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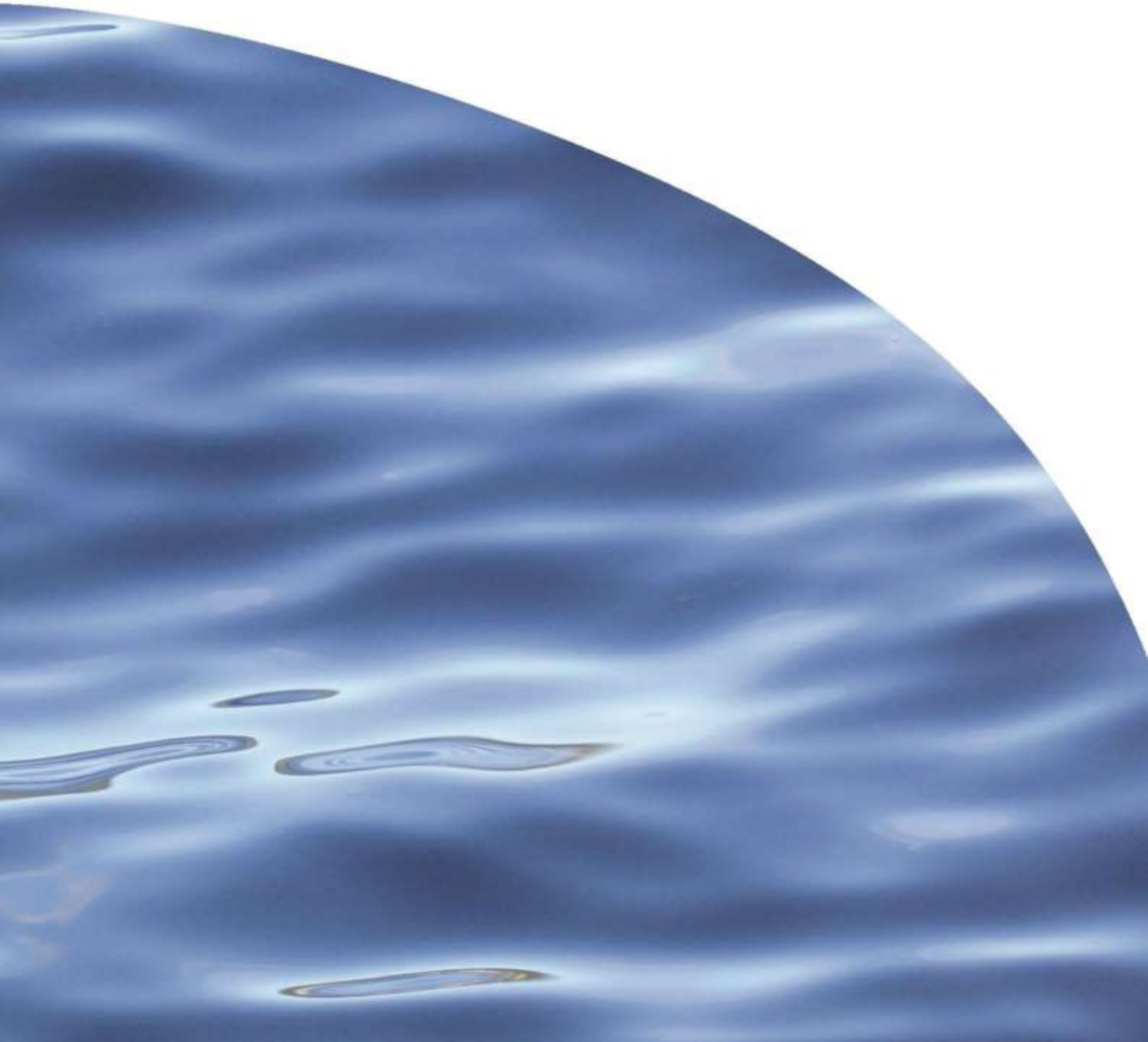
REPORT NO. 3491

KAIPARA LTD OFFSHORE SAND EXTRACTION: MARINE MAMMAL ASSESSMENT OF EFFECTS



KAIPARA LTD OFFSHORE SAND EXTRACTION: MARINE MAMMAL ASSESSMENT OF EFFECTS

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Prepared for Kaipara Limited

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EXECUTIVE SUMMARY

Kaipara Limited (Kaipara) is applying for resource consents to continue to extract sand from the Auckland Offshore Extraction Area. This coastal area is located approximately 1.2 to 2 km offshore of the Mangawhai-Pakiri embayment in water between the 25 and 40 m isobaths. The application is for the extraction of a total of up to 2,000,000 m^3 of sand (but no more than 150,000 m^3 per 12-month period from between the 25 m and the 30 m isobath) from the Auckland Offshore Sand Extraction Area. In response to a s92 request for more information by Auckland Council, Cawthron Institute has been contracted to provide a technical assessment of the potential effects on marine mammals arising from continuing the existing extraction activities within the offshore extraction area.

Kaipara operations within the Mangawhai-Pakiri embayment involve return trips of a purpose-built trailing suction hopper dredge vessel, the *William Fraser*, to and from the Ports of Auckland daily, with no local on-shore components. The dredge vessel currently makes approximately 16 to 18-hr daily return trips, travelling around 8 knots loaded and 9.5 knots unloaded. Dredging in the Auckland Offshore Extraction Area takes an average of 4-5 hr, most of which occurs overnight.

A large proportion of New Zealand's marine mammals live or migrate along the north-eastern coastline of the North Island. Both the Hauraki Gulf and Bay of Islands are known tourist destinations to view local and migrating species in this area. The species most likely to be affected by the proposal are common and bottlenose dolphins, orca and Bryde's whales. Other species of interest include NZ fur seals, southern right and humpback whales, pilot whales, and sperm whales, due to their potential vulnerabilities or conservation status. Based on the limited data available, the Mangawhai / Bream Bay coastal waters are not considered ecologically significant habitats for nearly all of these species. The exception is the small population of critically endangered Bryde's whales that use Hauraki Gulf waters as important resting and feeding habitats throughout the year. The general region also supports populations of nationally endangered or threatened bottlenose dolphins, orca and southern right whales that need to be considered.

Extraction activities more likely to affect marine mammals are the production of underwater sound and vessel movements associated within the general extraction region. However, the overall risk of any significant adverse effects arising from the proposed consent activities is assessed as less than minor to negligible. To ensure that the most appropriate measures are in place and to further reduce any identified risks, several suggested best management practices and formalising of existing operational mitigation actions are recommended as part of the development of a Marine Mammal Management Plan (MMMP).The report also addresses the collision risks of dredge vessel transiting through Hauraki Gulf water and suggests further reducing any accidental interactions with Bryde's whales by formally implementing the Ports of Auckland's Hauraki Gulf voluntary transit protocol for commercial shipping.

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1. INTRODUCTION

Kaipara Limited (Kaipara) is applying for consent to continue sand extraction activities within the Auckland Offshore Extraction Area located in the Mangawhai–Pakiri embayment (North Auckland; see Figure 1). Kaipara are seeking consent to extract up to 2,000,000 m^3 of sand over a 20-year consent period (restricted to no more than 150,000 m^3 of sand per 12-month period from between the 25 m and the 30 m isobath). The landward (western) side of the Auckland Offshore Extraction Area is adjacent to existing and newly proposed inshore extraction areas by the McCallum Brothers Limited (MBL). The western boundary is between 1.2 and 2 km from the shore and follows the 25 m isobath (Figure 1). The consent area covers water depths out to 40 m and is approximately 44 km^2. In reply to the s92 request by Auckland Council, Kaipara have contracted Cawthron Institute (Cawthron) to provide a technical assessment of potential sand extraction operations on marine mammals.

1.1. Scope of assessment

This report provides an assessment of potential effects on marine mammals from the continuation of sand extraction activities in the Auckland Offshore Extraction Area. The report includes descriptions of the proposed sand-extracting activity and the existing environment from a marine mammal perspective. It focuses on three key assessment components:

1. Desktop review of resident and transient marine mammal populations using the wider Bream Bay to Cape Rodney coastal ecosystems with reference to:
    a. abundance and seasonal distribution information
    b. presence of any known important habitats, such as nursing or feeding areas; and known life history dynamics that may make a species more vulnerable to sand dredging activities.
2. Reference / review of comparable national and international literature as well as the collection of any necessary data to describe the potential marine mammal effects associated with sand extraction activities.
3. Identification and categorisation of any potential effects; specifically, considering the types of effects, their spatial scales and durations, likelihood and potential consequences.
4. Recommendations for avoidance, remediation and mitigation options based on the final risk assessment of effects.

We note that as the Kaipara resource consent proposal is reliant on MBL's dredging vessel and as the consent area is near to the existing MBL sand extraction consent area, this report is based heavily on the findings and assessment of the earlier report by Clement and Johnston (2019).

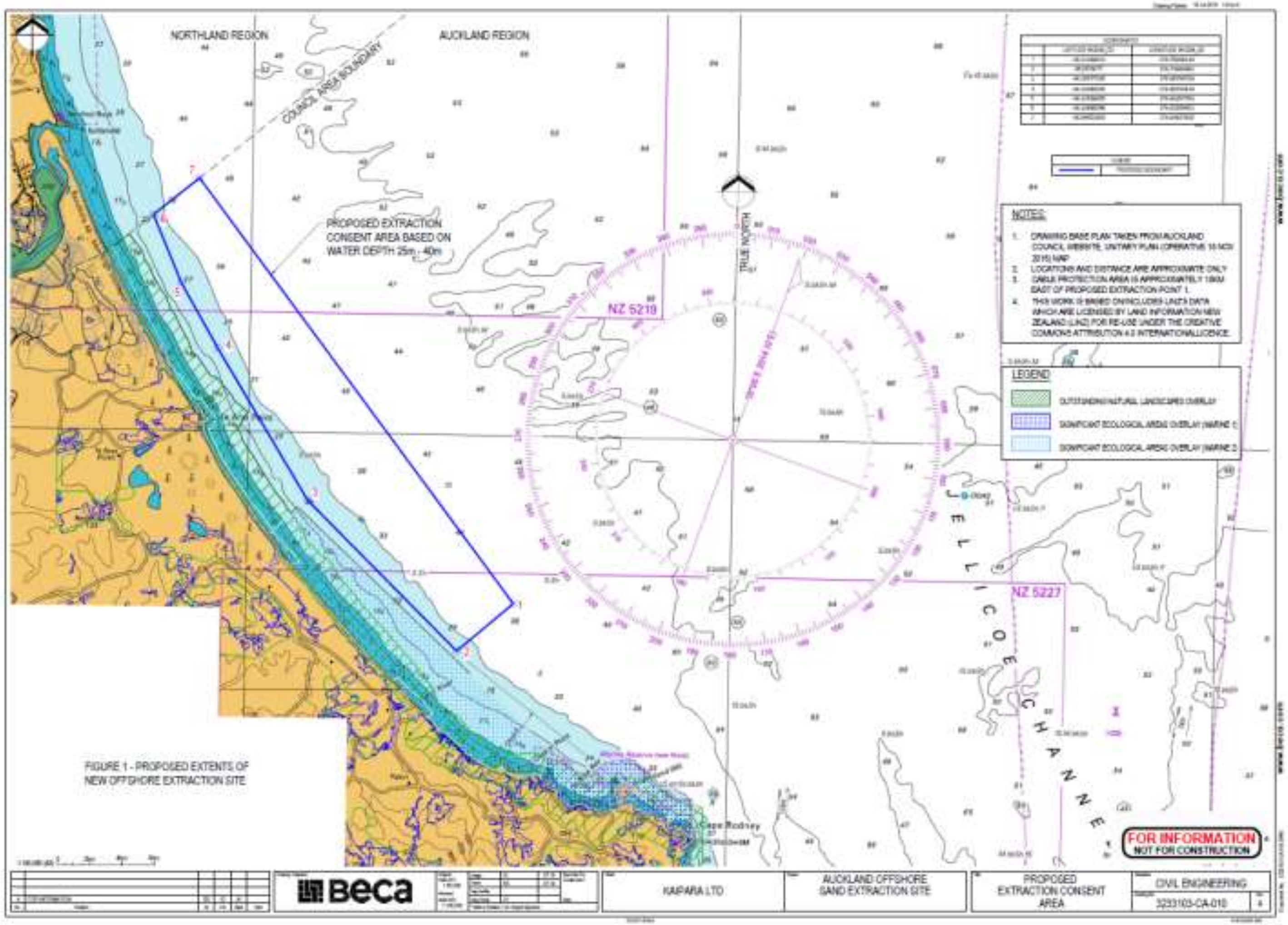

Figure 1. The location of the Auckland Offshore Extraction Area along the Mangawhai and Pakiri coastline. Map provided by BECA.

2. ACTIVITY CHARACTERISATION

Current Kaipara sand extraction operations within the extraction area rely on dredging and pumping of a sand slurry from the seabed to a new purpose-built trailing suction hopper dredge vessel, the *William Fraser*[1], owned and operated by MBL. MBL's trailing suction hopper dredger (TSHD) operates by sucking material from the seabed as a sand slurry using a trailing suction head fitted to pipes that trail over the bed as the ship slowly steams over the extraction area. The sand pumps lift the extracted sand slurry through the pipework to pass through sand screens to be deposited in the onboard hopper. A schematic diagram of a TSHD is presented in Figure 2. This figure illustrates the various physical and environmental effects that can be associated with dredging seafloor sediments with a vessel similar to the *William Fraser*. Those potential effects that are most relevant to local and visiting marine mammals are discussed further in Section 4.

A key component of this activity is that once the dredge vessel is fully loaded, it returns directly by sea to the Ports of Auckland for unloading, hence there are no local onshore components to the extraction operation. Dredging operations within the current consent area can take place 24 hours, 7 days a week and any day throughout the year. The *William Fraser* normally leaves the Ports of Auckland around late morning to midday and begins dredging in the Auckland Offshore Extraction Area by late afternoon or early evening. The average extraction time takes between 4 to 5 hours, the majority of which occurs overnight. Once the TSHD has reached its load limit, the vessel returns to the Ports of Auckland. A round trip from Auckland averages about 16-18 hours.

[1] *William Fraser* is a 68-m long trailing suction dredger proposed to undertake all extraction in the offshore extraction area. Cruising speed is around 8 knots loaded and 9.5 unloaded and extraction speed is 2–2.5 knots.

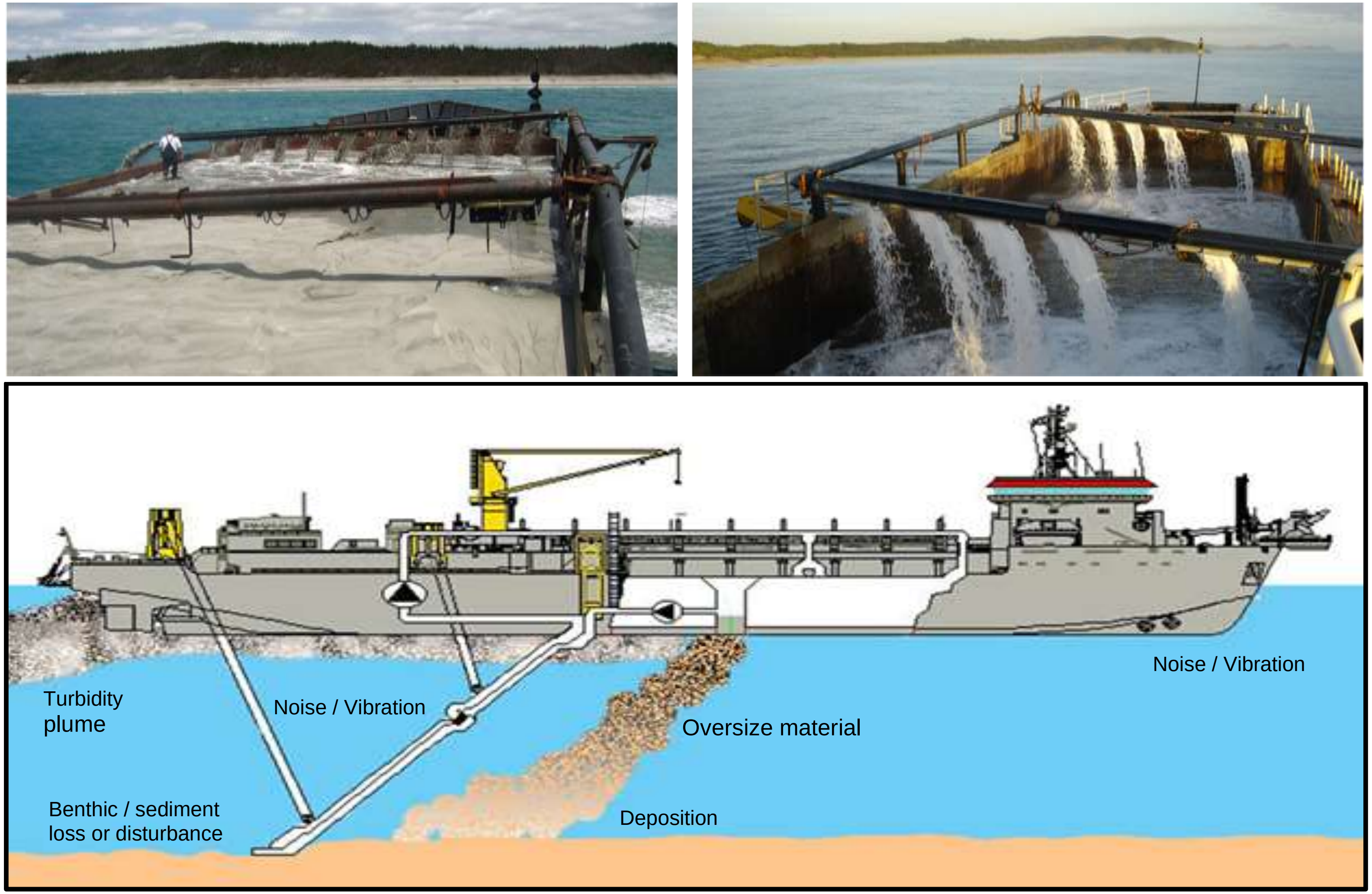

Figure 2. Top: An example of trailing suction dredge vessel extracting sands from the extraction area (images from MBL website 12.7.19). Bottom: Generic illustration of sand extraction and possible impacts, not all of which will be applicable to the current proposal (modified from Bioresearches 2019a).

3. ENVIRONMENT CHARACTERISATION

3.1. General approach

When considering the potential implications of marine activities on marine mammals, the appropriate scale of consideration is not just the level of the proposed activities but also the spatial scales relevant to the marine mammal species involved. For most marine mammals, normal home ranges can vary between hundreds to thousands of kilometres. Southern right whales, for example, are considered only infrequent seasonal visitors through Mangawhai / Bream Bay waters, yet mother / calf pairs pass by this stretch of water each year to reach Northland nursery grounds during their winter migration. Hence, the importance of these coastal waters needs to be considered in the context of the relevant species' regional and NZ-wide distributions.

To date, several university research programmes have been undertaken on marine mammal species in the Bay of Islands and within the Hauraki Gulf regions since the mid-1990s (see details in Appendix 1). However, no marine mammal studies have focussed on the Mangawhai / Bream Bay region. In the absence of any long-term and spatially explicit baseline research on marine mammals in the greater Mangawhai area, species information and sighting data were collated from ongoing research throughout the North Island's central-eastern coastal region (e.g. Massey University-Albany, University of Auckland, Orca Research Trust). In addition, opportunistic sightings reported to DOC (including the public, tourism vessels, seismic surveys, etc.) and strandings (previously collated through Te Papa National Museum and now DOC) were reviewed (see Appendix 1).

Without adequate population information (e.g. growth trends, total abundance), the potential risks to marine mammal species associated with various anthropogenic activities must be assessed based on a general understanding of the species' life-history dynamics (e.g. species-specific sensitivities, conservation listing, life span, main prey sources) summarised from New Zealand and international data sources. Collectively, this information is used to determine what is currently known about any relevant species' occurrence, behaviour, and distribution within the area of interest and to evaluate those species most likely to be affected by the proposed project.

3.2. General site description

Out of the more than 50 species of cetaceans (whales, dolphins and porpoises) and pinnipeds (seals and sea lions) known to live or migrate through New Zealand waters, at least 27 cetacean and two pinniped species have been sighted or stranded along the north-eastern coastline of the North Island. Appendix 2 highlight the various marine mammal species recorded between the Bay of Islands (to the north) and the entrance to the Hauraki Gulf and Great Barrier Island (to the south) over several decades. It is important to note again that most of these sightings are collected opportunistically rather than systematically. Consequently, the number of sightings does not necessarily represent unique animals (i.e. the same animal may be reported by multiple members of public or on separate days / in separate years) or their regular distribution patterns (see Appendix 2, Figures A2.1 to A2.3). As effort is not considered with opportunistic data, favourite fishing spots and tour boat tracks are likely to be over-represented, especially during periods of more favourable conditions (e.g. summer, daylight periods over evening).

3.3. Species of interest

The more common species occurring along the Mangawhai coastline, and therefore most likely to be affected by the proposed project, include common dolphins (*Delphinus delphis*), bottlenose dolphins (*Tursiops truncatus*), orca (*Orcinus orca*), and Bryde's whale (*Balaenoptera edeni*). Other species of interest include those that may be less frequent visitors but are more vulnerable to anthropogenic (human-made) impacts due to their current conservation status (e.g. southern right whales) or species-specific sensitivities. Appendix 2 summarises the marine mammal species considered further in terms of any effects associated with this proposal.

Based on the available species data, and in reference to Section 6(c) of the Resource Management Act (RMA) [2], Policy 11 of the New Zealand Coastal Policy Statement (NZCPS), and the Auckland Unitary Plan (AUP), there is no evidence indicating that most of these species have home ranges restricted solely to Mangawhai and nearby Bream Bay waters. While several whale species have migration routes through this region, these waters are not considered an important migration corridor as most whales generally pass by the area further offshore. Hence, based on current knowledge, the proposal area itself is not considered ecologically more significant in terms of feeding, resting or breeding habitats for any marine mammal species relative to nearby coastal regions or those further along the north-eastern coastline.

The situation is different for the 'nationally critical' Bryde's whale. The Hauraki Gulf is one of the few New Zealand locations where this species of whale occurs year-round. Gulf waters are considered important resting and feeding habitat for a population of less than 200 mature whales (Constantine et al. 2015). Their tendency to remain just below the surface and their distribution across inner Gulf water contribute to their high vessel strike risk (see Appendix 2, Figure A2.3). As highlighted in Appendix 2, these waters also support other endangered species, such as bottlenose dolphins, orca and southern right whales. These species are relevant in regard to Policy 11(a) of the NZCPS, which refers to avoiding adverse effects on nationally and / or internationally recognised threatened species.

[2] Section 6(c) - the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.

4. ASSESSMENT OF EFFECTS

The most consequential interactions between marine mammals and coastal development usually result from a direct overlap between the spatial location of an anthropogenic activity and important habitats of the species (i.e. feeding or nursing grounds). However, recent studies into the effects of anthropogenic (human-made) underwater noise are demonstrating that this overlap is spatially larger and the effects far wider-ranging than previously thought. Anthropogenic underwater noise is now recognised as a concern by several industries and regulatory agencies around the world (e.g. OSPAR 2009; DPTI 2012; WODA 2013; ACCOBAMS 2013; NOAA 2018).

Despite the frequent use of dredges in most ports and coastal development projects, little research has focused specifically on the effects of dredging operations on marine mammals (see review by Todd et al. 2015 and references therein). Irrespectively, the act of disturbing and / or removing bottom substrate in itself is not expected to directly affect any marine mammals known to frequent Mangawhai waters (e.g. Todd et al. 2015). Instead, the activities more likely to affect marine mammals are the production of underwater sound and vessel movements associated within the general extraction region. Possible indirect effects of sand extraction include physical changes to the habitat itself that adversely affect the health of the local ecosystem and / or impinge on important prey resources.

The likelihood of these potential effects on local or visiting marine mammals is discussed in the following sections and summarised in Table 3. The recommended management options based on these risks are discussed in Section 5 and summarised in Table 4.

4.1. Underwater noise

The proposed sand extracting and associated activities (e.g. vessel traffic, dredging activities) are mechanical sources that generate underwater noise (e.g. CEDA 2011; WODA 2013). Materially increasing underwater noise has the potential to adversely affect both cetacean and pinniped species as they rely heavily on underwater sounds for communication, orientation, predator avoidance and foraging. Nowacek et al. (2007) noted that underwater noises can elicit three types of responses in marine mammals: behavioural (e.g. changes in surfacing or diving patterns), acoustic (e.g. changes in type or timing of vocalisations) and physiological (e.g. auditory threshold shifts and stress).

For effects-based monitoring, these responses are often quantified as: 1) behavioural effects, 2) masking effects, 3) temporary auditory shifts (TTS – temporary threshold shift), or 4) permanent auditory injury (PTS – permanent threshold shift; Todd et al. 2015; see Pine 2020 for more details). In humans, the onset of TTS is often described as the muffled effect your hearing might have after a loud concert; the longer the exposure time, the longer this temporary effect lasts. PTS results in alternations of hearing function leading to actual physical damage and irreversible hearing loss. PTS can occur suddenly through trauma (i.e. intense impulses) or develop gradually over time.

4.1.1. Marine mammal hearing

Marine mammals have different hearing sensitivities depending on their mode of communication, navigation and behaviour. These differences have been generalised into five groups based on the sensitivity of their hearing across the different frequencies (Table 1). Species from three of these categories (low and medium frequency cetaceans and otariid pinnipeds) are found within the associated proposal areas (see Section 3.3).

The lower frequency hearing sensitivity of baleen whales (LF cetaceans) overlaps with most anthropogenic underwater noise, including the dredging activities proposed for this project. As a result, baleen whales are the species most susceptible to any noise effects from dredging (e.g. Clark et al. 2009). Most odontocetes (MF cetaceans) likely detect low-frequency sounds but they generally communicate over a wider frequency band than baleen whales (e.g. 150 Hz–160 kHz; NOAA 2018). However, their sensitivity significantly decreases at frequencies below 1–2 kHz (Au 2000; Southall et al. 2007). They also have the capability to echolocate (produce biological sonar) for navigation and hunting. Pinnipeds' hearing ranges are thought to vary more widely (otariid pinnipeds = 60 Hz–39 kHz and phocid pinnipeds = 50 Hz to 86 kHz; NOAA 2018), including some ultrasonic frequencies, with some being quite sensitive to frequencies below 1 kHz (based on overseas research on Atlantic grey and harbour seals; Thomsen et al. 2009).

Table 1. Summary of the generalised hearing range defining the different marine mammal hearing sensitivity groups used by the USA National Oceanic and Atmospheric Administration (NOAA) agency. Source: NOAA 2018.

Hearing Group	**Generalised Hearing Range**
Low-frequency (LF) cetaceans - baleen whales	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans - toothed dolphins and whales, beaked whales	150 Hz to 160 kHz
High-frequency (HF) cetaceans - porpoises, Hector's / Maui dolphin	275 Hz to 160 kHz
Otariid pinnipeds (OP) - sea lions and fur seals	60 Hz to 39 kHz

4.1.2. Dredge noise

The underwater noises produced from dredging activities are continuous, broad-band sounds at frequencies mostly below 1 kHz (Todd et al. 2015). Underwater noise reviews by CEDA (2011) and WODA (2013) found that suction dredges (similar to the methods proposed in this application) produce mostly low frequency, omni-directional sounds between 100–500 Hz (Figure 3). Their bandwidths can fluctuate as low as 20 Hz and as high as 20 kHz as sound levels will be dependent on the specific vessel, the sediment extraction process and the types of sediment being extracted, with coarser gravel causing greater sound levels (WODA 2013, references therein).

Empirical measurements of the sounds from the dredger *William Fraser* were taken within an existing offshore consent site[3] while extracting as permitted. The average broad-band source level was calculated at 168 dB re 1 µPa @ 1 m with a main energy component between 200 Hz and 2000 Hz (or 2 kHz; Pine 2020). This level is significantly lower than noise levels that are produced by a large ship, which is between 180-190 dB *re*1 µPa rms @ 1 m (OSPAR 2009; Todd et al. 2015; Pine & Styles 2016).

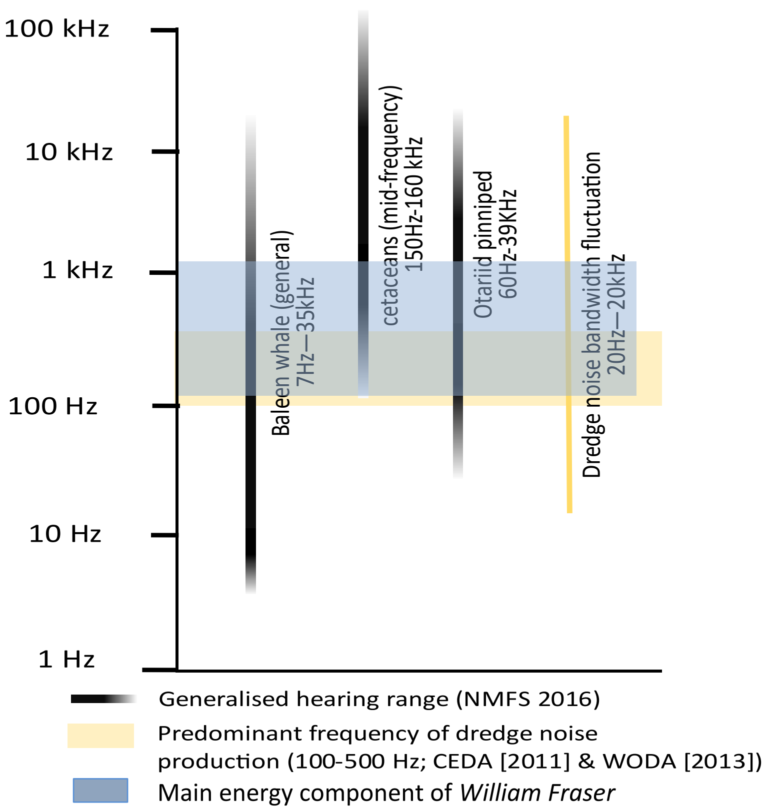

Figure 3. Schematic summary of the overlap in frequency of the three marine mammal hearing sensitivity groups relevant to this proposal with general dredge noise production.

[3] The *William Fraser* followed the 30 m contour, as per the offshore consent owned by Kaipara Ltd and operated by MBL.

Although no underwater noise guidelines exist for dredging activities and marine mammals within New Zealand, several overseas regulators provide context and guidance on appropriate noise thresholds and mitigation measures for avoiding adverse noise effects on marine mammals (e.g. United States—NOAA 2018, Australia—DPTI 2012). Pine (2020) used the most recent NOAA (2018) thresholds to estimate the area over which underwater noise effects from the proposed dredging operation would occur. These estimates are based on the measured sound exposure levels of the newly-built *William Fraser*, and the relevant species of concern.

Pine (2020) has estimated that the potential for the most injurious effects—the onset of temporary threshold shifts (TTS) or permanent threshold shifts (PTS)—are unlikely to occur for all three for the different marine mammal groups of interest (refer to Table 1) beyond a distance of 1 m [4]. Using a new, custom approach[5], Pine (2020) also estimated potential distances from the dredger that low level behavioural responses[6] and moderate level behavioural responses[7] may occur for the species of interest (Table 2). As expected, the distances in which no behavioural response (either low or moderate) are predicted varies by species (e.g. from 200 m to just under a kilometre) but the risk increases as an individual animal gets closer to the dredge vessel. These distances are compared to the more generic 120 dB re 1 µPa rms threshold applied by NOAA (2011) that has been used previously in lieu of species-specific data for behavioural impacts (see Appendix 3).

Pine (2020) also calculated distances from the dredger where the associated noises might interfere or prevent an animal from hearing natural acoustic signals (e.g. members of the same species trying to communicate across particular frequencies / levels while in proximity of the operating dredge). The estimated reductions in an animal's listening space (e.g. volume of ocean around an individual) as it approaches a dredger are listed in Table 2 and illustrated in Appendix 3. For all species (Bryde's whale, orca, bottlenose dolphin and NZ fur seal), the greatest risk of reduction to their listening space (> 75%) would be limited to within 35 m or less from the dredge vessel when in full operation (Table 2).

[4] Based on NOAA (2018) safe distance method that 'allows one to determine the distance that receiver would have to remain in order to not exceed some predetermined exposed threshold'.
[5] This method is based on the specified dose-response function and behavioural thresholds from Joy et al. (2019) and uses the categories of 'low' and 'moderate' behavioural responses as suggested by NOAA (2018); limited behavioural response data of bowhead whales and killer whales to underwater noises in the North Hemisphere.
[6] For example, minor changes in swimming direction / speed, surface intervals, respiration rates, vocalisation behaviours.
[7] For example, moderate to extensive changes in swimming direction / speed, surface intervals, respiration rates, cessation of vocalisations.

Table 2. Estimated distance ranges for potential behavioural impacts and listening space reduction (i.e. masking) of the three modelled hearing groups in Pine (2020). Distances equate to the maximum distance estimated from sound propagation models developed for the consent area by Pine (2020) and listed in Appendix 3. LF = Low Frequency group, MF = Mid-Frequency group, and OP = Otariid Pinniped group.

William Fraser	**Chance of behavioural effect**	**LF** (baleen whales) Max Distance (m) *	**MF** (orca) Max Distance (m) *	**MF** (other delphinids) Max Distance (m) *	**OP** (fur seal) Max Distance (m) **
PTS (permanent threshold shift)	-	0.0	0.0	0.0	0.0
TTS (temporary threshold shift)	-	0.0	0.0	0.0	< 1.0
Low Behavioural Response #	0%	927	412	412	-
	25%	281	168	168	-
	50%	195	124	124	-
	75%	146	28	28	-
Moderate Behavioural Response ^	0%	-	207	207	-
	25%	-	79	79	-
	50%	-	NA	NA	-
	75%	-	NA	NA	-
	Percent reduction	**LF** (baleen whales)	**MF** (orca)	**MF** (other delphinids)	**OP** (fur seal)
Listening Space (Masking)	0%	3191	5005	4998	5014
	25%	884	2419	2399	2437
	50%	141	305	311	354
	75%	NA	NA	NA	35

* Where available, these were based on the relevant species audiogram data (Pine 2020). Masking result for whales were calculated based on fin whale audiograms.

** Masking range based on northern fur seal audiogram data in the absence of NZ fur seal audiogram.

\# For whales, the received level at which there was 50% risk of a low behavioural response occurring was set at 120 dB re 1 μPa (based on bowhead whale behavioural responses to continuous noise – Southall et al. 2007) and for MF species, 129.5 dB re 1 μPa was used (based on killer whale behavioural data – Joy et al. 2019).

^ There are no data available to inform received level for moderate behavioural effects for whales. MF species were based killer whale data (Joy et al. 2019) with a 50% risk of a moderate behavioural response occurring at 137.2 dB re 1 μPa.

Overall, any effects from underwater noise generated from this dredging proposal will likely be transitory and non-injurious based on the estimates of Pine (2020). The overall levels and character of dredging noise will be much less than the numerous vessels currently travelling to and from the Ports of Auckland on a daily basis. The likelihood of any hearing injury effects (TTS or PTS) occurring is considered *not applicable*. Effects will be predominantly limited to the temporary masking of some noise signals when animals are within several kilometres of the dredge and a range of potential behavioural responses at closer proximity (< 400 m). The most relevant factors contributing to this assessment are summarised below:

Spatial and temporal factors

- Only a few migrating whales are sighted within the wider Mangawhai / Bream Bay area each year; the majority pass by in deeper, more offshore waters (e.g. further than 5 to 10 nm).
- Most whales occur in the area for a limited period each year; restricted mainly to winter months and some spring months when most only remain for a day or up to a week. The exceptions are Bryde's whales, which occur in the region year-round.
- Most odontocete and pinniped species known to frequent Mangawhai and Hauraki Gulf waters are regularly exposed to similar types and levels of underwater noise from commercial and recreational vessels throughout their distributional range.
- The Mangawhai region is not considered unique or particularly important feeding, resting or nursery habitats for any residential or visiting species.

Known acoustic factors

- Mainly lower-frequency noise is generated by proposed dredge vessels and activities, and this is at levels significantly lower than most commercial vessels currently passing by this region and / or Hauraki Gulf.
- Dredge sound levels are not expected to exceed PTS at all or TTS criteria at greater than 1 m from the dredge vessel (Pine 2020).
- A range of potential behavioural and masking effects are possible, but the risk is greatest (> 75%) only in very close proximity to the dredge (~150 m to not applicable).

Table 3. Summary of potential effects on marine mammal species from sand extracting of the Mangawhai coastal area with mitigation measures (*see Section 5 and Table 5 for more details).

Potential environmental effects	Spatial scale of effect on marine mammals	Persistence / duration of effect for marine mammals	Consequences for marine mammals	Likelihood	Avoidance Factors / Mitigation Options*	Significance Level of Residual Effect
Behavioural and / or physical responses to underwater sound	**Small to Large** Behavioural / masking responses predicted at varying distances	**Short to Persistent** Whales only present in proposal area for a day to weeks; ~5 hrs of dredging noise daily for duration of consent	**Individual Level:** Individuals may avoid or approach dredging activities; individuals subject to potential behavioural responses and acoustic masking but only within close proximity	**Not Applicable** – TTS / PTS **to** **Low –** behavioural **to** **Moderate –** masking	• Very low probability of whale presence near proposal area • Regular maintenance and proper up-keep of all dredging equipment and the vessel • *In situ* verification of noise levels associated with any new vessels, dredgers or dredge equipment	**Nil –** TTS / PTS **to** **Less than Minor –** behavioural, masking
Marine mammal / vessel collision risk: Extraction area	**Large** Extraction over several km^2	**Short to Persistent** Animals only present in proposal area for a day to weeks but for length of consent	**Individual Level:** Death or injury of non-threatened species	**Low –** Mangawhai region	• Very low probability of whale encounter (other than Bryde's whales mainly in Gulf water) • Relatively slow speeds of dredging vessels help reduce consequences of a collision to injury rather than mortality • Continue recording all sightings (including absences) • Adoption of Hauraki Gulf voluntary transit protocol for shipping that include speed limits and crew member on watch while transiting through Gulf waters in daylight hours	**Negligible**
MBL vessel route through Hauraki Gulf	**Large** Daily movements between sites and port (~80 km)	**Short to Persistent** Daily transits through Gulf limited duration but for length of consent	**Population Level:** Death or injury of endangered or threatened species	**Moderate –** Hauraki Gulf		**Less than Minor**
Attraction to artificial lighting on vessel(s)	**Small** Dependent on types of lights	**Short and Persistent** Daily for ~5 hrs while extracting	**Individual Level** Local attraction of pinnipeds and some dolphins	**Low to Moderate**	• Minimum amounts of lighting and proper positioning to reduce the attraction of wildlife	**Nil to Negligible**
Entanglement in operational gear and / or debris	**Small to Medium** Limited to immediate waters around operating dredge vessels	**Short to Persistent** Daily for ~5 hrs while extracting	**Population Level:** Death or injury of endangered or threatened species **Individual Level:** Death or injury of pinniped or dolphin	**Low** **Low**	• Avoid use of loose rope and other lines • Compliance with NZ Maritime Rules Part 180	**Nil to Negligible**
Contaminant effects from dredged sediments	**Small to Large** Limited to immediate waters and habitats adjacent to extraction sites	**Short to Persistent** Dependent on type and level of any contamination in sediments	**Individual Level** Limited potential for any individual to consume more than few prey species exposed to dredging sediments	**Not Applicable to Low**	• Tested sediments have less than trace levels of contaminants and a low silt content (i.e. relatively lower potential for contaminant accumulation). Only localised spread of spoil (e.g. within 250 m from source)	**Nil to Negligible**
Habitat and / or prey disturbance from loss of benthic habitat and increased turbidity	**Small to Large** Limited to immediate waters and habitats adjacent to extraction sites	**Short to Persistent** Periodic disturbance to benthos; plume expected to settle out within less than a day	**Individual Level** Possible avoidance of disturbed area, individuals may approach site(s) for opportunistic foraging	**Not Applicable to Low**	• No unique feeding habitats in the proposed areas, and areas represent only a small portion of similar available habitat • Use of sub-surface moon pool technology to ensure turbidity limits	**Nil to Negligible**

Ranking of terms used in table:
- Spatial scale of effect: Small (tens of metres), Medium (hundreds of metres), Large (> 1 km)
- Duration of effect: Short (days to weeks), Moderate (weeks to months), Persistent (years or more)
- Consequence: Individual, Regional, Population
- Likelihood of effect: Not Applicable (NA), Low (< 25%), Moderate (25–75%), High (> 75%)
- Significance of effect: Nil (no effects at all), Negligible (effect too small to be discernible or of concern), Less than Minor (discernible effect but too small to affect others), Minor (noticeable but will not cause any significant adverse effects), More than Minor (noticeable that may cause adverse impact but could be mitigated), Significant (noticeable and will have serious adverse impact but could be potential mitigated)

4.2. Vessel strike

Current sand extraction activities take place year-round. Given that MBL's vessels' unloaded speeds are less than 10 knots, and even slower when loaded with sand, a typical extraction return trip lasts approximately 16–18 hours from the Ports of Auckland. The current extraction schedule involves around 120–144 return trips to the consent zone each year (e.g. 10–12 trips a month). Trip numbers to the consent area are expected to remain similar to these current rates.

Vessel strikes are a well-known source of injury and mortality for several species of marine mammals around the world, particularly baleen whales (Laist et al. 2001). In New Zealand waters, vessel strikes are often associated with large fast vessels, such as container or carrier ships (e.g. DOC website). Between 1996 and 2014, 17 Bryde's whale deaths in the Hauraki Gulf have been attributed to vessel strike and the speeds at which commercial ships pass through the area (Constantine et al. 2015).

The likelihood of vessel strike depends on a number of operational factors including vessel type, speed, and location (van Waerebeek et al. 2007). The greatest increase in both the risk of a collision and the likelihood that it will result in severe injury or death occurs at speeds over 11 knots (Vanderlaan & Taggart 2007; Gende et al. 2011). The slower speeds in which dredge vessels generally travel may explain why only one out of the 134 worldwide reported collisions that occurred between 1975 and 2002 was with a dredge vessel (Jensen & Silber 2004). In South Africa, a southern right whale cow / calf pair surfaced directly in front of a 110 m dredge (speed unknown) while it was underway and the calf was subsequently struck, cut by the propellers and later died (Jensen & Silber 2004).

A recent worldwide review of dredging effects suggests that the risk of collision between dredge vessels and marine mammals can also be minimised if the activity avoids critical habitats and seasons when the species of concern may be more 'distracted' while feeding or resting (Todd et al. 2015). Some species (i.e. baleen whales) and certain age groups (i.e. calves and juveniles) are noted as being more susceptible to vessel strike than others.

For this proposal, the species considered most vulnerable to any potential vessel collisions include Bryde's, southern right and humpback whales and to a much lesser extent, bottlenose dolphins and orca (given their current endangered species status rather than propensity for vessel strike). The likelihood of a vessel collision (injury or mortality) within the proposal area is assessed as *low* for migrating baleen whales and odontocete species within the sand extraction consent region. This conclusion is based on the relevant factors as summarised below:

Spatial and temporal factors

- Low probability of the dredge vessel encountering a migrating whale within the consent area as the majority of whales are likely to pass further offshore in deeper waters (e.g. further than 5 to 10 nm).
- Most whales occur in the area for a limited period each year; mainly in the winter months and some spring months, and most only remain for a day up to a week.
- Most odontocete and pinniped species known to frequent Mangawhai waters are in regular contact with all types and speeds of commercial and recreational vessels throughout their entire distributional range.

Known collision factors

- Low probability of the dredge vessel striking an individual animal given the vessel will be stationary (barge) or slow moving while dredging.
- Most dolphin species have a general attraction to boats and safely approach and/or bowride. Fur seals often respond neutrally to boats when in the water (although they may bowride occasionally).
- Mangawhai waters are not considered unique or important feeding, resting or nursery habitats for any residential or visiting species, hence individuals are less likely to be 'distracted' by such activities, and are thus less vulnerable to collision risk.

While the transiting of dredging vessels to and from the Ports of Auckland does not require resource consent, their passage through the Hauraki Gulf is the main region where a collision risk with marine mammals is more likely to occur. Bryde's whales have an extremely high vessel strike rate within Gulf waters given their tendency to rest or remain just below the water's surface (i.e. < 12 m) for large periods of time, making it difficult for vessels to see them. Hence, while the likelihood of a vessel collision (injury or mortality) when travelling through the Hauraki Gulf is still assessed as *low* for migrating baleen whales and odontocete species, it is *moderate* for Bryde's whales, which are present in the Gulf year-round (Table 3).

However, it is important to emphasise that any vessel on the water in areas that marine mammals reside has the exact same chance of striking an animal, regardless of type (commercial or recreational). This is due to the fact that marine mammals spend the majority of their time underwater and are usually only visible as they are coming to the surface. The only difference between a small recreational boat striking a marine mammal and a container ship is the potential outcome to the animal (i.e. injury vs mortality).

To reduce the likelihood of a strike to as close to zero as possible and avoid any risk of a mortality, several mitigation actions are already in place (Table 3) and a few further actions have been recommended (see Table 4). For example, the dredge vessel adheres to the Ports of Auckland's Hauraki Gulf voluntary transit protocol for commercial shipping to protect Bryde's whales (Hauraki Gulf Forum 2017), which includes speed limits and maintaining a designated watch for whales across Gulf waters. Following these guidelines means that if a collision did occur, the whale will more likely be injured (than killed), thus avoiding any wider scale effects on the local Bryde's whale population. Together, these mitigations actions will ensure that all available information is being used to help locate, further reduce and avoid any interactions between the dredge vessel and whales throughout this consent.

This conclusion is based on the relevant factors as summarised below:

Spatial and temporal factors

- Overlap between Bryde's whale distribution within the Hauraki Gulf and the general transit route of dredge vessels (e.g. Figure A2.3).
- Bryde's whales are regularly found within inner Gulf waters where they are known to rest and feed throughout the year.

Known collision factors

- When travelling to and from the Ports of Auckland, the normal operating speed of an unloaded dredge vessel (10 knots or less, depending on dredge vessel used) should be slow enough for the animals to manoeuvre out of the path of the vessel or be spotted by crew and avoided.
- A voluntary transit protocol to minimise Bryde's whale collisions was initiated in 2013 between the shipping industry and the Ports of Auckland for the Hauraki Gulf region. The protocol recommends lowering the average speed of commercial ships within the inner Gulf to 10 knots. Implementation of the protocol (i.e. reducing average speed to 10 knots) has been estimated to reduce the probability of a lethal ship strike from 51% to 16% (Riekkola 2013).

4.3. Vessel lighting

To date, the effects of artificial lighting on marine mammals is relatively unknown with little to no research in this area nationally or internationally. As most dredging occurs in the late afternoon or evening, dredge vessels and any barges will have standard navigation and safety lighting in operation. However, any lighting footprint will most likely be confined to within a few hundred metres of the vessel and within surface to sub-surface depths.

Night lighting on more stationary or slow-moving vessels has the potential to attract small food species including plankton, larvae and bait fish. This attraction in turn might similarly attract any small cetaceans, such as common and bottlenose dolphins, already in the area to the vessel. However, marine mammals will more likely be attracted to increases in noise or changes in vessel activity rather than the lights themselves. To help reduce any potential responses to dredge vessel lighting, some simple mitigation suggestions are recommended in Section 5 and Table 4.

4.4. Operational loss and possible entanglement

The nature of dredge operating activities and the equipment involved means the likelihood of marine wildlife entanglement in marine debris is *low* (Table 3). Marine debris collectively includes such items as lost ropes, support buoys, bags and plastics (e.g. Laist et al. 1999). Whales, dolphins and pinnipeds are often attracted to floating debris, with a potential risk of becoming entangled in floating lines and netting (e.g. Suisted & Neale 2004; Groom & Coughran 2012). Loose, thin lines pose the greatest entanglement risk (e.g. lines used to tie up boats, floats and other equipment) and especially lost ropes or lines.

However, marine debris generation is generally non-existent in well-maintained coastal projects with proper waste management programmes in place (e.g. secure onboard storage of lines, ropes, and waste) in order to comply with the NZ Maritime Rules Part 180. In such cases, any subsequent effects to marine mammals are expected to be *negligible*.

4.5. Indirect effects through the ecosystem

The extraction of coastal sand within any established ecosystem will result in some change to that system. However, the nature and extent of such change will be dependent on many variables, including the scale and duration of dredging. Currently there is little to no research on how ecosystem changes due to dredging activities might indirectly affect marine mammals. While most cetaceans are generalist feeders and flexible in their habits, some species have been known to dramatically alter their distribution patterns in response to even small changes in prey availability (e.g. bottlenose dolphins: Bearzi et al. 2004) and / or ecosystem dynamics (e.g. North Atlantic right whales: Baumgartner et al. 2007). The following section focuses on potential indirect effects that dredging activities could have on the ecosystem as a whole, and more specifically on the abundance, distribution and / or health of marine mammal prey resources.

4.5.1. Exposure to resuspended contaminants

Contaminants and bacteria adsorb to marine sediments, leading to their accumulation and bioturbation over time. Dredging re-suspends these sediments and may result in the contaminants becoming biologically available to potential prey species. Pollutants, present in prey items, are taken up by marine mammals through their absorption with prey fat and are subsequently concentrated within their blubber or other tissue layers. Marine mammals are particularly vulnerable to the bioaccumulation of lipophilic (fat soluble) environmental chemicals, such as organochlorine insecticides (dioxins and pesticides including DDT) and PCBs (industrially-associated polychlorinated biphenyls) due to their thick layers of vascularised blubber (Woodley et al*.* 1991; Weisbrod et al*.* 2000).

The review by Todd et al. (2015) noted that exposure risks from any resuspended contaminants due to dredging activities are greatest to marine mammals only when dredging contaminated sediments (i.e. not all sediments have heavy contaminant loads) and concluded that in even those cases, exposure was still spatially restricted. Potential exposure to contaminants for any local marine mammals will depend on the chemical characteristics (e.g. types of contaminants, bioavailability), the subsequent uptake by relevant prey resources (e.g. plankton, fish, rays, cephalopods) and the feeding habits and ranges of the marine mammal species (see e.g. Jones 1998; Evans 2003). The Mangawhai-Pakiri coastal region, relative to other regions along the north-eastern coastline, is not currently considered unique or important feeding habitats for local or visiting marine mammals (see Section 3.3). In fact, most local species, such as bottlenose dolphins, common dolphins and NZ fur seals, are generalist feeders that will opportunistically forage throughout the entire proposal area, along most north-eastern coastal regions, and more offshore waters. Orca are considered more specialist feeders; they regularly forage for rays among estuarine mud and sand flats areas from the Bay of Islands to Auckland Harbour (Visser 1999). Some migrating species (i.e. humpback whales) may not even feed while passing through New Zealand waters during parts of their migration (Dawbin 1956).

In situ sediment sampling associated with the sand extraction activities has not identified any contaminants (e.g. heavy metals, PCBs or PAHs) that represent a risk for the ecology of Mangawhai waters (Bioresearches 2020). Therefore, the likelihood for bioaccumulation and biomagnification effects on local marine mammal species from the resuspension and dispersal of any contaminants during extraction activities is *not applicable* to *low* and the overall effect assessed as *nil to negligible*.

4.5.2. Ecological effect on habitat and prey species

Benthic disturbance and loss

The dredging of sediments causes the immediate loss of existing benthic biota and permanently alters the habitat within the immediate region of activity to some degree (Todd et al. 2015; see Figure 2). However, the level of effect that this loss will have on the coastal ecosystem will depend on the proportion of available habitat that is similar. Any subsequent flow-on effects of physical habitat or biota changes to local marine mammal species are dependent on their reliance of prey resources in the area.

In situ observations of the current extraction methods found burrowing fauna at the proposed site were not affected to the same extent as seen with more stationary or slow-moving harbour dredging techniques (i.e. dredging depths of 50–80 mm vs 300 mm below the seabed surface, respectively). As it is unlikely that these sites currently serve as unique or important feeding grounds for any marine mammal species (given the marine mammal data available), any benthic flow-on effects to local marine mammals are expected to be *nil* to *negligible*.

Turbidity plumes

Turbidity plumes are generated from the re-suspension of sediments at the dredging site (Figure 2). High turbidity levels and movements of any sediment plumes created by dredging activities can be a concern to fauna within or next to work sites (e.g. Todd et al. 2015). There is potential for such plumes to be additive to existing turbidity levels or become entrained in local gyres and eddies.

Marine mammals are known to inhabit fairly turbid environments worldwide and especially within New Zealand's nearshore environments. While they have very good vision, it does not appear to be the sense they rely upon most for foraging. Instead, odontocetes mainly depend on their sonar systems for underwater navigation and searching for food. Even baleen whales, which do not have the ability to echolocate, regularly forage in dark, benthic environments stirring up sediments to find prey. Thus, turbidity plumes are more likely to affect marine mammals indirectly via their prey resources rather than directly (Todd et al. 2015).

Based on *in situ* sampling at more inshore sites to the current extraction area, and taking into consideration the lack of fine sediment particles present in the area, any effects of increased turbidity will be limited in their spatial extent, fade to ambient levels relatively quickly (e.g. 250 m) and thus, will be constrained in their impacts (Bioresearches 2019b, 2020). Overall, any turbidity plumes generated from extraction activities are not expected to have any detrimental or long-term flow-on effects to local marine mammals in the region, and therefore will be *nil to negligible*.

5. MANAGEMENT OF EFFECTS

Overall, the residual effect of any impacts from sand extraction activities on local and visiting marine mammals is considered to be *less than minor to negligible* (Table 3). This assessment is based on the consideration of the types of effects, their spatial scales and durations, and relevant species information. It also takes into consideration existing operational aspects, as well as natural avoidance factors, that currently help mitigate adverse effects on marine mammals. However, given that some of the possible consequences of rare events (i.e. vessel strike) could have population level effects (i.e. injury or death of a threatened animal), further mitigation is discussed and several recommended actions are listed in Table 4 to help reduce these risks to as close to zero as possible.

To ensure that the most appropriate measures are in place, it is suggested that a marine mammal management plan (MMMP) be developed by a marine mammal expert in consultation with DOC. As a minimum, this plan should outline in detail: (i) mitigation procedures referred to in Table 4, (ii) any procedures that will need to be reviewed for effectiveness during operations (e.g. standardised sighting protocol) and (iii) determine timelines for any subsequent reporting requirements (if warranted).

Acoustic measurements suggest that the chance of any auditory injury effects on marine mammal hearing (i.e. TTS / PTS) are not applicable, and hence, additional safety or shut down zones are not warranted. Instead, we recommend that Kaipara encourage MBL vessels to continue to collect marine mammal sighting data while dredging and transiting during daylight hours. The collection of additional information on how often, which species and in what conditions (including parts of the dredging cycle) a marine mammal might approach the dredge vessel while dredging is underway is recommended as it will inform future consents or renewals.

To help ensure the low likelihood of a vessel strike and avoid any risk of a mortality if a collision does occur, we recommend Kaipara and MBL vessels formally adopt several existing operation actions as well as suggest some additional mitigations (see Table 4, Appendix 4). Collision risk is highest when transiting through the Hauraki Gulf region and when the vessel(s) are unloaded and travelling their fastest. We suggest designating a crew member (e.g. skipper) to maintain a watch for any sign of animals during these higher-risk, daylight periods only, setting speed limits and the adoption of simple and common-sense best boating behaviour guidelines around marine mammals by the dredge vessel. These recommendations are in line with the Ports of Auckland's Hauraki Gulf voluntary transit protocol for commercial shipping to protect Bryde's whales (e.g. Hauraki Gulf Forum 2018), a protocol which MBL is in the process of implementing on its vessels. Together, these further actions will ensure that all available information is being used to help locate, reduce and avoid any interactions between the dredge vessel and any visiting marine mammals that may occur within the proposal area and the Gulf during the course of this project.

Table 4. Proposed mitigation goals and practices to mitigate or minimise the risk of any adverse effects of sand extracting activities on marine mammals along the Mangawhai coastline and transiting through the Hauraki Gulf. DOC-Department of Conservation, AC – Auckland Council.

Management goal	BMP	Reporting
1. Minimise the avoidance (attraction) or potential for injury of marine wildlife to dredging activities	1a. Use best practical option to minimise underwater noise effects	• Measure underwater noise levels from any new dredging equipment or activities as soon as practical
	1b. Regular maintenance and proper up-keep of all dredging equipment and the vessel (e.g. lubrication and repair of winches, generators)	• Nothing required, self-checking as part of marine mammal management plan with up-to-date records available
	1c. Record marine mammal interactions with the dredge, noting the dredging cycle, conditions and animal's behaviour	• Record and report the type and frequency of marine mammal sightings (including absences and effort), in a standardised format. Annual records provided to DOC and AC and made publicly available (e.g. web) • Encourage the collection of additional information on species' behavioural responses during dredging operations
	1d. Ensure only minimum amount of boat lighting used, minimise light 'spill' overboard to reduce attraction of prey fish	• Nothing required, self-checking as part of marine mammal management plan • Encourage or support specific research into effects
2. Minimise the risk of dredge vessel collisions with any marine mammal and aim for zero injury/mortality	2a. Formal adoption of best boating guidelines for marine mammals, including speed limits, to reduce any chances of mortality from vessel strikes (see Appendix 4)	• Record all vessel strike incidents or near incidents regardless of outcome (e.g. injury or mortality) in a standardised format. This is consistent with the Hauraki Gulf's voluntary shipping protocol
	2b. Formally establish and maintain a watch for marine mammals while transiting through Gulf waters during daylight hours	• In case of a fatal marine mammal incident, carcass(es) recovered (if possible) and given to DOC, and further steps taken in consultation with DOC to reduce the risk of future incidences. This is consistent with the Hauraki Gulf's voluntary shipping protocol
	2b. Continue to record marine mammal sightings to build a baseline occurrence in waters near the proposal site as well as to and from port	• Record and report the type and frequency of marine mammal sightings (including absences and effort), in a standardised format. Annual records provided to DOC and AC and made publicly available (e.g. web)
3. Aim to minimise entanglement with a goal of zero mortality	3a. Avoid loose rope and / or nets around or off vessels. All deck lines should be tied up when not in use or under some degree of tension	• Nothing required, self-checking as part of marine mammal management plan with up-to-date records available
	3b. Minimise potential for loss of rubbish and debris from vessels and recover lost material	• Nothing required, self-checking as part of marine mammal management plan with up-to-date records available
	3c. Record all entanglement incidents regardless of outcome (e.g. injury or mortality)	• Records available to DOC and AC. In case of a fatal incident, carcass(es) recovered, given to DOC, and steps taken in consultation with DOC to reduce the risk of future incidences

6. CONCLUSIONS

This report describes the local and visiting marine mammals that use and / or are influenced by Mangawhai / Bream Bay coastal waters and the nearby Hauraki Gulf ecosystem. Information on the various species was reviewed for any life history dynamics that could make them more vulnerable to dredging activities or where the proposed sand extraction sites may overlap with any ecologically significant feeding, resting or breeding habitats. This, in turn, enabled the potential effects associated with the dredging components on marine mammals to be assessed in the context of the proposal.

The marine mammals most likely affected by the proposal include the few species that frequent the wider region associated with Mangawhai / Bream Bay year-round or on a semi-regular basis. These species include common dolphins, bottlenose dolphins, orca, and Bryde's whales. Other species including NZ fur seals, southern right and humpback whales, pilot whales, and sperm whales were also considered because of their records of occurrence in the general area, their known species-specific sensitivities (e.g. underwater noise); and / or potential public and iwi concerns.

Mangawhai / Bream Bay coastal waters are not considered ecologically significant habitats for any of these species. Instead, these waters represent only a small fraction of similar habitats available to these marine mammals throughout nearby coastal regions. However, the nearby Hauraki Gulf represents important year-round habitat for a small local population of critically endangered Bryde's whales. It is also important to note that several of the above listed species are nationally and / or internationally recognised as threatened species that live in semi-isolated sub-populations, and thus need to be considered in regard to Policy 11(a) of the NZCPS.

In light of the potential direct and indirect effects highlighted in this report, the overall risk of any significant adverse effects for marine mammals arising from the proposed offshore consent is assessed as *less than minor* to *negligible*. These conclusions were based in part on other consultant reports. Recommended mitigation actions are aimed mainly at formalising existing best practices. The report also addresses the collision effects of dredge vessel transiting through Hauraki Gulf water and suggests further reducing any accidental interactions with Bryde's whales by adopting the Ports of Auckland's Hauraki Gulf voluntary transit protocol for commercial shipping.

Records on the presence (and absence) of marine mammal species in the general region of the activities, along with any detailed observations of their time spent under or around dredge vessels, should continue to be compiled. A well-kept database can be used to understand which species may be more attracted to various dredging activities and what aspects of dredging they may be avoiding. Such information is crucial towards developing appropriate and effective mitigation measures for marine mammals and any future dredging operations.

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8. APPENDICES

Appendix 1. Sources of marine mammal data and information

Only broad-scale, regional information is available for most marine mammals using the general Bream Bay / Mangawhai region. Multiple and finer-scale studies have been undertaken in both the Bay of Islands to the north and south in the wider Hauraki Gulf region. The studies and databases used to make summaries and assessments of the various marine mammal species discussed in this report are listed below:

- Department of Conservation opportunistic database and stranding record database 1869-2018
- Marine mammal tourism operations in the Bay of Islands and Hauraki Gulf region
- National Aquatic Biodiversity Information System (NABIS)
- MBL marine mammal sightings recorded since May 2018
- Scientific research through University of Auckland:
    - R Constantine – various studies in Bay of Islands, Bryde's whales in the Hauraki Gulf, and humpback whales around NZ
    - G Tezanos-Pinto – research on bottlenose dolphins in Bay of Islands
    - E Carroll – various studies on southern right whales
- Scientific research through Massey University at Albany:
    - K Stockin – various studies on common dolphins and Bryde's whales in the Hauraki Gulf
    - N Wiseman – studies on Bryde's whales in Hauraki Gulf
    - S Dwyer – cetaceans in the Hauraki Gulf and Great Barrier Island
    - K Hupman –leopard seals and common dolphins in the Hauraki Gulf
- Orca Research Trust - various Visser publications and sighting database
- Berkenbusch K, Abraham ER, Torres L 2013. New Zealand marine mammals and commercial fisheries. New Zealand Aquatic Environment and Biodiversity Report No. 119. 110 p.
- Clement D, Elvines D 2015. Phase 1: Preliminary review of potential dredging effects on marine mammals in the Whangarei Harbour region. Prepared for Chancery Green on behalf of Refining New Zealand Limited. Cawthron Report No. 2711. 31 p. plus appendix.

Appendix 2 Marine mammals in Mangawhai / Bream Bay waters

The majority of opportunistic marine mammal sightings were recorded around the Bay of Islands and Hauraki Gulf regions (Figure A2.1, Figure A2.2), most likely a reflection of the marine tour companies operating within these vicinities that offer marine mammal tours and regularly report their sightings to DOC. Various sightings observed by MBL vessels over the last year and short-term underwater acoustic sampling by Pine (2019) were used to confirm those species more likely to occur near the consent area and wider Hauraki Gulf region (e.g. Figure A2.3). For this assessment, less importance is placed on the location of sightings with more emphasis on the presence and timing of an identified species in the Mangawhai / Bream Bay region.

The more prevalent species are listed in Table A2.1 and divided into three general categories that describe the current knowledge about their distribution patterns within Mangawhai / Bream Bay and nearby waters. Species information is likely to change as more systematic research becomes available, particularly for less common species.

- *Resident* — a species that lives (remains and feeds and / or breeds) within Mangawhai or nearby waters either permanently (year-round) or for regular time periods.
- *Migrant* — a species that periodically travels through part(s) of Mangawhai waters but remain only for temporary time periods that may be predictable seasonally.
- *Visitor* — a species that visits Northland or nearby waters intermittently. Depending on Mangawhai's proximity to the species' normal distribution range, visits may occur seasonally, infrequently or rarely.

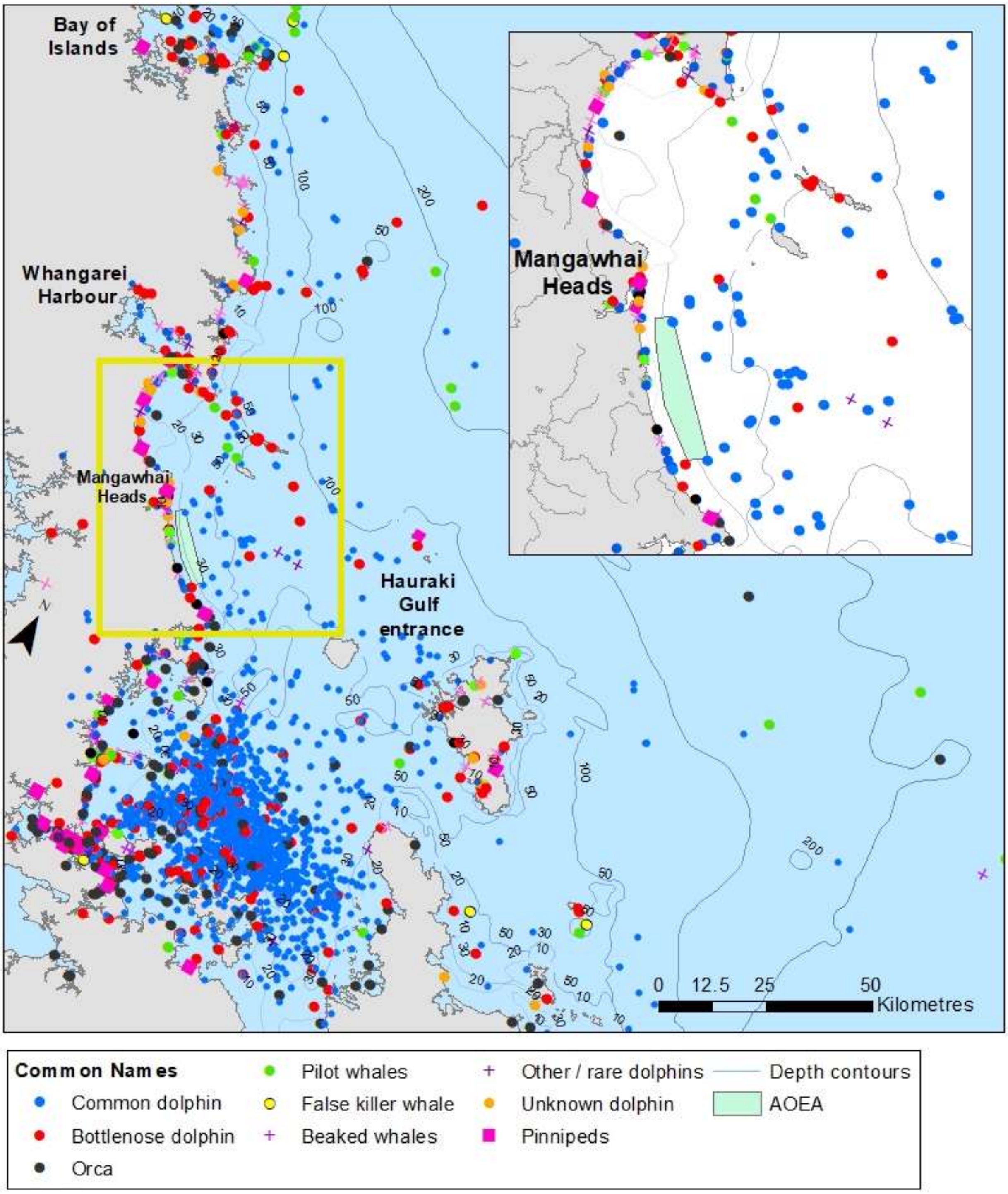


Figure A2.1. All Department of Conservation (DOC) sightings (1978–2018) and strandings (1869–2018) reported between Bay of Islands and Hauraki Gulf. Toothed whales and dolphins plus pinnipeds (seals) are shown in the image above; migrating whale species are shown in Figure A2.2. The general coastal area represented by the inset map is indicated on the larger map by the yellow rectangle and the Auckland Offshore Extraction Area (AOEA) is indicated on both maps as a green polygon.

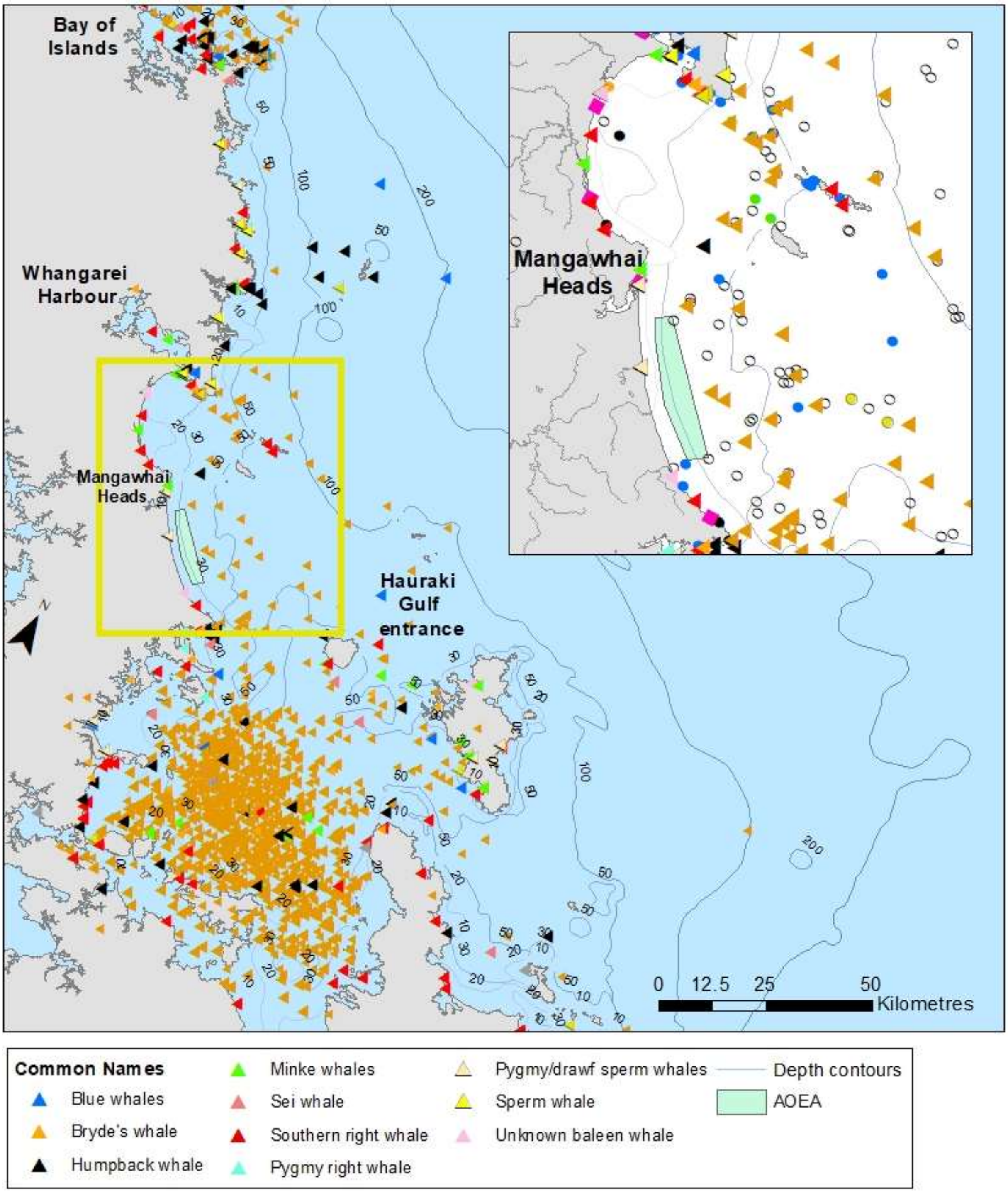


Figure A2.2. All Department of Conservation (DOC) sightings (1978–2018) and strandings (1869–2018) of migrating whale species (baleen and toothed) reported between Bay of Islands and Hauraki Gulf. The general coastal area represented by the inset map is indicated on the larger map by the yellow rectangle and the Auckland Offshore Extraction Area (AOEA) is indicated on both maps as a green polygon.

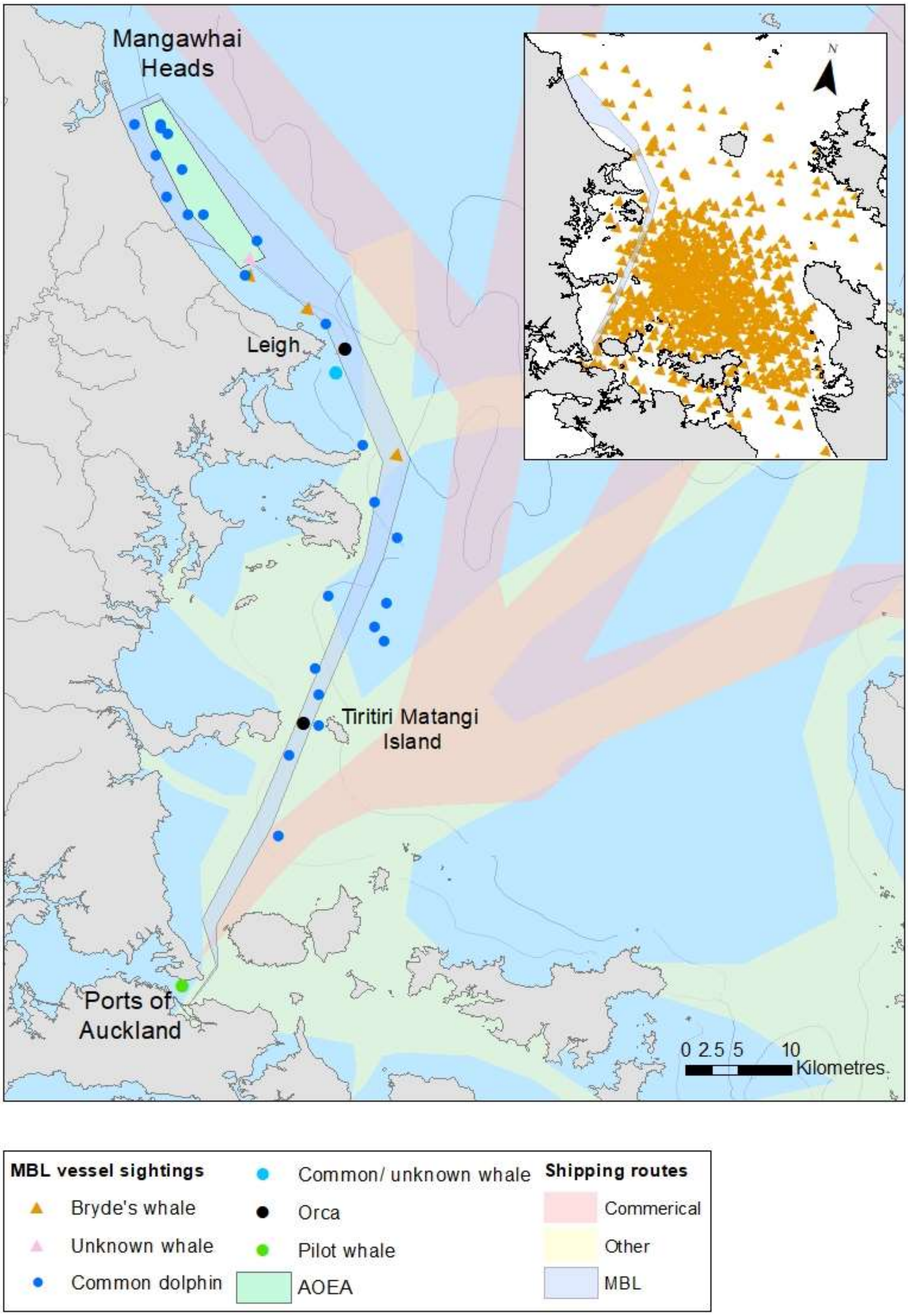
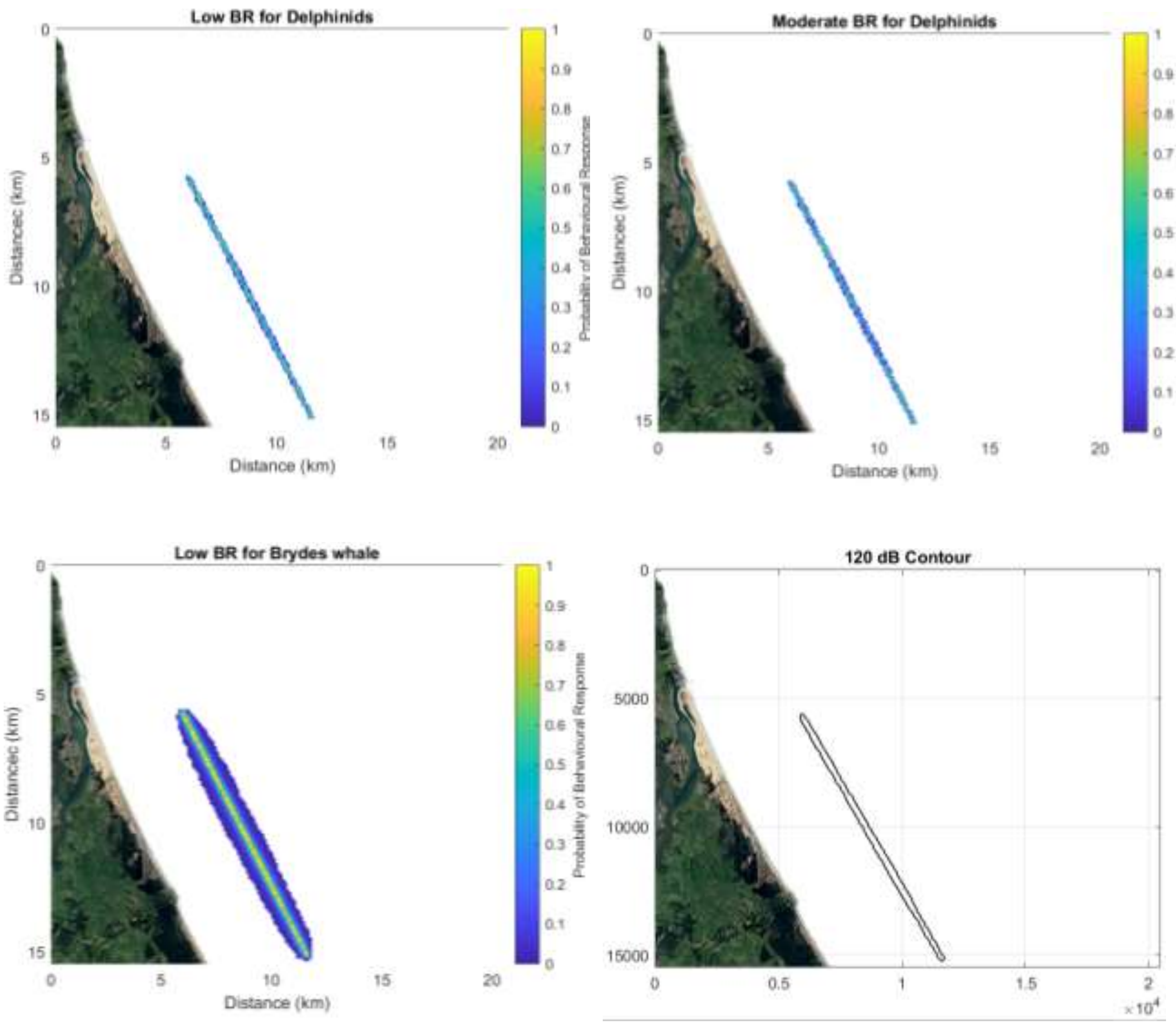


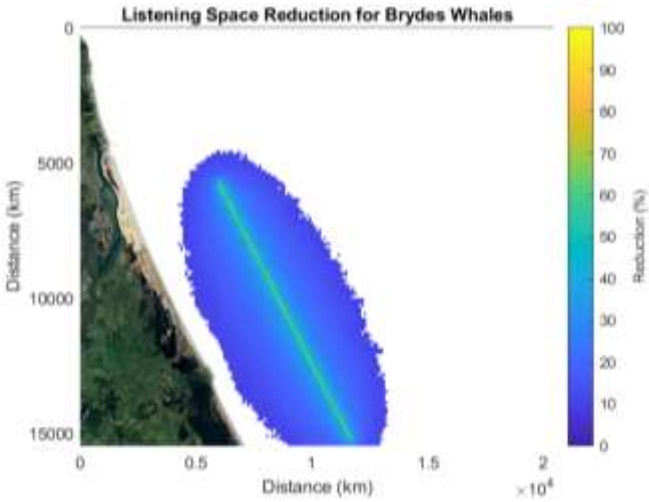
Figure A2.3 Map of all the marine mammal sightings recorded on MBL vessels since August 2018 overlaying the generalised shipping routes of commercial, MBL and other vessels within the Hauraki Gulf region (modified from Constantine et al. 2012). The inset map demonstrates where the MBL vessel route lies with respect to Bryde’s whale sightings in the Gulf (e.g. Constantine et al. 2015; DOC database).

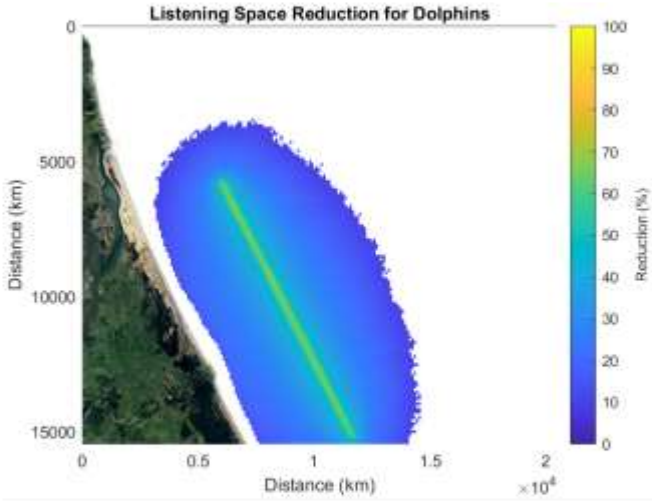
Table A2.1. The residency patterns of marine mammal species known to frequent Mangawhai / Bream Bay and nearby waters. Species' conservation threat status is listed for the New Zealand system (NZTCS——Baker et al. 2019) and internationally (IUCN system, ver 3.1). Modified from Clement and Elvines (2015).

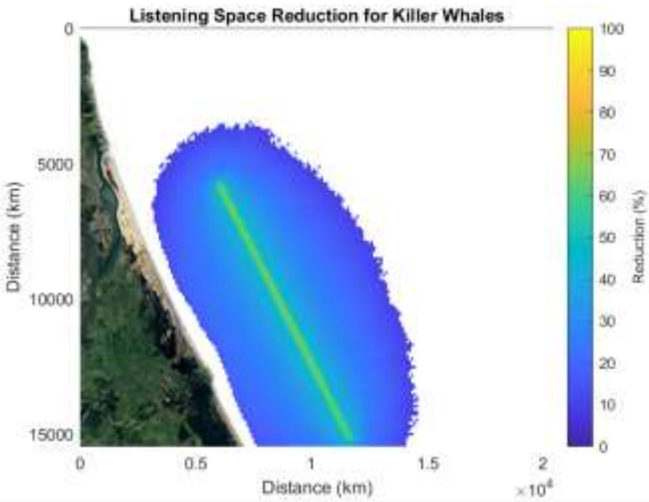
Common name	**Species name**	**NZ Threat Classification System**	**IUCN Listing**	**Residency category in Northland**	**Patterns of Seasonality (relative to proposal area)**
Common dolphin	*Delphinus delphis/capensis*	Not Threatened	Least Concern	Seasonal to Year-Round Resident	Common throughout north-eastern waters year-round. Feed on schooling or more pelagic fish species. Generally observed in waters deeper off Mangawhai / Bream Bay with occasional inshore sightings in the proposal area.
Bottlenose dolphin	*Tursiops truncatus*	Nationally Endangered	Data Deficient	Seasonal to Year-Round Resident	Resident sub-population to north in Bay of Islands that ranges between Doubtless Bay, Great Barrier Island and Tauranga. Occasional visits to Mangawhai / Bream Bay perhaps more over summer months. Generalist feeders. Currently in decline.
NZ fur seal	*Arctocephalus forsteri*	Not Threatened	Least Concern	Seasonal to Year-Round Resident	Present year-round with multiple haul-out sites and breeding colonies in the Hauraki Gulf and regular sightings on offshore islands and Bay of Islands. More susceptible to human effects at breeding colonies. Feed mainly over shelf waters but inshore regions as well.
Orca (killer whale)	*Orcinus orca*	Nationally Critical	Data Deficient	Seasonal to Semi-Resident	Frequent north-eastern waters year-round, more common in late winter / early spring. Forage in harbours, estuaries and sandy beaches on rays, fish and other marine mammal species.
Bryde's whale	*Balaenoptera edeni brydei*	Nationally Critical	Data Deficient	Seasonal to Semi-Resident	Most commonly observed whale species in north-eastern waters year-round, and particularly within the Hauraki Gulf. Feed on small schooling fish, salps and krill. Regularly move through Mangawhai / Bream Bay travelling between Bay of Islands and Hauraki Gulf.
Pilot whale	*Globicephala melas / macrohynchus*	Not Threatened to Data Deficient	Data Deficient	Offshore Semi-Resident	While a more offshore species, inshore sightings occur mainly over summer months. Forages off shelf waters. Known for frequent and mass strandings in Bream Bay and surrounding waters.
Southern right whale	*Eubalaena australis*	At Risk - Recovering	Least Concern	Seasonal Migrant	Generally use more inshore, shallow regions of Northland during seasonal migration periods, particularly with new-born calves. Once present, they can remain in the Northland region for several days to weeks. Most often seen between August and November.
Humpback whale	*Megaptera novaeangliae*	Migrant	Endangered	Seasonal Migrant	Pass by Mangawhai / Bream Bay on both north and south migrations but more prevalent and closer to shore on southern return migration when with calves (mainly Oct to late Dec).
Sperm whale	*Physeter macrocephalus*	Not threatened	Vulnerable	Offshore Visitor	Increased sightings along the north-eastern coasts, mainly over summer and autumn months. Taonga species.

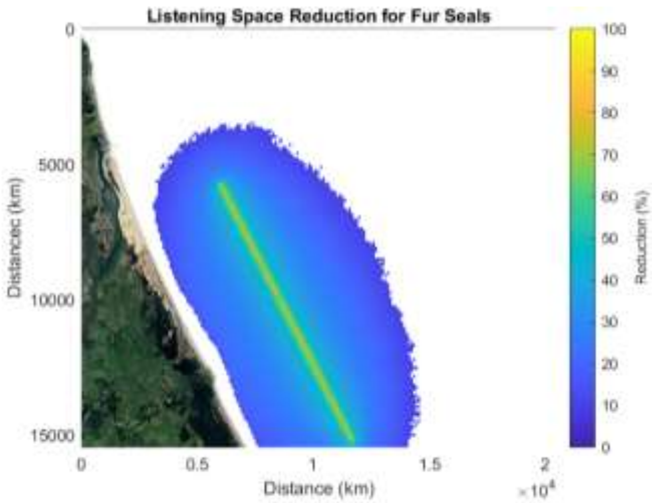
Appendix 3. Contour plots of the estimated range (in kilometres) of species' risk (as a percent) of behavioural responses (BR) and percent reduction in listening space from Pine (2020). The plots are within the current consent sites and represent the area in which the dredges will be moving. Data are not available to calculate low or moderate BR in fur seals or moderate BR for Bryde's whales. The behavioural impact threshold of 120 dB for continuous noise is given as a reference.




Listening Space Reduction for Brydes Whales
Distance (km)
Distance (km)
×10^4
Reduction (%)


Listening Space Reduction for Dolphins
Distance (km)
Distance (km)
×10^4
Reduction (%)


Listening Space Reduction for Killer Whales
Distance (km)
Distance (km)
×10^4
Reduction (%)


Listening Space Reduction for Fur Seals
Distancec (km)
Distance (km)
×10^4
Reduction (%)

Appendix 4. Best boating behaviour guidelines around marine mammals

The overall risk of a vessel strike between operating dredge vessels and marine mammals is low, but moderate while transiting within the Hauraki Gulf region. In the unlikely case that a vessel should encounter a marine mammal while working, implementing the following 'best practice' boating behaviours (used worldwide) around marine mammals shall reduce any chance of collision.

General practice

If a whale or dolphin is sighted, but not directly in the path of the vessel:

- Keep boat speed constant and / or slow down while maintaining current direction
- Avoid any abrupt or erratic changes in direction
- Maintain or resume normal operating speeds once well way from animals.

Large baleen whales—such as Bryde's or southern right whales

If a whale is sighted directly in the path of the vessel:

- If the whale is far enough ahead of the vessel (e.g. > 500 m) and can be avoided, slow to 'no-wake' if necessary and maintain a straight course away from the immediate sighting area (where practicable)
- If the whale is too close to the vessel and cannot be avoided, immediately place the engine in neutral and allow the boat to drift to one side of the sighting area where practicable (do not assume the whale will move out of the way)
- Avoid any abrupt or erratic changes in direction while at speed
- Once the whale has been re-sighted away from the vessel, slowly increase speed back to normal operation levels.

If a cow / calf pair is sighted within 500 m of an underway vessel:

- Gradually slow boat while maintaining a course away from the immediate sighting area (where practicable)
- Allow the pair to pass
- Once the pair has been re-sighted away from the vessel (> 500 m), slowly increase speed back to normal operation levels
- Avoid any abrupt or erratic changes in direction while at speed.

If a whale and / or cow / calf pair approaches a stationary vessel:

- Keep the engine in neutral, and allow the animal to pass
- Maintain or resume normal operating speeds once well way from animals (> 500 m).

Small to medium whales and dolphins —– such as bottlenose dolphin or orca

If a dolphin(s) is sighted directly in the path of the vessel:

- Keep boat speed constant and / or slow down while maintaining a course slightly to one side of the group, do not drive through the middle of a pod
- Avoid any abrupt or erratic changes in direction
- Maintain or resume normal operating speeds once well way from animals.

If a dolphin(s) approaches an underway vessel to bow-ride or ride the stern wave:

- Keep boat speed constant and / or slow down while maintaining course
- Avoid any abrupt or erratic changes in direction
- Do not drive through the middle of a pod
- Maintain or resume normal operating speeds once well way from animals (> 500 m).