



**MARINE MAMMAL AND
UNDERWATER NOISE MONITORING
AND MITIGATION PLAN**

Fraser Surrey Canola Oil Transload
Facility Project

October 13, 2022

Prepared for:
DP World (Canada) Ltd.

Prepared by:
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Project Number:
123222054

Marine Mammal and Underwater Noise Monitoring and Mitigation Plan

Limitations and Sign-off

October 13, 2022

Limitations and Sign-off

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Acronyms / Abbreviations

#	number
%	percent
µPa	micropascal
BC	British Columbia
BMP	best management practice
CDC	Conservation Data Centre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dB	decibel
DFO	Fisheries and Oceans Canada
DPW	DP World (Canada) Ltd.
kHz	kilohertz
km	kilometre
kPa	kilopascal
m	metre
MMO	marine mammal observer
NOAA	National Oceanic and Atmospheric Administration
PER	Project and Environmental Review
PTS	permanent threshold shift
QEP	qualified environmental professional
rms	root-mean-square
RRER	Race Rocks Ecological Reserve
SARA	<i>Species at Risk Act</i>
SPL	sound pressure level



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Stantec	Stantec Consulting Ltd.
TTS	temporary threshold shift
US	United States
VFPA	Vancouver Fraser Port Authority



1 Introduction and Background

DP World (Canada) Ltd. (DPW) has retained Stantec Consulting Ltd. (Stantec) to conduct construction environmental monitoring for the Fraser Surrey Canola Oil Transload Facility (the Project).

The Project is located at the former Fraser Surrey Docks terminal, situated on the south bank of the South Arm of the Fraser River, Surrey, British Columbia (BC) (Figure 1). Historically, the site (which is no longer in use) has been used as a transload facility for agriproducts, breakbulk steel, and container operations. In 2020, DPW acquired the long-term lease from the Vancouver Fraser Port Authority (VFPA) for the Fraser Surrey Docks marine terminal, now renamed DP World Fraser Surrey. The objective of the Project is to redevelop a portion of the site to function as a transload facility utilizing the existing berth #10 configuration for mooring and loading vessels, and existing ancillary infrastructure, including existing dock and dolphin. In addition, the Project will require the development of several in-water infrastructure components at berth #10 for mooring and loading vessels and upgrades to upland infrastructure. The Project is subject to a full application review under VFPA's Project Environmental Review (PER No 22-017) process intended to satisfy Section 82 of the *Impact Assessment Act*.

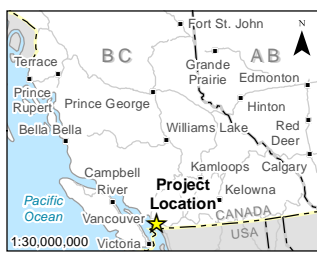
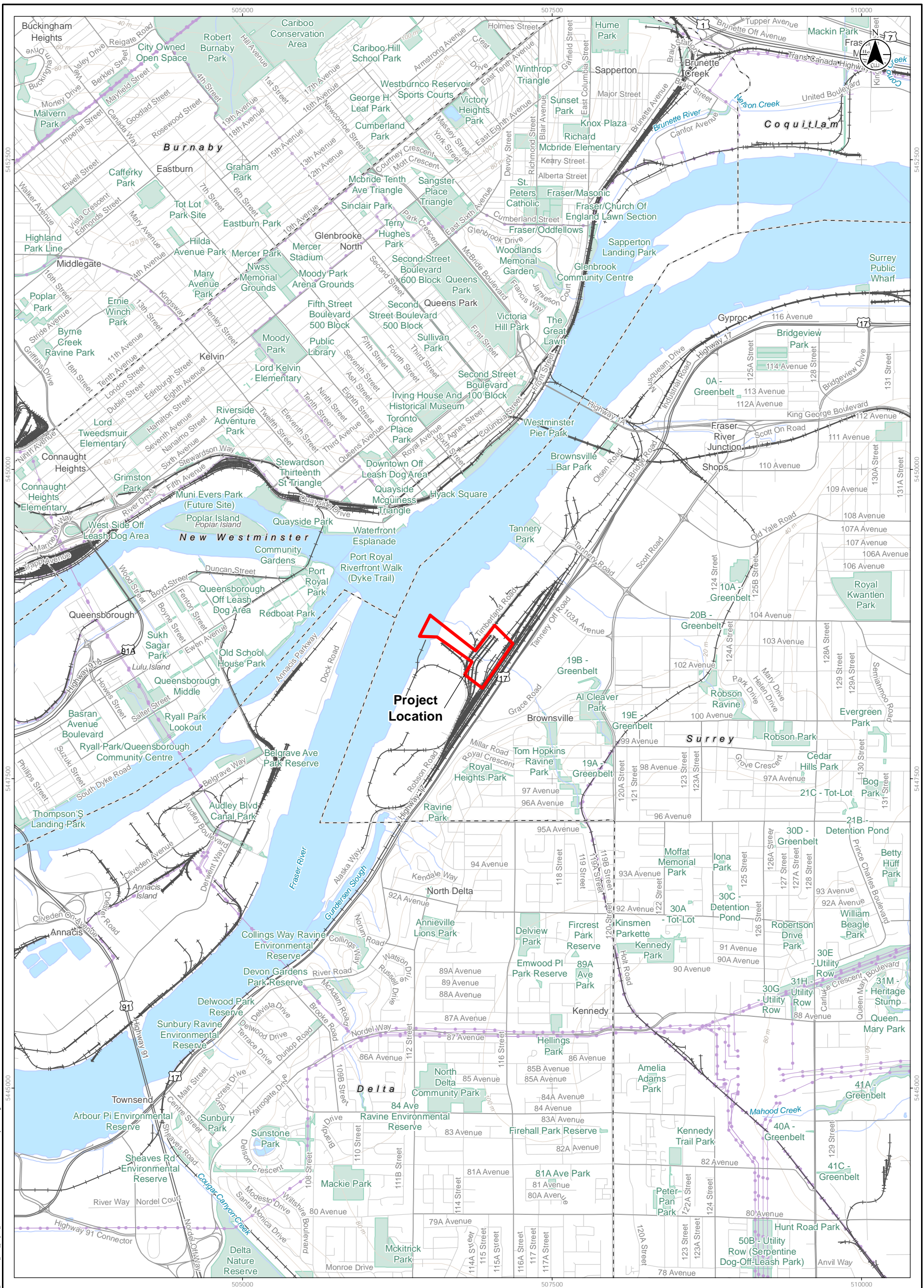
Construction is planned to commence in early 2023 with in-water works to be completed during the Fisheries and Oceans Canada (DFO) least risk window for the Fraser River (i.e., June 16 through February 28). The timing will be subject to approval and conditions received for the Project.

The Fraser River supports many aquatic species, including marine mammals. Underwater noise created during pile installation has the potential to result in behavioural disturbance (impact and vibratory piling) or hearing injury (impact piling only) to marine mammals. Mitigation can help to reduce the extent and severity of behavioural disturbance.

As part of the environmental monitoring program, Stantec will provide underwater acoustic and visual monitoring to mitigate potential adverse effects from underwater noise generated during impact pile installation.

This document outlines strategies that will be implemented as part of the acoustic monitoring program to protect marine mammals. Fish and fish habitat protection mitigation measures are outlined in the Construction Environmental Management Plan prepared for the Project.





- Highway
- Road
- Local Street
- Railway
- Transmission Line
- Topographic Contour
- Watercourse
- Waterbody
- Local Greenspace
- Municipal Boundary
- Site Boundary



Stantec DP WORLD
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Client/Project/Report: DP World (Canada) Fraser Surrey Canola Oil Transload Facility

Figure No. 1
 Title: Site Location

Notes
 1. Coordinate System: NAD 1983 UTM Zone 10N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada

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2 Marine Mammals in the Fraser River

Marine mammals other than seals and sea lions (i.e., cetaceans) do not typically occur in the Fraser River. Rare sightings of wayward cetaceans, including one grey whale (*Eschrichtius robustus*) and one harbour porpoise (*Phocoena phocoena*), have been reported (CBC 2007, Guenther et al. 1993), and transient or southern resident killer whales (*Orcinus orca*) remain possible, but cetaceans in general would be considered an abnormal and unexpected occurrence.

Harbour seals (*Phoca vitulina*) and Steller sea lions (*Eumetopias jubatus*) occur in the Fraser River seasonally, with peak abundance in the lower Fraser River and estuary typically coinciding with seasonal physical and biological factors such as availability of prey. A high-level overview of the life history and occurrence of harbour seals and Steller sea lions in the region are described below. California sea lions (*Zalophus californianus*) are potential rare visitors to the Fraser estuary and Steller sea lions are considered an appropriate representative species for the development of mitigation and monitoring measures, which would be applied to all species.

2.1 Harbour Seals

The harbour seal is the most abundant marine mammal species in BC and can be seen year-round. They are commonly observed in small groups in coastal areas, inlets, and estuaries throughout BC, also occurs in some rivers and lakes, and hauls out on rocks, reefs, sandbars, and beaches as well as man-made structures. They can sleep for short periods underwater, on the ocean floor or under ledges if no suitable haulout is present (Baird 2001). Unlike sea lions (see Section 2.2), harbour seals do not congregate on a few large rookeries (i.e., breeding colonies), but instead breed in smaller groups along shorelines throughout most of their range. In southern BC, female harbour seals give birth to a single pup each year, from early July to late August, while hauled out on shore (Olesiuk et al. 1990, Olesiuk 1999, DFO 2010a). Harbour seal pups are relatively mature and mobile at birth and are reared in the water as well as on land (Riedman 1990). The mother and pup remain together until weaning occurs at three to six weeks after birth (Bishop 1967, Bigg 1969). Moulting (i.e., shedding of hair) occurs from late June to October, and during this time harbour seals are typically hauled out on shore.

Harbour seals are considered non-migratory and are common year-round in the Strait of Georgia (Keple 2002), and relatively common in the lower Fraser River, especially in channels and sloughs. Thought to be primarily an inshore species with high site fidelity to their haulouts (Frost 1997, Lowry et al. 2001), they typically occur within 20 km of land (Spalding 1964), though individuals have been observed up to 100 km from shore (DFO 2010a). They forage at the mouth of rivers and streams, entering navigable rivers and lakes in pursuit of prey such as spawning salmon (e.g., Baird 2001), and have been known to travel 50 km up the Fraser River (DFO 2010a). The nearest documented haulout site to the Project site is at Garry Point, on the southeastern edge of Sturgeon Bank (EAO and VFPA 2012). Harbour seals are opportunistic predators and feed on fish species that they encounter in their nearshore habitat. They have been regularly observed feeding on migrating runs of eulachon and salmon (DFO 2010a). Vessel operators along the river have reported seals at the river mouth and hundreds



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2 Marine Mammals in the Fraser River

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hauled-out on log booms. A DFO assessment in 2000 determined that approximately 1,600 harbour seals are present in the Fraser River (Pablo 2008, DFO 2010a).

Harbour seals in BC are considered not at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1999, Baird 2001), are not listed under the *Species at Risk Act* (SARA) (SARA Registry 2022), and are on the provincial Yellow List (BC Conservation Data Centre [BC CDC] 2020).

2.2 Steller Sea Lion

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). When not foraging, sea lions haul out on a variety of surfaces, including rocky outcrops, log booms, floats, docks, and piers. They do so to avoid predators, thermoregulate, engage in social activity, rest, and reproduce. DFO has defined three categories of haulouts: (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). Steller sea lions tend to be highly gregarious while on land and pack close together in dense breeding colonies (rookeries) or on their non-breeding winter or year-round haulouts.

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 (those that breed from southeast Alaska to north-central California [Pitcher et al. 2007]) are located in BC. The tenth rookery is located at Forrester Island north of Haida Gwaii in United States (US) Alaskan waters.

Currently there are between 23 and 34 year-round haulout sites in BC (Olesiuk 2018). A number of these are protected within national or provincial parks, such as Pacific Rim and Gulf Islands National Park Reserves, Race Rocks Ecological Reserve (RRER), and others; however, none of these sites are near the Project site in the Fraser River. 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 the leeward side of an island. 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. Steller sea lions occasionally congregate in freshwater and estuaries to feed on migrating salmon, herring, or eulachon (COSEWIC 2013, DFO 2010b). The closest documented haulout to the Project is approximately 28 km downstream, at the mouth of the Fraser River, along the Steveston jetty near Sand Heads (DFO 2010b).



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DFO's Steller sea lion Management Plan 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). There is also some evidence that sea lions (and seals) tolerate regular acoustic disturbance, while returning to their haulouts shortly thereafter, with no measurable effect on seal or sea lion populations (Edgell and Demarchi 2012).

Steller sea lion is designated as special concern by COSEWIC (COSEWIC 2013), listed as special concern on Schedule 1 of SARA (SARA Registry 2022), and is provincially blue-listed (BCCDC 2022).



3 Importance of Sound to Marine Mammals

Marine mammals use sound to communicate, forage, orient, locate mates and conspecifics, and respond to perceived threats (e.g., Ketten 1998, Southall et al. 2007, Ellison et al. 2012).

Given the importance of a functional acoustic environment to most marine mammal life functions, the introduction of anthropogenic underwater noise can result in behavioural disturbance.

Disturbance can range from overt and visually observable responses such as displacement or avoidance behaviours and changes in activity state (e.g., swim speed or direction, surfacing interval) to less obvious changes such as increases in stress hormones. Behavioural disturbance in response to underwater noise depends on a number of variables, including the magnitude, duration, and wavelength of the noise, distance of the animal from the sound source, species, and the context (e.g., activity of the animal at the time).

Marine mammals subject to high intensity sound pressure levels (SPLs), such as impact pile driving, may experience a temporary or permanent decrease in hearing sensitivity (i.e., temporary or permanent threshold shift [TTS or PTS, respectively]) (Richardson et al. 1995, Southall et al. 2007, Popper and Hawkins 2012).



4 Regulatory Requirements

Regulation and management of marine mammals occurs primarily through the Marine Mammal Regulations (SOR/93-56) of the *Fisheries Act*, R.S.C. 1985, c. F-14, and the *Species at Risk Act* (SARA), S.C. 2002, c. 29. These acts are administered by DFO in partnership with other federal departments and are the main federal statutes that pertain to the conservation and protection of marine mammals.

Section 7 of the Marine Mammal Regulations prohibits disturbance of marine mammals except when fishing for them under the authority of the Regulations.



5 Best Management Practices and Standards

The VFPA is a port authority created pursuant to the *Canada Marine Act*. Under this *Act*, the VFPA is responsible for the administration, management and control of the land and water within its jurisdiction. The VFPA administers a Project and Environmental Review (PER) process on projects within its jurisdiction. The PER applies to all physical works proposed on Federal Lands and allows the VFPA to fulfill its responsibilities under the *Canada Marine Act* and the *Impact Assessment Act*. DPW has applied to the VFPA under PER 22-017 and will adhere to conditions of the permit set by the VFPA.

5.1 Acoustic Thresholds

Canada does not currently have established regulatory acoustic thresholds for underwater sound levels that should not be exceeded, nor are there national or provincial guidelines outlining mitigation measures or protocols to protect marine mammals exposed to noise from in-river pile installation or other marine construction activities.

Environmental assessments and management plans in Canada therefore frequently rely on regulatory thresholds and guidance in place in the US, which are provided by the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration (NOAA Fisheries). NOAA Fisheries provides guidance for assessing the potential for underwater sound levels to injure or disturb marine mammals. This guidance includes the provision of thresholds that can be used to assess both behavioural disruption and injury (where onset of PTS is used as the threshold for injury).

With respect to behavioural disruption, NOAA Fisheries has historical interim guidance¹ that sets thresholds for broadband underwater root-mean-square (rms) sound pressure levels² (SPLs) predicted to cause behavioural disruption (NOAA Fisheries 2022). NOAA Fisheries has recently released updated regulatory guidance for assessing the potential for underwater noise to cause injury (i.e., PTS) (Southall et al. 2019; NOAA 2018). However, these more recent recommendations do not update the interim guidance for disturbance (NOAA Fisheries 2022).

¹ <https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west#marine-mammal-acoustic-thresholds>

² Sound pressure level: a metric, measured in decibels (dB) that is commonly used to describe the magnitude of sound.



Marine Mammal and Underwater Noise Monitoring and Mitigation Plan 5 Best Management Practices and Standards

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A pinniped exclusion area will be implemented by DPW to mitigate potential injury to pinnipeds during impact pile installation. The size of this area will be based on the NOAA dual metric threshold for hearing injury in seals³ (i.e., 218 dB re 1 micropascal [μPa] rms SPL, and 185 dB re 1 $\mu\text{Pa}^2\text{s}$ cumulative sound exposure level ; NOAA Fisheries 2022). The actual size of the exclusion zone will be determined through an underwater noise field verification program during the first week⁴ of impact pile installation, with the initial monitoring area set at 75 m, in keeping with recent DFO guidance on other Canadian projects on the west coast (e.g., Rio Tinto, Trans Mountain)⁵ (see Section 7).

5.2 Pile Installation

The BC Marine and Pile Driving Contractors Association and DFO have developed a policy document—*Best Management Practices for Pile Driving and Related Operations*—that identifies the best management practices (BMPs) for pile installation activities that occur on the water in BC (BC Marine and Pile Driving Contractors Association 2003). These include recommended practices for installing piles of varying materials, styles, and sizes, and using a variety of methods (e.g., drop, impact, or vibratory hammer). While these guidelines were designed primarily to prevent fish mortality (predicted to occur at underwater pressure levels in excess of 30 kPa [kilopascals])⁶, they provide a basis point from which to prioritize activities that may require mitigation for marine mammals as well.

Vibratory installation of steel piles is not explicitly identified in the BC BMPs as an activity requiring mitigation or monitoring; however, this method of pile installation is frequently selected over impact pile driving as a mitigation measure in itself, as it does not produce the high impulse sound signatures of impact pile driving that can result in hearing injury to marine mammals. In contrast, the BC BMPs recommend that driving steel pipe piles with a diameter greater than 610 mm (24 inches) using an impact hammer requires monitoring and mitigation measures such as bubble curtains.

While noise levels produced during pile installation are highly situation-specific, on average, use of a vibratory driver produces sound pressure levels (peak and root mean square) that are lower than those produced by an impact hammer in a comparable setting (e.g., Illingworth and Rodkin Inc. 2007, McCauley and Salgado Kent 2008).

³ PTS onset levels for seals are conservative relative to recommended levels for sea lions

⁴ Additional underwater acoustic noise monitoring (beyond the first week) will be conducted to verify the pinniped exclusion zone boundary if pile installation specifications or site environmental conditions change substantially (e.g., pile diameter, number of pile driving rigs, substrate type, etc.).

⁵ The Rio Tinto Terminal A Extension Project has specified a fixed-distance pinniped-specific exclusion zone of 75 m during its construction period (Fisheries Act authorization 17-HPAC-00076) (Rio Tinto 2018). Similarly, a 150-m fixed distance exclusion zone has been set for harbour seals during the construction of the Trans Mountain Westridge terminal in Vancouver, BC (Trans Mountain 2018a,b).

⁶ Equivalent to 206 peak decibel (dB_{peak}).



6 Mitigation Measures

The following section specifies mitigation measures and protocols to reduce the degree to which underwater noise may cause behavioural disturbance or injury to marine mammals. For the purposes of developing effective mitigation measures, it is assumed that seals or sea lions could be in the vicinity of the Project at any time of year, and therefore may be exposed to sound levels with the potential to cause change in behaviour or injury. Given that seals and sea lions often display curiosity or habituation in proximity to in-river construction works, mitigation measures for pinnipeds focus primarily on reducing or eliminating the potential for injury during impact piling.

The geographic area within which underwater noise from Project construction activities may result in auditory injury to pinnipeds is termed the exclusion area. During active pile driving, a marine mammal observer (MMO) will monitor the exclusion area and stop the activity if a pinniped is observed. The boundaries of this area are location- and activity-specific, and will be determined based on a field-verification program to measure underwater sound levels during the first week of impact pile-driving activities.

Field-verification will be conducted during the first week of impact pile installation to determine the exclusion zone boundary at which underwater sound levels do not exceed the peak SPL threshold for injury for impulsive noise for seals (see Section 5.1). Underwater sound levels will be remeasured with field-verification if pile installation specifications or site environmental conditions change substantially (e.g., pile diameter, number of pile driving rigs, substrate type, etc.) to confirm underwater sound levels do not exceed the peak SPL and SELcum standards at the exclusion area perimeter.

The monitoring plan incorporates the use of an MMO to maintain a visual watch of the exclusion area during in-river pile driving activities and to implement shut-down procedures in the event a pinniped enters the exclusion zone. A qualified environmental professional (QEP) will identify the number and locations of MMOs required to providing the best practical vantage point to observe the entirety of the exclusion zone, considering safety limitations. The number of stations and MMOs will be dependent on multiple factors, including the scope of construction activities, viewing conditions, and the presence of viewing obstructions (e.g., vessels) within the pinniped exclusion zone. Stations may be located on land, a small vessel, or on a barge in proximity to the pile driving being monitored. The designated and qualified MMO will be responsible for monitoring the pinniped exclusion zone, and waters just beyond, and will work with the Construction Manager during the course of all activities requiring monitoring. Detailed monitoring procedures are outlined below.

The pinniped exclusion zone is a specifically-aquatic area (i.e., applies only to pinnipeds in the water); however, as part of the program, the MMO will remain aware of any hauled out pinnipeds in the immediate area, and record any apparent behavioral responses.



6.1 Implementation of Mitigation Measures

For in-river impact pile driving, the MMO will stop the activity if:

- A seal or sea lion is observed within the predetermined pinniped exclusion zone.
- A seal or sea lion exhibits signs of distress.
- A cetacean is observed.

The MMO will implement the following monitoring protocols in relation to the pinniped exclusion zone:

- Pre-scan: Prior to the start of in-river pile driving activities each day, the MMO will visually scan the entire pinniped exclusion zone with binoculars and naked eye for 30 minutes. During this time, visibility must be sufficient for detecting pinnipeds (i.e., scan must be completed during daylight hours and with no prohibitively thick fog or heavy precipitation impeding monitoring of the full extent of the exclusion zone).
- Pile driving can only commence following completion of a full pre-scan. If visibility becomes compromised during the pre-scan, the activity must be delayed until visibility allows for monitoring of the entire zone.
- If a pinniped is detected within the exclusion zone during the pre-scan, the MMO will:
 - Notify the Environmental Manager and/or Construction Manager to delay start-up.
 - Continue to monitor the exclusion zone until:
 - The sighted pinniped has been observed to leave the exclusion zone and the initial pre-scan period has been completed without additional pinniped sightings, or,
 - The pinniped has not been re-sighted within the exclusion zone and a full additional 30 minutes has elapsed following the last sighting.
- Once the exclusion zone has been deemed clear of pinnipeds as per the directives above, the MMO will communicate to the Environmental Manager and/or Construction Manager using an agreed and clear communication signal to indicate that pile installation may proceed.

Impact pile driving will only commence upon positive confirmation with the MMO and following the procedures outlined below:

- Pile installation will follow the BMPs developed by DFO and the BC Marine and Pile Driving Contractors Association (BC Marine and Pile Driving Contractors Association 2003).
- Ramp-up: Where equipment allows, the contractor will make efforts to use dry-fire impact drives, ramp-up, or soft-start technique following the pre-scan to reduce risk to any pinnipeds that may not have been identified by the MMO during the pre-scan and to give adequate time for marine wildlife to leave the vicinity before exposure to the maximum SPLs.



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- If impact pile driving has been initiated under the appropriate conditions (i.e., following the complete pre-scan in acceptable sightability conditions), then it may persist on a continuous basis throughout the daytime period.
- If pile driving ceases during the daylight hours for a period of time exceeding 30 minutes, piling activity may resume following completion of a new pre-scan and equipment ramp-up.

Although mitigation measures are primarily focused on reducing potential hearing injury during in-river impact pile driving, additional measures will be used to further reduce the areal extent over which behavioural disturbance in pinnipeds may occur during any construction activity. These measures to reduce behavioural disturbance include the following:

- Multiple, concurrent underwater noise generating activities will be minimized when practical (e.g., pile driving will be conducted on only one pier at a time). Where multiple underwater noise generating activities are planned, they will be sequenced to minimize construction duration if practical.
- Vibratory pile installation will be used preferentially, where practical and feasible.
- If hard substrates are encountered during impact pile driving, the hammer operator will attempt to drive piles with a reduced hammer force, the feasibility of which will be determined by the Contractor. The MMO will record changes in hammer type, size, and use.
- During impact pile installation, a bubble curtain (or other feasible sound attenuation method) will be used to lessen SPLs. Bubble curtains reduce SPLs and pressure waves and, therefore, reduce the radius around the source within which injury may occur.



7 Monitoring and Follow-up Plans

7.1 Underwater Acoustic Noise Monitoring

Underwater acoustic noise monitoring will be conducted during the first week of marine impact pile installation to establish the extent of the pinniped exclusion zone during impact pile driving. Whenever impact pile installation specifications (e.g., type of equipment, pile diameter, pile material, number of pile driving rigs) or environmental conditions (e.g., water depth, water temperature, substrate type) at the installation site substantially change, additional underwater noise monitoring at the established pinniped exclusion zone boundaries will also occur.

Underwater noise monitoring is not planned during marine vibratory pile installation, as it is not anticipated to result in underwater noise levels that can cause hearing injury to pinnipeds. Following the initial seven-day monitoring period and any additional monitoring due to substantial changes to pile installation specifications or site environmental conditions, underwater noise levels will be monitored at the discretion of the QEP.

Resulting data will be used on-site to verify that the exclusion zone is appropriate to protect pinnipeds from hearing injury during impact pile driving under river-specific conditions. Should measured hydroacoustic data indicate that peak injury threshold sound levels extend beyond the established exclusion area, the size of the exclusion area and any monitoring techniques applied therein will be adjusted to reflect the site-specific data obtained during the field trial. If necessary, the exclusion zones may thus be increased or decreased to reflect updated measured values, and DFO will be notified of any such changes.

A quality assurance and quality control program will be implemented to evaluate the precision of underwater noise measurements and verify instrument calibration and field procedures. This program will include routine instrument inspections and calibrations, collection of multiple readings at each sampling location, and inclusion of reference site measurements.



8 Reporting and Communications

8.1 Monitoring Reports

The MMO will actively monitor the in-river impact pile driving pinniped exclusion zone to support implementation of mitigation measures (e.g., shut-downs). Sightings of pinnipeds will be documented.

The following information will be collected during monitoring periods:

- Date and time that construction activity starts and ends.
- Weather and river conditions.
- Date and time of marine mammal sighting, species, the number of individuals, location, orientation, and the time at which the individual(s) entered and left the exclusion zone (if applicable).
- Pinniped behaviour at time of sighting (e.g., resting, foraging, travelling or surface active behaviour).
- Any mitigation measures enacted (i.e., if there is a delayed start or stop in the activity)
- Estimated distance of pinniped from MMO and from construction activity when first sighted.
- Other human activity in the area, such as other vessel activity, including fishing.
- Underwater noise measurements using the form provided in Appendix A, or a similar form that provides the equivalent information.
- Pinniped sightings using the form provided in Appendix B, or a similar form that provides equivalent information.

This information will be collated into monitoring reports that will be sent to DFO and VFPA upon completion of construction, consistent with agency permitting requirements.

8.2 Environmental Incident Reports

The MMO will immediately report observations of injured, sick, or dead marine mammals to the Environmental Manager, Construction Manager and Senior Manager of Infrastructure, who will in turn contact the whale emergency hotline (1-800-465-4336), operated by DFO's BC Marine Mammal Response Program.



9 References

- Baird, R.W. 2001. Status of harbour seals, *Phoca vitulina*, in Canada. *Canadian Field-Naturalist* 115(4): 663–675. B.C. CDC 2014.
- BCCDC. 2022. *BC Species and Ecosystems Explorer*. B.C. Minist. of Environ. Victoria, B.C. Available at: <https://a100.gov.bc.ca/pub/eswp/>. Accessed August 2022.
- British Columbia Marine and Pile Driving Contractors Association. 2003. *Best management Practices for Pile Driving and Related Operations*. In association with Fisheries and Oceans Canada. Available at: https://buyandsell.gc.ca/cds/public/2016/08/17/f0fcf96f5bd08535ff8e81aac62bbd74/fp802-160141_bc_pile_driving_practices.pdf. Accessed February 2019.
- Bigg, M. A. 1969. The harbour seal in British Columbia. *Bulletin of the Fisheries Research Board of Canada* 172:1–33.
- Bigg, M. A. 1985. Status of the Steller sea lion (*Eumetopias jubatus*) and California sea lion (*Zalophus californianus*) in British Columbia. *Canadian Special Publication of Fisheries and Aquatic Sciences* 77:1–20.
- Bishop, R. H. 1967. Reproduction, age determination, and behavior of the harbor seal, *Phoca vitulina* L., in the Gulf of Alaska. M.Sc. Thesis, University of Alaska, Fairbanks, AK.
- British Columbia Conservation Data Centre (BC CDC). 2020. *BC Species and Ecosystems Explorer*. British Columbia Ministry of Environment. Victoria, BC. Available at: <http://a100.gov.bc.ca/pub/eswp/>. Accessed March 13, 2020.
- Canadian Broadcasting Corporation (CBC) News. 2007. Grey whale seen in Fraser River. <https://www.cbc.ca/news/canada/british-columbia/grey-whale-seen-in-fraser-river-1.646866#:~:text=Likely%20lost%20and%20alone%20after%20taking%20a%20wrong,mammal%2C%20dotted%20with%20its%20characteristic%20grey-white%20marks%2C%20%22Moby.%22>.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 1999. COSEWIC assessment and update status report on the harbour seal *Phoca vitulina richardsi* in Canada. Status Report. Ottawa.
- COSEWIC. 2013. COSEWIC assessment and status report on the Steller sea lion *Eumetopias jubatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 54 pp. www.registrelep-sararegistry.gc.ca/default_e.cfm.
- Edgell, T.C. and M.W. Demarchi. 2012. California and Steller sea lion use of a major winter haulout in the Salish Sea over 45 years. *Marine Ecology Progress Series* 467:253-262 doi:10.3354/meps09911.



Marine Mammal and Underwater Noise Monitoring and Mitigation Plan

9 References

October 13, 2022

- Ellison, W.T., B.L. Southall, C.W. Clark and A.S. Frankel. 2012. A new context-based approach to assess marine mammal behavioural responses to anthropogenic sounds. *Conservation Biology* 26(1): 21–28.
- Environmental Assessment Office (EAO), and Vancouver Fraser Port Authority (VFPA). 2012. Vancouver Airport Fuel Delivery Project Assessment Report and Screening Report. EAO and VFPA, Vancouver. B.C. Available at <http://portmetrovancover.com/docs/default-source/PROJECTS-Vancouver-Airport-Fuel-Delivery-/environmental-assessment-report.pdf?sfvrsn=0>. Accessed October 2014.
- DFO. 2010a. Population Assessment Pacific Harbour Seal (*Phocavitulina richardsi*). Fisheries and Oceans Canada. Nanaimo, BC.
- DFO. 2010b. Management Plan for the Steller sea lion (*Eumetopias jubatus*) in Canada [Final]. Fisheries and Oceans Canada. Fisheries and Oceans Canada. Ottawa, ON. vi + 69 pp.
- Frost, K. J. 1997. Harbour seal, *Phoca vitulina richardsi*. Restoration Notebook, Exxon Valdez Oil Spill Trustee Council.
- Guenther, T.J., R.W. Baird, J.K.B. Ford, K.M. Langelier, M.L. McAdie, S.G. Wishniowski, and T.E. Cornish. 1993. Cetacean strandings and entanglement in fishing gear on the west coast of Canada during 1992. International Whaling Commission Meeting Document SC/47/06.
- Illingworth and Rodkin Inc. 2007. Compendium of Pile Driving Sound Data. (report). Prepared for the California Department of Transportation. Petaluma, CA. 129 pp.
- Keple, A. R. 2002. Seasonal abundance and distribution of marine mammals in the southern Strait of Georgia, British Columbia. M.Sc. Thesis, University of British Columbia, Department of Zoology, Vancouver, BC.
- Ketten, D.R. 1998. Marine Mammal Auditory Systems: A Summary of Audiometric and Anatomical Data and its Implications for Underwater Acoustic Impacts. NOAA Technical Memorandum National Marine Fisheries Service. La Jolla, California.
- Lowry, L., K. Frost, J. Ver Hoef, and R.A. DeLong. 2001. Movements of satellite-tagged subadult and adult harbor seals in Prince William Sound, Alaska. *Marine Mammal Science*. 17. 835-861.
- McCauley, R.D. and C.P. Salgado Kent. 2008. Pile Driving Underwater Noise Assessment, Proposed Bell Bay Pulp Mill Wharf Development. Prepared for Gunns Limited. Centre for Marine Science and Technology Report 2008-27. Curtin University. Perth, Australia.
- National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2018. *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing*. Available at: <https://www.fisheries.noaa.gov/resource/document/technical-guidance-assessing-effects-anthropogenic-sound-marine-mammal-hearing>. Accessed August 2020.



Marine Mammal and Underwater Noise Monitoring and Mitigation Plan

9 References

October 13, 2022

- NOAA Fisheries. n.d. *ESA Section 7 Consultation Tools for Marine Mammals on the West Coast*. Available at: <https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west>. Accessed October 2022.
- Olesiuk, P. F. 1999. An assessment of the status of harbour seals (*Phoca vitulina*) in British Columbia. Canadian Stock Assessment Secretariat Research Document, Fisheries and Oceans Canada, Nanaimo, BC. Available at <http://www.dfo-mpo.gc.ca/Library/114690.pdf>. Accessed October 2014.
- Olesiuk, P.F. 2018. Recent trends in Abundance of Steller sea lions (*Eumetopias jubatus*) in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2018/006. v + 67 p.
- Pablo, C. 2008. Native seal kills on the Fraser raise questions. Georgia Strait News. Available at <http://www.straight.com/news/native-seal-kills-fraser-raise-questions>. Accessed October 2014.
- Pitcher, K.W., P.F. Olesiuk, R.F. Brown, M.S. Lowry, S.J. Jeffries, J.L. Sease, W.L. Perryman, C.E. Stinchcomb, and L.F. Lowry. 2007. Abundance and distribution of the eastern North Pacific Steller sea lion (*Eumetopias jubatus*) population. Fishery Bulletin 107: 102-115.
- Popper, A.N. and A. Hawkins (Eds.). 2012. Effects of Noise on Aquatic Life (Vol. 730). New York. Springer.
- Richardson, J., C.R. Greene Jr., C. Malme and D. Thomson. 1995. Marine Mammals and Noise. Academic Press. San Diego
- Riedman, M. 1990. The pinnipeds: seals, sea lions, and walruses. University of California Press, Berkeley, CA.
- Rio Tinto. 2018. Terminal A Extension Project Marine Monitoring Plan. 135 p.
- Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 17: 273-275.
- Southall, B. L., Finneran, J., Reichmuth, C., Nachtigall, P. E., Ketten, D. R., Bowles, A. E., ... & Tyack, P. L. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals, 45(2), 125-232.
- Spalding, D. J. 1964. Comparative feeding habits of the fur seal, sea lion and harbour seal on the British Columbia coast. Fisheries Research Board of Canada Bulletin 146:1-52.
- Species at Risk Act (SARA) Public Registry. 2022. Government of Canada Listing of Species at Risk. [Species at risk public registry - Canada.ca](https://www.sararegistry.gc.ca/). Accessed August 2022.



Marine Mammal and Underwater Noise Monitoring and Mitigation Plan

9 References

October 13, 2022

Trans Mountain Pipeline ULC. 2018a. Westridge Marine Terminal Environmental Protection Plan. 123 p.

[https://docs2.cer-rec.gc.ca/ll-](https://docs2.cer-rec.gc.ca/ll-eng/llisapi.dll/fetch/2000/90464/90552/548311/956726/2392873/2981674/3410777/A89187-2_Trans_Mountain_Attachment_1_WMT_EPP_Condition_81_-_A5Z1S0.pdf?nodeid=3409350&vernum=-2)

[eng/llisapi.dll/fetch/2000/90464/90552/548311/956726/2392873/2981674/3410777/A89187-](https://docs2.cer-rec.gc.ca/ll-eng/llisapi.dll/fetch/2000/90464/90552/548311/956726/2392873/2981674/3410777/A89187-2_Trans_Mountain_Attachment_1_WMT_EPP_Condition_81_-_A5Z1S0.pdf?nodeid=3409350&vernum=-2)

[2_Trans_Mountain_Attachment_1_WMT_EPP_Condition_81 -](https://docs2.cer-rec.gc.ca/ll-eng/llisapi.dll/fetch/2000/90464/90552/548311/956726/2392873/2981674/3410777/A89187-2_Trans_Mountain_Attachment_1_WMT_EPP_Condition_81_-_A5Z1S0.pdf?nodeid=3409350&vernum=-2)

[_A5Z1S0.pdf?nodeid=3409350&vernum=-2](https://docs2.cer-rec.gc.ca/ll-eng/llisapi.dll/fetch/2000/90464/90552/548311/956726/2392873/2981674/3410777/A89187-2_Trans_Mountain_Attachment_1_WMT_EPP_Condition_81_-_A5Z1S0.pdf?nodeid=3409350&vernum=-2). Accessed August 2020.

Trans Mountain Pipeline ULC. 2018b. Managing Impacts: Pile Driving at Westridge Marine Terminal Delayed While Stray Sea Lion Escorted Home to Marine Research Station.

<https://www.transmountain.com/news/2018/managing-impacts-pile-driving-at-westridge-marine-terminal-delayed-while-stray-sea-lion-escorted-home-to-marine-research-station>.

Accessed August 2020.



APPENDICES



Appendix A Underwater Noise Data Sheet



Appendix B Marine Mammal Observation Form



