



enviser

Marine Mammal Management Plan

LPC Cruise Berth Project



Lyttelton Port Company
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lpc Lyttelton
Port
Company

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Foreword

This plan has been collated by Enviser Limited with technical input provided by the following:

- Deanna Clement, Marine Mammal Expert, Cawthron Institute
- Matt Pine, Underwater Acoustics and Marine Mammal Monitoring Expert, Styles Group Ltd
- Darran Humpheson, Underwater Acoustics (sound propagation and modelling) Expert, AECOM

We would also like to thank Andrew Baxter (DOC) and Simon Childerhouse (Blue Planet Marine/Cawthron Institute) for their valued input and review of this MMMP.

Abbreviations

CD:	Chart Datum
LPC:	Lyttelton Port Company
MMMP:	Marine Mammal Management Plan (this plan)
MPMP:	Marine Piling Management Plan
TTS:	Temporary Threshold Shift
MMO:	Marine Mammal Observer
MMOZ:	Marine Mammal Observation Zone

1 Introduction

1.1 Purpose of the MMMP

Lyttelton Port Company (LPC) is undertaking construction of a purpose-built cruise berth to facilitate the return of large cruise vessels to Lyttelton. Construction of the wharf requires driving of tubular steel piles, excavation of the shoreline, dredging of the seabed and placement of rock to prevent erosion and scour.

Pile driving for the wharf and mid-slope retaining wall will generate noise underwater, which could result in effects on marine mammals. This Marine Mammal Management Plan (MMMP) has been prepared to outline in detail the appropriate management responses to ensure any identified adverse effects in relation to marine mammals and cruise berth construction activities are reduced to the greatest extent practicable. The project area is within the Banks Peninsula Marine Mammal Sanctuary and includes habitat for the endangered Hector's Dolphin.

The purpose of this plan is to assess the risk of and provide measures to minimise the effects of underwater noise generated by pile driving activities specifically, as all other effects are considered to be negligible (Clement 2018).

1.2 Scope of MMMP

Three species are identified as being present within the Harbour area and potential influence of underwater noise generated by pile driving activities:

- Hector's dolphin / upokohue (*Cephalorhynchus hectori hectori*);
- New Zealand fur seal (*Arctocephalus forsteri*); and
- Southern right whale (*Eubalaena australis*).

This MMMP describes the monitoring and mitigation measures that will be employed during the Cruise Berth works to minimise effects on these species.

1.3 Roles and responsibilities

Table 1.1 summarises LPC's key project staff and contact details for each. The Project Director is ultimately responsible for implementing this MMMP.

It is the responsibility of LPC to ensure that the Contractor understands and can implement the requirements of this MMMP. The Contractor is responsible for training their staff and ensuring that they understand and are able to implement the requirements of the MMMP.

Table 1.1: Summary of key contacts, roles and responsibilities

Name	Role/Responsibility	Organisation	Contact details
Mike Simmers	Project Director	LPC	mike.simmers@lpc.co.nz 021 821590
Derek McFadden	Project Manager	LPC/Genesis Projects	derek@genesisprojects.co.nz 027 22 66 414
Jared Pettersson	Project Environmental Adviser	LPC/Enviser Ltd	jared.pettersson@lpc.co.nz 021 679 838
Scott Vallely	Contractor Project Lead	HEB	scott.vallely@heb.co.nz 027 459 9933
Werner du Plessis	Contractor Site Manager	HEB	werner.duplessis@heb.co.nz 027 2810418
Dr Deanna Clement	Project Marine Mammal Specialist	Cawthron Institute	deanna.clement@cawthron.org.nz
Dr Matt Pine	Project Underwater Noise Specialist (measurement)	Styles Group	matthew@stylesgroup.co.nz
Darran Humpheson	Project Underwater Noise Specialist (modelling)	AECOM	darran.humpheson@aecom.com

To ensure pile driving crew are aware of the risks and controls to be implemented during cruise berth construction, all pile driving crew will attend the Marine Mammal Observation toolbox talk. This will be given by the marine mammal expert (Deanna Clement, Cawthron Institute) and the Project Environmental Adviser. The Contractor will keep records of who attended the training.

Where required, the Project Environmental Adviser will give training to other relevant project personnel (i.e. site supervisors, project engineers, etc) whenever new piling crew

commence work for the project. Reminders and updated information will be provided in toolboxes throughout the project.

2 Environment and project description

2.1 Environment

Lyttelton Port and the cruise berth construction site are located within the boundaries of the Banks Peninsula Marine Mammal Sanctuary (BPMMS). The Sanctuary covers approximately 413,000 hectares and places restrictions on activities within its boundaries for the protection of marine mammals (in particular the endangered Hector's dolphin/upokohue).

More than 25 cetacean (marine mammal) species have been sighted or stranded within the waters of Banks Peninsula. However, only the Hector's dolphin and New Zealand fur seal reside in the Harbour year-round with the southern right whale often sighted offshore of Banks Peninsula.

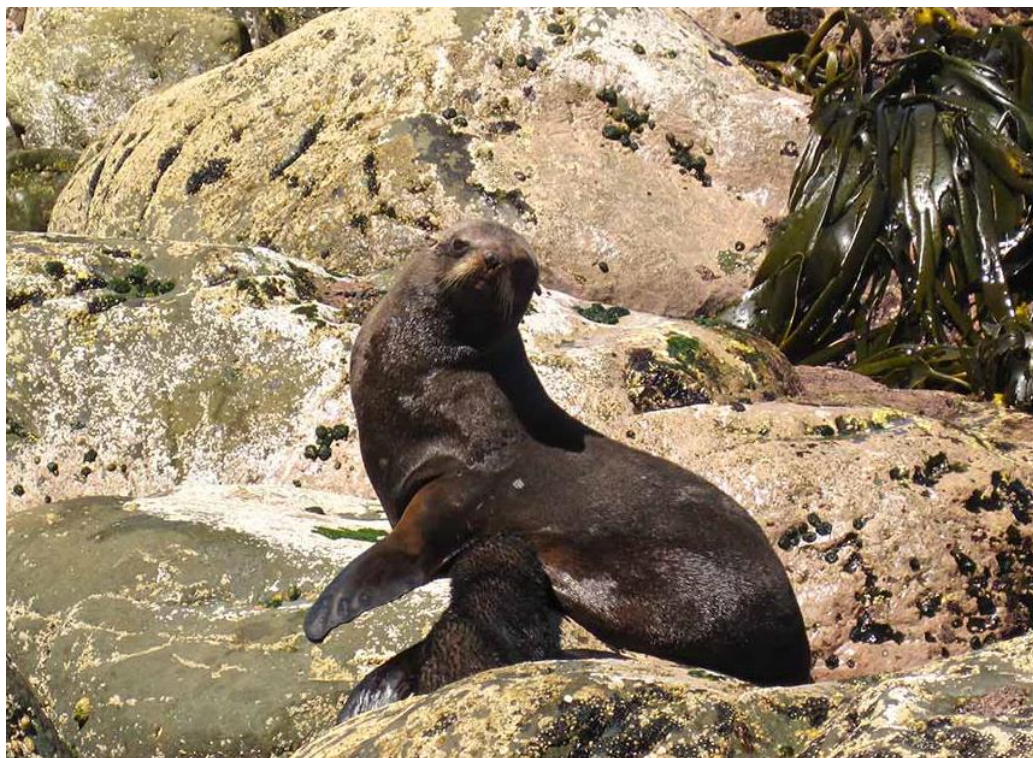
Hector's dolphin/upokohue is endemic to New Zealand waters. Of the estimated 15,000 Hector's dolphins known to occur around the South Island, approximately 2,000–4,000 dolphins are found in the waters of Pegasus Bay year-round. The dolphins generally reside in the bays and harbours of Banks Peninsula in the summer and autumn months and move further offshore in the cooler months.



Photograph 2.1: Hector's Dolphin (WWF New Zealand)

Several New Zealand fur seal breeding colonies are located throughout the more eastern and southern bays of Banks Peninsula (more than 20 km away from Lyttelton Harbour/Whakaraupō and the offshore disposal ground). However, New Zealand fur

seals often cover large distances away from their breeding grounds and thus are commonly seen within Lyttelton Harbour/Whakaraupō, Port Levy/ Koukourarata and Pegasus Bay.



Photograph 2.2: New Zealand fur seal (DOC image¹)

Periodic and occasional sightings of southern right whales occur each year off Banks Peninsula. In particular, in the northern bays and along the Lyttelton Harbour coastline, as whales migrate back to their traditional wintering and calving grounds around New Zealand. At the current sighting rate, at least one or two southern right whales are expected to appear near Lyttelton Harbour / Whakaraupō each winter where they will remain for anywhere from a few days to several weeks (Cawthron, 2018).

¹<http://www.doc.govt.nz/nature/native-animals/marine-mammals/seals/nz-fur-seal/>



Photograph 2.3: Southern Right Whale and calf

2.2 Description of the proposed works

Construction of the Cruise Berth involves three main components, including temporary works to enable access to the site for construction equipment.

2.2.1 Temporary works piling

Prior to starting the piling for wharf construction, a large number of piles need to be driven to make the land stable enough to withstand the weight of the construction equipment. Two phases of piling are required; the first is on land and will provide support for the main piling crane. These crane support piles comprise two parallel rows running along the Eastern Mole. The seaward piles are larger (710mm diameter) and longer (15m) compared to the Inner Harbour side (610mm diameter and 6-10m long). In total, 187 piles are required for the support piles.

The second phase is a 'pinning wall' on the seaward slope of the Eastern Mole, just below the low tide line. This pinning wall is designed to stabilise the Eastern Mole during construction works and will consist of 79 piles, of 810mm diameter and 39m long.

Whilst these piles are considered temporary in terms of the design process, they will not be removed at completion of the works.

2.2.2 On-land bollard piling

The bow and stern lines from the cruise vessels will be affixed to on-land bollard structures, one for the bow and one for the stern. Each bollard structure comprises two parallel rows of 30 piles, 914mm in diameter and 15m long with a concrete capping beam and connecting steel tie rods. In total, approximately 120 piles will be required for the bollard structures.

2.2.3 Main wharf piling

Construction of the main wharf requires driving approximately 65 piles, 900mm in diameter and driven to depths of approximately 60-70m. A concrete deck will be cast in-situ atop the piles.

2.2.4 Piling methodology

Whilst there may be slight differences in the detail of how each phase is installed, the overall piling methodology is the same for all phases. The steps are as follows:

- A pre-fabricated pile gate (to hold and guide the piles) is positioned on site. Small H piles (or tubular piles) may need to be driven (using vibro methods) to hold the pile gate in place.
- A pile is pitched in the pile gate using a specialised excavator.
- The main piling rig uses a vibro-piling method to drive this pile as far as possible.
- The pitching and vibro-piling are continued until the pile gate is full, typically the pile gate will be designed for four piles.
- The piling head is then changed to a hydraulic hammer and all piles are driven to their design depth.
- For the deeper piles (20m+) additional pile sections will need to be welded onto the already driven piles. Once welded, hydraulic hammering of these extended piles will then continue.
- Once the desired pile depth is reached, the gate is removed and the piles are cut to the desired height.
- The equipment then repositions to the next set of piles and the above is repeated.

For the Cruise Berth, only one piling rig will operate at one time on the site and only in daylight hours. Due to the welding, pile pitching and repositioning of the equipment, actual hydraulic hammering will be limited to at most 6 hours/day, but more likely, will occur intermittently over 2-4 hours within a day.

2.2.5 Timeframes

The Cruise Berth is to be completed for the 2020/2021 summer cruise season. The timing and duration of the piling components are set out in the table below:

Piling phase	Start date	Duration
Crane support piles (on land)	Completed (mid October)	Completed
Pinning wall	Late November	2-3 months
Bollard Structure (on land)	April-May 2019	2 months
Main wharf piling	February 2019	10-11 months

2.3 Regulatory requirements

The management of effects on marine mammals is subject to the provisions of the Resource Management Act 1991, New Zealand Coastal Policy Statement and Regional Coastal Environment Plan for the Canterbury Region.

The construction of the Cruise Berth, including the marine piling, is a permitted activity under the Regional Coastal Plan. To confirm this, LPC sought and received certificates of compliance for the construction activities, these are listed below:

CRC184552 To erect a wharf structure in Area B of the Operational Area of Lyttelton Port.

CRC184553 To disturb the seabed.

- CRC184554 To reconstruct an existing seawall within the Operational area of Lyttelton Port.
- CRC184555 To discharge sediment already present in, on or under the seabed into water.
- CRC184556 To discharge dust from unsealed or unconsolidated land.
- CRC184557 To discharge stormwater from a new structure into water.
- CRC184699 To excavate and deposit material.
- CRC184700 To deposit seabed material in, on, or under the foreshore or seabed within the Operational Area of Lyttelton Port.
- CRC184702 To discharge dust from handling of bulk solid materials.
- CRC184703 To discharge dust from outdoor storage of bulk solid materials.

A condition of the permitted activity rule to erect the structure is that marine-based piling be undertaken in accordance with a marine piling management plan (MPMP) and shall cease when marine mammals are within 300m of the pile driving unit and shall only occur in daylight hours. A complying MPMP was submitted with the application for the certificate of compliance.

This MMMP is not a requirement of the certificate of compliance or any consent conditions. LPC recognises the unique position of operating a port in an environment where endangered marine mammals exist and wish to put in place the best practicable mitigation measures. This MMMP sets out those measures and how LPC and the contractor will seek to mitigate effects of the cruise berth construction on marine mammals.

3 Environmental risk assessment

The potential risks to marine mammals associated with the underwater noise generated by pile driving activities has been separately evaluated (Clement 2018). A summary of that evaluation is presented below.

The construction of the cruise berth will involve an increase in mechanical activities that will alter the amount and character of underwater sound in the project area. The underwater noise generated from the different construction activities will vary with the construction stage, piling methods, strike rate and duration, type and size of piles, intermittent versus persistent piling action and the background sound conditions.

Marine mammals use sound for communication, orientation, foraging and predator avoidance. An increase in underwater noise can impact marine mammals, resulting in avoidance of noisy areas, behavioural changes, auditory masking or physical injury.

The unmitigated risk of underwater noise from pile driving operations impacting on marine mammals is assessed as LOW to MODERATE for the following reasons²:

- Pile driving activities within water are not expected to exceed any marine mammal injury threshold criteria (PTS—permanent threshold shift), except within extremely

² Clement D 2018. Cruise Berth Development 2018: Assessment of effects on marine mammals. Prepared for Lyttelton Port of Christchurch. Cawthron Report No. 3251.

close range (i.e. < than 10m); however, *in situ* validation of the actual noise levels is necessary.

- An estimated spatial zone for TTS—temporary threshold shift - to occur will be confined to within 450m of the source, and mainly within nearby Port waters.
- The semi-confined nature of the pile-driving locations means the spatial area for any behavioural responses will be within 1-2 kilometres or mainly mid-Harbour regions; and unlikely to affect most odontocetes or any whales migrating near the entrance or outside of the Harbour.
- Pile driving will be limited to daylight hours only and only one unit will carry out hydraulic impact hammering at any one time; which limits the actual time of hydraulic hammering to at most 6 hours/day but more likely, 2-4 hours/day.
- Recent Hector's dolphin data suggest slightly lower use of mid-Harbour waters compared to Outer Harbour waters within the same season. Animals are present on average 13.7 hours per day over summer in mid-Harbour waters and they occur more often from mid-afternoon to dawn.
- Over winter, Hector's dolphin presence drops to an average of 4.4 hrs a day and they occur more equally throughout the day (i.e. no diurnal patterns)³.
- The greater than two-year duration of the project means that subsequent summer seasons, when dolphins are most prevalent within the Harbour, will be affected.
- Environmental factors, such as soft mud substrates, shallow depths and high sediment load, and seasonal temperature gradients act to dampen underwater noise production, and have been considered in the model estimates; and
- Previous and current exposure to similar types and levels of pile driving noise within Lyttelton Harbour / Whakaraupō has not resulted in any known long-term avoidance behaviours (i.e. these species continue to regularly visit the harbour) or led to any known vessel strikes through acoustic masking.

4 Control measures to minimise noise

Because of the low to moderate risk rating, control measures are required to manage the risks of pile driving activities on marine mammals. These measures are summarised in Table 4.1 and described in more detail in the following sections.

Table 4-1 Control measures

Type of work	Marine mammal risk	Control
Other operation equipment for cruise berth construction (i.e. vessels, rock tipping, dredging)	LOW	Regular maintenance of all pile driving equipment and any associated vessels to reduce noise and vibration, including maintaining and lubricating rotating parts, as required Avoid loose ropes over the side of the vessel and minimise loss of debris from the vessel.

³ Pine (2018) - It is important to note that these data are preliminary, and results are subject to change with more information being gathered over the next few years.

Pile driving within water	LOW to MODERATE	<ul style="list-style-type: none"> Regular maintenance of all pile driving equipment to reduce noise and vibration, including maintaining and lubricating rotating parts as required. <i>In situ</i> noise levels to be measured as soon as practical (see section 4.1.1); if they are found to be different than estimated models, the marine mammal observation zone will be adjusted accordingly. Choose plant/techniques on the basis of minimisation of underwater noise levels (e.g. vibro-driving preferred over impact-driving). Adoption of standard operating procedures for pile driving activities (see section 4.2.1). Appropriately trained marine mammal observer(s) will be continuously on watch for 30-min before, during and for 1-hour after any pile driving activities. Pile driving activities shall cease if a marine mammal comes within a pre-determined marine mammal observation zone (MMOZ) of active pile driving and until the animal has left the zone. Liaise with the Department of Conservation on whale sightings, particularly southern right whales and monitor the Harbour for the presence of other species (see section 6).
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4.1 Underwater noise levels

Several of these measures to control the impacts of underwater noise on marine mammals will be re-evaluated once the *in situ* noise levels of the various pile driving activities are characterised and the model estimates validated. The purpose of characterising the noise is to ascertain the potential for the noise to cause TTS in marine mammals and to refine the proposed measures to reduce this potential effect.

Acoustic monitoring shall be undertaken at the earliest possible date once the pile driving into water has begun to confirm that the actual noise levels associated with activities are as expected (e.g. Cawthron 2018, Humpheson 2018). Using these measurements, the existing spatial acoustic modelling will be validated by the Underwater Noise Specialist. The Marine Mammal Specialist will then recommend any modifications to the proposed control measures, which will be finalised by the Project Manager in consultation with the Contractor and Department of Conservation staff.

4.1.1 Method to characterise noise

In order to characterise the underwater noise, measurements of the underwater noise shall be taken as soon as practicable and during normal operating conditions:

- On each of the different pile diameters used;
- For sufficient time to characterise the noise produced by the piling activity;
- Measured as the one hour cumulative Sound Exposure Level ($SEL_{cum(1h)}$); and

- SEL_{cum(1h)} shall be derived from the maximum combined noise within mid-water depths (not the surficial layer), from the impact driven and vibro-driven piling operations over a one hour period.

The methodology for collecting the underwater noise measurements shall include:

- Measurements taken during good weather conditions (Beaufort scale 0-3) to minimise natural noise sources (waves etc);
- Use of LPC's existing passive acoustic recorders (CPODs) already deployed at various locations in the harbour will remain for at least the duration of this project at the same locations to collect co-incident data on mammal presence. These devices log the number of dolphin click detections, but do not record the signal's waveform (i.e. audible sound files, digitalised as .WAV files). As such, general noise is not recorded;
- Soundtrap HF autonomous recorders will be used to continuously record all sounds from these same fixed locations, using the following method:
 - Installation of the recorders on the existing moorings that house the CPOD devices;
 - Moorings will be selected to capture the noise at various locations in the Harbour and at varying distances from the source;
 - The recorders will be attached to the line in a way which prevents noise contamination from the mooring or the connection to the mooring;
 - Recordings shall be collected for a duration of at least one month during each type of piling, and
- Additional mobile noise measurements will be collected, also using Soundtrap HF recorders. This will be achieved by:
 - Deploying a recorder (s) from a small vessel with a tether to reduce noise contamination from the vessel;
 - Measure sound at multiple locations around the pile driving source (i.e. multiple bearings), multiple distances (log based, i.e. 50m, 100m, 200m, 500m, 1000m) and at two depths for each location; 1-2m and 5m or mid depth in shallow water locations. Noting that harbour geometry, navigation issues and water depth will restrict the placement of instruments;
 - Recordings should be of a duration that allows for at least three, one hour periods of representative piling to be sampled in good weather over the same day, and
 - Noise levels will be measured to compare with the TTS criteria for ground-truthing and development of underwater noise propagation models.

4.2 Potential TTS effects

For the cruise berth construction project, the TTS threshold has been considered the level for which additional mitigation actions are necessary to protect Hector's dolphin hearing within Lyttelton Harbour from pile driving generated noise. The TTS threshold for Hector's dolphin has been defined as the distance at which the one-hour cumulative

Sound Exposure level ($SEL_{cum(1h)}$) occurs, measured as either 146 dB re $1\mu Pa^2s$ or $SEL_{cum(24\text{ hour})}$ of 140 dB re $1\mu Pa^2s$ for high-frequency cetaceans (Humpheson 2018). These two exposure durations reflect that there are two established sets of criterion that have been used to establish the TTS threshold. The one hour exposure duration reflects the short nature of the piling (2-4 hours typical) and is based on specific observations of Harbour porpoises (which are known to have similar hearing characteristics as Hector dolphins), whereas the 24 hour duration is based on literature findings of high frequency cetaceans. The size and extent of the marine mammal observation zone (MMOZ) will be based on the furthest of these TTS exposure thresholds.

4.2.1 Standard operation procedures (SOP)

Standard operation procedures (SOP) that must be undertaken by contractors during piling activities to protect against any TTS effects include **pre-start, soft start, normal operation, stand-by operation, shut-down procedures** and **post-piling observation**. The marine mammal observer (MMO) associated with the pile-driving works will be familiar with the SOP and will document the process. A record is to be kept of all sightings, delayed start-up or enforced shut-downs due to presence of marine mammals. Details of any shut down event should be captured on the sighting form (see Appendix A).

4.2.1.1 Pre-start procedure

Potential marine mammal presence should be visually monitored by the MMO(s) for at least 30 minutes before the commencement of the soft start procedure. Particular focus should be put on the MMOZ, but scanning should take place beyond the zone and up to 1 km radius from the source where visibility allows. Observations should be made from the piling rig or a better vantage point if possible [i.e. in the absence of a high vantage point, a large observation zone may require an additional vessel as sufficient observation platform].

4.2.1.2 Soft start procedure

If marine mammals have not been sighted within or are likely to enter the MMOZ during the pre-start procedure, the soft start procedure may commence in which the piling impact energy is gradually increased over a 10 minute time period. The soft start procedure should also be used after long breaks of more than 30 minutes in piling activity and visual observations have ceased. Visual observations for marine mammals within the MMOZ should be maintained by the MMO(s) throughout soft starts. The soft start procedure may alert marine mammals to the presence of the piling rig and enable animals to move away to distances where injury is unlikely.

In some instances, such as pile testing which requires immediate full energy, soft starts will not be possible. Testing situations will only occur in optimal visibility conditions (i.e. MMO can easily and confidently observe the MMOZ for the required period) when the designated MMO shall ensure that the exclusion zone has been closely monitored for 30 minutes and that no mammals have been present in that period.

4.2.1.3 Normal operation procedure

If marine mammals have not been sighted within or are not likely to enter the MMOZ during the soft start procedure, piling may start at full impact energy. MMO(s) should continuously undertake visual observations during piling activities and shut-down periods. After breaks longer than 30 minutes in piling activity and visual observations or were hampered by poor visibility, the pre-start procedure should be used.

4.2.1.4 Stand-by operations procedure

If a marine mammal is sighted near the observation zone during the soft start or normal operation procedures, the operator of the piling rig should be placed on stand-by ready to shut-down the piling rig. The MMO(s) should continuously monitor the marine mammal in sight.

4.2.1.5 Shut-down procedure

If a marine mammal is sighted within or about to enter the shut-down zone, the piling activity should be stopped immediately. If a shut-down procedure occurred and marine mammals have been observed to move outside the observation zone, or 30 minutes have lapsed since the last marine mammal sighting, then piling activities should recommence using the soft start procedure. If marine mammals are detected in the observation zone and poor visibility sets in, operations should switch to poor visibility procedures.

4.2.1.6 Post-piling observations

The MMO(s) should maintain a watch of the MMOZ (and beyond) for at least one hour after pile driving activity has ceased (or as long as daylight allows). In particular, observers are looking for any indication of marine mammal presence in the wider vicinity to evaluate the duration of effect that piling activities might be having.

4.2.1.7 Poor visibility procedure

Poor visibility is defined as sea fog (on the water surface), winds greater than 20knts and/or rain or sun glare that obstructs more than 50% of MMOZ. If these any of these conditions occurs to an extent that makes it too difficult for the MMO to visually inspect the MMOZ for marine mammals, then piling activities should be postponed until conditions improve. If the MMOZ is prone to strong sea chop or afternoon sea breezes (i.e. wind greater than 20knts), and does not adversely affect piling operations, an additional MMO should be employed at a second observation location to ensure adequate coverage of the MMOZ. If, during periods of poor visibility, there are more than three shut-downs due to marine mammals within the MMOZ, piling activities should be stopped for the remainder of the day.

4.2.2 Marine mammal observers (MMO)

As many of the control measures are triggered by the sighting of a marine mammal, a key part of these measures is having a MMO on continuous watch throughout pile driving operations. All MMOs on the project will, at a minimum, have attended and

passed a DOC approved **MMO** training course in accordance with the code of conduct⁴ developed by the Department of Conservation.

The DOC approved MMO training course comprises two parts, an online component and a 3-4 day practical, these will cover:

- Online component
 - NZ law and requirements of the code
 - The role of observers
 - NZ marine mammals
 - Marine Mammal Acoustics and underwater sound
 - General seismic operations
 - Visual observations
 - Navigation
 - Weather and Environmental conditions
 - Passive acoustic monitoring
 - Vessel health and safety
 - General observer issues
- Practical component
 - MMO equipment
 - Navigation (compass use, bearings etc)
 - Calculating distance (reticule binoculars etc)
 - Plotting marine mammal detections and track logs
 - Marine Mammal identification
 - Detection procedures
 - Completing DOC reporting forms

The above standard course material will be supplemented with a piling specific module, developed for Lyttelton's special characteristics and the cruise berth project.

The observer(s) has two general duties;

1. to detect, record and report the presence of marine mammal within the wider operations area, and
2. to enforce noise control measures, including documenting any action taken (if necessary).

Marine mammal sightings will be logged and reported according to the schedule in section 5.2.

Through its normal inspection and validation procedures, LPC will undertake periodic audits of the MMO performance, qualifications and effectiveness. The LPC personnel undertaking the audit(s) will also have attended and passed a DOC approved **MMO** training course in accordance with the code of conduct⁴ developed by the Department of Conservation.

⁴ Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations



Photograph 4.1: Marine mammal observation

4.2.3 Visiting cetaceans

To minimise the risk of any visiting species (e.g. visiting southern right whale or orca) swimming into inner Harbour regions and becoming confused and 'trapped' by pile-driving noise, a central contact point will be established with DOC (and other project staff) to obtain up-to-date regional sighting information for the duration of the project (see section 6). With this information, the MMO can anticipate and verify the potential presence or absence of any other marine mammals sighted in or near the project area.

Specifically, if a southern right whale, orca, or humpback whale is sighted within Lyttelton Harbour/Whakaraupō west of a line between Godley Head and Adderley Head, LPC will investigate, and if their presence is confirmed, pile driving will cease and be suspended until the animal(s) has relocated east of a line between the western headland of Breeze Bay and the eastern headland of Camp Bay (Appendix A).

4.2.4 Additional control measures

Other, more theoretical, mitigation options could be considered and tested during the cruise berth construction period, given that LPC has several future development projects that will also involve extensive pile driving. To evaluate the effectiveness of potential noise reduction options, and alternative observation methods the following controls/methods shall, if possible, also be evaluated:

- Piling modification mitigation options including pile stroke (e.g. change in contact time of the hammer) and contact dampening (e.g. wood, plastic or nylon dolly/cushion block);
- Any other sound isolation or dampening techniques considered practical or warranted by LPC;
- Use of autonomous unmanned aerial vehicles to provide imaging (colour and infra red) of the MMOZ, including investigation of automated warning systems

The results will be reviewed to determine the distance that TTS effects could occur, effectiveness of alternative observation methods and effectiveness of any contingency measures considered to reduce any effects. Actual implemented controls will be dependent on the underwater noise levels recorded and efficacy of the controls/methods.

5 Monitoring and reporting

Monitoring and reporting measures will allow the LPC Project Manager and Contractor to adjust mitigation where necessary to manage any risk of impacts on marine mammals. Monitoring and reporting requirements are set out in the following sections.

5.1 Monitoring

The monitoring of marine mammals focuses on monitoring any behaviour responses of marine mammals to piling operations using visual observations by the MMO(s) on the piling platform (and/ or any alternative observation platform) and passive acoustic detections of Hector's dolphin presence around the Harbour. Combining this monitoring data will determine marine mammal (primarily Hector's dolphin) behavioural responses to the various pile driving activities and noise levels and enable mitigation to be improved, for example more effective sized MMOZ or better observation techniques.

5.1.1 Visual monitoring

Before, during and after pile driving operations, the MMO(s) must visually monitor the area around the pre-determined marine mammal observation zone from the piling activity as well as scanning the wider area of the Harbour.

Each observer will have electronic or hard-copies of the Marine Mammal Sighting forms (Appendix A) with them at all times. When a marine mammal is sighted this will be reported on the sighting form sheets.

- What species of marine mammal is sighted?
- Date and time the marine mammal is sighted?
- At what stage of piling operations is the marine mammal sighted (e.g. pre-start, soft start, normal operation, stand-by operation, shut-down or post operations)?
- At what approximate distance is the marine mammal visible?
- Heading and distance from the vessel.
- Direction in which the animal is travelling.
- If the marine mammal is present while the pile driving operation changes, what is its reaction (eg does it immediately leave, does it leave and return, does it stay)?
- Short description of the animal(s) and their behaviour.
- Mitigation action taken, if any.
- Observer name and position.
- Photographs and video footage are recommended.
- Local weather conditions and sea state.

5.1.2 Underwater acoustic monitoring

Passive underwater acoustic monitoring within the proposal area will occur before, during and after the construction of the cruise berth. Four CPODs (passive acoustic monitoring devices) are installed to gather seasonal data on Hector's dolphin presence and frequency within the Harbour and near pile driving areas, as well as outside the Harbour (e.g. control sites). These devices have gathered over one year of baseline data

prior to any of the cruise berth construction commencing. These CPODs will remain for the duration of the project and for as long as practical after the project has been completed.

The resulting data from the CPODs, moored Soundtraps and temporary devices (discussed in section 4.1.1) will be used (in conjunction with the visual monitoring data) to verify the predicted visitation/presence of marine mammals to determine use of the project area by marine mammals during active piling operations and to determine the continued presence, or return, of marine mammals in the project area following the completion of pile driving activities.

5.2 Reporting

The following table sets out the reporting frequency.

Table 5-1 Written Report requirements

Information	Timeframe
Marine mammal observer watch and sighting forms must be provided to the LPC Project Manager	Weekly
Providing marine mammal observation sheets and any monitoring data to DOC	Quarterly
Noise verification data collated and reported to LPC Project Manager and DOC	Provide relevant reports to DOC within two weeks of providing to Environment Canterbury
Meetings between LPC Project Manager and DOC staff to discuss monitoring results	Every three months during works and on completion of behavioural and noise monitoring report
All data Cruise Berth Stage Completion Report	Within one year of completing the project

6 Department of Conservation liaison procedures

A two-way liaison with the Department of Conservation shall be established for exchange of marine mammal (southern right whale, humpback whale and orca) sighting data throughout the project.

The Department of Conservation shall be contacted weekly over the project period to obtain real-time/recent sighting information. Information will be shared with the MMO(s). This will allow project managers to anticipate and mitigate potential interactions with any whale species sighted in and near the project area.

In addition, LPC shall collate and, on a quarterly basis, share any observer sighting data with DOC.

Contact persons and contact details:

Contact person (DOC): Rachel Brown 0275417691 rabrown@doc.govt.nz

Contact person (LPC): Jared Pettersson 021 679 838 jared.pettersson@lpc.co.nz

7 Updating the MMMP

To maintain relevance, this Plan must be reviewed at the following times and amended where necessary:

- Upon completion of the pile driving noise monitoring and spatial acoustic modelling;
- Following collation and reporting of the behavioural and noise monitoring data and before any subsequent seasonal piling stage, particularly the second summer season;
- Following any marine mammal entanglement incident or near incident;
- At the completion of each piling stage;
- If the size or length of the pile changes or the piling method during the project; and
- Any new dolphin sighting or information data as it becomes available.

8 References

Clement D 2018. Cruise berth development 2018: Assessment of effects on marine mammals. Prepared for Lyttelton Port Company Ltd. Cawthron Report No.3251. 29 p. plus appendix.

Humpheson D. 2018. Cruise Berth : Underwater sound levels. Prepared for Lyttelton Port Company Ltd. Report No. 60554229. P. 24.

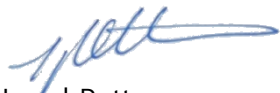
Pine MK 2018. Acoustic monitoring of Hector's dolphins within Lyttelton Harbour: third quarterly report. Draft report prepared for Lyttelton Port Company Ltd. by Styles Group – Acoustic & Vibration Consultants. 32 p.

9 Applicability

Enviser Ltd has prepared this report for Lyttelton Port Company and contractors delivering the Cruise Berth Project in accordance with the agreed scope. No other party may rely on this report, or any conclusions or opinions within it, for any purpose without the express written permission of Enviser Ltd.

The opinions and conclusions within this report are based on the information that was viewed during preparation of the report.

Prepared for Enviser Ltd by:



Jared Pettersson
Director
CPEng, CMEngNZ, IntPE

Reviewed for Enviser Ltd by:



Director

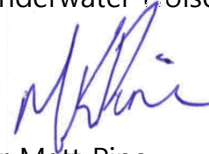
Marine Mammal Expert



Dr Deanna Clement
Marine Mammal Ecologist
Cawthron Institute



Underwater Noise Specialist



Dr Matt Pine
Marine Acoustician
Styles Group Limited



Noise modelling specialist



Darran Humpheson
AECOM
BSc(Hons), MSc, MIOA, MASNZ



Appendix A: Reporting Forms

MARINE MAMMAL SIGHTINGS FORM				
Date	Pile driver type/name	Pile number	Time at start of encounter	Time at end of encounter
Observer name		Location / position on land		Water depth (metres), Beaufort, glare:
Species		Bearing/angle to animal (when first sighted)	Distance to animal (when first sighted)	
Description (include features: size, colour and pattern, shape and position of dorsal fin, direction and shape of blow)		Total number	Number of adults	
		Number of juveniles	Number of calves	
Behaviour (at start of sighting and any changes observed relative to changes in pile driving activity) (Feeding, resting, travelling, socialising, breaching, bow riding etc – see reference sheets)			Photograph taken <div style="display: flex; justify-content: space-around;"> Y N </div>	
			Direction of travel (compass) <div style="display: flex; justify-content: space-around;"> <div> N NE E SE variable </div> <div> S SW W NW stationary </div> </div>	
Direction of travel (relative to platform) Towards Away Parallel (east or west direction) Variable Stationary Other (explain)		Piling activity at first animal detection Normal Soft start Pre-start Post-observation Stand-by Shut-down	Piling activity at last animal detection Normal Soft start Pre-start Post-observation Stand-by Shut-down	
Time animals entered mitigation/exclusion zone	Action taken None required Delayed start Stand-by Shut down		Time animals left mitigation/exclusion zone	
	Length of time mitigation employed			

MARINE MAMMAL OBSERVER WATCH

Observer name and location:

Observer watch start/end times:

Piling start/end times.....

START A NEW LINE FOR EACH NEW START-UP OF PILE DRIVER.

RECORD FOR ALL WATCHES EVEN IF NO MARINE MAMMALS ARE SEEN

[illegible]

Appendix B: Whale and Orca Line

