IN THE MATTER OF
ENBRIDGE NORTHERN GATEWAY PROJECT JOINT REVIEW PANEL

WRITTEN EVIDENCE OF RAINCOAST CONSERVATION FOUNDATION

Part 7: Tanker Risks

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Date Submitted

Signature

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1.0 Introduction

1. The Raincoast Conservation Foundation submits its written evidence in the matter of the Enbridge Northern Gateway Project Joint Review Panel in seven parts:

Part 1: Terrestrial and Cumulative Impacts, Pipeline Risks, Natural Hazards and Climate Change

Part 2: Marine Impacts – Marine Mammals

Part 3: Marine Impacts – Marine Birds

Part 4: Marine Impacts – Salmonids

Part 5: Marine Impacts – Herring

Part 6: Marine Impacts – Eulachon

Part 7: Tanker Risks

2. The Raincoast Conservation Foundation hereby submits the following documents as Part 7 – Tanker Risks as its written evidence, in part, in the matter of the Enbridge Northern Gateway Project Joint Review Panel:

(a) the written evidence of Brian Falconer;

(b) the written evidence of Andrew Rosenberger;

(c) the written evidence of Misty MacDuffee; and

(d) the written evidence of Paul Paquet.

3. The follow documents are submitted as attachments to these written submissions.

A: Resume of Brian Falconer

4. The Raincoast Conservation Foundation proposes to present the following individuals as a panel at the hearing:

Name	**Topics**
Paul Paquet	All topics
Christopher Darimont	Terrestrial and Cumulative Impacts, Pipeline Risks, Natural Hazards and Climate Change Marine Impacts - Salmonids
Misty MacDuffee	Marine Impacts – Marine Mammals Marine Impacts – Salmonids Tanker Risks
Andrew Rosenberger	Marine Impacts – Marine Mammals Tanker Risks
Michael Jasny	Marine acoustic impacts
Caroline Fox	Marine Impacts – Marine Birds Marine Impacts – Herring
John Kelson	Marine Impacts – Eulachon
Brian Falconer	Tanker Risks

2.0 Written Evidence of Brian Falconer, Andrew Rosenberger, Misty MacDuffee and Paul Paquet

Please state your name and business address

5. Brian Falconer
54 Pirates Lane
Nanaimo, B.C.
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Andrew Rosenberger
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Victoria, BC V8V 3J1

Misty MacDuffee
2621 Chart Drive
Pender Island, BC V0N 2M1

Paul Paquet
Box 150
Meacham, SK
S0K 2V0

Please provide your background and work history.

6. Filed with this written submission as Attachment “A” to Part 7 is the resume of Brian Falconer. The resume of Andrew Rosenberger is filed as Attachment “B” to Part 2 of the Raincoast Conservation Foundation written evidence. The resume of Misty MacDuffee is filed as Attachment “A” to Part 2 of the Raincoast Conservation Foundation written evidence. The resume of Paul Paquet is filed as Attachment “B” to Part 1 of the Raincoast Conservation Foundation written evidence.

Have you previously testified before the National Energy Board?

7. No, for all of us.

Do you submit the contents of this written submission, Part 7 – Tanker Risks, as your written evidence and was the submission prepared by you or under your direction?

8. Yes. Part 7 – Tanker Risks of this Raincoast Conservation Foundation written evidence was prepared by or under the direction of Brian Falconer, Andrew Rosenberger, Misty MacDuffee and Paul Paquet.

3.0 Part 7 – Tanker Risks

Marine transport related incidents

9. This Part 7 focuses on material presented in the Marine Shipping Quantitative Risk Analysis (QRA) by Det Norske Veritas[1] and material presented in the TERMPOL studies and answers the following sub questions. In summary, the QRA gives a cursory, superficial, and even a misrepresentation of the following issues:

-No assessment of environmental consequence was associated with marine transport

-No suitable risk assessment for marine transport incidents was undertaken

-Insufficient collection and treatment of data by Enbridge

-Methods chosen for the QRA were inappropriate

-Enbridge's putative risk' analysis was inappropriate for a project of such broad geographic extent and potential adverse environmental consequences

-Conclusions of the QRA and TERMPOL studies were not supported by empirical data or evidence

Please describe your concerns regarding the adequacy of the information and data used in the QRA

10. Although the risk assessment carried out by DNV is elaborate, the fundamental appropriateness of the methods, data, and the assumptions are questionable. TERMPOL

[1] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8.

3.8 concludes, "incidents in the study area involving commercial deep-sea vessels are so infrequent that no statistical conclusion on the historic and future trend in incidents can be made".[2] Statistically valid incident frequencies could not be established based on the low frequency of locally occurring incidents. Therefore, "In order to provide a valid statistical foundation for the QRA, incident data covering a larger geographical area must be used".[3]

11. In the QRA[4], the probability of a spill associated with project tanker traffic was quantified by using incident statistics from the Lloyds Register Fairplay (LRFP) database over the period 1990-2006. However, this database is proprietary, not available without a significant purchase cost, and carries disclosure limitations. Consequently, independent analysis by interveners is effectively precluded. No other databases were referenced to assess the extent, sources, or completeness of the data used for the analysis. All the calculations and assumptions in the QRA are based on information in this database. Therefore, even if the methods used for the analysis were acceptable, analyzing the conclusions would not be possible.

12. Although little information is available from tanker incidents on the BC coast (owing to the absence of an oil industry and the presence of a tanker exclusion zone), highly applicable information is available. This includes incidents on a wide range of large ship casualties in Douglas Channel in the CCAA, the adjoining OWA areas and Prince Rupert Harbour. Based on the conclusions of TERMPOL Study 3.8, whether local incidents (and likely some of the most relevant) were included in this assessment is unclear, because data from the Canadian Coast Guard and Transport Canada were excluded from the analysis in favour of data covering a broader geographical area from the LRFP database.[5]

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[2] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-9 - TERMPOL Surveys and Studies - Section 3.8 - Casualty Data Survey - A1Z6J3, pg. 7-1.

[3] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-9 - TERMPOL Surveys and Studies - Section 3.8 - Casualty Data Survey - A1Z6J3, pg. 7-1.

[4] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 8-122.

[5] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-9 - TERMPOL Surveys and Studies - Section 3.8 - Casualty Data Survey - A1Z6J3, pg. 7-1.

13. The LRFP database includes vessels of appreciably different sizes (10,000-320,000 tonnes) on voyages in parts of the globe with vastly different physiographies and climates, and with correspondingly unique voyage characteristics. The arbitrary choice to include only accidents from 1990-2006, excludes the most relevant incident to Enbridge's proposal; the grounding of the Exxon Valdez and subsequent catastrophic oil spill in 1989.

Please describe your concerns regarding the methods used in the QRA and the methods of Enbridge to assess "risk"?

14. The methods used in the QRA are not appropriate or suitable for a variety of reasons. Key questionable assumptions and shortcomings in the QRA include:

-assumption that calculation of a return period is the most appropriate method to assess 'risk'

-inclusion of statistics from dissimilar voyages, terminals, and exclusion of local and regional non-tanker incidents

-inclusion of statistics for ships not likely to be used for transport of oil or condensate

-treatment of all project ship classes (i.e. Suezmax, Afromax and VLCCs) as equal

-Probability Per Voyage Methodology versus Per Volume of Oil Transported

Use of a return period calculation is inappropriate

15. The use of frequentist based statistical probability analyses that attempt to predict rarely occurring and potentially catastrophic events is considered flawed and dangerous.[6] These, 'Black Swan' occurrences are highly improbable events with three principal characteristics. They are unpredictable, carry a massive impact, and, after the fact, we fabricate an explanation that makes them appear less random and more predictable than they actually are.[7] In theory, to make accurate predictions of future occurrences, a longer period of observations - perhaps three times, is required.[8] Accordingly, to be statistically robust the determination of a net scaled and mitigated spill return period of 15,000 years would require about 45,000 years of observations on the transport of oil and the efficacy of mitigation measures. At present, we have only a few decades of suitable and context appropriate observations.

16. The authors of a recent paper on the devastating 2003 heat wave in Europe estimated a return period of 35-50 years regionally using detailed statistical methods, even though a similar event has likely not been seen for centuries.[9] The study made two important conclusions related to the analysis of return periods. First, the authors showed that the probability in a localised region could be higher than the probability of a larger scale anomaly. Secondly, the risk associated with the assessment of one event does not necessarily carry over to another.

17. For example, whereas an enhanced probability of the 2003 heat wave in Southern and Central Europe has been attributed to human influence[10], a recent analysis of the 2010 Moscow heat wave concluded it was more of a "black swan" event, a rare result of

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[6] Taleb, N.N. 2008. The fourth quadrant: a map of the limits of statistics. Accessed online at http://www.edge.org/, November 30, 2011.
[7] Taleb, N.N. 2007. Black Swan: The impact of the highly improbable. Random House, Inc., New York.
[8] Taleb, N.N. 2008. The fourth quadrant: a map of the limits of statistics. Accessed online at http://www.edge.org/, November 30, 2011.
[9] Stott, P.A., Christidis, N. and R.A. Betts. 2011. Changing return periods of weather-related impacts: the attribution challenge. Climatic Change 109:263-268.
[10] Stott, P.A., Stone, D.A,, Allen, M.R. 2004. Human contribution to the European heatwave of. Nature 432:610–614

persistent atmospheric blocking in a region with no background warming.[11] Extending this rationale to oil spills suggests that oil spills in one region of the world are not always reliable predictors of oil spills elsewhere.

The proponent includes information from dissimilar voyages and terminals, but excludes local and regional incidents.

18. The inclusion of information from voyages in other areas of the world, which do not pose similar hazards (such as weather and proximity to land), likely skews the assessment. Although attempts were made to scale these statistics to the BC coast, they were at best qualitative and speculative.

19. A more appropriate method for estimating the probability of a major incident in BC waters would be to examine the history of incidents and spills from terminals with similar geographic, climatic, and navigational parameters, as well as incidents and spills associated with shipping to and from those terminals commencing with their construction. All of the terminals mentioned in the QRA (Sullom Voe, Mongstadt and Port Valdez) had major oil spills from vessels, either berthing at those terminals or in transit to or from those terminals within 1-15 years of their completion; yet these incidents are not discussed.

20. Similarly, the LRFP dataset analyzed was based on oil tanker statistics only. Thus, QRA ignores marine casualties of non-oil tankers, which occurred in the region potentially affected by the proposed project. Numerous incidents in local waters that did not involve oil tankers have occurred. Most recently, the *Queen of the North* ferry in 2006 sailed off course, ran aground, and sank on Gil Island in Wright Sound due to human error.[12] This incident was not included in the statistical QRA risk analysis, even though it happened directly on the tanker route to Kitimat and within the CCAA. The 2004 grounding of the

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[11] Dole, R., Hoerling, M., Perlwitz, J., Eischeid, J., Pegion, P., Zhang, T., Quan, X-W., Xu, T., Murray, D. 2011. Was there a basis for anticipating the 2010 Russian heat wave? Geophysical Research Letters 38, 5 pages.

[12] BC Ferries, Divisional Inquiry: Queen of the North grounding and sinking #815-06-01. 28 pages. Available online at http://www.bcferries.com, Accessed December 2, 2011.

freighter *Selendang Ayu* (as a result of propulsion failure) off Unalaska Island in 2004 released more than a million liters of heavy bunker fuel while in transit from Seattle to China. [13] This incident was not discussed in the QRA risk analysis.

21. The *Exxon Valdez* oil spill in 1989 was not included because the dataset chosen for analysis in the QRA covered the period from 1990-2006. This represents a major oil spill in a region geographically and climatologically similar to the area potentially affected by the proposed project. The experience of non-tanker shipping in the north Pacific coast is appropriate because the casualties that have occurred in this area are relevant for illustrating local conditions. Exclusions such as these in DNV's analysis selectively limit a comprehensive assessment of local events.

The inclusion of statistics for oil tankers not contemplated for use by the proponent

22. The inclusion of statistics for oil tankers the proponent does not expect to use (10,000 tonne range) is questionable. Without access to the database used by DNV, confirming whether these data bias the calculation of return periods is not possible. Considering that the smallest of the tankers proposed for the ENGP are in the range of 100,000 tonnes, why statistics for 10,000 tonne vessels were included is unclear.

Treatment of all project ship classes (i.e. Suezmax, Afromax and VLCCs) as equal

23. "The incident frequencies derived from the LRFP data are considered to be valid for all three tanker classes forecast to call at the Kitimat Terminal. Tanker incident frequencies are influenced more by the specific shipping route, than the type of tanker. The materials and equipment as well as hull and tank configurations do not vary significantly between classes".[14]

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[13] National Transportation and Safety Board, US, website t http://www.ntsb.gov, Accessed December 1, 2011.
[14] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 5-49.

24. Whereas the equipment, materials, and configuration may be similar, the handling characteristics and hence navigational concerns do vary among size classes of tankers. This is demonstrated in Figures 4.2 to 4.6 in FORCE Technology's tanker manoeuvring study, which shows different size tankers do have different handling characteristics.[15] Notably, the turning radius of a VLCC (Very Large Crude Carrier) in ballast or loaded condition at full sea speed and at 10 knots is almost double that of a loaded Afromax or Suezmax class tanker. In addition, the emergency stop distance of a loaded VLCC is double that of a loaded Suezmax tanker, and almost double that of a loaded Afromax tanker.

25. Given differences in manoeuvring abilities, tonnage, draft, length, and width of a VLCC relative to smaller tankers, treating them differently would seem reasonable, especially in the case of narrow confined channel assessments with complicated compound turns. Further confounding these assumptions is the inclusion of statistics from the LRFP database relating to 10,000 tonne tankers, which are shorter, smaller, shallower, and far more manoeuvrable than VLCC class tankers.

Using probability *Per Voyage* Methodology versus *Per Volume* of Oil Transported

26. "The Per Volume of Oil Transported Methodology assumes that there is a direct correlation between spill frequency and the volume of oil transported. Frequencies are based on incident data compared to the volume of oil shipped in the same period. A project that ships twice the volume of oil compared to another operation is forecast to have twice the number of incidents."[16] However, the

"Per Voyage Methodology was selected for completing the marine QRA… because it can more accurately assess the range of tanker sizes, the relatively long distances travelled in confined channels and the risk mitigation measures planned to be implemented. The Per

[15] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-18 – Gateway Application - TERMPOL TDR - Maneuvering Study of Escorted Tankers to and from Kitimat Part 1 Executive Summary (FORCE Technology) A1Z6K2, pages 21-25.
[16] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 2-7.

Voyage Methodology takes into consideration that fewer transits by tankers are required to ship the same volume of cargo if Very Large Crude Carriers (VLCCs) are used rather than Suezmax and / or Aframax vessels. This could not be taken into account using the Per Volume Methodology. The Per Voyage Methodology is also more adequate for examining the benefit of using tug escorts along portions of the marine tanker routes."[17]

27. Although the authors select the Per Voyage Methodology based on these factors, they do not provide evidence to support this claim of greater accuracy. The choice to use incidents per nautical mile travelled is similarly a questionable choice. The selection of this methodology over other, possibly more appropriate choices, served to extend the incident return frequency and present a scenario that, while reassuring, is not supported.

28. Casualties are assumed in linear miles traveled with no justification offered. This assumption is crucial to all analyses that follow because casualties are likely concentrated at the beginnings and ends of voyages, in confined areas and areas of particularly bad weather - precisely the conditions that exist in the entire assessment area. The conditions (and therefore probable failures) are vastly different in the CCAA from 99% of the miles travelled by the world's large tanker fleet.

Are the conclusions of the QRA and TERMPOL studies supported?

29. Tanker spill frequency has been extensively studied.[18] Anderson and Labelle analyzed the occurrence rate for oil tanker and terminal spills globally, in US waters, and those associated with Alaska North Slope oil transportation using the Per Volume Oil Transported Methodology. [19] Based on these spill rates, the Enbridge Gateway project would be expected to experience seven spills from tankers and the port operation over

[17] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 2-7.
[18] Van Hinte, T., Gunton, T.I. and J.C. Day. 2007. Evaluation of the assessment process for major projects: a case study of oil and gas pipelines in Canada. Impact Assessment and Project Appraisal, 25:123-137.
[19] Anderson, C.M., Labelle, R.P. 2000. Update of comparative occurrence rates for offshore oil spills. Spill Science and Technology Bulletin 6:303-321.

1,000 barrels during its 30-year life.[20] Using their data from 1985-1999 (they document declining rates of tanker spill, so we used the most current rates as closely representative of project rates), we calculated spill return periods and the number of spills over the lifetime of the ENGP (Table 1).

Table 1: Return periods of spills from tankers based on spill rate (per billions of barrels shipped) data from literature [21] and proposed oil transport rates from the ENGP.

	Spill Size (bbls)	**Rate[a]**	**Return Period (Years)[b]**	**Number of Spills Over Project Lifespan[c]**
1985-1999 Globally	**>1000**	**0.82**	**6.4**	**4.7**
	>10000	**0.37**	**14.1**	**2.1**
	>100000	**0.12**	**43.5**	**0.7**
1985-1999 US	**>1000**	**0.72**	**7.2**	**4.1**
	>10000	**0.25**	**20.9**	**1.4**
1985-1999 ANS	**>1000**	**0.92**	**5.7**	**5.3**
	>10000	**0.34**	**15.3**	**2.0**

[a] rate is expressed in spills / billion barrels transported

[b] return period is calculated based on 525000 bbls per day through pipeline

[c] project lifespan used in calculation is 30 years

30. Notably, using these data, the return period for a spill of greater than 1,000 barrels (159 m^3), is approximately 6.5 years based on proposed production volumes. This is in stark contrast to the unmitigated return period of an incident resulting in a spill (of any size, oil or condensate) of 78 years, and the mitigated return period of 250 years presented in the

[20] Gunton, Thomas I, T Van Hinte and J C Day 2005. Managing Im-pacts of Major Projects: an Analysis of the Enbridge Gateway Pipeline Project. Burnaby BC: Simon Fraser University, School of Resource and Environmental Management.
[21] C. Anderson, Labelle R.P., Update of Comparative Occurrence Rates for Offshore Oil Spills, *Spill Science & Technology Bulletin*, Vol. 6, No. 5/6, pp. 303-321, 2000 Elsevier Science Ltd.

QRA.[22] Using these return periods, we calculate a spill rate of only 0.07 and 0.02 spills for every billion barrels shipped for any size spill from a tanker.

31. This is a 10-fold and 40-fold lower rate per billion barrels shipped than the average rate in Table 1 (based on spills greater than 1000m^3). How Enbridge could possibly provide such a reduction in spills per volume shipped relative to other projects is uncertain, even given the documented decline in tanker spill rates over the last decade and the purported benefits of mitigation. Based on our own analysis, results for a larger spill from the QRA (when fitted to an exponential regression curve R^2=0.98) indicate that mitigated return period for a spill of 10,000 bbls (1,590 m^3) would be about 354 years, and an unmitigated spill of greater than 10,000 bbls would be about 120 years. This is also in stark contrast to the averaged return period (16.8 years) for a spill greater than 10,000 barrels in Table 1.

32. It is important to note that we have compared the data on Per Volume spills with unmitigated numbers and Enbridge's mitigated numbers, based on DNV's assumption that mitigation will work, and that return periods could not be accurately predicted with mitigation using Per Volume methods. In addition, the distance sailed in confined channels to the Kitimat terminal is 4-6 times longer (with 5-10 times less traffic) than similar terminals in western Norway.

33. Finally, the QRA makes no mention of the Kitimat LNG proposal, even though a projected additional seven LNG carriers would be transiting the same route per month as tankers from ENGP. Even if tanker incident rates have declined in the years since 1999 by two-fold, the return period based on Per Volume and Per Voyage methodology is at least an order of magnitude different. These discrepancies are not discussed in the QRA.

[22] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 7-110.

Are there deficiencies in the QRA with respect to methodology and assessment of natural conditions and hazard identification?

34. Yes. The following section describes the weather in the area of the three proposed tanker routes to and from the Kitimat Terminal, with a focus on the environmental aspects relevant to the QRA. Addressed are a number of inadequacies related to the assessment of:

-Waves, wind, currents and visibility

-Hazard identification

-Simulations

Waves, Wind and Current

35. In the QRA, maximum and means for wind, wave height, and surface currents are given for Queen Charlotte Sound, Dixon Entrance, Hecate Strait, South Hecate Strait, and Nanakwa Shoal.[23] These data are taken from the ASL 2010 report.[24] In the lifetime of this project, vessels navigating to a terminal in Kitimat would very likely encounter the maximums of all these parameters and likely in combinations (i.e. high winds and high waves). The parameters used in the simulations (voyage and spill) are not based on the likely maximums, and subsequently increase the inaccuracy and detract from the credibility of the simulations.

Winds

36. The stated maximum operational wind speed limit for berthing and deberthing worldwide is 25-40 knots, which is frequently exceeded in Douglas Channel. During the winter

[23] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 3-37
[24] Enbridge Northern Gateway Pipelines. 2010. Exhibit B17-18 – Gateway Application - Weather and Oceans Conditions TDR - Part (1 of 1) - A1V8J0.

months, the average daily wind gusts at Nanakwa Shoals (in Kitimat Arm/Douglas Channel near the site of the proposed marine terminal) exceed 10 m/s (~ 20 knots) about 12% of the time.[25] This is approaching the low end of operational wind speed limits. Because this value is presented as a mean with no estimate of error, gusts will on occasion likely exceed operational limits for berthing and deberthing. Operational limits are not detailed, being postponed until the design phase. The QRA concludes that, "provided that operating limits are observed and tug boats are used, wind should not constitute an uncontrollable risk to tankers or operations at the Kitimat Terminal".[26]

37. Notably, however, weather was an important contributing factor in a major incident at the Suulom Voe terminal and another on a voyage from Bergen (Mongstad). One incident occurred during an attempted berthing when the tethered berthing tug became incapacitated. The other suffered a loss of power due to saltwater contamination of the fuel. In both cases, winds were a major contributing factor to large spills. The reference to similar wind levels in other areas without referencing that they have caused catastrophic losses in nearly identical situations to those projected at the Kitimat Marine Terminal is a serious omission at best, and more accurately a dishonest presentation of past events. The failure to assess worst-case scenarios is a major shortcoming of this section and depicts Enbridge's discretionary treatment of history.

38. Outflow winds in Douglas Channel can be extremely strong and can last for prolonged periods of hours to days; conditions that are not adequately captured by average wind measurements. Although simulations were carried out where a vessel could not maintain its aspect to the wind, and other scenarios, the conclusions do not appear to have been included in the risk analysis by DNV.[27] In addition, there is no analysis of whether a tug or even two tugs could maintain the aspect of a tanker in ballast, and control the direction of drift in narrow channels with strong outflow winds. Indeed, there are several instances

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[25] Enbridge Northern Gateway Pipelines. 2010. Exhibit B17-18 – Gateway Application - Weather and Oceans Conditions TDR - Part (1 of 1) - A1V8J0. Table 2-4, page 2-3.

[26] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 3-38.

[27] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8,

where these scenarios occurred with disastrous results, including with a tethered tug. One of the full bridge simulation exercises illustrated that an emergency manoeuvre preventing an incident could only be accomplished by exceeding the breaking strength of the towline.

39. The QRA states that strong outflow and inflow winds in the channel will seldom pose a risk for navigation, as they run parallel to the channels and therefore the ship.[28] However, a number of turns of large magnitude (greater than 100 degrees) are in extremely confined channels over short distances, and must be accomplished with the vessel aspect not always parallel to the wind. The lack of acknowledgement of these conditions and the lack of assessment of their effect on the risk is a serious deficiency of this assessment.

Waves

40. The wave data in Table 3.6 of the QRA only take into account significant wave height. Wave period and the confused nature of seas (caused by the unique bathymetry and currents in Hecate Strait), combined with hurricane force winds are not considered. Significant wave height is defined as "the average of the one-third largest measured waves".[29] Again, this is an average measure, and individual waves can be much higher. Despite the assurance in the QRA that these tankers are designed for world trade and regularly sail in areas with similar wave conditions, the QRA does not mention that similar wave conditions have resulted in many founderings, groundings and other weather related tanker casualties, and subsequent oil spills.

[28] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 4-46.
[29] Enbridge Northern Gateway Pipelines. 2010. Exhibit B17-18 – Gateway Application - Weather and Oceans Conditions TDR - Part (1 of 1) - A1V8J0, pg. v.

Currents

41. Although currents can make controlling an emergency more problematic, no discussion of foreseeable 'risks' is made. The conclusion of this section states that, "local pilots have intimate knowledge of the local currents and can safely guide tankers to and from the Kitimat Terminal".[30] This may be the case in everyday operations but there is no additional discussion of emergencies and currents.

Visibility

42. Judging the correctness of sound, distance, and movement in conditions of reduced visibility increases the difficulty of navigation. However, modern navigation technology including AIS, DGPS, ECDIS, and radar minimizes these problems. Generally, visibilities lower than one nm (~1.85 km) are regarded as problematic for navigation and are reflected in the safety limitations for tanker and terminal operations. The operational limit for tanker manoeuvres will be in the range of 1 to 2 nm and will be defined during detailed design and the development of safe operating criteria with the involvement of pilots.

43. This is one of the areas of the weather assessment where lack of appropriate data and the practice of averaging present a false impression of much lower levels of risk. The statement "On average, the visibility is less than the 1 nm for few hours at a time"[31] is misleading and inappropriate as Enbridge's Weather and Ocean Conditions TDR[32] clearly indicate that in many areas of Queen Charlotte Sound and Hecate Strait, the maximum duration of exceedance is many hours to days long.[33] T he application of average conditions to assess risk is an obvious inadequacy. As confirmed by the

[30] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 3-38.
[31] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 3-39.
[32] Enbridge Northern Gateway Pipelines. 2010. Exhibit B17-18 – Gateway Application - Weather and Oceans Conditions TDR - Part (1 of 1) - A1V8J0.
[33] Enbridge Northern Gateway Pipelines. 2010. Exhibit B17-18 – Gateway Application - Weather and Oceans Conditions TDR - Part (1 of 1) - A1V8J0. Table 2-31

experience of local mariners[34], tankers may be forced to wait longer periods in reduced visibility conditions.

44. Although the Etheida Bay and Bonilla weather stations are close to the CCAA, most visibility data were collected at stations much farther away. The CCAA is likely the area where low visibilities create the most navigational hazard, due to confined channels and higher traffic. Local experienced mariners have reported periods of visibilities less than one nm for up to 48 hours in the CCAA.[35]

45. During discussions with local participants, reduced radar visibility due to heavy snow was identified.[36] Heavy, wet snow is common during the winter in Douglas Channel especially in the areas at the upper end of the CCAA due to the effects of the high mountains. Often lasting for many hours, heavy snow has the capacity to limit the quality of, or completely disable, radar performance. Visibilities during snowfalls are near zero and much of the channel is less than 1 nm wide. Although this level of snow is generally forecast and short in duration, predicting exactly where, when, and to what extent fog or snow will occur on this route is impossible. It is highly unlikely that a tanker would stop operations because of forecast snowfall. In any event, no discussion of this possibility is included in the QRA.

46. The lack of data on visibility conditions in the CCAA and neglect by Enbridge to collect it, demonstrate another significant failure to properly assess this risk to tanker transit. Reduced visibility and human error was the cause of the 2007 *Cosco Busan* accident that spilled more than 200,000 L of oil into San Francisco Bay after a collision with a well-known and marked bridge pier.

[34] Brian Falconer, personal communication, December 2011.
[35] Brian Falconer, personal communication, December 2011.
[36] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 4-46.

Hazard Identification

47. Worldwide frequencies are scaled to the British Columbia coast environment and traffic volumes using factors developed during the gathering of local knowledge and a peer review by DNV. This is an important area of qualitative input into the QRA. Hazards identified in the QRA comprise known causes of worldwide marine tanker and terminal incidents, as well as local factors unique to the British Columbia and the Kitimat. One of the major failings of the methodology used is the failure to consider hazards in combination. By partitioning individual hazards, the QRA has consistently ignored the probability of simultaneously encountering more than one (in fact all of them) and thus has under represented the cumulative hazard.

48. A HAZID workshop was held in Vancouver, British Columbia with local maritime experts to discuss local hazards and their influence on the risk to marine transportation to and from the Kitimat Terminal. We identified many deficiencies in the HAZID workshop process in both data and methodology. The data are the same global data used throughout the QRA and then qualitatively scaled to estimate incident frequencies on the BC coast. The qualifications of the group of experts who assessed this are not provided. No detailed methods or results are reported and no measures of disagreements among experts were included. This is a critical deficiency as the scaling assigned to the various segments dramatically affects the outcomes of the spill return periods and the assessment of overall risk.

49. Given that the experience of the scaling committee and hazard identification workshop participants are not actually provided in the form of CVs, what relevant experience do the pilots and other experts have with particular respect to navigating VLCCs? Local knowledge of weather, bathymetry (charts), and currents, in addition to experience relevant to the class of vessels (i.e. large tankers) proposed for oil transport, are requisites to providing expert advice as to the hazards. As the names of participants are listed without qualifications, assessing their ability to accurately forecast scaling factors directly related to oil tankers is not possible.

50. The tanker routes were divided into segments so that bathymetry, traffic, and weather were relatively consistent.[37] Although each segment might be consistent in bathymetry and weather parameters, navigational problems can be highly variable. Portions of some segments (e.g. segment 2) have greatly increased navigational difficulties due to the requirement for consecutive large magnitude course changes with little room for error. This generalization could result in serious hazards being omitted from the scaling process.

51. Key personnel from DNV toured portions of the northern and southern routes. Given the scale of the project and the complexity of navigation hazards involved, a trip on a sunny day with light wind in a vessel completely unrelated to the size or handling characteristics of a large oil tanker is of questionable use. An adequate assessment of the route should at a minimum include transits on vessels similar to those contemplated for service and at various times of the year, under different weather and visibility conditions.

52. Participants in local meetings and interviews failed to identify 'hidden' rocks or shoals that would be a concern for navigation. Some of the participants also noted that the current communications infrastructure in some areas, including Douglas Channel, could be improved and that radio communication and GPS sometime do not work near the steep mountains that rise from the channels.[38] Although the area is reasonably well charted and charts are being updated, many rocks and shoals are unmarked. The possibility of radar and GPS being simultaneously inoperative, combined with possible limited visibility, presents considerable risk. Although DNV acknowledges that more traffic would be present during some portions of the year, and the seasonal traffic due to cruise ships is addressed in the QRA, the scaling of hazard factors does not include projected increases in traffic owing to other projects proposed and approved in the CCAA (e.g. Kitimat LNG).

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[37] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 3-39.
[38] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 4-47.

Simulations

53. Fast time and Full Bridge simulations were conducted and reported[39] but no accompanying discussion was included in the route evaluation. Although a reasonable range of simulations was conducted, serious deficiencies occurred in their reporting. Many of the voyages were completed successfully. A number of simulations, however, were given low safety ratings by the participants. Some indicated that the voyages would be successful only if unrealistic parameters were applied. In one instance, a vessel was assisted (in the simulation) but the breaking strength of the towline was exceeded.

54. In all cases, the only traffic considered were single large vessels being operated by other highly skilled crew with sophisticated equipment. The simulations are unable to portray realistic traffic scenarios, given the low levels of experience and equipment possessed by much of the traffic in this area. No evaluation of these scenarios is presented in the body of the TERMPOL report and there is no discussion of the risks identified.

55. The conclusion of the hazard identification process states, "the hazards presented appear manageable".[40] Many of the hazards (i.e. wind, waves, currents, visibility) have a considerable amount of baseline data presented in the Weather and Ocean conditions TDR.[41] However, hazards have been assessed in the QRA in a cursory and dismissive fashion. Thus, we stress that weather and navigational hazards interact synergistically, amplifying the potential for problems related to transport of oil by tankers.

56. The presentation of many of these risks in the form of averages instead of likely extremes is misleading and inappropriate. Mitigation of these hazards, especially with the use of escort tugs, is controversial. The lack of assessment in terms of combinations of

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[39] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-18 – Gateway Application - TERMPOL TDR - Maneuvering Study of Escorted Tankers to and from Kitimat Part 1 Executive Summary (FORCE Technology) A1Z6K2

[40] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 4-47.

[41] Enbridge Northern Gateway Pipelines. 2010. Exhibit B17-18 – Gateway Application - Weather and Oceans Conditions TDR - Part (1 of 1) - A1V8J0.

extremes and worst-case scenarios make it likely that 'manageable' hazards in isolation will become unmanageable in combination or with the addition of confounding variables and unpredicted situations.

Is this 'risk' analysis appropriate for a project of this scale and level of environmental consequence?

57. No. Given the availability of other statistical approaches, we question whether the choice of presenting spill or incident return periods (the time frame where it is statistically probable that a spill or incident **will** occur) is an appropriate or useful accounting of risk. Any assessment of risk for activities with such a high level of consequence should include the periods for which an incident **might** occur and the consequences of that risk. Although the QRA does calculate the probability of a spill occurring, a risk assessment includes the consequences of that event, not just the occurrence. In risk assessment studies, the objective is to assess the potential consequences if a spill were to occur. Accordingly, oil spill risk is defined as the likelihood (i.e. probability) of spills occurring multiplied by the consequences (impacts) of those incidents.[42] Enbridge simply quantified the probability of oil, bunker fuel, or condensate spills occurring during marine transport. They did not assess the consequences of these hypothetical spills, either qualitatively or quantitatively.

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[42] French-McCkay, D., Beegle-Krause, C.J., Etkin, D.S. 2009. Oil Spill Risk Assessment – Relative Impact Indices by Oil Type and Location. In Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 655-681. Available online at <http://www.asascience.com/about/publications/publications09.shtml>, Accessed December 11, 2011.

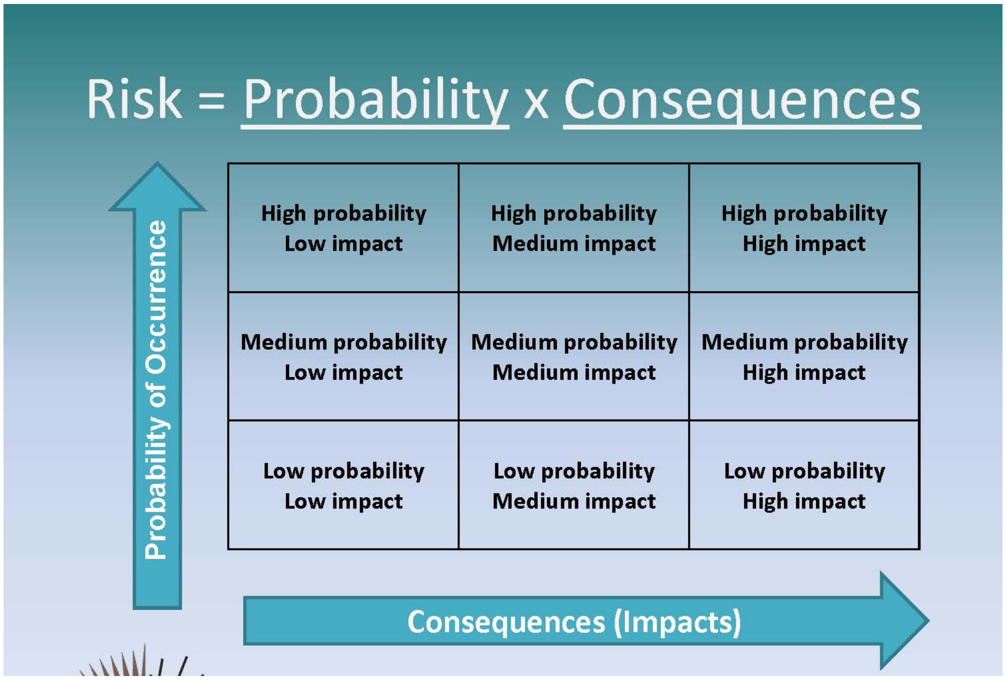

Fig 1: Risk = Probability x Consequences

58. Tools from the field of ecological risk assessment can be used in combination with GIS to produce relative risk maps of large geographic areas that integrate risk to habitat quality, communities of indicator taxa, and cultural resources.[43],[44],[45] Lacking a comprehensive assessment of risk by Enbridge, Raincoast carried out a quantitative risk assessment that evaluated the environmental impact of tanker related spills to three highly vulnerable indicator taxa; marine birds, marine mammals, and anadromous wild salmon in the Queen Charlotte Basin.

Methods

59. Three broad groups of animals were chosen to examine risk; marine birds, marine mammals (cetacean and pinnipeds) and five species of anadromous commercial salmon. For each group of animals assessed, the probability of a tanker incident resulting in an oil

[43] Kapustka, L.A., Landis W.G. 2010. Environmental Risk Assessment and Management from a Landscape Perspective. John Wiley & Sons, Inc. New York
[44] Landis, W.G., Wiegers, J.K. 2007. Ten years of the relative risk model and regional scale ecological risk assessment. Human and Ecological Risk Assessment.13:25-38.
[45] Hull, R. N., Swanson, S. 2006. Sequential analysis of lines of evidence—An advanced weight-of-evidence approach for ecological risk assessment. Integrated Environmental Assessment and Management 2:302–311.

(or condensate) spill was determined using Enbridge's spatial tanker segments[46] and their spill probability numbers.[47] Our use of Enbridge's spill probabilities for tanker segments is not an endorsement of their validity.

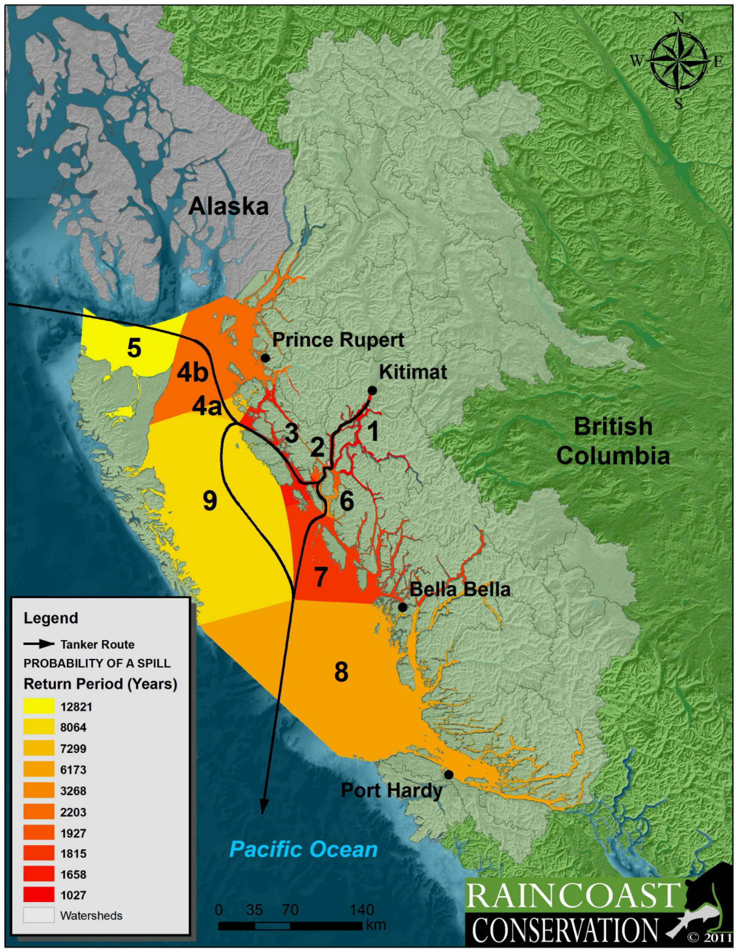

Figure 1. Probability of an oil spill associated with each segment of the proposed marine transportation routes to the Kitimat Marine Terminal. Linear spill probabilities were extended spatially to marine waters and watersheds from the intersection points of adjacent segments.

60. To assess the environmental risk associated with an oil spill, marine bird density and diversity were combined and equally weighted. The result was then combined with an

[46] Enbridge Northern Gateway Pipelines. 2010. Exhibit B3-37 – B3-42 - Vol 8C – Gateway Application – Risk Assessment and Mgmt of Spills - Marine Transportation (Part 1-6 of 6) - A1T0I7-A1T0J2, pg. 3-3.

[47] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 8-122.

equally weighted marine mammal density (Figure 2a). To quantify the risk to marine birds and marine mammals, the composite map of consequence was multiplied by the probability of an oil spill occurring (Figure 2b).

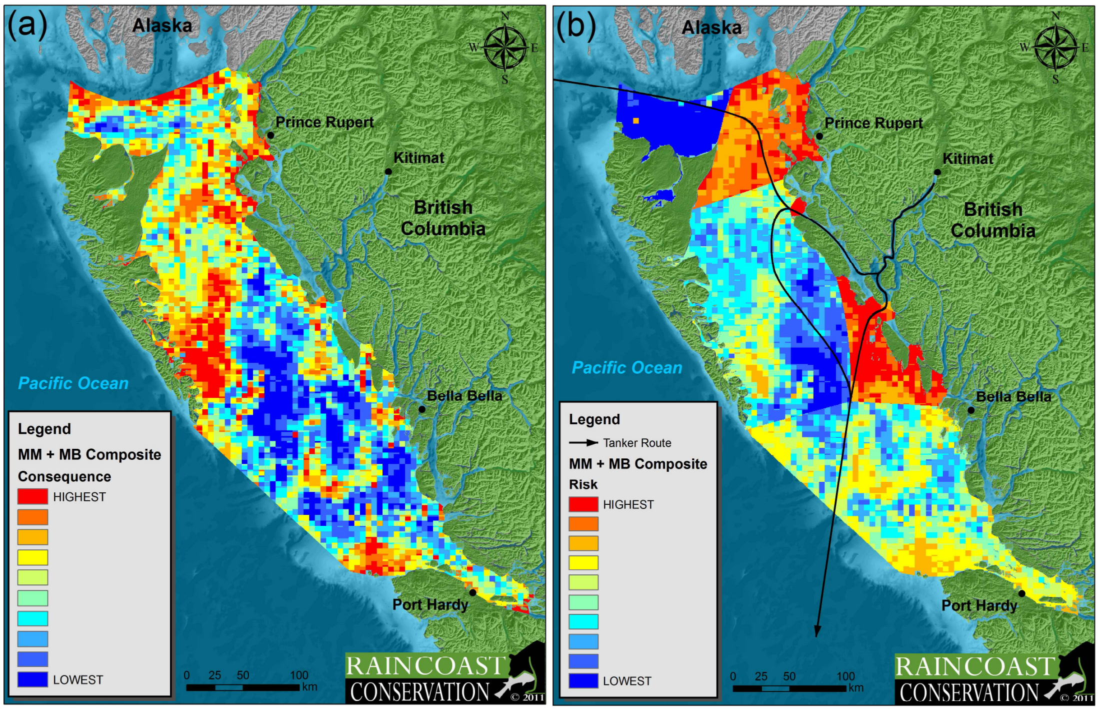

Figure 2a: Combined map of oil spill consequence to marine mammals and birds in the Queen Charlotte Basin. Areas of highest consequence (red) and lowest (blue) are displayed according to the diversity and abundance of 17 marine birds species/groups and density of 10 marine mammal species. Data for this map were based on systematic surveys conducted by Raincoast from 2004-2008. **Figure 2b.** Risk is displayed from highest (red) to lowest (blue) based on consequence (left panel) x probability of a spill. Probability of an oil spill was taken from Enbridge's QRA.[48]

61. Assessing risk in this manner is important because probability alone would not predict high risk in areas such as the southeast coast of Haida Gwaii and the northwestern tip of Vancouver Island. By integrating ecological indices with probability, areas such as these are elevated from presumed lower risk (due to low probability of a spill) to moderate or high risk (due to high consequence). Areas that have lower consequence are also

[48] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 8-122

elevated to higher risk given the spill probability (see high-risk clusters surrounding segments 2, 3, 6 and 4b). Where the combined index of marine mammal and marine bird habitat value (density and diversity) is moderate to high, the higher probability of a spill puts these areas at the highest risk.

62. Risk can also be quantified in relation to watershed values that may be affected by an oil spill. To quantify risk to wild Pacific salmon at the watershed level, two indices of salmon consequence were combined; vulnerability of intertidal spawning grounds and juvenile nearshore marine rearing habitat to oil spills, and salmon abundance based on density within watersheds (using relative biomass) (Figure 3a). This combined value was then multiplied by the oil spill probability assigned to each watershed (Figure 3b).

63. The highest risk areas include those watersheds that surround the CCAA, and those segments that have the highest probability of an oil spill associated with them (Figure 3). The upper watersheds of the Skeena and Nass Rivers are also elevated in risk due to the high probability of a spill from segment 4b.

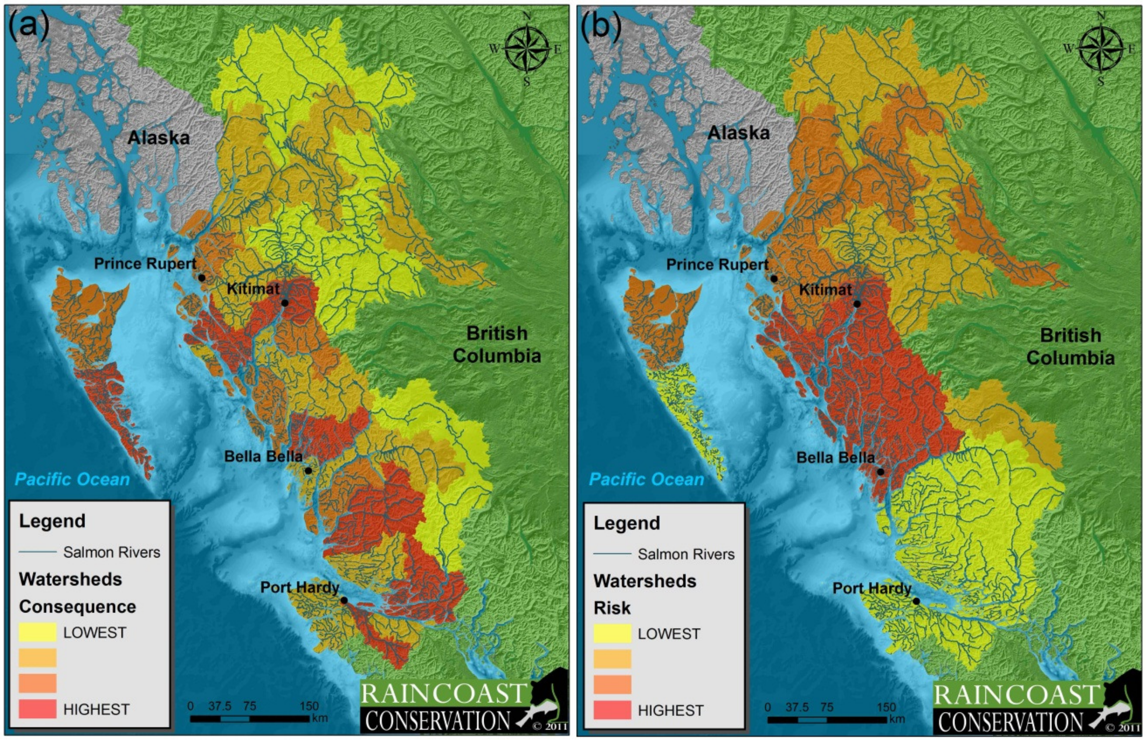

Figure 3a: Map of oil spill consequence to salmon in the watersheds of the Queen Charlotte Basin. Areas of highest consequence (red) and lowest (blue) are displayed according to the density of spawning salmon within watersheds and their vulnerability to oil exposure in nearshore juvenile marine rearing habitat and intertidal spawning grounds. **Figure 3b.** Risk is displayed from highest (red) to lowest (blue) based on consequence (left) x probability of a spill. Probability of an oil spill was derived from Enbridge's QRA.[49]

64. In the last map series, the marine mammal, marine bird and wild salmon consequence maps are combined creating a composite map of consequence for these three broad groups of animals (Figure 4).

[49] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 8-122

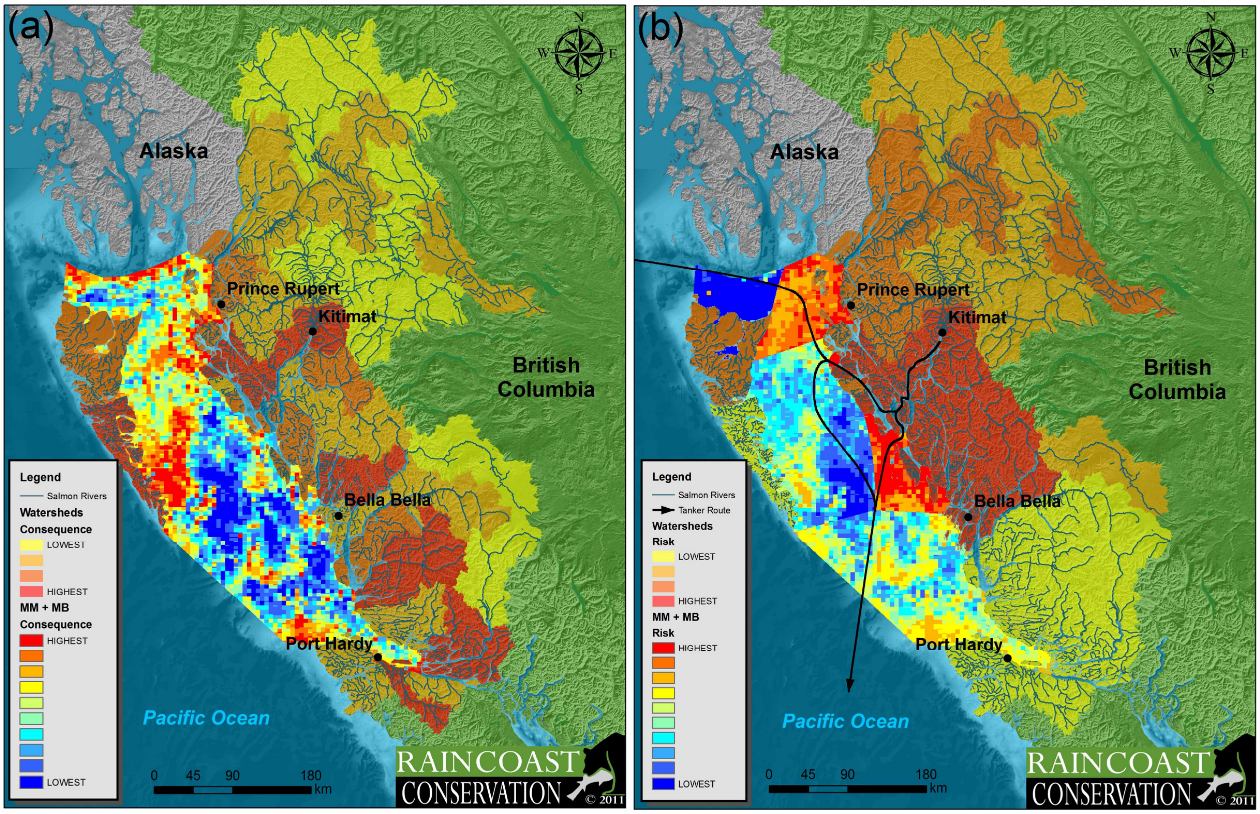

Figure 4a. Combined map of oil spill consequence to BC's marine mammals, marine birds and wild Pacific salmon from headwaters to subtidal waters of the Queen Charlotte Basin. Areas of highest consequence (red) and lowest (blue) are displayed according to the diversity and abundance of marine birds and marine mammals, density of spawning salmon and the habitat vulnerability of watersheds to nearshore and intertidal spawning grounds. **Figure 4b.** Risk is displayed from highest (red) to lowest (blue) based on consequence (left) x probability of a spill. Probability of an oil spill was taken from Enbridge's QRA.[50]

65. Areas within and entering the CCAA show the highest levels of risk due to a combination of high salmon, marine mammal, bird density or habitat values combined with a high spill probability. Upper watersheds with high habitat values are also at elevated risk, something that Enbridge does not address in any meaningful way.

[50] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23–B34 - Gateway Application – TERMPOL TDR Marine Shipping Quantitative Risk Analysis – A1Z6L8, pg. 8-122

66. This figure illustrates of a risk assessment using ecologically appropriate indices, and not solely on the probability of an oil spill. This is the type of assessment that Enbridge failed to complete, which represents a serious inadequacy in their ESA. Notably, a comprehensive risk assessment would include many factors (animal use of intertidal zones, archaeological sites, social values, cultural values, and economic values like ecotourism or fisheries), each assigned values and then related to the probability of a spill. Such an assessment would more adequately portray the real risks to the regions surrounding the project footprint.

What risk and environmental impacts do marine transport incidents pose to the project area?

67. The environmental risks introduced by tankers are first associated with the transportation of petroleum products such as bitumen, condensate, light fuel, bunker oil and crude. The spill of these substances from catastrophic or chronic releases threatens the presence of countless species, food webs and ecosystems that are relied upon for subsistence, cultural, social, economic, physical and spiritual well being by an untold number of individuals and communities. In many cases, hydrocarbon impacts to species and habitats are additive in terms of the cumulative impacts and stressors that coastal ecosystems are under.

68. Many other contributors to environmental risk exist, such as garbage disposal, sewage discharge, water ballast, noise, ship wake and anti-fouling substances that are again cumulative to the existing pressures. The focus of this rapid risk assessment is limited only to accidental spills of persistent oil and condensate.