MARSHALL DAY Acoustics

EASTLAND PORT TWIN BERTHS CONSTRUCTION NOISE ASSESSMENT

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Project: **TWIN BERTHS CONSTRUCTION NOISE ASSESSMENT**

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1.0 SUMMARY

Eastland Port has engaged Marshall Day Acoustics Limited to assess the construction noise effects from Stage 2 of the Twin Berths project at Eastland Port (the Proposal).

The Proposal includes extending Wharf 8 (including impact and vibro piling), upgrading the outer breakwater, a new reclamation, dredging, as well as other minor works. Noise from future port operations has been addressed in a separate report ('Twin Berths Operational Noise Assessment', dated 15 August 2022).

We have carried out an effects assessment of airborne noise, vibration, and underwater noise from the proposed construction works, and a compliance assessment with the relevant noise and vibration rules. The findings of our assessments are as follows:

Airborne construction noise (humans):

- The noise generated by most of the Proposal's daytime construction works is predicted to be generally comparable to existing port noise levels and character, although some activities such as impact piling are likely to be noticeable to nearby receivers across the river. We consider the potential noise effects to be reasonable provided nearby receivers are informed, and noise is managed through a Construction Noise Management Plan (CNMP).
- We predict that all construction activities would comply with the airborne noise limits in the TRMP except for:
    - Night-time dredging of the berth area. We predict that the effects would be minimal because the dredging noise level would be a similar to the existing port operations.
    - All works near the Heritage Reserve Zone. This Zone is not noise sensitive and the noise levels would be similar to the existing port operations.
- There is an infringement of the construction duration limit, but the effects would be negligible given the noise levels are similar to existing port operations which are continuous.

Construction vibration (humans):

- We predict that vibration from the proposed works would be negligible and generally imperceptible at nearby sensitive receivers.
- Vibration from the proposed construction works is predicted to readily comply with the relevant TRMP rules.

Underwater construction noise (marine mammals):

- We have calculated the temporary threshold shift (TTS) and permanent threshold shift (PTS) (i.e. onset thresholds for risk of temporary and permanent hearing damage) for the marine mammal species known to frequent the area. We have also provided zones where there is the potential for behavioural effects.
- The predicted PTS zones for piling are negligible, and the predicted TTS zones are small (100m for impact piling, and <10m for vibro piling). Piling noise could result in a behavioural response to nearby visitor individuals/groups. We have recommended general best practice measures to minimise piling noise effects on marine mammals.
- The predicted TTS and PTS zones from all dredging operations are negligible. As with the piling, the dredging could result in a behavioural response to nearby transient individuals/groups.
- We consider that compliance would be achieved with the TRMP rule for long term behavioural response to marine mammal aggregations because there are no known aggregations in the affected area.

Airborne construction noise (birds):

- Nearby aggregations of sea birds may be affected by close proximity construction works, but this is expected to be primarily due to physical disturbance as opposed to noise specifically. For bird aggregations further afield, noise levels from the construction works are predicted to be similar to the existing levels and specific 'long term' behavioural response to noise from the construction is not expected. Therefore, we consider that compliance would be achieved with the TRMP rule for long term behavioural response to bird aggregations.
- Potential effects on the nearby kororā population have been addressed in the 'Eastland Port Twin Berths Project Little Penguin/ Kororā (Eudyptula minor) Assessment of Ecological Effects' dated July 2022.

Recommendations:

We recommend that:

- The construction noise-related consent conditions included in the resource consents for Stage 1 of the Twin Berths Project (the slipway and wharf 6/7 redevelopment), as approved by Environment Court, are adopted for this project for consistency and are in-line with current best practice.
- A Construction Noise Management Plan (CNMP) be implemented to manage construction noise effects both in air and underwater.

2.0 INTRODUCTION

2.1 Proposed works

The full project is known as the Twin Berth Project (TBP). It is designed to enable two ships up to 200m long to berth at the port simultaneously. This will unlock greater capacity for bulk freight and potential options for container freight in future.

Stage 1 of the TBP were consented in December 2020. These stages remediated the former slipway to reduce its footprint within the port to enable more manoeuvring space for ships, and rebuilt part of Wharf 6 and all of Wharf 7.

Stage 2 provides for the remaining works required to complete the TBP as follows:

- Extension of the existing Wharf 8 structure into the area of the inner breakwater;
- Reclamation next to the Southern log yard;
- Rebuilding the outer breakwater structure;
- Deepening access channels in the outer port to accommodate larger Handymax vessels; and
- Improving stormwater collection and treatment facilities in the Southern log yard.

Stage 2 is referred to as 'the Proposal' in our report.

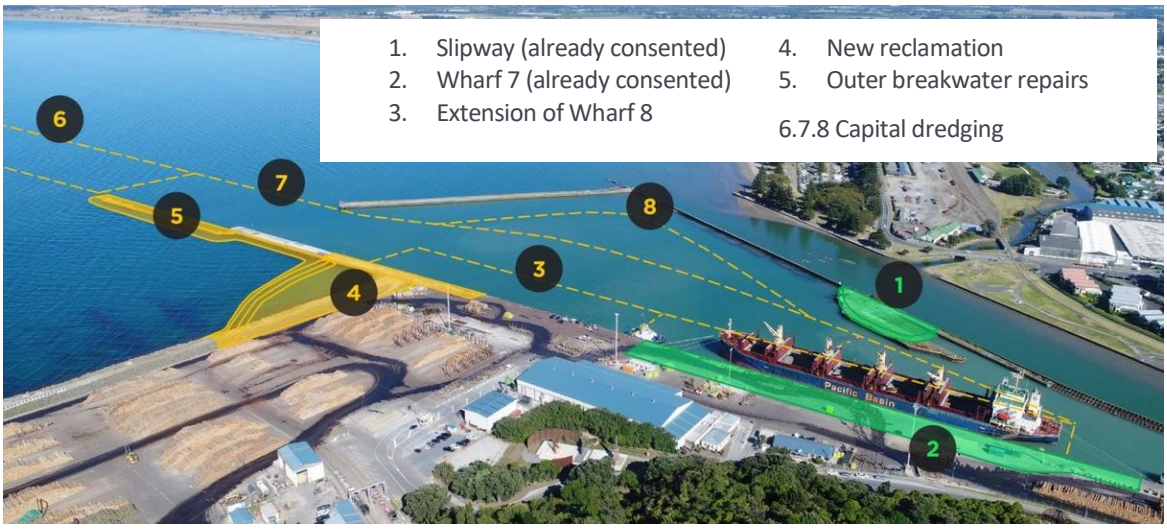
2.2 Scope of Construction Noise Assessment

This report focusses on the construction works associated with the Proposal. We have addressed the operation of the Proposal once the construction works are complete in a separate report.

The primarily land-based construction works involve upgrading of the outer breakwater, extension of Wharf 8, a reclamation adjacent to the Wharf 8 extension and Southern logyard, along with some minor stormwater improvements to the Southern logyard. The proposed works would allow two logging vessels to be berthed and unloaded/loaded in the port at the same time. The coastal marine area works involve capital dredging (deepening) of the outer port to better accommodate future logging vessels and other vessels, along with continued port wide maintenance dredging.

The proposed construction works areas are shown on Figure 1.

Figure 1: Illustrative view of the Proposal's construction works



The dredging component includes disposal of the capital and maintenance dredge material at the existing Offshore Disposal Ground (OSDG) located approximately 4km offshore in Tūranganui-a-Kiwa/Poverty Bay.

An indicative construction methodology has been provided by Worley. Based on this information, the key construction works from an acoustic perspective are:

- Piling works at Wharf 8 (airborne and underwater noise, vibration)
- Stabilisation works at the Outer Breakwater (airborne noise)
- General construction equipment at Wharf 8, reclamation and outer breakwater (airborne noise)
- Dredging in the harbour and berth areas (airborne and underwater noise)

3.0 METHODOLOGY

3.1 Supporting Documentation

Our assessment is based on the following documentation:

- Worley construction methodology (Capital Dredging & Disposal and Reclamation, Wharf 8 Extension & Outer Breakwater reports)
- 4Sight Ecology assessment
- 4Sight Assessment of Environmental Effects (AEE)

We have assessed noise and vibration effects on marine mammals based on our experience having undertaken noise impact assessments on wildlife on the following projects:

- CentrePort (Thorndon Wharf and Seaview piling works): marine mammals and little blue penguins
- Kennedy Point Marina: marine mammals and little blue penguins
- Port Napier (Wharf 6 piling): marine mammals and little blue penguins
- Picton Terminal Redevelopment: marine mammals
- Numerous projects in the Waitematā Harbour including the Downtown Redevelopment, America's Cup and Devonport Navy Base piling.

3.2 Proposed Activities, Equipment and Durations

Table 1 summarises the key construction activities, expected equipment and anticipated timeframes provided in the construction methodology documentation. The overall duration is expected be approximately 5 years.

In general, the works would be undertaken during daytime hours (7:30am – 6pm), Monday to Saturday. The exception is dredging, which is proposed to operate for 4 – 5 hours per night with the potential for 24/7 operations if required.

The AEE states the following regarding concurrent construction works

> *"Not all three landside construction projects will be undertaken concurrently, they need to be staggered to maintain an operational port. The Wharf 8 extension and Outer Port reclamation are likely to start at similar times but the Wharf 8 extension needs to be completed in its entirety before the Outer Port reclamation can be completed. The Outer Breakwater upgrade, is most likely to be undertaken post completion of the Wharf 8 extension and Outer Port reclamation."*

Table 1: Activities, equipment and durations

Activities	Equipment	Duration
Wharf 8: 8 months total duration, daytime works		
Site mobilisation	Crane, trucks	2 weeks
Install 200 piles (1,250mm diameter steel tubes)	Impact piling rig, vibro piling rig, drill rig, crane	3 months
Install tie rods and capping	Crane, concrete pump, trucks	2 months
Supply and placement of fill	Crane, excavators, trucks	1.5 months
Concrete slab and pavement construction	Concrete pump, vibro roller, trucks	1 month
Reclamation: 3 years total duration, daytime works		
Site mobilisation	Crane, trucks	1 – 2 months
Construct working platform	Crane, excavator, vibro roller, trucks	6 – 12 months
Construction of revetment toe (concurrent with working platform construction)	Cranes, excavators	6 – 10 months
Construct temporary works area	Crane, excavator, vibro roller, trucks	4 – 6 months
Construct revetment	Crane, excavator, vibro roller, trucks	12 – 18 months
Outer Breakwater: 5 years total duration, daytime works		
Site mobilisation	Crane, trucks, barge	1 – 2 months
Ground improvement	Jet grouting rig, deep soil mixing rig	6 – 12 months
Placement of armour units	Crane/excavator, trucks, barge	6 – 12 months
Construct concrete capping	Concrete pump, trucks	5 – 8 months
Capital Dredging: 12 months total duration, daytime and night-time works		
Deepening the harbour channel and berth areas	Backhoe dredging, trailing hopper suction dredging (THSP) and rock breaking using Xcentric ripper	12 months

4.0 EXISTING ENVIRONMENT

4.1 Closest Receivers

The closest noise-sensitive receivers[2] are located across the Turanganui River as shown on Figure 2.

Figure 2: Closest receivers to Proposal area

The 100 Customshouse Road dwellings and Portside Hotel have direct line of sight to the construction activities in the Wharfside Yard and Wharves 6, 7 & 8. The closest construction works are approximately 250m from the façades of these buildings.

The next closest receiver is the Waikanae Beach TOP 10 Holiday Park camping (400m from the works).

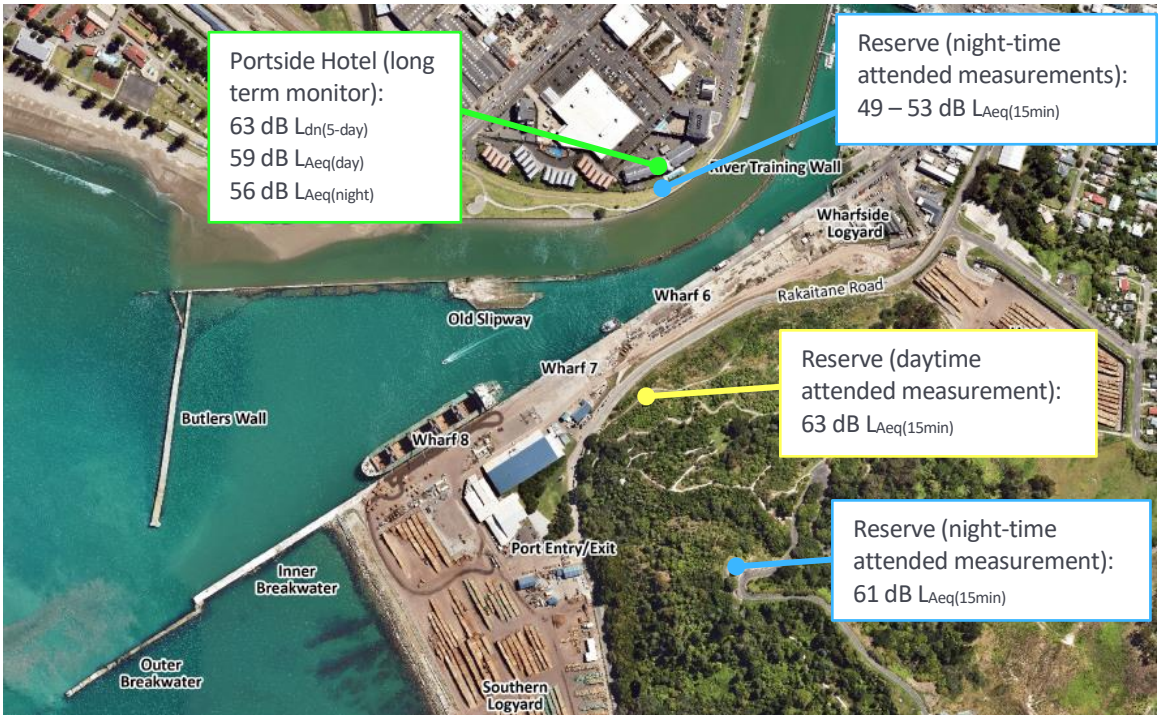
4.2 Ambient Noise Levels

The existing environment adjacent to the port is dominated by port noise. The main noise producing activities are the log ships (ship cranes and generators/stacks), log handling (loaders and high stackers) and transport of logs (road and port trucks).

We have carried out several attended measurements at locations surrounding the port and analysed the data from the long-term monitor on the Portside Hotel roof. Figure 3 shows a map of the positions and measured levels. The attended results are presented in detail in Appendix B.

[2] 'TRMP definition of Noise Sensitive Activity': 'Dwellings, visitor accommodation, hospitals, health care and medical centres, residential care housing, educational institutions, structures for the purpose of, or activities involving public assembly.'

Figure 3: Map of existing noise environment measurements



The measured average levels of 59 dB $L_{Aeq\ (day)}$ during the daytime and 56 dB $L_{Aeq\ (night)}$ during the nighttime at the Portside Hotel monitor are representative of the cumulative noise levels during peak port operations for receivers overlooking the port from an elevated position. These are representative of the 'worst-case' existing noise levels. We note that this data includes extraneous noise, but the levels are likely to be controlled by port activities.

4.3 Ambient Vibration Levels

We have not carried out ambient vibration surveys at the nearby receivers as:

- We predict the vibration levels received from the relevant receiving areas are negligible, and
- Vibration from the proposed construction works would also be negligible given the large setback distance from any of the vibration producing construction works (primarily the Wharf 8 piling works).

4.4 Ambient Underwater Noise Environment

We have undertaken a detailed survey of the existing underwater noise environment in the outer harbour area. The survey involved positioning two hydrophones 200m and 1km west of the southern logyard seawall. They continuously recorded ambient levels for two weeks, measuring between 12.5 Hz and 125 kHz. Detailed results of this survey are included in Appendix C.

The key results from our survey are summarised in Table 2.

The levels have been weighted based on the hearing response of the species of interest (discussed further in Section 7.3).

Table 2: Summary of ambient underwater noise environment

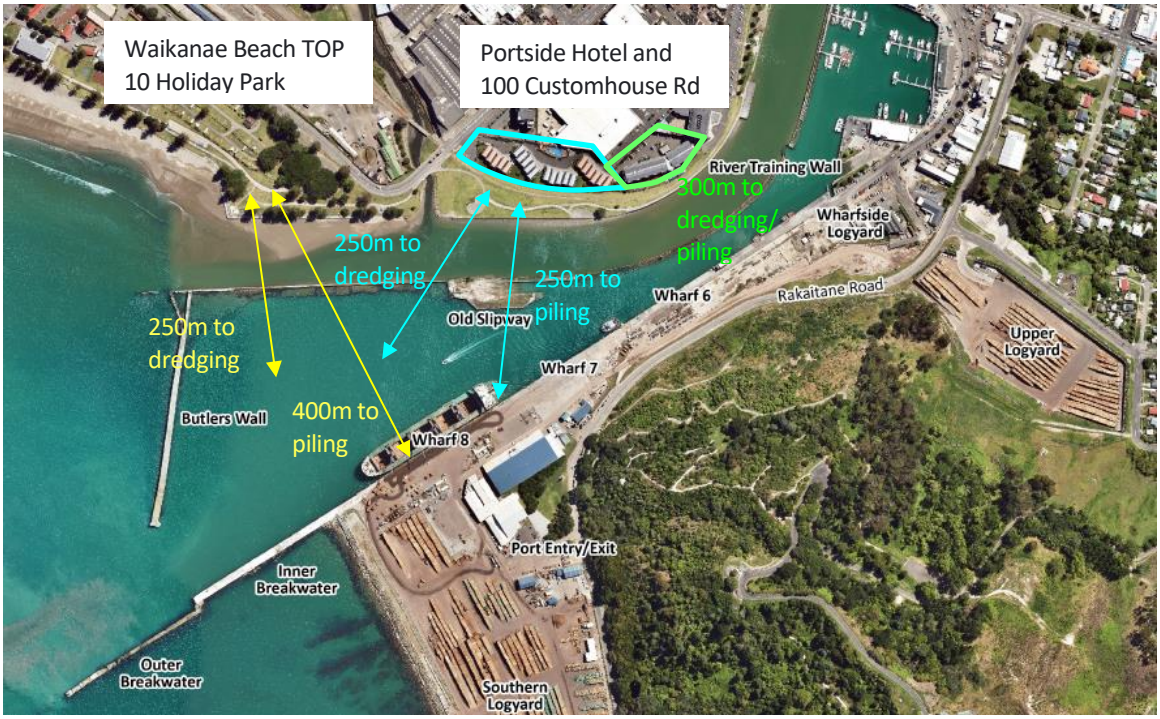
Location	Parameter	Ambient noise levels (dB re. 1 uPa)		
		Unweighted	NOAA weighted for mid-frequency cetacean hearing	NOAA weighted for Otariid pinniped hearing
200m west of the seawall	RMS (average level)	112	98	103
	10^{th} percentile – L_{10} (background level)	103	91	93
	90^{th} percentile – L_{90} (representative of louder periods)	110	98	103
1km west of the seawall	RMS (average level)	120	100	107
	10^{th} percentile – L_{10} (background level)	97	89	92
	90^{th} percentile – L_{90} (representative of louder periods)	110	97	104

5.0 AIRBORNE CONSTRUCTION NOISE ASSESSMENT

5.1 Setbacks of Closest Receivers

Figure 4 shows a map of the closest receivers and the setback distance from the closest construction works areas (dredging of the berth areas and piling at Wharf 8).

Figure 4: Closest receivers to Proposal area



5.2 Airborne Noise Source Levels and Compliance Setbacks

Table 3 presents the airborne noise source levels for each type of construction activity, and the corresponding setback distance to achieve compliance with the recommended construction noise limits of 70 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night.

These recommended noise limits align with the conditions for the redevelopment of wharves 6 and 7 and the remediation of the slipway that were approved by the Environment Court in 2020[3], and the limits in New Zealand Standard NZS 6803: 1999 *Acoustics - Construction Noise*. Refer Section 9.0 for a full discussion of the planning framework.

[3] ENV-2018-WLG-000119

Table 3: Predicted construction noise levels and setback distances to achieve compliance.

Activity	Sound power level (dB L_{Aeq})	Noise level (dB L_{Aeq}) *			Noise limit setback (m)	
		50m	200m	500m	Day 70 dB L_{Aeq}	Night 45 dB L_{Aeq}
Wharf 8 main sources						
Impact piling with casing and dolly	121	81	65	56	130m	-
Vibro piling	116	76	60	51	83m	-
Crane mounted drill rig	111	71	55	46	52m	-
Outer Breakwater main sources						
Jet grouting / deep soil mixing rig	110	70	54	45	52m	-
Mass stabilisation	103	63	47	38	25m	-
Dredging sources						
Dredge (backhoe, Xcentric ripper) – noise from excavator	110	70	54	45	48m	480m
Dredge (TSHD) – noise from vessel	107	67	51	42	36m	360m
General sources (all works areas)						
100T excavator	114	74	58	49	69m	690m
20T excavator	103	63	47	38	25m	250m
Vibro roller	103	63	47	38	25m	250m
Concrete truck and pump	103	63	47	38	25m	250m
Truck movements	103	63	47	38	25m	250m
Crawler crane	100	60	44	35	18m	190m
Mobile crane	98	58	42	33	14m	160m
Generator/compressor	93	53	37	28	8m	40m

* Indicative noise levels at 1m from a building façade in accordance with NZS 6803:1999

5.3 Predicted Airborne Noise Levels at Closest Receivers

Table 4 summarises the predicted noise levels at the closest noise sensitive receivers (see map in Section 4.1). We have also included a representative location on Kaitī Hill, although we note this is not a noise sensitive receiver.

The table is simplified to show the loudest construction activities in each area. Other activities (crane operations, concrete pours etc.) are predicted to be significantly lower in level and well within the existing noise environment levels.

Table 4: Predicted noise levels at closest receivers

Activity	Highest predicted noise levels at closest receivers (dB L_{Aeq}) *		
	100 Customhouse Rd dwellings	Portside Hotel	Holiday Park
Wharf 8 extension			
Impact piling	63	61	58
Vibro piling	58	56	53
Drilling	53	51	48
Outer breakwater			
100T excavator	46	47	44
Jet grouting/ deep soil mixing	42	43	40
Reclamation			
100T excavator	49	47	50
Dredging			
Backhoe dredge/ Xcentric ripper	58	56	58
TSHD	54	52	54

* Indicative noise levels at 1m from a building façade in accordance with NZS 6803:1999

5.4 Airborne Construction Noise Effects Assessment

The existing port operations were measured to generate noise levels of up to 59 dB L_{Aeq} during the daytime and 56 dB L_{Aeq} during the night-time at the closest noise sensitive receivers, and generally above 60 dB L_{Aeq} during the daytime and night-time on Kaiti Hill (refer to Section 4.1).

All activities are predicted to generate similar noise levels to the existing port operations with the exceptions of:

- **Impact piling:** noise levels would be noticeable due to its impulsive character and because the levels are higher than the ambient environment. We consider the overall noise levels to be acceptable for daytime construction works. The activity is predicted to readily comply with the most stringent 70 dB L_{Aeq} construction noise limit at all nearby receivers.
- **Night-time dredging of the inner breakwater area:** noise levels would have a similar continuous broadband character to existing port operations. Only the closest dredging pockets would result in levels that are marginally above existing levels for a several months. Although the noise levels activity would be significantly above the night-time construction noise limit for these isolated intervals, the internal noise environments of the most sensitive adjacent sensitive receivers (100 Customhouse Road apartments and Portside Hotel) have been designed to higher levels of port noise on a continuous basis. Noise from the dredging may be audible above port noise during the night-time at the holiday park but we note that this receiver is adjacent to SH35 and would already be exposed to relatively high road traffic noise levels

6.0 CONSTRUCTION VIBRATION ASSESSMENT

Activities such as impact and vibratory pile driving have the potential to produce high vibration levels. However, the affected zones are relatively small and proximate compared with noise (i.e. less than 50m from the equipment).

All nearby receivers are well set back from the works (several hundred meters away), and therefore, the predicted vibration levels are negligible.

No specific mitigation and management measures are necessary to control vibration emissions from the proposed works.

7.0 UNDERWATER CONSTRUCTION NOISE ASSESSMENT

7.1 Overview

Our assessment has been based on our experience on similar port and marina construction projects.

Wildlife noise effects assessments are a rapidly developing area. The following precautionary approach is based on current best practice in harbour environments with relatively high levels of anthropogenic noise. However, we note that best practice may change over time due to changes in piling methods, effects thresholds, or management methods.

7.2 Underwater Noise Producing Activities

Varying levels of underwater noise is generated by the proposed marine based construction works as follows:

- Impact piling produces the highest levels of underwater noise. The impulsive strikes are of a different character and much higher level than the ambient environment.
- Vibro piling can also generate relatively high levels of underwater noise, but the levels are significantly lower than impact piling and of a similar character to other continuous noise sources such as vessel movements.
- Dredging is quieter than piling but can produce appreciable levels of underwater noise. The most notable noise sources proposed are an Xcentric ripper for rock breaking and a TSHD dredge. Backhoe dredging produces minimal underwater noise
- Pile drilling, excavation and other similar sources produce minimal underwater noise. These sources have not been considered further as the effects would be negligible.
- Vessel movements associated with the construction works would be similar or quieter to the existing port vessel operations, so these sources have not been considered further.

These sources are discussed in detail in the Piling and Dredging underwater noise assessments in Section 7.4 and Section 7.5.

7.3 Marine Mammal Species and Thresholds

7.3.1 Species of Interest

The marine mammal species of interest identified in the ecology assessment are summarised in Table 5. The marine mammal species of interest are supported by a 2010 summary report of the Gisborne area[4].

To align with the ecology assessment, we have not considered species which have negligible or very low likelihood of being in the project vicinity when the works are taking place (e.g., whale species which may occur offshore).

We understand from the project's marine ecologist that marine mammals in the area are itinerants, and that there are no known aggregations in Tūranganui-a-Kiwa/Poverty Bay[5].

[4] https://envirolink.govt.nz/assets/Envirolink/827-GSDC67-Marine-mammals-within-Gisborne-District-coastal-waters.pdf

[5] Email discussion with Mark Poynter (Ecologist for 4Sight) on 7 March 2022

Table 5: Summary of species of interest

Species	Importance of environment	Relevant to our assessment
Orca, common/bottlenose dolphins	Residents, but not seen within port breakwater area	Included in assessment
Fur seals	Occasionally seen on breakwater	Included in assessment
Hectors dolphin	Infrequent to rare visitor	Not included in assessment
Long-finned pilot whale, pygmy sperm whale, beaked whale	Potential offshore residents, not known to be within harbour area	Not included in assessment
Other whale/dolphin species found in NZ waters	Rare visitors	Not included in assessment

7.3.2 Marine Mammals – Physiological Hearing Effects

There are no New Zealand national guidelines for underwater noise effects. However, the US Department of Commerce National Oceanic and Atmospheric Administration (NOAA) has provided guidance for assessing the physiological impacts of anthropogenic (human-made) sound on marine mammals[6] (referred to as the 'NOAA Guidelines'). While the NOAA Guidelines are not applicable in New Zealand, they are useful to give context to the underwater noise assessment.

The NOAA Guidelines identify the received levels above which individual marine mammals are predicted to experience changes in hearing sensitivity. These changes are either temporary ('Temporary Threshold Shift' or TTS), or permanent ('Permanent Threshold Shift' or PTS)[7]. Auditory threshold shifts can be caused from peak exposure (high-level impulsive events such as pile strikes) or from cumulative exposure (lower noise levels over an extended period such as from vibro-piling or multiple pile strikes).

The NOAA Guidelines provide TTS and PTS onset thresholds for impulsive (i.e., impact piling) and non-impulsive sources (i.e., vibro piling, dredging and rock breaking with an Xcentric Ripper). The thresholds use the 'SEL_{cum}' assessment descriptor, which is the species-weighted cumulative sound exposure level over a 24-hour period. The criteria are summarised in Table 6.

[6] National Oceanic and Atmospheric Administration: *'Technical Guidance for Assessing the Effects on Anthropogenic Sound on Marine Mammal Hearing'* (April 2018).

[7] TTS in humans can be likened to the 'muffled' effect on hearing after being exposed to high noise levels such as at a concert. The effect eventually goes away, but the longer the exposure, the longer the threshold shift lasts. Eventually, the TTS becomes permanent.

Table 6: Summary of NOAA TTS and PTS thresholds[8]

Criteria	Hearing Group	Impulsive sources (impact piling)	Non-impulsive sources (vibratory piling, dredging, rock breaking)
Cumulative thresholds			
TTS thresholds	Mid-frequency cetaceans (Orca, common/bottlenose dolphins)	170 dB $SEL_{cum(MF)}$	178 dB $SEL_{cum(MF)}$
	Otariid pinnipeds (Fur seals)	188 dB $SEL_{cum(OW)}$	199 dB $SEL_{cum(OW)}$
PTS thresholds	Mid-frequency cetaceans (Orca, common/bottlenose dolphins)	185 dB $SEL_{cum(MF)}$	198 dB $SEL_{cum(MF)}$
	Otariid pinnipeds (Fur seals)	203 dB $SEL_{cum(OW)}$	219 dB $SEL_{cum(OW)}$
Peak thresholds			
TTS thresholds	Mid-frequency cetaceans (Orca, common/bottlenose dolphins)	224 dB L_{peak}	N/A
	Otariid pinnipeds (Fur seals)	226 dB L_{peak}	N/A
PTS thresholds	Mid-frequency cetaceans (Orca, common/bottlenose dolphins)	230 dB L_{peak}	N/A
	Otariid pinnipeds (Fur seals)	232 dB L_{peak}	N/A

7.3.3 Marine Mammals – Behavioural Effects

Behavioural responses to underwater noise can vary significantly depending on species, the noise environment, and the character (temporal and frequency characteristics) of the noise source in relation to the existing environment. These effects can include temporary avoidance of the noisy area, disorientation, or impeded communication.

Relatively little is known about the thresholds above which there are likely to be behavioural impacts. As a conservative approach, the onset of behavioural effects could occur when the noise source is audible above the ambient environment.

We have considered the following thresholds for estimating the potential behavioural effects zones:

- The interim guidance from NOAA which states that behavioural impacts can occur at 160 dB re. 1 μPa rms for impact piling, and as low as 120 dB re. 1 μPa rms for vibratory driven piling, and
- We have also compared the predicted levels to the measured background noise levels (10^{th} percentile) and representative loud ambient noise periods (90^{th} percentile). The predicted levels and measured ambient levels have been weighted according to the NOAA weighting curves for each of the species of interest. This shows the audibility distance (and therefore the potential behavioural response envelope) during both quiet and louder ambient noise periods.

[8] SEL thresholds have a reference of 1 μPa^2s and L_{peak} thresholds have a reference of 1 μPa

7.4 Piling Underwater Noise Assessment

7.4.1 Piling Model Inputs

We have developed an underwater noise model using the dBSea 3D modelling software. The key inputs are as follows:

- Bathymetry from Land Information New Zealand (LINZ)
- Seafloor consisting of sand
- Source spectra based on our measurements of equivalent piling works
- Piling methodology based on our experience on similar projects:
  - 1,000 strikes per day for impact piling (2 piles, 500 strikes each)
  - 30 minutes vibro driving per day (2 piles, 15 minutes each)
- Piling at a representative location on Wharf 8
- A dolly/cushion will be used for impact piling to mitigate noise emissions

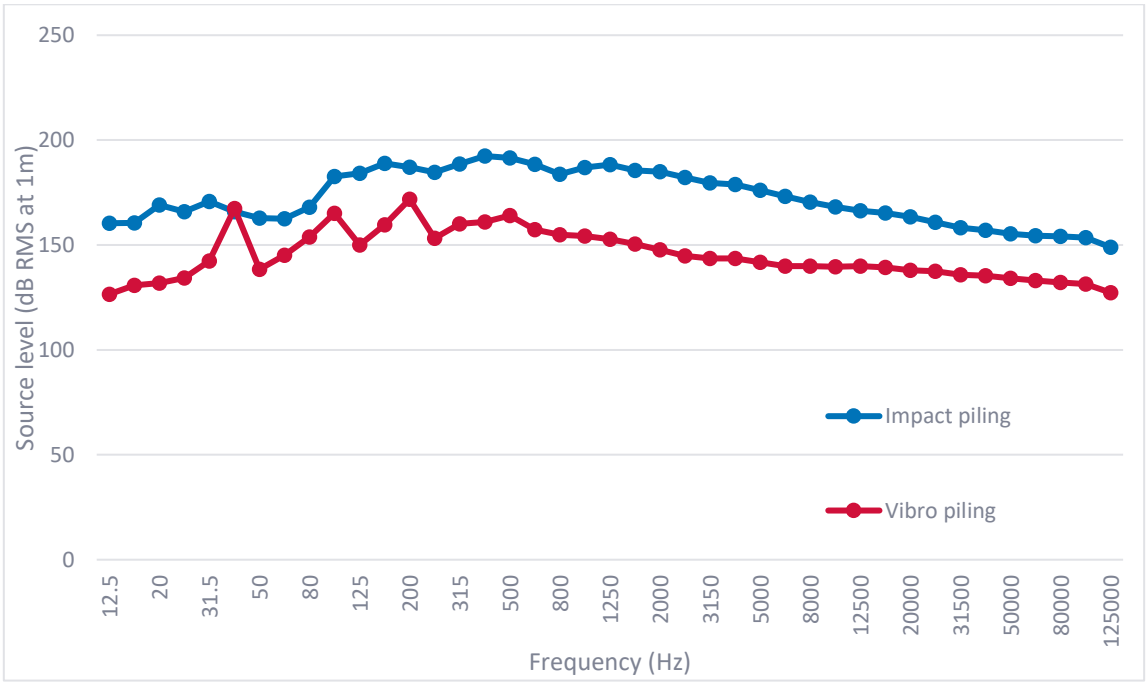
The unweighted source levels used in the underwater noise model are shown in Table 7.

Table 7: Predicted piling source levels at 1m from the pile[9]

Piling details	Peak	RMS	$SEL_{(single\ strike)}$	SEL_{cum}
1,200mm impact driven steel pile (top driven)	222	200	191	221
1,200mm vibro driven steel pile	N/A	175	175	208

RMS source spectra for each piling type are provided in Figure 5.

Figure 5: Unweighted source spectra for piling



[9] SEL thresholds have a reference of 1 µPa^{2}s and L_{peak}/RMS thresholds have a reference of 1 µPa

7.4.2 Predicted Piling TTS and PTS Zones

The predicted TTS and PTS zones for the piling methodology described in Section 7.4.1 are summarised in Table 8.

Table 8: Summary of NOAA TTS & PTS zones

Pile Driving	Hearing Group	Zones*	
		TTS	PTS
Cumulative exposure			
Impact piling	Mid frequency cetaceans	100m	<10m
	Otariid pinnipeds	55m	<10m
Vibro piling	Mid frequency cetaceans	<10m	<10m
	Otariid pinnipeds	<10m	<10m
Peak exposure			
All piling	All species	Below criteria	Below criteria

*Largest distance measured from pile.

The TTS zones are generally contained within the berth area. The zone for a representative piling area is sown on Figure 6.

Figure 6: Map of TTS zone for a representative piling location for the Wharf 8 works

The largest predicted zone is 100m. This zone which can be effectively monitored by a trained Marine Mammal Observer (MMO) to ensure there are no marine mammals present during piling works. Given that no marine mammals have been sighted in the port berth area, we consider that an MMO is only necessary where the TTS zone extends beyond the port entrance.

7.4.3 Predicted Piling Behavioural Response Zones

Table 9 presents the estimated behavioural response zones based on the general NOAA behavioural response thresholds and existing ambient environment measurements.

Table 9: Summary of potential behavioural response zones for piling

Piling type	Criteria	Threshold	Zones (distance from pile)
NOAA behavioural response			
Impact piling	NOAA behavioural response	160 dB RMS	350m
Vibro piling	NOAA behavioural response	120 dB RMS	5.8km
Audibility			
Impact piling	Equivalent to background noise levels for mid-frequency cetaceans	89 dB L_{10} (MF-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
	Equivalent to typical loud ambient period for mid-frequency cetaceans	97 dB L_{90} (MF-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
	Equivalent to background noise levels for otariid pinnipeds	92 dB L_{10} (OW-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
	Equivalent to typical loud ambient period for otariid pinnipeds	103 dB L_{90} (OW-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
Vibro piling	Equivalent to background noise levels for mid-frequency cetaceans	89 dB L_{10} (MF-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
	Equivalent to typical loud ambient period for mid-frequency cetaceans	97 dB L_{90} (MF-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
	Equivalent to background noise levels for otariid pinnipeds	97 dB L_{10} (MF-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay
	Equivalent to typical loud ambient period for mid-frequency cetaceans	92 dB L_{90} (OW-weighted)	Within Tūranganui-a-Kiwa/Poverty Bay

The table above shows that noise levels from the Wharf 8 piling works are predicted to be above ambient levels within Tūranganui-a-Kiwa/Poverty Bay. It is impracticable for an MMO to monitor the behavioural response zones.

We note the following in relation to the character of each piling type:

- Impact piling generates distinct broadband impulses. These impulsive events are of a different character to the existing environment, and therefore, are more likely to result in behavioural responses than continuous noise sources.
- Vibro piling generates continuous low and mid frequency noise. The continuous character is comparable to the existing environment which is influenced by vessel traffic to and from the port and marinas. Vibro piling is unlikely to result in a behavioural response beyond the immediate vicinity of the port despite marginally elevating the existing noise levels.

7.5 Dredging Underwater Noise Assessment

7.5.1 Dredging Model Inputs

We have predicted underwater noise levels from dredging using the dBSea model.

The key inputs are as follows:

- Bathymetry from Land Information New Zealand (LINZ)
- Seafloor consisting of sand
- Source spectra as follows:
  - Backhoe dredging based on our measurements of dredging works in Auckland's Outer Viaduct harbour for America's Cup. Assumed to operate continuously for 8 hours/day
  - Trailing Suction Hopper Dredger (TSHD) level from measurements carried out by Styles Group of the *William Fraser* TSHD [10]. Assumed to operate continuously for 8 hours/day
  - Xcentric Ripper measurements of the underwater rock breaking at Acheron Head in Otago. Assumed to operate continuously for 8 hours/day.

The Xcentric ripper and TSHD dredges are generally similar in underwater noise level and frequency content, while the backhoe dredge produces significantly lower underwater noise emissions.

We are not aware of any practicable noise reduction measures for dredging.

The unweighted source levels used in the underwater noise model are shown in Table 10.

Table 10: Predicted dredging source levels at 1m from the equipment [11]

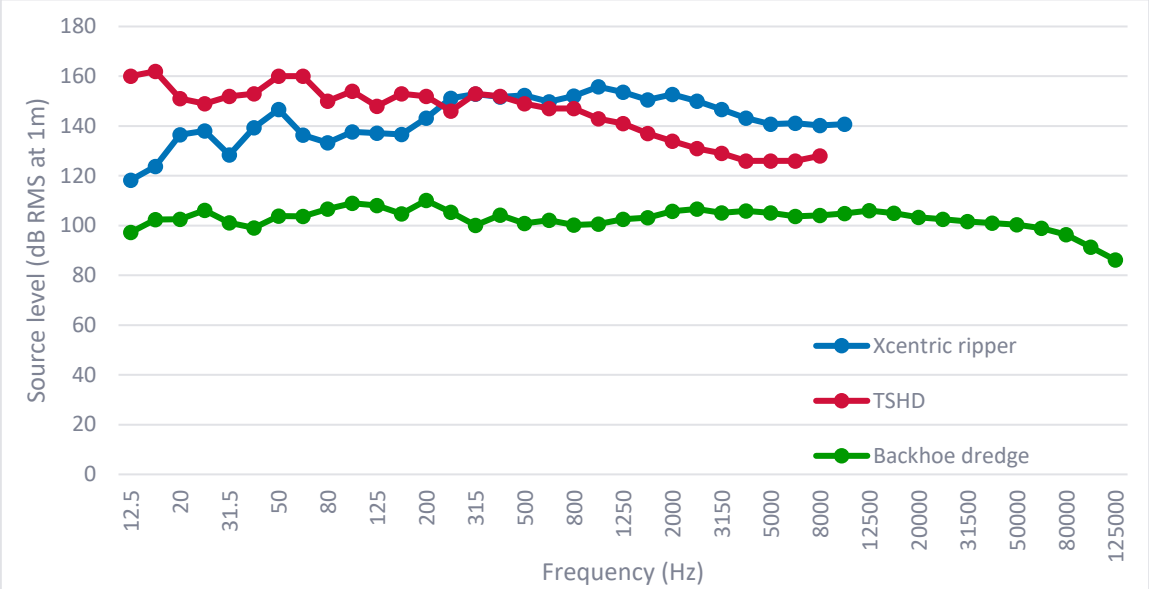
Piling details	RMS	SEL_{cum}
Xcentric Ripper	163	208
TSHD	168	213
Backhoe dredge	120	165

RMS source spectra for each dredging type are provided in Figure 7.

[10] 'CST60343373_S92_Assessment of Underwater Noise Effects (Styles Group)', dated 31 March 2020

[11] SEL thresholds have a reference of 1 μPa^2s and L_{peak}/RMS thresholds have a reference of 1 µPa

Figure 7: Source spectra for dredging at 1m from equipment [12]



7.5.2 Predicted Dredging TTS and PTS Zones

The predicted TTS and PTS zones are summarised in Table 11.

Table 11: Summary of dredging TTS and PTS zones

Dredging type	Species	TTS zone	PTS zone
Xcentric Ripper	Mid-frequency cetaceans	<10m	<10m
	Otariid pinnipeds	<10m	<10m
TSHD	Mid-frequency cetaceans	<10m	<10m
	Otariid pinnipeds	<10m	<10m
Backhoe dredge	Mid-frequency cetaceans	<10m	<10m
	Otariid pinnipeds	<10m	<10m

In summary, the zones for TTS and PTS are negligible and any effects are expected to be highly site constrained. There is no need for MMO's to monitor these zones.

7.5.3 Predicted Dredging Behavioural Response Zones

The predicted potential behavioural response areas are summarised in Table 12.

As with the piling in Section 7.4.3, we compared the predicted unweighted RMS levels to the general NOAA behavioural response thresholds, and the predicted weighted levels to the measured background noise levels to shows the audibility distance (and therefore the potential behavioural response envelope) during both quiet and louder ambient noise periods.

[12] The source spectrum for the Xcentric Ripper does not include content above 10 kHz due to equipment limitations at the time of measurement. This has negligible effect on the results as most of the source content is contained between 250 Hz – 2 kHz.

Table 12: Summary of potential behavioural response zones for dredging

Dredging type	Criteria	Threshold	Zone of potential behavioural response (distance from dredging)
Xcentric ripper	NOAA behavioural response	120 dB RMS	2.5km
	Equivalent to background noise levels for mid-frequency cetaceans	89 dB L_{10} (MF-weighted)	Tūranganui-a-Kiwa/Poverty Bay area
	Equivalent to typical loud ambient period for mid-frequency cetaceans	97 dB L_{90} (MF-weighted)	3.9km
	Equivalent to background noise levels for otariid pinnipeds	92 dB L_{10} (OW-weighted)	Tūranganui-a-Kiwa/Poverty Bay area
	Equivalent to typical loud ambient period for otariid pinnipeds	103 dB L_{90} (OW-weighted)	Tūranganui-a-Kiwa/Poverty Bay area
TSHD	NOAA behavioural response	120 dB RMS	6.5km
	Equivalent to background noise levels for mid-frequency cetaceans	89 dB L_{10} (MF-weighted)	950m
	Equivalent to typical loud ambient period for mid-frequency cetaceans	97 dB L_{90} (MF-weighted)	100m
	Equivalent to background noise levels for otariid pinnipeds	92 dB L_{10} (OW-weighted)	Tūranganui-a-Kiwa/Poverty Bay area
	Equivalent to typical loud ambient period for otariid pinnipeds	103 dB L_{90} (OW-weighted)	2.8km
Backhoe dredge	NOAA behavioural response	120 dB RMS	<1m
	Equivalent to background noise levels for mid-frequency cetaceans	89 dB L_{10} (MF-weighted)	<100m
	Equivalent to typical loud ambient period for mid-frequency cetaceans	97 dB L_{90} (MF-weighted)	<100m
	Equivalent to background noise levels for otariid pinnipeds	92 dB L_{10} (OW-weighted)	<100m
	Equivalent to typical loud ambient period for otariid pinnipeds	103 dB L_{90} (OW-weighted)	<100m

The table above shows that the noise levels from the backhoe dredge drop below the background underwater noise levels in a short distance, while the Xcentric Ripper and TSHD are predicted to be above ambient levels in the general Tūranganui-a-Kiwa/Poverty Bay area. It is impracticable for an MMO to monitor these zones, and we note that it is not current practice for MMO's to monitor behavioural response zones.

There is potential for behavioural response from marine mammals in Tūranganui-a-Kiwa/Poverty Bay as noise levels from the dredging would be detectable. The Xcentric Ripper and TSHD sources are generally constant and broadband and would be of a similar level to existing vessel movements, but they would be present for longer periods than typical vessel pass-bys.

7.6 Summary of Underwater Noise Assessment

In summary:

- Piling:
  - The predicted TTS zones are 100m for impact piling, and <10m for vibro piling. The predicted PTS zones are negligible.
  - Piling noise is predicted to be above background levels in the wider Tūranganui-a-Kiwa/Poverty Bay area. The existing Outer Breakwater provides shielding which is predicted to reduce piling noise to below ambient levels beyond the Tūranganui-a-Kiwa/Poverty Bay Marine mammals would detect piling noise in parts of Tūranganui-a-Kiwa/Poverty Bay, which could result in behavioural response.
  - We recommend the following mitigation and management measures for piling works in accordance with current best practice:
    - A dolly/cushion be used for impact piling to mitigate noise emissions (this has been assumed in our predictions)
    - A marine mammal observer monitors the TTS zones where they extend beyond the port entrance
- Dredging:
  - The predicted TTS and PTS zones from all dredging operations are negligible, so an MMO is not needed.
  - Noise from backhoe dredging drops below background levels a short distance from the activity, but the Xcentric Ripper and TSHD are predicted to be above background levels in the wider Tūranganui-a-Kiwa/Poverty Bay area. This would be detectable to marine mammals and therefore may cause behavioural response, but we note that noise levels would be similar in level to the existing vessel movements but would be present for longer periods.

As per the ecology assessment, there are no known aggregations of marine mammals in wider Tūranganui-a-Kiwa/Poverty Bay area, so behavioural impacts such as temporary avoidance of the area during piling and dredging would be limited to itinerant individuals/small groups.

8.0 NOISE EFFECTS ON BIRDS

We have carried out a high-level assessment of bird species in the following sections.

In general, we note that the environment in the vicinity of the port is characterised by high noise levels. This includes both continuous noise from equipment operating and impulsive noise from the movement of logs (bangs, crashes etc.). Noise received from the proposed construction activities in the outer breakwater and similar locations where birds gather would be of a similar character and level to existing activities.

8.1 Sea Birds

The marine ecologist has noted that there are two resident bird species that have been identified using the Outer Breakwater as a roosting/nesting site at times: white fronted terns and red billed gulls. The bird species of interest are supported by a 2009 study[13].

We are not aware of any specific noise effect thresholds for these species. We have therefore discussed potential effects by comparing the proposed construction works to the existing noise environment.

Nesting/roosting birds may be disturbed by close proximity construction works such as piling, jet grouting, excavation and similar activities. However, the ecologist notes that the primary disturbance is likely to be due to the physical works as opposed to noise specifically, and therefore specific noise management measures are not required.

8.2 Little Blue Penguins

Kororā (Little Blue Penguins) are common in coastal areas and known to nest in man-made structures. We understand that there is a colony nearby the port.

As a general guideline, there is the potential for disturbance to Kororā at noise levels of 70 dBA and above, with 80 dBA being adopted as the upper limit for a construction project in Auckland with nearby burrows[14]. We understand that there have been no significant project effects on this colony thus far.

The 70 dB L_{Aeq} compliance setbacks in Table 5 can be used as an effects envelope to determine whether specific noise mitigation measures (Section 10.0) and kororā management procedures are necessary. Specific measures for kororā are addressed in Section 9 of the 'Eastland Port Twin Berths Project Little Penguin/ Kororā (Eudyptula minor) Assessment of Ecological Effects' dated July 2022.

[13] https://envirolink.govt.nz/assets/Envirolink/829-GSDC60-Coastal-dwelling-birds-on-the-East-Cape.pdf

[14] https://ourauckland.aucklandcouncil.govt.nz/media/ivfd2jke/cst60082321-c24a-mda-acoustic-report-certified.pdf

9.0 PLANNING FRAMEWORK

We have assessed Proposal using the following:

- TRMP General Noise Section construction noise and vibration rules (activities on land).
- TRMP Coastal Environment construction noise rules (activities in the Coastal Marine Area).
- New Zealand Standard NZS 6803: 1999 *Acoustics - Construction Noise* (and the 1984 provisional version)
- The Resource Management Act's (RMA) requirement to avoid unreasonable noise and to adopt the best practicable option to avoid, remedy or mitigate adverse effects.
- TBP Stage 1 construction noise limits. We recommend they are also applied to this Stage 2 Proposal as per current best practice and to ensure a consistent management approach.

9.1 TRMP General Noise Section (Activities on Land)

Section C11.2.15 Rules for Noise of the TRMP addresses noise and vibration emissions from land-based port activities.

Infringements of the rules in this section result in a **Discretionary Activity Status**.

9.1.1 Methods of Assessment of Noise

Rule C11.2.15.8 A 1. – Proposal has been assessed in accordance with this rule, but we recommend the current version of NZS 6803 is adopted as per industry best practice.

This rule addresses the methods for the measurement and assessment of noise. It states that:

> *"All measurements shall be taken in accordance with:*
>
> *a) NZS6801:1991 "Measurement of Sound";*
>
> *b) NZS 6803P:1984 "The measurement and Assessment of Noise from Construction, Maintenance and Demolition Work", NZS6803:1999 "Acoustics – Construction Work"*

We note that this provisional version of the NZS 6803:1984P has been superseded by New Zealand Standard NZS 6803:1999 *"Acoustics - Construction Noise"*. We recommend the 1999 version is adopted as current best practice (refer to Section 9.3 for further details on these Standards).

9.1.2 General Rules and Standards for Construction Activities in All Zones

Rule C11.2.15.2 A 1 – Proposal infringes number of days rule

Rule C11.2.15.2 A states the following in relation to long term construction works all zones:

> 1. *"Emissions of construction noise shall not exceed 168 calendar days in any 12 month period"*

Construction works associated with the Proposal will generate noise for more than 168 days.

An overall duration restriction irrespective of received noise levels is highly unusual and we are not aware of this control anywhere else in New Zealand. New Zealand Standard NZS 6803: 1999 *Acoustics - Construction Noise* (NZS 6803) specifies three durations with varying reasonable noise thresholds: short term (less than 14 days), typical (more than 14 days but less than 20 weeks) and long-term (more than 20 weeks). It is standard best practice to adopt these durations, and no versions of the NZS 6803 specify a limitation on the overall construction days in a year.

We note that there is an equivalent number of days restriction for construction vibration, but it does not apply to activities in the Port Zone. Furthermore, Rule C11.2.13 applies NZS 6803 for works in the CMA and the rule does not contain an overall limit of days for construction noise emissions.

Rule C11.2.15.2 A 2 – Proposal exceeds noise limits in some zones, but the effect is reasonable based on the high existing noise levels

Rule C11.2.15.2 A states the following:

2. *"The construction activity shall comply with the noise limits specified in Figure C.11"*

We assume that this is meant to refer to Figure C11.9 as opposed to C.11.

Table 13 summarises the relevant construction noise limits. These limits are based on Figure C11.9, which references Figures 11.3, C11.4 and C11.7.

Figure 8 shows a zoning map where the above limits apply.

Eastland Port land is zoned Port Management Zone - Port B. This includes all wharf and land areas except for the proposed reclamation area.

The receiving environment comprises a variety of zones, including Heritage Reserve, Amenity Reserve, Recreation Reserve, Amenity Commercial (assumed to relate to Suburban Commercial in the noise rules), Inner City Residential and Port A.

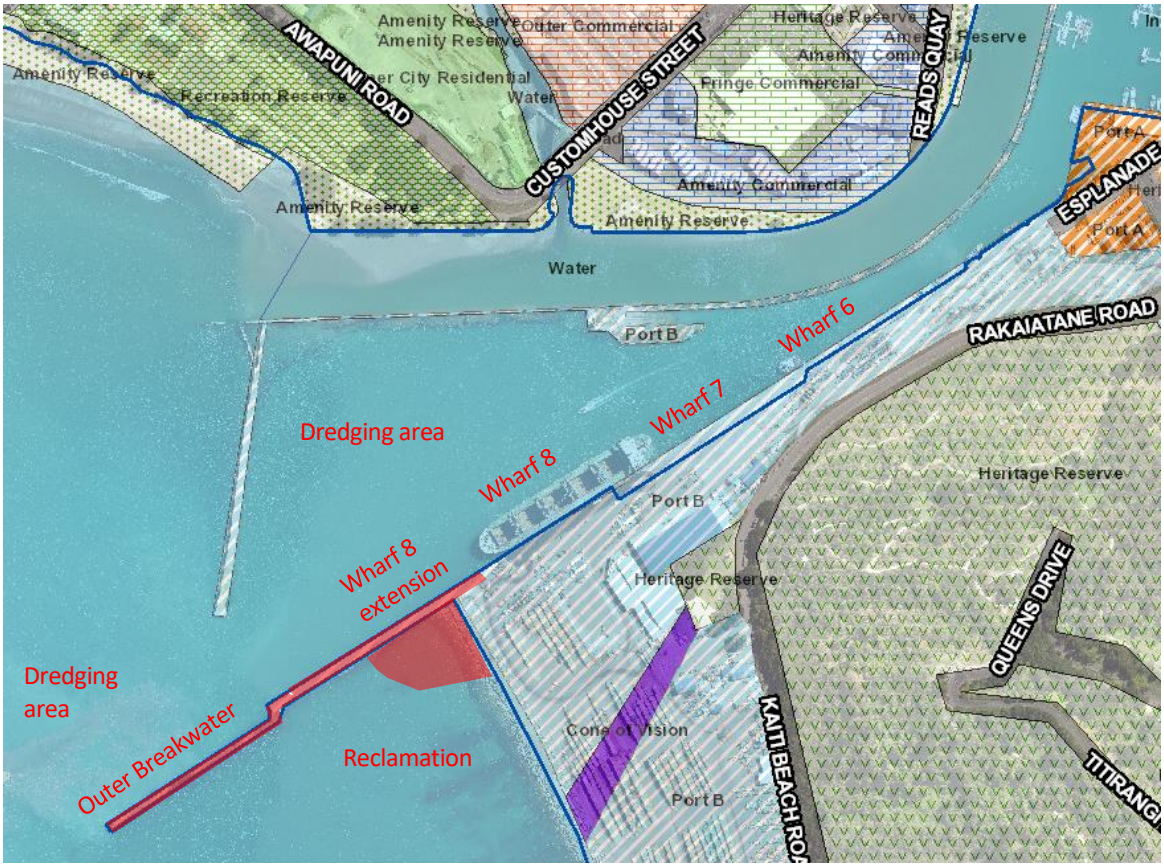
All construction works are predicted to comply with the relevant limits except for:

- Night-time dredging of the berth areas and excavator operations in the reclamation area are predicted to infringe the 45 dB L_{A10} evening and 40 dB L_{A10} night-time noise limits which apply at the Inner-City Residential Zone to the north. The resulting effect would be negligible as this site does not contain any residential developments, and therefore, is not noise sensitive at night.
- Daytime and night-time works are predicted to exceed the 50 dB L_{A10} limit in the Heritage Reserve Zone. The resulting effect is predicted to be negligible as the works would be generally comparable to existing port operations, and the reserve area immediately adjacent to the port is not considered to be noise sensitive.

Table 13: Summary of noise limits for works in the Port B zone

Construction & temporary activity noise measured within the	Time period	Noise limits (dB)		
		L_{A95}	L_{A10}	L_{Amax}
Residential Zones adjacent to industrial zones	Monday – Saturday:			
	- 7am – 6pm (day)	60	75	90
	- 6pm – 10pm (evening)	-	50	-
	- 10pm – 7am (night)	-	45	70
	Sundays & Public Holidays:			
	- 7am – 6pm (day)	60	75	90
	- 6pm – 10pm (evening)	-	45	-
	- 10pm – 7am (night)	-	45	70
All other Residential Zones	Monday – Saturday:			
	- 7am – 6pm (day)	60	75	90
	- 6pm – 10pm (evening)	-	45	-
	- 10pm – 7am (night)	-	40	65
	Sundays & Public Holidays:			
	- 7am – 6pm (day)	60	75	90
	- 6pm – 10pm (evening)	-	45	-
	- 10pm – 7am (night)	-	40	65
Commercial and Suburban Commercial/Amenity Commercial Zones	Monday – Saturday, all times	60	75	90
	Sundays & Public Holidays, all times:			
	- Suburban/Amenity Commercial	-	65	-
	- Commercial	-	70	-
Industrial and Port Zones	Monday – Saturday, all times	-	90	-
	Sunday & Public Holidays, all times	-	75	-
Heritage Reserves Zone	Monday – Saturday, all times	60	75	90
	Sunday & Public Holidays in Heritage Reserve:			
	- 7am – 9pm (day)	-	50	-
	- 9pm – 7am (night)	-	50	50
Amenity and Recreation Reserves Zones	All times		75	

Figure 8: Zoning map with Port Management Zones



9.2 TRMP Coastal Environment Section

Section 11.2.16 Rules for Noise in Coastal Environment of the TRMP addresses noise emissions from port activities within the Coastal Marine Area.

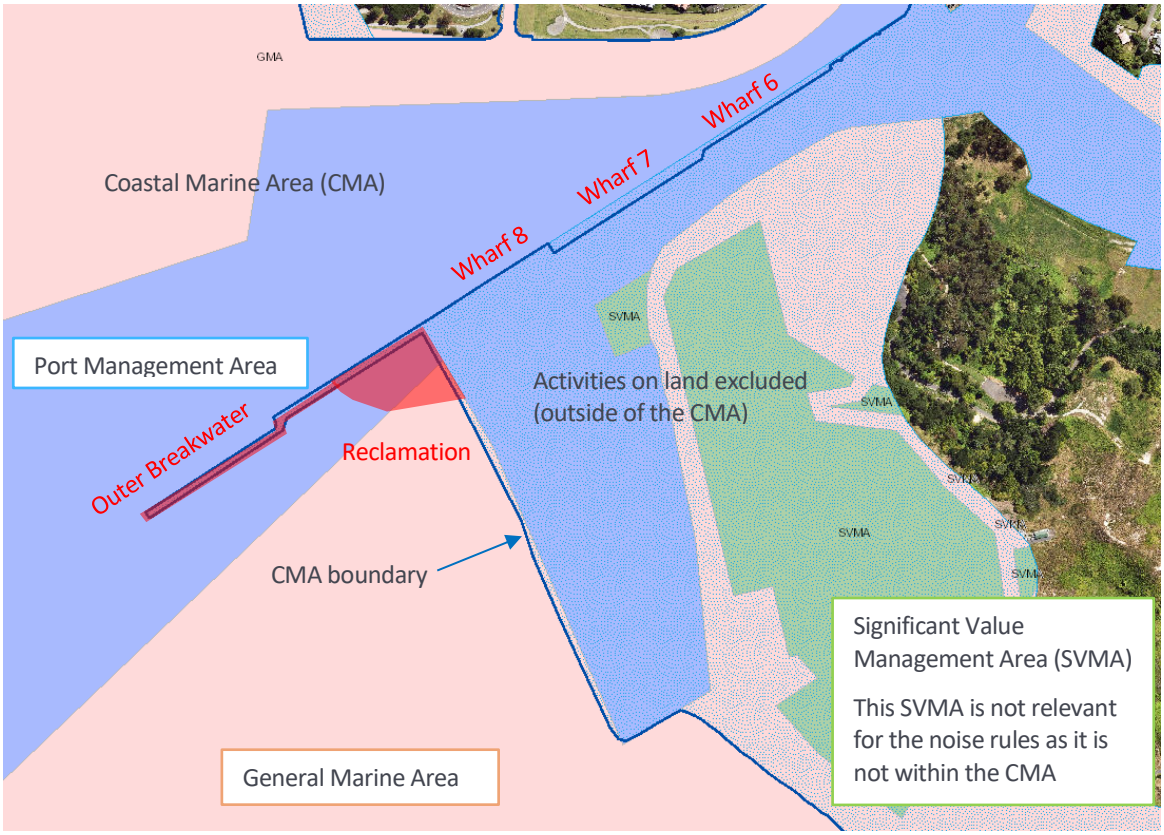
Infringements of the rules in this section result in a **Discretionary Activity Status**, except for infringing the noise limits in the Coastal Marine Area (CMA) of a Significant Values Management Area (SVMA), which is a **Non-Complying Activity Status**.

9.2.1 Coastal Environment Zoning

Noise emissions from the Proposal are subject to the noise rules for the Coastal Environment. Figure 9 shows the Coastal Management Zones.

All port operations (including those associated with the Proposal) are within the Port Management Area shown in blue on Figure 9. We note there is a small section of the new reclamation in the General Marine Area.

Figure 9: Coastal Management Zones



The relevant rules for activities in the CMA are addressed in the following sections.

9.2.2 Coastal Marine Area Policies

Policy C11.2.13 6 – Proposal has been assessed in accordance with this policy, but we recommend the current version of NZS 6803 is adopted.

Policy C11.2.13 6. states that:

> *"Construction noise arising from any activity in the CMA shall meet the limits recommended in, and be measured and assessed in accordance with, New Zealand Standard NZS6803P:1984 "The "Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work"."*

This provisional version of the Standard has been superseded by New Zealand Standard NZS 6803:1999 *"Acoustics - Construction Noise"*. We recommend that the current version of the Standard be adopted for the Proposal.

The relevant limits for both versions of the Standard are provided in Section 9.3.

9.2.3 Coastal Environment Rules

Rule C11.2.16.1 B a) – Proposal infringes noise limits at boundary of the Port Management Area, no known effects

This rule states:

> a) *"The average maximum noise level (dB L_{A10}) and maximum noise level (dB L_{Amax}) generated within the Coastal Marine Area of the Port Management Area as measured at or within the boundary of (respectively) the General Management Area, the CMA of the Port Management Area and the Significant Value Management Area, shall not exceed the following limits set out Figure C11.15 (table below)*

Management Areas (within the Coastal Marine Area only)	*Average Maximum Noise Level at all times (dB L_{A10})*	*Maximum Noise Level between 9pm – 7am (dB L_{Amax})*
General Management Area and CMA Boundary of the Port Management Area	*70*	*70*
Significant Value Management Area	*50*	*70 – at all times*

Figure C11.15 – Noise Standards for the Port Management Area

The predicted noise level at the closest General Marine Area (within the proposed reclamation area) from activities in the CMA is predicted to be above 70 dB L_{A10} as this construction equipment would be operating at the boundary of this zone for the reclamation works. We are not aware of any noise sensitivity at this location.

The next closest General Marine Area is on the other side of Butlers Wall to the north. The predicted noise level from the loudest works (impact piling at a distance of 150m) is predicted to exceed the 70 dB L_{A10} limit by around 2 – 3 decibels. We are not aware of any noise sensitivity of this location.

The closest SVMA that is within the CMA is Tuamotu Island which is 3.5km to the south and well away from activities related to the Proposal. The 50 dB L_{A10} limit would therefore be complied with.

Rule C11.2.16.1 B b) – Proposal is compliant

This rule states:

> b) *Noise shall not reach a level or be of such a nature that it results in the long-term modification of the behaviour of aggregations of marine mammals or birds. Long-term, for the purpose of this standard, means any change in behaviour which is not corrected within 30 minutes and repetitive modifications to behaviour which culminate in more than 60 minutes of response to noise. Modification of behaviour includes any visible flight or flee response to noise - especially movement from a nesting or rearing site but does not include accommodation responses such as re-orientation to the source of noise; or*

This rule is addressed in Section 7.0 (marine mammals) and Section 8.0 (birds).

Rule C11.2.16.1 B c) – Proposal has been assessed in accordance with rule

This rule states:

> *c) The noise is generated by any siren, bell, foghorn or any other device used for navigation and/or warning purposes."*

We have not included any of these sources in our assessment.

9.3 New Zealand Standard NZS 6803

The TRMP rules refer to *NZS6803P:1984 "The "Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work"*. This Standard has been superseded by New Zealand Standard NZS 6803: 1999 *Acoustics - Construction Noise*.

While similar in practice, NZS 6803:1999 uses the more modern L_{Aeq} measurement descriptor in place of the outdated L_{10} metric. We recommend the 1999 version be adopted for the Proposal.

The relevant limits from NZS 6803P:1984 are summarised in Table 14 and Table 15.

Table 14: NZS6803P:1984 Construction noise limits for works in the CMA at residential receivers (incl. hotels)

	Noise level (dB)								
	Weekdays			Saturdays			Sundays and Public Holidays		
Period	L_{A10}	L_{A95}	L_{Amax}	L_{A10}	L_{A95}	L_{Amax}	L_{A10}	L_{A95}	L_{Amax}
6:30am – 7:30am	55	40	65	**	**	**	**	**	**
7:30am – 6pm	70	55	85	70	55	85	**	**	**
6pm – 8pm	65	50	80	**	**	**	**	**	**
8pm – 6:30am	**	**	**	**	**	**	**	**	**

The ** refers to the upper limits in New Zealand Standard NZS 6802:1991 *"Assessment of Environmental Sound"*. These are 55 dB L_{A10} during the daytime (7am – 10pm) and 45 dB L_{A10} / 75 dB L_{Amax} during the night (10pm – 7am).

Table 15: NZS6803P:1984 Construction noise limits for works in the CMA at commercial receivers

	Noise Level (dB)	
Time period	L_{A10}	L_{A95}
7:30am – 6pm	70	60
6pm – 7:30am	75	N/A

The limits for NZS 6803:1999 are provided in Table 16 and Table 17.

Table 16: NZS6803:1999 Construction noise limits for works in the at residential receivers (including hotels)

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

Table 17: NZS6803:1999 Construction noise limits for works in the at commercial receivers

Time period	Duration of work		
	Typical duration	Short-term duration	Long-term duration
	L_{eq} (dBA)	L_{eq} (dBA)	L_{eq} (dBA)
0730-1800	75	80	70
1800-0730	80	85	75

9.4 Stage 1 TBP Noise Limits

The following noise limits were included in the conditions for the redevelopment of wharves 6 and 7 and the remediation of the slipway that were approved by the Environment Court in 2020:

> *"Construction on the site shall be designed and conducted to ensure the noise measured at any dwelling does not exceed the limits in the following table from NZS 6803:199 Acoustics – Construction Noise. Noise levels shall be measured and assessed in accordance with NZS 6803:1999 Acoustics – Construction Noise."*

Time period	***Weekdays (dB)***		***Saturdays (dB)***		***Sundays and Public Holidays (dB)***	
	L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax}
6:30am – 7:30am	*55*	*75*	*45*	*75*	*45*	*75*
7:30am – 6pm	*70*	*85*	*70*	*85*	*55*	*85*
6pm – 8pm	*65*	*80*	*45*	*75*	*45*	*75*
8pm – 6:30am	*45*	*75*	*45*	*75*	*45*	*75*

The noise limits align with those recommended in 6803 for residential receivers. Although it is not mentioned in the Decision, the corresponding noise limit at commercial receivers from NZS 6803:1999 is 70 dB L_{Aeq} during the daytime (7:30am – 6pm). This aligns with the daytime limit applying at dwellings in the above table.

We consider that the limits from the Stage 1 TBP consent conditions are appropriate for the Proposal, and should be adopted in relation to all residential receivers (including the Portside Hotel) for the following reasons:

- To enable consistency across the construction projects. It would be problematic to have different noise limits and corresponding mitigation/management measures applying to similar port construction works.
- The Stage 1 TBP consent conditions use the current version of the Construction Noise Standard (NZS 6803:1999) instead of the superseded version NZ 6803P:1984. This uses the L_{Aeq} parameter instead of the L_{A10} in accordance with current best practice.
- Complying with 70 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night-time at the closest residential receivers would ensure compliance with all Tairāwhiti Resource Management Plan limits.
- The limits in the Stage 1 TBP consent conditions are slightly more stringent than the Port B Zone limits which apply at the adjacent noise sensitive receivers (a limit of 70 dB L_{Aeq} is roughly 73 dB L_{A10}). Therefore, a marginally better outcome would be achieved by achieving these limits.

9.5 TRMP Vibration Rules

9.5.1 Methods for Assessing Vibration

Rule C11.2.15.8.C – Proposal has been assessed in accordance with this rule, but we recommend the current version of DIN4150-3:1999 is adopted as per industry best practice

Rule C11.2.15.8 C states the following in relation to assessing vibration:

1. *"Assessment of vibration will initially involve assessment by a suitably experienced person using unaided senses.*
2. *If, during initial unaided senses, assessment vibration is detected and further clarification of the level of vibration emitted is required, a secondary assessment of weighted vibration levels (Wb and Wd) shall be measured according to BS6841:1987. The average vibration shall be measured over a time period not less than 60 seconds and not longer than 30 minutes. The vibration shall be measured at any point where it is likely to affect the comfort or amenity of persons occupying an adjacent site."*

We note that measuring and assessing vibration in acceleration (mm/s^2) as opposed to peak particle velocity (mm/s PPV) is uncommon. We recommend that German Standard DIN 4150-3:1999 *Structural Vibration - Effects of Vibration on Structures* has been widely adopted in New Zealand as best practice for measuring and assessing vibration.

We note that the choice of Standard and threshold does not affect the assessment as the predicted vibration levels are negligible at all nearby receivers.

9.5.2 General Vibration Rules

Rule C11.2.15.3 – Not applicable to construction vibration rom the Proposal

Rule C11.2.15.3 provides vibration criteria which apply to "*all activities with respect to vibration*".

This rule contains vibration criteria which we consider to apply to day-to-day activities such as ongoing port operations. It does not exclude construction works; however, specific vibration criteria for construction works are provided in Rule C11.2.15.4. On this basis we consider that Rule C11.2.15.3 is not applicable to construction noise generated by the Proposal.

Nonetheless, we note that the proposed construction works would still comply with Rule C11.2.15.3 given the large setback distances from the works to the adjacent zones.

9.5.3 Construction Vibration Rules

Rule C11.2.15.4 A 1 – Proposal complies with this rule

TRMP Rule C11.2.15.4.A.1 addresses vibration within residential zoned sites. It states that:

1. *"The period for which vibration is emitted shall not exceed 15 calendar days in any 12 month period;"*

However, Rule C11.2.14.4.B.2 states the following in relation to Industrial, Port, Suburban Commercial or Reserve Zones:

2. *"There shall be no restriction on the duration of construction activities"*

We therefore conclude that the Proposal complies with this rule.

Rule C11.2.14.4.A. 2 & 3 – Proposal is complaint with this rule

TRMP Rule C11.2.15.4A 2 & 3 address vibration within residential and rural zoned sites. It states that:

…

2. *All activities shall comply with the rules specified in Figure C11.12*

3. *The maximum weighted vibration level (Wb or Wd) arising from any zone as measured at or within the boundary of any site zoned residential, or Rural Lifestyle or the notional boundary of any dwelling zoned Rural Production, Rural General, shall not exceed the following limits*

Zone	***Time***	***Maximum Weighted Vibration Level (Wb or Wd)***
Residential	*7am – 6pm, Monday to Saturday*	*60 mm/s²*
	At all other times	*15 mm/s²*

Figure C11.12 – Rules for Vibration Constriction in Residential and Rural Zones"

All residential and rural zoned sites are a significant distance from the proposed construction works. Vibration from the works would be imperceptible and therefore readily compliant with this rule.

The proposed works would also be readily compliant with the limits in the more widely used DIN 4150-3:1999 standard.

Rule C11.2.15.4.B – Proposal is compliant with this rule

Rule C11.2.15.4 B addresses vibration in the industrial, port, commercial, suburban commercial and reserve zones. The relevant limit is 60 mm/s^2 at all times. We have assumed this rule applies at sites at the boundary of the Port B management zone (i.e. outside of the zone where the activity takes place).

The proposed construction works are well set back from adjacent zones so the predicted vibration levels are readily compliant with this threshold.

The proposed works would also be readily compliant with the limits in the more widely used DIN 4150-3:1999 standard.

9.6 The Resource Management Act (RMA)

Section 16 of the RMA is the Duty to Avoid Unreasonable Noise. Section 16 is applicable to the project in terms of the noise from construction of the Twin Berths project. It requires:

> *"Every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level."*

Section 17 is the Duty to Avoid Remedy or Mitigate Adverse Effects. It requires all parties to:

> *"Avoid, remedy, or mitigate any adverse effect on the environment arising from an activity … whether or not the activity is carried on in accordance with … a national environmental standard, a rule, a resource consent, or a designation."*

The activities associated with the Proposal typical of large-scale port construction projects, and we have recommended best practice assessment, mitigation and management measures to use the best practicable option control noise and vibration emissions.

Overall, we consider that the noise levels from construction works associated with the Proposal are reasonable as:

- Noise levels are predicted to be below the typical long term construction noise limit of 70 dB L_{Aeq} at all nearby noise sensitive receivers.
- Vibration from the works would be generally imperceptible at all nearby receivers

- Night-time noise levels from dredging the berth area are predicted to exceed the 45 dB L_{Aeq} limit but would be comparable to existing port operations and therefore considered reasonable
- A CNMP would be used to mitigate and manage construction noise (airborne and underwater) and vibration emissions to a reasonable level.

10.0 RECOMMENDED MITIGATION AND MANAGEMENT MEASURES

10.1 Underwater Noise Mitigation and Management Measures for Piling

We recommend that the following measures are adopted as general best practice to mitigate underwater noise effects:

- Use a dolly/cushion to dampen noise emissions from impact piling by approximately 10 decibels (assumed to be included in the airborne and underwater noise predictions as per current best practice). Plywood cushions generally achieve the best reduction in noise level and should be used where practicable. However, we note that modern hammers include an inbuilt plastic/polymer cushion.
- Use soft starts for impact driven steel piles.
- Consideration of additional mitigation measures where practicable (e.g. use of bubble curtains or a change in piling methodology) if the onsite monitoring finds the piling to be significantly louder than predicted.

The following best practice management measures are recommended:

- Carry out underwater noise monitoring for the first instance of impact and vibro pile driving to validate the zones presented in Section 7.4.
- Monitoring of the TTS zones by an MMO for the presence of marine mammals where they extend beyond the port entrance (to be validated through underwater noise monitoring). A trained observer is recommended as per requirements for other similar projects around New Zealand.

We suggest that these recommendations will be included in a CNMP as per recommended Condition 2 (see Section 11.0).

With the implementation of the above mitigation measures we anticipate that underwater noise emissions would be controlled to a reasonable level.

10.2 Construction Noise and Vibration Management Plan

A CNMP will be developed for the Twin Berths project provide adequate mitigation for airborne noise, vibration and underwater noise.

It will identify practicable noise mitigation measures and ensure effective communication between contractors and neighbours.

A CNMP should include:

- The performance standards;
- Predicted noise levels for relevant equipment and/or activities;
- Construction noise mitigation and management strategies;
- Noise monitoring requirements, with triggers and feedback mechanisms; and
- Communication, consultation and complaints response procedures.

Where practicable and appropriate, specific measures which can be employed to reduce or manage the effects of underwater noise include:

- Using a wooden (preferable) or plastic hammer cushion for the steel piles;
- Consideration of a bubble curtain to mitigation piling noise;
- Undertaking visual monitoring during piling operations to identify any marine mammals in the area;
- Not starting piling if a marine mammal is identified within the TTS zones identified in Section 7.4.2 (subject to verification through monitoring);
- Using 'soft starts' (gradually increasing the intensity of impact piling) and minimising duty cycle; and
- Implementing low power or shut down procedures when a marine mammal is identified within the TTS zones identified in Section 7.4.2 (subject to verification through monitoring).

The CNMP is recommended as a condition of any consent granted for the Proposal.

11.0 RECOMMENDED CONDITIONS OF CONSENT

We recommend the following conditions for any consent granted:

1. *Construction noise shall be measured and assessed in accordance with New Zealand Standard NZS 6803:1999 "Acoustics - Construction Noise" and comply with the following Project Standards at any occupied building unless otherwise provided for in the CNMP (Condition 2).*

Time period	***Weekdays (dB)***		***Saturdays (dB)***		***Sundays and Public Holidays (dB)***	
	L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax}
6:30am – 7:30am	*55*	*75*	*45*	*75*	*45*	*75*
7:30am – 6pm	*70*	*85*	*70*	*85*	*55*	*85*
6pm – 8pm	*65*	*80*	*45*	*75*	*45*	*75*
8pm – 6:30am	*45*	*75*	*45*	*75*	*45*	*75*

2. *A Construction Noise Management Plan (CNMP) must be prepared by a suitably qualified person and submitted to Gisborne District Council for certification at least 5 days prior to the commencement of the works. The certified CNMP must be implemented throughout the Project.*

   The CNMP objectives are:

   a) *Identify and adopt the best practicable option (BPO) for the management of construction noise;*

   b) *Define the procedures to be followed when the noise standards in Condition 1 cannot be met;*

   c) *Inform the duration, frequency and timing of works to manage disruption;*

   d) *Require engagement with affected receivers and timely management of complaints; and*

   e) *Manage the underwater noise levels from impact and vibratory pile driving methods to protect marine mammals and avoid adverse effects on threatened or at-risk species.*

3. *The CNMP shall include:*

   a) *The relevant measures from NZS 6803:1999 "Acoustics – Construction Noise", Annex E2 "Noise management plans"*

   b) *Measures to minimise underwater noise effects on marine mammals, including:*

      i. *Restrict in-water impact or vibration pile driving to within half an hour after sunrise and half an hour before sunset (i.e. daylight hours only);*

      ii. *Use a non-metallic 'dolly' or 'cushion cap' between the impact piling hammer and the driving helmet (e.g. plastic or plywood);*

      iii. *Use piling methods that minimise underwater noise where necessary (e.g. 'Soft starts' – gradually increasing the intensity of impact piling, and the consideration of alternative driving methods and use of bubble curtains);*

      iv. *Establish marine mammal observation zone(s) around the construction area to minimise any risk of hearing impairment or injury to marine mammals from impact and vibration pile-driving activities. These zones shall:*

1. *Reflect piling method, pile size, noise mitigation method(s), and species sensitivity;*
2. *Use the TTS thresholds in the following table:*

Hearing Group	***Impulsive sources (impact piling)***	***Non-impulsive sources (vibratory piling)***
Mid-frequency cetaceans (Orca, common/bottlenose/dusky dolphin)	*170 dB $SEL_{cum(mf)}$ 224 dB L_{peak}*	*185 dB $SEL_{cum(mf)}$*
Otariid pinnipeds (Fur Seals)	*188 dB $SEL_{cum(ow)}$ 226 dB L_{peak}*	*199 dB $SEL_{cum(ow)}$*

3. *Be based initially on the mammal observation zone(s) identified in the Marshall Day Acoustics report 'Rp 004 R01 20200542 BL (Eastland Port - Twin Berths Construction Assessment', dated 24 February 2022 (Table 12);*
4. *Be verified by underwater noise monitoring. The certified CNMP shall be revised and submitted to the Council for re-certification if measured levels exceed the predicted levels, or there is a change in piling method, size or type of piles to be driven which could result in larger mammal observation zone(s); and*

v. *Cease or not commencing impact or vibration piling activities if a marine mammal is observed within the marine mammal observation zone(s).*

APPENDIX A GLOSSARY OF TECHNICAL TERMINOLOGY

dB	Decibel. The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_P or SPL	Sound Pressure Level. A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
L_W or SWL	Sound Power Level. A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
Noise Sensitive Activity	Tairāwhiti Resource Management Plan, Chapter 24 definition: Dwellings, visitor accommodation, hospitals, health care and medical centres, residential care housing, educational institutions, structures for the purpose of, or activities involving public assembly.
Underwater noise	A sound that is unwanted by, or distracting to, the receiver underwater.
Lpeak	The peak instantaneous pressure level (un-weighted).
RMS	Root Mean Square (RMS) is the equivalent continuous (time-averaged) sound level commonly referred to as the average level (period matches the event duration).
SEL	Sound exposure level (SEL) is the total sound energy of an event, normalised to an average sound level over one second. It is the time-integrated, sound-pressure-squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels and temporal characteristics.
SELcum	The SELcum is the 'cumulative' sound energy of all events in a 24-hour period, normalised to an average sound level over one second.
TTS	Temporary Threshold Shift (TTS) is the temporary loss of hearing caused by sound exposure. The duration of TTS varies depending on the nature of the stimulus, but there is generally recovery of full hearing over time. TTS in humans can be likened to the 'muffled' effect on hearing after being exposed to high noise levels such as at a concert. The effect eventually goes away, but the longer the exposure, the longer the threshold shift lasts. Eventually, the TTS becomes permanent (PTS).
PTS	Permanent Threshold Shift (PTS) is the permanent loss of hearing caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear.

APPENDIX B EXISTING ENVRIONMENT NOISE MEASUREMENTS

Table 18 presents a full summary of the attended measurements of the existing noise environment.

Table 18: Existing noise environment measurements

Position	Date, time	Duration	Measured levels (dB)				Noise sources
			L_{Aeq}	L_{A10}	L_{Amax}	L_{95}	
Portside Hotel (room below long-term monitor)	23/11/20 4:45pm	15 mins	58	60	67	67	Log ship, high stacker, port trucks
Reserve in front of Portside Hotel	5/10/2020 10:51 pm	15 mins	49	51	62	46	Log ship
Reserve in front of Portside Hotel	6/10/20 12:29 am	15 mins	53	54	77	47	Log ship and high stacker in Wharfside Logyard
Path up to Kaitī Hill	23/11/20 4:09 pm	15 mins	63	64	80	57	Log ship, high stacker, port trucks
Top of Kaitī Hill	6/10/20 12:02 am	5 mins	61	63	73	56	Southern Logyard and log ship

APPENDIX C AMBIENT UNDERWATER NOISE ENVIRONMENT

Ambient underwater noise levels were recorded continuously from 6 – 20 October 2020 at the two locations shown on Figure 10.

Figure 10: map of hydrophone locations

Across the recording period, the average broadband unweighted RMS level was 120 dB re. 1µPa at the location of hydrophone 5190. This is already at the NOAA behavioural response threshold for continuous noise sources such as vibro piling and dredging (refer Section 7.3.3).

The broadband unweighted RMS level was 112 dB re. 1µPa at the location of hydrophone 5184.

Both measurements were filtered to remove self-noise from the recording equipment below 10 Hz.

The power spectral density of sound power level in respect to frequency was fairly uniform across frequencies at location 5190 (Figure 11), but at location 5184 the sound pressure level was raised in the 100 Hz region (Figure 12).

Figure 11. Power spectral density of the data recorded 6 – 20 October 2020 (hydrophone ID 5190)

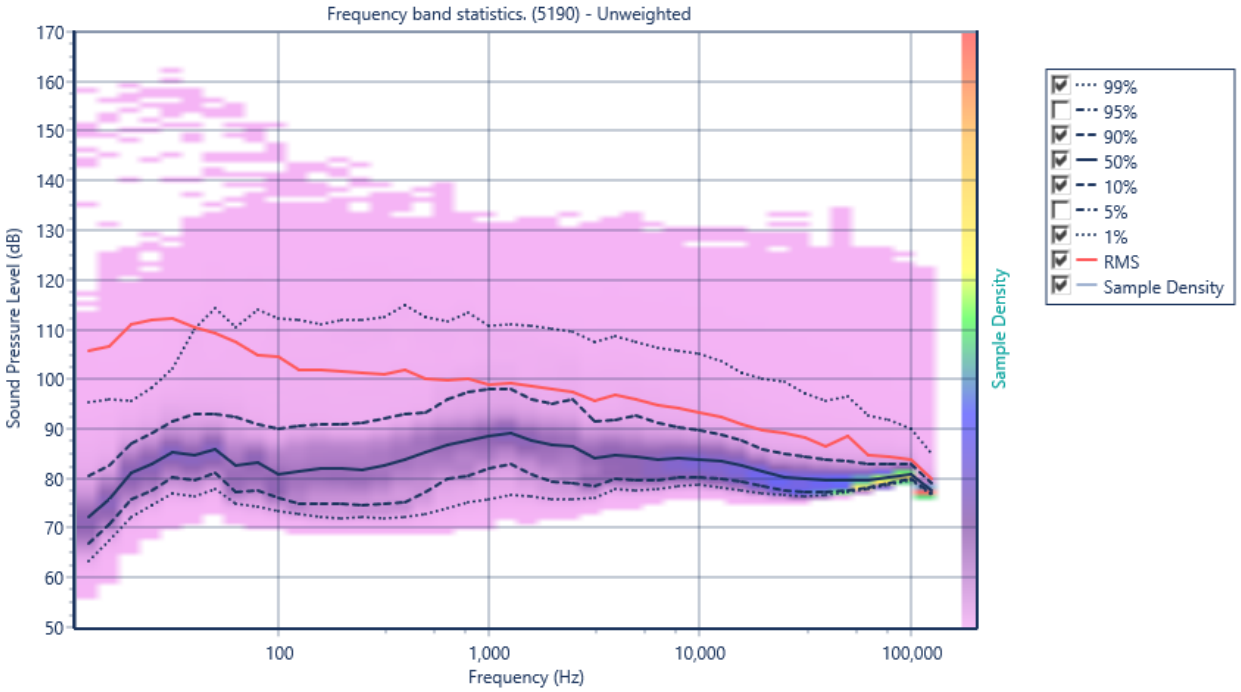


Figure 12. Power spectral density of the data recorded 6 – 20 October 2020 (hydrophone ID 5184)