ARUP

DCT Gdańsk Sp. z o. o.

# Gdansk Port | DCT Terminal 3 (T3) | Poland

## Appendix A - Marine Mammal Mitigation Review

Reference:

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# 1. Introduction

The project will involve multiple construction activities within the marine environment that will generate underwater noise impulses, namely piling and dredging works, as summarised in Section 2.

The Baltic Sea is an important area for endangered, endemic and migratory species of marine mammals also associated with local Natura 2000 sites. Harbour porpoise - Baltic Sea subspecies endemic population (*Phocoena phocoena*), grey seal - Baltic Sea subspecies endemic population (*Halichoerus grypus*) and Harbour seal (*Phoca vitulina*).

The effects of underwater sound on the hearing abilities of marine mammals are of particular concern and are well documented. High intensity underwater sounds can cause mortality, injury and Permanent Threshold Shift (PTS – permanent 'deafness') at short range, Temporary Threshold Shifts (TTS – temporary 'deafness') at mid-distance ranges, and disturbance over longer distances – circa 26km.

The installation of driven piles in the marine environment without mitigation is likely to produce noise levels capable of causing mortality, injury and disturbance to marine mammals. Disturbance triggers behaviour change, such as altered vocalisations, changes in surfacing patterns, displacement, and increased stress levels. Disturbance therefore impacts communication, orientation, navigation and feeding with indirect effects on breeding success and young rearing, whilst PTS and TTS may also lead to increased indirect mortality rates. Impacts arise both from single-pulse sources, and continuous noise sources leading to cumulative impacts. Similarly, simultaneous piling can lead to increased peaks in noise source levels, further increasing impact thresholds.

# 2. Summary of Relevant Works

The following summary has been taken from the preferred Contractor JV's Construction Method Statement (CMS). The CMS does not allow for any marine noise mitigation, nor are technology specific noise-attenuation devices proposed within the CMS, nor are component source levels provided at this stage. Details on specific piling technology, noise specification and noise abatement options will be shared by the Contractor and implemented into Dredging Management Plan to inform a review of marine mammal mitigation. Both documents will be submitted for review to Supervision Engineer, Lenders Technical and E&S Advisor prior to commencement of respective works. Mitigation measures will be under constant review to ensure the most robust and proportionate processes are followed. It is important to note that, the DCT T3 Environmental Permit restricts certain activities between April and August inclusive, to reduce impacts on nearby ornithology receptors. Regarding marine mammals, the Environmental Decision (2019)[1] requires that soft-start is required for relevant activities; i.e. a gradual ramping up to target power levels to allow sensitive receptors to clear the impact zone.

## 2.1 Quay Wall Construction

The proposed sequence is summarised as follows:

- Phase 1: removal of soft soils until 50m behind the future quay wall by means of Trailing Suction Hopper Dredger.
- Phase 2: Piling works of the main structure by means of piling equipment installed on a Jack-Up Barge.
- Phase 3: Piling works of the front rail crane beam foundation pile by means of piling equipment installed on a Jack-Up Barge.

[1] Environmental Decision for Expansion of the DCT Gdansk container terminal in the Northern Port in Gdansk, RDOŚ-Gd-WOO.420.125.2018.AT.11, Gdansk 2019

- Phase 4: Partial backfill behind the quay wall by means of dry earth movement.
- Phase 5: Installation of anchor structure followed by further backfill behind the quay wall.

### 2.1.1 Impact Pile Works

Sheet pile driving works will be carried out from the water, using marine equipment like pontoon with crawler crane working on. Manoeuvring of pontoons will be delivered by pushers. Installation of the sheet piles and steel pipes will be carried out using a vibro hammer and a percussive hydraulic hammer in order to ensure appropriate ordinate of the bottom of the elements. It is interpreted that vibro-piling will be implemented to bedrock level, then percussive piling will be implemented to attain target design depth. Key depths and proportionality of piling type is unknown at this stage.

Sheet piling is anticipated to take approximately eight months, 24-hours a day, seven days a week. Measurements of sheet piles are anticipated to be as follows.

**Sheet Piles:**

Width 700mm.

Height 421-501mm.

Length 3- 25m.

192 pcs.

**Bearing Piles:**

Diameter 1,420mm.

Length 35-39m.

259 pcs.

### 2.1.2 CFA Piles

CFA (Continuous Flight Auger) piles belongs to the group of bored piles. The main drilling tool in this technology is the continuous auger. Concrete is fed through the hollow stem of the auger, which allows concreting from the very bottom of the pile. Drilling and concreting are carried out in two different stages, that are performed consecutively. During the drilling and concreting (under certain pressure) the ground is partially spread towards the sides, what has a positive effect on the bearing capacity of CFA. Typical piling rig is equipped with a rotating head, auger and other components and devices that are essential for the installation of CFA piles. All rigs used by Subcontractor are equipped with a measuring system that allows for a constant measurement of the following parameters while drilling: start date, finish date, drill pressure, drilling depth, crowd speed, total amount of concrete, pull up speed. All parameters are registered automatically on an electronic device. During the drilling, the internal part of the auger is filled with concrete. The concrete is maintained under pressure to prevent the penetration of soil and water into the auger and drilling hole. After reaching the designed depth, the auger is gradually pulled up and the CFA pile shaft is filled with the concrete. Concreting under pressure assures a good contact of the CFA with the adjacent ground and prevent of ground collapse. Maintaining of concrete pressure (with lower values in the upper parts of the pile) and pulling out the auger allows to execute CFA without casing. After the concreting of CFA shaft is completed, spoils are removed by excavator, the top of the pile is cleaned and exposed by piling crew, the required reinforcement is installed into fresh concrete, with the support of the hydraulic vibrator.

It is anticipated that CFA piling will take approximately five months, from March- September, 7am-7pm. Measurements of CFA piles are anticipated to be as follows:

Diameter 630mm.

Length 26m.

583 pcs.

### 2.1.3 Respective Piling Technology Risks

Both vibro-piling and percussive piling may have impacts on marine mammals; whilst CFA piling is likely to have minimal impact on marine mammals, vibro-piling may have moderate impacts (particularly cumulative impacts from prolonged exposure) and percussive piling may give rise to more significant and long-ranging impacts in the absence of mitigation – especially where simultaneous piling is employed.

## 2.2 Dredging and Reclamation

Multiple activities shall be undertaken to complete the works:

- Dredging of suitable material and reclamation by means of rainbowing, spreader pontoon, etc.
- Dredging of unsuitable material and dump offshore.
- Clean up of sedimented layers during the works.
- Soil replacement behind the future quay walls.
- Final clean up before handover of the works.

Dredging may incur a minor to moderate impact on marine mammals, primarily through disturbance and prolonged noise exposure. Impacts would predominantly arise from the release of any contaminants within the seabed substrates. Mitigation measures for this risk are covered separately in the draft Dredging Management Plan[2].

## 2.3 Marine Mammal Risk - Dredging

Dredging sounds are comparatively lower intensities in contrast to piling driving, occurring at frequencies to which harbour porpoise are less sensitive. Dredging produces predominantly low-frequency sounds, which are typically continuous and non-impulsive.

Heinis et al. (2013) monitored Trailing Suction Hopper Dredgers to estimate potential risks to harbour porpoise and seals. Results from this study did not indicate that harbour porpoises or seals would exceed PTS or TTS thresholds during dredging operations. Short term avoidance behaviour of dredging has been observed in harbour porpoises; however, harbour porpoises returned to the areas after the dredging activity was completed.

Noise levels produced by Trailing Suction Hopper Dredgers have been reported at Sound Pressure Levels (SPL) of 189.9dB re 1 µPa @ 1m (Robinson et al., 2011). Sound levels that marine mammals are exposed to are usually below suspected injury thresholds or PTS; however, TTS cannot be ruled out if marine mammals are exposed to noise for prolonged periods (Kastelein et al., 2012).

Impacts of dredging noise concern short, perhaps medium-term behavioural reactions and masking of low-frequency calls (Todd et al., 2014). Based on the data available for marine mammal responses to other anthropogenic underwater sounds, risks associated with dredging are likely limited to masking and behavioural effects (Thomsen et al., 2016). Temporary hearing loss is possible if receptors stay for extended periods near the dredger, but auditory injury is unlikely.

As such, **no additional marine mammal mitigation is proposed for dredging activities beyond the soft-start measures** proposed in the formal consent (ED, 2019).

# 3. Limitations

This assessment it limited by the available information provided in the construction method statement regarding timing and duration of dredging and piling activities. Estimates and assumptions have been made regarding noise levels associated with the works, based on available data and literature.

[2] Greer D. & Borrero J. C. 2022. Deepwater Container Terminal T3: Draft Dredging Management Plan. eCoast, Arup Poland, New Zeland

There is also a lack of data availability regarding distribution and seasonality of marine mammals (detailed in Section 4) in and surrounding areas of the proposed works. Available data is also limited by data resolution (SAMBAH project – two C-POD detectors in Gdansk Bay area) and temporal accuracy; most recent data from 2014. Recent unpublished data from 2021 and 2022 has kindly been shared by Hel Marine Station of the University of Gdansk to support this mitigation review.

Appropriate mitigation measures have been produced using a precautionary approach (in accordance with Habitats Directive requirements – noting each marine mammal species present is a feature of a nearby European Site / Natura 2000 site) and available guidelines (detailed in Section 6).

# 4. Marine Mammal Baseline

Species of special interest related to their endangered, endemic, migratory and protected status in the area of impact and to be the focus for this impact assessment are:

- Harbour Porpoise - Baltic Sea subspecies endemic population (*Phocoena phocoena*).
- Grey Seal - Baltic Sea subspecies endemic population (*Halichoerus grypus*).
- Harbour seal (*Phoca vitulina*).

## 4.1 Harbour Porpoise [Baltic Sea Sub-Population]

*Summary Status – Critically Endangered [IUCN Red List], Endemic, Migratory, Protected Species.*

The harbour porpoise is the only cetacean species which occurs throughout the year in the Baltic Sea (ASCOBANS 2016, ASCOBANS Recovery Plan for Baltic Harbour Porpoises - Jastarnia Plan[3]). The population in the Baltic Sea is small, estimated at approximately 500 individuals, and has been drastically reduced in recent decades. At this extremely low population level it is important to conserve every individual to support a viable population and hopeful recovery to favourable conservation status.

Harbour porpoise face numerous threats, notably underwater noise, being caught as bycatch in gillnets and reduced amounts of prey. Baltic Sea harbour porpoise generally feed on pelagic clupeids, such as herring (*Clupea harengus*), and bottom-dwelling gadids, such as cod (*Gadus morhua*) but adapt to local and regional conditions. Harbour porpoises primarily occur in waters shallower than 40m and with a tendency to higher densities at 20-40m depth.

The endemic and geographically isolated Baltic Sea sub-population is listed as Critically Endangered (CR) category within the IUCN Red List of Threatened Species (IUCN Red List of Threatened Species 2007, IUCN Red List Harbour Porpoise). Accordingly, the Polish Red Book of Animals also classifies harbour porpoise as Critically Endangered (CR) (Głowaciński, 2001). Harbour porpoise are strictly protected under national law as a species requiring active protection (Regulation of the Minister of Environment of 16 December 2016 on species protection of animals, Polish Journal of Laws 2016, item 2183). As a species listed in Annex II (Priority Species) of the Habitats Directive it is protected under the Natura 2000 Site Zatoka Pucka i Półwysep Helski SAC PLH220032 (the area is a part of another Natura 2000 site called Zatoka Pucka PLB220005).

This species is a feature of the Zatoka Pucka i Półwysep Helski SAC PLH220032 site, which is located 20km north of Gdansk Port and the proposed works. Zatoka Pucka is an area understood to be used by harbour porpoise between February and April (ASCOBANS, 2016). [PLACEHOLDER – awaiting data on seasonal presence from Hel Marine Station – likely to extend duration of presence in Gdansk Bay] Harbour porpoise are highly mobile and may forage / transit further south than the boundary of the SAC, potentially bringing them closer to the proposed works. Similarly, acoustic disturbance can affect cetaceans >26km from the source (Tougaard et al., 2013) [see Section 5.2].

[3] https://www.ascobans.org/sites/default/files/document/ASCOBANS_JastarniaPlan_MOP8.pdf

Acoustic monitoring using CPOD detectors was carried out in 2013-2014 (13 August 2013 to 4 July 2014) (Sveegaard et al., 2015 – SAMBAH Project). The results of this monitoring confirmed the presence of harbour porpoise in the studied area of the Gulf of Gdańsk. At stations CPOD01 (approximately 23km north of the site) and CPOD02 (approximately 18km north of the site), the findings of harbour porpoise were recorded on 21 and 22 December 2013 respectively, and at the station CPOD03 (approximately 12km north of the site) on 26 February 2014 (Data WWF Poland). The limitations of this data are acknowledged (only two C-POD detectors for the Gdansk Bay area). There is also a factored 20% probability of detection of harbour porpoises in the Gdansk Port area from February to April (ASCOBANS, 2016). Consequently, harbour porpoise may be present within the Zone of Influence between December and February inclusive.

Consultation with Hel Marine Station has confirmed that more recent data [2021 / 2022] identifies harbour porpoise records within the vicinity of the Port of Gdansk between January and April. Wider in the Bay of Gdansk, the Hel Marine Station 2021 / 2022 surveys indicated presence throughout the year, within approximately 10-20km of the proposed development. This data is unpublished but has kindly been shared to inform appropriate mitigation.

## 4.2 Grey Seal [Baltic Sea Sub-Population]

*Summary Status – Endangered [Polish Red Book], Endemic, Migratory, Protected Species.*

The grey seal (*Halichoerus grypus*) is the largest of the three seal species found in the Baltic Sea. The population of grey seals in the whole Baltic Sea region is estimated to exceed 30,000 individuals, with most grey seals found between the Northern Baltic proper and the southern Bothnian Sea (HELCOM, 2013). Grey seals gather for breeding, moulting and hauling out. Within the Baltic Sea the main breeding season is from February to March. No breeding sites are known within the 10km of Gdansk Port. Grey seals feed on a wide variety of fish, with a diet that varies with locations, season and prey availability. Grey seals can dive to a depth exceeding 200m and remain under water for up to 20 minutes (Keilpinska and Kowalski, 2021). Grey seals are currently threatened by habitat loss due to coastal development, overfishing and pollution.

Grey seal records are recorded within and in the immediate vicinity of Gdansk Port [Hel Marine Station unpublished data 2019-2021] all year round.

The IUCN Red List of Threatened Species classifies Baltic Sea grey seal as 'Least Concern' – LC category (IUCN 2007, IUCN Red List *Halichoerus grypus*). However, the Polish Red Data Book of Animals (Głowaciński, 2001) classifies grey seal as a species of very high risk – Endangered (EN) category or even at risk of extinction.

This species is protected under Polish national legislation (Regulation of the Minister of Environment of 16 December 2016 on species protection of animals, Polish Journal of Laws 2016, item 2183, Species Protection of Animals Regulation). As a species listed in Annex II of the Habitats Directive it is protected under the Natura 2000 Site Zatoka Pucka i Półwysep Helski SAC PLH220032. The area is a part of another Natura 2000 Site called Zatoka Pucka PLB220005. In the area surrounding the proposed works, grey seals are also associated with the Ostoja w Ujściu Wisły SAC PLH220044 - approximately 3km east of the proposed works.

There have been 1,901 observations of grey seals in Gdansk Bay from January 2009 to July 2014 (WWF Poland data). The largest colony (haul out – non-breeding) of grey seals in Poland inhabits the Vistula River Estuary (Keszka et al., 2020), approximately 14km from the construction area, with largest abundance from June-August. Visual sightings at sand bars in the Mewia Łacha Nature Reserve range from 30 to 300 individual seals per observation (approximately 500m north of the Vistula River Estuary). Data collected between August and October 2014 at Mewia Łacha Nature Reserve (54°22′ 09.4"N, 18°56′ 51.6"E) at the mouth of the Vistula River identified the diet composition of grey seals as being predominately made up of perch (*Perca fluviatilis*), pikeperch (*Sander lucioperca*), river lamprey (*Lampetra fluviatilis*), Baltic cod (*Gadus morhua callarias*) and sea trout (*Salmo trutta trutta*). This data confirms that the grey seal is an opportunistic predator, with a diet that reflects and exploits the variations in its habitat.

## 4.3 Harbour Seal

*Summary Status – Migratory, Protected Species.*

The harbour seal (*Phoca vitulina*) mainly occurs in the southern Baltic Sea. The abundance of the Baltic Sea Harbour Seal has been in decline since the beginning of the 20th Century. Currently, their number is estimated at approximately 1,000 individuals (HELCOM, 2013). Harbour seals are listed on Annex II and IV of the Habitats Directive and are regionally listed as an Endangered species. The IUCN Red List of Threatened Species classifies Harbour Seals globally as 'Least Concern' – LC category (IUCN 2007, IUCN Red List *Phoca vitulina*).

Generally, the species is gregarious, hauling out in groups to breed, moult and rest. This species usually lives in shallow waters, near sandy or rocky beaches. Pups are usually born on sheltered beaches, rocks or littoral sandbanks, from where they can follow the mother into the water immediately after birth. Harbour seals feed on a great number of fish species, including clupeoids, gadoids, sand eels, sculpins and flatfish. They tend to stay within 25km of the shore, but with individuals occasionally found 100km or more offshore.

Although rare within the Baltic Sea, the Vistula River Mouth Ramsar site (14km east of the site) is an important resting area for harbour seals and the reason for their listing as a protected feature of the Ramsar Site. Harbour seals occasionally breed at the site, which is the only known breeding location for this species in Poland.

# 5. Marine Mammal Impacts

## 5.1 Acoustic Impacts - Piling

Piling represents the most significant noise source and potentially the most damaging noise source associated with the construction work. Piling source levels vary depending on the diameter of the pile and the method of pile driving, see Section 2 for proposed piling methodology at time of writing.

Source levels of 228dB re 1µPa m (Peak) or 243–257dB re 1µPa m (Peak-to-Peak) have been reported during percussive pile driving (ACCOBAMS, 2016[4]). Within 10m of impact pile driving activities Reyff (2012) reports peak sound pressure levels up to 220dB for 2.4m steel CISS and SEL impacts at 195dB.

Vibratory pile driving produces a continuous sound with peak pressures lower than those observed in pulses generated by impact (percussive) pile driving. Average, near source, peak sound pressure levels range from 165-185dB. Sound or vibrations generated by pile driving may also be transferred via the substrate and emerge at some distance from the source.

Table 1 below, from Reyff (2012), summarises near source (<10m) unattenuated sound pressures for in water pile driving.

**Table 1. Pile Driving Acoustic Source Levels**

| Pile Type and Approximate Size | Relative Water Depth, m | Average Sound Pressure, dB | | |
|---|---|---|---|---|
| | | Peak | RMS* | SEL** |
| Impact pile driving | | | | |
| 0.30-m Steel H type – Thin | <5 | 190 | 175 | 160 |
| 0.6-m AZ steel sheet | ~15 | 205 | 190 | 180 |
| 0.61-m Concrete pile | ~15 | 188 | 176 | 166 |
| 0.36-m Steel pipe pile | ~15 | 200 | 184 | 174 |
| 0.61-m Steel pipe pile | ~15 | 207 | 194 | 178 |
| 0.8-m Steel pipe pile | ~10 | 210 | 193 | 183 |
| 1.5-m Steel CISS | <5 m | 210 | 195 | 185 |
| 2.4-m Steel CISS | ~10 | 220 | 205 | 195 |
| Vibratory pile installation | | | | |
| 0.30-m Steel H type | <5 | 165 | 150 | 150 |
| 0.30-m Steel pipe pile | <5 | 171 | 155 | 155 |
| 0.8-m Steel pipe pile | ~5 | 180 | 170 | 170 |
| 0.6-m AZ steel sheet | ~15 | 175 | 160 | 160 |
| 1-m Steel pipe pile - loudest | ~5 | 185 | 175 | 175 |
| 1.8-m Steel pipe pile | ~5 | 183 | 170 | 170 |

*RMS, root mean square; impulse level (35 ms average)
**SEL, sound exposure level for 1 s of continuous driving. CISS, cast-in steel shell

## 5.2 Sensitivity - Harbour Porpoise

The harbour porpoise is a cetacean species that is particularly sensitive to noise and has a high dependency on echolocation for orientation and foraging. This means the species is susceptible to impact from a vast range of anthropogenic underwater noise sources. Harbour porpoise hear frequencies in the range of 16-150kHz, with maximum sensitivity between 100-140kHz. High levels of underwater noise can damage hearing apparatus, which results in permanent or temporary echolocation disturbance leading to navigation errors, food tracking problems and may lead to gradual decline until death.

[4] https://accobams.org/wp-content/uploads/2019/04/MOP7.Doc31Rev1_Methodological-Guide-Noise.pdf

At short range, noise levels can induce physiological effects known as Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS); (Southall et al., 2007, Lucke et al., 2009, Kasteleinet al., 2016). PTS is a permanent impact on individuals, whereas TTS lasts minutes to hours. Prolonged exposure to PTS is likely to affect the energetic status of animals and hence survival, and possibly ability to mate and nurse offspring. The impact on energetic status from a few hours of moderate hearing loss (TTS) is less significant but still has the possibility to induce behavioural change.

The thresholds for PTS and TTS in harbour porpoise are described in Southall et al. (2019) and Tougaard (2021), see below table taken from (Tougaard 2021):

**Table 2. Impact Threshold Source Levels – Harbour Porpoise**

| | TTS | PTS |
|---|---|---|
| P-type and other sounds | 153 dB SEL VHF weighted | 183 dB SEL VHF weighted |
| I-type sounds | 140 dB SEL VHF weighted | 155 dB SEL VHF weighted |

The thresholds are divided into categories for I-type sounds and P-type sounds. Type-I sounds are characterized by the following three criteria:

- Very fast onset, often, but not always, followed by a slower decay.
- Short duration, fraction of a second.
- Large bandwidth.

P-Type sounds are characterised by fulfilling up to two but not all three of these criteria. The distinction between these sounds is important as is it recognised that Type I sounds have greater potential to induce hearing loss.

At noise levels where physiological injury is no longer a concern, noise can continue to interfere with the animals' ability to orientate, communicate and forage, likely causing avoidance behaviour. This may then cause a decrease in energy intake via lost feeding time. According to the Harbour Porpoise Conservation Program (2015) anthropogenic underwater noise of the intensity and frequency heard for porpoises can cause a 'masking effect'. In some situations, it drowns out the background and other sounds which are essential for survival. This causes problems in communication between individuals (mother-young, male-female) and it makes locating fish or identifying obstacles harder.

For avoidance behaviour, a Sound Pressure Level (SPL) of Leq-fast 45dB above the harbour porpoise's hearing threshold have been proposed as an exposure limit for harbour porpoises, where *Leq-fast* denotes the total sound energy averaged over 1/8 of a second. Kastelein et al. (2015) note that maximum sensitivity of harbour porpoise was experienced at ~39dB re 1 µPa. As such, avoidance behaviour is interpolated to be triggered at circa 84dB re 1 µPa.

For TTS, a Sound Exposure Level (SEL) of 100–110dB above the porpoises hearing threshold for pure tones at the relevant frequency was suggested as a preliminary exposure limit (Tougaard et al., 2015). Implementing the hearing threshold reported by Kastelein et al. (2015), TTS is interpolated as 145-155dB re 1 µPa. This value accords with the TTS values proposed by Tougaard (2021).

For large diameter monopiles, Effective Deterrence Ranges (EDRs) between 18km and 34km have been reported for the driving of the piles without noise abatement. Tougaard et al. (2013) estimated an EDR of 26km to reflect the overall temporary loss of habitat from the use of monopile foundations.

## 5.3 Sensitivity - Grey Seal and Harbour Seal

Grey seals rely heavily on acute underwater hearing to detect prey, detect danger and recognise conspecifics (members of the same species). Seals hear in the range 0.1 to ~69kHz, with maximum

sensitivity at around 1kHz. Since the hearing abilities of grey seals is centred more around the lower frequencies (compared to harbour porpoises), and most anthropogenic sound is at similar lower frequencies, they are likely to be particularly sensitive to anthropogenic sound. Noise can cause disturbance and scare individuals, which is a particularly unfavourable factor at breeding or moulting sites. Pups are known to be present in the vicinity of Gdansk Port (Hel Marine Station; pers. comm.).

There is limited information available regarding grey seal or harbour seal susceptibility to noise induced hearing loss. No TTS thresholds or any other information on TTS in grey seal or harbour seal is available, however Southall et al. (2019) suggested that as thresholds for other species of seal (harbour, northern elephant and northern fur) are all similar, grey seal thresholds are likely to be similar (harbour seal assumed to be similarly aligned), see below table taken from Tougaard (2021).

**Table 3. Impact Threshold Source Levels – Phocids (Seals)**

| | TTS | PTS |
|---|---|---|
| P-type sounds | 181 dB SEL PCW weighted | 201 dB SEL PCW weighted |
| I-type sounds | 170 dB SEL PCW weighted | 185 dB SEL PCW weighted |

Behavioural impacts of pile driving on grey seal have been found several tens of kilometres away from pile driving sites in the North Sea. Aarts et al. (2018) found that grey seals reduced descent speed and reduced bottom time during pile driving events up to 36km from pile driving activity. This has potential to alter food intake and foraging ability. This study also indicated that a behavioural response by grey seals to pile-driving occurred in response to SELs of 133dB re 1 $\mu Pa^2s$.

Similarly, displacement of harbour seals up to 25km away from piling activities have been observed (Russell et al., 2016). It has been predicted that harbour seals are displaced at SPLs of between 166 and 178dB re 1 µPa (p-p), and at SELs of between 142 and 151dB re 1 µPa2 s−1.

## 5.4 Indicative Impact Thresholds - Summary Tables

**Table 4. Indicative Impact Thresholds [dB]**

| Species | PTS | TTS | Disturbance |
|---|---|---|---|
| Harbour Porpoise | [SEL] 155 dB re 1 µPa2s | [SEL] 140 dB re 1 µPa2s | [SPL] ~84dB re 1 µPa |
| Grey Seal | [SEL] 185 dB re 1 µPa2s | [SEL] 170 dB re 1 µPa2s | [SEL] 133dB re 1 $\mu Pa^2s$ |
| Harbour Seal | [SEL] 185 dB re 1 µPa2s | [SEL] 170 dB re 1 µPa2s | [SPL] 166-178 dB re 1 µPa(p-p)<br>[SEL] 142-151 dB re 1 µPa2 s−1 |

**Table 5. Indicative Distance Thresholds***

| Species | Mortality | PTS | TTS | Disturbance |
|---|---|---|---|---|
| Harbour Porpoise | ≤20m | ≤150m | ≤400m | ≤26km [max. 34km] |
| Grey Seal | ≤20m | ≤100m | ≤250m | ≤36km |
| Harbour Seal | ≤20m | ≤100m | ≤250m | ≤25km |

*Threshold distances dependent upon technology proposed, local physical conditions and any technology-specific mitigation applied.

Notably, harbour porpoise are more sensitive to acoustic impacts than seals, experiencing significant impacts at lower dB thresholds and at greater distances from source. It should be noted that under the

Habitats Directive, disturbance has been determined through case law to result in significant impacts on the integrity of European Sites.

Mitigation measures are required to manage potential impacts on marine mammals on a precautionary basis, in accordance with the fundamental tenet of the Habitats Directive [the 'Precautionary Principle']. A preliminary Schedule of Mitigation follows to be reviewed upon receipt of additional pertinent data, including specific piling technology, associated acoustic data and preliminary noise monitoring. Mitigation measures will be under constant review to ensure the most robust and proportionate processes are followed.

# 6. Schedule of Mitigation

The following mitigation measures have been recommended based upon guidelines produced by the UK's Joint Nature Conservation Committee (JNCC). Notably, *Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise*[5] to reduce the potential risk of mortality, injury or disturbance to marine mammals near piling operations to reduce the potential risk of mortality, injury or disturbance to marine mammals near piling operations.

The mitigation measures herein shall be secured in the relevant Contractor Method Statements and Construction Management Plans, and implemented in full. On receipt of further information (technology-specific piling information) or following noise monitoring, the Schedule of Mitigation shall be reviewed and updated as necessary by EPC / Dredging Contractor for review by Supervision Engineer and the Lender or Lender's Technical and E&S Advisor Consultant via an experienced marine ecologist.

Whilst harbour porpoise presence in Gdansk Bay was understood to be seasonal [2014 data], recent unpublished data [2021 – 2022] from Hel Marine Station of the University of Gdansk suggests a seasonal presence in the vicinity of the Port of Gdansk [within 5km] and a nearly annual presence within the Bay of Gdansk; including approximately 10-20km from the proposed development. Similarly, grey seal and harbour seal are reportedly present throughout the year. Notably, harbour seal are known to breed at the Vistula River Mouth Ramsar site (14km east of the site – only known site in Poland), whilst both grey seal and harbour seal use the site and surrounds for resting and foraging. No impact on the breeding site is anticipated but mitigation measures are included to protect seals and pups.

Consequently, the Schedule of Mitigation is to be implemented for the full duration of all vibratory and percussive piling activities. Agreement on seasonal requirements for marine mammal mitigation shall be agreed with the Lender once the piling programme is confirmed; e.g. should vibratory and / or percussive piling be restricted to the period November to June, marine mammal mitigation would only be required during this period. This approach will ensure that all the construction works of Terminal T3 will be undertaken in accordance with the prevention and foresight principle mentioned in Article 6 of the Environment Protection Act of 27 April 2001 (Polish Journal of Laws 2021, Item 1973 as amended).

As stated within Section 2.3, dredging activities only require 'soft-start' to ensure compliance with the Environmental Decision [ED, 2019].

## 6.1 Marine Mammal Mitigation Protocol

### 6.1.1 Best Available Technique

The Contractor should demonstrate that Best Available Techniques (BAT) are being implemented in their construction, piling and dredging methodologies - utilising techniques, generally in the following sequence of priority: gravity-based piling > drilled piles (least impact) > vibratory piling (manageable impact) > percussive piling (greatest potential for impact).

Noise Abatement Techniques - technology-specific mitigation such as hammer modifications, sleeving or muffling are typically available to reduce noise emissions. For example, pile enclosures

[5] JNCC Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise. August 2010.

may reduce dB levels by ~23dB or can be maximised to a ~26dB reduction combining enclosures and bubble curtains[6]. No such noise abatement techniques are currently proposed.

### 6.1.2 Noise Impact Monitoring

At the onset of the piling programme, noise impact monitoring shall be undertaken on the first pile installations [2-3 vibratory and percussive piles each] to gather data on actual piling noise impacts utilising the chosen piling technology, with and without proposed noise abatement techniques where applicable. This data shall be shared with the Lenders Technical and E&S Advisor and used to refine threshold distances and inform a review of the Schedule of Mitigation. The noise monitoring shall also obtain data on the ambient noise to inform the impact threshold review in the absence of piling activities. Both ambient noise and anthropogenic noise sources contribute to the baseline sound conditions of the site. As such, additional construction noise may act cumulatively on a site-specific basis with baseline noise conditions.

A specification for noise monitoring shall be prepared by the Contractor and submitted to the Lenders Technical and E&S Advisorfor review prior to the commencement of piling. The initial pile installations (vibratory and percussive independently) shall be measured by hydrophone at appropriate threshold distances (e.g. 10m, 50m, 100m, 250m, 500m from the pile location). Data is to be recorded and compared to standard specifications for the respective piling technology. A monitoring report shall be shared with the Supervision Engineer, Lenders Technical and E&S Advisor to enable a review of marine mammal mitigation informed by site-specific noise data. Should the monitoring identify significant noise impacts, additional noise abatement techniques may be required.

Where significant changes are made to the construction methodology, such as change of piling rig or pile type / size, additional noise monitoring and review of mitigation may be required.

### 6.1.3 Marine Mammal Observers

Dedicated Marine Mammal Observers (MMOs) should be stationed at appropriate positions (quay or boats - MMO / PAM Team to confirm locations based on training / experience) in order to detect marine mammals during piling activities and implement the JNCC Piling Protocol and agreed marine mammal mitigation measures. MMO observation shall monitor marine mammals within a mitigation zone of no less than 500m. MMO's must be experienced and qualified MMO Practitioners (see JNCC guidance) and must be provided with authority and means to enable immediate cessation of soft-start works in the event of cetaceans encroaching within the 500m buffer during piling activities.

Observer fatigue must be considered in resourcing MMO, such that if the piling programme occurs over long periods in the day, suitable breaks are included and / or additional resource is provided to allow a shift change. Two teams of two MMO's are recommended to work on rotation as appropriate to the piling programme.
MMO and PAM Operators are available in Poland and nearby countries, frequently travelling to provide services; example sources (not endorsed) include the Marine Mammal Observer Association (MMOA) (mmo-association.org)

### 6.1.4 Passive Acoustic Monitoring (PAM)

Passive Acoustic Monitoring (PAM) is implemented to detect harbour porpoises within the mitigation zone. PAM shall be used to supplement or replace visual observations; particularly in poor visibility or during any piling required during hours of darkness (important for winter working). PAM

[6] Example pile enclosure – Page 8: http://greenglobalgroup3g.com/images/sampledata/parks/landscape/IHCHydrohammerOffshore.pdf

Operators must be experienced and qualified PAM Practitioners and must be provided with authority and means to enable immediate cessation of soft-start procedures in the event of cetaceans encroaching within the mitigation zone during piling activities.
Fatigue must be considered in resourcing PAM Operators, such that if the piling programme occurs over long periods in the day, suitable breaks are included and / or additional resource is provided to allow a shift change. Two teams of one PAM Operator are recommended to work on rotation as appropriate to the piling programme.

Note, PAM is not suitable for pinnipeds (in this case grey seal and harbour seal) due to limited vocalisations and can therefore be only applied to harbour porpoises

### 6.1.5 Mitigation Zone

A pre-agreed radius around the piling site must be established, which the MMO / PAM operative will monitor visually and acoustically for marine mammals before piling commences. The extent of this zone represents the area in which a marine mammal could be exposed to sound that could cause disturbance or injury and will be determined by factors such as the pile diameter, the water depth, the nature of the activities (for example whether drilling / dredging / other piling will also take place) and the effect of the substrate on noise transmission. The radius of the mitigation zone is proposed at 500m from the noise source in accordance with best practice**Error! Bookmark not defined.**.

### 6.1.6 Pre-Piling Search

The 500m mitigation zone should be monitored visually by MMOs, and/or acoustically using PAM, for an agreed period prior to the commencement of piling. It is recommended that the pre-piling search duration should be a minimum of 30 minutes.

### 6.1.7 Poor Visibility / Sea State

Piling should not commence when visibility/sea state is not conducive to visual observation and reliance is solely on the use of MMO. Detection of marine mammals, particularly porpoises, will decrease as sea-state increases. While ideally sea-states of '2' on the Beaufort Scale or less, are required for optimal visual detection the risks of not detecting individuals within the Mitigation Zone should be reduced by the combined use of visual monitoring and PAM. Piling may progress where PAM is operational and has been agreed in advance. Effective observation is deemed viable up to and including a Beaufort Scale of 4.

### 6.1.8 Soft-Start Requirement

As a pre-requisite of the EIA Consent, soft-start protocols (a gradual ramping up of power to target operational levels), should be undertaken during all impulsive or continuous noise generating activities to allow marine mammals to move away from the noise source, reducing likelihood for injury from exposure and enabling individuals to move away from the affected area prior to 'full power' piling.

### 6.1.9 Break in Piling Activity

If there is a pause in piling operations for >10 minutes, the pre-piling search and soft-start procedure must recommence before piling restarts. If a watch has been kept during the piling operation, the MMO or PAM operative should be able to confirm the presence or absence of marine mammals, and it may be possible to commence the soft-start immediately. However, if there has been no watch, the complete pre-piling search and soft-start procedure should be undertaken.

### 6.1.10 Acoustic Deterrent Devices

The use of devices that have the potential to exclude seals from the piling area shall be implemented to deter seals. Acoustic Deterrent Devices (ADDs – 'seal scarers') shall be used to discourage animals from the piling area, in conjunction with visual or acoustic monitoring. ADDs should be positioned in the water near the pile to be installed. ADDs should be switched on throughout the pre-piling search and turned off immediately after the piling activity has started.

### 6.1.11 Simultaneous Piling

Simultaneous piling shall be avoided whenever practicable to avoid cumulative impacts. Should simultaneous piling (vibratory and / or percussive) be required, the marine mammal mitigation schedule shall be reviewed by an appropriately experienced marine ecologist.

### 6.1.12 Marine Mammal Mitigation Protocol – Process Summary

The sequence of events for relevant activities shall be as summarised below. This Protocol is to be implemented for the full duration of all vibratory and percussive piling activities.

Whilst harbour porpoise presence in the vicinity of Gdansk Port is seasonal, an annual presence is reported throughout Gdansk Bay [Hel Marine Station unpublished data, 2021-2022], grey seal and harbour seal presence is reported to be throughout the year. Notably, harbour seal are known to breed at the Vistula River Mouth Ramsar site (14km east of the site – only known site in Poland), whilst both grey seal and harbour seal use the site and surrounds for resting and foraging. No impact on the breeding site is anticipated but mitigation measures are included to protect seals and pups.

## 6.2 Mitigation Process Summary

1. 30 minute pre-piling search by MMO / PAM.

2. If no marine mammals are observed within the mitigation zone (Section 6.1.6), soft-start can commence. Soft-start should not be commenced if marine mammals are detected within the mitigation zone during the pre-piling search, or until 20 minutes after the last visual or acoustic detection.

3. Soft-start (Section 6.1.8) to be implemented over 30 minute duration (JNCC Protocol recommends that the soft-start duration should not be less than 20 minutes), gradually increasing energy output, until full operational power is achieved. [Note – this is the only requirement for dredging activities, in compliance with ED, 2019].

- 30-minutes duration of soft start protocol is necessary for the initial pile installation of each piling operation, and any other operation for which the break between piling activity is longer than 60 min when Acoustic Deterrent Devices was on,
- or longer than 10 minutes if they were off.
- In cases where there are 10-30 or 60-minutes breaks, the time for soft-start procedure from zero to full power could be reduced to 5 minutes, if the acoustic deterrent has been on during the break lasting longer than 10minutes

The proposed timing deviates from the JNCC protocol considered good practice for piling activities. As the JNCC protocol has been developed in the UK with specific objective of protecting species present in the North and Irish Seas and Atlantic Ocean, the proposed changes will be consulted with experts of Hel Marine Station of the University of Gdansk through focused engagement during disclosure of this documentation

4. If marine mammals are sighted within the mitigation zone during soft-start then MMO / PAM to instruct cessation of activity dependent on location and behaviour – to be advised by the MMO / PAM Operator. If soft-start is stopped, recommence Protocol with Pre-Piling Search. If no observations / PAM contacts, then continue to full strength piling.

6. If observation of marine mammals is made during full-power piling, no cessation to be triggered – marine mammal approaches aware of the full impact (deemed to have entered the area voluntarily).

7. Should there be any break in piling (as defined in [#3: soft-start] above), recommence Protocol with Pre-Piling Search.

## 6.3 Monitoring

Monitoring reports detailing the piling activity and implementation of the marine mammal mitigation, shall be sent to the Lender (or Lender's Consultant) on a monthly basis for review by an experienced marine ecologist. Monitoring reports should include:

- Completed Marine Mammal Reporting Forms: date, location and duration of piling operations.
- A record of all occasions when piling occurred, including details of the duration of the pre-piling search and soft-start procedures, and any occasions when piling activity was delayed or stopped due to presence of marine mammals.
- Details of watches made for marine mammals, including details and photographs (where practicable) of any sightings, details of the PAM equipment and detections, and details of the piling activity during the watches.
- Details of any Acoustic Deterrent Devices (ADDs) used, and any relevant observations on their efficacy.
- Details of any problems encountered during the piling process (e.g. technical issues, weather delays), including instances of non-compliance with the agreed piling Protocol.
- Any recommendations for amendment of the Protocol.

# 7. Next Steps

Recommendations for subsequent actions as follows [all reviews shall be undertaken by an experienced marine ecologist]:

- Focused stakeholder engagement will be organised by DCT with Chief of the Seal Sanctuary of the Hel Marine Station of the Institute of Oceanography of Gdansk University to discuss the proposed deviations from the JNCC Protocol and their effectiveness in protection of marine mammals from project piling activities.
- A specification for noise monitoring at commencement of the piling programme shall be prepared by the Contractor and submitted to the Lender's E&S Advisor for review.
- Noise Monitoring to be undertaken and results shall be prepared by the Contractor and submitted to the Lender's E&S Advisor for review.
- The Contractor shall provide details on the proposed piling technology and associated hammer specifications, calculated or monitored noise values, details of relevant noise abatement opportunities available – technology-specific or general (bubble curtain, etc.) – including calculated reduction in noise impact.
- The Contractor shall provide details on the proposed piling methodology – number of piles, diameter and composition of piles, outline piling programme including anticipated daily duration and likelihood of simultaneous, continuous or 24-hour piling.
- Preliminary Schedule of Mitigation outlined in this Report is to be further developed by DCT and their dredging / piling contractor under Detailed Construction Environmental and Social Management Plan and Dredging Management Plan. Both documents will be submitted for review to Supervision Engineer, Lenders Technical and E&S Advisor.
- The Contractor shall complete monthly Marine Mammal Monitoring Report following commencement of piling. The monitoring reports shall provide the details requested in Section 6.3 above.
- Lenders Technical and E&S Advisor shall undertake a review of the monthly Marine Mammal Monitoring Reports, providing constructive feedback to the Contractor.

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