APPENDIX J

NAPIER PORT WHARF NO. 6 ASSESSMENT OF CONSTRUCTION NOISE EFFECTS

NAPIER PORT

MARSHALL DAY Acoustics

PORT OF NAPIER - WHARF 6

CONSTRUCTION NOISE ASSESSMENT

Rp 001 R06 2016446A | 28 April 2017

84 Symonds Street
PO Box 5811 Wellesley Street
Auckland 1141 New Zealand
T: +64 9 379 7822 F: +64 9 309 3540
www.marshallday.com

Project: **PORT OF NAPIER - WHARF 6 CONSTRUCTION**

Prepared for: **Port of Napier**
PO Box 947
Napier 4140

Attention: **Michel de Vos**

Report No.: **Rp 001 R06 2016446A**

Document control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Issued	-	For Resource Consent	10 Aug 2016	Benjamin Lawrence	Curt Robinson Craig Fitzgerald
Issued	01	Feedback S. Allan	23 Sep 2016	Benjamin Lawrence	Craig Fitzgerald
Issued	02	Feedback S. Allan	26 Sep 2016	Benjamin Lawrence	Craig Fitzgerald
Issued	03	Feedback S. Allan	26 Sep 2016	Benjamin Lawrence	Craig Fitzgerald
Issued	04	Feedback M. De Vos	17 Oct 2016	Benjamin Lawrence	Craig Fitzgerald
Issued	05	Feedback S. Allan	24 Apr 2017	Benjamin Lawrence	Craig Fitzgerald
Issued	06	Feedback D. Clement	28 Apr 2017	Benjamin Lawrence	Craig Fitzgerald

Photo credit: Oana Ungureanu

TABLE OF CONTENTS

1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by Port of Napier Ltd to undertake an assessment of noise effects from the construction of a new wharf (named 'Wharf 6') at the existing container terminal. This assessment relates to the construction works only; operational noise from the proposed wharf is addressed in MDA report '*Rp 004 r02 2015784A CMF (Port of Napier Wharf 6 Future Noise Maps 2016)*'.

This report contains a description of the project and methodology, relevant noise performance standards, predicted noise levels and an assessment of the noise effects. The report has been divided into two parts:

1. Airborne construction noise
2. Underwater noise from construction and dredging works

Due to the large separation distance from the proposed construction works to nearby residential receivers, effects from construction vibration would be negligible and have not been considered further.

A glossary of technical terms is included in Appendix A.

2.0 PROJECT DESCRIPTION

2.1 Wharf 6 Description

The new wharf is to be constructed from a 700mm thick continuous deck which is 350m long and 34m wide. Figure 1 shows the proposed location of the wharf.

The wharf is to be supported by 900mm and 1200mm steel piles in an approximate 6.5m grid. The inner and outer edges of the concrete deck are to be thickened and a precast retaining wall is to be constructed below the inner edge where the new wharf meets the existing wharf. Figure 2 shows a typical cross section of the proposed wharf.

Figure 1: Aerial Map showing proposed location of Wharf 6

2.2 Summary of Construction Works

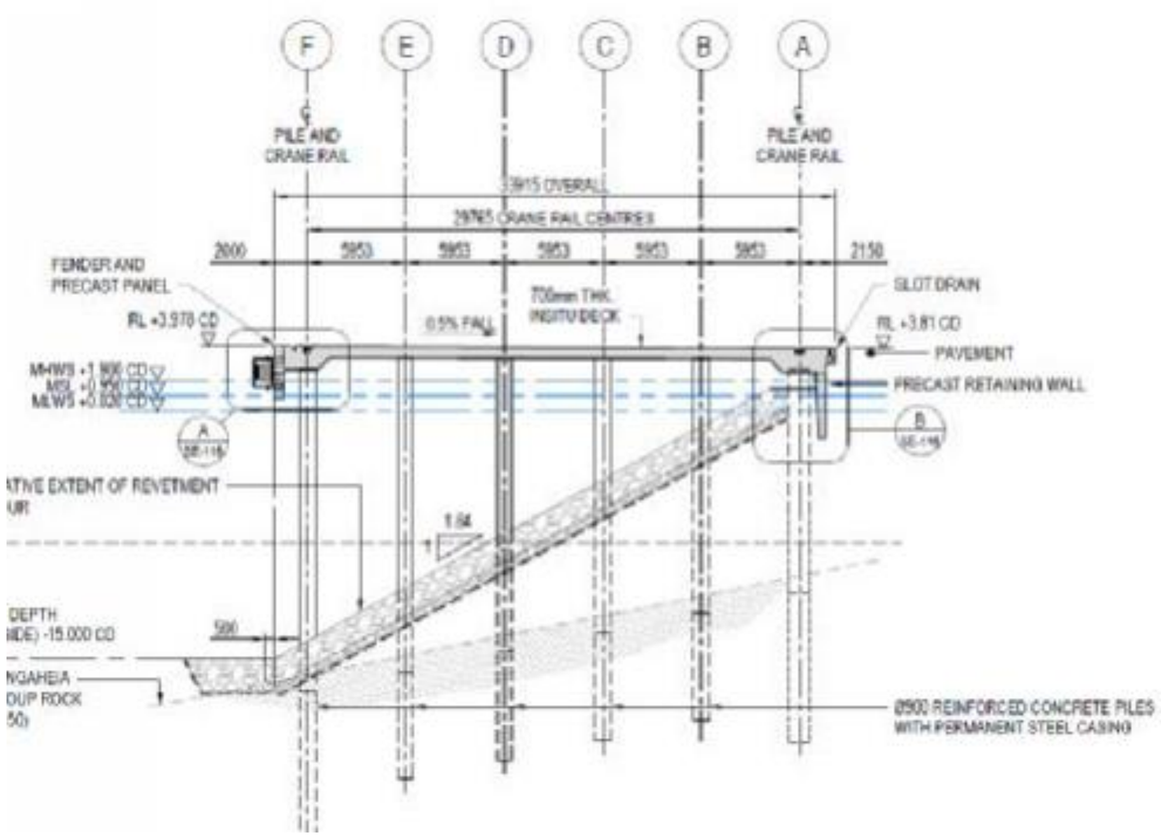
Indicative construction methodology and equipment has been provided by Beca[1]. Based on this information, the construction works can be summarised as follows:

1. Installation of stone columns to support western end of the wharf. The columns would be installed by vibro-replacement or driving open ended tubes and extracting them as they are filled with gravel
2. Install 900mm and 1200mm steel piles using a large hydraulic hammer
3. Drill pile sockets then install rebar cages and fill with concrete
4. 'Trim' existing slope using backhoes and place armour material
5. Install formwork for deck slab and edge beams and position the precast retaining wall
6. Position deck slab
7. Install wharf furniture and fittings

The primary activity of interest is impact piling. This activity is likely to generate significantly higher airborne and underwater noise levels than all other activities.

Dredging works are also proposed which would use a trailing hopper suction dredge (THSD) and backhoe. The majority of dredging would take place in proximity to the new wharf to provide sufficient depth for large vessels to manoeuvre.

Figure 2: Typical wharf cross section



[1] BECA: '*Wharf Construction Methodology*', dated 16 May 2016

3.0 AIRBORNE NOISE ASSESSMENT

3.1 Airborne Noise Performance Standards

The proposed Wharf 6 is located within the Coastal Marine Area, but both the City of Napier District Plan and the Hawke's Bay Regional Coastal Plan apply in terms of noise generated from port activities. Both plans require that noise arising from construction, maintenance and demolition work must comply with New Zealand Standard NZS 6803: 1999 "*Acoustics - Construction Noise*"[2].

The works associated with the construction of the new wharf are understood to be more than 20 weeks in duration, and are therefore subject to the 'long-term duration' noise limits in NZS 6803:1999. These limits are summarised in Table 1 below.

The times highlighted in **bold** are the intended hours for construction activities to take place. These times are referred to as 'appropriate construction hours' throughout this report. The full construction noise limits are provided in Appendix B.

Table 1: Construction Noise Limits (Long-Term Duration)

Type of Receiver	Time of week	Time period	Noise Limit	
			L_{Aeq}	L_{AFmax}
Residential or Rural	Weekdays	0630 - 0730	55	75
		0730 - 1800	**70**	**85**
		1800 - 2000	65	80
		2000 - 0630	45	75
	Saturdays	0630 - 0730	45	75
		0730 - 1800	**70**	**85**
		1800 - 0630	45	75
	Sundays and public holidays	0630 - 0730	45	75
		0730 - 1800	55	85
		1800 - 0630	45	75
Commercial or Industrial	All days	**0730 - 1800**	**70**	-
		1800 - 0730	75	-

New Zealand Fur Seals (otariid pinnipeds) are also known to occasionally haul-out and rest on the main breakwaters. Research[3] indicates that impact piling has the potential to result in Temporary Threshold Shift (TTS) in otariid pinnipeds at levels of 149 dB L_{peak} or 144 dB SEL for a single piling strike, with behavioural response invoked at levels of approximately 109 dB L_{peak} or 100 dB L_{rms}. For ease of comparison, otariid pinnipeds in-air hearing is less sensitive than humans, in the order of 10 decibels higher than equivalent OSH thresholds at which humans are required to wear hearing protection.

3.2 Existing Airborne Noise Environment

The existing ambient noise environment for the residential receivers directly to the south is generally controlled by port operations, which include truck movements, vessel movements, forklifts, excavators and crane operations. Recent measurements undertaken by MDA[4] show that on a typical day the annual average 24-hour noise level received at the Bluff Hill Noise Monitoring Terminal on the corner of Seascape and Karaka Roads is 56 dB L_{Aeq}.

3.3 Modelling Parameters

The noise model has been prepared using SoundPLAN, an internationally recognised computer noise modelling programme. SoundPLAN uses a digital topographical terrain map of the area as its base. Each noise source is located at an appropriate height above the digital map and the software then calculates noise propagation in multiple directions, allowing for buildings, topography, shielding, reflections and meteorological conditions. The SoundPLAN model uses the calculation algorithms of ISO 9613-2: 1996 'Acoustics – Attenuation of noise during propagation outdoors – Part 2: General method of calculation'. Its accuracy has been established by a number of field trials, including comparisons in New Zealand between predictions and measurements.

The model relies on the following geo referenced base data sourced from Napier City Council (May 2015):

- Topographical contours at 1m intervals
- Cadastral boundaries
- Building footprints and heights

The noise contours are obtained by computer interpolation between calculated grid points at 10m intervals.

3.4 Predicted Airborne Noise Levels

Impact piling works would produce the highest noise levels of all the proposed constructions works. If compliance with the construction noise limits is achieved for this activity, it would be achieved for all construction works.

Figure 3 overleaf shows the predicted L_{Aeq} noise contours from the impact piling works. The piling works are predicted to achieve compliance with the daytime construction noise limit of 70 dB L_{Aeq} and 85 dB L_{AFmax}, with the closest dwellings receiving noise levels in the order of 55 dB L_{Aeq} and 65 - 70 dB L_{AFmax}.

Where New Zealand Fur Seals are resting on the breakwater, they would only need to be at least 5 - 10m from the impact piling rig to ensure compliance with the relevant thresholds in Section 3.1. However practically, it is highly unlikely that seals would be able to get this close to the rig during piling, or that works would continue in such a scenario.

[2] Rule 57.14 in the City of Napier District Plan and Rule 176 d) in the Hawke's Bay Regional Coastal Plan

[3] Southall et al 2007, Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations, Tables 3 and 5

[4] Rp 001 r01 2015784A CMF (Port of Napier Current Port Noise Maps 2016)

3.5 Assessment of Airborne Construction Noise Effects

Based on measurements of general port operations, it is considered that airborne noise from the majority of construction works would be similar to normal port activities. This would include excavator and crane operations, truck and vessel movements, and mechanical plant operation. Provided that these works were undertaken at appropriate times of the day, and that the activities are no louder than necessary, in MDA's opinion the noise effects of these activities would be negligible.

While noise from the impact piling would likely be noticeable at the nearest dwellings due to its character, MDA considers that the predicted noise levels are reasonable on the basis that the works would be of limited duration and undertaken within appropriate hours of the day.

A Construction Noise Management Plan (CNMP) should be produced and implemented throughout the projects duration to ensure that airborne noise from construction works do not exceed a reasonable level (see Section 5.0 for more details).

Figure 3: Predicted Noise Levels for Impact Driven Steel Piles

4.0 UNDERWATER NOISE ASSESSMENT

4.1 Marine Mammals

There is no New Zealand guidance on underwater noise effects. However, the US Department of Commerce National Oceanic and Atmospheric Administration has provided guidance for assessing the effects of anthropogenic (human-made) sound on marine mammals[5] (referred to as the 'NOAA Guidelines'). It is noted that US statutes do not apply in New Zealand, and the NOAA Guidelines have only been provided to give context to the underwater noise assessment.

The NOAA Guidelines identify the received levels above at which individual marine mammals are predicted to experience changes in hearing sensitivity, either temporary or permanent. Permanent Threshold Shift (PTS) is the permanent loss of hearing caused by some kind of acoustic effect or trauma. Dual PTS onset thresholds are provided for mid-frequency and low-frequency cetaceans as well as pinnipeds using 'peak' and 'SEL_{cum}' assessment descriptors. The peak level is the un-weighted peak instantaneous pressure level recorded during the measurement period, whereas SEL_{cum}[6] is the M-weighted cumulative sound exposure level over a 24 hour period.

The Cawthron assessment details the marine mammals known to visit the wider area. Based on correspondence with Cawthron[7], it is understood that the following represent the species of interest in the harbour and local surrounding area:

- Species which are frequently sighted in and around the harbour area:
  - New Zealand fur seal (otariid pinniped)
  - Common dolphin (mid-frequency cetacean)
  - Orca (mid-frequency cetacean)
- Species which are rarely sighted:
  - Southern Right Whale (low-frequency cetacean)
    (1-2 pairs per year with calf, which visit between August and November)

Pilot, Pigmy and Sperm Whales have been also sighted in the area but usually in deeper water approximately 20km off the coast. As these species are rarely sighted in the projects vicinity, they have not been included in this assessment.

The NOAA PTS onset thresholds for the identified species of interest are summarised in Table 2 below.

Table 2: NOAA PTS Thresholds (peak levels in dB re 1µPa and SEL_{cum} levels in dB re 1 µPa²/s)

		Impulsive Sources (e.g. impact piling)		Non-Impulsive Sources (e.g. vibro-piling, dredging)
Functional Hearing Group	Hearing Range	Peak (peak)	Cumulative (SEL_{cum})	Cumulative (SEL_{cum})
Low-frequency cetaceans	7Hz – 25kHz	219	183	199
Mid-frequency cetaceans	150Hz – 160kHz	230	185	198
Otariid pinnipeds	100Hz – 48kHz	232	203	219

[5] National Oceanic and Atmospheric Administration: 'Technical Guidance for Assessing the Effects on Anthropogenic Sound on Marine Mammal Hearing' (July 2016)

[6] SEL_{cum} is the cumulative sound exposure level (SEL) of a number of pile strikes over a 24 hour period. Mathematically, it is the SEL of a single pile strike + 10log(number of pile strikes)

The NOAA Guidelines also cover "*sound characteristics likely to cause injury and behavioural disruption in the context of the Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA) and other statutes*". The Interim Sound Threshold Guidance relating to behavioural disruption is summarised in Table 3. Note these are currently under review by NOAA, but provide suitable context.

Table 3: MMPA behavioural disruption thresholds (NOAA, n.d.)

Criterion	Definition	Threshold
Level B	Behavioural disruption for impulsive noise (e.g. impact pile driving)	160 dB re 1 µPa rms
	Behavioural disruption for non-pulse noise (e.g. drilling and vibratory piling, dredging)	120 dB re 1 µPa rms*

* Threshold maybe adjusted where background noise is at or above this level. The measurements undertaken of the existing underwater noise environment (see Section 4.4) have shown that a threshold of 140 dB re 1 µPa rms would be more appropriate.

4.2 Divers

The US Navy (US Federal Register, 2002) states there are no adverse noise effects below 145 dB re 1 µPa rms. At noise levels above 154 dB re 1 µPa rms, effects such as changing heart rates or breathing frequency have been found to occur. Safety guidelines for human divers published in a NATO Undersea Research Centre (NURC) publication[8] recommends experienced divers should avoid areas where noise levels exceed 160 dB re 1 µPa rms (125Hz – 4kHz).

Underwater noise levels from construction works of up to 160 dB re 1 µPa rms would be clearly noticeable above the general ambient underwater noise environment (see Section 4.4 overleaf). However, is considered an acceptable management trigger threshold for divers near the proposed works. It also aligns with the marine mammal behavioural response threshold for impulsive sources (impact piling) in Table 3 above, enabling implementation of a simple one-zone management strategy (refer Section 5.0).

4.3 Recommended Thresholds for Impact Piling Activities

The following performance standards are recommended for the assessment of underwater noise effects from the proposed impact piling activities:

- PTS onset single strike:
  - Low-frequency cetaceans: 219 dB re 1 µPa peak
  - Mid-frequency cetaceans: 230 dB re 1 µPa peak
  - Otariid Pinnipeds: 232 dB re 1 µPa peak
- PTS onset 24 hour cumulative exposure:
  - Low-frequency cetaceans: 183 dB re 1 µPa²/s $SEL_{cum\ (LF)}$
  - Mid-frequency cetaceans: 185 dB re 1 µPa²/s $SEL_{cum\ (MF)}$
  - Otariid Pinnipeds: 203 dB re 1 µPa²/s $SEL_{cum\ (OW)}$
- Behavioral response (marine mammals and divers): 160 dB re 1 µPa rms

[7] Phone discussion with Deanna Clement on 21 July 2016

[8] '*NATO Undersea Research Centre Human Diver and Marine Mammal Risk Mitigation Rules and Procedures*', NURC-SP-2006-008, September 2006

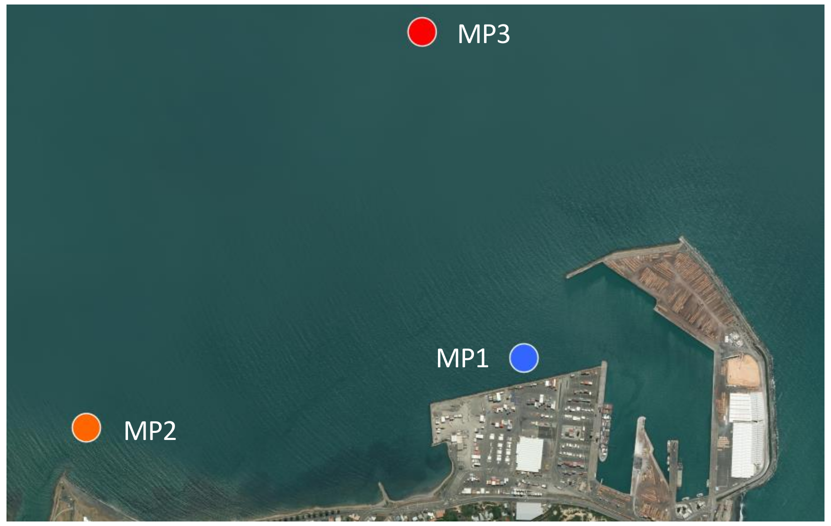
4.4 Existing Underwater Noise Environment

4.4.1 Measurement Methodology

Existing underwater noise levels were measured in three locations as shown on Figure 4, using Ocean Instruments SoundTrap 201 recording hydrophones. The hydrophones were secured to existing weather and wave monitoring stations owned by Port of Napier. A diagram of the measurement setup is included in Appendix D.

The hydrophones recorded underwater noise levels continuously from 7 – 12 July 2016. Meteorological conditions were fine on 7 July, although from 8 July onwards there were a number of periods of high wind and rainfall which continued for the remainder of the survey.

Figure 4: Hydrophone Measurement Locations



4.4.2 Underwater Ambient Noise Measurement Results

A summary of the measured levels is provided in Table 4. Time traces showing the variation in measured level at each measurement position are shown by Figures 5 – 7.

Table 4: Measured Underwater Noise Levels over Survey Period

	Measured Levels (dB re 1µPa)			
	$RMS_{(1\ second)}$		$L_{peak(1\ second)}$	
Position	Average	Range	Average	Range
MP1	117	102 – 163	135	117 – 186
MP2	119	97 – 167	136	113 – 183
MP3	123	99 – 173	138	113 – 181

Figure 5: MP1 – Proposed Wharf Location ($RMS_{(1\ second)}$ dB re 1µPa)

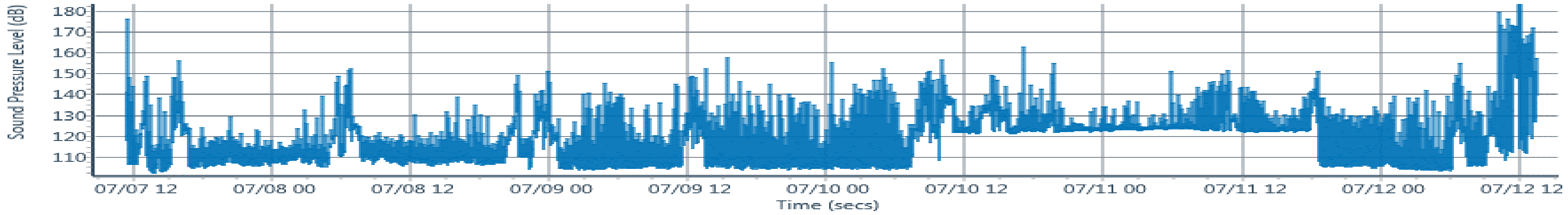


Figure 6: MP2 – West Position ($RMS_{(1\ second)}$ dB re 1µPa)

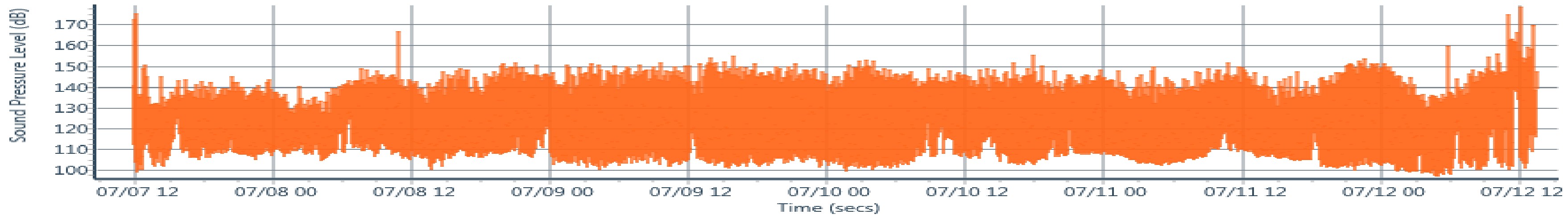
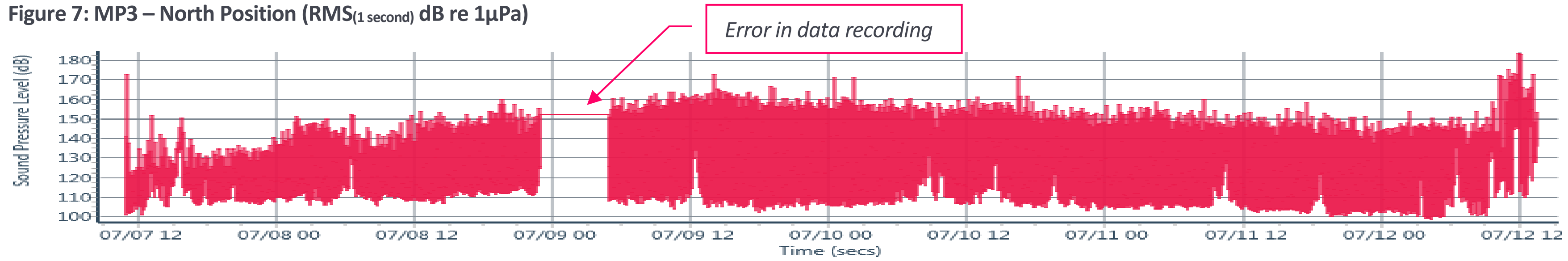


Figure 7: MP3 – North Position ($RMS_{(1\ second)}$ dB re 1µPa)



4.4.3 Discussion of Ambient Measurements

The ambient underwater noise level at all three locations was generally typical of a coastal harbour environment, with wave noise, vessel movements and port activity being the principle noise sources.

The effect of the meteorological conditions can be seen at position MP3 as the upper range of the measured noise level increases from 8 July onwards. A slight increase in upper noise levels at MP2 can also be seen, while the noise level at MP1 remains relatively constant as this position is sheltered by the port infrastructure.

The elevated level at MP1 on 10 and 11 July is likely to be associated with the logging vessel 'Glorious Splendour', which was docked at the port during this time. Analysis of the audio recordings indicated that the noise source was an engine which was running continuously.

The ambient noise levels regularly reached levels of 130 – 140 dB re 1 µPa rms in the absence of man-made noise sources, confirming that the 120 dB re 1 µPa rms Level B limit is too stringent for this acoustic environment (see Section 4.1).

Figure 8 contains a time trace showing the variation in measured level at each position for the arrival of the container vessel 'Xin Chang Sha' on 9 July 2016.

In addition, at MP3 there were a number of periods which were influenced by an intermittent 'squeaking'. It is assumed that this was 'chatter' from Orca as a calf and mother were sighted in the harbour when the hydrophones were retrieved (see Figure 9).

Figure 8: Departure of Container Vessel 'Xin Chang Sha'

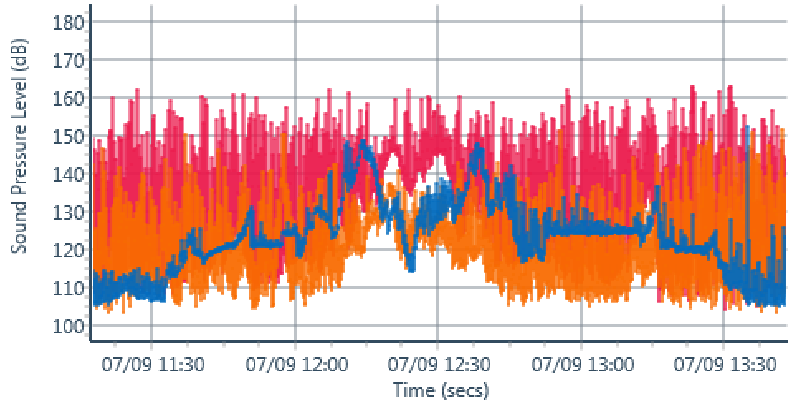
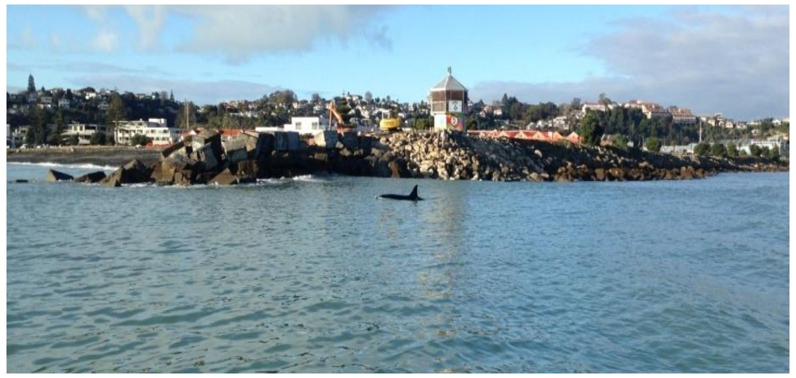


Figure 9: Orca Sighting during Hydrophone Retrieval



4.5 Impact Piling Underwater Noise

Impact piling is predicted to produce the highest levels of underwater noise, generating peak noise levels of between 180 and 250 dB re 1µPa peak at 1m depending on the pile type (e.g. timber pile, concrete pile, steel H pile, sheet pile), size of pile and piling rig, and the piling method and mitigation employed.

Comparable reference measurements[9] for the proposed impact piling of 900mm and 1200mm steel piles are summarised in Table 5. As the species of interest are low-frequency cetaceans, mid-frequency cetaceans and Otariid Pinnipeds, the equivalent weighted SELs have also been calculated (subscripts LF, MF and OW respectively in Table 5).

Table 5: Impact pile driving underwater noise levels from a single strike (dB re 1µPa at 10m)

Measurement Descriptor		Steel Pile Size	
		900mm	1200mm
Linear (no weighting)	Peak	210	213
	RMS	192	193
	SEL	179	183
Marine Weighted	$SEL_{cum\,(LF)}$	178	182
	$SEL_{cum\,(MF)}$	160	164
	$SEL_{cum\,(OW)}$	173	177

4.5.1 Noise Modelling

Modelling of impact piling noise levels has been carried out for both piling sizes. The modelling has been undertaken using dBSea, which is a 3D underwater noise modelling software that enables spatial visualisation for the various zones of influence. The model inputs are summarised as follows:

- Napier harbour bathymetry supplied by Port of Napier and supplemented with data from LINZ
- Source spectrums based on in-water measurements of impact driven steel pile driving between 12.5Hz – 20kHz[10] scaled to the source levels shown in Table 5
- The noise contours were calculated using 15Log distance attenuation approximation for frequencies 2kHz and below and a 'Ray Trace' solver for 2.5kHz and above.

4.5.2 Predicted Piling Noise Levels

Underwater noise levels have been predicted for impact driven steel piles. The predicted zones of influence, provided as distances from the proposed wharf, are presented in Table 6. These zones are based on the criteria provided in the NOAA guidelines (see Section 4.1) and an estimated 290 – 360 impacts per day. A doubling of the number of impacts per day would result in a doubling of the zones of influence and vice versa for a halving of impacts.

Table 6: Impact piling zones of influence (using the underwater noise model)

Description	Species	NOAA Criterion	Zone of Influence for each pile size: 900mm	1200mm
PTS single strike	All species of interest	219 – 230 dB re 1 µPa peak	<10m	<10m
PTS cumulative exposure	Low-Frequency Cetaceans	183 dB re 1 µPa^2/s $SEL_{cum\,(LF)}$	360m	580m
	Mid-Frequency Cetaceans	185 dB re 1 µPa^2/s $SEL_{cum\,(MF)}$	10m	20m
	Otariid Pinniped	203 dB re 1 µPa^2/s $SEL_{cum\,(OW)}$	<10m	10m
Behavioural response	Divers and marine mammals	160 dB re 1 µPa rms	2,000m	2,250m

Figure 10 illustrates the RMS noise contours for the 1200mm impact driven piles (worst case). The behavioral response area for marine mammals and divers is up to 2,250 m (shown as the green contour). With the use of a dolly/cushion block (see Section 5.0), the noise levels are predicted to reduce by 7 – 26 decibels depending on the material used[11]. Assuming 10 decibels mitigation, the zone would reduce to approximalty 560 m (yellow contour).

Path: Z:\Jobs\2014\2014180A\06 Drawings\Out\ARR\Port Napier Wharf 6 R03.mxd

MARSHALL DAY Acoustics

Figure 10 - Predicted RMS Noise Levels (1200mm Steel Piles)
(Behavioural Response in Green)

0 125 250 500 m

Prepared By: BL
Date: 19/04/2017
Time: 5:25:36 p.m.

N

[9] California Department of Transportation: 'Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish' (Nov 2015), Table VI-1

[10] ITAP –Institut für technische und angewandte Physik GmbH: 'Ermittlung der Schalldruck-Spitzenpegel aus Messungen der Unterwassergeräusche von Offshore-WEA und Offshore- Rammarbeiten' (2005)

[11] California Department of Transportation: 'Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish' (Nov 2015), Section 4.4.2.4

4.5.3 Impact Piling Underwater Noise Effects

Impact piling will be significantly louder and of a different character to the existing noise environment in the vicinity of the project.

It is predicted that PTS would not be caused by a single impact, however driving of impact driven steel piles have the potential to result in PTS from cumulative exposure at underwater receiver distances of up to approximately 580m for low-frequency cetaceans such as baleen whales and less than 20m for mid-frequency cetaceans such as dolphins and orca, and pinnipeds such as fur seals. It is noted that the cumulative exposure is based on the species being present in within these distances for a 24 hour period. The PTS cumulative exposure distances would decrease if the species is in the area for a shorter time period.

General measures to mitigate and manage underwater noise effects associated with the impact piling should include the following:

- Where practicable, prioritise equipment and technology that results in low noise levels and has favourable spectral characteristics (e.g. bored piling, vibro piling and then impact piling in order of preference)
- Soft starts (gradually increasing the intensity of impact piling) and minimise duty cycle (operational time vs. down time)
- Implement passive/visual monitoring of the harbour during piling to identify marine mammals surfacing in the area, with low power or shut down protocols in place
- Utilising a non-metallic 'dolly' or 'cushion cap' between the hammer and the driving helmet of the impact piling rig (e.g. plastic or plywood). Where practicable, this mitigation should be used for all impact piling works to significantly reduce airborne and underwater noise levels. Correspondingly, the management zones for underwater noise also significantly reduce.

Overall, the underwater noise effects from piling activities are considered to be reasonable provided that they are managed through a suitable construction noise management plan (refer Section 6.0).

4.6 Dredging Underwater Noise

Underwater noise from trailing suction hopper dredging (TSHD) and backhoe dredging is primarily produced by the engine and propeller cavitation during transit to and from the dredging and disposal areas, as is normal for ships. For TSHD dredging, there is also noise generated at the suction intake and along the suction line into the vessel during dredging. With backhoe dredging, there is noise generated by excavation activities in addition to noise from the vessel, such as the excavator bucket striking the seabed.

According to measurements undertaken for a number of TSHD vessels[12], source levels can range from 172 to 188 dB re 1 µPa rms at 1m. These source levels are similar to the majority of vessels currently travelling to and from the port, and while the TSHD would operate for longer periods of time and also travel to a disposal area which is 1 – 3km from the normal shipping channels, it is considered that the overall level and character would be generally comparable to existing vessel movements.

Measurements of a number of backhoe dredging vessels[13] indicate that source levels can range from 154 – 179 dB re 1 µPa rms at 1m, which is significantly quieter than THSD activities.

The proposed dredging works, including disposal activities, are predicted to be generally similar in noise level and character to normal vessel movements. The potential noise effects are considered to be local, behavioural (as opposed to physical trauma) and comparable in scale to existing shipping activities.

5.0 CONSTRUCTION NOISE MANAGEMENT PLAN

A Construction Noise Management Plan (CNMP) should identify practicable noise mitigation measures and ensure effective communication between contractors and neighbours and minimise adverse noise effects on marine animals and fauna.

Regarding airborne construction noise, the CNMP should include, but not be limited to, the following:

- The performance standards that must, as far as practicable, be complied with
- Predicted noise levels for relevant equipment and/or activities
- Construction noise mitigation strategies to be employed where practicable, for example:
  - Utilising a non-metallic 'dolly' or 'cushion cap' between the hammer and the driving helmet of the impact piling rig (e.g. plastic or plywood).
  - Use an enclosed impact piling driving system that shrouds the point of impact
  - Fitting of silencers on the rig engine
  - Fitting (or upgrading) of engine covers
  - Construction of an effective acoustic barrier, such as a stack of containers placed on the land side of the piling rig
- Noise monitoring requirements, with triggers and feedback mechanisms
- Communication, consultation and complaints response procedures

Specific management measures which can be employed to reduce or manage the effects of underwater noise could include, but not be limited to:

- Do not start piling if a diver or marine mammal is identified within:
  - 2.25 km of the piling rig with no dolly (refer Table 6)
  - 560 m if a plastic or plywood dolly/cushion head is utilised
- Use 'soft starts' (gradually increasing the intensity of impact piling) and minimise duty cycle
- Implement low power or shut down procedures if a diver or marine mammal is identified within:
  - 2.25 km of the piling rig with no dolly (refer Table 6)
  - 560 m if a plastic or plywood dolly/cushion head is utilised
- Stop piling if a diver or marine mammal is identified within:
  - 580 m of the piling rig with no dolly (refer Table 6)
  - 150 m if a plastic or plywood dolly/cushion head is utilised

Furthermore, where a vessel or mechanical plant on a vessel (such as a generator) is identified as being particularly noisy, action should be taken to reduce noise and vibration emissions where practicable. This may involve the fitting of mitigation devices, such as silencers or enclosures. Plant should be maintained to ensure that noise emissions remain as low as practicable, such as balancing and lubricating rotating parts and vibration isolation from the hull where possible.

These recommendations should be included in the CNMP. The CNMP is recommended as a condition of any consent granted.

[12] Marine Aggregate Levy Sustainability Fund: 'Measurement of underwater noise arising from marine aggregate dredging operations' (Feb 2011), Table 2.1

[13] Terra et Aqua, Number 144, September 2016: 'Dredging Sound Levels, Numerical Modelling and EIA'

6.0 CONCLUSIONS

MDA have undertaken an assessment of airborne and underwater noise effects for the proposed construction of a new wharf at the Port of Napier. In summary:

- The airborne noise from the proposed works are considered to be reasonable provided that they are undertaken within appropriate hours of the day, are no louder than necessary and are managed through a suitable construction noise management plan
- Underwater noise from the proposed impact piling activities has the potential to result in physical injury marine mammals within 580 m and behavioural response at receiver distances in the order of 2.25 km
- Underwater noise from dredging and disposal activities is predicted to be comparable to existing shipping activities

MDA considers that the potential adverse noise effects can be mitigated and managed to a reasonable level through a suitable construction noise management plan, including the measures outlined in Section 5.0.

APPENDIX A GLOSSARY OF TERMINOLOGY

dB Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where dB = 20 x log(P/Pr). The convention is a reference pressure of Pr = 20 μPa in air and Pr = 1 μPa underwater.

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 is used in airborne acoustics.

$L_{Aeq\,(t)}$ 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_{Amax} The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.

RMS/rms The RMS (root mean square) is the steady sound level which, over a given period of time, has the same total energy as the actual fluctuating sound level. For the purposes of this assessment, the time period used for calculating the RMS is typically 1 second. However, when considering the RMS of a specific event, the time period is the duration of the event.

L_{peak} The peak instantaneous pressure level recorded during the measurement period (un-weighted).

SEL Sound exposure level (SEL) is the constant sound level acting for a reference period (typically a one second period in air and a 24 hour 'cumulative' period underwater denoted by the addition of subscript 'cum' – see below). 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.

SEL_{cum} Cumulative sound exposure level (SEL_{cum}) is the summation of multiple impulsive or transient signals. SEL_{cum} is calculated by summing the cumulative pressure squared over the time of the event and normalized to one second, and adding 10 x log(number of signals).

TTS Temporary Threshold Shift (TTS) is the temporary loss of hearing as a result of exposure to sound over time. Exposure to high levels of sound over relatively short time periods will cause the same amount of TTS as exposure to lower levels of sound over longer time periods. The duration of TTS varies depending on the nature of the stimulus, but there is generally recovery of full hearing over time.

PTS Permanent Threshold Shift (PTS) is the permanent loss of hearing caused by some kind of acoustic or trauma. PTS results in irreversible damage to the sensory cells of the ear, and thus a permanent loss of hearing

Ambient The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.

NZS 6803:1999 New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*

APPENDIX B NZS 6803:1999

"Residential zones and dwellings in rural areas:

Table 2 – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

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

Industrial or commercial areas:

Table 3 – Recommended upper limits for construction noise received in industrial or commercial areas for all days of the year

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*

Notes in the standards to the tables above:

7.2.5

The night time limits in Table 2 shall apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas. The limits in Table 2 may also be used to protect other specific noise sensitive activities at certain hours of the day.

7.2.6

One major factor which should be considered is whether there is a relatively high background sound level (L_{90}) due to noise from sources other than construction work at the location under investigation. In such cases limits should be based on a determination of the existing level of noise in the area (a "background plus" approach).

7.2.7

Where there is no practicable method of measuring noise outside a building, the upper limits for noise measured inside the building shall be the levels stated in tables 2 and 3 minus 20 dBA. This is considered to be a typical value for the sound reduction normally achieved in New Zealand buildings with doors and windows closed."

APPENDIX C HYDROPHONE DEPLOYMENT ARRANGEMENT