Stornoway Deep Water Port – Marine Mammal and Basking Shark Risk Assessment

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Contents

1 Introduction 4
1.1 Background 4
1.2 Scope of Work 5
1.3 Construction Area 5
1.4 Schedule of Works 6
2 Description of Proposed Construction Works 6
2.1 Impact and Vibro-Piling 6
2.2 Odex Piling 7
2.3 Dredging 7
3 Marine Mammal Baseline 7
3.1 Cetaceans 7
3.1.1 Regularly Occurring Cetaceans 7
3.1.2 Other Cetaceans 10
4 Risk Assessment 11
4.1 Hearing Thresholds of Marine Mammals 12
4.2 Auditory Injury Criteria for Marine Mammals 12
4.3 Underwater Construction Noise 14
4.3.1 Impact and Vibro-Piling Underwater Noise Source Levels 14
4.3.2 Odex Piling Source Levels 16
4.3.3 Dredging Source Levels 16
4.4 Risk of Acoustic Injury 17
4.4.1 Impact Piling 17
4.4.2 Odex Piling 19
4.4.3 Dredging 19
4.5 Risk of Acoustic Disturbance 20
4.5.1 Impact Piling 20
4.5.2 Odex Piling 20
4.5.3 Dredging 20
4.6 Risk of Physical Injury 21
5 Consideration of Alternatives 21
5.1 Project Need 21
5.1.1 Cruise Tourism 21
5.1.2 Renewables Industry 21
5.1.3 Commercial Freight 22

5.1.4 Oil and Gas Decommissioning 22
5.1.5 Other Sectors 22
5.2 Location 22
5.3 Design Evolution 22
6 Proposed Mitigation 23
6.1 Piling 23
6.1.1 Marine Mammal Monitoring Protocols 25
6.2 Dredge Disposal 28
6.2.1 Visual Monitoring Protocols 28
6.2.2 Acoustic Monitoring Protocols 29
7 Conclusion 30
8 References 32
9 Glossary 34

1 Introduction

1.1 Background

This Marine Mammal and Basking Shark Risk Assessment has been produced on behalf of the Stornoway Port Authority (SPA) to support the European Protected Species (EPS) Licence and Licence to Disturb Basking Shark application(s) for the proposed Stornoway Deep Water Port (DWP) development.

The SPA is proposing the construction of a new DWP to facilitate sustainable economic growth, by serving several diverse sectors in the Outer Hebrides and the Western Isles. The four main sectors that the DWP intends to support are the Renewables Industry, the Cruise Tourism Industry, Commercial Freight, and Oil and Gas Decommissioning. The main components of the development include the construction of a 306m long Main Quay, a heavy load area covering an area of 105m^2, a 100m long and 4m wide heavy-duty pontoon, a 200m long freight ferry berth and up to 500,000m^3 of seabed material to be removed through dredging to achieve a water depth of up to 10m around the main quay.

The waters within the vicinity of the development are important to several species of marine mammal, including both cetacean and pinniped species, and basking shark (*Cetorhinus maximus*). These waters also include designated sites for marine mammal species, including the Inner Hebrides and The Minches Special Area of Conservation (SAC) for harbour porpoise and the Northeast Lewis Nature Conservation (NC) Marine Protected Area (MPA) for Risso's dolphins.

All UK cetacean species are listed under Annex IV of the European Habitats Directive and are therefore included in Schedule 2 of the Habitats Regulations 1994 as European Protected Species. Under regulation 39(1) of the Habitats Regulations 1994, it is an offence to deliberately or recklessly kill, injure, harass, or disturb an EPS.

Pinnipeds are not listed as Annex IV EPS species under the Habitats Directive, however both common and grey seals are included in Annex II, meaning that their core habitat must be protected under the Natura 2000 Network and managed in accordance with their ecological requirements. Under the Marine (Scotland) Act 2010, it is an offence to kill, injure or take a seal, as well as to deliberately or recklessly harass a seal at a significant haul out site. Pinnipeds were considered within the Stornoway DWP Environmental Impact Assessment (EIA). The mitigation identified in this document therefore applies to pinniped. However, pinnipeds are not exclusively discussed in this Marine Mammal and Basking Shark Risk Assessment, as they are not subject to an EPS Licence for works which may disturb them.

Marine mammals and basking shark are sensitive to anthropogenic underwater noise, and as such, construction activities which give rise to underwater noise associated with the development require an EPS Licence and a Licence to disturb Basking Shark. In addition, activities which could cause physical disturbance or harm to marine mammals and basking shark also require an licensing. The purpose of this Risk Assessment is to understand the potential risks of acoustic injury or disturbance to marine mammals, particularly cetaceans, and basking shark and to identify appropriate mitigation with regard to the activities which may cause injury or disturbance to marine mammals and basking shark during the Stornoway DWP development.

This Risk Assessment will seek to lay out the relevant information which concerns the following:

- The baseline information on marine mammals and basking shark in and/or around the area of development;
- The activities taking place which are most likely to cause injury and/or disturbance without mitigation;
- The likelihood of risk and potential impacts;
- The effects on the protected species of concern without mitigation; and
- The mitigation and management strategies implemented to minimise disturbance and/or prevent harm.

An Environmental Impact Assessment Report (EIAR) (Affric, 2020) has been completed for the Stornoway DWP development, and the following sections of the EIAR are relevant to the EPS licence application:

- Volume 2: EIAR
    - Chapter 2: Project Description;
    - Chapter 7: Marine Mammals;
    - Chapter 8: fish Ecology;
    - Chapter 11: Underwater Noise; and
    - Chapter 17: Schedule of Mitigation.
- Volume 3: Appendices
    - Appendix F.1: Habitat Regulations Appraisal (HRA) Report; and
    - Appendix K.1: Underwater Noise Modelling Report.

1.2 Scope of Work

The Stornoway DWP project will include multiple construction techniques to facilitate the development. However, only those which give rise to underwater noise and have the potential to cause physical disturbance and/or harm/injury will be discussed for the purpose of this Risk Assessment. These include:

- Pile Driving;
- Vibro-piling;
- Odex Piling – which is a pneumatic impact drilling technique; and
- Backhoe and/or Cutter-Suction Dredging.

1.3 Construction Area

The proposed location for the Stornoway DWP is located on the western coastline of Cala Ghlumaig (Glumaig Harbour), on the Isle of Lewis. The DWP has a central grid reference point of NB 42333 31164. Stornoway is the main township on the Isle of Lewis and the current ferry services that run from Stornoway to the west coast of the Scottish mainland provide the shortest possible route. The DWP is located south west across Glumaig Harbour from Stornoway town centre and is a 10 – 15-minute car journey by road. Stornoway falls within the administrative area of the Comhairle nan Eilean Siar (CnES).

The combined marine construction and dredge area is bounded by Mean High Water Springs (MHWS) and the coordinates outlined in Table 1.1. As shown on Drawing SDWP-WS2139-XX-

00-DR-C-9017. The Stornoway dredge disposal site reference HE035, located to the east of Arnish point shall be utilised for the disposal of unsuitable dredge material.

Table 1.1: Boundary of DWP Offshore Construction Works

Point Number	Lat /Long	
	'N	'W
1	58°11.818	006°23.388
2	58°11.845	006°23.099
3	58°11.715	006°23.102
4	58°11.930	006°22.499
5	58°11.715	006°22.433
6	58°11.537	006°22.654
7	58°11.533	006°22.850
9	58°11.348	006°22.912

1.4 Schedule of Works

The current programme is scheduled with works commencing in March 2022. Piling works are expected to commence 2 months into the construction programme and are estimated to be undertaken over a period of ~ 13 months, although piling works will not be continuous during this timeframe.

Dredging works will commence once the land reclamation piling and revetment are in place and will last 4 to 6 months.

It is part of the Marine Licence Conditions (Licence Number: MS-00008749) that the Licensee must complete and submit a new proposed activity form on the Joint Nature Conservation Committee (JNCC) Marine Noise Registry (MNR). This needs to be undertaken for piling activities no later than seven days prior to commencement of the Licensed Activity.

For dredging activities (Licence Number: MS-00008748), the Licensee must submit full details of the vessels to be utilised to deposit substances or objects to the Licensing Authority no later than one month, or at such a time as agreed with the Licensing Authority, prior to the commencement of the Licensed Activity.

2 Description of Proposed Construction Works

As aforementioned, only construction activities which give rise to underwater noise and/or risk of physical disturbance or harm/injury will be discussed for the purpose of this Risk Assessment. As such, Sections 2.1 – 2.3 provide more detailed information on the proposed pile driving, vibro-piling, odex piling and dredge-disposal activities.

2.1 Impact and Vibro-Piling

Piling will be utilised for the Main Quay, the Freight Ferry Berth and other components of the SDWP development. The proposals are to utilise steel tube 123cm diameter king piles at 3 metre intervals for the main berth at the Main Quay (192m long) and also at the Freight Ferry Berth (140m long). Approximately 80cm diameter steel tube piles will be used for other components of the DWP development, including at the linkspan dolphins and finger pier (114m long). In addition, 30cm diameter steel tube piles will be used at close centres in the Heavy Load Area.

Although pile sizes will vary, piles will be vibrated (vibro-piling) in as far as possible prior to being impact piled.

2.2 Odex Piling

As aforementioned, odex piling is a pneumatic impact drilling method and is suitable for softer sediments as it allows for simultaneous lining and drilling. Given that ground investigations have provided an understanding of the seabed, it is known that Odex Piling will not be required for the majority of piles. However, it may be required for the king piles in the 140m long combination wall for the construction of the Freight Ferry Berth, where there are softer sediments.

2.3 Dredging

Dredging will be carried out on a 24-hour basis, to minimise the duration of the dredge. Dredging techniques will primarily involve the use of a trailer suction dredger, due to the large volumes of material to be moved and their ability to transit from the area being dredged to the land reclamation area, and pump out the material to infill the land reclamation area directly. Unsuitable material would be discharged via the bottom doors in the disposal ground. Where pockets of dredge material are still required to be removed, a barge mounted backhoe dredger, or a land based long reach excavator would be used to place material directly into the infill area or to fill barges which would be unloaded into the infill area or sent to the disposal ground – Stornoway (HE035).

3 Marine Mammal Baseline

3.1 Cetaceans

3.1.1 Regularly Occurring Cetaceans

3.1.1.1 Harbour Porpoise (*Phocoena phocoena*)

The harbour porpoise is distributed throughout temperate and subarctic waters of the North Pacific and North Atlantic oceans and is the most abundant cetacean to occur in north west European shelf waters (Evans *et al.*, 2003). They are the UK's smallest, and most abundant cetacean, with highest densities occurring along the North Sea coast, around the Northern Isles and the Outer Hebrides (Hammond *et al.*, 2003; Reid *et al.*, 2003). As such they are expected to be one of the most frequently encountered cetaceans during the construction of the proposed development. The harbour porpoises occurring within the vicinity of the development are likely to be members of the West Scotland management unit, which is estimated to be composed of 21,462 individuals (IAMMWG, 2015).

The harbour porpoise is found within Scottish waters throughout the year (Evans *et al.*, 2003), although there is limited information on their seasonal movements (Reid *et al.*, 2003). Numerous studies have been conducted to model harbour porpoise distributions within Scottish waters however (SNH, 2016). These studies utilised visual and acoustic harbour porpoise observation data, combined with environmental variables. The studies concluded that the waters of the Minch, together with the sea of Hebrides, provide valuable habitat to harbour porpoises, and consistently support some of highest densities of this species within the UK (SNH, 2016).

The Inner Hebrides & the Minches SAC is designated for the conservation of harbour porpoise under the European Habitats Directive. The area is of key importance to the UK as part of the harbour porpoise management unit. The Inner Hebrides & the Minches SAC is estimated to support approximately 5,438 individuals for at least part of the year, equating to approximately 32% of the management unit (SNH, 2016). It is suggested that these areas, relative to the rest of the continental shelf, include the best habitat for harbour porpoises, and have been used consistently by the species over the last two decades (SNH, 2016).

3.1.1.2 White-Beaked Dolphin (*Lagenorhynchus albirostris*)

The UK is in the Southern extent of the range of white beaked dolphins, and as such the UK distribution is centred in the north. Scottish shelf waters are considered to be the main stronghold of this species in Europe, particularly in the Minch, to the north of the Outer Hebrides, the outer Moray Firth, and off the coast of Aberdeenshire (Northridge *et al.*, 1995; Reid *et al.*, 2003). The species typically inhabits deeper coastal waters that can hold a depth of around 200m (Reid *et al.*, 2003).

White-beaked dolphins from British and Irish waters are considered a single population of 15,895 individuals (IAMMWG, 2015). The high densities of this species reported in the Minches make it likely that this species will be present within the vicinity of the development. Sightings of white-beaked dolphin in the UK peak between June and October, although they are present year-round (Reid *et al.*, 2003).

3.1.1.3 Risso's Dolphin (*Grampus griseus*)

Risso's dolphins have been identified in many parts of the UK including parts of the North Sea, the western shores of Scotland, the Outer Hebrides, the Irish and Celtic seas and around Bardsey Island, Wales. Risso's dolphins however, despite their widespread distribution throughout UK waters, are considered as a single population due to the lack of population estimates (IAMMWG, 2015). Although the species is comparatively uncommon when considering sightings of other species, there is some evidence of changes in the seasonal distribution of this species. Risso's dolphin accounts demonstrate the highest sighting rates in the Minch being recorded between May and September. Conversely, detection rates in offshore waters near the continental shelf break were more frequent during the winter months of October to May (Reid *et al.*, 2003).

The North East Lewis NC MPA is designated for the protection of Risso's dolphins. The area is highlighted as a key area of importance to the UK as it is one of the two only places in the UK where high numbers of Risso's dolphins are recorded and thought to be resident, the other being Bardsey Island, Wales. Risso's dolphins normally favour deeper offshore waters where the continental shelf slopes off quickly, but around the Isle of Lewis they gather close to shore in water depths ranging from 20 - 200m. Sightings of Risso's dolphins have been most prominent on the eastern and northern coasts of the Isle of Lewis, with the Eye Peninsula and Butt of Lewis acting as 'hotspots' (Scottish Government, SNH, & Conservation, 2014; Weir *et al.*, 2019). It is suggested that the area is an important site for feeding, particularly during summer months, due to the presence of Risso's dolphins all year-round around the Isle of Lewis, and the continued re-sighting of particular individuals (Weir *et al.*, 2019).

Dedicated research efforts by Whale and Dolphin Conservation between 2010 and 2017 focussing on the North East Lewis NC MPA area produced relative abundance values of 0.554 to 6.647 individuals per km^2 (Weir *et al.*, 2019) with the southern coastline of the Eye Peninsula

achieving the greatest relative abundance. As of 2017, a total of 113 individual Risso's dolphins have been identified in the North East Lewis NC MPA (Weir *et al.*, 2019). A study during the late 1990's however identified 142 individuals (Atkinson, Gill, & Evans, 1999), although the identification of more individuals may be attributed to greater samples of photographs taken over a longer duration of time, which does nothing to suggest there has been a decline in the number of individuals present here.

3.1.1.4 Minke Whale (*Balaenoptera acutorostrata*)

The minke whale is the most common baleen species recorded in British shelf waters, including in the north-eastern Atlantic, where high densities are present off the west coast of Scotland, particularly in the Minch (Hammond & Jones, 2008; Reid *et al.*, 2003) They feed mainly in deep coastal waters (<200m deep) over the continental shelf, rather than out in the open ocean. They regularly appear around sandbanks or where upwellings bring nutrients and fish near the surface, or in the strong currents around headlands and small islands (Reid *et al.*, 2003).

Minke whales throughout British and Irish waters are considered a single population of 23,528 individuals, although this is an underestimate (IAMMWG, 2015). Densities of minke whale are found to be greatest in Scottish seas during the summer months, between May to September, although there is evidence to suggest that some individuals remain in Scottish waters all year round (Macleod *et al.*, 2004).

The Sea of The Hebrides MPA is proposed to be designated for the protection of minke whales. The MPA proposal covers the Sea of the Hebrides between the east coast of the Outer Hebrides and the west coasts of Skye, Mull and the Ardnamurchan Peninsula, incorporating waters around the islands of Rum, Eigg, Muck, Coll and Tiree (SNH, 2014). Minke whale have been recorded most frequently in the north-west boundary of the Sea of The Hebrides MPA and along the coast of the Outer Hebrides, with greatest densities on the east coast of South Uist (SNH, 2014).

3.1.1.5 Killer Whale (*Orcinus orca*)

Killer whales occur frequently in the deep North Atlantic, and in coastal waters of north-west Europe. In UK waters, the highest densities of killer whales are recorded off north-eastern Scotland and the Shetland coast, although regular sightings are also noted off north west Scotland (Reid *et al.*, 2003). Killer whales are present all year-round throughout Scottish waters, although they are primarily recorded in coastal waters during the summer months (Evans *et al.*, 2010).

The majority of killer whale sightings in Scottish waters are transient visitors from pods based in Iceland, the Faroe Islands, and Norway (Evans *et al.*, 2010). However, there is a small resident pod of killer whales that are based on the west coast of Scotland, known as the 'West Coast Community'. The West Coast Community is a pod of 8 animals, and is considered to be declining, as no calves have ever been recorded within the pod (Hebridean Whale and Dolphin Trust, 2018). These resident animals are most frequency sighted in the Sea of the Hebrides, to the south of the development area, however they are known to forage in the Minch (Hebridean Whale and Dolphin Trust, 2018).

3.1.2 Other Cetaceans

3.1.2.1 Bottlenose Dolphin (*Tursiops truncatus*)

Bottlenose dolphins are distributed throughout the UK shelf waters, primarily close to shore. Two of the largest aggregations of bottlenose dolphins are found in the Moray Firth, in North east Scotland, as well as in Cardigan Bay, Wales (Reid *et al.*, 2003), both of which are designated as SACs.

In total, there are six management units for bottlenose dolphins in UK waters, and as bottlenose dolphins are most commonly recorded within the 20m depth contours, they have a predominantly coastal distribution (IAMMWG, 2015). Individuals occurring within the vicinity of the development, due to its position on the Isle of Lewis are most likely to belong to Coastal West Scotland and Hebrides (CWSH) management unit, which is estimated to include 45 individuals (Cheney *et al.*, 2018). Bottlenose dolphins in the CWSH management unit have been shown to move throughout the west coast of Scotland (Cheney, *et al.*, 2018), where they are most frequently sighted off the north-east coast of Lewis (Reid *et al.*, 2003).

3.1.2.2 Short-Beaked Common Dolphin (*Delphinus delphis*)

Common dolphins are one of the most abundant cetacean species, and is the most numerous offshore cetaceans in the north-east Atlantic (Reid *et al.*, 2003). Common dolphins from British and Irish waters are considered a single population of 56,556 individuals (IAMMWG, 2015). However, the Outer Hebrides is towards the northern extent of the species' range, which, combined with the coastal nature of the Minch means that this offshore species is not present in high numbers (Reid *et al.*, 2003). There have been few sightings in the vicinity of the development site (Marine Scotland, 2020; Reid *et al.*, 2003). Many sightings on the west coast of Scotland are to the north or south of the development; at the continental shelf break, or in the Sea of the Hebrides respectively (Marine Scotland Science, 2020).

3.1.2.3 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

Atlantic white-sided dolphins are predominantly an offshore, deep-water species, and are most frequently encountered at the continental shelf break, in areas of steep seabed relief, to the north-west of the Outer Hebrides (Reid *et al.*, 2003). Atlantic white-sided dolphins from British and Irish waters are considered a single population of 46,249 individuals (IAMMWG, 2015). Little is known about the temporal movements of this species, although they are occasionally recorded in shallower continental shelf waters, including the Minch (Reid et al, 2003).

3.1.2.4 Humpback Whales (Megaptera novaeangliae)

Humpback whales are a large, baleen whale, inhabiting both shallow and deep waters and capable of diving to depths of over 600m (Derville *et al.*, 2020). They are a migratory species, migrating from feeding grounds in the Northeast Atlantic and Barents Sea to breeding grounds in the Caribbean, Cape Verde and the Azores. From data collected over the recent years, the Minch has been noted as a hot spot with a number of sightings concentrated in this area during late autumn and winter, and in early to mid-summer, coinciding with migration. Sightings of humpback whales in Scotland have increased along with population numbers of humpback whales globally, however, it has not been concluded whether humpbacks in Scottish waters are a result of increased shore-based sightings effort or whether this is due to an increase in the number of animals frequenting Scottish waters (WDC, 2018). It has been

estimated that there are at least 35,000 humpback whales in the North Atlantic Management Unit and that humpback whales are likely to be resident year-round in Scottish waters but in extremely low numbers (Marine Scotland Science, 2020).

4 Basking Shark Baseline

The basking shark (*Cetorhinus maximus*) is the largest coastal-pelagic shark found within Scottish waters, growing to lengths larger than 11 meters and weighing around 4 tonnes (Sims, 2008a). The species is a 'ram filter-feeding shark' and feeds in areas of high plankton concentrations. Basking sharks are also selective zooplankton feeders, with research showing a preference for high energy calanoid copepods such as Calanus finmarchicus (Sims, Fox, & Merrett, 2005). Feeding generally occurs from surface waters to depths of 320m (Skomal, Wood, & Caloyianis, 2004). Monitoring of the species feeding behaviour shows that basking sharks aggregate in coastal waters of continental shelfs dominated by transitional waters, where steep bathymetry combined with strong ocean currents result in areas of high phytoplankton and zooplankton density (Drewery, 2012).

In Scottish waters, basking sharks are particularly prevalent on the west coast during summer months, with highest densities observed in the Sea of the Hebrides (Paxton et al., 2014). There is some evidence to suggest that relatively high summer densities of this species are also found in the waters to the west of the Outer Hebrides, although the sparse availability of data casts some doubt over this finding (Paxton et al., 2014). Basking shark are not expected to be present in high densities within the Minch, to the east of the Outer Hebrides, although some sightings have been recorded (Marine Scotland, 2020). The shallow waters of Glumaig Harbour are not anticipated to provide valuable habitat for basking sharks, where no sightings have been reported (Marine Scotland, 2020). Although the wider Stornoway Harbour provides deeper waters in comparison with Glumaig Harbour, no sightings of basking shark have been recorded (Marine Scotland, 2020; NBN Atlas, 2020).

Seasonal oceanic cycles cause fluctuating phytoplankton and zooplankton densities in Scottish waters. These variations in phytoplankton and zooplankton availability make basking sharks a highly migratory animal, with no resident populations in UK waters (Sims, Southall, Richardson, Reid, & Metcalfe, 2003). Therefore, populations of basking sharks are not anticipated near the Western Isles in winter when phytoplankton and zooplankton levels are low (Drewery, 2012). No population estimates for basking sharks in Scotland exist and wider aspects of their ecology including reproduction in Scottish territories is relatively unknown (Drewery, 2012). However, recent research by SNH indicates basking sharks may gather in large numbers of Scotland's Western coast to potentially mate, though data is still insufficient to fully conclude mating of basking sharks in Scottish waters (Witt et al., 2016).

5 Risk Assessment

To assess the risks of underwater noise, disturbance and physical injury to marine mammals, it is necessary to address the following aspects:

- The hearing sensitivities of the species most likely to be present within, or close to the construction area (Section 5.1);
- The auditory injury criteria for the species most likely to be present within, or close to the construction area (Section 5.2);

- The source levels of the sounds that will be produced from the construction activities (Section 5.3.1 – 5.3.3), as outlined in Section 2;
- The risk of acoustic injury to marine mammals and basking shark (Section 5.4);
- The risk of acoustic disturbance to marine mammals and basking shark (Section 5.5); and
- The risk of physical injury to marine mammals and basking shark (Section 5.6).

The likely source levels of underwater noise calculated (see Section 5.3.1), and the risks of acoustic injury (Section 5.4) and disturbance (Section 5.5) have been compared against the original noise modelling, as per the EIA (Affric Limited, 2020).

With specific regard to the risks of acoustic disturbance, Section 5.5 will discuss the likelihood of underwater noise to impair an individual's (i.e., marine mammal receptor) ability to survive, breed, reproduce, or raise young, or the likelihood that an individual may be displaced from an area for a longer period than would occur during normal behaviour.

5.1 Hearing Thresholds of Receptors

This section identifies the hearing sensitivities of the receptors likely to be present in the vicinity of the construction area.

The hearing groups for marine mammals, as given by Southall *et al.* (2019) are summarised in Table 5.1. Table 5.1 also lists the marine mammal species within each hearing group that are most likely to be encountered within the vicinity of the DWP development.

Table 5.1: Marine Mammal Hearing Groups (Southall *et al.*, 2019)

Hearing Group	Relevant Receptors	Generalised Hearing Range
Low Frequency (LF) Cetaceans	Minke Whales Humpback Whales	7Hz to 35kHz
High Frequency (HF) Cetaceans	All dolphins identified in Sections 3.1.1 & 3.1.2 Northeast Lewis NC MPA Killer Whales	150Hz to 160kHz
Very High Frequency (VHF) Cetaceans	Harbour Porpoises Inner Hebrides and the Minches SAC	275Hz to 160kHz
Phocid Pinnipeds (PW) (Underwater)	Grey Seals Common Seals	50Hz to 86kHz

The latest 'Summary of Criteria for Physical Injury on Fish from Impact Piling Noise' (Popper et al., 2014) groups the types of fish into functional hearing groups as shown in Table 5.2. The specific fish receptors relevant to the Stornoway DWP development are summarised in Table 5.2.

Table 5.2: Functional Hearing Groups, and Relevant Fish Receptors (after Popper et al., 2014)

Hearing Group	Relevant Fish Receptors	Sensitivity to Underwater Noise
Fish: No Swim Bladder (P-)	Basking Shark	Least Sensitive
Fish: Swim Bladder Not Involved in Hearing (P-)	Atlantic Salmon Sea Trout European Eel	↓

	Raitt's Sandeel	
Fish: Swim Bladder Involved in Hearing (P+)	None	Most Sensitive

5.2 Auditory Injury Criteria for Receptors

Southall *et al.* (2019) presents single strike, unweighted sound pressure level peak criteria (SPL_{peak}) and cumulative (i.e., more than a single sound impulse) weighted sound exposure level criteria (SEL_{cum}) for both permanent threshold shift (PTS), where unrecoverable hearing damage may occur, and temporary threshold shift (TTS), where a temporary reduction in hearing sensitivity may occur in individual receptors.

Tables 5.3 (where both unweighted SPL_{peak} and SEL_{cum} are reported) and 4.3 (where only weighted SEL_{cum} are reported) present the Southall *et al.* (2019) criteria for the onset of PTS and TTS risk for each of the key marine mammal hearing groups. Each table considers impulsive (i.e., impact pile driving) or non-impulsive (i.e., dredging) noise sources. It should be noted that the values presented Tables 5.3 and 5.4 do not represent the source levels of underwater noise from construction activities associated with the DWP development.

Table 5.3: Impulsive criteria for PTS and TTS in marine mammals (Southall *et al.* 2019) from impulsive noise source.

Functional Hearing Group	Impulsive			
	Unweighted SPL_{peak} (dB re 1 µPa)		Weighted SEL_{cum} (dB re 1 μPa^2s)	
	PTS	TTS	PTS	TTS
LF Cetaceans	219	213	183	168
HF Cetaceans	230	224	185	170
VHF Cetaceans	202	196	155	140
PCW Pinnipeds	218	212	185	170

Table 5.4: Acoustic Injury Criteria for Marine Mammals in Relation to Non-Impulsive Noise (Southall *et al*, 2019).

Functional Hearing Group	Non-impulsive	
	Weighted SEL_{cum} (dB re 1 μPa^2s)	
	PTS	TTS
LF Cetaceans	199	179
HF Cetaceans	198	178
VHF Cetaceans	173	153
PCW Pinnipeds	201	181

For fish species, unweighted peak criteria (SPL_{peak}) and cumulative sound exposure criteria (SPL_{cum}) for impact piling noise are the noise criteria used to determine the onset of mortality and potential mortal injury, recoverable injury, and TTS, where a temporary reduction in hearing sensitivity may occur in individual receptors. These are presented in Table 5.5.

Table 5.5: Summary of Criteria for Physical Injury on Fish from Impact Piling Noise (after Popper et al. 2014)

Impact Piling		Impairment

Type of Fish	Mortality & Potential Mortal injury (dB re 1 µPa)	Recoverable Injury (dB re 1 µPa)	TTS (dB re 1 µPa)
Fish: No Swim Bladder	> 219 SPL_{cum} > 213 SPL_{peak}	> 216 SPL_{cum} > 213 SPL_{peak}	> 186 SPL_{cum}
Fish: Swim Bladder Not Involved in Hearing	210 SPL_{cum} > 207 SPL_{peak}	203 SPL_{cum} > 207 SPL_{peak}	> 186 SPL_{cum}

5.3 Underwater Construction Noise

This section provides details of the source levels to be emitted by the construction activities, as noted in Section 2.

Source levels, as identified by noise modelling (i.e. sound pressure or sound exposure levels) are compared with the latest marine mammal auditory injury criteria provided by Southall *et al* (2019) to estimate the ranges at which different magnitudes of acoustic impact may occur from the construction activities. The marine mammal auditory injury criteria to which source levels are compared to, are outlined in Section 5.2.1. The auditory injury criteria groups marine mammals into functional hearing groups and applies filters to the unweighted noise levels to approximate the hearing response of the receptor.

5.3.1 Impact and Vibro-Piling Underwater Noise Source Levels

Underwater noise levels generated by piling increase with pile diameter. This is due to larger diameter piles having greater surface areas in contact with the surrounding environment. As such, more energy can be transferred from the strike of the hammer into the water column and seabed in the form of noise. The pile diameter utilised in the underwater noise modelling was 220cm.

The modelling was completed prior to the design being optimised. Hence it is now proposed to that steel tube 123cm diameter king piles are utilised in the construction of the main berth at the Main Quay and in the Freight Ferry Berth. In addition, 80cm diameter steel tube piles will be used in the construction of the linkspan dolphins and finger pier construction, whilst 30cm diameter steel tube piles will be used in the Heavy Load Area.

As detailed in Table 5.6, underwater noise modelling for impact piling of 220cm piles estimated source levels to have a single strike SPL_{peak} of 231.6 dB re 1 µPa ±1.38dB. When comparing the estimated source levels of the proposed pile sizes to be used in construction, single strike peak SPLs were lower than that estimated in the underwater noise modelling assessment. In summary, source levels for impact piling of 123cm diameter piles are estimated to be 4.1dB less than that for impact piling of 220cm diameter piles.

Table 5.6: Impact Piling Peak Sound Pressure Levels (SPL_{peak}) by Pile Diameter

Pile Type	Pile Diameter (cm)	SPL_{peak} (dB re 1 µPa)	Difference from levels modelled (dB)
Modelled Pile	220	231.6	0
Main Berth at the Main quay and Freight Ferry Berth King Piles	123	227.5	-4.1

Finger Pier Piles	80	225.0	-6.6
Heavy Load Area Piles	30	218.0	-13.6

Similar trends in underwater noise levels for impact piling are also observed when taking into consideration the SELs of piles varying in diameter (Table 5.7). Differences in single strike peak SPLs and SELs between impact and vibro-piling are also evident (Table 5.7). As vibro-piling is a more continuous noise source than impact piling (impulsive, transient noise source), the root mean squared (RMS) of the acoustic signal is used to denote a sound exposure level.

Table 5.7: Derived pile source levels for various diameters under impulsive and continuous piling methodologies

Pile Diameter (cm)	Impact Piling		Vibratory Piling	
	Single Strike SPL_{peak} (dB re 1 µPa)	Single Strike SEL (dB re 1 μPa^2s)	SPL_{peak} (dB re 1 µPa)	RMS (dB re 1 µPa)
220	231.6	203.2	217.7	204.8
123	227.5	225.6	213.1	200.2
80	225.0	196.6	211.1	198.2
30	218.0	189.6	204.1	191.2

The likely frequencies of underwater noise arising from piling works are shown in Figure 5.1. It's important to note that Figure 5.1 does not illustrate the modelled frequencies for the Stornoway DWP. The band levels are therefore derived from another project which utilised similar pile sizes.

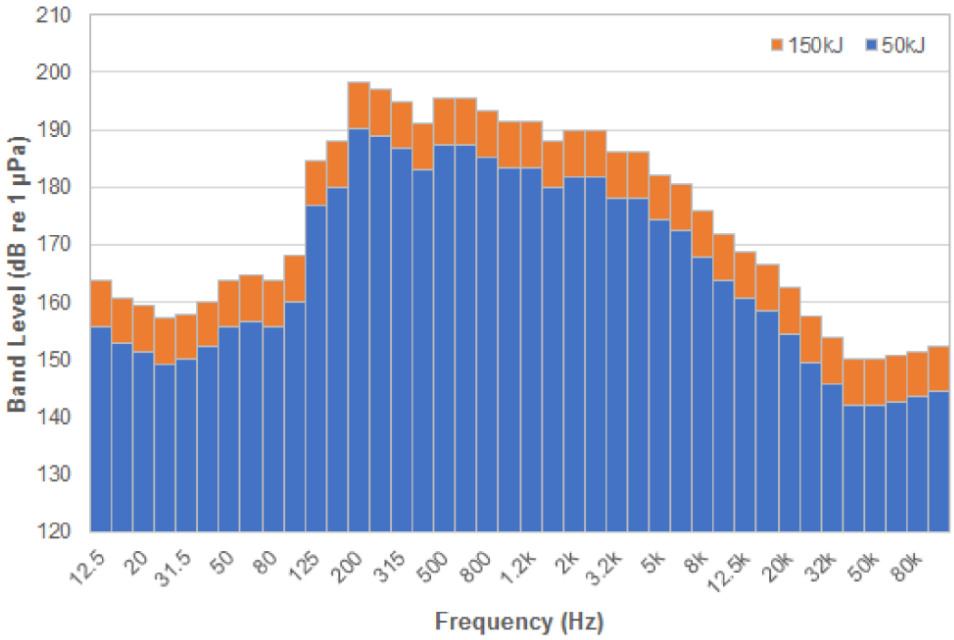

Figure 5.1: The likely band levels based on those derived from another project which utilised similar pile sizes.

5.3.2 Odex Piling Source Levels

While Odex piling is in fact a series of impacts, the impact rate is over 1200 strikes/min (20/sec), meaning that the noise is better described as continuous. Source levels for Odex piling are estimated to reach a maximum of ~ 167 dB_{RMS} re 1 µPa. The likely band levels for odex piling are illustrated in Figure 5.2.

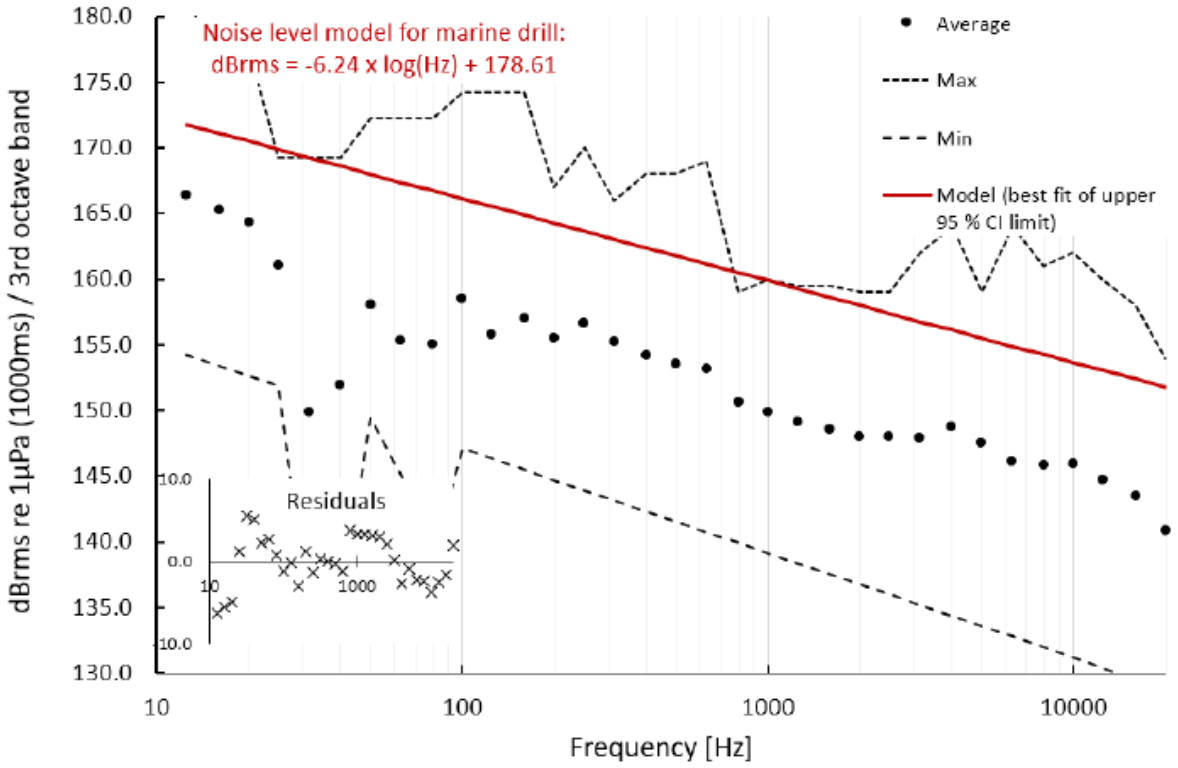

Figure 5.2: The red line indicates the band levels model representative for Odex piling. The model is a result of the average (black dots) of similar marine drills and the associated upper limit for the 95 % confidence interval for those. The dashed lines are the highest and lowest values found for similar marine drilling equipment.

5.3.3 Dredging Source Levels

Source levels for dredging were based upon the worst-case scenario (i.e. noisiest) dredging technique, cutter-suction dredging (CSD). Broadband source noise levels for the cutter suction dredger were identified to be in the region of 175dB_{RMS} re 1µPa. The likely band levels for dredging are illustrated in Figure 5.3.

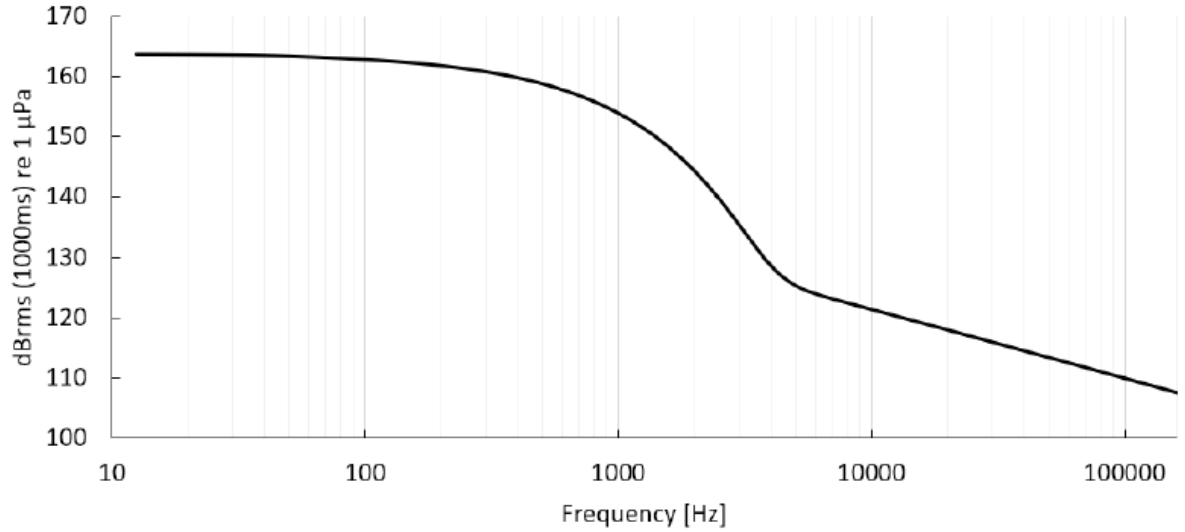

Figure 5.3: Band levels and the associated source levels for cutter suction dredging.

5.4 Risk of Acoustic Injury

5.4.1 Impact Piling

Worst-case scenario source levels for impact piling at the DWP development are associated with 123cm diameter king piles.

As the cumulative effects of multiple strikes are required for construction works, impact ranges of auditory injury to marine mammals for 123cm diameter piles are considered at the 1000 strike. Table 5.8 identifies the difference in the auditory injury impact ranges at the 1000 strike level for 123cm diameter piles.

It should be noted however, that the risk zones presented assume that the receptors do not move away from the noise source for the duration of the multiple strikes. This approach may seem pessimistic and unrealistic, but the output gives an understanding of the distance that each hearing group would need to swim to exit the risk zone.

For VHF cetaceans (i.e., harbour porpoise), zones of TTS are likely to encompass the majority of the Stornoway Harbour area and further in a south easterly direction out of the entrance to the harbour. This impact range would likely encroach and extend into the area designated as the Inner Hebrides and The Minches SAC. PTS zones are highlighted to potentially encompass much of the harbour area (see Table 5.8). Due to the nature of and characteristics of Glumaig Harbour however, it is unlikely that harbour porpoise will be present within zones of PTS, as the area provides unsuitable habitat for them and is generally much shallower (0-15m water depth) than their preferred foraging depths (~20 – 50m).

The next largest impact range is for LF cetaceans, which in this case pertains to minke and humpback whales. Impact piling will have a range of PTS beyond 500m, with the potential to be as far reaching as 1.5km, with zones of TTS encompassing the entire harbour area (see Table 5.8). Since the waters within 500m of the works are very confined, and less than 15m deep, it is extremely unlikely that minke or humpback whales will be present in the area where they may suffer PTS. However, while still confined, the waters within the 1.5km anticipated TTS zone include depths up to 30m, making it possible that minke whales could be present, as it

provides a more suitable environment for biologically important behaviours such as foraging. Sightings data for humpback whales, however, does not suggest they would utilise this area.

Impact piling is likely to have a PTS range of no more than 500m, with zones of TTS encompassing potentially up to 1.5km for HF cetaceans (see Table 5.8). This includes Risso's dolphin (which are a qualifying interest of the North East Lewis NC MPA), short-beaked common dolphin, and killer whale. The areas in which dolphins and killer whales may be subject to PTS and TTS are not considered to be valuable for biologically important behaviours, and low densities of these species overall in the area suggested that the number of animals possibly subjected to acoustic injury will be low.

Basking sharks do not have swim bladders, making them less sensitive to underwater noise than the diadromous receptors (Table 5.5). In order to suffer either mortal or recoverable injury, a basking shark would need to remain within 1m of the works during 24hr of continuous piling. This would not happen, and hence no risk of injury to this species exists. The maximum TTS range for basking sharks is predicted to extend 150m from the piling works. The waters within 150m of the works are <10m deep, and extremely confined, making them unsuitable for such a large fish. Therefore, basking sharks are not anticipated to be present in the area where they may be subject to TTS. This species may be subject to behavioural disturbance within 1,000m of the piling works, however, these waters are still shallow and confined, and do not provide any valuable habitat to basking sharks.

Table 5.8: Overview of auditory injury risk zone for impact piling at 1000 strikes of a 123cm pile.

Receptor Hearing Group	Relevant Receptors	123cm pile diameter	
		PTS	TTS
LF	Minke Whales Humpback Whales	Beyond 500m, potentially up to 1.5km.	The majority of the harbour area.
HF	All dolphins identified in Sections 3.1.1 & 3.1.2 Northeast Lewis NC MPA Killer Whales	Within 500m of source.	Potentially up to 1.5km from source.
VHF	Harbour Porpoises Inner Hebrides and the Minches SAC	Potentially the majority of the harbour area.	The majority of the harbour area and further in the southeast direction.
P-	Basking Shark	No Risk	Within 150m of source

5.4.2 Odex Piling

The risks of auditory injury, as displayed in Figure 5.4 were initially modelled for each piling location. However, as aforementioned in Section 2.2, odex piling will be limited to the Freight Ferry Berth. As such, it is expected that the actual PTS and TTS impact areas will be concentrated to the north of the development, with lower impacts out to the east and south than those shown in Figure 4.1. This figure is based on impact if the animal stays within the area. It should be noted that Figure 4.1 indicates piling works to be undertaken at Newton Marina, but these works have since been completed and thus can be ignored for the purpose of this document.

Notwithstanding this, there is a potential for PTS in VHF cetaceans (i.e., harbour porpoise) because of odex piling, if they stay within 200m of the works for long durations. Both VHF and LF TTS zones extend beyond 500m of the works however this is based on them staying in the area for 24 hours, which is highly unlikely.

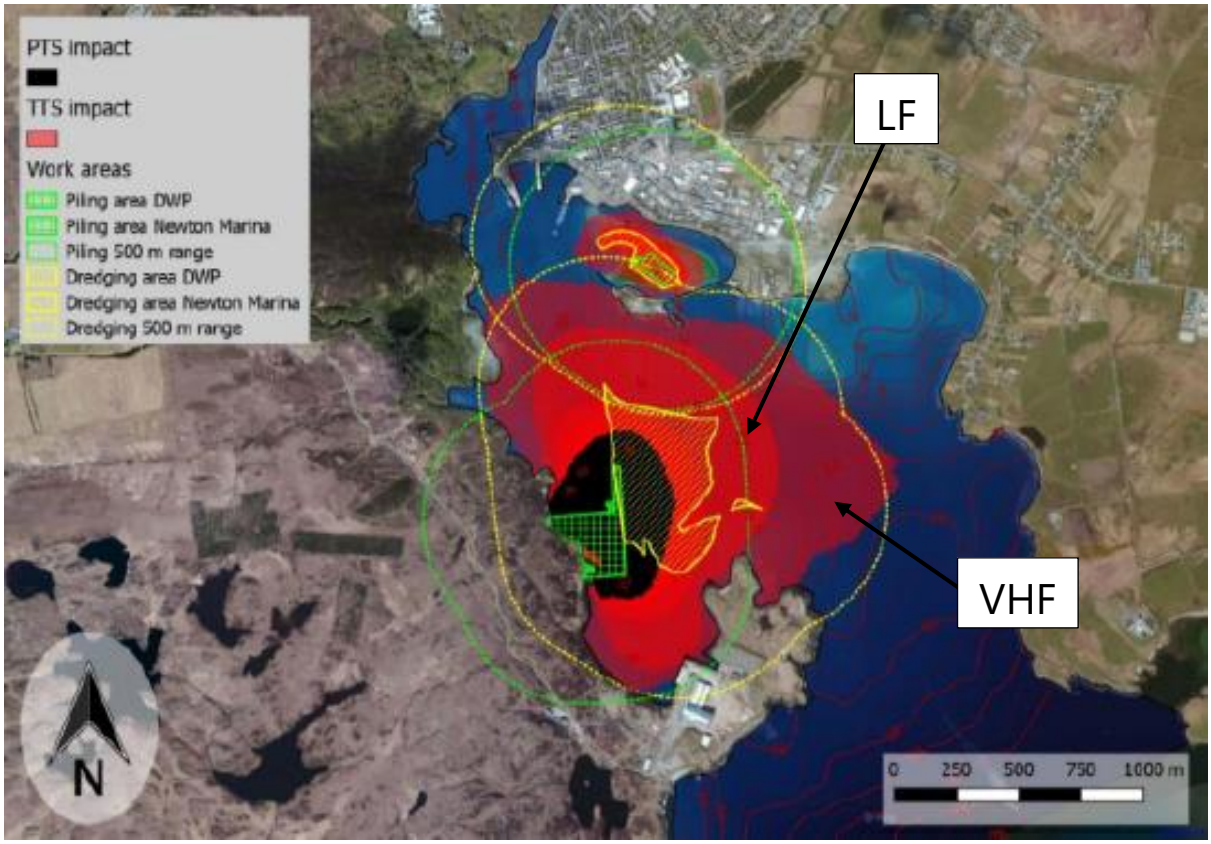

Figure 5.4: Risk of auditory injury due to odex piling when no impact piling is ongoing. Red areas are all hearing groups' TTS risk zones, while the black area is the harbour porpoise PTS risk zone. Dashed lines are 500 m buffer zones, with colours corresponding to activity.

5.4.3 Dredging

The noise model showed that noise levels higher than the TTS for Low Frequency (LF) cetaceans such as minke whales was limited to an area within 200m of the dredge vessel, and within 100m for other species. As aforementioned, in Section 4.3.1, marine mammals are unlikely to be present within the Stornoway Harbour area, and as such, within impact zones which could cause PTS (maximum ~500m, depending on hearing group). As zones of TTS for

dredging are less than those for PTS derived from impact piling, the number of animals possibly subjected to acoustic injury as a result of dredging activities will be low.

5.5 Risk of Acoustic Disturbance

There is the potential that the impact piling, odex piling, and dredging operations could cause disturbance to marine mammals within the vicinity of these activities. A disturbance effect, as defined under the European Habitats Directive, will occur if animals incur sustained or chronic disruptions to behaviour, that are likely to impair an individual's ability to survive, breed, reproduce, or raise young, or that are likely to result in that individual being displaced from an area for a longer period than would occur during normal behaviour.

The risks of acoustic disturbance, when considering each construction technique, are considered below.

5.5.1 Impact Piling

At 1000 strikes of a 123cm diameter pile, it is anticipated that there may be a high risk of acoustic disturbance outside the natural confines of the harbour area. The risks of acoustic disturbance are likely to enter both the Inner Hebrides and The Minches SAC and the nearby Northeast Lewis NC MPA. Although effects of disturbance are not predicted to be directly injurious, it is possible for sound levels to create a disturbance effect known as masking. Masking occurs when sound interferes with a marine mammals' ability to perceive and distinguish different sounds. Although it is still relatively unclear on how masking affects each marine mammal species in particular, it is understood that masking could inhibit vocalisations relating to foraging and breeding success (National Research Council (U.S.), 2003). Some researchers however, have shown that marine mammals may have the ability to increase the amplitude of their vocalisations as a short-term response to increased noise levels (Clark *et al.*, 2009; Parks, 2011) and prevent inhibition from occurring.

As impact piling is expected to be carried out over a period of ~ 13 months and will not be a continuous source of noise, effects of disturbance are likely to be short-term. Overall, the chance of disturbance causing effects at a level to impact upon an individual's ability to survive, breed, reproduce or raise young is unlikely, due to the short-term nature of the works.

5.5.2 Odex Piling

As ranges of acoustic injury for odex piling are less than that of impact piling, it is anticipated that the ranges of acoustic disturbance will also be less. In addition, as odex piling will be limited to the Freight Ferry Berth with lower impacts out to the east and south, it is less likely that the risks of acoustic disturbance will go beyond the confines of the harbour.

As such, the chances of acoustic disturbance causing effects at a level to impact upon an individual's ability to survive, breed, reproduce or raise young is unlikely.

5.5.3 Dredging

When considering sound exposure levels of dredging activity, the ranges at which marine mammals are at risk to acoustic injury from dredging are far less than that of impact piling. As such, the ranges at which marine mammals and basking shark are likely to be at risk to acoustic disturbance from dredging will also be less. Therefore, the chances of acoustic disturbance causing effects at a level to impact upon an individual's ability to survive, breed, reproduce or raise young are highly unlikely.

5.6 Risk of Physical Injury

During dredged spoil disposal operations, there is the potential for a marine mammal and basking shark to be directly under the disposal vessel when the spoil is released. In this event, the animal could be injured or killed by falling debris.

The spoil ground is approximately 850m from the Inner Hebrides and the Minches SAC and within the North East Lewis NC MPA, and hence, spoil disposals have the potential to negatively impact the harbour porpoise and Risso's dolphin features of these sites. In addition, Risso's dolphins are known to regularly frequent the waters around north-east Lewis.

Marine mammal and basking shark densities in the vicinity of the spoil ground are not expected to be high however, and therefore the probability of these receptors being in the spoil ground, and directly under the spoil vessel at the time of release is extremely low. This potential effect therefore is unlikely to affect the conservation status of a marine mammal and basking shark receptors.

6 Consideration of Alternatives

The need for the development of the Stornoway DWP along with the consideration of alternative options was fully considered during the EIA process and are detailed within Chapter 2 of the EIAR. A summary of these are provided here.

6.1 Project Need

As aforementioned in Section 1.1, the SPA is proposing the construction of a new DWP to facilitate sustainable economic growth. Serving several diverse sectors in the Outer Hebrides and the Western Isles, the expansion of the port will facilitate uses beyond those already operable at Stornoway, be that through their use of the proposed new DWP facilities, or the existing facilities which become more attractive or available to them as some of the vessel traffic utilises the DWP. The four main sectors that the DWP intends to support are the Renewables Industry, the Cruise Tourism Industry, Commercial Freight, and Oil and Gas Decommissioning.

6.1.1 Cruise Tourism

As cruise ships visiting Scottish ports are increasing in size to respond to market demand, cruise operators prefer to berth alongside, for the reasons noted above. In some cases, cruise ship companies are having vessels built which will not support the option of tendering passengers to the shore.

In order to maintain and grow the cruise ship market share in Stornoway, the harbour requires a facility which can enable alongside berthing of vessels up to 360m in length. It is anticipated that this would attract 35 additional vessel visits per year and, in turn, increase the number of passenger visitors.

6.1.2 Renewables Industry

Once operational, offshore energy devices require regular maintenance, for logistical reasons the preference is to utilise a local port, hence the DWP could support developments in the Minch or west of the islands. This support could be in the form of manufacturing renewable energy components at the Arnish Fabrication Yard and the potential for the DWP to support the production of green hydrogen and its use as a marine fuel.

6.1.3 Commercial Freight

The delivery of items such as fuel oils and potential export of renewable energy sources e.g. hydrogen or ammonia, are strictly regulated to minimise environmental and safety risks such as explosion, as such it is more appropriate to carry out these bunkering activities away from highly populated areas. Hence the creation of a facility out of the town of Stornoway would be beneficial.

6.1.4 Oil and Gas Decommissioning

As many of the existing oil and gas assets in the North Sea are aging, there is a growing need to refurbish or decommission oil rigs. This is a multibillion-pound sector, it requires harbours of suitable depth to have heavy lift capacity, and large laydown areas. The Arnish Industrial Estate provides facilities suitable for supporting the sector, but the existing quay does not meet the requirements of the sector.

6.1.5 Other Sectors

The availability of new opportunities offered by the development may also benefit smaller, local businesses within the Islands, from increased tourism associated with the cruise sector purchasing their goods. For example, crafts, arts and artisan food producers may benefit from increased tourism.

6.2 Location

The scale of the development design requires a large area, ideally where existing water depths with a link out to the Minch are close to 10m, to minimise the dredge requirements. Sandwick Bay provides a large area, however it is shallow, whereas Glumaig Harbour is spacious and quite deep. Areas to the southeast of Arnish point provide the water depths but they do not have the natural protection from the weather and large sea states which is the main benefit of the Stornoway Harbour Area to the north and west of Arnish point. As such, Glumaig Harbour area was selected.

6.3 Design Evolution

Ground investigations were completed which identified that the seabed in the south west of Glumaig Harbour is very soft and not conducive for piling and would give rise to settlement issues associated with land reclamation due to the enclosed nature of the environment. The proposals are therefore to construct further to the north. The design aimed to reach a cut and fill balance, such that the dredge material removed can be reused within the land reclamation to minimise material import and disposal.

The use of a finger pier to form part of the 'Main Quay' provided the opportunity to have an additional berth for use by smaller vessels.

The freight ferry berth requires a linkspan to facilitate a Roll-on Roll-off (Ro/Ro) facility, however, to maximise the flexibility of the facility, it is preferred that a quay wall suitable for use as a berth is provided alongside it.

7 Proposed Mitigation

7.1 Piling

The impact piling underwater noise modelling showed that there is the potential for the piling operations to cause disturbance and auditory injury to the marine mammal species and basking shark in the vicinity of the development site. In line with best practice, the piling marine mammal and basking shark mitigation identified below will apply to all marine mammal species and will be implemented for both vibro and impact piling operations.

The mitigation measures are aligned to the Joint Nature Conservation Committee's (JNCC) Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals and basking shark from piling noise (JNCC, 2010). However, in line with Section 4 of JNCC protocol, the developer may propose an amended protocol, if it is deemed that the standard protocol is unduly restrictive. Moreover, a soft start procedure is proposed and will be implemented by using a 'noise generator'. The noise generator is proposed to be operated by using an electric drill motor and generator fitted to a small tubular pile with attachment brackets. At the end of the drill motor is a hammer attachment, which makes contact with the tubular pile when the generator is running (see Figure 6.1). This type of noise generator has been utilised on other projects, such as Scrabster Harbour, for generating noise during soft start procedures. Previously, where the generator has produced too much noise and not remained in line with a soft start procedure, the noise has been required to be muffled and therefore reduced by placing foam around the hammer. By placing foam around the hammer to reduce noise levels further soft start procedures are ensured and remain adequate (see Figure 6.2).

Figure 6.1: A noise generator similar to the one proposed to be used at the SDWP development to implement soft start procedures

Figure 6.2: Foam placed around the hammer of the noise generator to ensure noise becomes 'muffled', so soft start procedures are performed correctly

A summary of the changes made to the JNCC protocols, together with the supporting rationale is provided in Table 6.1.

Table 6.1: Summary of Modifications to the JNCC Piling Marine Mammal Protocols.

Aspect	Change	Rationale
Pre-Watch Duration	The duration of the pre watch (both visual and acoustic) is reduced from 30min to 20min.	The 30min pre watch is designed to maximise detection probability within the mitigation and allow for deeper diving marine mammals which may be present in the zone, but submerged and undetectable for extended periods. However, given that water depths within the 500m zone do not exceed 10m, prolonged deep dives cannot occur. A 30min watch will not increase detection probability but will result in unwarranted delays to operations.
Delays After Detection in Mitigation Zone	The delay following a detection within the mitigation zone during the pre-watch is reduced from 20min to 10min.	For the reasons stated above, a period of 10min following the last detection within the mitigation zone provides sufficient confidence that the mitigation zone is clear of marine mammals, allowing piling to commence.
Soft Start	No soft start will be provided for 30cm diameter piles	The purpose of the soft start is to allow animals which may be present (but undetected) within the injury zones to move away before full power piling is reached. However, given the shallow waters and that 30cm diameter piles give rise to noise levels at least four times lower than those modelled, the acoustic injury zones (compared with piles larger in diameter) are significantly

Aspect	Change	Rationale
		lower. A 500m mitigation zone and low anticipated marine mammal densities also prevents the risk of an animal being present but undetected within the injury zone is extremely low for 30cm diameter piles. As such, additional delays resulting from implementing a soft start is not justified by a meaningful reduction in marine mammal risk for this pile size.

Visual observations are preferred over acoustic when possible. Passive acoustic monitoring (PAM) will be required during hours of darkness, reduced visibility (fog) and when the sea state is >3. Beaufort Scale is often used as an indicator of sea state hence, visual observation when Beaufort is ≥4 may not be possible. However, it should be noted that a Beaufort level of ≥4 does not necessarily correspond to sea states in which visual observations cannot be undertaken, especially in coastal locations. As such, in this instance when a Beaufort level of ≥4 is recorded the marine mammal observer (MMO) will consider sea state and actually visibility to decide whether MMO or PAM should be utilised.

7.1.1 Marine Mammal and Basking Shark Monitoring Protocols

The impact piling mitigation will provide the following measures, and will also be applied to otter:

1. A 500m mitigation zone will be established around the piling rig.
2. During periods where the visible conditions and sea state are not conducive for visual mitigation practices (MMO) (i.e. darkness, fog reducing visibility to <500m, or graded sea states of >3); PAM will be utilised by a trained PAM operator to monitor the mitigation zone.
3. The MMO/PAM operator should be informed by the site manager or piling foreman of proposed piling start times as soon as possible (at least 90 minutes notice, or the night before for a morning start).
4. If visual observations are being undertaken, an MMO will commence the watch using binoculars (minimum characteristics of 8x42). If PAM is being undertaken, the PAM operator will be required to use the specified PAM equipment. At least a 20-minute watch is required to be conducted prior to the anticipated start time. The MMO/PAM operator should focus their effort on the mitigation zone and advise the site piling foreman if marine mammals, otter or basking sharks are present.
5. Prior to piling, if the 500m mitigation zone remains clear of cetaceans and basking shark during the watch, and the 100m mitigation zone remains clear of all seal species and otter, the MMO/PAM operator will give permission to commence the soft-start, but:
    a. If a mammal/shark is sighted in the zone, the MMO/PAM operator will track the animals visually, and the soft-start will be delayed until the mitigation zone has been clear for 10min. The MMO/PAM operator will keep the site team up to date with progress.
    b. A 30-minute soft start-up for 123cm diameter king piles and 80cm diameter bearing piles is required to protect HF hearing receptor groups (a noise generator may be used for this).

c. A soft start-up is not required for the piling of the heavy load area 30cm diameter piles.

6. Once the soft-start has commenced the MMO/PAM operator should be notified. If the mitigation zones during the soft-start procedure have been clear of marine mammals, otter and/or basking shark for 30 mins, then the MMO/PAM operator will give permission to commence piling at full power.
    a. If a marine mammal/otter/shark is sighted in the mitigation zones during the soft-start, the MMO/PAM operator will track the animals visually, and the power will not be increased until the mitigation zones have been clear for 10min. The MMO/PAM operator will keep the site team up to date with progress.
7. Once piling has commenced at full-power, the MMO/PAM operator should be notified. The MMO/PAM operator does not need to continue watching during piling at full-power. If marine mammals, otters, or basking sharks are observed during piling operations within their designated mitigation zones, details should be noted on a recording form.
    a. There is no requirement to stop works for mammals or basking sharks entering the mitigation zone once piling has commenced, provided piling is continuous.
    b. Continuous is defined as without a break in operations exceeding 10min in duration.
8. If a break in piling operations exceeds 10min the following conditions will apply:
    a. A noise generator will be utilised to produce sound at lower pressures to deter marine mammals away from the construction area and maintain a soft-start procedure. There is no requirement for the use of an MMO or PAM operator in combination with the noise generator.
    b. If the noise generator is not available, then a normal 20min MMO/PAM watch with soft start (if applicable) shall be deployed.
9. If a break in piling operations has been planned to last for a period of up to <30min, but exceeds this timeframe, irrespective of whether the noise generator has been running or not, a 20min pre-watch will be required before piling can recommence as detailed above.
10. All MMO/PAM operations will be recorded using the JNCC marine mammal reporting forms template and submitted to Marine Scotland once the works are complete.

A flow chart summarising the mitigation protocols is provided in Figure 6.1.

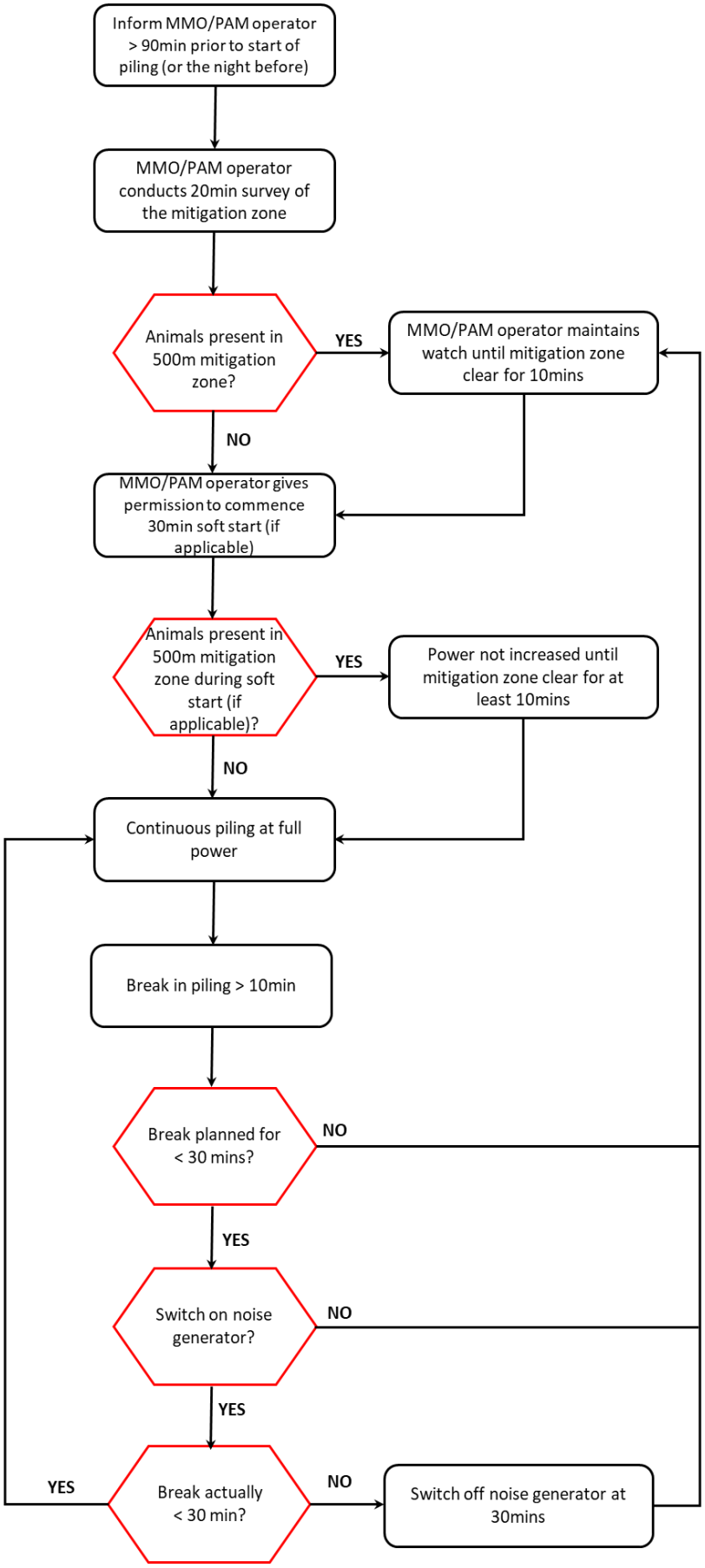

Figure 6.1: Flowchart of the Mitigation Protocols for piling

7.2 Dredge Disposal

Dredging is a 24hour a day operation, hence there is a potential that dredge disposals will be carried out in hours of darkness, as such both visual and acoustic protocols are proposed.

7.2.1 Visual Monitoring Protocols

Visual marine mammal and basking shark observations will be conducted by an MMO at a suitable observation location, either shore based, or vessel based on the disposal vessel or separate observation vessel. A 200m mitigation zone around the disposal vessel will be established for cetaceans. The following protocol will be followed regardless of the MMO location:

1. The MMO should be informed by the dredge spoil disposal plant via VHF radio or phone once dredging is complete and that the ship is on route to the spoil ground. The vessel must give suitable warning to the MMO observer to allow them to get into position and start a watch at least 20 minutes before the anticipated arrival time.
2. The MMO will commence the watch using binoculars (minimum characteristics of 8x42) so that at least a 20-minute watch has been conducted by the time the ship reaches the spoil ground. The MMO should focus their effort on the spoil ground and advise the ship if animals are present to avoid them if possible.
3. Once in the spoil ground the ships officers will ask the MMO if they are clear to commence the disposal. If the mitigation zone is clear, then MMO will give permission to proceed. If animals are present within the mitigation zone, disposal will be delayed until the animals have left the mitigation zone and 5 minutes have passed since an animal was last sighted within the zone.
4. Visibility Limits:
    - Shore based – Must have clear visibility to 700m, sufficient light (i.e., daylight hours), and sea state must be ≤3.
    - Vessel based – Must have clear visibility to 300m from the disposal vessel, sufficient light (i.e., daylight hours) and sea state must be ≤3.

A flow chart summarising the visual observation protocols is provided in Figure 6.2.

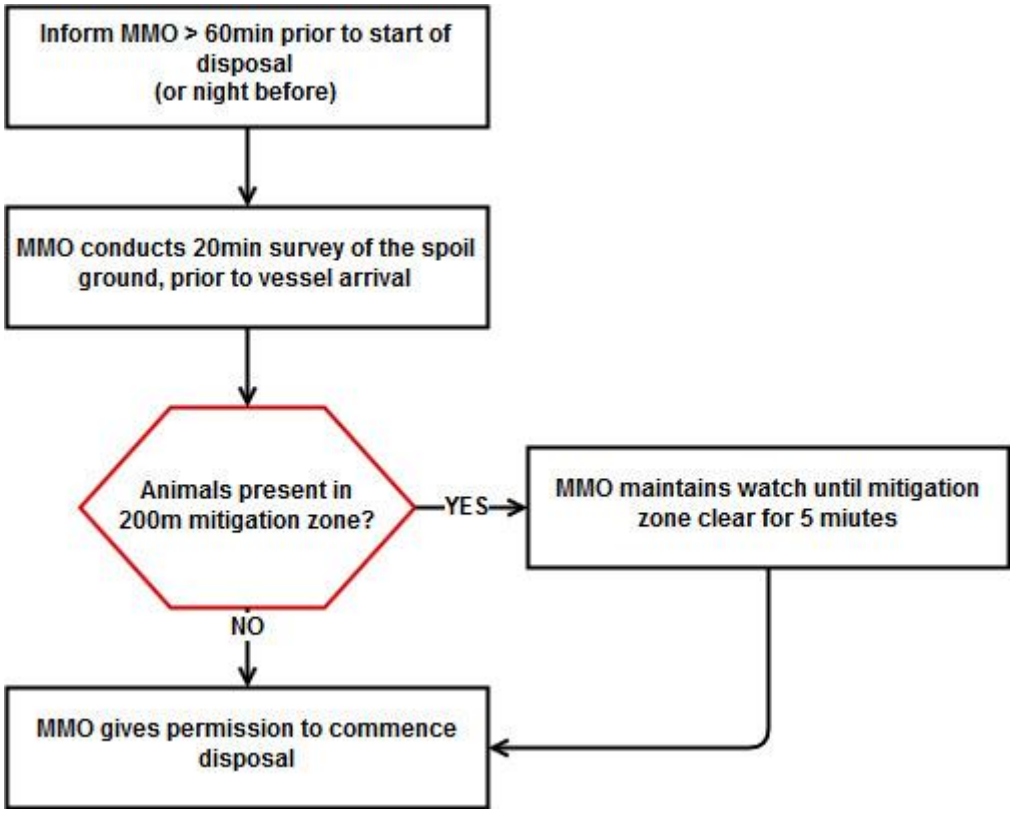

Figure 6.2: Flowchart of Spoil Disposal Visual Observation Protocols

7.2.2 Acoustic Monitoring Protocols

During hours of darkness, sea states ≥4, or if visibility falls to below 300m for vessel-based observation or visibility is not clear past the spoil ground for shore-based observation, marine mammal detection will be conducted acoustically using PAM. The PAM system will be either be deployed from the disposal vessel, or buoy mounted in a location where the system provides sufficient coverage of the spoil ground to allow detection of vocalising cetaceans in the area. The following protocol will be used for PAM:

1. The PAM technician shall be given a minimum warning of 60 minutes ahead of the intended disposal time, to prepare for the watch. The operator will work from the PAM base station where the laptop will receive data from the PAM hydrophones. The base station will be located on the disposal vessel for vessel deployed systems, or on land if the hydrophones are buoy mounted.
2. The PAM technician should perform a minimum of a 20-minute watch before the vessel reaches the Spoil Ground.
3. Once the PAM technician is satisfied no marine mammals are present within the 200m mitigation zone, they may advise the crew to commence the disposal. If mammals are detected within the zone, the disposal will be delayed until 10 minutes have passed since last detection within the zone.

A simple flow chart summarising the acoustic monitoring protocols is provided in Figure 6.3.

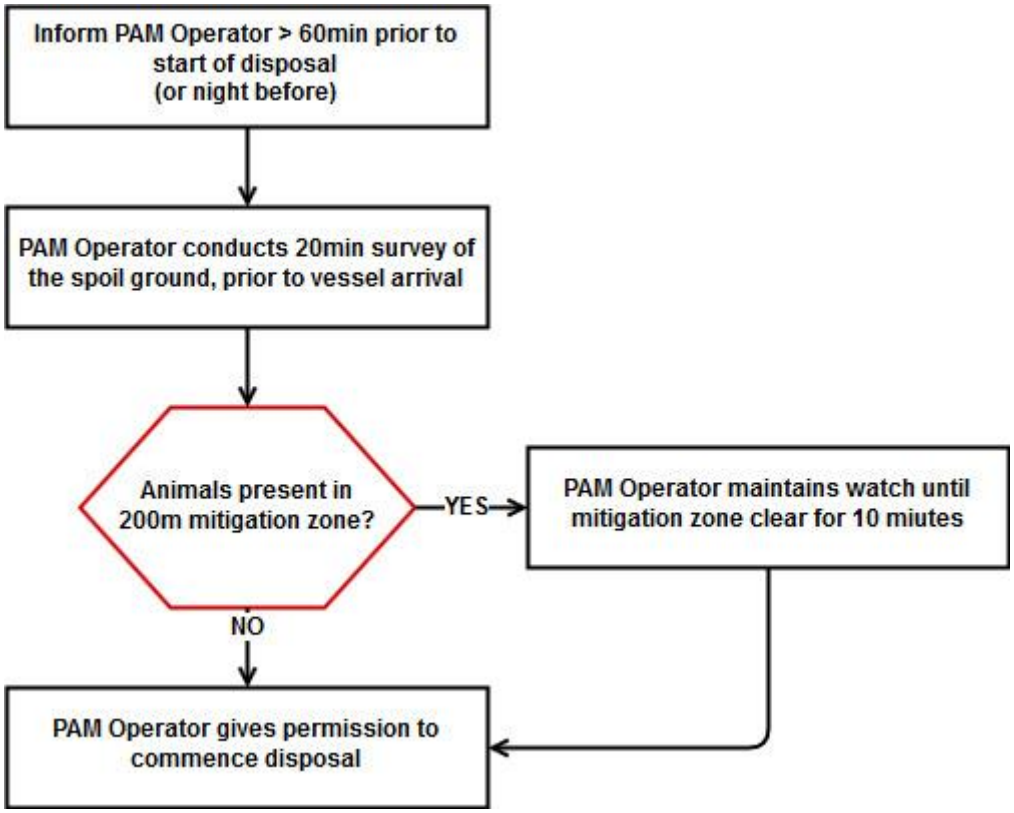

Figure 6.3: Flowchart of Spoil Disposal Acoustic Observation Protocols

8 Conclusion

The proposals to develop the Stornoway DWP and the potential construction impacts on cetaceans have been considered in detail in the EIAR and this document. Considerations of alternative techniques have been taken into account in Section 6. However, the activities required to be performed are imperative to the construction of the Stornoway DWP and its intended uses. As such, there is justification to carry out these activities with appropriate mitigation.

Through the adoption of effective and proportionate marine mammal and basking shark mitigation, the construction of the Stornoway DWP development poses no risk of causing disturbance or injurious effects at a level which could impact upon an individual's ability to survive, breed, reproduce or raise young long-term.

Marine mammals may experience some disturbance due to the location of the works and the potential for sound to dissipate out of Glumaig Bay and out towards The Minch. This however, will be limited in extent and short-term in duration. It is therefore very unlikely that longer term and larger scale impacts of disturbance will occur to the exposed group(s) of animals as a whole. Basking shark are at no risk to PTS and are unlikely to be present in areas where they may experience TTS.

The comprehensive strategy proposed to mitigate risks of disturbance and/or injury to marine mammals, will reduce the severity of the potential impacts outlined in Section(s) 5.4 – 5.6. It is therefore concluded that with mitigation, the piling, drilling and dredging works required for

the Stornoway DWP will not significantly affect any marine mammal species and basking shark at individual or population level.

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10 Glossary

Acronym	Definition
µPa	Micro-pascals
cm	Centimetres
cm	Centimetre
CnES	Comhairle nan Eilean Siar
CWSH	Coastal West Scotland and Hebrides
dB	Decibels
DWP	Deep-Water Port
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPS	European Protected Species
HF	High Frequency
HRA	Habitat Regulations Appraisal
IAMMWG	Inter-Agency Marine Mammal Working Group
JNCC	Joint Nature Conservation Committee
km	Kilometres
km^2	Kilometre-squared
LF	Low Frequency
m	Metres
m^2	Metres-squared
m^3	Metres-cubed
MHWS	Mean High Water Spring
MMO	Marine Mammal Observer
N	North
NC	Nature Conservation
PAM	Passive Acoustic Monitoring
PTS	Permanent Threshold Shift
PW	Phocid Pinnipeds Underwater
RMS	Root Mean Squared
SAC	Special Area of Conservation
SDWP	Stornoway Deep-Water Port
SEL_{cum}	Cumulative Sound Exposure Level
SNH	Scottish Natural Heritage
SPA	Stornoway Port Authority
SPL_{peak}	Peak Sound Pressure Level
TTS	Temporary Threshold Shift
VHF	Very High Frequency
W	West
WDC	Whale & Dolphin Conservation