Evaluation of the National Energy Board's Trans Mountain Expansion Project Report in relation to Oil Spill Planning and Response

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for
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SUMMARY

1. Nuka Research and Planning Group, LLC (Nuka Research) was retained by the Tsleil-Waututh Nation (TWN) to provide our professional opinion on the National Energy Board's (NEB) conclusions in its May 2016 report for the Trans Mountain Expansion Project (Project) in relation to oil spill planning and response.

2. Nuka Research prepared a May 2015 report entitled *Technical Analysis of Oil Spill Response Capabilities and Limitations for Trans Mountain Expansion Project*[1] (May 2015 Report) which was submitted by TWN, the City of Vancouver, and Tsawout First Nation as part of their written evidence in the NEB hearing for the Project. Our May 2015 Report presented primary analysis and our professional opinions about oil spill preparedness and response for the Project.

3. Nuka Research subsequently reviewed the NEB's May 2016 Report for the Project,[2] together with other relevant evidence filed with the NEB, including the reply evidence that Trans Mountain filed with the NEB on August 20, 2015. In our professional opinion:

    - none of the information presented in Trans Mountain's reply evidence alters Nuka Research's original analysis or conclusions about oil spill response capacity or response gaps;

    - Trans Mountain's reply evidence contains several inaccuracies and mischaracterizations of Nuka Research's analysis;

    - Trans Mountain's reply evidence calls into question Nuka Research's credibility and experience as oil spill response experts and analysts. However, Nuka Research is an established expert on these issues with a broad range of clients that include major international oil companies, Canadian and U.S. government entities, and oil spill response organizations;

    - the NEB's May 2016 Report dismisses several of the key conclusions that we reached in our May 2015 Report on the basis of Trans Mountain's reply evidence. As a result, the NEB's conclusions in its May 2016 Report and the 157 conditions it proposes therein are based on an underestimate of potential worst case discharges from the Project, the adverse consequences that may result, and the response capacity needed to mitigate those impacts. Specifically:

[1] C358-13-18 to C358-13-22: *Technical Analysis of Oil Spill Response Capabilities and Limitations for*
[2] Canada, National Energy Board (NEB), *National Energy Board Report, Trans Mountain Expansion Project*, OH-001-2014 (Calgary: NEB, May 2016) (A5A9H0) ("**NEB, 2016**").

- the NEB did not propose any conditions in its May 2016 Report related to the response gap analysis or the limits to effective oil spill recovery based on sea state or other environmental conditions;

- in its May 2016 Report, the NEB acknowledges some of the findings from Nuka's response capacity analysis (as set out in our May 2015 Report), but does not link this information to its decision, recommendations, or conditions for Project approval in any way;

- the NEB's May 2016 Report and its proposed conditions underestimate the potential for on-scene conditions to limit oil spill response capacity, leading to an overestimation of the capacity to mitigate oil spill impacts; and

- the NEB's May 2016 Report and its proposed conditions underestimate the potential for flow conditions or logistical constraints to preclude or limit effective oil spill response on the Lower Fraser River.

4. After careful review of the evidence in the NEB's hearing record, Nuka Research affirms that the following conclusions reached in our May 2015 Report continue to apply to the Project;

KEY FINDINGS FROM RESPONSE GAP ANALYSIS:

1. There is no location along the Trans Mountain tanker route where on-water oil spill response will always be possible.

2. There may be times when on-water vessel operations are possible but poor visibility—including darkness—precludes aerial reconnaissance, making it very difficult to track and target oil for recovery.

3. During the winter, response is not possible between 56% and 78% of the time at sites along the Trans Mountain tanker route.

4. If a spill occurs during a time when response gap conditions exist, the unmitigated oil slick will remain in the environment until conditions improve. If the response gap conditions extend for several days, there may not be any opportunity for on-water recovery.

5. Lack of a response gap does not ensure that a response *will* occur, nor does it guarantee that the response will be effective.

KEY FINDINGS FROM RESPONSE CAPACITY ANALYSIS:

1. On-water oil spill recovery capacity is reduced during winter months by as much as 50% compared to summer.

2. If spill response were delayed for any reason—lags in detection, poor weather, equipment malfunction—the total volume of oil recovered would decrease significantly. A 48-hour delay in the modeled response to a 16,000 m^3 Outer Harbour spill would result in over 11,000 m^3 of oil left in the environment.

3. The modeled response capacity estimates do not consider the potential for shoreline stranding. This may overestimate total recovery at all sites, and most significantly in Burrard Inlet where models show up to 90% of an oil spill stranding on the beaches.

4. The spill response forces currently available in Southern B.C. have the capacity to recover only 10–20% of a worst case oil spill under favourable conditions.

5. Current response forces are clustered in the Vancouver Port area, which reduces response capacity for other sites along the Trans Mountain tanker route.

6. Night operations require double the personnel and create significant safety risks that may not be justified by the modest improvement to oil recovery from 24-hour operations.

7. Changes to diluted bitumen density and viscosity within the first few days of the release may render oil spill response systems ineffective.

KEY FINDINGS FROM LOWER FRASER RIVER LOGISTICS ANALYSIS:

1. If an oil spill occurs at the Port Mann Bridge and moves downriver at 8 kph or faster, there may not be time to mobilize and deploy equipment in time to control the spill before it reaches the Lower Fraser Delta. At transport speeds of 12 kph or higher, this becomes impossible.

2. Response equipment inventories along the Lower Fraser River are limited.

3. Existing river response equipment is meant for floating oil, and would not be effective in the event that a diluted bitumen spill submerged or sank in the Lower Fraser River.

4. It is unclear whether Trans Mountain has access to the specialized oil spill response equipment, tactics, and trained personnel necessary to control oil spills in fast water conditions (greater than 0.8 kts/1.5 kph).

5. The evidence Trans Mountain's submitted in the NEB hearing lacks critical detail about how responders will manage practical and logistical considerations—such as site access, travel routes, boat launch access, and tactical planning—that are critical to successful river response.

5. Many of the findings in our May 2015 Report were reinforced by the recent fuel oil spill from the tug *Nathan Stewart* on the northwest coast of Bella Bella in October 2016. The response to that incident, as described in daily Situation Reports,[3] provided a vivid illustration of several of our key conclusions:

   - The *Nathan Stewart* spill response substantiated our expert opinion that response gaps—periods of time during which on-scene environmental conditions limit or preclude on-water oil spill response—exist and can cause a measurable reduction in potential oil spill containment and recovery. Situation Reports from the first week of the incident describe several occasions during the spill response when on-water operations were halted due to sea state and wind conditions. Boom that was deployed to contain the oil did not hold due to currents and weather conditions. In one case, a response vessel sunk due to on-scene conditions.

   - The *Nathan Stewart* incident illustrated the critical importance of having a distributed spill response capacity that can be quickly dispatched to the scene to initiate containment and recovery. In the case of the *Nathan Stewart,* the nearest response resources were located in Prince Rupert and did not arrive on-scene until more than 34 hours had elapsed.[4] This

[3] Seaforth Channel, "Incident Unified Command Information Site, online: <spillresponsebc.ca/news/>.
[4] Incident was reported at 01:13 on October 13, 2016; containment boom around the vessel was secured at 11:17 on October 14, 2016 (34 hours after the incident occurred), online: <spillresponsebc.ca/2016/10/14/example-news-item-four/>.

substantiates the findings in our May 2015 Report that the location and deployment timing for response resources will impact the effectiveness (or lack thereof) of a response.

- The *Nathan Stewart* incident substantiated our analysis of response capacity, which we note to be limited by on-scene conditions, distance from equipment cache to spill site, and reduced efficiency of mechanical skimmers as oil spreads and weathers.

1. INTRODUCTION

6. Nuka Research authored a May 2015 Report entitled *Technical Analysis of Oil Spill Response Capabilities and Limitations for Trans Mountain Expansion Project* (May 2015 Report) which was submitted by TWN, the City of Vancouver, and Tsawout First Nation as part of their written evidence in the NEB hearing for the Project.[5] Our May 2015 Report presented our analysis and our professional opinions about oil spill preparedness and response for the Project. Nuka Research's expertise on these issues is described on pages 3–4 of our May 2015 Report and my *curriculum vitae* is attached as Appendix E to that report.

7. Since preparing our May 2015 Report, I have reviewed the relevant evidence that was filed during the NEB's hearing for the Project as well as the NEB's May 2016 Report and the recommendations contained therein.

8. The purpose of this report is to evaluate the conclusions in the NEB's May 2016 Report in relation to oil spill preparedness and response for the Project.

9. I have prepared this report in accordance with my duty as an expert to assist: (i) TWN in conducting its assessment of the Project; (ii) provincial or federal authorities with powers, duties or functions in relation to an assessment of the environmental and socio-economic effects of the Project; and (iii) any court seized with an action, judicial review, appeal or any other proceeding in relation to the Project.

10. In preparing this report, I acknowledge that it is my duty to provide evidence as follows:

    (a) to provide evidence that is fair, objective, and non-partisan;

    (b) to provide evidence that is related only to matters within my area of expertise; and

[5] C358-13-18 to C358-13-22: *Technical Analysis of Oil Spill Response Capabilities and Limitations for Trans Mountain Expansion Project* prepared by Nuka Research and Planning Group, LLC for Tsleil-Waututh Nation, City of Vancouver, and Tsawout First Nation (26 May 2015) [TWN Record, Vol 8, Tab 4D] (A70206).

(c) to provide such additional assistance as may reasonably be required to determine a matter in issue.

11. I acknowledge that my duty is to assist the entities listed in paragraph 9, not to act as an advocate for any particular party. This duty prevails over any obligation that I may owe any party, including TWN on whose behalf I have been engaged.

2. TRANS MOUNTAIN REPLY EVIDENCE

12. On September 2, 2015, I swore an affidavit stating Nuka Research's opinion that Trans Mountain's reply evidence: (1) does not identify any new issues raised in our May 2015 Report that Trans Mountain would have been unable to address in the Application or other evidence it has filed in this matter; (2) raises new issues that Nuka Research was unable to consider when preparing our May 2015 Report; (3) includes statements and conclusions that mischaracterize or misunderstand our May 2015 Report and the underlying analyses set out therein, such that additional evidence is required to assist the NEB in resolving or understanding oil spill responses in relation to the Project; and (4) includes statements and opinions that conflict with the statements and opinions contained in our May 2015 Report.

13. Upon reviewing the NEB's 2016 Report, we find that the NEB's conclusions and, ultimately, its recommendations do not adequately address the issues described in my September 2015 affidavit. Rather, the NEB relies on statements and conclusions from Trans Mountain's reply evidence that, in my professional opinion, are unsupported or technically inaccurate. Because TWN was not afforded the opportunity to provide additional evidence from Nuka Research to address these inaccuracies or respond to new issues that are raised in Trans Mountain's reply evidence, the NEB's May 2016 Report and recommendations are based on an incomplete assessment of oil spill preparedness and response in relation to the Project.

14. Subsequent sections of this report describe how Trans Mountain's reply evidence mischaracterizes or incorrectly presents information that the NEB subsequently relied on to reach its recommendation for the Project.

3. WORST CASE DISCHARGE VOLUME

15. Nuka Research modeled oil spill response capacity for a series of hypothetical spills along the Trans Mountain tanker route. Some of these overlapped with scenarios presented in Trans Mountain's application, while others reflected additional analysis informed by the concerns and priorities of TWN and the other intervenors who commissioned our work. The NEB adopted Trans Mountain's flawed assessment, and subsequently dismissed modeling and analysis performed by Nuka Research and other experts.

16. In its reply evidence, Trans Mountain challenged two of the hypothetical worst case oil spill scenarios that we presented—an 8,000 m^3 spill at the Westridge Terminal and a 16,000 m^3 spill in English Bay—on the grounds that these spills were so unlikely as to not warrant further consideration or planning. Trans Mountain also questioned our qualification to identify worst case scenarios.

17. In my professional opinion, the two worst case discharge scenarios that Nuka Research modeled represent a credible worst case scenario and the NEB erred in dismissing all evidence related to these two hypothetical spills. This subsequently led the NEB to fail to consider and assess the potential consequences from a major marine oil spill on TWN.

18. In particular, the NEB's dismissal of Nuka Research's analysis has tainted the NEB's May 2016 Report and recommendations, such that it has recommended Project approval without requiring that sufficient oil spill response planning and capacity be put in place to mitigate a low probability, high consequence event in Burrard Inlet.

3.1 8,000 m^3 Oil Spill at Westridge Terminal

3.1.1 New Issues Raised by Reply Evidence

19. In our May 2015 Report, Nuka Research presents a rationale for using 8,000 m^3 as a worst case oil discharge volume for modeling oil spill trajectories and spill response capacity at the Westridge Terminal. Our approach applies the same conditional probability criteria used by Trans Mountain to select 16,000 m^3 as a worst case discharge volume for oil spills along the tanker route.

20. Trans Mountain's reply evidence, which the NEB ultimately relied on, suggests that Nuka Research's worst case discharge volume is not "credible" because of the low probability of an initiating event occurring. Instead, Trans Mountain estimates that a 160 m^3 release from a loading arm into containment, with 20% of that volume (32 m^3) escaping containment, is a credible worst case scenario.

3.1.2 Unsupported or Incorrect Statements or Conclusions

21. Nuka Research disagrees with the use of a loading arm incident as a credible worst case discharge for a spill at the Westridge Terminal. Even though Trans Mountain's risk assessment estimates a low probability of a tanker being struck at berth, the evidence in the NEB hearing record for the Project confirms that such an event is *possible* and that if such an event occurred it could result in a release of between 2,000 to 12,000 m^3.[6]

[6] B21-1 to B21-3: TERMPOL 3.15 (TR 8C-12) "General Risk Analysis and Intended Method of Reducing Risks," prepared by Det Norske Veritas (U.S.A.), Inc. for Trans Mountain (A3S5F4 to A3S5F8).

22. While Nuka Research understands the rationale that DNV and Trans Mountain used to determine that a ship strike is not a credible initiating event, we disagree with the idea that return rates necessarily disqualify larger spill volumes from consideration in planning and risk analysis.

23. In our professional opinion, Trans Mountain, and subsequently the NEB, should have used an 8,000 m^3 spill volume initiated by a tanker strike at berth to assess potential spill trajectories and effects of oil spills from the Terminal, as well as to evaluate on-water response capacity. This would have enhanced overall preparedness and planning for marine spills from the Terminal.

24. Moreover, information in Trans Mountain's application contradicts its decision, which was subsequently adopted by the NEB, to use a release from loading arm as representative of a credible worst case discharge from loading incidents at the Terminal. Trans Mountain's evidence includes a distribution of spills from loading incidents, which I have reproduced below for ease of reference (Table 30).[7] The table sets out the distribution of spill sizes for different scenarios involving a spill during loading operations. It provides that 90% of the time, the release from a loading arm would result in a *small spill*, as compared to releases caused by equipment failure or mooring failure, which would result in a *medium spill* 100% of the time. As a result, a credible worst case scenario from a loading incident should consider potential spill volumes associated with equipment failure or mooring failure, not a spill during loading operations.

Table 30 - Distribution of spills from loading incidents (DNV 2000)

Event	Distribution of medium/small spill	
	Medium spill (%)	Small spill (%)
Release from loading arm	10	90
Failure in equipment	100	0
Failure in the vessels piping system or pumps	10	90
Human failure	10	90
Mooring failure	100	0
Overloading of cargo tank	0	100

3.1.3 Impact to NEB's 2016 Report, Recommendations, and Proposed Terms and Conditions

25. It is international standard best practice for oil spill contingency planning and preparedness to ensure that the capability exists to respond to the worst possible spill, under the worst possible conditions, across the entire vessel route *even if*

[7] B21-1 to B21-3: TERMPOL 3.15 (TR 8C-12) "General Risk Analysis and Intended Method of Reducing Risks," prepared by Det Norske Veritas (U.S.A.), Inc. for Trans Mountain (A3S5F4 to A3S5F8).

such an incident is highly unlikely to occur. Nuka Research provided the NEB with our professional opinion that the 160 m^3 spill to pre-deployed boom during loading operations is not an appropriate worst case scenario, and suggested an alternative reasonable worst case scenario of an 8,000 m^3 spill. Our professional opinion was based on Trans Mountain's application, which shows other possible initiating events that could cause a tanker spill while the tanker is at the Westridge Terminal, including a tanker being struck while at berth.

26. Nuka Research maintains that an 8,000 m^3 spill from a tanker struck at berth at the Westridge Terminal is a reasonable worst case discharge to assess potential impacts to TWN and to evaluate the capabilities and limitations of the on-water spill response system in place to mitigate spills from the Terminal.

27. The Genwest trajectory modeling of an 8,000 m^3 spill, which TWN also submitted to the NEB as part of its written evidence,[8] informed TWN about the potential impacts of a worst case spill at a location that is immediately proximate to their reserve and the high value resources in Burrard Inlet and Indian Arm that TWN relies on. Moreover, Nuka Research's response capacity analysis in our May 2015 Report illustrated the scope and scale of an on-water response that would be necessary to mitigate such a release. The information that these two analyses generate is salient to understanding the potential for a Westridge Marine Terminal spill to adversely impact TWN, and it is salient to understanding the capacity and limitations to mitigating such a spill with on-water containment and recovery.

28. Unfortunately, the NEB set aside both of these analyses based on Trans Mountain's incorrect assertions that such an incident is not likely and therefore not credible.

29. In my professional opinion, the NEB erred in failing to apply the response capacity analysis set out in our May 2015 Report to better understand the potential consequences of an oil spill at the Westridge Marine Terminal, and to evaluate the response system in place. In particular, as described in further detail below in Section 6, the NEB's proposed conditions for the Project are based on: (i) a fundamental underestimate of oil spill risks from the Terminal and shipping activities; and (ii) an incomplete assessment of on-water spill response capabilities and limitations.

[8] C358-13-16: *Oil Spill Trajectory Modeling Report in Burrard Inlet for the Trans Mountain Expansion Project*, prepared by Genwest Systems Inc. for Tsleil-Waututh Nation at 26–35 [TWN Record, Vol 6, Tab 4B at 1010–1019] (A4L6A7).

3.2 16,000 m^3 Oil Spill in English Bay

3.2.1 New Issues Raised by Trans Mountain's Reply Evidence

30. In our May 2015 Report, Nuka Research presents a series of scenarios to compare on-water spill response capabilities and limitations across the tanker routes. For this analysis, we used a worst case discharge volume of 16,000 m^3 at all locations, including an oil spill from a tanker at anchor in English Bay. As stated in our May 2015 Report, scenario locations were selected based on proximity to high consequence areas based on the priorities and concerns identified by TWN, the City of Vancouver, and Tsawout First Nation.

31. Trans Mountain's reply evidence dismisses the English Bay scenario as improbable because of the low likelihood of an initiating event, and suggests that the response capacity analysis for this site should be disregarded. The NEB accepts and adopts Trans Mountain's position that a large spill in English Bay is not a credible worst case scenario. On that basis, the NEB dismisses both Nuka Research's response capacity analysis and Genwest's trajectory analysis for a 16,000 m^3 English Bay spill.[9]

3.2.2 Unsupported or Incorrect Statements or Conclusions

32. Trans Mountain identifies a 16,500 m^3 spill as the "credible worst case" discharge for tankers along the route to and from Westridge Terminal, but based on a route analysis, concludes that the probability of initiating events that could cause a spill this size is credible at locations D through H (see reprint of Figure 39 map, below), but not a locations A through C.

[9] C358-13-16: *Oil Spill Trajectory Modeling Report in Burrard Inlet for the Trans Mountain Expansion Project*, prepared by Genwest Systems Inc. for Tsleil-Waututh Nation at 35–43 [TWN Record, Vol 6, Tab 4B at 1019–1027] (A4L6A7).

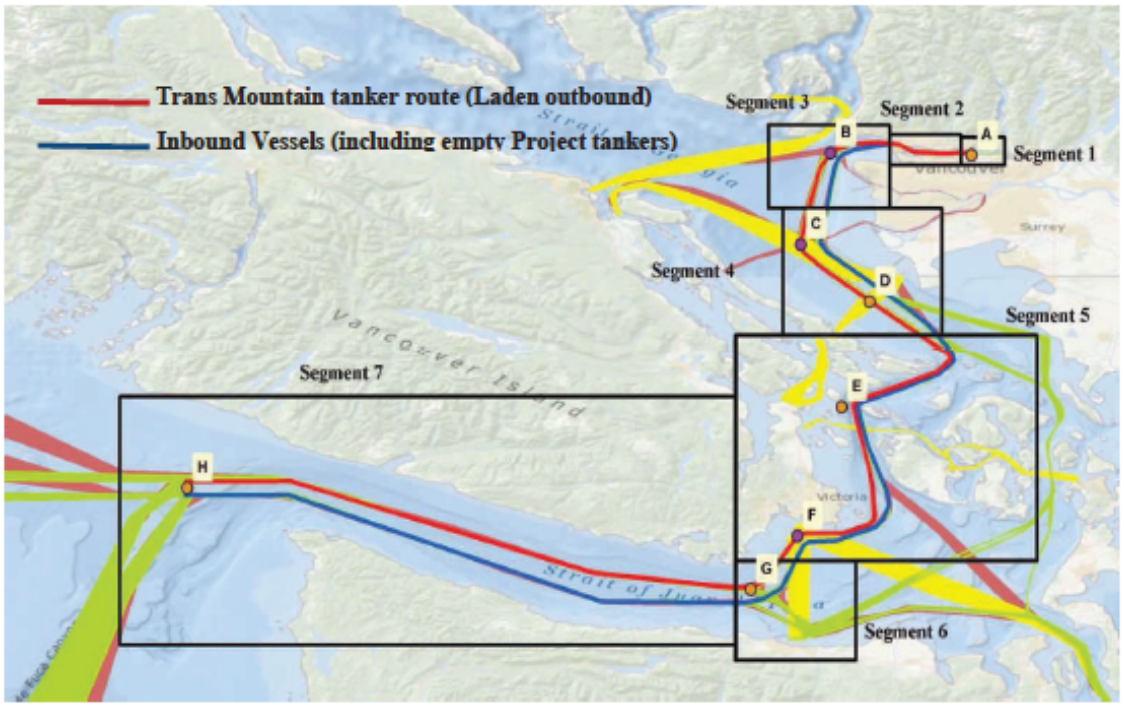

Figure 39 - Hypothetical Accident Locations – assumed oil spill locations in orange

33. Trans Mountain's reply evidence points to this analysis in stating that Nuka Research's analysis of spill response capacity for a 16,000 m^3 spill in English Bay is not credible, since the initiating event is so unlikely. The NEB's May 2016 Report accepts Trans Mountain's position on the following basis:

> The Board does not accept the assertion made by participants that spill volumes ranging from 8 000 m^3 at the Westridge Marine Terminal to 16 000 m3 at other locations in Burrard Inlet are credible worst-case scenarios. The Board notes that Trans Mountain's risk assessments show a very low likelihood of major oil spills within Burrard Inlet and English Bay. No credible large oil spill scenarios in these segments of the transit were identified and this view is supported by the TERMPOL Review Committee's report. Further, in response to a question from Port Metro Vancouver, Trans Mountain filed additional evidence indicating that an incident in Burrard Inlet would not be likely to puncture a double-hulled tanker. Trans Mountain also discussed specific marine safety mitigation measures within Burrard Inlet and area such as pilotage, tug escort, and traffic restrictions. The Board accepts Trans Mountain's evidence in response to the assertion made by Tsleil-Waututh Nation, City of Vancouver and the City of Burnaby that a potential large spill for a tanker at anchor in English Bay is not credible. Among other reasons, Trans Mountain said that there is no incident on record of a vessel being struck by another while at anchor in English Bay; in the event of a collision, there would not be sufficient energy to puncture both hulls of a double hull tanker; and a laden tanker would not be likely to anchor in English Bay.

34. As with the worst case discharge for the Westridge Terminal, the NEB has opted to accept Trans Mountain's assertion that the low probability of certain types of spills occurring renders planning for their occurrence unnecessary. Other experts, such as the Concerned Registered Professional Engineers (CPE), offered analysis to support the fact that Trans Mountain has overlooked potential initiating events—i.e. a laden tanker striking the Second Narrows bridge[10]—that could result in much more substantial spill volumes within Burrard Inlet.

35. In my professional opinion, the NEB's determination that Trans Mountain need not plan and equip for low probability, high consequence events in Burrard Inlet is fundamentally inconsistent with industry standards and best practices. The use of a 16,000 m^3 worst case discharge volume for a spill in English Bay, as we did in our May 2015 Report, is consistent with industry standards and worldwide best practice for developing oil spill response scenarios to support contingency planning and preparedness.

36. For example, the International Association of Oil and Gas Producers has published "Good practice guidelines for the development of an effective spill response capacity,"[11] which contains the following statement:

> Planners should also include an estimation of worst credible case discharge and ensure that the associated scenario is carried forward for consequence analysis.

37. By comparison, the worst case scenario volume for a Trans Mountain tanker in neighboring jurisdictions would be 47,000 m^3 in Alaska,[12] and 120,000 m^3 in US federal waters,[13] and in excess of 120,000 m^3 in the State of Washington.[14] Oil spill contingency plans submitted by vessel operators in any of those jurisdictions would include a worst case scenario for a much larger volume, regardless of how unlikely the initiating event for such a spill to occur.

38. The corresponding response capacity required from tanker operators in any of these neighboring jurisdictions would be significantly higher than the standard to which Trans Mountain would be held based on the NEB 's May 2016 Report. This releases Trans Mountain from the obligation to prepare or equip for a large tanker spill in English Bay or at the Westridge Terminal, to the detriment of TWN and others who would suffer the consequences of an unmitigated spill in Burrard Inlet.

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[10] Concerned Professional Engineers, Letter of Comment filed on July 22, 2015 (A4R6S8).
[11] IPIECA, "Contingency planning for oil spills on water" (April 2015), online: <www.ipieca.org/resources/good-practice/contingency-planning-for-oil-spills-on-water/>.
[12] 300,000 bbl for vessels with a capacity of 500,000 bbl or more (18 AAC 75.437).
[13] The entire cargo of the vessel under adverse weather conditions (33 CFR 155.020).
[14] The entire cargo of the vessel, plus bunker fuels, under adverse weather conditions (WAC 173-182-030(67)(c)).

3.2.3 Impact to NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

39. As we explained in our May 2015 Report, the purpose of selecting the same spill size (16,000 m^3) for multiple locations along the tanker route was to allow for comparison of on-water recovery estimates across these sites in order to understand the impact that environmental conditions, distance from response resources, spill timing, response force composition, and other factors might play in influencing the effectiveness of spill response operations at each location. This type of analysis is more detailed and sophisticated than any spill response capacity estimates provided by Trans Mountain, and its due consideration by the NEB would have enriched the quality of the NEB's recommendations and the conditions attached to it.

3.3 Nuka Research Expert Qualifications

3.3.1 New Issues Raised by Trans Mountain's Reply Evidence

40. Trans Mountain's reply evidence challenges Nuka Research's credibility to develop realistic oil spill scenarios that reflect risk reductions that result from existing or proposed future enhancements to overall system safety.

3.3.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

41. Trans Mountain's reply evidence questions Nuka Research's professional judgment in selecting a worst case discharge scenarios that Trans Mountain's experts do not find "credible." Nuka Research has well established oil spill contingency planning credentials that include extensive scenario development for regulatory and industry emergency response plans as well as for drills and exercises. We have written oil spill scenarios for exploration and production, pipeline, tanker, and oil storage facilities in the U.S., Australia, and West Africa. We have provided expert technical review of oil spill response scenarios and contingency plans under State of Alaska and U.S. federal regulations since 1995. We have provided expert support to inform oil spill capacity analysis and oversight of oil and gas and shipping operations for the Province of British Columbia and the Government of Canada, as well as multiple U.S. jurisdictions. We are currently part of a team of experts engaged by the Clear Seas initiative to inform an understanding of marine casualty risks from vessels operating in Canadian waters, which includes consideration of both risk factors and mitigation measures.

42. Nuka Research is a practitioner of oil spill risk assessment and has conducted oil spill occurrence estimate studies for the U.S. government. In that regard, we have a robust understanding of the limited ability to predict the future occurrence of oil spills based solely on return rate estimates derived from historic spill data. We have also led several prominent risk assessments in the U.S. that have examined

spill occurrence rate estimates and outflow data and offered informed recommendations about risk-based spill scenario development.[15] Based on this experience, it is our professional opinion that the spill size and scenario selected by Trans Mountain as the basis for its spill response planning at the Westridge Terminal and in English Bay significantly underestimates a credible worst case, and in so doing does not adequately consider the risks associated with oil spills from the Project, or their potential consequences.

3.3.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

43. The NEB was faced with differences in professional opinions between Trans Mountain's experts and Nuka Research. Nuka Research conducted primary analysis of on-water oil spill response capacity at the Westridge Terminal and in English Bay, but the NEB dismissed our analysis because they accepted Trans Mountain's opinion that spill volumes of 8,000 m^3 at the Westridge Marine Terminal and 16,000 m^3 in English Bay are not credible worst case volumes because of the low probability of initiating events.

44. The NEB's May 2016 Report recognizes that there are no proposed or widely accepted risk acceptance for marine oil spills.[16] The NEB then proceeds to accepts Trans Mountain's evidence regarding worst case spill volumes at Westridge Marine Terminal and in English Bay as follows:

> The evidence in section 14.4 indicates that a large spill of 8,000 m^3 for a tanker at the WMT or a 16,000 m^3 spill within Burrard Inlet and English Bay area are not credible worst-case spill scenarios. The Board has therefore given little weight to evidence showing potential effects associated with such a scenario or the response capacity analysis commissioned by the City of Vancouver, Tsleil-Waututh Nation and Tsawout First Nation for these areas.

45. Nuka Research agrees that the categorization of risks is necessarily subjective and that risk tolerance is influenced by perception. Oil spills are by nature low probability, high consequence events. For that reason, in our professional opinion, it is critical to balance spill preparedness against considerations of both likelihood and potential consequences. Trans Mountain's approach to oil spill risk assessment, which drives their preparedness to respond, focuses disproportionately on the probability side of the equation. Trans Mountain has designed their worst case spill response planning based on probabilistic modeling of return rates, basing their risk tolerance solely on the likelihood of an event occurring. By limiting their consideration of "credible worst case" to a small spill that is mostly contained at the Terminal and dismissing the possibility of a large

[15] Cook Inlet Risk Assessment, "Final Advisory Report" (January 2015), online: <www.cookinletriskassessment.com>; Aleutian Islands Risk Assessment, online: < www.aleutianriskassessment.com/>.
[16] NEB, 2016, *supra* note 2 at 388.

spill in English Bay, Trans Mountain avoids having to consider the potential consequences of a low probability, high consequence spill at the Terminal or in English Bay, and also avoids the need to plan for such a response.

46. By adopting and applying Trans Mountain's approach, the NEB has failed to assess the consequences and potential effects associated with such scenarios in Burrard Inlet, including the extent to which such oil spills can be cleaned up, in light of the results of Nuka Research's response capacity and gap analyses discussed below.

4. RESPONSE GAP ANALYSIS METHODOLOGY AND OUTPUTS

47. Nuka Research conducted a response gap analysis to estimate the percentage of time that on-water spill response and aerial surveillance could be deployed in relation to the Project based on historical or modeled weather conditions in coastal and marine areas in Southern BC.

48. Key findings set out in our May 2015 Report include:

- response gaps exist along the entire tanker route;
- the response gap is more significant when on-water operations and aerial reconnaissance are considered together;
- response gaps are higher during winter;
- the timing of response gaps is critical to overall response opportunities; and
- lack of a response gap does not guarantee that effective response will occur, only that it is possible.

49. Trans Mountain's reply evidence asserts that there are errors and omissions in Nuka Research's Response Gap Analysis data, methods, and results set out in our May 2015 Report. Trans Mountain's subsequent recalculation of the response gap is based on an incorrect assumption resulting from a typographical error (subsequently corrected) in our May 2015 Report.

50. The NEB acknowledges Nuka Research's Response Gap Analysis in its May 2016 Report, and also recognizes that Trans Mountain did a response gap analysis, although as we noted in our May 2015 Report, the Nuka Research analysis was more comprehensive and technically rigorous than the study submitted by Trans Mountain in their application.

51. The NEB does not indicate in its 2016 Report the extent to which Nuka Research's analysis or findings in relation to response gap analysis were considered in its final recommendations or proposed conditions.

4.1 Missing Wave Data

4.1.1 New Issues Raised by Trans Mountain's Reply Evidence

52. Trans Mountain's reply evidence alleges that Nuka Research's response gap analysis did not consider waves with a height between 0.9 m and 1.2 m with a steepness of less than 0.0025. Consequently, Trans Mountain's reply evidence attempts to revise the response gap analysis outputs based on the assumption that Nuka Research ignored all observations that fall within those wave parameters. Trans Mountain's reply evidence extrapolates from Nuka Research's results in an attempt to reinsert the "missing" data into the analysis, the result of which is a discounted response gap estimate. In so doing, Trans Mountain presented the NEB with a contradicting (and competing) set of response gap values.

4.1.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

53. Trans Mountain correctly identified an oversight in Table 2.2 of our May 2015 Report. Rather than seeking to clarify how this oversight influenced the data analysis (e.g. through an IR to TWN), Trans Mountain incorrectly assumed that Nuka Research had omitted this portion of the data from our analysis and opted to re-analyze our results.

54. Trans Mountain's allegation that wave data was excluded is entirely incorrect. Table 2.2 in our May 2015 Report includes a mistake and does not show the reader how waves with a height between 0.9 m and 1.2 m with a steepness of less than 0.0025 were treated in the model. In fact, these observations were included as "green" conditions. Therefore, there was no justification to adjust our final response gap estimates. Consequently, all of the analysis presented in Section 4.1, 4.2.2.3, 4.2.3, 4.2.4, and 4.2.5, including Tables 4 through 8 and Figures 4 through 6 of Trans Mountain's reply evidence, which is predicated on a revised analysis of our results, is invalid and incorrect.

55. The corrected version of Table 2.2, which I have set out below, clearly shows that the observations alleged by Trans Mountain it its reply evidence to be missing from our analysis were in fact included in the model, and therefore that all contradicting response gap estimates included in Trans Mountain's reply evidence are invalid. Nuka Research can also provide the raw model inputs and outputs to verify that these observations were included in the initial analysis.

Corrected version of Open Water Mechanical Recovery Limits in Table 2.2 from Nuka Research Expert Report

ENVIRONMENTAL FACTOR	GREEN Response: Not Impaired	YELLOW Response: Impaired	RED Response: Not Possible/Effective
Open-water Mechanical Recovery			
W (Wind in m/s)	W ≤ 10	10 < W < 15	W ≥ 15
H (Wave height in meters) S (non-dimensional wave-steepness)	H ≤ 0.9 when S ≥ 0.0025 or H ≤ 1.2 when S < 0.0025	0.9 < H < 1.8 when S ≥ 0.0025 or 1.2 < H < 2.4 when S < 0.0025	H ≥ 1.8 when S ≥ 0.0025 or H ≥ 2.4 when S < 0.0025
V (Visibility in km) Daylight/Darkness	V ≥ 0.9 & Daylight	0.9 > V ≥ 0.2 & Daylight or V ≥ 0.9 & Darkness	V < 0.2 & Daylight or V < 0.9 & Darkness

4.1.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

56. None of the NEB's conditions for Project directly address the response gap issues identified in our May 2015 Report.

57. The NEB's May 2016 Report acknowledges that a response gap exists and that there will be periods of time during which on-water recovery will be precluded, but suggests that other activities such as "shoreline protection or cleanup or tracking of oil" could be conducted during that time. This may be the case during part of the time, but it is important to recognize that shoreline protection, which is typically accomplished using fixed boom arrays adjacent to sensitive shoreline areas, is also subject to environmental limits (wind, current, sea state). The recent *Nathan E Stewart* towing vessel spill illustrated that the same factors that may disrupt on-water recovery will also affect containment at the source and deployment of shoreline protection measures.

58. The NEB's May 2016 Report does not consider the fact that cleanup of oil—presumably along shorelines—occurs *after* shoreline impacts have occurred. While this is still a necessary and important part of a response, by the time it occurs the oil has already impacted the shoreline, habitat, and wildlife. Shoreline cleanup may reduce the opportunity for future damages, but it does not mitigate the initial impacts. In my professional opinion, the NEB should not consider shoreline cleanup as an equivalent mitigation to on-water recovery, because oil that has reached the shoreline will have already created adverse impacts.

4.2 Meteorological Data Sources for Response Gap Analysis

4.2.1 New Issues Raised by Trans Mountain's Reply Evidence

59. Trans Mountain's reply evidence calls into question the choice of data sources for the response gap and response capacity analyses set out in our May 2015 Report. It challenges the selection of specific weather buoys and airport visibility data, and suggests alternate meteorological data sources that we should have considered. It also challenges our use of 2005 data for certain parameters.

4.2.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

60. In our May 2015 Report, Nuka Research recognized that there are limited observation data available for the Study Area, and we were often forced to use data from proximate locations to infer conditions. For example, we agree with Trans Mountain's statement in its reply evidence that the Halibut Bank buoy does not capture conditions for all of the Georgia Strait. We note, however, that it is the only oceanographic observation buoy available. Data availability is a real world constraint that impacts modelers and analysts across disciplines.

61. Nuka Research is wholly transparent in our May 2015 Report about the data sources we used, and we acknowledge where data quality may influence results. The use of closely proximate weather data in cases where data is limited across a geographic area is standard best practice in response gap analyses, and similar to approaches taken by other authors. For example, the response gap analysis commissioned by the NEB for the Beaufort Sea and Davis Strait relied on visibility data from two land-based locations, similar to our reliance on nearby airport visibility data. The 2011 report to the NEB notes, "These two towns provided the closest weather data available for the two areas of interest: appropriate long-term weather data is not available from any specific offshore locations." (SL Ross, 2011) Nuka Research agrees that ideally, all environmental factors would be collected through a single observational dataset at the site of analysis. However, that was not possible as such information does not exist in Southern BC.

62. Trans Mountian's reply evidence lists several Environment Canada weather stations "that could have greatly informed the response gap analysis." Nuka Research reviewed all of these data sources and none would have provided improved data. Trans Mountain's statement in its reply evidence in this regard is inaccurate for the following reasons:

- **Estevan Point** is a lighthouse halfway up the outer coast of Vancouver Island. We did not model an outer coast spill. Estevan Point does not record wave data. The central Juan de Fuca buoy we used is more relevant to our study location and has more complete data.

- **Amphitrite Point** is a lighthouse is outside Ucluelet. It lacks wave data and is not proximate to any of our modeled spill locations.

- **Cape Beale** and **Pachena Point** are also outside Ucluelet. These also lack wave data and are not proximate to any of our modeled spill locations.

- **Carmanah Point** is a lighthouse on Vancouver Island, slightly north of the entrance to the Strait of Juan de Fuca. It is situated on a headland above sea level. The most recent hourly data recorded here is from 2001. The central Juan de Fuca buoy we used is more relevant to our study, since it is on-water and has a more recent, continuous observation set.

- **Trial Island** is situated near the southern entrance to Haro Strait. The only hourly data available from Environment Canada are two incomplete years almost two decades ago: 1997 and 1998.

- **Tsawwassen** is more distant from the response gap analysis sites than the stations we used. It is south of Vancouver near Delta Port.

- **Entrance Island Light Station** is on the south side of the Strait of Georgia, about 12 nm (roughly estimated) from the Halibut Bank buoy. It has wind and air temperature, but no other data (such as waves or visibility). It is a lighthouse located on a small, rocky island and it has hourly data for multiple recent years. It would be relevant for an additional RGA of the south shore in that area, but the Halibut Bank buoy is preferable for a response gap analysis because it has wave observations.

- **Merry Island Light Station** is on the north side of the Strait of Georgia, several nm from the Halibut Bank buoy. The most recent hourly data available is from 2001 and is discontinuous (approximately 5 observations per day). A second Merry Island weather station recorded hourly data only for 1997 and 1998.

63. Trans Mountain in its reply evidence also suggests that the Vancouver Airport would be a more appropriate source for visibility data than the Victoria Airport for the Georgia Strait response gap analysis. Nuka Research selected the Victoria Airport as a better surrogate for on-water conditions in Georgia Strait based on professional judgment and local knowledge from our clients. The impact of using Vancouver Airport data in place of Victoria Airport data would not substantially change the results; visibility limits derived from the Vancouver Airport data create a response gap for on-water response 1% of the time, compared to 2% at the Victoria Airport.

64. Nuka Research acknowledges that we limited our data ranges to 2005 for certain sites and parameters to align our analysis with other expert analysis prepared for our clients. We would have been willing to re-run the response gap analysis for the Central and Outer Harbour sites using 2011-2012 CALMET data, as

suggested by Trans Mountain in its reply evidence, had the NEB provided TWN with an opportunity to respond, and assuming that we could access the 2011-2012 CALMET data. Similarly, we would have been willing to re-run the response gap analysis for Georgia Strait using the data sets recommended in Table 2 of Trans Mountain's reply evidence.

4.2.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

65. The NEB's 2016 Report does not propose any conditions related to the response gap analysis or the limits to available environmental and meteorological data to support future analyses.

66. Nuka's May 2015 Report and Trans Mountain's reply evidence both point out limitations to available meteorological and environmental observation data in the Study Area. Conditions 52 (d) and 125(b)(viii) include provisions that will rely on meteorological data, but the NEB's May 2016 Report does not contemplate how limits to or gaps in observational data will influence these conditions.

4.3 Influence of Swell on Mechanical Recovery Operations

4.3.1 New Issues Raised by Trans Mountain's Reply Evidence

67. Trans Mountain's reply evidence suggests that long-period waves (swell) should be removed from the response gap analysis because they do not impact spill response operations.

4.3.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

68. Trans Mountain's reply evidence cites the CISPRI Technical Manual, which is a technical manual for an Alaska-based oil spill response organization, as stating that swell does not impede response equipment efficiency. It extrapolates that sentence to suggest that swell should be removed from the response gap analysis.

69. Nuka Research agrees that longer period waves do not impact response efficiency *to the same extent* as shorter period waves do. However, there are well-accepted limits to on-water mechanical recovery systems that have been correlated to significant wave height, regardless of period or whether the wave is generated by wind or categorized as swell. Nuka Research's application of response limits in our response gap analysis set out in our May 2015 Report are consistent with other published studies, including a 2011 report commissioned by the NEB for the Canadian Beaufort Sea and Davis Straight, which does not distinguish between wind-generated waves or swell, stating, "In wave conditions exceeding 2 m, oil cannot be effectively contained in booms for recovery by skimmers" (SL Ross, 2011).

70. The response gap methods in Nuka Research's May 2015 Report align with other published studies in including swell but treating short-period wind driven waves as a more significant limit than long period waves.

4.3.3 Impact to NEB's May 2016 Report, Recommendations, and Proposed Terms Conditions

71. The NEB's May 2016 Report does not propose any conditions related to the response gap analysis or the limits to effective oil spill recovery based on meteorological and oceanographic conditions. We note in Section 3.2.3 that some of the conditions that the NEB has proposed may rely on incomplete or non-existent meteorological or oceanographic data.

4.4 Spectral analysis of waves

4.4.1 New Issues Raised by Trans Mountain's Reply Evidence

72. Trans Mountain's reply evidence provides a detailed discussion of the complexities in categorizing waves in the Study Area, particularly the western entrance to Juan de Fuca Strait (Neah Bay). It states that the wave spectrum in this area is complex, and suggests that Nuka Research's study should have characterized the waves with more granularity. It also questions the methods that Nuka Research used to characterize wave parameters and suggests that we should provide an update to the report to clarify this point.

4.4.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

73. Trans Mountain's reply evidence correctly explains that waves are complex, and that characterization of waves requires a consideration of the many complex components that drive sea conditions.

74. Nuka Research agrees that the response gap analysis methods simplify wave parameters for the purpose of analysis. However, there are no existing response gap models that can address these more nuanced wave parameters because of the manner in which response gap limits are derived. As explained in our May 2015 Report, the response limits applied in our analysis were derived originally through a consensus process in Alaska where experts from oil spill response organizations, regulators, and industry agreed to classify operating limits for various classes of equipment based on simplified environmental parameters—wind speed, wave height, wave steepness, and horizontal and vertical visibility. These limits were further vetted through peer review of response gap analyses by the National Academy of Sciences. They reflect decades of field experience deploying mechanical recovery equipment on water, and the industry best practice that recognizes sea state—primarily wave height and steepness—as a factor that limits and eventually precludes safe or effective booming and skimming operations at various thresholds based on the type of equipment.

75. Nuka Research's methodology for assigning operating limits based on simplified wave parameters is consistent with the state-of-knowledge in the response gap analysis field.[17] For example, a 2014 response gap analysis by DNV simplified wave observations based on significant wave height and period. This is comparable to our approach, which used a steepness value that is derived from wave period.[18] Trans Mountain's suggestion in its reply evidence that the response gap analysis should have considered the wave spectrum in greater detail belies a general lack of understanding about how mechanical oil spill response system operating limits are established.

76. Nuka Research is a recognized expert in response gap analyses, having pioneered the concept and methodology. We recently completed a peer-reviewed response gap analysis in the U.S. Arctic Ocean for the Bureau of Safety and Environmental Enforcement[19] and are presently working with DNV-GL, under contract to the Arctic Council Emergency Prevention, Preparedness and Response (EPPR) working group, on a circumpolar oil spill response gap analysis jointly funded by the U.S. and Norwegian governments.[20] We were also recently hired to conduct a Gulf of Mexico Response Viability Analysis for the Bureau of Safety and Environmental Enforcement.[21]

4.4.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

77. The NEB's May 2016 Report does not propose any conditions related to the response gap analysis or the limits to effective oil spill recovery based on sea state or other environmental conditions.

5. OIL SPILL RESPONSE CAPACITY ANALYSIS

78. In our May 2015 Report, Nuka Research conducted a marine oil spill response capacity analysis to estimate the amount of oil that could be recovered from a worst case spill to coastal and marine waters in the first three days after the spill occurs, which is the critical window-of-opportunity to mitigate impacts. The analysis led to the following findings:

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[17] See SL Ross, 2011, Terhune, 2011, DNV-GL, 2014, and Nuka Research, 2006; 2007a; 2007b; 2008; 2012; 2014a; 2014b.

[18] Wave steepness is calculated as: Wave Height/(Gravity * Wave Period * Wave Period). The resulting value is nondimensional (does not have units) because the units used to calculate the value cancel out.

[19] Bureau of Safety and Environmental Enforcement, "OSRR-1022-Estimating an Oil Spill Response Gap for the U.S. Arctic Ocean," online: <https://www.bsee.gov/research-record/osrr-1022-estimating-oil-spill-response-gap-us-arctic-ocean>.

[20] Emergency Prevention Preparedness and Response, EPPR Working Group Meeting, "Impact of Metocean Conditions on Oil Spill Response Viability in the Arctic" (December 2–3, 2015) , online: <www.arctic-council.org/eppr/wp-content/uploads/2015/06/2015_11_16_COSRVA_Analysis_Update.pdf>.

[21] Contract #GS-10F-164AA, recently awarded.

- spill response capacity is lower across all location during winter;
- delays to response implementation significantly decrease oil recovery;
- shoreline stranding reduces the volume of oil available for on-water recovery;
- additional response forces are necessary to achieve the modeled oil spill recovery estimates;
- force distribution is critical to on-water oil recovery;
- night operations modestly increase oil recovery; and
- ohanges to oil properties may reduce on-water spill recovery.

79. Trans Mountain's reply evidence questions the validity of the model, the qualifications of Nuka Research to conduct this modeling, and certain specific model outputs.

80. The NEB's May 2016 Report acknowledges the response capacity analysis and recognizes generally that the factors analyzed may impact spill response efficacy, but does not apply any of Nuka Research's analysis to develop its recommendations in relation to the Project or the terms and conditions it has proposed.

5.1 Suitability of ROC Model for Response Capacity Analysis

5.1.1 New Issues Raised by Trans Mountain's Reply Evidence

81. Trans Mountain's reply evidence calls into question the suitability of the ROC model that Nuka Research used in our May 2015 Report, referring to it as an "on the fly" tool that is inferior to the SPILLCALC model for the purpose of estimating oil spill response capacity.

5.1.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

82. The characterization of ROC as a sloppy or *ad hoc* modeling tool is inaccurate. The ROC model, developed by Genwest Systems for the U.S. National Oceanic and Atmospheric Administration, is a peer-reviewed model that was recently described in a report commissioned by the U.S. government as follows:

> The ROC was designed as a scientifically advanced model to handle a broad range of oil types, predicting the hourly thickness of an oil spill using a combination of calculations involving the oil characteristics and environmental conditions selected by the user. One can also select a constant thickness for a set of conditions over a specified period of time. The calculator performs its calculations by allowing for the weathering

> and spreading of a spill, or by using a constant oil thickness. It performs its calculations over intervals of one hour, providing detailed results of system performance for mechanical recovery systems, chemical dispersant application systems, and for vessels deployed to conduct controlled in-situ burns.[22]

83. The U.S. Coast Guard and the Bureau of Safety and Environmental Enforcement commissioned that 2012 study to consider whether a simplified version of ROC could be used to assess compliance with oil spill response planning standards for U.S. offshore oil and gas operations, and concluded that the model was the preferred option for improving on the current U.S. federal response planning standard, which is based on the effective daily recovery capacity (EDRC) of skimming systems.[23] The fact that the U.S. government is considering regulatory changes to adapt a ROC-derived system for assessing compliance with oil spill contingency plans speaks to the appropriateness of this model to evaluate spill response capacity, which is exactly how it was used by Nuka Research in our May 2015 Report.

84. More recently, the Royal Society of Canada recognized the important role that models such as ROC may play in better understanding oil spill response capacities and constraints as follows:

> Research is needed to develop physical and numerical models for simulating, predicting and optimizing response processes and evaluating their individual and collective effects on response decision and effectiveness, particularly in terms of accuracy and adaptability to different environmental conditions. The dynamic links with spill modeling and decision-making should also be realized.[24]

85. SPILLCALC is proprietary software that was developed by TetraTech, one of Trans Mountain's experts. In our professional opinion, the SPILLCALC model is not superior to the tools we used for our analysis. There are a number of different modeling approaches to estimating oil spill response capacity; the existence of competing models does not invalidate our methods or selection of modeling tools.

5.1.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

86. The NEB's May 2016 Report disregards two of the scenarios presented in Nuka Research's response capacity analysis for reasons described in Section 5.1.2. In particular, the NEB acknowledges the key findings of the response capacity analysis, but does not propose any conditions that relate to the fact that spill

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[22] Genwest & Spilltec, 2012.
[23] Genwest & Spilltec, 2012.
[24] Royal Society of Canada et al, *Expert Panel Reports*, "The Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments" (25 November 2015) at 271, online: <www.rsc.ca/en/expert-panels/rsc-reports/behaviour-and-environmental-impacts-crude-oil-released-into-aqueous>.

response capacity will be limited by factors such as environmental conditions, response force composition and distribution, and reporting or notification delays.

5.2 Credibility of Experts as Marine Oil Spill Responders

5.2.1 New Issues Raised by Trans Mountain's Reply Evidence

87. Trans Mountain's reply evidence states that Nuka Research's methods and results "demonstrate a lack of understanding regarding the operation of spill response equipment and fail to recognize the critical path decisions field responders must make during an incident." The evidence calls into question assumptions regarding the use of open water assets in protected water operating environments, the effectiveness of on-water recovery operations at night, and the capacity for oleophilic skimmers to recover submerged oil.

5.2.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

88. Trans Mountain's reply evidence suggests that Nuka Research has academic experience with spill response rather than hands-on field experience, and that, consequently, the assumptions and methods used in our analysis are invalid. This is inaccurate.

89. Nuka Research's experience is very much grounded in real world operations. The team of authors and analysts that prepared this analysis include experienced field responders who have deployed skimmers and boom during actual oil spills dating back to the *Exxon Valdez* oil spill and spanning through until present day, including coordinating offshore skimming operations during the Macondo well blowout in the Gulf of Mexico in 2010. One of the authors of Nuka Research's May 2015 Report is an instructor for the U.S. Coast Guard's Oil Spill Response Technician training course, where he teaches Coast Guard personnel how to operate skimming systems in a test tank using actual oil. We run a program in the U.S. that has trained over 1,000 first responders in protective boom deployment. We have developed oil spill tactics guides and training materials for government and industry clients, including major international oil companies and U.S. oil spill removal organizations. Our credentials and experience as practitioners of oil spill response are significant and well-established.

5.2.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

90. The NEB's May 2016 Report acknowledges some of the findings from our response capacity analysis but does not link this information to its recommendations or the terms and conditions it has proposed for the Project.

5.3 Night Response

5.3.1 New Issues Raised by Trans Mountain's Reply Evidence

91. Trans Mountain's reply evidence challenges the conclusions that Nuka Research reached in our May 2015 Report in relation to the feasibility and effectiveness of on-water oil recovery at night.

5.3.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

92. Table 8 in Trans Mountain's reply evidence recalculates our response gap estimates based on the incorrect assumption that there was a gap in the wave record (see discussion in Section 2.1 of this report). It does so by applying a discount to the response gap estimates shown in Table 2.3 of our May 2015 Report, which show how the aerial reconnaissance response gap contributes to the overall gap at each location. The response gap estimates shown in Table 8 of Trans Mountain's reply evidence as "Nuka Research, unadjusted" represent the response gap estimate for each location when aerial surveillance is not considered. Trans Mountain suggests in its reply evidence that this is the only response gap that should be considered, because of improvements in remote sensing technology that make on-water recovery at night potentially feasible at some locations under the right conditions.

93. Nuka Research disagrees with eliminating aerial reconnaissance from the response gap estimates; to do so would be to overestimate the opportunity to respond to an oil spill. Nuka Research agrees that remote sensing may be feasible in some circumstances to support on-water recovery where aerial surveillance is not possible. However, in our professional opinion, it is unrealistic and imprudent to assume that remote sensing can be substituted for visual observation in all circumstances or with an equivalent level of functionality. We were very clear in reporting the separate components of the response gap to plainly show how each factor contribute to the overall response gap, and present response gap estimates both with and without visibility limits. However, in our professional opinion, Trans Mountain has not presented adequate information to support its assumption that remote sensing could be substituted for aerial reconnaissance to overcome the contribution of visibility limits to the response gap.

94. In discussing night operations with respect to the response capacity analysis, Trans Mountain states in its reply evidence that:

> Worldwide, professional spill responders recognize that night time operations cannot be ignored; technology is being developed and employed to improve the safety and performance of night time operations. Currently night operations are unlikely to be as

> comprehensive as daytime operations but it is an unfounded assumption that all response efforts will cease during hours of darkness.[25]

95. Nuka Research agrees with this characterization, and our May 2015 Report does not assert that all response efforts will cease during hours of darkness. We acknowledge that certain activities may continue during the night, such as resupply and repair of equipment. We also acknowledge that night operations may be feasible, and in fact we run a sensitivity analysis to evaluate the improvements to total response that are gained from conducting night operations. Our method in that case applies a discount to total recovery at night to account for the fact that operations would typically be conducted slower and may be much less efficient due to the additional challenges of using remote sensing technologies to communicate slick positions to on-water strike teams.

96. We agree with Trans Mountain's reply evidence that night operations is an area where technological improvements are likely in coming years; however, it is our professional opinion that night operations should not be relied upon when assessing overall response capacity, as this capability is evolving and unproven in the Study Area.

5.3.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

97. The NEB's May 2016 Report does not address night operations directly, but does generally affirm that the response capacity presented in the Trans Mountain application satisfies their obligations for oil spill response.

98. The NEB's May 2016 Report and proposed conditions underestimate the potential for on-scene conditions to limit oil spill response capacity, leading to an overestimation of the capacity to mitigate oil spill impacts.

5.4 Systematic Approach to Prevention and Response

5.4.1 New Issues Raised by Trans Mountain's Reply Evidence

99. Trans Mountain's reply evidence asserts that Nuka Research's response gap, response capacity, and Fraser River logistics analyses are invalid because they do not take into account oil spill prevention and risk reduction measures in place or proposed for the Project.

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[25] B440-1-1: Trans Mountain, "Reply to the City of Vancouver, Tsleil-Waututh Nation, City of Burnaby, Metro Vancouver, 'Technical Analysis of Oil Spill Response Capabilities and Limitations of the Trans Mountain Expansion Project'" (December 2015) at 21–22 (A4W317).

5.4.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

100. Nuka Research was hired by three Interveners to complete a series of analyses that consider the capacity to respond to oil spills based on a variety of methods. All of our analyses relate to oil spill contingency planning and response preparedness. It is industry best practice to approach contingency planning from the assumption that oil spills – however unlikely – can and do occur. We absolutely agree with Trans Mountain's reply evidence that oil spill prevention and risk mitigation measures are critical to the overall project safety. However, our professional experience has been that oil spills do still occur, even in the safest of systems. It is impossible to foresee and pre-empt all possible accident scenarios, and for this reason we engage in contingency planning.

101. We strongly disagree with statements in Trans Mountain's reply evidence which suggest our analysis is unrealistic or irrelevant because Trans Mountain has proposed a systematic approach. Any system that relies on human operators is vulnerable to failure, and Trans Mountain is no exception.

102. In its reply evidence, Trans Mountain traces its risk-based approach back to Environment Canada evidence submitted during the Enbridge Northern Gateway Hearing. The referenced evidence suggested that a risk assessment process similar to the Aleutian Islands Risk Assessment should be implemented. Nuka Research was the lead contractor on the Aleutian Islands Risk Assessment, and we are well versed in its methodology, which is derived from a special report by the U.S. National Academies of Science recommending a stakeholder-based approach to risk assessment. *In our assessment, nothing in the Trans Mountain risk-based approach aligns with the Aleutian Islands Risk Assessment or the approach recommended by the National Academies*.

5.4.3 Impact to NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

103. The NEB's May 2016 Report generally affirms Trans Mountain's spill prevention and response system, noting:

> Parties such as City of Vancouver, City of Burnaby and the Province of British Columbia argued that Trans Mountain had not provided enough information to inform the Board about emergency preparedness and response. The Board does not share this view. The Board finds that a large spill, due to a malfunction or accident from the pipeline or the terminals, can be mitigated through prevention measures as well as being prepared and response ready. The Board finds that Trans Mountain and other parties have provided extensive evidence regarding oil spill modelling, prevention measures, firefighting systems and firefighting activities at terminals, planning and response to inform the Board's views and requirements regarding malfunctions, accidents, and emergency preparedness and response planning at this stage and for the

> condition compliance stage of the lifecycle regulatory process. The Board also finds that the broad range of spill prevention and mitigation measures committed to by Trans Mountain, including those to address human error for control centre personnel, are comprehensive and appropriate.[26]

104. Nuka Research disagrees with the NEB's assessment, because in our professional opinion Trans Mountain's application and reply evidence underestimate the potential for low likelihood, high consequence events to cause adverse impacts that cannot be mitigated. Our analysis, which was largely dismissed by the NEB in its May 2016 Report, establishes that larger worst case spill volumes should have been considered to inform oil spill response capacity. While it is impossible to predict whether Trans Mountain's prevention measures will effectively prevent all possible initiating events that could lead to an oil spill, in our professional opinion the NEB erroneously concluded that a large spill can be mitigated by being "prepared and response ready." Our professional opinion is based on our conclusion that Trans Mountain has not demonstrated that it is prepared and response ready to mount an effective response in Burrard Inlet for a worst case spill under adverse conditions.

6. FRASER RIVER RESPONSE ANALYSIS

105. In our May 2015 Report, Nuka Research conducted a Lower Fraser River response logistics analysis to estimate the mobilization and downstream transport of oil spills on the Lower Fraser River. We concluded that:

- timing is critical for river response;
- available river response resources are limited;
- available oil spill response equipment is appropriate for floating oils only, but a spill to the Lower Fraser River may submerge or sink;
- oil spill response in high velocity currents requires special capabilities that are not currently in place in the region; and
- pre-planned logistics are critical to successful river spill containment but have not been provided in Trans Mountain's application.

106. Trans Mountain's reply evidence challenges the validity of our analysis on several fronts, including the contention that a spill to the Fraser River is highly unlikely, challenges to assumptions about river flow and response equipment, and statements regarding the intention to develop future plans for the Lower Fraser River. The NEB's May 2016 Report adopts Trans Mountains statements about

[26] NEB, 2016, *supra* note 2 at 143.

response, and finds that Trans Mountain outlined sufficient planning and preparedness activities to manage spills to the Lower Fraser River.

6.1 Unlikelihood of Oil Spill Reaching Fraser River

6.1.1 New Issues Raised by Trans Mountain's Reply Evidence

107. Trans Mountain's reply evidence asserts that the oil spill scenario which underlies the river response logistics analysis in our May 2015 Report is implausible because of the risk-based design of the pipeline expansion. It characterizes our study assumptions as incorrect because a spill to the Fraser River is an unlikely event.

6.1.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

108. Nuka Research was contracted to analyze response logistics and capacity to control a spill on the Fraser River. It is our professional opinion that no pipeline is spill-proof and that a spill to the Fraser River is a credible scenario that would have significant adverse consequences to the Fraser River Delta. It is impossible to develop a spill response scenario without first presuming a spill. This is a standard and necessary planning assumption for the type of analysis we performed.

6.1.3 Impact to NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

109. The NEB's May 2016 Report considers the evidence in our expert report and Trans Mountain's reply evidence and concludes that:

> …adequate preparation and planning can lead to an effective response, but the ultimate success of the response would not be fully known until the time of the spill event due to the many factors which could inhibit the effectiveness of the response.[27]

110. The NEB cites Condition #153 as being designed to address this issue. The NEB indicates that it is content with Trans Mountain's stated intent to develop tactical plans that will enhance the ability to control spills to the Lower Fraser River.

111. Nuka Research cannot evaluate plans that we have not developed or were not submitted as evidence in the NEB hearing, but based on Trans Mountain's wholesale dismissal of our analysis, we are concerned that their tactical response planning may not adequately consider the critical elements of downstream transport, response logistics, and fast water booming challenges when developing plans and staging equipment.

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[27] NEB, 2016, *supra* note 2 at 157.

6.2 Lower Fraser River Flows

6.2.1 New Issues Raised by Trans Mountain's Reply Evidence

112. Trans Mountain's reply evidence asserts that the flow rates used in our May 2015 Report are too high and do not take into account flow reversal due to tidal influence or low flow rates.

6.2.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

113. Nuka Research used published data as reference in our May 2015 Report, which includes a Trans Mountain study conducted by DNV, as the basis for our flow rates. We stand by the flow rates as reasonable for the purpose of our analysis, which was to consider time-to-intercept oil at critical control points during times when downriver flow creates a threat that oil would reach the Fraser River Delta, a high value resource to our clients.

114. Nuka Research agrees that our study does not consider flow reversals, but our May 2015 Report recognizes that upstream flow occurs and can be a significant planning factor. Because our study was focused on potential impacts to the Fraser River Delta, we did not assess upriver flow. Footnote 50 in our May 2015 Report acknowledges that this may be an important consideration for Trans Mountain as they develop future river contingency plans.

6.2.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

115. The NEB's May 2016 Report accepts the level of planning described by Trans Mountain as appropriate to prepare for transport of oil spills on the Fraser River. Nuka Research offered more substantial analysis of potential time-to-intercept, which was not considered by the NEB in its May 2016 Report. Trans Mountain dismissed our analysis, and the NEB has accepted Trans Mountain's evidence, attaching a proposed condition (#153) requiring the development of tactical response plans. Based on Trans Mountain's lack of consideration for the logistical and planning challenges described in detail in our May 2015 Report, it is our professional opinion as tactical response planners that Trans Mountain may not fully appreciate the potential for a spill to the Lower Fraser, during certain conditions, to escape containment and migrate to the Fraser River Delta before adequate containment tactics can be deployed.

6.3 Response Equipment Caches

6.3.1 New Issues Raised by Trans Mountain's Reply Evidence

116. Trans Mountain's reply evidence asserts that Nuka Research did not consider the full complement of spill response equipment available to Trans Mountain as described in various application documents.

6.3.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

117. Trans Mountain's reply evidence lists equipment inventories for WCMRC South Coast caches and OSCAR trailers. These include trailers in Kamloops, Blue River, Jasper, and Stony Plain. Nuka Research did not include these four trailers in our analysis because of their geographic distance from the Lower Fraser River. It is our professional opinion as oil spill contingency planners and responders that those resources would be unlikely to be mobilized in time for initial containment of a Lower Fraser River pipeline spill.

118. Trans Mountain's reply evidence suggests that Nuka Research did not consider all response resources available to the Project. Trans Mountain's assertion is patently wrong. In fact, it appears that Nuka Research **overestimated** the available boom. Not including those four interior OSCAR trailers, Trans Mountain's reply evidence shows 8,800 feet of available boom (850 ft at Westridge OSCAR, 1200 ft at Burnaby OSCAR, 750 ft at Hope OSCAR, and 6,000 ft in WCMRC South Coast caches). Our analysis presumes that much higher quantities of boom would be available, based on our review of Project materials supplemented by primary research into the WRRL (a database of spill response resources maintained by the U.S. but including equipment in BC). We assumed that there was 17,500 feet of boom within 2 hours of the Lower Fraser River and another 13,000 feet of boom in warehouses within 6 hours of travel.

119. As noted in our May 2015 Report, Nuka Research found it extremely difficult to determine response resource inventories, and the confusion between the quantities provided in Trans Mountain's reply evidence and in our May 2015 Report point to the fact that it is nearly impossible to actually pin down the response resource inventory available to Trans Mountain. For example, Trans Mountain's reply evidence states that WCMRC has 6,000 feet of fast water boom in their South Coast industry. We did not see any notation to this effect in the application. Generally, we found the description of boom inventories to be very vague. We are accustomed to categorizing response equipment according to industry conventions, based upon boom specifications (size, type, manufacturer) rather than using general terms like "containment" or "river" boom. The lack of clarity in the application materials makes meaningful analysis of spill response capacity very challenging.

6.3.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

120. The NEB's May 2016 Report states that:

> The Board is satisfied that Trans Mountain has access to internal and external equipment and has mutual aid agreements in place to execute, if needed, should an incident occur.[28]

121. As a practitioner of oil spill response planning and preparedness analysis, in our professional opinion the information presented in the Trans Mountain application and in its reply evidence is in fact fragmented and contradictory, and is not sufficient to assess or make any definitive determinations regarding the capacity that may or may not be in place to contain and recover a spill to the Lower Fraser River.

6.4 Future Response Plans

6.4.1 New Issues Raised by Trans Mountain's Reply Evidence

122. Trans Mountain's reply evidence describes efforts to develop geographic response plans (GRP) along the Lower Fraser River, among other areas. It characterizes Nuka Research's selection of control point locations as unrealistic and inconsistent with these future response plans.

6.4.2 Unsupported or Incorrect Statements or Conclusions in Trans Mountain's Reply Evidence

123. Nuka Research acknowledged in our May 2015 Report that we had to select control points based on our best professional opinion because the application did not specify how or where Trans Mountain intends to control a spill to the Lower Fraser River. Nuka Research is certainly qualified to select control points for GRPs or tactical response plans; we have developed GRPs for over 900 sites in the U.S., Canada, and Australia, including inland rivers.

6.4.3 Impact to the NEB's May 2016 Report, Recommendations, and Proposed Terms and Conditions

124. The NEB's May 2016 Report accepts Trans Mountain's commitments to develop GRPs in the future as sufficient consideration for controlling the migration of spills on rivers. Nuka Research completed our analysis based on the timelines established by the NEB, such that we have not had the opportunity to review Trans Mountain's future GRPs. Without the opportunity to review these plans, Nuka Research cannot make any assumptions about their validity or Trans Mountain's ability to implement them effectively. Given that there is existing risk of an oil spill to the Lower Fraser River from Trans Mountain's current

[28] NEB, 2016, *supra* note 2 at 157.

operations, our professional opinion is that GRPs should already have been developed and tested, and equipment caches established to support their deployment.

7. NEB CONDITIONS FOR TRANS MOUNTAIN PROJECT

125. Nuka Research was asked to review the conditions recommended by the NEB in its May 2016 Report as they relate to the analysis and conclusions in our May 2015 Report. As summarized above by topic, the NEB generally disregarded most of our analysis and conclusions, and accepted the information provided by Trans Mountain in their project application and reply evidence as sufficient to support the NEB's recommendation to issue a certificate of public convenience for this Project.

126. In reviewing the 157 conditions, Nuka Research noted that all but six of these relate to administrative or planning requirements. As professional contingency planners who have engaged in regulatory and peer review of oil spill and emergency response plans for decades, we emphasize that the requirement to develop a plan does not in and of itself ensure that the plan will be comprehensive, actionable, or effective. The contingency planning process is necessarily iterative, and no plan should be considered complete until it has been exercised.

127. The NEB conditions that relate to issues Nuka Research raised are:

- Condition 91: Plan for implementing, monitoring, and complying with marine shipping-related commitments;
- Condition 117: Reporting on improvements to Trans Mountain's Emergency Management Program;
- Condition 119: Emergency Preparedness and Response Exercise and Training Program;
- Condition 120: Notification and reporting on emergency response exercises;
- Condition 124: Implementing improvements to Trans Mountain's Emergency Management Program;
- Condition 126: Emergency Response Plan for the Westridge Marine Terminal;
- Condition 131: Marine public outreach program;
- Condition 133: Marine shipping-related commitments;

- Condition 134: Updated tanker acceptance standard;
- Condition 136: Pre-operations full-scale emergency response exercises;
- Condition 144: Ongoing implementation of marine shipping-related commitments; and
- Condition 153: Full-scale emergency response exercises during operations.

7.1 Comments on Conditions that Relate to Oil Spill Planning, Preparedness, and Emergency Response

Condition 91: Plan for implementing, monitoring, and complying with marine shipping-related commitments and Condition 133: Marine shipping-related commitments

128. Condition 91 requires that Trans Mountain prepare a plan for implementation of Condition 133 in consultation with external parties. There exist a wide range of concerns, priorities, and expectations across the entities named in the condition. It is unclear whether the NEB expects Trans Mountain to ensure that the plan satisfies all of these parties, or whether Trans Mountain must simply discuss the plan with them and then submit it, in order to satisfy the condition. If it is the latter, this is more of an administrative than a substantive requirement.

129. Condition 133 requires a commitment from Trans Mountain to implement, or indicate a commitment to implement, a tug matrix and an enhanced (20,000 t) spill response regime. Nuka Research's May 2015 Report analyzes oil spill response capacity by modeling hypothetical response to a range of scenarios, based on the location and composition of response resources. The assertion by Trans Mountain that they have a 20,000 t spill response capacity would not necessarily change any of the conclusions or observations in our May 2015 Report; we would need to re-run the analysis with the new or additional capacity to consider how this enhanced regime would influence the estimated response capacity.

Condition 117: Reporting on improvements to Trans Mountains' Emergency Management Program

130. Condition 117 requires progress reports on the emergency management program, outlining plans for the Emergency Management Program at least 2 years and 1 year prior to commencing operations. This is primarily an administrative requirement and does not alter any of the conclusions in Nuka Research's May 2015 Report.

Condition 119: Emergency Preparedness and Response Exercise and Training Program

131. Conditions 119(a) through (h) are largely administrative requirements. While it is important that Trans Mountain develop an objectives-based training and exercise program, with a schedule of events and benchmarks for measuring performance, the design of this program on paper does not guarantee its successful implementation. Condition 119(i) requires third party confirmation but does not expand on the requirements. The condition does not alter any of the conclusions in Nuka Research's May 2015 Report.

Condition 120: Notification and reporting on emergency response exercises, Condition 136: Pre-operations full-scale emergency response exercises; and Condition 153: Full-scale emergency response exercises during operations

132. Condition 120(a) establishes a 45-day requirement for notifying participants and observers ahead of emergency response exercises. Condition 120(b) establishes after-action reporting requirements. Providing adequate notice ahead of exercises and filing after-action reports are both standard practice in most exercise programs.

133. Condition 136(a)(i) requires a pre-operations full-scale emergency response exercise that demonstrates the ability to respond to a 160 cubic meter spill at Westridge, and that also "consider(s) emergency preparedness and response planning for a release that exceeds the credible worst case spill scenario event." Condition 136(b) requires external notifications 45 days in advance of an exercise, but it is not clear whether this means that all notified parties would be invited to observe the exercise. Condition 153 establishes similar expectations for exercises once operations are underway.

134. These conditions do not alter any of the conclusions in Nuka Research's May 2015 Report.

Condition 124: Implementing improvements to Trans Mountain's Emergency Management Program

135. Condition 124(a-c) appears to require that Trans Mountain prepare a summary of changes to their emergency management program for NEB review, but does not require actual review of the primary documents by NEB or other levels of government. Condition 124(c) addresses site-specific planning, which is of high interest to Tsleil-Waututh, but does not include a requirement for coordination with First Nations and other levels of government in developing GRPs, control point plans, tactical plans for submerged and sunken oils, and other activities that may impact the coastal resources of other jurisdictions.

136. Condition 124(ii) requires that the summary of the work describe for the NEB how the plans "consider, and would allow coordination with relevant federal, provincial, municipal, and Aboriginal community emergency response plans." It appears that the NEB is asking Trans Mountain to describe how they will coordinate, without actually ensuring that the coordination occur, or that it is done meaningfully or to the satisfaction of other parties. Condition 124(v) requires third party confirmation but does not expand on the requirement.

137. Nothing in Condition 124 changes any of the conclusions in Nuka Research's May 2015 Report.

Condition 126: Emergency Response Plan for the Westridge Marine Terminal

138. Condition 126 requires the Westridge Marine Terminal emergency response plan to be filed with the NEB at least 6 months prior to commencing operations, and specifies that the plan must include certain information.

139. Condition 126 does not alter any of the conclusions in Nuka Research's May 2015 Report.

Condition 131: Marine public outreach program

140. Condition 131 requires outreach activities that include: coordination with the Pacific Pilotage Authority (PPA); consultation with First Nations, other levels of government, and stakeholder groups; developing a plan for future outreach; and developing summaries of consultations conducted as of 3 months prior to commencing operations. The condition is written such that only the PPA consultation appears to require that Trans Mountain consider feedback received. Other outreach activities appear to involve information dissemination only, with little opportunity for groups such as TWN ("potentially affected Aboriginal groups") to engage in a meaningful dialogue or provide input on substantive issues.

141. Condition 131 does not alter any of the conclusions in Nuka Research's May 2015 Report.

Condition 134: Updated tanker acceptance standard

142. Condition 134 specifies that the Tanker Acceptance Standard must be updated, but does not provide any substantive technical requirements that the standard should meet, therefore it is unclear how this condition will meaningfully improve the tanker vetting process.

143. Condition 134 does not alter any of the conclusions in Nuka Research's May 2015 Report.

Condition 144: Ongoing implementation of marine shipping-related commitments

144. While First Nations are included in the report distribution for other conditions, Condition 144 excludes First Nations from the list of entities to receive copies of the annual marine shipping-related commitment report.

145. Condition 144 does not alter any of the conclusions in Nuka Research's may 2015 Report.

7.2 Issues raised in Nuka Research Expert Analysis that are not resolved through NEB Conditions

146. Nuka Research conducted three primary analyses based on the information in the Trans Mountain application to assess oil spill response capacity and limitations for spills to Burrard Inlet, Georgia Strait, and the Fraser River. We highlighted three key issues that were common to all of our findings:

- Timing is critical to oil spill response capabilities and limitations;
- The type, quantity, and location of oil spill response equipment is critical; and
- Planning assumptions should be verified and information gaps filled.

147. Based on our review of the NEB's May 2016 Report and the 157 conditions attached to its recommendation to approve the Project, in our professional opinion the NEB has failed to require that Trans Mountain provide sufficiently detailed information to address these three important points.

7.2.1 Timing of Spill Response

148. Nuka Research's May 2015 Report illustrates how oil spill containment and recovery is a race against time. We highlighted specific factors that may delay and therefore diminish response, including: delayed oil spill reporting or detection; occurrence of adverse environmental conditions that make response unsafe or unfeasible (response gap); or delays in mobilizing, transporting, and deploying response equipment. Nuka Research provided initial primary analysis to estimate some of these factors, but more work is required. The NEB missed an opportunity, during the NEB hearing for the Project, to require Trans Mountain to conduct baseline studies to estimate spill timing factors and then revisit these as a measure of overall preparedness.

149. Nuka Research presented an oil spill response gap analysis that showed how periods of adverse weather may slow or stop response, effecting the overall outcome. The ongoing *Nathan E Stewart* oil spill in Bella Bella provides a real world example of how environmental conditions can shut down on-water

containment and recovery. None of the NEB conditions address the oil spill response gaps that exist, or require Trans Mountain to adopt additional mitigation practices during time when spill risks exist but an effective response may be precluded.

150. Some of the spill response timing estimates in Nuka Research's analysis could be ground-truthed through actual deployments that demonstrate how quickly resources could be loaded, transported, unloaded, and deployed to various scenario locations, both in marine waters and on rivers. The NEB failed to require Trans Mountain to provide such an assessment during the NEB hearing, and none of the conditions proposed by the NEB address this important issue.

7.2.2 Type, Quantity, and Location of Spill Response Equipment

151. Nuka Research was confounded by the lack of information in the Trans Mountain application about spill response equipment specifications. The 10,000 t and 20,000 t standards do not necessarily guarantee that all – or any – of the equipment in stock is fit-for-purpose for certain types of incidents. A 20,000 t equipment cache may be useless for a spill at a certain location if the winds are too high, currents too strong, or visibility too poor to track and contain the oil. Skimmers that work well for fresh, unweathered oil may not work at all for oil that has been weathering for days or weeks.

152. The NEB conditions require some basic accounting/inventorying of additional equipment. However, the NEB should have required Trans Mountain during the hearing to conduct further analysis to assess how the equipment may function or how it may be optimized in the event of various response scenarios. This information can be developed using analysis similar to the one Nuka Research did in our May 2015 Report, or through field deployments and evaluations of various systems in different environments, or a combination of both. Absent such analysis, the only way to really know whether response capacity is sufficient or appropriate is to wait for a spill to occur and hope that the outcome is more favorable than has been realized during recent incidents in BC (*Nathan E Stewart, Marathassa)*.

7.2.3 Verifying Assumptions and Filling Gaps

153. Nuka Research's analysis included the identifications of gaps in the system. Understanding weaknesses is critical to growth and improvement. Several of the NEB's conditions that focus on emergency response exercises include a discussion of improving the system based on lessons learned. It is critical that process moving forward allows for measured and transparent consideration of gaps.

154. Nuka Research is often hired by government, regulators, or industry to conduct analyses very similar to the ones we completed for Trans Mountain in order to

inform and improve oil spill preparedness and capacity. In our professional opinion, the NEB failed to build on the analyses set out in our May 2015 Report by not requiring Trans Mountain to explore some of the issues we raised in greater depth during the hearing. Many of the gaps we identified could be closed or reduced, but at present these issues will be left unresolved.

7.2.4 Other Comments

155. The NEB conditions rely almost exclusively on Trans Mountain completing various steps and reporting on their completion to the NEB. There is no clear mechanism to evaluate the quality of Trans Mountain's work, and no opportunity for anybody other than the NEB to evaluate and accept Trans Mountain's submittals in satisfaction of the condition.

156. While the NEB is the regulatory authority, it is not necessarily the subject matter expert in many of the areas where conditions have been attached. The requirements for third party audits are positive, but without more detail about how auditors will be selected or their impartiality assured, it is difficult to have faith in this process.

157. Many of the conditions call for consultations, but the consultation process as envisioned by the NEB seems to be strictly one-dimensional; Trans Mountain disseminates information and in some instances collects feedback, but once the consultation is completed, Trans Mountain is then left to manage and report on the feedback. The process does not appear to be juried, which makes it difficult to envision how Trans Mountain will be held accountable to feedback received during these consultations.

8. CONCLUSION

158. In reviewing the NEB's May 2016 Report and 157 conditions, Nuka Research did not note any substantive changes or conditions established by NEB in response to the issues raised or analysis presented in our May 2015 Report. Our analysis was largely dismissed or disregarded, and as a result there has been no information provided by Trans Mountain or the NEB subsequent to the completion of our May 2015 Report that changes any of our conclusions.

Dated: November 23, 2016

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