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August 17, 2020

Impact Assessment Agency of Canada
Via Email

Whom It May Concern:

RE: LNG Canada Development Inc. ("LNG Canada") Decision Statement – Application for Amendment

LNG Canada writes pursuant to s. 68 (1) of the *Impact Assessment Act* (S.C. 2019, c. 28, s. 1) to request an amendment to its Decision Statement, issued June 17, 2015 (the Decision Statement) in respect of the construction and operation of LNG Canada's natural gas liquefaction facility and marine terminal for the export of liquefied natural gas (LNG) in the District of Kitimat, British Columbia (the Project). LNG Canada hereby seeks approval to amend the language of Condition 3.9 of the Decision Statement to reflect Project-specific and taxonomy-specific environmental protection measures for marine mammals during approved marine construction activities. The proposed amendment would bring the requirements of Condition 3.9 in line with the exclusion zones contemplated by the provincially approved Marine Monitoring Plan (MMP).

LNG Canada submits that the proposed amendment to the Decision Statement Condition 3.9 would provide additional clarity for required mitigation measures for marine mammals, particularly the required exclusion zones for marine mammal groups by appropriately reflecting the differences between marine mammal taxonomic groups identified as being present in the Project local setting (i.e., within range of underwater acoustic effects). The taxonomic groups being referenced herein, include cetaceans (i.e., whales, dolphins and porpoises) and pinnipeds (i.e., seals and sea lions). The specific amendment being sought in respect of Condition 3.9 is reflected below, where the bold and underline text denotes proposed condition language amendment:

3.9 To avoid detrimental behavioural change in or injury to marine mammals, ***including cetaceans and pinnipeds,*** *the Proponent shall establish and maintain* ~~***a***~~ *marine mammal exclusion zone****s*** *for all construction activities where underwater noise*

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*levels are anticipated to exceed 160 decibels **or 180 decibels** at a reference pressure of one micropascal. In doing so, the Proponent shall:*

- *3.9.1 identify the construction activities that generate underwater noise levels greater than 160 decibels or **180 decibels**, and the periods of time when those activities will occur;*
- *3.9.2 establish the boundary of **an** exclusion zone for each construction activity at the distance from the activity that the underwater noise level reaches 160 decibels **for cetaceans and 180 decibels for pinnipeds**;*
- *3.9.3 employ a marine mammal observer and specify the role of that person in observing and reporting marine mammals in the exclusion zone**s** during construction activities identified in condition 3.9.1;*
- *3.9.4 specify the circumstances in which construction activities identified in condition 3.9.1 must stop or not start if a marine mammal is sighted in **an** exclusion zone by the observer referred to in condition 3.9.3 and not re-start until the marine mammal has moved out of the **relevant** exclusion zone; and*
- *3.9.5 specify mitigation measures, such as sound dampening technology and soft-start procedures to reduce construction noise levels in the exclusion zone.*

Impact Assessment

LNG Canada has engaged the services of Stantec Consulting Ltd. ("Stantec") to provide a qualified professional review of the marine monitoring plan measures in place and the proposed amendment in order to update and confirm that these practices are appropriate, specifically those that relate to the protection of marine mammals or pinnipeds (including harbour seals and Steller sea lions) (see "Stantec Report" as Attachment 1). The Stantec Report confirms that the proposed amendment will not result in adverse impact arising from Project activities or increase the extent of the effects already contemplated in the project description, impact assessment or resulting Decision Statement.

The Stantec Report provides technical and scientific assurance that the pinniped specific exclusion zone as contemplated in the amendment, in combination with the additional mitigation measures implemented by LNG Canada in its marine construction work, will be effective in preventing impact during pile installation. The Stantec Report concludes that measures taken in respect to potential environmental effects of LNG Canada marine construction, that is impact pile driving, on pinniped individuals and populations are sufficiently mitigated. LNG Canada submits that this updated impact assessment information is wholly consistent with the requirements of the completed Environmental Assessment and previously issued Decision Statement.

Rationale for Proposed Pinniped Exclusion Zone Threshold – 180 decibels

As can be seen from the proposed amendment language, LNG Canada is proposing inclusion of a pinniped-specific exclusion zone at 180 decibels. You will see in the Stantec Report (Attachment 1), that 190 decibels is an established generic threshold for protection of

pinnipeds from injury, while 180 decibels has been determined to be generic threshold for injury for cetaceans. Notwithstanding that 190 decibels has been identified in the Stantec Report and other modeling as the threshold for pinniped injury, LNG Canada has chosen to propose an exclusion zone at 180 decibels, on the basis of and in an effort to provide additional protections to pinniped species. The proposed amendment language is more conservative than the generic threshold of injury for pinniped protection and is intended to also take into account other factors that support the use of a wider exclusion zone than contemplated by a generic 190 decibel threshold.

At a reference pressure of 1 micro pascal (µPa) the Sound Field Verification Report conducted by JASCO Applied Sciences dated July 15, 2020 and submitted to IAAC on July 30, 2020 (the "JASCO Report") determined that a 190-decibel sound pressure level correlated to a distance of approximately 14 metres (m) from the noise source, whereas 180-decibel sound pressure level occurred at approximately 76 m from the source activity.

In fact, notwithstanding the proposed Amendment to the Decision Statement, if approved, LNG Canada would apply an even more conservative exclusion zone for pinnipeds in practice, in accordance with its existing MMP. This 150-m pinniped-specific exclusion zone was determined by a Qualified Professional based on an assessment of global experience/expertise and review of applied practices on previous projects in BC. Both underwater acoustics modelling conducted prior to the start of construction (MMP) and recent sound field verification confirmed the distance from activity to measurements of 180 decibels and 190 decibels as being smaller than 150 m. However, a holistic consideration of risk to pinnipeds during the proposed construction activities, as well as consultation with Indigenous Groups as well as other relevant stakeholders identified 150 m as an appropriate exclusion zone distance. To operationally ensure consistency with feedback from previous engagement with Indigenous Groups and other stakeholders, LNG Canada would propose to continue to implement a 150 m exclusion zone for pinnipeds even if future sound field verifications showed 180 decibels to occur within a smaller range.

It is LNG Canada's submission that a 180-decibel pinniped specific exclusion zone, as proposed in this Amendment Application, as well as the 150 m exclusion zone imposed under the existing MMP would not be likely to be detrimental or adverse to individual health or the health and viability of harbour seal or Steller sea lion populations in BC (Stantec Report, page 8 of 24, conclusion 5) and will constitute a more conservative approach than required to manage and mitigate potential impacts to pinniped species and ensuring the health and protection of marine mammals during the LNG Canada project construction activities.

Consultation and Engagement

LNG Canada has previously consulted on the measures contemplated by this amendment application during the development of the MMP as required under its provincial Environmental Assessment Certificate ("EAC"), specifically Condition 5 issued under the British Columbia *Environmental Assessment Act*. Consultation and engagement was completed

with regulatory agencies and Indigenous Nations listed under the EAC in 2018 and during the update of the Marine Monitoring Plan in 2019, which was approved by the British Columbia Environmental Assessment Office in both instances.

In addition, LNG Canada has more recently engaged with potentially impacted Indigenous Groups. LNG Canada has provided notice of the proposed amendment to Condition 3.9. Notice of the proposed amendment with details regarding the nature of the proposed change was sent to all potentially impacted Indigenous Groups, including the Haisla, Gitga'at, Gitxaala, Kitselas, Kitsumkalum, Lax Kw'alaams, Metlakatla Nations, along with the Métis Nation BC. In providing notice of the proposed amendment, LNG Canada sought any preliminary feedback and comments, and no substantive comments were received. Prior to submitting this application, LNG Canada has followed up on this preliminary engagement by providing copies of this application and the supporting technical reports to each of these First Nation Groups. LNG Canada will allow time for review of the application materials before following up with each Nation and will address any further comments or feedback received. A fulsome consultation and engagement tracker can be provided in support of this application once this consultation process has been completed. Given that the exclusion zones contemplated in this application have been consulted on prior to this application as part of LNG Canada's consultation on it's MMP, LNG Canada does not anticipate substantive comments or concerns as part of this process.

In addition to First Nation groups, LNG Canada has also discussed this proposed amendment with local environmental interest groups in the Kitimat area earlier in July 2020. No substantive comments or concerned were raised at that time.

LNG Canada trusts that the information provided in this application is sufficient for the Impact Assessment Agency of Canada to commence and complete the amendment review process available under the Act. LNG Canada will continue be available to engage with those representing an interest in the subject of the proposed amendment to support the Agency and the Minister's review efforts and in alignment with our goal to be the Safest Project on Earth, inclusive of protecting the environment in which we construct and operate.

Sincerely,

<Original signed by>

LNG Canada Development Inc.
Johnna S. van Keuren
HSSE Director

ATTACHMENT

Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone

Stantec Consulting Ltd. Technical Memorandum – July 2020

Stantec

Memo

To:	Andrew Betts Marine Environmental Lead LNG Canada	From:	Sonya Meier Burnaby
File:	Pile_driving_memo_20200316	Date:	July 21, 2020

Reference: Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone

BACKGROUND

During the environmental assessment of the LNG Canada Export Terminal, LNG Canada Development Inc. (LNGC) committed to monitoring and mitigating potential adverse effects to marine mammals, including pinnipeds (seals and sea lions), from underwater noise during construction activities. The federal decision statement, provincial environmental assessment certificate (EAC #15-01), marine *Fisheries Act* authorization (15-HPAC-00585) and *Canadian Environmental Protection Act 1999* disposal at sea permit (4543-2-03675 and 4543-2-03724), establish the requirements for the implementation of a marine mammal monitoring program and specify mitigation measures for the protection of marine mammals[1] during construction-related activities.

Experience during the first season of marine construction has shown that the blanket exclusion zone for the protection of marine mammals should not be applicable to pinnipeds (i.e., harbour seals and Steller sea lions). Stantec Consulting Ltd. (Stantec) has prepared this memorandum to provide the rationale for a pinniped-specific exclusion zone during construction of the LNGC Project. This memo will summarize the LNGC marine mammal assessment conclusions from the environmental assessment certificate (EAC) application, the development of the marine monitoring plan (MMP), the current mitigation measures being implemented during in-water impact pile installation (including the rationale for pinniped-specific exclusion zones), and recent in-field sound verification measurements during Project impact pile installation.

See **Appendix A** for a literature review of the life history, distribution, abundance and conservation status of harbour seals and Steller sea lions in BC. See **Appendix B** for a summary of best management practices and mitigation measures for pinnipeds in Canada. See **Appendix C** for the regulatory context of the LNGC marine mammal exclusion zone (MMEZ).

LNGC MARINE MAMMAL ASSESSMENT CONCLUSIONS

The environmental assessment for the project assessed the potential effects to marine mammals (including seals and sea lions) during the construction period, including harm (hearing injury) or behavioural effects. In its assessment, LNGC used conservative assumptions, including the assumption that piles would be installed with impact piling methods during the construction period, as opposed to vibratory installation methods that produce less underwater noise in comparison. As stated in Section 5.8.5.4.2 EAC application, pile installation can generate high-intensity impulse sounds and changes in underwater sound pressure levels that can result in hearing injury and/or behavioural effects to marine mammals (Southall et al. 2007).

Based on the findings of its assessment, LNGC committed to develop and implement a MMP in accordance with applicable federal and provincial legislation and regulations to proactively manage pile installation with noise measurements, active monitoring of a marine mammal exclusion zone (MMEZ), and implementation of vibratory

[1] For the purposes of this memorandum, marine mammals are defined by Schedule 1 (Common and Scientific Names of Marine Mammals) of the Marine Mammal Regulations (SOR/93-56) under the *Fisheries Act*, as amended on 2019-08-28.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

piling if technically feasible to reduce sound levels. With the implementation of the proposed measures, LNGC concluded that underwater noise during construction and pile installation was anticipated to adversely affect few marine mammals, relative to their abundance in Kitimat Arm/Douglas Channel and in BC waters. It was not expected that these potential changes in behaviour would have an adverse effect on the population viability of marine mammals in BC. The environmental assessment predicted no significant residual effects to marine mammals (including seals and sea lions) after the implementation of the proposed mitigation measures. As described in Section 5.8.2.10 of the EAC application, the significance thresholds for residual effects to marine mammals were any residual effect with a high likelihood of affecting population viability of marine mammals, or of species at risk, or any residual effect with a high likelihood of causing harm to species designated as *endangered* or *threatened* under Schedule 1 of the *Species at Risk Act* (SARA) or by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC).

Under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), the Minister issued a Decision Statement under section 54 of the *Act*, which included enforceable conditions that LNGC is responsible for implementing. Condition 3.9 of the Decision Statement states that:

> *"To avoid detrimental behavioural change in or injury to marine mammals, the Proponent shall establish and maintain a marine mammal exclusion zone for all construction activities where underwater noise levels are anticipated to exceed 160 decibels at a reference pressure of one micropascal."*

Following receipt of the positive Decision Statement for the project, LNGC applied for and received a paragraph 35(2)(b) *Fisheries Act* authorization for the project's marine terminal infrastructure (15-HPAC-00585). The authorization specifies measures to protect fish and fish habitat (including marine mammals) from potential adverse effects during the construction period. The authorization does not explicitly recommend a specific MMEZ or specific exclusion zones for seals and sea lions during pile installation; however, condition 6.2.4.1 states:

> *"A qualified environmental monitor will be present during pile installation to verify compliance with the terms of the Fisheries Act authorization and relevant environmental management plans. Underwater sound pressure levels will be monitored during pile installation for a period of seven days beginning on the first day of each period of pile installation (inclusive of temporary shut downs due to marine mammal presence in a defined marine mammal exclusion zone), or whenever pile installation methods or environmental conditions."*

LNGC MARINE MONITORING PLAN

Following the federal and provincial environmental assessment decisions and receipt of the marine *Fisheries Act* authorization, LNGC submitted an MMP to the British Columbia Environmental Assessment Office (EAO) that provided details on how LNGC would implement monitoring and mitigation requirements specified in EAC #15-10 and the *Fisheries Act* authorization. The MMP was developed in consultation with EAO, Ministry of Environment and Climate Change Strategy (MOECC), Ministry of Health (MOH), and the Oil and Gas Commission (OGC). The MMP was also developed in consultation with, and reviewed by Indigenous Groups, including Haisla Nation, Gitga'at Nation, Kitselas First Nation, Kitsumkalum First Nation, Gitxaala Nation, Lax Kw'alaams First Nation, Metlakatla First Nation, and Metis Nation BC. The MMP was then reviewed by relevant agencies and as such, represents enforceable requirements under the federal and provincial environmental assessment decisions.

In its MMP, LNGC established a cetacean MMEZ for construction activities (**Table 1**). The modelled radius for the MMEZ, dictated by condition 3.9 of the CEAA 2012 Decision Statement, was based on the 95th percentile radius (R95%) zone of disturbance to cetaceans from impact pile installation (unweighted root mean square [rms] sound pressure level [SPL] of 160 dB re 1 µPa) and extends to 1,900 m (JASCO 2015). Modeling results for dual impact

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

piling activities, both at the LNG Canada marine terminal site and the Rio Tinto site, resulted in a MMEZ of 3,040 m (based on the unweighted rms SPL of 160 dB re 1 µPa).

A pinniped-specific exclusion zone of 150 m was defined in consultation with stakeholders and Indigenous groups during the development of the MMP. This exclusion zone was defined based on the following understanding:

1. Harbour seals and Steller sea lions would consistently remain in the Project area throughout the construction period (based on traditional ecological knowledge and scientific studies/surveys of pinniped use of Kitimat Arm)
2. Potential hearing injury to harbour seals and Steller sea lions was fully mitigated with a 150 m exclusion zone (based on acoustic modelling of impact pile installation presented in the EA)
3. Potential behavioural disturbance to harbour seals and Steller sea lions was unlikely and would not result in significant adverse population effects (based on qualified profession (QP) professional opinion and ongoing observations of harbour seals and Steller sea lions in Kitimat Arm during existing conditions of underwater noise, and by trained marine mammal observers during LNGC dredging/pile installation)

Both the environmental assessment and MMP used the most conservative assumption (use of impact pile installation primarily) in its prediction of potential effects to marine mammals and in the development of proposed mitigation measures. As a result, the current cetacean MMEZ zones of 1,900 m (LNGC only) and 3,040 m (both LNGC and Rio Tinto) are conservative predictions of the 160 dB cetacean exclusion zone based on acoustic modelling of impact pile installation in the environmental assessment. However, since the issuance of the provincial EAC and federal Decision Statement, and the development of the MMP, engineering plans have been refined and LNGC has modified its construction methods to use predominantly vibratory piling methods to reduce underwater noise levels during construction. Impact pile installation is only used for approximately 10-15 minutes to seat each pile with up to eight piles installed per day.

Pinniped-specific exclusion zones are commonly implemented during other in-water construction works for projects currently underway in BC. For example, the Rio Tinto Terminal A Extension Project immediately adjacent to the LNG Canada project area is implementing the same MMEZ as LNG Canada for cetaceans during construction, but Rio Tinto has specified a pinniped-specific exclusion zone of 75 m during its construction period. This modified measure is in compliance with Rio Tinto's environmental assessment certificate #T15-01 (condition 7 – Marine Mammal Management and Monitoring Plan) and its *Fisheries Act* authorization *17-HPAC-00076*, developed in consultation with DFO and Haisla Nation (Rio Tinto 2018). Similarly, an exclusion zone for harbour seals is implemented during the construction of the Trans Mountain Westridge terminal in Vancouver, BC where the exclusion zone for cetaceans and threatened or endangered marine mammals is 1.74 km based on injury and behavioural effect thresholds, but is 150 m for harbour seals (Trans Mountain 2018). This harbour seal exclusion zone is in compliance with National Energy Board Condition 81 – Marine Terminal Environmental Protection Plan (Trans Mountain 2018) and its *Fisheries Act* authorization (DFO 2017).

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

Table 1. LNGC Marine Mammal Exclusion Zones for Specific Construction Activities

Construction Activity	Species	Marine Mammal Exclusion Zone	LNGC Response
Pile driving Vibro-hammer	Cetaceans	300 m	Prohibit non-essential traffic, slow to no-wake speed, avoid marine mammals
	Pinnipeds	150 m	Prohibit non-essential traffic, slow to no-wake speed, avoid marine mammals
	All	Immediate vicinity	Shut-down
Pile driving Impact hammer Single site operation	Cetaceans	1,900 m	Shut-down
Pile driving Impact hammer Dual site operation		3,040 m	Shut-down
Pile driving Impact hammer	Pinnipeds	150 m	Shut-down
Dredging	Cetaceans	300 m	Prohibit non-essential traffic, slow to no-wake speed, avoid marine mammals
	Pinnipeds	150 m	Prohibit non-essential traffic, slow to no-wake speed, avoid marine mammals

UNDERWATER SOUND FIELD VERIFICTION

As stated previously, both the environmental assessment and MMP used the most conservative assumptions in their prediction of potential effects to marine mammals during construction and in their development of proposed mitigation measures. Based on these assumptions, the predicted distance to the 160 dB re 1 µPa SPL threshold during impact pile installation was 1,900 m (JASCO 2015).

In June 2020, sound verification measurements were conducted by JASCO Applied Sciences during impact pile installation for LNGC's Materials Offloading Facility (MOF) (Warner et al. 2020). The piles were installed in water less than 5 m deep, using two different impact hammers of different energies, and with an active bubble curtain providing mitigation. Underwater sound measurements were obtained at different distances between 8.8 m and 1 km from the source, and then extrapolated to the thresholds of interest. Based on these in-field measurements and sound spreading calculations, the distance to the 160 dB re 1 µPa SPL threshold, during mitigated impact pile installation, was determined to be 762 m (i.e., less than half the distance assumed in the EA and MMP). Measured distances to the NOAA pre-2016 marine mammal acoustic injury criteria[2] for pinnipeds and cetaceans are presented in **Table 2** (see Appendix Table B-1). The distance to the 206 dB re 1 µPa (peak) threshold was also requested by DFO for assessing potential for injury to fish.

[2]The US National Marine Fisheries Service (NMFS) marine mammal criteria for acoustic injury were revised in 2016, and again in 2018 (NMFS 2018); however, the 2013 criteria identified in Table 2 were in place when the MMP was developed for this Project, and are thus the relevant thresholds for consideration in the MMP. Additional details on the various regulatory thresholds are presented in Appendix B.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

Table 2. Distances to Impulsive Sound Level Thresholds (from Warner et al. 2020).

Species Group	Threshold (dB re 1µPa)	Distance to Threshold (m)
Fish (injury)	206 (PK)	14
Pinnipeds (injury)	190 (SPL)	14
Cetaceans (injury)	180 (SPL)	76
Marine mammals (behavior)	160 (SPL)	762

POTENTIAL ADVERSE EFFECTS TO SEALS AND SEA LIONS WITH A 150 M EXCLUSION ZONE

Harbour seals demonstrate considerable site fidelity and are local to Kitimat Arm. A small proportion of the BC population of Steller sea lions occur within Kitimat Arm near the construction area during the fall-winter period, likely to feed. Three year-round Steller sea lion haulout sites exist near the mouth of Kitimat Arm: Ashdown Island, Isnor Rock and Steele Rock (see Appendix Figure A-2, Olesiuk 2018). During the fall-winter period, the sea lions leave breeding rookeries (likely on Bonilla Island and Danger Rocks outside of Kitimat Arm, see Appendix Figure A-2) and disperse to winter and year-round haulout out sites from which they travel from to opportunistically feed on prey that is seasonally abundant, primarily at night (Olesiuk 2018).

Steller sea lions are listed as a species of "Special Concern" under the *Species at Risk Act*, despite an increasing population in BC at an average rate of 3.8% per year (Pitcher et al. 2007, DFO 2018, Olesiuk 2018). This designation is based on the limited number of breeding sites in Canadian waters, and because the species is sensitive to human disturbance while on land and vulnerable to catastrophic events such as major oil spills due to its highly concentrated breeding aggregations. DFO's Steller sea lion Management Plan, states the risk to the BC population from acoustic disturbance in aquatic habitat (i.e. displacement from feeding areas, forging success) is likely *low* with a level of concern of *low*, compared to other identified potential threats such as prey reduction or environmental contaminants, or disturbance at breeding rookeries or major haulouts (DFO 2010b). A recent report on the progress of the implementation of the Steller sea lion Management Plan supported this conclusion and affirmed that under existing conditions of underwater noise disturbance in BC, the population is growing at a rate of 3.8% (DFO 2018). DFO states that chronic underwater noise stress could have long-term effects near breeding rookeries, but that as Steller sea lions are able to surface or exit the water to avoid acute underwater noise, the concern for acute noise disturbance at aquatic feeding sites is low (DFO 2010b).

Ongoing monitoring at the LNGC terminal construction site by trained marine mammal observers (MMOs) has not demonstrated any apparent behavioural disturbance or displacement of seals or sea lions from habitat during the construction period. During the fall-winter period when both impact and vibratory piling were occurring, harbour seals and Steller sea lions have been consistently and regularly observed in Kitimat Arm within the Project Area by MMOs (**Table 3**). Feeding habitat in Kitimat Arm is not considered limiting, as Steller sea lions are known to travel long distances from haulouts in the winter to feed along the coast of BC and the US (Olesiuk 2018) and the potential disturbance of a small number of sea lions adjacent to the Project area would not result in adverse health effects to individuals or population viability. See Appendix A for a full description of Steller sea lion distribution and abundance in BC.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

PINNIPED PRESENCE IN THE CONSTRUCTION AREA AND IMPACT GIVEN EXISTING MITIGATION MEASURES

Based on the regular presence of harbour seals and Steller sea lions in the LNGC project construction area throughout the fall-winter period (**Table 3**), if a 160 dB rms MMEZ is applied to harbour seals and Steller sea lions, (as per CEAA Decision Statement condition 3.9), Stantec considers it inevitable that LNG Canada's construction program will be subject to regular and prolonged, full shut downs of pile installation due to seals or sea lions entering and/or remaining in the MMEZ for sustained periods.

Table 3. Number of Harbour Seals and Steller sea lions Observed During Marine Mammal Monitoring for LNG Canada and Rio Tinto In-Water Construction.

Month-Year	Harbour Seal	Steller sea lion
September 2018	240	17
October -2018	235	2
November 2018	159	0
December 2018	219	9
January 2019	416	58
February 2019	119	69
May 2019	108	19
June 2019	42	0
July 2019	100	0
August 2019	42	0
September 2019	332	11
October 2019	871	16
November 2019	421	14
December 2019	473	35
January 2020	377	12
February 2020	323	4

EFFECTIVENESS OF PINNIPED-SPECIFIC EXCLUSION ZONE DURING PILE INSTALLATION

Monitoring of seals and sea lions by MMOs at both the LNG Canada and Rio Tinto construction sites has not shown any apparent behavioural disturbance or displacement of individuals from aquatic feeding habitat. This is consistent with the DFO Steller sea lion Management Plan conclusion that overall concern for acute noise disturbance at aquatic sites is low, compared to haulout site and rookeries (DFO 2010b, DFO 2018). There is no present concern from DFO regarding prey availability in the short-term and the population in BC is at pre-development levels and growing, therefore the likelihood of effects to individuals or the population from pile installation activities in Kitimat Arm is low. This is consistent with the environmental assessment predictions of no significant residual effects to marine mammals (including seals and sea lions) after the implementation of proposed mitigation measures.

As a result, it is Stantec's professional opinion that the application of a 160 dB exclusion zone for harbour seals and Steller sea lions is not required. Further, it is not practical or feasible due to both species' consistent and

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

regular presence in the Project area in Kitimat Arm during the ongoing construction period. The in-field sound verification measurements during mitigated (bubble curtain) impact pile installation at the LNG Canada Export Terminal MOF in June 2020, determined that the distance to the 190 dB 1µPa SPL hearing injury threshold for pinnipeds was 14 m from the source. Therefore, a 150 m pinniped-specific exclusion zone[3] would therefore protect individual seals and sea lions from hearing injury during the limited, short-term impact pile installation.

SUMMARY RATIONALE FOR PINNIPED-SPECIFIC EXCLUSION ZONE

1. Seals and sea lions have been regularly observed by trained MMOs throughout the construction period with no apparent behavioural effects or displacement from habitat.
2. Project construction will occur adjacent to existing terminals (i.e., Rio Tinto) within an established industrial area used extensively by seals and sea lions for decades with existing contributions of underwater noise to the acoustic environment. Seals and sea lions have habituated to some extent to underwater noise levels from historical and existing industrial activity.
3. Both the harbour seal and Steller sea lion populations are healthy and growing under existing conditions. In particular, the current annual increase in the growth rate of the Steller sea lion population is high at 3.8%, despite existing underwater noise levels in BC. Potential localized, short-term, and reversible behavioural effects from pile installation noise (primarily vibratory methods) are not anticipated to be detrimental and result in adverse effects to the health of individuals or population viability in BC of harbour seals or Steller sea lions. Hearing injury from limited, short-term impact pile installation methods after the implementation of a 150 m pinniped-specific exclusion zone is not anticipated. In-field sound measurements during mitigated impact pile installation of the MOF have confirmed the effectiveness of the 150 m pinniped-specific exclusion zone at reducing potential for acoustic injury (Warner et al. 2020).
4. The current practice in BC is to apply exclusion zones to eliminate or reduce potential adverse effects to marine mammals, including seals and sea lions. In the specific case where marine mammals, specifically seals and sea lions, remain in high numbers during the construction period (see **Table 3**) they have been observed by trained MMOs to not display apparent adverse changes in behaviour or be displaced from habitat, and accordingly, other projects in BC (e.g., RioTinto, Westridge) have applied practical exclusion zones during in-water construction works where pinnipeds are common.
5. It is Stantec's professional opinion that the use of a 150 m pinniped-specific exclusion zone during in-water impact pile installation is unlikely to be detrimental or adverse to individual health or the health and viability of harbour seal or Steller sea lion populations in BC. This is consistent with the environmental assessment predictions of no significant residual effects to marine mammals (including seals and sea lions) after the implementation of proposed mitigation measures, and verification of sound levels during impact pile installation during the construction period (Warner et al. 2020).
6. If a 160 dB rms MMEZ is applied to all marine mammals, Stantec considers it inevitable that LNGC's construction program will be subject to regular and prolonged, full shut downs of pile driving due to seals or sea lions entering and/or remaining in the 160 dB exclusion zone.

[3] Although the known hearing range of harbour seals and Steller sea lions (see Southall et al. 2007) are not identical, pinnipeds have similar hearing physiology, are similar in nature, occupy comparable habitats, play similar ecological roles, and may be affected in similar ways.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

CLOSURE

Stantec has prepared this memorandum to support LNGC in their discussions with DFO and IAAC regarding feasible, practical, and appropriate mitigation measures to reduce potential adverse effects to seals and sea lions during in-water pile installation. If you have any questions regarding the content of this memorandum or have any additional questions, please contact the undersigned.

Stantec Consulting Ltd.

<Original signed by>

Sonya Meier M.Sc., R.P.Bio.
Senior Marine Biologist
Phone: <personal information removed>
Mobile: <personal information removed>
<email address removed>

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

APPENDIX A – HARBOUR SEAL AND STELLER SEA LION LITERATURE REVIEW

PINNIPEDS IN KITIMAT ARM

Two pinniped species, harbour seals (*Phoca vitulina richardsi*) and Steller sea lions (*Eumetopius jubatus*), occur in Kitimat Arm. Aerial surveys have been regularly conducted to monitor harbour seal and Steller sea lion populations in BC since the early 1970s (DFO 2009, Olesiuk 2010, Olesiuk 2018). LNG Canada conducted 12 marine mammal surveys during 2012 and 2013 near the proposed terminal and within Kitimat Arm to inform its environmental assessment regarding the distribution, abundance, and seasonal use of these areas by marine mammals, including seals and sea lions. Surveys were planned to capture high density and low density periods of marine mammal abundance and to overlap with biologically important times for certain species in the region. Further information has been gathered by marine mammal observers during construction dredging and pile installation.

Harbour Seal

Life History

Like most other marine mammals, they have a thick layer of fat which keeps them insulated from the cold water. Seals differ from sea lions in that they have no external ear flaps, they have short, fur-covered front flippers, and they can't raise their head and shoulders well while on land. Seals propel themselves through the water by sculling with their hind flippers and steering with their front ones. Male adult harbour seals in eastern Canada reach a length of about 154 cm compared with about 143 cm for females (Olesiuk 2010). Males rarely exceed 100 kg and females rarely exceed 90 kg (Olesiuk 2010) Harbour seal populations of the Atlantic and Pacific Oceans are significantly genetically differentiated and *P. v. richardsi* is clearly separated from two other subspecies located outside of BC (Olesiuk 2010).

Mating generally occurs in late spring or summer, shortly after the previous year's pup has been weaned. Each male harbour seal will mate with several females during the breeding season. Competition for mates and copulation usually occur in the water. In BC, the seal pup is born on tidal reefs or on beaches between late June and September, peaking in July and August. Females generally have one pup every year on land, and the pupping season in any particular area can extend for one to two months with a two-week peak (Bigg 1981).

Harbour seals are opportunistic predators and feed on fish species that they encounter in their nearshore habitat. Preliminary studies analyzing harbour seal scat (feces) for bones and hard parts, indicate that the majority of their diet consists of small reef or shallow dwelling fishes including rockfishes, greenlings, smelt, perch, and some herring and flatfishes with adult seals eating 3-5 kg of food per day (Olesiuk 2010).

Hearing sensitivity of harbour seals ranges from 0.5 kHz to 40 kHz, with sensitivity decreasing outside of this range (Kastelein et al. 2009).

Distribution

Harbour seals have the broadest distribution of any pinniped species, occurring over a latitudinal range from about 30°N to 81°N in the eastern Atlantic and 28°N to 62°N in the eastern Pacific. The species is common in coastal area, inlets and estuaries throughout BC and also occurs in some rivers and lakes. Although harbour seals are known to undergo extensive movements (up to several hundred kilometers) associated with feeding breeding and moulting, they are not considered migratory and will often return to specific sites or areas, demonstrating considerable site fidelity (Olesiuk 2018). They are typically observed in nearshore waters (Best and Halpin 2011).

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

In the water, they are usually solitary or occur in small groups; whereas, they congregate in larger groups when hauled out on land (Baird 2001a). Along the BC coast, harbour seals haul out on rocks, islets and islands, and sand bars. Some of these haulout sites are also used for pupping (Heise et al. 2007).

Abundance and Conservation Status

Between 1913 and 1970, the combination of a bounty implemented by the Canadian federal government and extensive hunting of the harbour seal for its pelt lowered seal populations dramatically with an estimated half a million seals were killed. for the commercial fur trade and for predator control. After undergoing exponential increases between the 1970s and 1980s, the population appears to have stabilized, displaying moderate growth through the 1990s and is currently considered to be at or above historical levels (DFO 2010a, 2020). Because of the species' large and stable population, it is considered not at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1999, Baird 2001), is not listed under the *Species at Risk Act* (SARA) (Government of Canada 2012), and is on the provincial Yellow List (BC Conservation Data Centre [BCCDC] 2020). The harbour seal's primary predator is the transient killer whale. Threats to harbour seals are environmental contamination and entanglement in fishing gear, but these threats are not currently affecting the harbour seal population in BC. There is currently some debate of high harbour seal populations in BC are adversely affecting declining numbers of one of their preferred prey, Chinook salmon (Nelson 2018).

Steller sea lion

Life History

The Steller sea lion is the largest member of eared seals and a relatively long-lived and slow reproducing species. The scientific name *(Eumetopias jubatus*) means having a broad forehead and a mane, a reference to the prominent ruff of coarse hair that mature males develop on their necks and chests which resembles a lion's mane. Steller sea lions exhibit significant sexual dimorphism, with adult males (bulls) attaining a length of up to 3 m and weighing 400-800 kg, although at the start of the breeding season the largest males can weigh over 1,100 kg. Mature males develop massive muscular necks and chests, and robust heads with flatter snouts than those of females. Adult females (cows) are noticeably smaller, averaging 2.2 m and 200-300 kg.

Steller sea lions feed on the continental shelf and are generally found in waters within 60 km of land and in depths of less than 400 m, although they can venture hundreds of kilometres offshore (COSEWIC 2013). Sea lions can haul out on a variety of surfaces, including rocky outcrops, log booms, floats, docks, and piers. Three categories of haulouts have been defined by DFO: (1) rookeries, used for breeding and rearing pups; (2) winter haulouts, primarily used during the breeding season; and (3) year-round haulouts, which are occupied continuously (DFO 2010b, COSEWIC 2013). They tend to be highly gregarious while on land and pack close together in dense breeding colonies (rookeries) or on non-breeding winter or year-round haulouts.

Steller sea lions exhibit a hearing range of 1 kHz to 34 kHz, with sensitivity decreasing outside of these ranges (Kastelein et al. 2005, Muslow and Reichmuth 2010).

Distribution

Steller sea lions range along the North Pacific Rim from northern Japan to the Kuril Islands, Sea of Okhotsk and Kamchatka Peninsula, west through the Bering Sea and Gulf of Alaska, and south along the continental shelf as far as central California. Worldwide, at least two populations of Steller sea lions are recognized based on genetic differentiation of mitochondrial DNA (which reflects maternal lineage): an Eastern Population (California to southeast Alaska) and a Western Population (Gulf of Alaska, Bering Sea, Aleutian Islands, and Russia) (Bickham

et al. 1996 in DFO 2010b). Female Steller sea lions in Asian waters (Kamchatka Peninsula, Kuril Islands and Okhotsk Sea) appear to be genetically distinct from the other populations (Baker et al. 2005) but there is greater gene flow for males (Hoffman et al. 2006). The eastern stock of Steller sea lion (a.k.a. Loughlin's northern Sea Lion) is distributed throughout southeastern Alaska, BC, Washington, and Oregon.

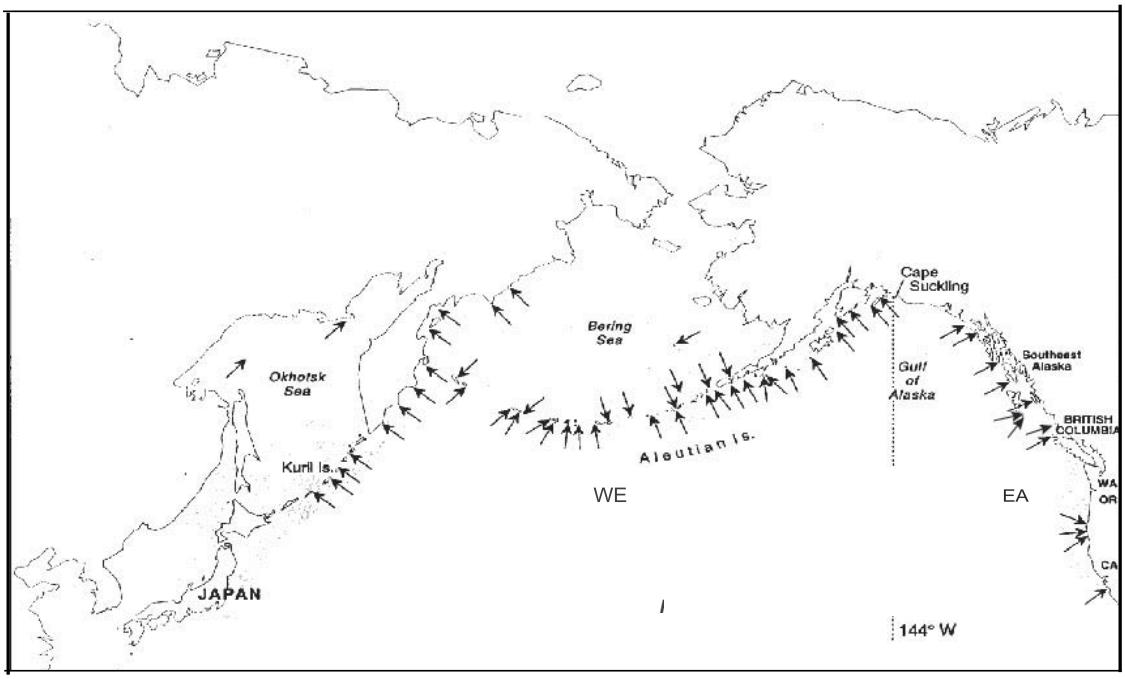

Figure A-1. Worldwide range of Steller sea lion. Arrows denote breeding rookeries and shaded areas denote the approximate non-breeding range of the species. The dashed line shows the separation between Asian, Eastern and Western stocks of Steller sea lions. (from COSEWIC 2013).

Abundance and Conservation Status

The western stock, having declined by about 80% since the 1970s (Merrick et al. 1987, Loughlin et al. 1992, Trites and Larkin 1996, Loughlin 1998, NMFS 2008 in Olesiuk 2018), is currently listed in the U.S. as Endangered under the *Endangered Species Act*, and has been the focus of much research in recent years (NMFS 2008). In contrast, the eastern stock appears to be increasing over most of its range (Calkins et al. 1999, Brown et al. 2002, Pitcher et al. 2007, Olesiuk 2008, NMFS 2013 in Olesiuk 2018). In the U.S., the eastern stock had previously been listed as Threatened due to concerns that the declines – which were first observed in the eastern Aleutian Islands and spread to the Gulf of Alaska (Braham et al. 1980 in Olesiuk 2018) – may continue spreading eastward and because there was some uncertainty at the time regarding the genetic division of stocks. However, the decreases never spread to the eastern stock and the genetic segregation of the two populations was reaffirmed. As a result, the U.S. recently delisted the eastern stock.

The reasons for the decline in the Gulf of Alaska and Bering Sea are poorly understood, although a leading hypothesis is nutritional stress as a result of a change in oceanographic conditions that affected the prey availability or quality (Alverson 1992, Alaska Sea Grant 1993, DeMaster and Atkinson 2002, Trites and Donnelly 2003, Trites

et al. 2007 in Olesiuk 2018). At this juncture, the reasons for the continued and accelerating growth of the eastern stock, which appears to have fully recovered from control programs and commercial harvests and surpassed peak historic levels, is also unclear. While the ecological processes are poorly understood, Steller sea lions are likely limited by bottom-up forcing and could serve as an indicator of the state of marine food chains.

In Canada, between 1912 and 1968, thousands of Steller sea lions were killed in BC in a campaign to reduce competition for fish stocks with commercial fishers. Estimated abundance in BC is approximately 39,200 (95% CI range 33,600 to 44,800) individuals in summer and an estimated 48,500 (95% CI 38,100 to 58,900) Steller sea lions in winter and is at or above historical pre-development levels (DFO 2008, DFO 2010b, Olesiuk 2018). With the recent increases in abundance on B.C. rookeries, Steller sea lions appear to have fully recovered from the predator control kills and commercial harvests. Recent surveys suggest that about a third of the eastern stock occurs and breeds in BC during summer, and half the eastern stock occurs and forages in BC during winter (Olesiuk 2018). COSEWIC originally concluded Steller sea lions were Not at Risk (Bigg 1988), but more recent assessments in 2003 and 2013 recommended the species be designated as Special Concern under the *Species at Risk Act* (SARA) (COSEWIC 2003, 2013). Despite an increasing population in BC, at an average rate of 3.8% (Pitcher et al. 2007, DFO 2018, Olesiuk 2018), the re-designation was based on the limited number of breeding sites in Canadian waters, and because the species is sensitive to human disturbance while on land and vulnerable to catastrophic events such as major oil spills due to its highly concentrated breeding aggregations.

BC Distribution

From May to August, most of the Steller sea lion population gathers in rookeries to mate and give birth (COSEWIC 2013). In late summer and autumn, individuals on rookeries disperse along the coast to numerous wintering sites and haulouts. Nine of the ten known breeding rookeries used by Steller sea lions from the eastern population are located in BC (**Figure 2**). Until recently, Steller sea lions in British Columbia utilized three rookeries including the Scott Islands, off the northwestern tip of Vancouver Island; Cape St. James, off the coast of the southern Haida Gwaii; and North Danger Rocks off the northern mainland coast (Banks Island). A fourth rookery was re-established in the Sea Otter Group off the central mainland in the early 2000s after being eradicated by intensive control kills during 1923-1939. New rookeries have been established in the early 2000s on Garcin Rocks, Gosling Island and Bonilla Island off the southeast end of Gwaii Haanas in Haida Gwaii (DFO 2008, COSEWIC 2013, Olesiuk 2018). Steller sea lions in BC breed at all known historic rookeries and at two or three new rookeries. The tenth rookery is located at Forrester Island north of Haida Gwaii in US Alaskan waters (**Figure 2**). The Scott Islands rookery accounts for 66-74%, Cape St. James 15-22%, North Danger Rocks 5-10%, and new/re-established rookeries 12% of pup production, respectively. Due primarily to the high rate of increase in recent years, pup production in BC increased more than 6-fold since the 1970s (Olesiuk 2018).

In addition to the increases observed in BC, Steller sea lion populations have also expanded in neighbouring waters in SE Alaska (Olesiuk 2018). Given its size and proximity to the Canadian border (<50 kilometers), it is difficult to assess overall trends without considering the influence of Forrester Island. In addition to the growth of Forrester Island, several new rookeries have been established in SE Alaska during the last 3 decades (Olesiuk 2018). Since the early 1990s, BC rookeries have accounted for 62% of the overall increase in pup production, Forrester Island for 3% of the increase, and the new rookeries in SE Alaska for 34% of the overall increase in pup production. Total pup production quintupled over the last five decades, and total abundance on rookeries in BC and SE Alaska appears to have surpassed the peak historic levels observed in the early 1900s by a factor of at least 2.5 times (Olesiuk 2018).

Currently there are between 23 to 34 year-round haulout sites in BC (**Figure 2**) (Olesiuk 2018). Numerous Steller sea lion haulouts in BC waters are also protected within national or provincial parks, such as Pacific Rim and Gulf Islands National Park Reserves, Race Rocks Ecological Reserve, and others, however done of these sites are near

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

the LNGC construction site. Steller sea lions also use many additional sites intermittently on a seasonal basis. These can be in exposed locations, as well as in sheltered inlets and channels and sometimes even up rivers. Sites in exposed locations are generally not directly exposed to ocean swells, but rather are sheltered to some extent by the surrounding topography, such as in a bay or on a leeward side of an island. Steller sea lions are occasionally found congregating in freshwater, such as the Fraser River, to feed on migrating salmon, herring or eulachon (COSEWIC 2013). These are opportunistic predators, feeding on prey that are locally or seasonally most abundant (DFO 2008, Olesiuk 2018) and foraging mainly at night. The location and timing of use of winter haulouts often appears to be related to the seasonal availability of prey resources, such as migrations or spawning aggregations of local fish stocks.

During the breeding season, Steller sea lions feed predominantly on fish, such as rockfish, sculpins, capelin, flatfish, and invertebrates, including squid, octopuses, shrimps, and crabs (BCMCA 2020). During the non-breeding season, they prey mainly on schooling fish such as herring, hake, pollack, dogfish, and salmon (Trites and Donnelly 2003, BCMCA 2020). On rare occasions, they have been observed to prey on birds and other mammals, including neonate fur and harbour seals (DFO 2008). The location and timing of use of winter haulouts often appears to be related to the seasonal availability of prey resources, such as migrations or spawning aggregations of local fish stocks (COSEWIC 2013).

There is also some evidence that sea lions tolerate regular acoustic disturbance. For example, the Department of Defense regularly conducts military training involving the blasting of explosives on Bentinck Island adjacent to the RRER. Previous monitoring of unmitigated underwater and in-air noise disturbance of seals and sea lions at RRER from blasting of explosives on Bentinck Island indicated that behavioural changes of sea lions, including movement off a haulout, were short-term with little or no long-term consequence for long-term use. After observable disturbance, animals typically returned to the haulout shortly after, suggesting they are resilient to disturbance. With repeated disturbance over a period of years, individuals continue to use Race Rocks as habitat with no measurable effect on seal or sea lion populations (Edgell and Demarchi 2012).

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

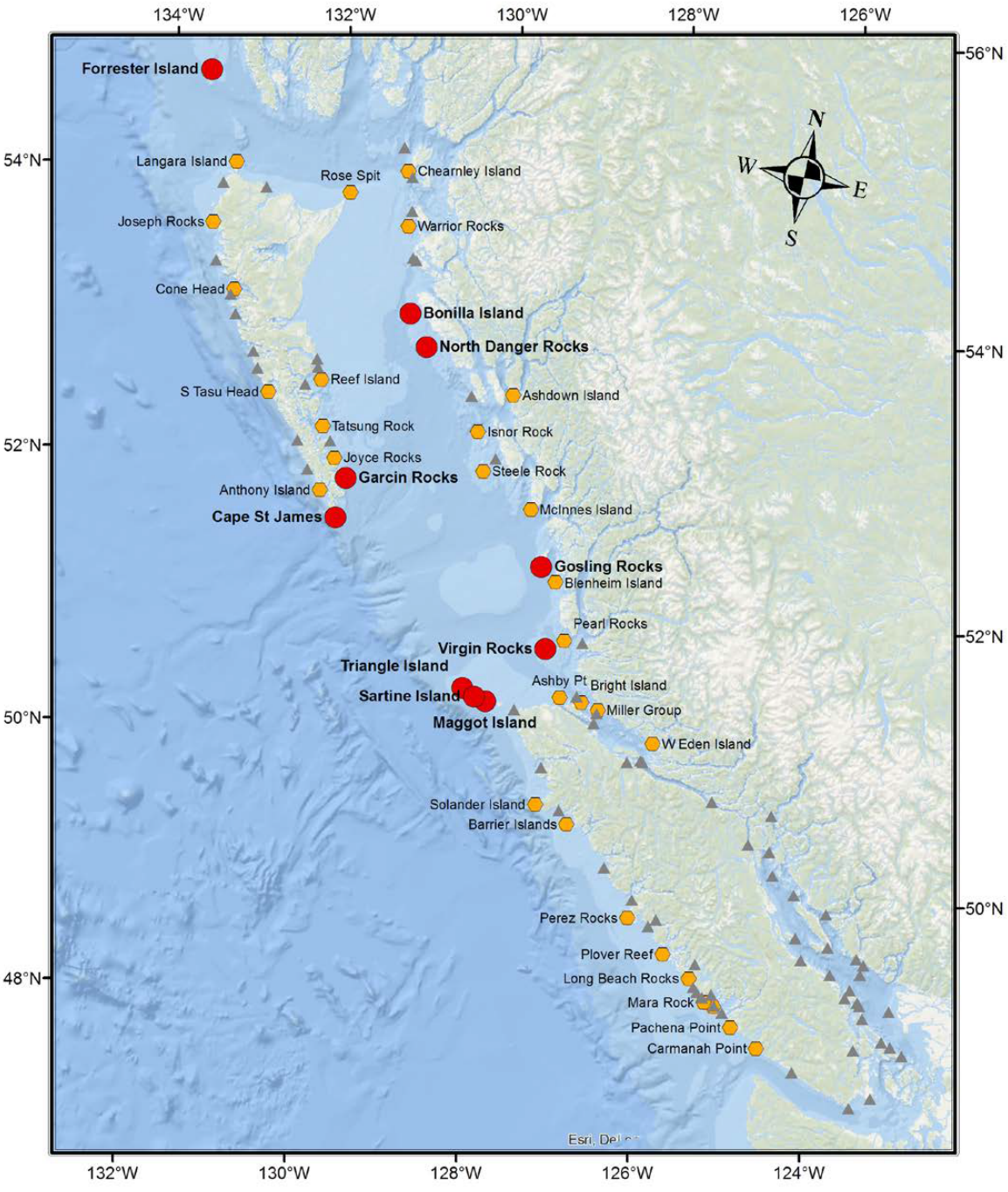

Figure A-2. Geographic location of Steller sea lion rookeries (●), year-round haulout sites (○) and major winter haulout sites (▲) in British Columbia (and Forrester Island, Alaska). (From Olesiuk 2018)

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

APPENDIX B – MITIGATION BEST PRACTICES

Underwater Noise Guidelines

Currently, DFO has not adopted regulatory thresholds for assessing effects of underwater noise on marine mammals. For marine mammals, there have been two widely acknowledged yet different sets of injury and behavioural disturbance criteria for sound exposure that are commonly used for environmental assessments and monitoring in Canada. These are discussed further below and summarized in **Table 1**.

- Regulatory criteria formally applied by the U.S. National Oceanic and Atmospheric Administration (NOAA) for both injury and behavioural effect thresholds and commonly used in Canada (**Table 1**)
- New, updated species-specific weighted regulatory criteria applied by U.S. NOAA for injury thresholds only (NOAA 2018)

As stated in LNGC EIS Section 5.8.5.4.1, the potential for harm to marine mammals depends on the level of underwater noise produced. Auditory injury thresholds from impulsive noise (such as pile installation) are expressed using two common metrics: sound pressure level (SPL), measured in dB re: 1 µPa, and sound exposure level (SEL), a measure of energy in dB re: 1 μPa^2s. SPL can be an instantaneous value, whereas SEL is the total noise energy to which the organism is exposed over a given time period, typically one second for pulse sources (Theobald et al. 2009). SPL and SEL are further categorized into the following metrics:

- Peak SPL (SPL_{peak}): the maximum sound pressure at any given moment produced by a particular activity, which is the maximum mechanical force that will be experienced by sound receivers
- Root mean square SPL (SPL_{RMS}): average root mean square pressure level over a given amount of time
- Cumulative SEL (SEL_{cum}): cumulative energy exposure over multiple pulses for a given period of time.

Regulatory criteria formally applied by NOAA prior to 2016, did not have established injury criteria for exposure to continuous sounds, and provide the only threshold-based behavioural disturbance criteria, (based on a limited set of behavioural data from baleen whales); these behavioral thresholds remain widely applied in Canada (see Table 1) and were applied in the LNGC EIS. The former NOAA behavioural disruption thresholds are 160 dB_{RMS} re 1 µPa for pulsed noise and 120 dB_{RMS} re 1 µPa for non-pulse noise for both pinnipeds and cetaceans; these values are not weighted by functional hearing group.

NOAA (2018) includes a protocol for estimating PTS onset thresholds for impulsive (e.g., airguns, impact pile drivers) and non-impulsive (e.g., vibratory pile drivers) sound sources, the formation of marine mammal hearing groups (low- (LF), mid- (MF), and high- (HF) frequency cetaceans, and otariid (OW) and phocid (PW) pinnipeds;), and the incorporation of marine mammal auditory weighting functions into the derivation of PTS onset thresholds. These thresholds for hearing injury use dual metrics of weighted cumulative sound exposure level (SEL_{cum}) and peak sound level (PK) for impulsive sounds and weighted SEL_{cum} for non-impulsive sounds and are not relevant for potential behavioural effects.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

Table 1. Auditory Injury and Disturbance Threshold Guidelines for Marine Mammals formally used by U.S. NOAA

	NOAA Thresholds - RMS SPL (dB re 1 µPa)			
	Continuous Sound (i.e., Vibratory Pile Installation)		Impulsive Sound (i.e., Impact Pile Installation)	
	Injury	Disturbance	Injury	Disturbance
Cetaceans	-	120	180	160
Pinnipeds in Water	-	120	190	160

Notes: NOAA - National Oceanic and Atmospheric Administration pre-2016 injury thresholds, and disturbance thresholds
RMS SPL - root mean square sound pressure level

Mitigation Best Practices

While there is no marine mammal-specific mitigation guidance for mitigating effects of pile installation noise on pinnipeds (including impulsive impact pile installation), there is federal guidance for the mitigation of noise effects during impulsive air gun noise during geophysical seismic surveys (DFO 2007). This DFO guidance for seismic surveys clearly states that they are not directed at mitigating underwater noise effects for non-SARA-listed species, such as harbour seals. Guidance was initially developed for the mitigation of underwater noise effects from geophysical seismic surveys (Weir and Dolman 2007; DFO 2004, 2010c). These mitigation guidelines have been used extensively throughout the world for decades to successfully mitigate the effects of underwater noise on marine mammals from seismic surveys and a range of marine activities, including marine construction such as pile installation (i.e., Johnson et al. 2007; DFO 2007, 2010c; JNCC 2010a,b,c, 2017; Nowacek and Southall 2016). See Weir and Dolman 2007, DFO 2010c, and Martin et al. 2014 for a review of mitigation use and effectiveness.

Current best practices for the mitigation of potential effects to marine mammals from underwater noise during construction are as follows:

- Vibratory pile driving, rather than impact pile driving, is recommended, if feasible, to reduce the potential impacts on marine mammals.
- If impact pile driving is to occur, the following additional mitigation measures are recommended:
    - Conduct hydroacoustic monitoring during impact pile driving to monitor underwater noise thresholds
    - Implement a sound attenuation device (e.g., bubble curtain) to reduce sound levels outside of the bubble curtain
    - A qualified marine mammal observer (MMO) will establish and monitor the prescribed marine mammal exclusion zone
    - Monitor for marine mammals within the marine mammal exclusion zone for at least 30 minutes prior to the start of pile driving. If a marine mammal enters the marine mammal exclusion zone, temporarily suspend pile driving until the individual has left the exclusion zone or has not been sighted for 30 minutes
    - Confirm no marine mammals have been observed for 30 minutes prior to initiating piling. For vibratory piling, initiate a noise from the hammer at 40-60% reduced energy, followed by a 1-minute waiting period prior to commencing works. For impact hammering, provide an initial set of three strikes from the impact hammer, followed by a 1-minute waiting period, then two subsequent three strike sets.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

APPENDIX C - REGULATORY CONTEXT FOR LNG CANADA

Multiple permits, a federal decision statement, and authorization establish requirements for the implementation of a marine mammal monitoring program and specified mitigation measures for the protection of marine mammals[4] from potential physical harm or behavioural disruption during construction-related activities. Some of these include Environmental Assessment Certificate #E15-01, Disposal at Sea Permit 4543-2-03675, and *Fisheries Act* Authorization *15-HPAC-00585*.

In addition to these permits and authorization, LNG Canada submitted a marine monitoring plan (MMP) to the British Columbia Environmental Assessment Office (EAO) that provides details on how LNG Canada will implement monitoring and mitigation requirements specified in its environmental assessment certificate. The MMP was developed in consultation with BCEAO, Ministry of Environment and Climate Change Strategy, Ministry of Health, DFO and the Oil and Gas Commission. The MMP was also developed in consultation with Indigenous Groups, including Haisla Nation, Gitga'at Nation, Kitselas First Nation, Kitsumkalum First Nation, Gitxaala Nation, Lax Kw'alaams First Nation, Metlakatla First Nation, and Metis Nation BC. The MMP has been reviewed and approved by the relevant agencies and as such, represents enforceable requirements. Most of the conditions and requirements set out within these permits, authorization and MMP are focused on construction activities (e.g., pile installation and ground improvement) that generate potentially disturbing underwater sounds.

Regulation and management of marine mammals under the Federal framework in Canada occurs primarily through the following statutes:

- Marine Mammal Regulations and *Fisheries Act* authorization under the *Fisheries Act*
- *Species at Risk Act* (SARA)
- Environmental assessment conditions outlined in federal Decision Statements under the *Impact Assessment Act* (IAA)

Fisheries Act

Marine Mammal Regulations

On June 22, 2018, Regulations Amending the Marine Mammal Regulations (SOR/2018-128) came into force. Section 7 of the Marine Mammal Regulations was amended, among other changes. The relevant portion of that amendment (paragraph 7(1)(a)) states the following exemption for works, undertakings or activities authorized under the *Fisheries Act*:

> **"7 (1)** No person shall disturb a marine mammal except
>
> **(a)** when carrying on a work, undertaking or activity that is authorized, otherwise permitted or required under the Act."

Fisheries Act Authorization

The Minister of DFO may issue an authorization under paragraph 35(2)(b) of the *Fisheries Act.* DFO issued an authorization FAA to LNG Canada, specifying measures to protect fish and fish habitat (including marine mammals) from potential adverse effects during the construction period (DFO file number *15-HPAC-00585*). The authorization

[4] For the purposes of this memorandum, marine mammals are defined by Schedule 1 (Common and Scientific Names of Marine Mammals) of the Marine Mammal Regulations (SOR/93-56) under the *Fisheries Act*, as amended on 2019-08-28.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

did not explicitly recommend specific marine mammal exclusion zones (MMEZ) or specific exclusion zones for seals and sea lions during pile installation.

Species at Risk Act

SARA discusses species listed as Special Concern, Threatened or Endangered[5]. DFO is responsible for administering all aspects of SARA related to aquatic species at risk. SARA contains specific requirements for when project reviews are being undertaken under CEAA 2012 (now IAA). It requires the assessment of adverse effects of a proposed project on any species listed on Schedule 1 of SARA, for measures to be taken to avoid or lessen those effects and requires those measures to be monitored. All measures must be consistent with any recovery strategies or action plans in place for SARA listed species.

Under SARA Section 32, only Extirpated, Threatened, or Endangered Species are protected from "Killing, harming, etc.," and "Damage or destruction of residence". For species of Special Concern, section 65 of SARA specifies that:

> "**65** …the competent minister must prepare a management plan for the species and its habitat. The plan must include measures for the conservation of the species that the competent minister considers appropriate and it may apply with respect to more than one wildlife species."

In the case of Steller sea lions, which are listed under SARA as Special Concern, the competent minister would be the Minister of Fisheries and Oceans. The Minister of Fisheries and Oceans also has the discretion of how to implement management plans for species of Special Concern. There is a management plan for Steller sea lions, which sets a goal of ensuring that anthropogenic threats do not cause unsustainable population declines or contraction of the current range or number of breeding sites in Canada, and which encourages research and monitoring (DFO 2010b, DFO 2018). See **Appendix A** for a full description of the conservation status of Steller sea lions in BC. Harbour seals are listed as Not at Risk under SARA and do not have a management plan.

Impact Assessment Act (replacing Canadian Environmental Assessment Act, 2012)

Under CEAA 2012, the Minister issued a decision statement, including any enforceable conditions with which the Proponent must comply. In its Decision Statement issued under section 54 of CEAA 2012, the Minister established conditions in relation to the environmental effects referred to in subsection 5(1) of CEAA 2012 with which LNG Canada must comply. Condition 3.9 states that:

> *"To avoid detrimental behavioural change in or injury to marine mammals, the Proponent shall establish and maintain a marine mammal exclusion zone for all construction activities where underwater noise levels are anticipated to exceed 160 decibels at a reference pressure of one micropascal."*

The *Impact Assessment Act* (IAA), came into force on August 28, 2019, replacing CEAA 2012. The IAA includes some of the same provisions as CEAA 2012, including the development and enforcement of conditions defined in the project decision statement. Section 68(1-3) states that:

[5] A species of Special Concern means a wildlife species that may become a Threatened or an Endangered species because of a combination of biological characteristics and identified threats. A Threatened species means a wildlife species that is likely to become an Endangered species if nothing is done to reverse the factors leading to its extirpation or extinction. An Endangered species means a wildlife species that is facing imminent extirpation or extinction.

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

"**68 (1)** The Minister may amend a decision statement, including to add or remove a condition, to amend any condition or to modify the designated project's description. However, the Minister is not permitted to amend the decision statement to change the decision included in it.

(2) The Minister may add, remove or amend a condition only if he or she is of the opinion that doing so will not increase the extent to which the effects that are indicated in the report with respect to the impact assessment of the designated project are adverse.

(3) The Minister may add or amend a condition only if the new or amended condition could be established under subsection 64(1) or (2). Subsection 64(3) applies with respect to the new or amended condition if it could be established under subsection 64(2)."

Reference: **Summary of current mitigation measures for marine mammals during in-water pile installation, and supporting rationale for a pinniped-specific exclusion zone**

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