrations and pressure pulses associated with nearby shale gas drilling operations."[129]
- Well blowouts can also result in leaks of drilling fluid and formation water into surface water resources. Spills are inevitable and have caused hospitalization due to contaminated drinking water.[130] A 2011 Environmental Protection Agency study in Wyoming noted observations of a sheen and odor from drinking water wells and found contamination including several components of fracking additives such as benzene. The study concluded that "constituents associated with hydraulic fracturing have been released into the Wind River drinking water aquifer at depths above the current production zone".[131] Pits used in that area to

> dispose of drilling cuttings, flowback and produced water were one source of contamination of shallow monitoring wells. Methane from the natural gas reservoir was also found in seven of the tested drinking water wells.[132]

According to one source, more than 1,000 cases of water contamination have been attributed to hydraulic fracturing operations by courts and state and local governments in the United States.[133]

Air Quality

Expanded natural gas development will likely impact air quality in Northeast BC. The following health and environmental concerns arise regarding air emissions from the gas industry:

- Local residents are extremely concerned about acute and chronic effects from sour gas releases. The production of natural gas often results in hydrogen sulphide (H_2S), or "Sour Gas".[134] Small amounts of Sour Gas are normally released slowly, and larger amounts can accidentally be released.[135] According to the Oil and Gas Commission, energy companies reported 73 sour-gas leaks between 1999 and 2004.[136]
- Sour Gas is as toxic as cyanide and was used as an agent of chemical warfare in World War I.[137] At 100 parts per million (ppm), Sour Gas destroys sense of smell and is "immediately dangerous to life and health".[138] Sour Gas triggers respiratory paralysis and unconsciousness at 500 ppm, and is immediately fatal at 1000 ppm.[139] These levels have already been exceeded in leaks in north eastern BC, including one leak in February 2001 which killed a young man.[140]
- Sour Gas is also found along with carbon disulphide (a hormone-disrupter).[141]
- Several European and United States studies indicate Sour Gas and its sulphurous companions may be potent neurotoxins and fetus-aborters in levels as small as 1 ppm.
- One 1999 study by a Texan researcher found that residents living downwind from a Sour Gas producer showed central nervous impairment at just 10 parts per billion.
- People who repeatedly inhaled 5 ppm of Sour Gas or less showed permanent deficits in balance and reaction time or complained about dizziness, insomnia and fatigue.
- Dr. Kaye Kilburn, an expert in chemically induced brain injuries at the University of Southern California, states that "even at levels as low as 1 ppm, H_2S is insidious and cumulative and irreversibly damages the brain."[142]

- The hazard zone for sublethal effects around Sour Gas wells encompasses from less than 400 meters up to 6500 meters, while lethal exposure to hydrogen sulfide could occur as far as 2000 meters from the source."[143]

There are numerous reports of accidents involving Sour Gas which have had serious consequences:

- Uncontrolled releases of Sour Gas from well heads have killed and seriously injured people; caused deaths, birth defects or miscarriages in cattle; forced people to abandon homes in the night; and led to at least one school district's decision to station buses outside an elementary school in case of a sour gas leak.[144]
- In China, Sour Gas turned an area of 25 square kilometres into a death zone, killing 243 people, poisoning another 9000, and leaving many survivors with reduced life expectancies and chronic respiratory problems.[145]
- In November 2009, failed piping at a gas well in BC's Peace region spewed 30,000 cubic metres of gas into the air. The estimated eight-hour gas leak forced the evacuation of 18 residents, killed a horse and resulted in at least one emergency hospitalization.[146]
- Over the last three decades, Sour Gas leaks, flares or emissions have reportedly killed at least 34 workers in Alberta and BC, and disabled hundreds more.[147]

In addition to concerns about sour gas, air emissions from gas operations raise other concerns:

- Exposure to air polluted by flaring has been linked to cancer and other diseases. SO_2 is a powerful respiratory irritant which can injure or kill.[148]
- Studies in Alberta have found a connection between beef herd proximity to flare sites and increased incidences of reproductive complications.
- Air emissions from sweet gas production contain massive amounts of benzene, and also contain toluene, xylene and highly toxic dioxins.[149]
- Shale gas activities release toxic VOCs (typically benzene, toluene, ethylene, and xylene). VOCs are released in a form of aerosol due to incomplete combustion, and can be transported up to a hundred kilometres on ambient wind.[150]
- VOCs releases are precursors to smog[151] and extremely carcinogenic. Toluene is carcinogenic and a potent central nervous system toxicant. [152] Xylenes are developmental toxins leading to delayed development, decreased fetal body weight and altered enzymes.[153] Benzene is a class 1 carcinogen with zero recommended exposure and acknowledged health risk at any level of exposure.

- Natural gas flares emit carbon particles (soot), unburned hydrocarbons, carbon monoxide, other partially burned and altered hydrocarbons, nitrogen oxides and sulfur dioxide (SO_2).

Land Impacts

Expanded gas extraction will affect the land in northeastern BC:

- The Peace Region is already subjected to many industrial-caused changes and is now dominated by a growing patchwork of agricultural fields, clearcuts, seismic lines, petroleum and natural gas wellsites and facilities, mineral developments, roads, transmission lines and pipelines.[154] A recent study found that approximately 70% of the Peace Region is disturbed.[155]
- The Beatton and Upper Peace-Kiskatinaw watersheds have less than 6% remaining intact forest landscapes.
- The clearing of undeveloped natural lands for well pads, transportation and any power lines required to power these projects will result in further loss and fragmentation of wilderness, wildlife habitat and agricultural land.[156]
- Loss of agricultural land and contamination of wildlife and livestock used for consumption will impact the long term food security of the region, particularly if the proposed Site C dam is built.
- The BC Oil and Gas Commission found that fracking caused minor earthquakes in the north east of British Columbia in 2009 to 2011 and recommended further study and monitoring.[157]

Wildlife Impacts in the Northeast

Wildlife may be impacted by water use, habitat loss and fragmentation and environmental contamination arising from natural gas industry activities.

Twelve species of sport fish live in the Peace Region, including mountain whitefish, Arctic grayling, char, rainbow trout, lake whitefish, walleye, bull trout, Kokanee, and northern pike. Nine groups of fish species have been identified as being "of management concern" in the McKenzie River drainage in northeastern BC.[158] Unfortunately, fish are particularly sensitive to gas extraction developments:

- Fish and other aquatic life may suffer from decreased stream and lake flows due to water extraction.
- Fish kills may result from fracturing fluids spilling into wetlands and creeks.[159] [160]

- Fish are sensitive to increased sedimentation, which can cause stress, reduced feeding success, respiratory problems and habitat degradation. Sedimentation may also result in reduced growth, delayed hatching and increased predation of fish fry.
- Altering the landscape around water bodies, for example by deforestation to build a well pad or access road, will increase the amount of light reaching the water and increase water temperatures, as well as decrease habitat for insects that fish rely on for food.[161]

Other Wildlife

Chronic exposure to oil and gas development can lead some species to experience ongoing stress which can impact the ability of entire populations to survive.[162] This is problematic, since:

- BC had identified over 250 species of plants, animals and insects in the northeast to be at risk, and approximately 30 of those species need riverine type habitat.[163]
- Marshes in the region provide important habitat for nesting and migratory waterfowl.
- Some of the songbirds that regularly migrate through the area are rare in the rest of British Columbia.
- There are extensive areas of critical ungulate wintering habitat along the south-facing banks of the Peace River and its major tributaries.
- The region is also habitat for grizzly bears and endangered woodland caribou.[164]
- Sedimentation from industrial activities can alter wetland ecosystems and affect wildlife populations that inhabit them, such as moose, an important food source.[165]
- As discussed in relation to pipelines above, increased development of gas wells may provide easier public access, hunting and poaching to at risk populations,[166] such as grizzly bears, a "species of special concern."[167] Segments of the grizzly population in north eastern BC are already becoming genetically separated by manmade barriers.[168]
- Animals such as caribou avoid cleared well pads and roads.[169]
- Wildlife can become sick from drinking wastewater and eating contaminated soil.[170]

These impacts will be more significant if the proposed Site C dam is built to service LNG.

Other Potential Environmental Impacts Related to the Coastal Liquefaction Plants and Ports

The creation of LNG liquefaction plants and ports will raise numerous additional issues, including:

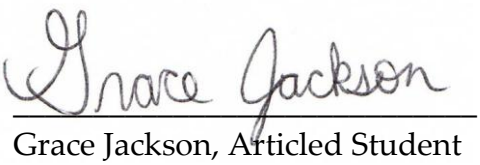
- The massive amount of energy necessary to power LNG plants. A single large LNG plant could take more energy than the proposed Site C dam would produce.[171]
- If hydro is not used to power the plant, then presumably natural gas will have to be burned to power the plant. [172] This will exacerbate GHG emissions. It will also raise concerns about air quality in the coastal community.
- Natural gas fired power plants emit sulphur dioxide, nitrogen and fine particulates. Sulphur dioxide and nitrogen contribute to acid rain and ground-level ozone (smog), which in turn can damage forests and agricultural crops. Smog is linked to a number of respiratory ailments, including premature death and the development of childhood asthma.[173] The U.S. EPA estimates that 77 per cent of particulates from natural gas plants are dangerously small. These fine particulates have the greatest impact on human health because they end up deep in the lungs. Studies have found that there is no safe limit for exposure to fine particulates.[174]
- Of particular concern is the Kitimat airshed. It is one of the most constrained airsheds in the world, and it is already being polluted by the RioTinto Alcan smelter.[175] The government has not studied the local capacity for air pollution from LNG-related projects, but has promised assessment as part of the environmental assessment and permit processes.[176]
- A whole galaxy of environmental concerns arise related to the construction and operation of port facilities and tanker traffic. For example, see Appendix D for a short discussion of how ports and tankers could impact marine birds, whales, and other cetaceans.

Conclusion

In light of the information above, it is clearly in the public interest that a careful Strategic Economic and Environmental Assessment be done before BC creates a massive new Liquid Natural Gas Industry. We respectfully request that you establish such a Strategic Assessment.

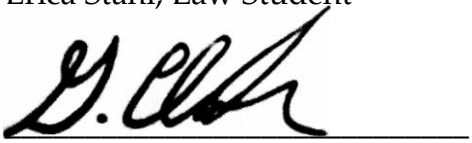
Sincerely,

Calvin Sandborn, Legal Director



Grace Jackson, Articled Student

Erica Stahl, Law Student



Gabrielle Clark, Law Student

APPENDICES

Appendix A:
List of proposed BC LNG projects by level of completion

Ready to go	
1. BC LNG Export Co-Operative (aka Douglas Channel Energy Project)	Douglas Channel Energy Partners, which is a partnership between LNG Partners and the Haisla Nation in British Columbia. Currently, there are 16 members of the Co-operative. All members will be entitled to submit bids to supply natural gas to be liquefied and/or submit bids to purchase all LNG exported by the Co-Operative. The facility is expected to have an export capacity of 0.10 Bcf/day. The NEB granted BC LNG a 20 year licence for the export of 1.8 million tonnes of LNG annually. Recently, Golar LNG, an Asian and Bermuda-based company that runs a fleet of LNG tankers, announced they have purchased a 25 per cent stake in the project.
Environmental Assessment in progress	
2. Kitimat LNG	Apache Canada and Chevron Canada Ltd. each own 50% of this project. The facility is expected to have an export capacity of 0.75-1.50 Bcf/day. In October of 2011 the NEB authorized the export of up to 468 Bcf per year for a term of 20 years. The project is currently undergoing an environmental assessment.
3. LNG Canada	LNG Canada is a JV comprised of Shell Canada, Korea Gas Corporation, Mitsubishi Corporation and Petro China Co. Ltd. On February 4, 2013, LNG Canada received approval from the NEB for a licence authorizing the export of up to 24 million tonnes of LNG per year for a term of 25 years. The project is currently undergoing an environmental assessment.
4. Pacific NorthWest LNG	This is a JV between Progress Energy Canada Ltd. and Petronas. Proposed LNG facility to be built on Lelu Island on land administered by the Port of Prince Rupert, capacity of 1-2 Bcf/day. Construction is anticipated to begin by early 2015, with the earliest LNG shipments to customers occurring in late 2018.On February 19, 2013, Pacific NorthWest LNG submitted their project description to the Canadian Environmental Assessment Agency. Currently CEAA is determining whether an environmental assessment is required for this project.
5. Prince Rupert LNG	BG Group is in the early stages of developing the Prince Rupert LNG project. Recently, BG Group announced its plan to invest $16 billion in the proposed export terminal which is expected to have an export capacity of 3.3 Bcf/day. BG Group has also announced plans to partner with Spectra Energy Corp. to build a pipeline capable of transporting up to 4.2 Bcf/day of natural gas from production areas in northeastern British Columbia to the Prince Rupert LNG facility for export. BG Group has secured an agreement with the Prince Rupert Port Authority to study the feasibility of an LNG export terminal on port lands. Plans call for a final investment decision to come sometime in the next few years. On May 2, 2013 BG Group submitted a project description to CEAA and the British Columbia Environmental Assessment Office.

6. Coastal Gas Pipeline Project	The proposed Project involves the construction and operation of an approximately 650 km long natural gas pipeline 1219 in diameter from near Dawson Creek in northeast BC to the proposed LNG Canada LNG export facility near Kitimat. The initial phase of the Project would have a capacity of 1.7 billion cubic feet (bcf)/day with one compressor station and has provisions for capacity expansion of up to 5 bcf/day with up to five additional compressor stations.
7. Prince Rupert Gas Transmission Project	Prince Rupert Gas Transmission Ltd. is proposing to construct and operate a natural gas pipeline from a point near Hudson's Hope, BC, to the proposed Pacific NorthWest LNG export facility near Prince Rupert, at Lelu Island, within the District of Port Edward, British Columbia. The proposed project involves the construction and operation of approximately 750 kilometres of 48 inch diameter pipeline, metering facilities at the receipt and delivery points, and two compressor stations with provisions for up to six additional compressor station sites to allow for future expansion.
Project partners in place, LNG feasibility studies in progress	
8. AltaGas/Idemitsu Joint Venture	Idemitsu Kosan and AltaGas each own 50% of a partnership to sell BC-sourced LNG and liquefied petroleum gas to Asia. LNG feasibility studies to be completed in 2014 with export terminal in place by 2017 (earliest date). The pipeline will be built by Pacific Northern Gas Ltd, a wholly owned subsidiary of AltaGas Ltd.
Very early stages	
9. WCC LNG Ltd. project	Imperial Oil Ltd. and its parent, Exxon Mobil Corp., are in the early stages of planning a LNG export business from British Columbia. The facility will build on their $3.1 billion acquisition of natural gas producer Celtic Exploration Ltd., as well as gas holdings they already own in western Alberta and in the Horn River shale gas play in British Columbia. The capacity of the facility has not yet been disclosed. As discussed below, Imperial Oil Ltd./Exxon Mobil have recently submitted non-binding expressions of interest to acquire Crown land at Grassy Point, British Columbia for development of an LNG export facility.
10. Nexen/Inpex LNG	Nexen Inc. and a consortium led by Japan's Inpex Corp. have a joint venture to develop unconventional shale gas assets in the Horn River, Cordova and Liard basins in northeastern British Columbia. As part of the joint venture, the partners intend to jointly investigate the feasibility of a potential downstream project, including an LNG export facility.
11. Kitisault Energy LNG Project	Kitisualt Energy intends to establish a LNG export facility at Kitisualt, BC. The plan is in its infancy and Kitisualt Energy has not yet announced export capacity for the proposed facility.

All information in this table from:
BC EAO
CEAA http://www.ceaa.gc.ca/050/index-eng.cfm
Northwest Institute
http://northwestinstitute.ca/images/uploads/LNG-leaflet-Apr2013.pdf
Stikeman Elliott (last updated June 10th, 2013)
http://www.mondaq.com/canada/x/244258/Oil+Gas+Electricity/LNG+Facilities+Under+Development+In+BC

Appendix B:
Oil-Indexed Pricing

Oil-indexed LNG pricing is a relic from when LNG was used largely as a replacement for oil, and when quantities of LNG sold were so small and dispersed that there was little competition within the LNG market.[177] However, the LNG market has grown and increasingly the product can be priced based on its own supply and demand.[178] This has already happened in North America, where the "Henry Hub" in Louisiana provides the base price of LNG for the continent.[179] Hub-based prices are typically much lower than oil-linked prices.[180]

For the last few years LNG has been a "seller's market" where Asian importers, seriously short of domestic energy supplies, were willing to pay high oil-indexed prices – to pay a so-called "Asian premium" for LNG. After the Fukushima nuclear disaster in early 2011, public backlash in Japan against nuclear power forced a policy change towards ever-greater imports of LNG.[181] In early 2012, Japan was paying $18/MMBtu when the North American price was $2-3/MMBtu.[182]

However, the International Energy Agency reports that oil indexation is being increasingly challenged in Asia as we move away from a seller's market.[183] Ernst & Young points out:

> Oil indexation of gas contracts will become more difficult with greater competition between sellers; more price-sensitive buyers; increasing energy deregulation; increasing gas-on-gas competition from new pipeline infrastructure; increasing spot market liquidity; and, most important, increasing availability of spot-price-based LNG exports. Developers of high-cost projects will find it harder to find shelter in bilateral contracts and high-cost sellers will struggle to preserve pricing power.[184]

While there is some disagreement in the literature, high oil-indexed prices may indeed be short-lived. There are three indisputable trends that ought to disturb our complacency around the longevity of oil-indexed pricing. First, all "lower 48" US LNG projects that have signed long-term contracts with Asian buyers have used the lower Henry Hub-based prices.[185] Second, there is rising interest among Asian countries in developing an Asian natural gas trading hub.[186] And third, as mentioned in the main

body of this report, Japan is pouring resources into developing methane and is close to commercialization.[187]

BC will need to ensure that any sales contracts with Asian buyers are set in stone, and avoid making large investments in infrastructure without guaranteed buyers. As Ernst & Young notes,

> High LNG development costs will require ironclad long-term off-take agreements. But more recently, the market is witnessing the inherent conflict of increasingly more expensive projects trying to sell to increasingly more price sensitive buyers. From the supply side, oil is becoming somewhat scarcer while gas is more plentiful. As a result, there is the inherent conflict of persistently high oil prices and a growing surplus of natural gas, with strict oil indexation becoming less tenable.[188]

Appendix C:
Selected Values of Some Industries that Depend on a Natural Environment

According to the Guide Outfitters Association of BC, the guide outfitting industry in British Columbia "directly employs more than 2,000 people and generates about $116 million of economic activity each year. Guide outfitting operations are typically family-run businesses that are several generations old. These businesses are crucial to the health and well-being of the economies of rural communities."[189] Industry revenues were $40 million in 2001 and account for 1727 jobs.[190]

Overall, wilderness tourism in BC is worth $1.5 billion a year and employs 40,000 people, not including the billions of dollars in tourism supply services (hotels, restaurants, transportation, etc) that the sector supports. Tourism in total is worth over $13 billion in revenue and directly employs 132,000 people.[191] There is therefore economic value in maintaining wilderness areas, including viewsheds. A study of one particular BC wilderness resort found that there is a tolerance threshold for negative effects on a viewshed beyond which resort guests would not re-visit a location.[192]

The external costs of the GHG emissions using predictions from the Natural Gas Strategy,[193] would be $25 billion per year in externalized costs on the low end. The higher estimate, based on output of 305 Mt for five major LNG plants, as per current BC government planning, at the top range cost of $500 per tonne implies external costs of $152 billion per year. By comparison, BC's GDP is about $200 billion per year.[194]

Caribou have an incalculable value because of their cultural significance.[195] They also provide revenue in terms of tourism, outfitting and meat processing. Caribou provide food, tools, clothing, learning opportunities, social and cultural activities, an opportunity for language development and other values to aboriginal communities that cannot be adequately substituted.[196] The value of the meat itself has been estimated in the tens of millions of dollars due to shipping costs.[197] However, such estimates ignore the cultural values and the fact that substitutes taste different, are not as satisfying and have different nutritional value. [198] As a very rough estimate, the 18,500 caribou harvested in 2001 from a different Canadian caribou herd were estimated to be worth at least $17 million not including meat processing and uses such as outfitting for non-residents.[199] The value of caribou has been estimated
as:

$$V_b(h) = \max_{x \geq h_e} E\left\{ \begin{array}{c} P_b^{h_e,x}(h)\left[\int_0^{T_b^x(h)} se^{-r\tau}d\tau + e^{-rT_b^x(h)}(V_a(x) - I_a)\right] \\ +(1 - P_b^{h_e,x}(h))\left[\int_0^{T_b^{h_e}(h)} se^{-r\tau}d\tau + e^{-rT_b^{h_e}(h)}\left(\frac{\omega}{r} - I_a\right)\right] \end{array} \right\} \Bigg| h_0 = h$$

However, the existence value of caribou will always be an estimate.[200]

In 2011, more than 100 species of fish, shellfish and marine plants were produced from British Columbia's oceans and fresh waters.[201] The capture fishery GDP was $102.3 million in 2011, representing a 7.4% increase from the previous year. 2,800 jobs were provided by the capture fishery. Revenue rose 4.1% to $344.8 million in 2011. Sport fishing in 2011 represented $325.7 million of GDP, 8400 jobs, and revenue of $936.5 million.[202]

Further reading:
The Economics of Ecosystems and Biodiversity for Business describes natural capital's inclusion in mainstream business practices.

> *Natural Capitalism:* Book frames natural capital as a lens on a new industrial revolution and offers four key principles for businesses.
>
> *The Natural Value Initiative:* Initiative works with the finance sector to identify risks relating to ecosystem services. Reports focus on specific sectors, including agriculture, mining, and pharmaceuticals.

David Suzuki Foundation published a GIS that calculates how much an area is worth in natural capital, although it is only available for the lower mainland: http://naturalcapital.davidsuzuki.org/

Appendix D:
Potential Impacts on Marine Birds and Whales Related to Marine Terminals and/or Marine Transportation

Should plans to export LNG to Asia come to pass, the northwest coast will see a sharp increase in industrial development, port facilities, and tanker traffic. Submissions to the recent hearings of the Enbridge Joint Review Panel (JRP) underscored some of the dangers such activity poses to marine birds and cetaceans. The submissions of BC Nature/Nature Canada to the Joint Review Panel regarding marine birds are reproduced below (with explanatory comments in brackets):[203]

1.1.1 Artificial Light Induced Mortality

[Port facilities and liquefaction plants will very likely be lit up at night.] The negative impacts of artificial lights on marine birds are well documented. Recent reviews list key impacts including increased energetic costs, deviation from normal migratory pathway, delayed migration, circling platforms for extended periods, collision with lighted structures, disorientation and collision with the ground. Red light is exceptionally attractive to marine birds and interferes with the magnetic compass, causing disorientation. Artificial light may also increase the risk of predation of nocturnal species at their breeding colonies and at sea.

[It is not just marine birds that are affected.] Artificial lights may also cause shorebirds to collide with structures, attract them to degraded habitat close to the sources of light and raise their risk of predation.

1.1.2 Collisions with Wires

Collisions by birds with power lines are a cause of mortality in many species. Collisions with power lines and electrocution are major causes of human caused mortality in Bald Eagles. Wires as collision hazards are especially important where raptors concentrate (e.g. salmon streams, at migration or staging areas) and for young birds learning to fly. The Kitimat estuary qualifies as a migration and staging area.

1.1.3 Chronic Oiling

[Tankers carrying LNG can still release oil into the water.] Two major reviews of oil in the marine environment note that non-compliant vessels and accidental discharge from ships and/or coastal facilities (e.g. caused by equipment failure or human error) are sources of chronic oiling. Published estimates of marine bird deaths resulting from

chronic oiling include 21,000 per year on the east coast of Canada and 72,000 annually across Canada.

A review by Camphuysen found that oil rates in seabirds found dead on beaches are highest along shipping lanes: the cluster of oil slicks in areas around the busiest marine shipping was clearly reflected in the oiling rates of beached bird corpses. On the east coast of Canada, Wiese et al. documented impacts of chronic oiling on seabird populations with an emphasis on areas where ship traffic and concentrations of birds overlap.

All information on cetaceans below is reproduced from Raincoast's submissions to the Enbridge Northern Gateway Pipeline Joint Review Panel.[204]

2. Cetaceans

2.1 Vessel strikes
Growing shipping traffic is escalating the risk of vessel strikes on whales and other marine mammals. In addition to the threat from supertankers in and out of Kitimat, expansion of the Port of Prince Rupert and high levels of cruise ship traffic all increase the potential for ship strikes. By 2020, container traffic travelling to Asia from BC is expected to increase by 300 percent from 2007 levels, further increasing the possibility of injury or mortality.

2.2 Chronic ocean noise
Increasing chronic ocean noise levels in important marine habitats. The probable tanker route provides important habitats for several marine mammal species. Chronic exposure to boat traffic and noise can cause killer whales to reduce their time spent feeding.

2.3 Cumulative effects
Concerns for cumulative impacts come from the incremental and combined effects of human activities. Many of the threats to marine mammals are shared across species: low populations from historical hunting, incidental catch from fishing gear, depletion of prey from overfishing, chemical pollution, vessel strikes, and ship noise. The removal of marine species that support habitat structure and food supply, destruction of the seabed, persistent addition of airborne and aquatic pollution, introduced species and diseases, and increased inputs of carbon dioxide to the atmosphere and ocean have all created multiple lines of interacting threats. Acting synergistically, their effect is to compromise ecological processes such as primary production and species interactions, which results in an altered coastal environment.

For example, the absorption of carbon dioxide by the ocean could create noisier oceans. When greenhouse gas reacts in the ocean, it lowers pH, creating more acidic waters. The more acidic the water, the less that sound waves are absorbed. Keith Hester, a researcher with the Monterey Bay Aquarium Research Institute, predicts sounds will travel 70% further by 2050 because of increased carbon dioxide acidifying our oceans. A louder ocean will negatively affect cetaceans that rely on sound to navigate, communicate, find food, and avoid predators.

The importance of regional scale connections for cetaceans and other pelagic marine predators was underscored by a recent study in Nature. A Census of Marine Life field program placed 4,306 tags on 23 different species in the North Pacific Ocean to provide tracking data of unprecedented scale. The results indicate that the California Current large marine ecosystem and the North Pacific transition zone attract and retain a diverse assemblage of marine vertebrates. The report identifies critical habitats across multinational boundaries showing that top predators exploit their environment in predictable ways, further highlighting the need for spatial management of large marine ecosystems

[1] The phrases "strategic environmental assessment", "regional study", and "Strategic Economic and Environmental Assessment" are used interchangeably in this letter.

[2] Note that alternatively the provincial government could ask the Environment and Land Use Committee to conduct the type of strategic assessment requested below, pursuant to s. 4 of the *Environment and Land Use Act*.

[3] Under S. 74 of the *Canadian Environmental Assessment Act* the federal minister is authorized to enter into an agreement with any jurisdiction respecting the joint establishment of a committee to conduct a regional study of the effects of existing or future physical activities carried out partially on federal lands. The regional study requested should be conducted as open, quasi-judicial hearings under s. 45 of the Act, to allow for evidence and cross-examination of experts. Furthermore, the Cabinet Directive states that Strategic Environmental Assessments of policies, plans and programs are "encouraged" when circumstances warrant – for example, to help implement government goals in sustainable development, or if there are strong public concerns about possible environmental consequences. The federal government is already involved the environmental assessment of specific LNG projects in British Columbia. In this case there are clearly significant public concerns about the possible environmental consequences of LNG development. In addition, the Directive states that Federal Ministers expect a Strategic Environmental Assessment of a policy, plan or program proposal submitted to a minister or Cabinet for approval, if the proposal may result in important environmental effects. This latter provision applies to situations where a policy is needed and to situations where an assessment is needed to validate a proposed policy, according to Bram Noble and Jill Harriman, "Regional Strategic Environmental Assessment (R-SEA): Methodological Guidance and Good Practice" (2008) online: <http://environment.gov.ab.ca/info/library/8181.pdf> at 9-10. See the Directive at: Privy Council Office and Canadian Environmental Assessment Agency, *Strategic Environmental Assessment: The Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals* (Ottawa: 2010) online: <http://www.ceaa-acee.gc.ca/Content/B/3/1/B3186435-E3D0-4671-8F23-2042A82D3F8F/Cabinet_Directive_on_Environmental_Assessment_of_Policy_Plan_and_Program_Proposals.pdf> at 1, 5-6.

[4] Most of the proposed BC LNG projects will be constructed from scratch with little or no pre-existing infrastructure. In contrast, most US LNG projects will be retrofitted LNG import facilities that have large portions of infrastructure (port facilities, utilities, storage, etc.) as well as zoning and permits already in place. BC greenfield plants will typically require engineering studies for site suitability, environmental assessments for every project, permitting processes, and so on.

Capital costs for the average US brownfield project will be substantially less than the average greenfield project. One example of greenfield LNG project costs comes from our neighbours to the north, Alaska. In Alaska, a proposed greenfield liquefaction plant is projected to cost $45-65 billion USD, not including the pipeline. Once the pipeline's cost is included, the anticipated price of the project is $71-91 billion USD. Many analysts are privately beginning to refer to the project as the "$100-billion proposition" (USD). In contrast, brownfield sites are much cheaper on average, broadly estimated to be between $550 million USD and $650 million USD for each million tons per annum (mtpa) of capacity.

See Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 9.

Also, see Shahriar Fesharaki, "Implications of North American LNG exports for Asia's Pricing Regime" (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Fesharaki.pdf> at 10.

[5] "The arbitrage opportunity that is driving actors to seek export permits and licenses for new liquefaction facilities is based on current price differentials," Iain Grant, of Athabasca University has commented [Matthew Brown, "U.S. LNG Profit Seen Elusive as Price Gap Closes: Energy Markets" (11January 2013) *Bloomberg* online: < http://www.bloomberg.com/news/2013-01-11/u-s-lng-profit-seen-elusive-as-price-gap-closes-energy-markets.html>].

[6] See James Henderson, "The Potential Impact of North American LNG Exports" (October 2012) *The Oxford Institute for Energy Studies*, online: <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/10/NG-68.pdf> at 6. Also see Platts "Platts: Asia Spot LNG Prices for July Delivery Fell 0.6% on Scarce Demand" (18 June 2013) online: <http://www.reuters.com/article/2013/06/18/platts-asia-lng-price-idUSnPNNY33842+1e0+PRN20130618>; and US Energy Information Administration, "US natural gas prices increased during first-half 2013," (22 July 2013) online: <http://www.eia.gov/todayinenergy/detail.cfm?id=12191>.

[7] See Platts "Platts: Asia Spot LNG Prices for July Delivery Fell 0.6% on Scarce Demand" (18 June 2013) online: <http://www.reuters.com/article/2013/06/18/platts-asia-lng-price-idUSnPNNY33842+1e0+PRN20130618>; and US Energy Information Administration, "US natural gas prices increased during first-half 2013," (22 July 2013) online: <http://www.eia.gov/todayinenergy/detail.cfm?id=12191>.

[8] Jeff Tollefson and Nature Magazine, "China slow to start fracking for natural gas in shale" (20 February 2013) *Scientific American*, online: <https://www.scientificamerican.com/article.cfm?id=china-slow-to-start-fracking-for-natural-gas-in-shale>; China has an estimated 50 trillion cubic metres of unconventional reserves according to Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 5-6; and International Energy Agency, "Golden Rules for a Golden Age of Gas: World Energy Outlook special report on unconventional gas" (November 2012) online: <http://www.worldenergyoutlook.org/publications/weo-2012/> at 115.

[9] See generally Hiroshi Hashimoto, "Evolving Roles of LNG and Asian Economies in the Global Natural Gas Markets" (2011) presented at the Pacific Energy Summit in Jakarta, Indonesia in February 2011, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2011_Hashimoto.pdf>; and Shahriar Fesharaki "Implications of North American LNG exports for Asia's Pricing Regime" (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Fesharaki.pdf>.

[10] Matthew Brown, "U.S. LNG Profit Seen Elusive as Price Gap Closes: Energy Markets" *Bloomberg,* online: <http://www.bloomberg.com/news/2013-01-11/u-s-lng-profit-seen-elusive-as-price-gap-closes-energy-markets.html>. The study referred to in the Bloomberg article is: Kenneth B. Medlock III, "U.S. LNG Exports: Truth and Consequences" (2012) *James A. Baker III Institute for Public Policy, Rice University*, online: <http://bakerinstitute.org/publications/US%20LNG%20Exports%20-%20Truth%20and%20Consequence%20Final_Aug12-1.pdf>.

[11] Shahriar Fesharaki "Implications of North American LNG exports for Asia's Pricing Regime," (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Fesharaki.pdf> at 22.

[12] All figures in this paragraph are from: Matthew Brown, "U.S. LNG Profit Seen Elusive as Price Gap Closes: Energy Markets" *Bloomberg,* online: <http://www.bloomberg.com/news/2013-01-11/u-s-lng-profit-seen-elusive-as-price-gap-closes-energy-markets.html>.

[13] James Slutz, "The US-Canada energy relationship and the growing role for Asia" (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online, <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Slutz.pdf> at 18.

[14] The methane hydrates are found in the Nankai Trough. See: William Pentland "Methane hydrates: Energy's most dangerous game," (14 October 2008) *CBC*, online: <http://www.cbc.ca/news/technology/story/2008/10/07/f-forbes-naturalgas.html>.

[15] BBC News, "Japan extracts gas from methane hydrate in world first," (12 March 2013) *BBC*, online: <http://www.bbc.co.uk/news/business-21752441>.

[16] FACTS Global Energy, see: <http://www.fgenergy.com>.

[17] Shahriar Fesharaki (2013) "Implications of North American LNG exports for Asia's Pricing Regime," presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Fesharaki.pdf> at 6.

[18] Personal communication with Shahriar Fesharaki, 8 July 2013.

[19] See Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 9.

[20] See Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 9.

[21] See Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 9.

[22] From See Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 9.

[23] It will come online early because of the project's small size and its use of existing pipeline infrastructure. See Nathan Vanderklippe, "Bermuda firm, Asian partner back Haisla LNG export project" (30 May 2013) *The Globe and Mail*, online: <http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/bermuda-firm-asian-partner-back-haisla-lng-export-project/article12260495/>.

[24] Ministry of Energy and Mines, "Liquefied Natural Gas: A Strategy for B.C.'s Newest Industry" online: <http://www.gov.bc.ca/ener/popt/down/liquefied_natural_gas_strategy.pdf> at 2.

[25] Shahriar Fesharaki "Implications of North American LNG exports for Asia's Pricing Regime," (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Fesharaki.pdf> at 21; and James Slutz, "The US-Canada energy relationship and the growing role for Asia" (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online, <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Slutz.pdf> at 11 note 22.

[26] Scott Simpson, "Asian gas buyers likely to leverage lower prices for B.C. LNG, experts suggest" (3 April 2013) *The Vancouver Sun* online: http://www.vancouversun.com/business/bc2035/Asian+buyers+likely+leverage+lower+prices+experts+suggest/8191713/story.html

[27] Shahriar Fesharaki "Implications of North American LNG exports for Asia's Pricing Regime," (2013) presented at the 2013 Pacific Energy Summit in Vancouver, Canada, online: <http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Fesharaki.pdf> at 24; personal communication with Shahriar Fesharaki, 8 July 2013.

[28] To take just two examples, Santos' Gladstone LNG project went over budget by 15% [Philip Wen, "LNG rivals hit gas sharing deal" (1 June 2013) *Sydney Morning Herald* online: <http://www.smh.com.au/business/lng-rivals-hit-gas-sharing-deal-20130531-2nhcw.html>], while Chevron's costs at the Gorgon development increased to $52 billion USD from $37 billion USD [Angela MacDonald-Smith "Gorgon LNG cost blows out to $52bn" (6 December 2012) *Financial Review* online: <http://www.afr.com/p/business/companies/gorgon_lng_cost_blows_out_to_bn_LfWE4X2s2IBY3Zn5OhGI8M>].

[29] Matt Chambers and Rick Wallace, "LNG costs in focus as $60 bn gas deals shelved" (29 May 2013) *The Australian*, online: <http://www.theaustralian.com.au/business/mining-energy/lng-costs-in-focus-as-60bn-gas-deals-shelved/story-e6frg9df-1226652612279>.

[30] See: Neil Hume, "Australian LNG industry faces headwinds" (2 December 2012) *Financial Times,* online: <http://www.ft.com/cms/s/0/980e3ea0-3903-11e2-981c-00144feabdc0.html#axzz2ZtcW9pQP>;

Matt Chambers and Rick Wallace, "LNG costs in focus as $60 bn gas deals shelved" (29 May 2013) *The Australian*, online: <http://www.theaustralian.com.au/business/mining-energy/lng-costs-in-focus-as-60bn-gas-deals-shelved/story-e6frg9df-1226652612279>;

and Philip Wen, "LNG rivals hit gas sharing deal" (1 June 2013) *Sydney Morning Herald,* online: <http://www.smh.com.au/business/lng-rivals-hit-gas-sharing-deal-20130531-2nhcw.html>.

Also see Ernst & Young, "Global LNG: will new demand and new supply mean new pricing?" (2013) online: <http://www.ey.com/Publication/vwLUAssets/Global_LNG_New_pricing_ahead/$FILE/Global_LNG_New_pricing_ahead_DW0240.pdf> at 13.

[31] The Canadian Association of Petroleum Producers (CAPP) states that the lack of skilled labour "cuts across all segments of the oil and gas industry. A shortage of skilled workers in a variety of trades categories, technical, and professional backgrounds, combined with a trend towards retirements due to an aging workforce, are forcing employers throughout the industry and across the country to deal with increased competitiveness in the labour market." See Diane LM Cook , "Building a workforce for the future" (2012) *Canadian Association of Petroleum Producers*, online: <http://www.capp.ca/context/Pages/ContextFeature2.aspx>.

[32] Neil Hume, "Costly lesson for energy groups in Australia LNG projects" (19 June 2013) *Financial Times*, online: <http://www.ft.com/intl/cms/s/0/f36824f6-d880-11e2-b4a4-00144feab7de.html#axzz2YlW1w5c8>.

[33] Neil Hume, "Costly lesson for energy groups in Australia LNG projects" (19 June 2013) *Financial Times*, online: <http://www.ft.com/intl/cms/s/0/f36824f6-d880-11e2-b4a4-00144feab7de.html#axzz2YlW1w5c8>.

[34]Department of State Development, Government of Western Australia, "Site Selection" (July 2012) online: <http://www.dsd.wa.gov.au/8605.aspx>.

[35] Personal communication with Gail McGowan, Deputy Director General, Dept of State Development, Government of Western Australia, 24 June 2013.

[36] Northern Development Taskforce , "Final Site Evaluation Report" (December 2012) Department of State Development, Government of Western Australia, online: <http://www.dsd.wa.gov.au/documents/NDT_Final_Site_Evaluation_Report_Dec_2008.pdf> at 4.

[37] Department of State Development, Government of Western Australia, "Precinct Overview" (July 2012) online: <http://www.dsd.wa.gov.au/8603.aspx>.

[38] Personal communication with Gail McGowan, Deputy Director General, Dept of State Development, Government of Western Australia, 24 June 2013. Also see: Department of State Development, Government of Western Australia, "Precinct Overview" (July 2012) online: <http://www.dsd.wa.gov.au/8603.aspx>.

It must be noted that in April 2013 Woodside Energy decided to shelve the plans to build the multi-user Price Point plant due to projected cost escalations. Although Woodside's CEO did not discuss publicly the capital costs or commercial terms used to evaluate the project, he did acknowledge that the decision to shelve the Browse project was not due to environmental or regulatory hurdles, but rather due to "commercial" factors. "Commercial factors" may refer to the combination of high labour costs and supply bottlenecks due to the simultaneous construction of seven LNG projects, and increased unwillingness among Asian buyers to pay oil-indexed prices as Henry Hub pricing glimmers tantalizingly on the horizon. BC can probably avoid this fate if we concentrate on shared infrastructure and a single pipeline corridor from the beginning. See: Woodside Petroleum Ltd., "Company Insight – Explains delaying Browse LNG project," (12 April 2013) online: <http://www.woodside.com.au/Investors-Media/Announcements/Documents/12.04.2013%20Company%20Insight%20-%20Explains%20Delaying%20Browse%20LNG%20Project.PDF>. And see: Clyde Russell, "LNG buyers want lower prices, but risk lower supplies," (16 April 2013) *Reuters*, online: <http://www.reuters.com/article/2013/04/16/column-russell-lng-asia-idUSL3N0D35ZK20130416>.

[39] Derek Wong, "Just how much, exactly, are you paying to subsidize fossil fuels?" (10 May 2013) online: <http://www.desmog.ca/2013/05/10/just-how-much-exactly-are-you-paying-subsidize-fossil-fuels>. Originally posted online at: <http://www.carbon49.com/2013/04/the-real-price-we-pay-for-fossil-fuel-energy/>.

[40] Derek Wong, "Just how much, exactly, are you paying to subsidize fossil fuels?" (10 May 2013) online: <http://www.desmog.ca/2013/05/10/just-how-much-exactly-are-you-paying-subsidize-fossil-fuels>. Originally posted online at: <http://www.carbon49.com/2013/04/the-real-price-we-pay-for-fossil-fuel-energy/>.

[41] Peter O'Neill, "Ottawa rejects call for tax breaks for LNG plants," (22 March 2013) *Vancouver Sun,* online: <http://www.vancouversun.com/business/Ottawa+rejects+call+breaks+plants/8137080/story.html>.

[42]Gordon Hamilton, "Oil and gas industry seeks billion-dollar tax break to lure LNG plants," (8 February 2013) *Vancouver Sun,* online: <http://www.vancouversun.com/business/2035/industry+seeks+billion+dollar+break+lure+plants/7935459/story.html>.

[43] Standing Committee on Finance, House of Commons, 41st Parliament 1st session, 22 October 2012 at 15:30, online: <http://www.parl.gc.ca/HousePublications/Publication.aspx?DocId=5773476&Language=E&Mode=1#Int-7729698>. See also Gordon Hamilton, "Oil and gas industry seeks billion-dollar tax break to lure LNG plants," (8 February 2013) *Vancouver Sun,* online: <http://www.vancouversun.com/business/2035/industry+seeks+billion+dollar+break+lure+plants/7935459/story.html>.

[44] Gordon Hamilton, "Oil and gas industry seeks billion-dollar tax break to lure LNG plants," (8 February 2013) *Vancouver Sun,* online: <http://www.vancouversun.com/business/2035/industry+seeks+billion+dollar+break+lure+plants/7935459/story.html>.

[45] Gordon Hamilton, "Oil and gas industry seeks billion-dollar tax break to lure LNG plants," (8 February 2013) *Vancouver Sun,* online:

<http://www.vancouversun.com/business/2035/industry+seeks+billion+dollar+break+lure+plants/7935459/story.html>.

[46] And an estimated "thousands" of indirect and induced jobs from these projects. See Kerry Jothen, "Resource Labour Market Information Report 2012," (June 2012) online: <http://www.rtobc.com/Assets/RTO+Assets/About+RTO/RTO+LMI+Report+2012.pdf> at 7.

[47] This report projects that 21,600 jobs will be directly involved in the building of LNG export facilities and associated pipelines at peak construction that is expected to occur 2016/2017; 41,900 jobs will be created in the industries that supply goods and services during the construction phase at peak; 2,400 permanent jobs are required to operate and maintain the plants and pipelines on an ongoing basis; and 61,700 jobs are required to support LNG operations including workers required to drill, produce, process and transport the natural gas required to feed the export facilities.

Petroleum Human Resources Council of Canada, "B.C. Natural Gas Workforce Strategy and Action Plan" (July 2013), online: <http://www.rtobc.com/Assets/RTO+Assets/About+RTO/BC+NG+Strategy+2013JUL.pdf> at 6.

[48] Canadian energy economist Peter Tertzakian, one of Canada's most cited energy economists, is skeptical that more than two projects will get a favourable final investment decision (FID) from the companies involved. He believes that only two LNG plants are likely to be built in B.C. by proponents that are able to secure 20-year contracts with buyers in Asia. See Western Investor, "LNG showdown: Conference this month will define potential and opposition to liquefied natural gas plays" (February 2013), online: <http://www.westerninvestor.com/index.php/news/55-features/1145-lng-showdown>

[49] Peter O'Neill, "Ottawa rejects call for tax breaks for LNG plants," (22 March 2013) *Vancouver Sun*, online: <http://www.vancouversun.com/business/Ottawa+rejects+call+breaks+plants/8137080/story.html>.

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[51] Jonathan Stern and Howard Rogers, "The Transition to Hub-Based Pricing in Continental Europe: A Response to Sergei Komlev of Gazprom Export," *Oxford Institute for Energy Studies*, online: <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/02/Hub-based-Pricing-in-Europe-A-Response-to-Sergei-Komlev-of-Gazprom-Export.pdf> at 5.

[52] The province is responsible for the environmental clean–up of numerous contaminated sites in the province. The provincial government's public accounts for the 2011-2012 fiscal year acknowledged a net liability of approximately $651 million (2011: $663 million) for sites the province does not own, and a further liability of $132 million (2011: $136 million) for sites that it does own. Many other sites remain to be evaluated; the future liability for all environmental clean–up costs is not currently determinable. [Office of the Comptroller General, "Public Accounts 2011/2012," online: <http://www.fin.gov.bc.ca/ocg/pa/11_12/Public%20Accounts%2011-12.pdf> at 74]

[53] Nathan Vanderklippe, "B.C. gas distributor warns about LNG exports" (21 November 2012) *The Globe and Mail*, online: http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/bc-gas-distributor-warns-about-lng-exports/article5540638/

[54] The National Energy Board's (NEB) view in 2009 was that increasing global demand for LNG imports was "likely to further connect North American natural gas markets to the world market. However, the relatively small volumes and the seasonal nature of North American imports may not be sufficient to create price convergence and result in common LNG pricing in a single global market." -- National Energy Board, "Liquefied Natural Gas: A Canadian Perspective" (February 2009) *Energy Market Assessment*, online: http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/ntrlgs/lqfdntrlgscndnprspctv2009/lqfdntrlgscndnprspctv2009-eng.html#s3

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[60] Forest Practices Board, "Cumulative Effects Assessment: A case study for the Kiskatinaw River Watershed" (March 2011) online: <http://www.fpb.gov.bc.ca/SR39_CEA_Case_Study_for_the_Kiskatinaw_River_Watershed.pdf> at 10-14.

[61] Robert W. Howarth, Renee Santoro, and Anthony Ingraffea, "Methane and the greenhouse-gas footprint of natural gas from shale formations" (2011) *Climatic Change,* online: <http://link.springer.com/content/pdf/10.1007/s10584-011-0061-5.pdf> at 680.

[62] Industry and some academics challenged the Howarth study's findings as exaggerated, mainly basing their critiques on calculations done using US Environmental Protection Agency figures from 1996.

Importantly, the EPA has since revised those seventeen year old numbers. In fact, a new EPA report from 2010 notes that the 1996 study used by critics "was conducted at a time when methane emissions were not a significant concern in the discussion about GHG emissions," and that emission factors from the 1996 report "are outdated and potentially understated for some emissions sources." [EPA, "Greenhouse gas emissions reporting from the petroleum and natural gas industry" (2010) *Background Technical Support Document*, online: <http://www.epa.gov/ghgreporting/documents/pdf/2010/Subpart-W_TSD.pdf> at 8].

Cornell Professor Howarth notes that the emission factors presented in the EPA's 2010 report are much higher than those in the 1996 report, by orders of magnitude for some sources. [Robert W Howarth, Renee Santoro & Anthony Ingraffea, "Methane and the greenhouse-gas footprint of natural gas from shale formations: A letter" (2011) *Climatic Change*, online: <http://link.springer.com/content/pdf/10.1007/s10584-011-0061-5.pdf> at 681. See Howarth et al., "Methane Emissions from Natural Gas Systems" *Background Paper Prepared for the National Climate Assessment*, online: <http://www.eeb.cornell.edu/howarth/Howarth%20et%20al.%20--%20National%20Climate%20Assessment.pdf> for a review of all studies on GHG emissions from unconventional gas].

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[67] Mark Jaccard, quoted in: Nathanael Baker "BC Premier Clark Redefines Natural Gas as "Clean Energy" to Serve Political Interests" (22 June 2012) online: <http://www.desmogblog.com/bc-premier-clark-redefines-natural-gas-clean-energy-serve-political-interests>.

[68] This should include at minimum, GHG emissions from fracking, fugitive emissions from pipelines, and emissions from natural gas-powered liquefaction plants.

[69] Spectra Energy "Answers to your Natural Gas Pipeline Questions" online: <http://www.spectraenergy.com/Operations/Pipeline-SafetPublic-Awareness/Natural-Gas-Pipeline-FAQs/>.

[70] Spectra Energy "Project Description Proposed Natural Gas Transmission System - Northeast British Columbia to the Prince Rupert Area" (October 2012) online: <http://prrd.bc.ca/board/agendas/2013/2013-03-5791911790/pages/documents/Spectra-Feb14additionalinfo.pdf> at 44-45.

[71] David A Levy, "Pipelines and Salmon in Northern British Columbia – Potential Impacts" (October 2009) online: <https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624910/695692/775718/D66-3-6_-_Living_Oceans_Society,_Raincoast_Conservation_Foundation_and_ForestEthics_-_Attachment_D_-_Salmon_Report_-_A2K2C8.pdf?nodeid=775618&vernum=0> at 43.

[72] Lucie M Levesque & Monique G. Dube, "Review of the effects of in-stream pipeline crossing construction on aquatic ecosystems and examination of Canadian methodologies for impact assessment" *Environ Monit Assess* (2007) 132:395-409, online: <http://link.springer.com/content/pdf/10.1007%2Fs10661-005-9098-0.pdf >.

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[74] Lucie M Levesque & Monique G. Dube, "Review of the effects of in-stream pipeline crossing construction on aquatic ecosystems and examination of Canadian methodologies for impact assessment" *Environ Monit Assess* (2007) 132:395-409, online: <http://link.springer.com/content/pdf/10.1007%2Fs10661-005-9098-0.pdf > at 407.

[75] Lucie M Levesque & Monique G. Dube, "Review of the effects of in-stream pipeline crossing construction on aquatic ecosystems and examination of Canadian methodologies for impact assessment" *Environ Monit Assess* (2007) 132:395-409, online: <http://link.springer.com/content/pdf/10.1007%2Fs10661-005-9098-0.pdf > at 395.

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[77] West Coast Environmental Law, "Enbridge Northern Gateway Pipeline – Risks for Downstream Communities and Fisheries," November 2009, online:

<http://wcel.org/sites/default/files/publications/Enbridge%20Northern%20Gateway%20Pipeline%20%E2%80%93%20Risks%20for%20Downstream%20Communities%20and%20Fisheries_0.pdf> at 2.

[78] David A Levy, "Pipelines and Salmon in Northern British Columbia – Potential Impacts" (October 2009) online: <https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624910/695692/775718/D66-3-6_-_Living_Oceans_Society,_Raincoast_Conservation_Foundation_and_ForestEthics_-_Attachment_D_-_Salmon_Report_-_A2K2C8.pdf?nodeid=775618&vernum=0> at 17.

[79] Lucie M Levesque & Monique G. Dube, "Review of the effects of in-stream pipeline crossing construction on aquatic ecosystems and examination of Canadian methodologies for impact assessment" *Environ Monit Assess* (2007) 132:395-409, online: <http://link.springer.com/content/pdf/10.1007%2Fs10661-005-9098-0.pdf > at 407.

[80] David A Levy, "Pipelines and Salmon in Northern British Columbia – Potential Impacts" (October 2009) online: <https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624910/695692/775718/D66-3-6_-_Living_Oceans_Society,_Raincoast_Conservation_Foundation_and_ForestEthics_-_Attachment_D_-_Salmon_Report_-_A2K2C8.pdf?nodeid=775618&vernum=0> at 16.

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[82] Michael R Ferrari, James R Miller, Gary L Russell, "Modeling changes in summer temperature of the Fraser River during the next century" (2007) *Journal of Hydrology* 342, 336– 346 <http://cohencommission.ca/en/pdf/InterimReport/Responses/Report%20025/025%20-%20Ferrari%20et%20al.%202007.pdf> at 337.

[83] See, for example: Melissa Gray, "Workers pump mud into leaking natural gas well in Gulf" (11 July 2013) *CNN* <http://www.cnn.com/2013/07/10/us/louisiana-gas-leak>; The Canadian Press, "Alberta gas pipeline springs leak" (16 June 2013) online: <http://metronews.ca/news/edmonton/708051/alberta-gas-pipeline-springs-leak/>; accidents can occur due to improper procedure, or events that cannot effectively be controlled. For example, according to Spectra Energy, ATVs and fourwheelers "have done damage to the pipeline cover and in some instances have damaged the pipeline itself" (Spectra Energy "Answers to your Natural Gas Pipeline Questions" online: <http://www.spectraenergy.com/Operations/Pipeline-SafetPublic-Awareness/Natural-Gas-Pipeline-FAQs/>).

[84] West Coast Environmental Law, "Enbridge Northern Gateway Pipeline – Risks for Downstream Communities and Fisheries," (November 2009) online: <http://wcel.org/sites/default/files/publications/Enbridge%20Northern%20Gateway%20Pipeline%20%E2%80%93%20Risks%20for%20Downstream%20Communities%20and%20Fisheries_0.pdf> at 2; see, for example, Material safety data sheet for natural gas condensate, prepared by Piedmont Natural Gas, online: <http://www.piedmontng.com/residential/aboutNaturalGasSection/uploadedGasLines/MaterialSafetyDatasheetDistillateVer020806.pdf>.

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