

Document Details

Company Submitting: DRAGADOS

Document Title: Environmental Mitigation - South Breakwater and Shore Blasting

Document Number: AHEP-DRA-EMP-0003

Revision: 04.1

The owner of this document holds the Obligation under the Contract to produce, manage and discharge the obligation to comply with the contract terms.

Prepared by	[Redacted]	Dragados	25/10/18	
Reviewed by	[Redacted]	Dragados	26/10/18	
Approved by	[Redacted]	Dragados	7/11/18	

1. Contents

1. Contents.....	2
1 Introduction	3
2. European Protected Species Legislation.....	3
2.1. Licensing	4
2.2. Construction Environmental Method Document (CEMD)	4
2.3. Associated method statements and guidance documents	4
3. Scope of Works.....	5
3.1. Schedule of the works.....	6
4. Works Methodology Land Based Drilling & Blasting – Rock Solutions	6
5. Work Methodology Marine Based Drilling & Blasting – Wasa.....	8
6. Environmental Controls for land and marine drilling and blasting above and below MHWS	9
6.1. Drilling above and below MHWS - Environmental Controls.....	13
6.2. PAM monitoring stations	13
6.3. Acoustic Deterrent Device (ADD).....	16
6.4. Double bubble curtain & blast noise monitoring.....	17
6.5. Rock removal by mechanical means	18
7. Rock Dredging	18
7.1. Rock Dredging & Disposal –Environmental Controls	18
8. Work within the SSSI	19
9. Reporting	20
Appendix A- Marine Mammal Recording Forms	1
Appendix B - Drawings.....	2
Appendix C – Equipment to loosen rock by mechanical means.....	2

1 Introduction

This document, which is an addendum to the approved Construction Environmental Management Document (CEMD)¹, describes the methodology and environmental mitigations for rock drilling, blasting and rock dredging and disposal works for the southern trenches along the South Breakwater and Southern shore areas which form part of the Aberdeen Harbour Expansion Project (AHEP). The works are to be carried out by Rock Solutions (land based) and Wasa (marine based) on behalf of Dragados UK Ltd.

2. European Protected Species Legislation

All marine drilling blasting and disposal works will comply with the European Protected Species Legislation, Marine Licensing, and requirements detailed in the approved CEMD and the AHEP Harbour Revision Order.

All species of cetacean are listed on Annex IV of the Habitats Directive (92/43/EEC), the Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (The Habitats Directive), that requires they are offered strict protection from: all forms of deliberate capture, killing or disturbance, particularly during the period of breeding, rearing, hibernation or migration; and deterioration and destruction of breeding sites or resting places. There is also an obligation to establish a system to monitor incidental capture and killing of cetaceans.

The Habitats Directive has been transposed into domestic law via secondary legislation including:

- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).
- The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2012 in relation to the terrestrial environment and in territorial waters out to 12 nautical miles (nm). These are often referred to as the 'Habitats regulations'.
- The Conservation of Offshore Marine Habitats and Species Regulations 2017 (the '2017 Regulations'), which consolidate and update the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (SI 2007/1842) (these are often referred to as the 'Offshore Marine Regulations') and apply to UK territorial waters outside 12 nm; and
- The Wildlife and Natural Environment (Scotland) Act (2011), WANE.

These pieces of legislation define two offences relating to European Protected Species (including marine mammals); deliberate injury and deliberate disturbance, as well as refining the circumstances in which disturbance may be particularly damaging to the animals concerned (as envisaged by Article 12 of the Directive). In addition, the amendments also provide for the offence of deliberate injury.

Under Regulations 39(1)(a) and (b) of the Habitats Regulations (as amended) for activities within Scottish inshore waters (12 nm) (MS 2014), it is an offence to:

- (a) Deliberately or recklessly to capture, injure, or kill a wild animal of a European protected species;
- (b) deliberately or recklessly:
 - i. to harass a wild animal or group of wild animals of a European protected species;
 - ii. to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
 - iii. to disturb such an animal while it is rearing or otherwise caring for its young;
 - iv. to obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;

¹ Aberdeen Harbour Expansion Project Construction Environmental Management Document, Rev 1 (April 2017)

v. to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; vi. to disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young; or vii. to disturb such an animal while it is migrating or hibernating.

Regulation 39(2) provides that it is an offence to:

- Deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean).

Furthermore, it is an offence of strict liability to damage or destroy a breeding site or resting place of such an animal (SNH 2014a).

All of the above offences apply to all stages of the animal's life to which they apply (SNH 2014a).

2.1. Licensing

The following licences relevant to the proposed activities have been applied for and received

- Marine (Scotland) Act 2010, Part 4 Marine Licensing; Licence to Construct, Alter or Improve Works and to Deposit or Use Explosive Substances or Articles Within The Scottish Marine Area- License Number 05965/16/0.
- Marine (Scotland) Act 2010, Part 4 Marine Licensing; Licence to Carry Out Dredging and to Deposit Dredged Spoil Substances or Objects Within the Scottish Marine Area –License Number 05964/18/0.
- Marine Scotland European Protected Species License –MSEPS 06/2018/1 15 October 2018.
- Aberdeen Harbour Revision Order May 2016.

2.2. Construction Environmental Method Document (CEMD)

Additional information relevant to the proposed activities can be found in the following chapters within the CEMD:

Chapter 3 – Construction Method Statement

Chapter 7 – Dredging & Dredge Spoil Disposal Management & Monitoring Plan

Chapter 8 – Fish Species Protection Plan

Chapter 11 – Marine Mammal Mitigation Plan

Chapter 13 – Noise and Vibration Management Plan

Chapter 15 – Pollution Prevention Plan

Chapter 17 – Vessel Management Plan

2.3. Associated method statements and guidance documents

This method statement should also be read in conjunction with the following;

- Aberdeen Harbour Expansion Project (AHEP) – Underwater Noise + Passive Acoustic Monitoring Procedure, August 2018, Eco Fish Global Rev 7
- Aberdeen Harbour Expansion Project (AHEP) – Drilling and blasting methodology – Environmental controls – Marine Mammals Rev 7

- AHEP Southern Shore works – construction of access road and blast platforms Rev 02
- Bubble Curtain Set Up Methodology Rev 1

3. Scope of Works

This document outlines the methodology for the drilling and blasting of rock for the trenches of the South Breakwater and the slopes of the Southern Shore at the AHEP. The mitigation and monitoring measures proposed and monitoring equipment are the same as presented in 'Underwater Noise + Passive Acoustic Monitoring Procedure Rev 7' and 'Drilling and blasting methodology – Environmental controls – Marine Mammals Rev 7' documents, apart from the locations of the PAM and underwater noise monitoring locations, which differ for the south breakwater trenches and southern shore slopes, as detailed in this document.

The term 'land blasting' refers to any blasting above and below MHWS that is carried out using land-based equipment operating from the existing land or on built-up platforms in the marine area. The term 'marine blasting' refers to blasting that is carried out above and below MHWS using marine-based plant, i.e. equipment on vessels, jack-up rigs or floating platforms. Some blasting occurs outside the marine area (above MHWS) but the majority is within the marine area below MHWS.

Land blasting will occur in areas of land above and below mean high water springs (MHWS), with land based drill rigs by Rock Solutions and marine blasting will occur in the marine environment below MHWS by Wasa as presented in Figure 1, please refer to full drawing AHEP-DRA-SKE-0274-001_rev3 Work Areas Land Based Drill and Blast in Appendix C. All blasting will be coordinated so that a maximum of two blasts a day is carried out in accordance with the Marine License 05965/16/0 and the CEMD 2017.

Blasting in areas above and below MHWS will occur behind a double bubble curtain which will be located in a layout that attenuates any blasting noise reaching 'open water' i.e. where a direct line of site occurs to open water from the blast position.

The southern land based rock blasting zone is illustrated in blue in Figure 1.

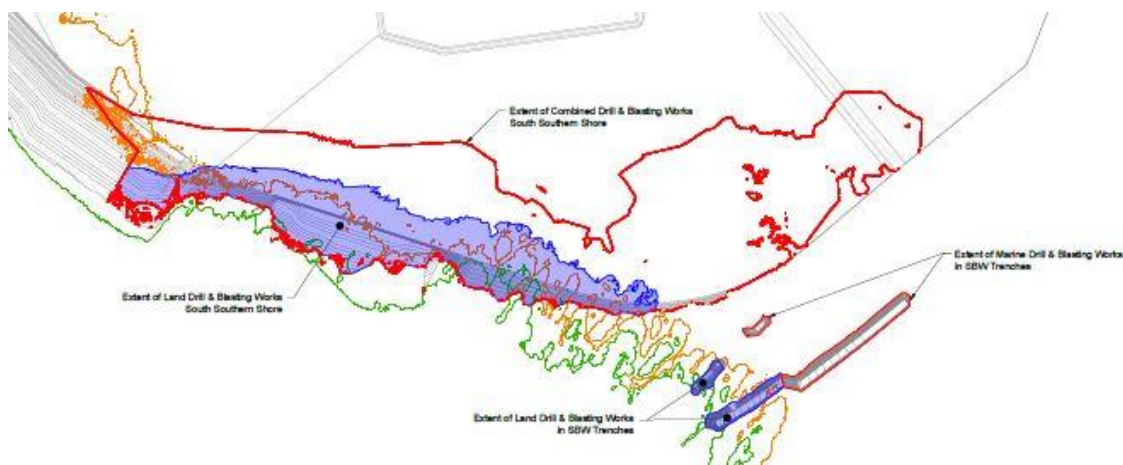


Figure 1: Plan on south shore including South Breakwater for land based operations (Please refer to Appendix C for full drawing)

Please refer to drawing AHED-DRA-SKE-0274-001-rev3 in Appendix C for details on how this land blasting relates to MHWS. The same environmental controls and mitigation will be applied to land based and marine based blasting.

The marine and land blasting works will be carried out in daylight hours between 7am and 7pm on weekdays, between 7 am and 4 pm on Saturdays with no blasting occurring on Sundays in accordance

with the Marine License 05965/16/0 and Harbour Revision Order. Land and marine based drilling will be on a 24/7 basis.

The blasted bedrock material will be placed in split hopper barges, these barges will dispose the blasted rock in the South Breakwater core, disposal up to the level of -4.00mCD (Chart Datum) or higher if possible. Rock can also be reused elsewhere within the site.

3.1. Schedule of the works

It is intended to commence the land and marine rock drilling and blasting to the trenches on the South Breakwater in November 2018 and complete within 7 weeks. The work is very dependent on weather and wave height and as such the duration may extend, perhaps into 2019 season.

Drilling and blasting works to the South Breakwater trenches by land based equipment will be carried out around the tidal movements with shifts approximating 6 hours on / 6 hours off, where areas of land are more easily accessible in low tide.

Marine, land blasting and dredging of blasted bedrock shall follow the approved procedures set out in the Underwater Noise and Passive Acoustic Monitoring Method Statement Rev 7, and reproduced below.

When blasting occurs the following conditions will be adhered to:

- a. Blasting is restricted to daylight hours unless during exceptional circumstances, this could be for Health & Safety reasons, delays to blasting due to weather or marine mammals being present or coming into the exclusion zone once charges have been set. Charges will not be set unless there is a high confidence that they can be detonated in daylight hours.
- b. A process to record and report, in writing to the licensing authority, within 48 hours, instances where blasting has occurred, outwith daylight hours, due to exceptional circumstances as detailed in point a above.
- c. The first blast will be a reduced charge size of 10 kg and all other blasts will be 20kg. If adverse effects on marine mammals are observed by the MMO'S, MS-LOT will be notified immediately/on the same day.
- d. Blasting will only occur behind a double bubble curtain which will attenuate any blasting noise reaching 'open water' i.e. where a direct line of sight occurs to open water from the blast position. Figure 7 outlines configurations of the Bubble Curtain.
- e. Blasting will not occur if wave heights are greater than Beaufort Sea State 3 (unless otherwise agreed by MS-LOT).
- f. Underwater noise recording will continue for all blasting operations unless agreed otherwise with MS-LOT.
- g. Blasting in the southern part of Nigg Bay or South Breakwater will not be carried out until the Southern Shore Works Final - Construction of access road and blast platforms rev 02 has been approved by MS-LOT.

4. Works Methodology Land Based Drilling & Blasting – Rock Solutions

Rock Solutions will be using a bulk emulsion explosive product for blasting operations. This is a water in oil emulsion containing dissolved ammonium nitrate, mineral oil and an emulsifying agent. Packaged product may be used initially during test blast phase.

Rock Solutions are contracted to blast approximately 120,000m³ of rock in three separate areas of the project as indicated in Table 1. This table provides a breakdown of the quantities of rock in each area with the anticipated quantity of explosive that will be employed in each area. This is calculated on the basis of 1kg of explosive per 1.3m³ of rock. Please refer to drawing AHEP-DRA-SKE-0274-001_rev 3 in Appendix C for details of the working areas.

Bulk emulsion will be delivered on a daily basis with no storage of emulsion material overnight on site. Detonators, boosters, connectors, firing lines and timing delays will be delivered separately to site daily or as required.

Location	Rock m3	Explosives (Kg)
North Quay	10,000 m ³	7,700
South Breakwater	5,461 m ³	4,200
South Shore		
Zone 3 – Area B2	46,085 m ³	35,500
Zone 3 – Area B3	58,082 m ³	44,700

Table 1: Estimated quantities of rock required to be removed and total weight of explosives

Temporary works piling platforms will be provided for access at the South Breakwater trenches at a level of +3mCD and for access to the South Shore at a level of +5mCD (Figure 2). All drilling will be carried out from these platforms.

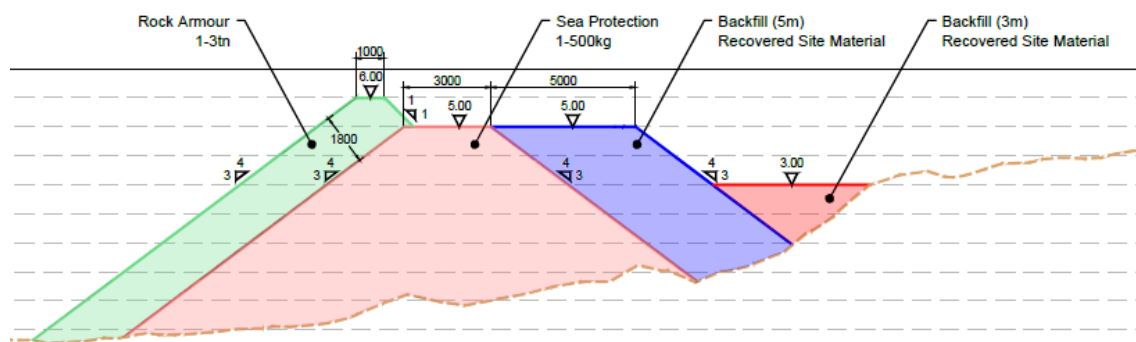


Figure 2: Typical section through platform on south shore

Rock Solutions will provide Dragados UK (DUK) with a drill grid detailing the pattern of shot holes, drill hole spacing, drill burden relative to the trench layouts and slope angles for each blasting event.

Each drill hole will be positioned by DUK using a 13T 360° excavator. Rock Solutions will drill through the platform's core fill material and 50mm into the rock with a Klemm crawler rig to position 1.5m long sections of steel casing (outside diameter 146mm and wall thickness 10mm) into which plastic pipe (diameter 105mm) will be installed. The Klemm rig will unscrew the casing and winch it from the hole, and disturbed material will be repositioned around the plastic pipe ensuring the pipe remains secure and vertical. Each pipe opening is then stoppered to prevent ingress of foreign material.

The Sandvik Tamrock Ranger 800-2 Drill Rig using 60mm drill rods and 102mm drill heads will commence drilling from rock level with each hole drilled to its predetermined depth taking due cognisance of trench slopes, formation levels and pre-split requirements as laid out in each blast plan.

Following completion of drilling and in preparation for blasting, each hole is checked for depth and alignment.

All charging operations will be carried out by the Shotfirer who may be assisted by other persons authorised by the Blast supervisor. If for any reason the Shotfirer has to leave the blast area whilst charging is in progress, they will ensure that all charging operations cease and that appropriate security

be appointed at the blast area before leaving. Detonators will be placed into a locked container suitable for the purpose and the Shotfirer will have the key at all times whilst away from the blast area.

Explosive requirements will be ascertained on the day prior to blasting. The delivery of explosives will be made on a daily basis as required and directly to the site by the explosives manufacturer. All explosives will be used on the day of delivery and no explosives will be stored on site. If explosives cannot be used on site that day they will be removed by the supplier.

The explosives used will be a pumped emulsion and the holes will be charged using a Nonel initiating system connected by down line to a primer charger. The hole will then be column charged with a pre-determined weight of explosives and the remaining depth filled with 10mm angular aggregate to form a tightly loaded plug. The minimum stemming depth will be calculated to ensure that the blast is horizontal and that the risk of vertical scatter is minimised.

The appointed Shotfirer will be fully experienced and will hold a Construction Skills Certification Scheme (CSCS) Shot firing certificate or an equivalent qualification. The Explosives / Blast Supervisor will be responsible for all aspects of the Blast Design and Specification. The Shotfirer will designate a danger zone while charging is taking place and sentries will be appointed as per the Sentry location map for each blast.

5. Work Methodology Marine Based Drilling & Blasting – Wasa

As detailed in the approved CEMD 2017 the following equipment will be used for marine drilling and blasting. Please refer to approved documents at section 2.3

A Top-hammer Rock Drill Sandvik Tamrock HL 1540 will be mounted on the barges (Boulder & Hector). Holes in diameter ranging from 92 to 126 mm will be drilled. A typical field for blasting can be up to 134 holes, depending on the sectioning (no of detonators in a hole).

Before drilling starts, the outer guidance tube is lowered on the seabed and pushed into the overlaying layer, down to the rock level, by assistance of air wash. The vertical position of the outer guidance tube is used for recording the top of rock level. This level is logged in the blasting plan chart and is later used to calculate the amount of explosive to be used.

The length of the hole and the final depth of drilling is determined by the amount of over-drill required. The over-drill ensures that when dredging is undertaken after the blast, it can take place to the required level without encountering hard spots. When drilling is on a grid of 4 x 4 m, the vertical over-drill usually is 2.5m and when drilling is on a 3 x 3 m grid the vertical over-drill is 2 m. The amount of over-drill will be kept to a minimum but both grid options are required to undertake the works.

This drill pattern is preferably chosen in a way so that on one side there is an open face, so that the rock during blasting can freely expand sideways (Figure 3).

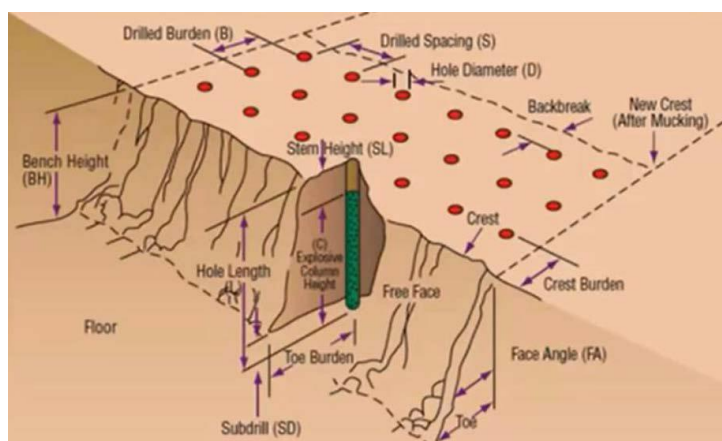


Figure 3: Blasting principles for marine blasting

When the drilling of a hole is finished, the drill rod is removed, and the hole is ready for charging. Prior to pumping the explosive, a Nonel detonator with booster (cartridge) is placed in the bottom of the hole. The amount of explosive pumped in to the hole is carefully monitored and logged for each hole by the loading computer. If necessary the charge is limited to a set quantity, some gravel is placed, and the next charge is pumped on top of the previous one, again with its own booster and detonator. No explosives will be stored on site unless it is deemed to be "in use".

After the hole is charged, the drill rig is moved on top of the next hole position. Upon completion of the row, the second row is drilled and charged, after that the pontoon is moved parallel sideways (backwards away from the field) to its next spud position in a controlled manner. Blasting will only take place once drilling is completed in accordance with the Drill and Blast design which accounts for spacing, rows, diameter, depth, charge weight and sequenced delays.

The appointed Shotfirer / Blast master will be fully experienced and will hold a Construction Skills Certification Scheme (CSCS) Shot firing certificate or an equivalent qualification. The Explosives / Blast Master will be responsible for all aspects of the Blast Design and Specification. The Shotfirer will designate a danger zone while charging is taking place and will ensure that the required exclusions are in place.

6. Environmental Controls for land and marine drilling and blasting above and below MHWS

Detailed below are the environmental controls and protocols to be followed for the land / marine drilling, blasting and disposal of material. The sequence of work will commence with drilling followed by blasting and latterly the dredging of blasted material which will be reused.

The southern trenches at the south breakwater that require drilling and blasting are above and below MHWS but are effectively land based and no drilling or blasting is predicted to occur in water as displayed in figure 4, however some areas of rock in the southern shore will require blasting in the marine environment with marine based equipment.

Between the drilling and blasting locations for the southern trenches, there is an area of dry land comprising of rocky beach and solid rock outcrops. The same mitigation for marine mammals will be conducted whether blasting is carried out on land or in the marine environment, .

Data will be analysed in parallel with activities and if noise levels are deemed at an acceptable level, i.e. below levels predicted to cause auditory injury to marine mammals, PAM / UWN monitoring will be discontinued following approval of MS-LOT. Blasting will be initiated with a 10 kg charge followed by a second blast with a 20Kg charge. No further blasting will take place until the calibrated results of these two blasts are verified not to have exceeded 183 dB re 1uPA (peak) outside the bubble curtain at 400m (or the modelled equivalent at the actual distance measured by the hydrophone). The results will be sent to MS-LOT within the following 72 hours of the blasts and no further blasting will take place until the results have been approved by MS-LOT (in conjunction with SNH) or if any of the recorded noise levels exceeds the aforementioned level.

An initial meeting will be held with Marine Scotland (and SNH if deemed appropriate by Marine Scotland) as soon as reasonably possible after the submission of the first blasts results to allow an early assessment of the recorded noise levels. The assessment of noise level monitoring results will be discussed at DUK's routine meetings with MS-LOT until agreed otherwise by MS-LOT. Once the results of the first tests blasts have been discussed in that first meeting, more frequent meetings may be agreed if required.

UWN monitoring, MMO and PAM mitigation will continue unless agreed otherwise by MS-LOT.

Seaward side trench



Harbour side trench



Figure 4: Areas requiring land blasting for the southern trenches

Prior to any blasting, agreed and approved safety and warning procedures are to be followed. The agreed procedures are;

1. When marine blasting of the southern trenches and the southern shore, PAM monitoring will be located on three vessels where line of sight to open water from the blast location requires it (some areas of southern shore blasting will require two vessels only). Typical locations and coverage for PAM and UWN monitoring are presented in Figure 6.1, 6.2 and Appendix C. This shows the areas that each boat will typically cover for mitigation control / PAM (pre-blast). Two MMOs will also be located on the north and south headlands and will be in radio contact with the lead MMO
2. One hour prior to the blast, the Blast master will alert the Lead MMO/PAM operator, MMO and the Bubble Curtain Operator of the intention to blast at a given time.
3. The Lead MMO/PAM operator will remain in constant communication with the acoustic technicians, MMOs, Blast master and the Bubble Curtain operator, via VHF Channel 13. The lead MMO/PAM operator will be responsible for mitigation controls across the site and will instruct the blast master to delay operations until the acoustic mitigation team is satisfied that all marine mammals are out of the exclusion zones and that mitigation protocols have been adhered to.
4. There will be a constant MMO presence during the whole period of blasting. One hour before the scheduled blast the MMO and PAM operator will undertake marine mammal monitoring within 1km (direct line of sight) of the blast. The MMOs will be positioned on the north and south headlands, which are at approximately 18m above sea level. (Figure 6). If any marine mammals are observed in the mitigation zones the blast will be postponed, until both PAM and the MMOs have confirmed the following:
 - For blasting in the northern part of the bay:
 - i. that no seals have been observed in the bubble curtain mitigation zone and
 - ii. no other marine mammals have been observed in the 1km exclusion zone for the last 30 minutes.
 - For blasting in the southern area (both for southern part of the bay and for the South breakwater trenches):
 - i. That no seals are either within the double bubble curtain or closer than 500m away from the blasting point, whichever is greater.
 - ii. no other marine mammals have been observed in the 1km exclusion zone for the last 30 minutes.

The Lead MMO then confirms to the Blast Master that blasting can commence. (Appendix 2 Blasting marine mammal protocol)

5. If seals are observed within the mitigation zones during this 30 minute observation period and no other marine mammals are present, the ADD will be activated for a maximum 20 minute period and will only be attempted twice within any one blasting operation. If this is not effective then use of the ADD will be ceased for that blasting operation as agreed in the EPS license variation MS/EPS/06/2018/1. Blasting will not go ahead if seals remain in the mitigation zone.
6. 15 minutes before the blast commences the bubble curtain is switched on, and the operator confirms to the Blast Master and MMO/PAM lead that it is operating effectively.
7. Before all blasts a small explosive device (for instance the 'Shockstar MS' containing 720mg of explosives) will be detonated one minute prior the start-up of the double bubble curtain to scare fish away.
8. The Project ECoW will also carry out checks for rafting birds in the vicinity of the blasting area and advise the Blast Master that the area is clear. The detonator charge used for fish scare will also scare any birds away in the immediate area. The movement of small vessels on the project also scares rafting birds off the water.

9. Drill platform / dredger is moved to safe distance from the blast area.
10. Blast master will visually check the area of blasting, to make sure no ships come near or that there is no one within the vicinity of the blast exclusion zone.
11. If there is a vessel approaching, or other activity occurs in or near the area of blasting, the procedure is suspended, until the vessel (or other activities) has left the area.
12. Blast master will make final check with MMO/PAM operator that no marine mammals are present in the exclusion zone.
13. Directly before the blast the Drill & Blast pontoon will signal the load horn using the blasting signal (increasing intervals).
14. The PAM operators on boats B and C as displayed in figure 6 will move into position for UWN monitoring as detailed in figure 8, which will take around a minute to achieve. Hydrophone systems will then be switched for UWN measurements.
15. Blasting takes place.
16. Immediately after blasting, the Drill & Blast pontoon will signal the “no more danger” signal (one long signal).
17. The Bubble curtain will be switched off and any fish kill or unusual activities will be recorded. As per the requirements of the current approved CEMD 2017, checks for any dead or injured salmon or other fish during marine construction activities will be carried out; this will form part of the environmental induction and toolbox talks.
18. All large fish carcasses which can be collected safely will be stored in an air tight container. The fish health inspectorate will be contacted immediately on collection of salmonid carcasses to arrange their collection and delivery to the MS-Fish Pathology Unit for sampling to determine cause of death. In the event that five or more fish carcasses (or injured, or moribund fish) are reported during one 24 hour period within 50m of a construction zone, the Ecological Clerk of Works (ECoW) will notify MS-LOT, Dee District Salmon Fishery Board and the Environmental Manager via phone and email. Within 24 hours of the fifth reported carcass, consultation will be sought with the Environmental Manager and MS-LOT to determine any temporary mitigation requirements. If deemed necessary, temporary mitigation will be implemented as soon as it is safe to do so.

Any dead marine mammal carcass will be delivered to SMASS team and reported to the Marine Scotland/SNH within 24 hours.
19. The number of dead or injured fish noted pre-blasting and post-blasting recorded, along with any pictures, will be provided to MS-LOT in the blasting report.
20. The Drill and Blast pontoon will be manoeuvred back into position ready for the next phase of drilling. The waste from the Nonel detonation cords are collected on board and drilling can be resumed.
21. The MMO will continue to watch for 20 minutes after blasting has occurred to record any information on behaviour of animals that enter into the mitigation zone after blasting.
22. PAM will continue monitoring for 20 minutes after blasting to determine how quickly marine mammals move back into the 1km mitigation zone

The Blast Propagation Modelling undertaken for the Environmental Statement and Additional Environmental Information Report predicted that the noise level at 400m from the blast site would be 170 dB re 1 uPa (rms), which equates to 183 dB re 1 uPa (peak). As described in Section 6.4, the outer hydrophone will be positioned at a varying distance from the blast site to record the propagation loss over distance.

An accurate real-time reading from the raw hydrophone data is not possible; however, the raw data will give an initial indication of the maximum recorded noise level. If the ‘initial indicator’ noise level

outside the bubble curtain exceeds 183 dB re 1uPA (peak) at 400m (or the modelled equivalent at the actual distance measured by the hydrophone), MS-LOT and SNH will be notified on the day of the blast, and no further blasting will be undertaken without the approval of MS-LOT.

The raw data will then be processed by the DUK appointed acoustician who will calculate the calibrated noise levels, and a report will be provided to MS-LOT within 72 hours of each blast. In these reports, both raw and calibrated measurements will be provided for all the blasts carried out up to date. The difference between raw and calibrated results will be assessed by DUK and it will be included in the report so that the accuracy and reliability of the raw data can be periodically validated by MS.

Once approval has been received from MS-LOT after they have considered the calibrated results of the first two test blasts, blasting will continue and the raw data from subsequent blasts will be provided to MS-LOT and SNH the same day, unless it is agreed that this is not required.

6.1. Drilling above and below MHWS - Environmental Controls

For areas that require drilling and blasting above and below MHWS as displayed in Figure 1, prior to the start of drilling the Marine Mammal Observer (MMO) will commence a 30 minute watch for marine mammals within the 500m (direct line of sight) exclusion zone area. If any marine mammals are observed the MMO will notify the Drill Master. Drilling will be postponed until the mammals move away and beyond the exclusion zone. Once the MMO is satisfied that the exclusion zone has been clear of marine mammals for at least 30 minutes the drilling will commence. All sightings will be recorded on MMO recording forms. The Drilling Marine Mammal Protocol presents the process to be used during all drilling.

6.2. PAM monitoring stations

The proposed PAM monitoring stations and detection coverage for harbour porpoise and bottlenose dolphin for the land and marine drilling and blasting of the southern shore and southern trenches are detailed in Figure 6.1 and 6.2 and Appendix C. There will be 360 degrees of coverage around each PAM location with harbour porpoise able to be detected within 300m and bottlenose dolphin within 1,000m from each location.

Three vessels will be used when required. The vessels will be statically positioned during the mitigation periods. Boat A (inner) will be positioned at the inner harbour/entrance channel. Boat B (outer north) will be positioned at the north of the outer bay. Boat C (outer south) will be positioned at the south of the outer bay when line of sight to the blasting works require it. After the south breakwater has progressed and line of sight is reduced, two vessels will be used for PAM as displayed in figure 6.2. The positions and mobility of the vessels may be adjusted after consultation with MS-LOT.

The calibrated PAM hydrophones will be deployed for one hour prior to a blast. Once there have been no marine mammals in the mitigation zones for a period of 30 minutes before the blast time, the Double Bubble Curtain is definitely on, the PAM Operator will give the 'green light' to the blast operator, who will detonate the blast.

Particular attention will be given to potential animals in the harbour, entrance channel and travelling from north and south into the mitigation zones.

Blasting will not take place in a Beaufort Sea State greater than 3 (unless agreed otherwise with MS-LOT) due to the efficacy of the MMO and PAM mitigation measures.

Note – noise monitoring positions during the blast will be carried out inside and outside of the bubble curtain. The positions will be in a straight line from the blast site as per figure 8 below. The distances from the blast site will be recorded to enable comparison with blast modelling and issue to MS-LOT.

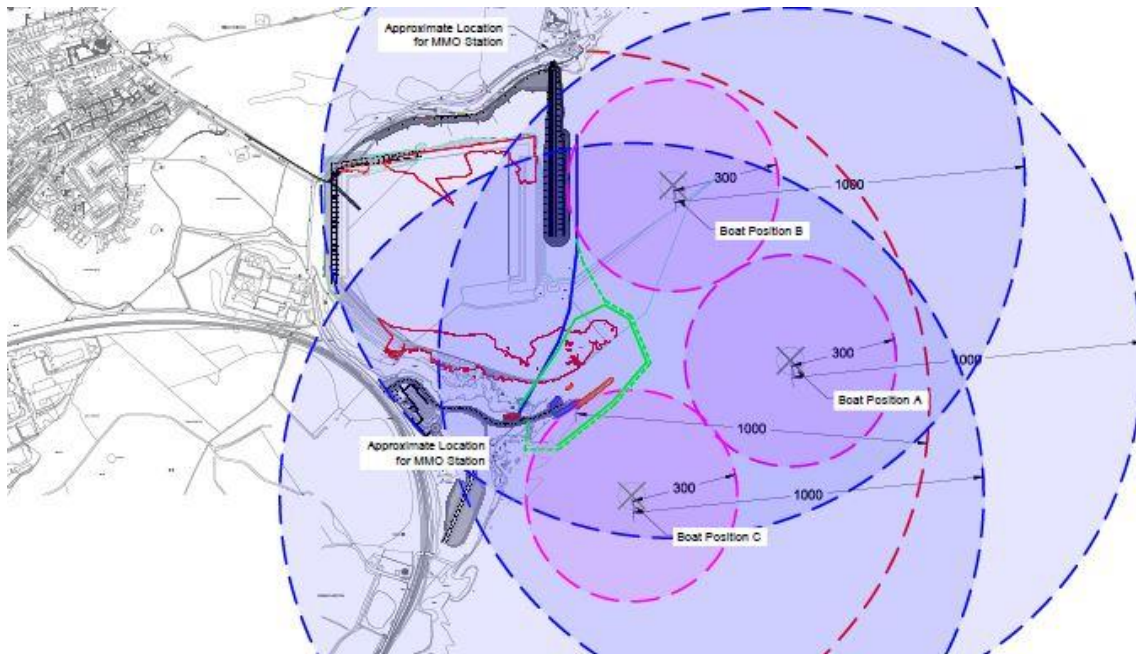


Figure 5.1 PAM Monitoring locations when line of sight to open water exceeds 90 degrees (please refer Appendix C for full drawing)

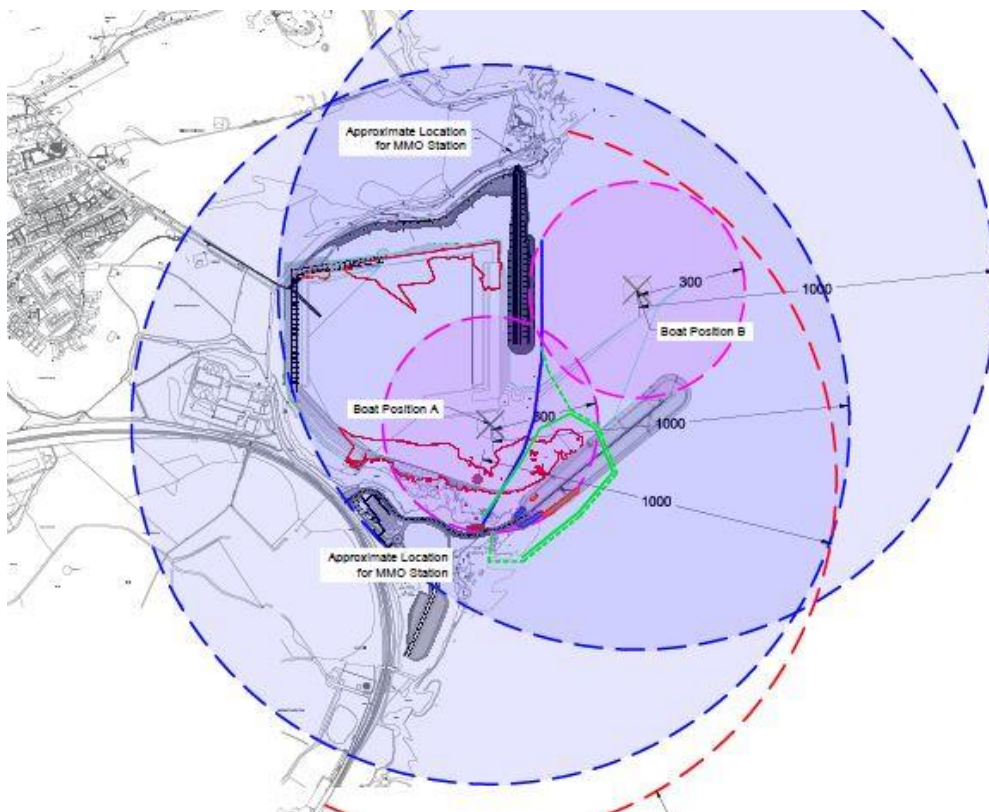


Figure 6.2 PAM Monitoring locations on southern shore (please refer Appendix C for full drawing)



Figure 6 Location for MMO Watches (height of each vantage point is approximately 18m above sea level).

6.3. Acoustic Deterrent Device (ADD)

Seals daily frequent the area around the south breakwater and may be present within the mitigation zones (as outlined in bullet point 4 in section 6). DUK have an approved European Protected Species (EPS) Licence MS/EPS/06/2018/0 for the use of Acoustic Deterrent Devices (ADDs) to deter seals during blasting operations. The use of an ADD is required to ensure seals are beyond the mitigation zones for blasting activities.

The ADD being used is developed by Lofitech. It will be used when seals are present for the duration of all blasting activities including those on land below MHWS which are planned to be undertaken from between August 2018 and October 2019.

The ADD will be positioned from a vessel within Nigg Bay. The exact location of the ADD will vary depending on where blasting activities are being undertaken within Nigg Bay and the location of any seals.

The exact details on how the ADD is to be used and the appropriate restrictions are stipulated in the approved EPS Licence MS/EPS/06/2018/1, however the details of methodology are detailed below.

- Prior to blasting the MMO/PAM will undertake a minimum 30 minute watch for all marine mammals out to 1 km to confirm there are no marine mammals present.
- If seals are observed within the mitigation zones during this 30 minute observation period and no other marine mammals within 1km are present the ADD seal scarer will be activated. The ADD will be switched on for 20 minutes followed by 20 minutes off. The MMOs will monitor the behavior of the seals and advise if they have moved out of the mitigation zone. If they have not moved the ADD will be reactivated for a further 20 minutes. If the ADD is not successful then operation will cease for that blasting operation. If required the vessel may be repositioned to ensure effectiveness of the ADD.
- The mitigation zone for seals will be as outlined in section 6.4 below.
- The mitigation zone for the southern trench area could be reduced pending noise modelling results and discussions with MS-LOT.
- The ADD will be located on an anchored vessel at a distance of 100m from any seal activity. Dependent on the water depth the ADD will be positioned mid –water. Vessels must not harass or approach the seals in an attempt to herd the seals out of the area.
- The audio frequency of the proposed ADD is 14kHz
- Initially a soft start procedure will be used with the ADD activated for short bursts, before ramping up to the full activation period detailed below.
- A record will be kept of each time the ADD is started and stopped. .
- The behavior of the seals will be monitored by MMOs before during and after the use of the ADD, and will be recorded and reported on.
- Following confirmation by the MMO/PAM that no marine mammals are within mitigation zones the bubble curtain will be switched on and blasting procedures (as described above from point four onwards) will commence.
- The MMO/PAM will continue observations during blasting and for at least 20 minutes post blasting.
- All observations will be recorded and reported.
- If the ADD appears to be ineffective or seals show habituation MS-LOT will be consulted immediately to discuss further mitigation measures. Blasting will not go ahead if seals remain in the mitigation zones.

6.4. Double bubble curtain & blast noise monitoring

An area in the South Compound has been allocated as the location of the Double Bubble Curtain compressor storage area. This area will contain 10 PTS 1600cfm compressors complete with two manifolds and compressor hoses which will provide compressed air to the Double Bubble Curtain Hoses.

DUK have procured 2 x 850m bubble curtain hoses from Hydrotechnik, Lubeck. The hoses will run from the compressor area in the South Compound to the South and will cover the South Breakwater areas, detailed on Figure 7 below.

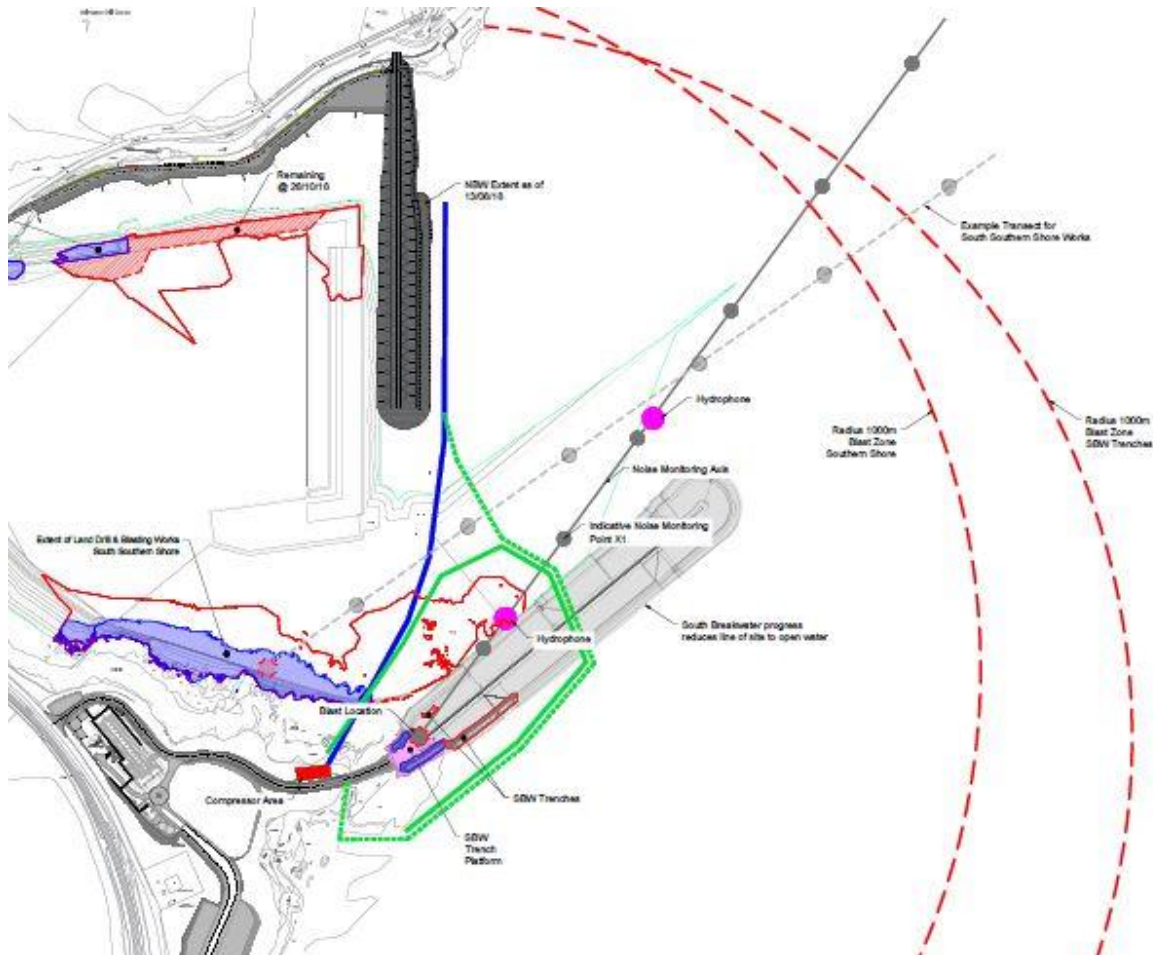


Figure 7: Map presenting planned locations for double bubble curtains and noise monitoring equipment for southern trenches and southern shore work. (please refer Appendix C for full drawing)

The small red area on Figure 7 is the compressor storage area. Two layouts for the blasting of the southern shore and southern trench areas will be utilized during blasting operations:

- The layout for the double bubble curtain for the South Breakwater trench areas will stretch from the southern shore of Nigg Bay, northwards and will form an arc around the South Breakwater blasting areas as depicted by the green line in Figure 8
- For areas that require blasting along the southern shore, the double bubble curtain will stretch from the south of Nigg Bay to the North Breakwater depicted as the blue line or green-dashed line in figure 8 to ensure sufficient distance between the blast site and the bubble curtain.
- If blasting is required elsewhere within the bay in conjunction with the southern shore and southern trenches, then a third configuration of the bubble curtain will be used as depicted by the dashed green line in figure 8, which will likely be used in 2019.

As blasting around the southern shore and southern trenches is in close proximity to a seal resting area, for added caution no blasting will occur in the southern trenches using the arc bubble curtain configuration if seals are present within the mitigation zone stated in Section 6 bullet 4, or as otherwise established after noise modelling results and discussions with MS-LOT.

The minimum separation between the blast location and the bubble curtain will be 30m (at the eastern end of the SBW trench). In this case, noise monitoring equipment will be deployed outside the bubble curtain at a distance of approximately 100m south-east from the blast towards open water and 50m outside the bubble curtain. The noise monitoring will be carried out using two boats positioned along a transect.

It should be noted that the configuration will make use of a double bubble curtain and it will be separated by approx. 15m. This separation is determined by the average depth of water along the transect of the double bubble curtain.

The bubble curtains will only be switched on once it has been confirmed that there are no marine mammals within the exclusion areas.

Noise monitoring of the southern shore and southern trenches will be carried out as indicated in figure 8 above.

The use of the Double Bubble Curtain during the land based works may be reduced on satisfactory noise modelling results and consultation with MS-LOT.

6.5. Rock removal by mechanical means

In periods where the blasting is not permitted and where volume of rock is too small to justify blasting, it is possible to loosen rock by mechanical means. Proposed means are by:

- Xcentric Ripper 120 – above and below water
- Hydraulic breaker to be used with excavator – above and below water
- Drum cutter – above and below water (previously approved on EPS license ref MS/EPS/06/2018/0)

The exact specifications of the requirement may change depending on success of the rock removal process. Please refer to Appendix D for details of the proposed equipment

During first use of mechanical means to loosen rock below water, noise monitoring will be carried out when in use at full power and a report will be issued to MS-LOT within 72 hours. UWN monitoring will be discontinued if noise levels are deemed acceptable following discussions with MS-LOT.

7. Rock Dredging

Suitable dredged material from the drilling and blasting will be re-used as much as possible in the project.

The backhoe dredger(s) will be used to take away the blasted rock. The backhoe will load the dredged or blasted material straight into split hopper barges. The split hopper barge will sail to a selected location to dispose of the material which will be used as the core for the south breakwater, or bring the material to an offloading location for re-use on land.

7.1. Rock Dredging & Disposal –Environmental Controls

For all dredged material disposed of at the designated off-shore disposal site, the following Environmental mitigation will be followed;

1. A non-dedicated but trained MMO will be present. The person may be a member of the rig's or vessel's crew providing they do not undertake other roles during mitigation periods.

2. Before disposal a trained MMO on the disposal vessel will carry out a 20 minute watch of a 500m radius of the disposal area. (Figure 8).
3. If marine mammals are spotted the MMO will notify the master of the vessel and disposal will be postponed until the MMO has confirmed that no marine mammals have been present in the 500m exclusion zone for a period of 20 minutes.
4. A continuous watch must be kept during operations and if marine mammals are observed within 500m then disposal operations must be ceased until the area has been clear of marine mammals for at least 20 minutes

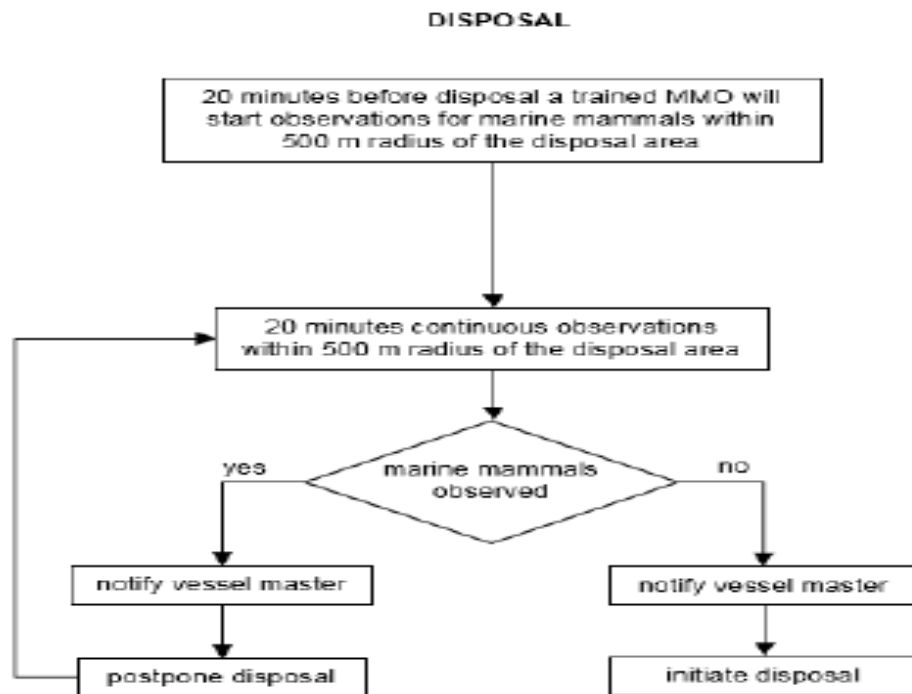


Figure 8: Dredged Material Disposal Marine Mammal Protocol

8. Work within the SSSI

Works within the SSSI will follow the approved method statement: AHEP Southern Shore works – construction of access road and blast platforms Rev 02, please refer for details.

9. Reporting

The MMO team will record all relevant events for all activities on standard forms and submit to JNCC on a monthly basis as detailed in table 2 below. An example of the recording form is included in Appendix A. Recorded information will include;

- Marine mammal identification
- Details concerning the behaviour of the animal
- Date and location of the operations
- Start and end time of the observation
- Weather conditions and visibility

Whilst activities are ongoing on site with the potential to create underwater noise likely to disturb marine mammals, the Dragados Environment Team will produce a monthly report on the mitigation measures deployed, marine mammal monitoring undertaken and noise measurements collected, as well as a forward look to activities planned in the next month and any specific mitigations proposed. This report will include an Action Log to detail any problems encountered or issues to be raised with the regulator and provided to Marine Scotland, SNH and other interested parties. The report will also detail any exceptional circumstances where blasting has occurred, out with daylight hours, although any specific incidences will be reported within 48 hours. Reports will include, but not limited to, the following:

- Completed Marine Mammal Reporting Forms
- Date and location of the operations including distance between blasting points and double bubble curtain.
- A record of all operation, including details of the duration of the MMO/PAM search and any occasions when activity was delayed or stopped due to presence of marine mammals
- Details of watches made for marine mammals, including details of any sightings, details of the PAM equipment and detections, and details of the activity during the watches. A comparison between detections of marine mammals made by MMOs and PAM registers will be included to monitor the efficacy of PAM.
- Details of any problems encountered including instances of non-compliance with the agreed MMMP
- Any recommendations for amendment of the MMMP.

If desired, Marine Scotland and SNH and other interested parties will also be able to visit site and operations to fully understand the ongoing activities and mitigation measures deployed and input suggested amendments/best practice ideas.

Report	Frequency	Reported by
MS Monthly report and ADD use / seal behaviour (As detailed above in section 9)	Monthly	Environmental team to MS and SNH
MMO logs (As detailed above in section 9)	Monthly	Environmental team to JNCC, SNH and WDCC
Dead fish (as outlined in CEMD Chapter 8)	Within 24 hours if 5 or more dead fish are observed	Environmental team to MS and DDSFB
Notifications		
Non-compliance (Anything that deviates from agreed methodology including any dead marine mammal)	Within 48 hours	Environmental team to MS
Exceedance of 183dB re μ Pa outside bubble curtain (As detailed in 6.0)	Early indication within 24 hours Accurate level within 72 hours	Environmental team to MS

Table 2. Reporting procedures.

Appendix A- Marine Mammal Recording Forms

MARINE MAMMAL RECORDING FORM - COVER PAGE

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	Country	Location	Ship/ platform name
Client Dragados	Contractor	Survey type <input type="checkbox"/> site <input type="checkbox"/> VSP <input type="checkbox"/> 2D <input type="checkbox"/> WAZ <input type="checkbox"/> 3D <input type="checkbox"/> piling <input type="checkbox"/> 4D <input type="checkbox"/> explosives <input type="checkbox"/> OBC <input type="checkbox"/> other <input type="checkbox"/> 4C	
Start date	End date		

Number of source vessels	Type of source (e.g. airguns)	Number of airguns (only if airguns used)	Source volume (cu. in.)
Source depth (metres)	Frequency (range in which peak energy is emitted, in Hz)	Intensity (primary peak-to-peak amplitude in dB re. 1µPa or bar metres)	Shot point interval (metres)
Method of soft start <input type="checkbox"/> increase number of guns <input type="checkbox"/> increase frequency (where permitted) <input type="checkbox"/> increase pressure (where permitted) <input type="checkbox"/> increase number and frequency <input type="checkbox"/> increase number and pressure <input type="checkbox"/> other			

Visual monitoring equipment used (e.g. binoculars, big eyes, etc.)	Magnification of optical equipment (e.g. binoculars)	Height of eye above water surface (metres)	How was distance of animals estimated? <input type="checkbox"/> by eye <input type="checkbox"/> with laser rangefinder <input type="checkbox"/> with rangefinder stick/ callipers <input type="checkbox"/> with reticle binoculars <input type="checkbox"/> by relating to object at known distance <input type="checkbox"/> other
Number of dedicated MMOs	Training of MMOs <input type="checkbox"/> JNCC approved MMO training course for UK waters <input type="checkbox"/> PSO training course for the Gulf of Mexico <input type="checkbox"/> MMO training course for Irish waters <input type="checkbox"/> MMO training course for New Zealand waters <input type="checkbox"/> other <input type="checkbox"/> none		

Was PAM used? <input type="checkbox"/> yes <input type="checkbox"/> no	Number of PAM operators	
Description of PAM equipment		
Range of PAM hydrophones from airguns (metres)	Bearing of PAM hydrophones from airguns (relative to direction of travel)	Depth of PAM hydrophones (metres)

Environmental Mitigation - South Breakwater and Shore Blasting

MARINE MAMMAL RECORDING FORM - EFFORT

Regulatory reference number

Ship/ platform name

(e.g. DECC no., BOEM permit no., OCS lease no., etc.)

Record the following for all watches, even if no marine mammals are seen.

START A NEW LINE IF SOURCE ACTIVITY OR WEATHER CHANGES. ENTER DATA AT LEAST EVERY HOUR.

Date	Visual watch or PAM (v/ p)	Observer's/ operator's name(s)	Time of start of section of watch (UTC, 24hr clock)	Time of end of section of watch (UTC, 24hr clock)	Source activity (f/ s/ r/ n/ v)	Start position (latitude and longitude)	Depth at start (m)	End position (latitude and longitude)	Depth at end (m)	Speed of vessel (knots)	Wind dir'n	Wind force (B' fort scale)	Sea state (g/ s/ c/ r)	Swell (o/ m/ l)	Vis. (visual watch only) (p/ m/ g)	Sun glare (visual watch only) (n/ wf/ sf/ vf/ wb/ sb/ vb)	Precip. (n/ l/ m/ h/ s)

Visual watch or PAM: v = visual watch; p = PAM

Source activity: f = full power; s = soft start; r = reduced power (not soft start); n = not active; v = variable (e.g. tests)

Sea state: g = glassy (like mirror); s = slight (no/ few white caps); c = choppy (many white caps); r = rough (big waves, foam, spray)

Swell: o = low (< 2 m); m = medium (2-4 m); l = large (> 4 m)

Visibility: p = poor (< 1 km); m = moderate (1-5 km); g = good (> 5 km)

Sun glare: n = none; wf = weak forward; sf = strong forward; vf = variable forward; wb = weak behind; sb = strong behind; vb = variable behind

Precipitation: n = none; l = light rain; m = moderate rain; h = heavy rain; s = snow

Total number	Number of adults (visual sightings only)	Number of juveniles (visual sightings only)	Number of calves (visual sightings only)	Photograph taken

MARINE MAMMAL RECORDING FORM - OPERATIONS

Regulatory reference number

Ship/ platform name

(e.g. DECC no., BOEM permit no., OCS lease no., etc.)

Complete this form every time the airguns are used, including overnight, whether for shooting a line or for testing or for any purpose.

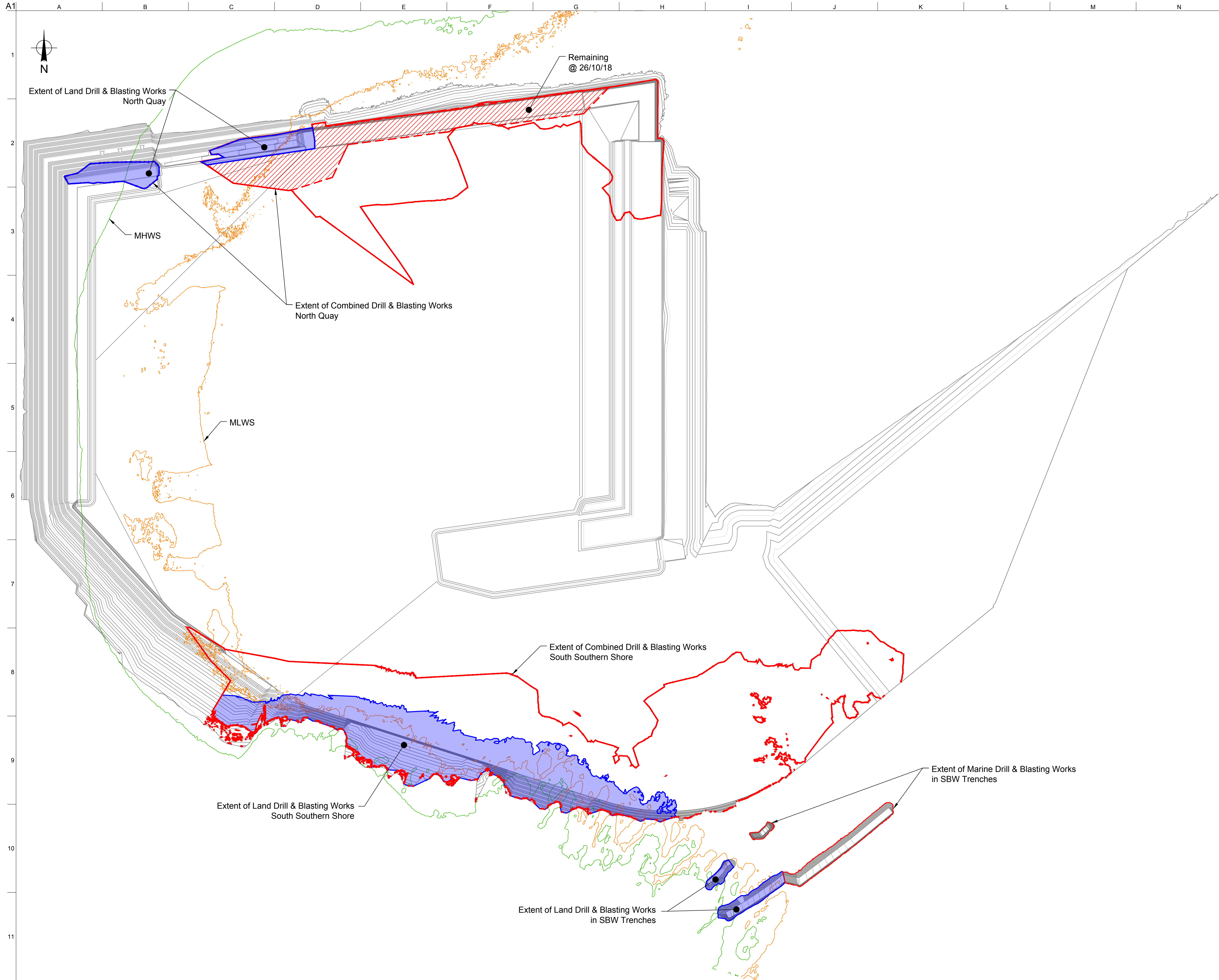
Times should be in UTC, using the 24 hour clock.

Date	Reason for firing l = line t = test x = test followed immediately by line	Time soft start/ ramp-up began	Time of full power	Time of start of line	Time of end of line	Time of reduced output (if relevant)	Time airguns/ source stopped	Time pre-shooting search began	Time search ended	Time PAM began	Time PAM ended	Depth range (during pre-shooting search) s = <200m d = >200m b = both	Was it day or night in period prior to firing? d = day n = night w = dawn k = dusk	Was any mitigating action required? (yes/ no)

Last distance	<input type="checkbox"/> power-down then shut-down of active source		
---------------	---------------------------------------------------------------------	--	--

Appendix B - Drawings

- **Drawing AHEP-DRA-SKE-0274-001 -- Rev 3 Work Areas Land Based Drill and Blast**
- **Drawing AHEP-DRA-SKE-0282-001 – Rev 2 Drilling & Blasting – Mitigation zone – SBW trenches**
- **Drawing AHEP-DRA-SKE-0298 – Rev 1 Drilling and blasting mitigation zone --South southern shore**
- **Drawing AHEP-DRA-SKE-0291-001 – Rev 3 Bubble Curtain and noise monitoring – SBW trenches**
- **Drawing AHEP-DRA-PRO-0055-DWG – Rev 3 Marine Drilling and Blasting Vibration Monitoring Location Plan**



Notes:

1. All dimensions are in metres unless stated otherwise.
2. All levels are in metres to chart datum.

Key:

MHWS —

MLWS —

Combined Drill and Blast Extents —

Land Drill and Blast Extents —

Drawing Status:

FOR INFORMATION ONLY
NOT VALID FOR CONSTRUCTION

3	26/10/18	[Redacted]
Issued For		
2	18/10/18	
Issued For		
1	24/07/18	
Issued For		
0	19/07/18	
Issued For Information		

Issue	Date	By	Chkd	Appd
DRAGADOS				

AHEP Project Office
St Fitticks Road
Nigg Bay
Aberdeen
AB11 8TN
Tel: +44 (0) 1224 439980
Client

Aberdeen Harbour

Job Title
Aberdeen Harbour Expansion Project

Land & Marine Based Drill and Blasting Work Areas

Scale at A1 Not To Scale

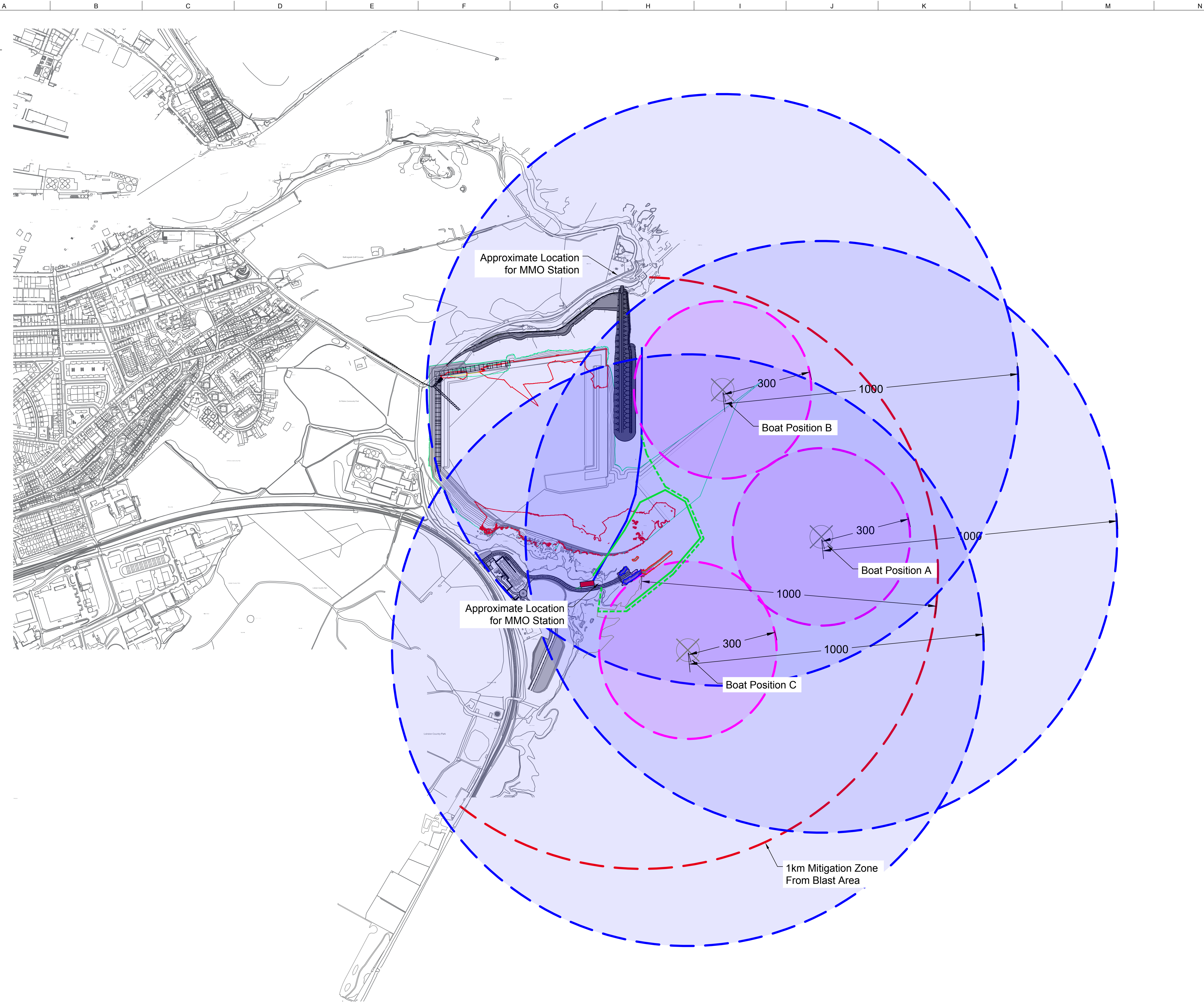
Discipline Civil Engineering

Drawing Status

Issued For Information

Drawing No AHEP-DRA-SKE-0274-001	Issue 3
--------------------------------------------	-------------------

A1
1
2
3
4
5
6
7
8
9
10
11



Plan View
(Not to Scale)

Notes:
1. All dimensions are in meters unless stated otherwise
2. All levels are in meters to chart datum

Key:

- NBW Bubble Curtain Route
- SBW Bubble Curtain Route
- SBW Bubble Curtain Alt. Position
- Blast Position

Drawing Status:
FOR INFORMATION ONLY
NOT VALID FOR CONSTRUCTION

2	07/11/18	[Redacted]		
Issued F				
1	02/10/18			
Issued F				
0	27/08/18			
Issued For Information				
Issue	Date	By	Chkd	Appd



AHEP Project Office
St Fitticks Road
Nigg Bay Aberdeen
AB11 8TN
Tel: +44 (0) 1224 439980



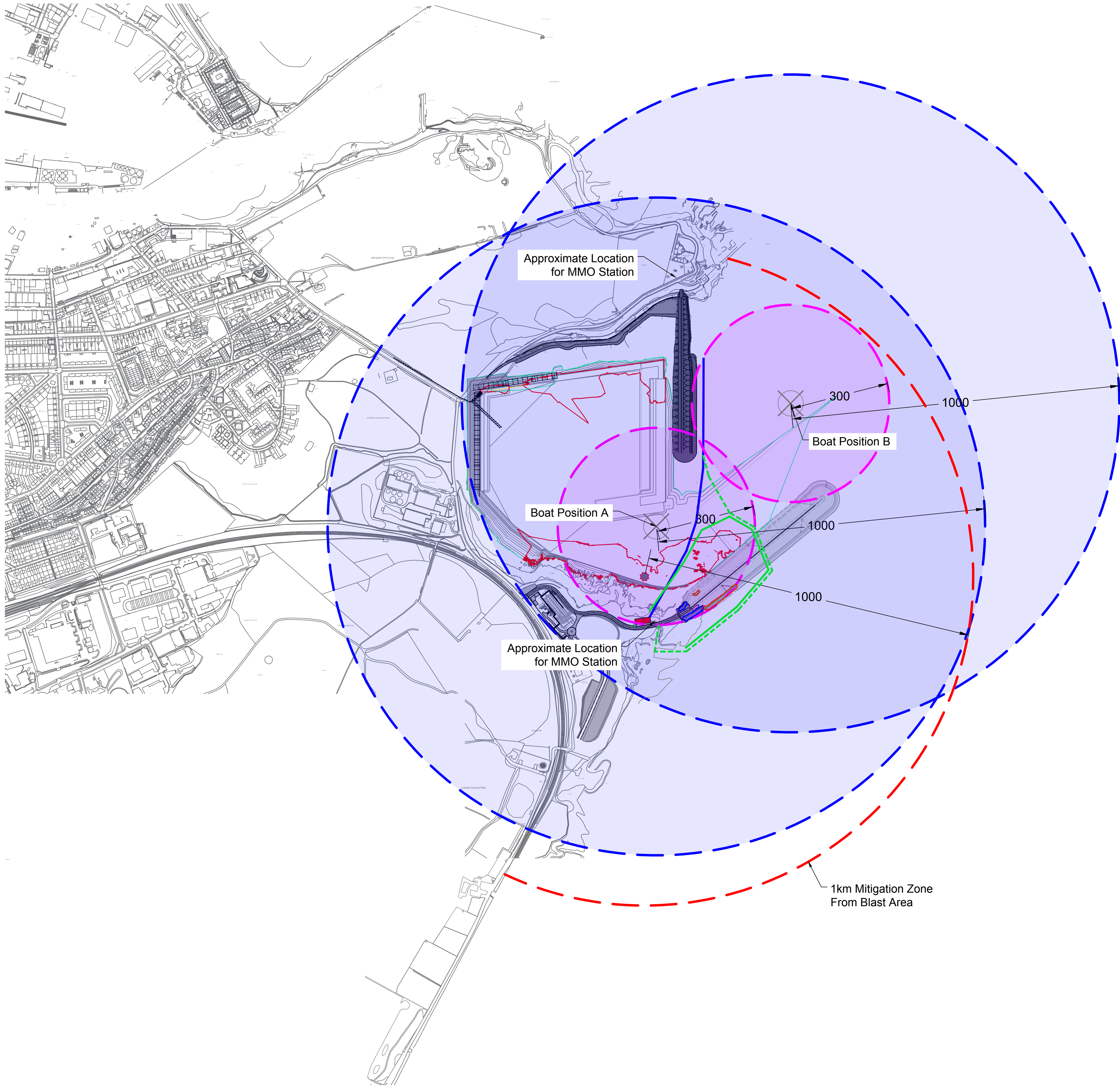
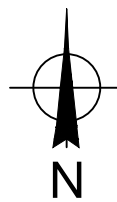
Job Title
Aberdeen Harbour
Expansion Project

Drilling and Blasting
Mitigation Zone
SBW Trenches

Scale at A1 As Shown
Discipline Civil Engineering
Drawing Status
Issued For Information
Drawing No AHEP-DRA-SKE-0282-001 Issue 2

A1
1
2
3
4
5
6
7
8
9
10
11

A B C D E F G H I J K L M N



Plan View
(Not to Scale)

- Notes:
1. All dimensions are in meters unless stated otherwise
 2. All levels are in meters to chart datum

Key:

- NBW Bubble Curtain Route
- SBW Bubble Curtain Route
- SBW Bubble Curtain Alt. Position
- Blast Position

Drawing Status:

FOR INFORMATION ONLY
NOT VALID FOR CONSTRUCTION

[Redacted]				
1	07/11/18	Issued F		
0	26/10/18	Issued For Information		
Issue	Date	By	Chkd	Appd



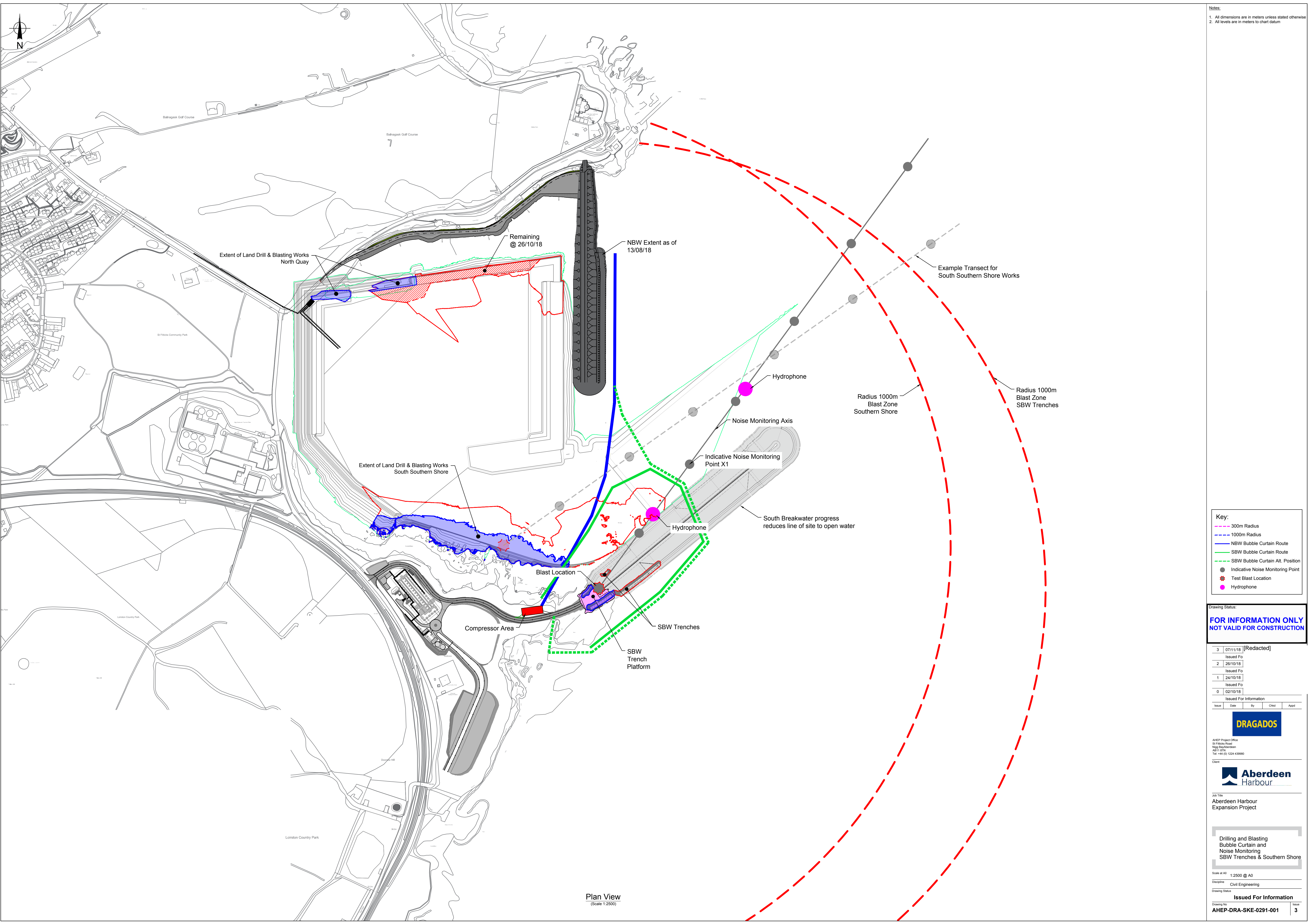
AHEP Project Office
St Fitticks Road
Nigg Bay Aberdeen
AB11 8TN
Tel: +44 (0) 1224 439080



Job Title
Aberdeen Harbour
Expansion Project

Drilling and Blasting
Mitigation Zone
South Southern Shore

Scale at A1	As Shown
Discipline	Civil Engineering
Drawing Status	Issued For Information
Drawing No	AHEP-DRA-SKE-0298-001
Issue	1



Plan View
(Scale 1:2500)

Notes:
1. All dimensions are in meters unless stated otherwise
2. All levels are in meters to chart datum

Key:

- 300m Radius
- 1000m Radius
- NBW Bubble Curtain Route
- SBW Bubble Curtain Route
- SBW Bubble Curtain Alt. Position
- Indicative Noise Monitoring Point
- Test Blast Location
- Hydrophone

For information only
NOT VALID FOR CONSTRUCTION

3	07/11/18	[Redacted]
2	26/10/18	Issued For
1	24/10/18	Issued For
0	02/10/18	Issued For

Issue	Date	By	Chkd	Appd
-------	------	----	------	------

DRAGADOS

AHEP Project Office
St Fitticks Road
Nigg Bay/Portlethen
AB11 8TN
Tel: +44 (0) 1224 439960

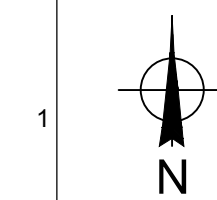
Client

Aberdeen Harbour

Job Title
Aberdeen Harbour
Expansion Project

Drilling and Blasting
Bubble Curtain and
Noise Monitoring
SBW Trenches & Southern Shore

A1 A B C D E F G H I J K L M N



1
2
3
4
5
6
7
8
9
10
11

Do not scale

Balnagask Golf Course

Balnagask Golf Course

Girdleness
#3/Greyhope
Rd Water
Main

Greyhope Road
MDPE Water Main

MS Intake
Pumphouse

Marine Drill and Blast
North Zone

Girdleness Sewer Outfall

Girdleness #1

91m

121m

499m

SSI

SSSI/
Long Sea
Outfall

Marine Drill and Blast
South Zone

107m

117m

Long Sea
Outfall
(Proposed)

Marine Drill and Blast
SBW Trenches

Long Sea Outfall

Notes:

1. All dimensions are in meters unless stated otherwise
2. All levels are in meters to chart datum
3. Vibration monitors to be situated at nearest critical receptors to blasting works. Monitors will be located as works progress to ensure coverage of critical assets. Where a vibration monitor cannot be placed at the nearest point and at asset level then interpolation calculations will be carried out to determine the critical monitoring levels at the monitor location.



Vibration Monitors North Zone Works



Vibration Monitors South Zone/SBW
Works (Proposed Locations)

Drawing Status:

FOR INFORMATION ONLY
NOT VALID FOR CONSTRUCTION

0	06/07/18			
Issued For Information				
Issue	Date	By	Chkd	Appd

DRAGADOS

AHEP Project Office
St Fitticks Road
Nigg BayAberdeen
AB11 8TN
Tel: +44 (0) 1224 439980

Client



Job Title

Aberdeen Harbour
Expansion Project

Marine Drilling and Blasting
Vibration Monitoring Plan
Location Plan

Scale at A1

As Shown

Discipline
Civil Engineering

Drawing Status

Issued For Information

Drawing No

AHEP-DRA-PRO-0055-DWG

Issue

0

Appendix C – Equipment to loosen rock by mechanical means

- **Xcentric Ripper 120**
- **HB4700 breaker**



Miles ahead

www.xcentricripper.com

A Revolution in Rock Excavation



The Xoentric® Ripper is an excavator attachment developed with the latest advances in excavation and demolition systems in mind.

It meets the highest standards. It was patented by Grado Cero Sistemas, a trailblazer in the industry. Through its design, an outstanding performance can be achieved, allowing more efficient work.

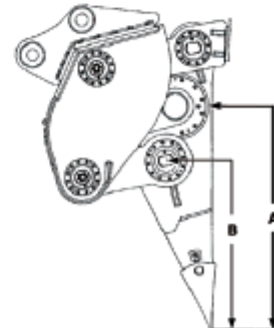
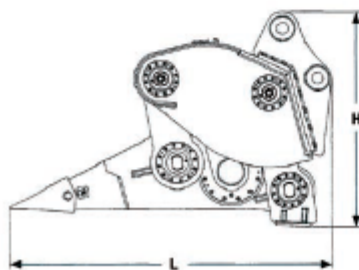


Made completely of wear-resistant steel, this attachment device is almost maintenance free, less noisy than any other excavation tool, can be used under water without any damage risk and be adapted to countless work sites. Thanks to its uncomplicated mechanical design, which has no pricey components, the maintenance cost are very low and down times are ignorable.

Standard specifications

Item	Model	XR 10	XR 15	XR 20	XR 30	XR 40
Hydraulic excavator	tons	7 - 10	11 - 16	18 - 24	24 - 30	32 - 40
Mass of ripper (incl. top bracket)	kg	930	1700	2500	3300	4200
Mass of ripper (less top bracket)	kg	829	1550	2200	2800	3600
Hydraulic working pressure	MPa	15 - 18	16 - 19	18 - 20	22 - 24	22 - 24
Hydraulic return pressure	MPa	0.6	0.6	0.6	0.6	0.6
Hydraulic oil flow	L/min	60	120	160	180	200
Case drain maximum pressure	MPa	0.4	0.4	0.4	0.4	0.4
Frequency	1/min	1500	1400	1400	1300	1200
Dimensions L x W x H	cm	168x45x90	220x66x130	240x78x175	280x85x160	310x90x184
Dimension A	cm	102	140	165	179.1	200
Dimension B	cm	76	105	130	139.1	155
Accumulator pressure	MPa	0.6	0.5	0.5	0.5	0.5

Item	Model	XR 50	XR 60	XR 80	XR 120-3M	XR 120-4M
Hydraulic excavator	tons	42 - 55	55 - 70	70 - 100	100 - 150	100 - 150
Mass of ripper (incl. top bracket)	kg	5600	7000	10500	13000	13000
Mass of ripper (less top bracket)	kg	5000	5700	8700	11000	11000
Hydraulic working pressure	MPa	26 - 28	26 - 28	30 - 32	30 - 32	22 - 24
Hydraulic return pressure	MPa	0.6	0.6	0.6	0.6	0.6
Hydraulic oil flow	L/min	250	280	380	500	600
Case drain maximum pressure	MPa	0.4	0.4	0.4	0.4	0.4
Frequency	1/min	1000	1000	1000	1000	1000
Dimensions L x W x H	cm	320x90x190	345x110x217	380x132x230	400x132x282	400x132x282
Dimension A	cm	210	226	240	243	243
Dimension B	cm	165	176	180	180	180
Accumulator pressure	MPa	0.4	0.25	0.6	0.6	0.6



www.youtube.com/xcentricripper

Wasa Dredging Possesses an XR 120 ripper

Xcentric® Ripper Benefits

- ✓ 3 to 5 times higher production
- ✓ Minimum noise levels
- ✓ Minimum maintenance
- ✓ No daily lubrication required
- ✓ Minimum wear parts consumption
- ✓ Long life components and materials
- ✓ Less fuel consumption per produced m3/ton
- ✓ Less emission per produced m3/ton
- ✓ Environmental protection (Bio Lubricants)
- ✓ Economical alternative for "Drilling and Blasting"
- ✓ Marine/underwater operation
- ✓ Easy operation
- ✓ Increased operators comfort

How it started...

Grado Cero Group has manufacturing plants for the production of heavy duty excavator buckets and patented Go Max quick couplers. At the same time one of their divisions are performing large rock excavation and trenching projects in the North of Spain. Thanks to this unique combination, they were able to invent and develop a completely new attachment to exoeecute these difficult projects much faster and much more efficient. In the beginning of 2009 the first prototypes started to work for the first practical tests in all kind of different rock conditions. Non stop and intense working from that moment on, in all types of rock, has resulted in a 100% reliable, efficient and maintenancelfree attachment: the Xcentric® Ripper.

Economical and financial demands in the market are always pushing for increased performance and production output in rock excavation and demolition. At the same time clients are asking for lower maintenance costs, less down time and better warranty conditions. In 2009 Grado Cero has developed a revolutionary attachment: the Xcentric® Ripper to do excavation and demolition in less time, for lower cost and with a minimum of noise. The Xcentric® Ripper is developed with a patented "Impact Energy Accumulation Technology", which makes it in 80% of the job applications more productive than any Hydraulic Breaker available on the market.

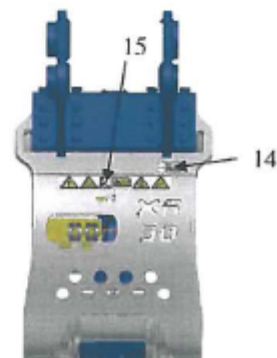
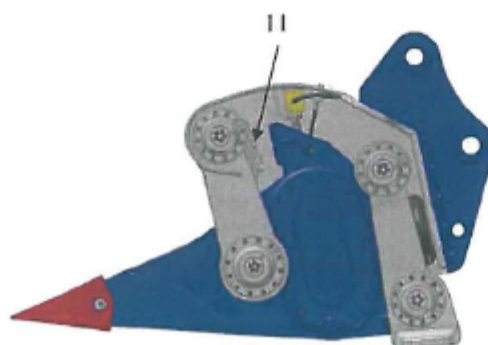
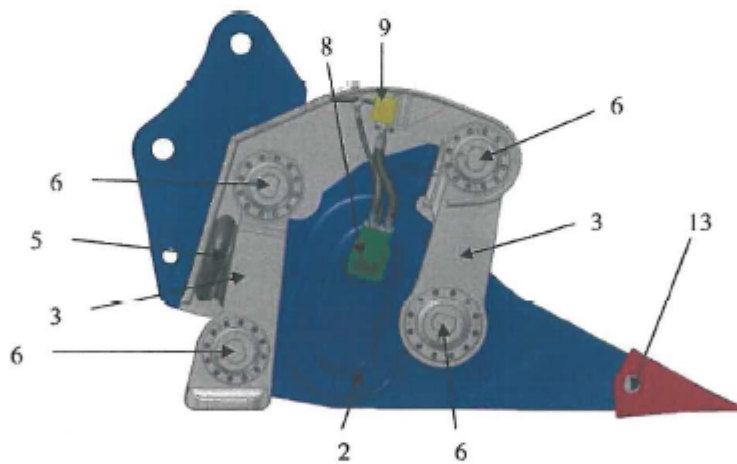
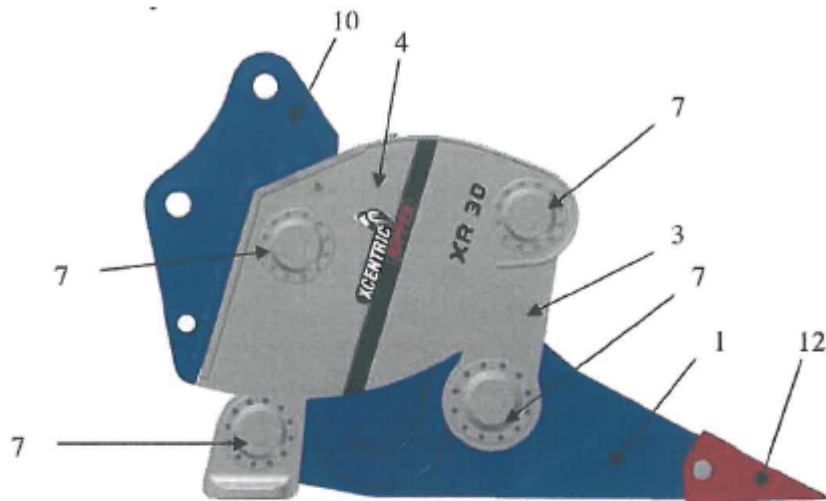


In even 70% of the job applications a 2 to 5 times higher production can be achieved. The Xcentric® Ripper's closed energy chamber cannot be influenced or damaged from the outside by dust, water, dirt or what so ever. This means that it can work without any problem in the most severe conditions in tunnels, foundations, muddy and wet places.

Even all kinds of work underwater in for example harbours, canals and open sea can be done without making any special expensive and complicated preparations. This is where and why the Xcentric® Ripper saves so drastically the high expensive maintenance and repair cost, that normally appear in such working circumstances.

NAME OF COMPONENTS AND SPECIFICATIONS

Name of components



1) Ripper impact arm

The ripper impact arm is a basic component that takes kinetic energy from the pivot arms and creates the striking motions needed for demolition

2) Eccentric gear housing

This housing contains the eccentric gears that create the ripper impact arm's striking motions and are synchronized in the housing.

3) Upper and lower pivot arms

They guide the ripper impact arm on its work path.

4) Ripper housing

This holds the unit made up of the ripper impact arm, pivot arms and pressure accumulator and has a threaded base plate for fastening the top bracket to the ripper.

5) Pressure accumulator

This is a pneumatic bag that directs the ripper impact arm's striking power to the tooth.

6) Pivot arm pins

They guide the pivot arms, the ripper housing and the ripper impact arm.

7) Pivot arm pin covers

These fasten the pivot arms to the ripper impact arm and to the ripper housing.

8) Hydraulic motor

An axial piston motor that sets the pivot arms moving.

9) Control block

A hydraulic system that starts and stops the hydraulic motor and controls it.

10) Top bracket

A component bolted to the ripper housing for attachment to the excavator.

11) Lower stop

An elastomeric part to cushion the ripper impact arm at the lower stop.

12) Tooth

A tool for striking the material to be demolished.

13) Pin

A component for fastening the tooth to the ripper impact arm.

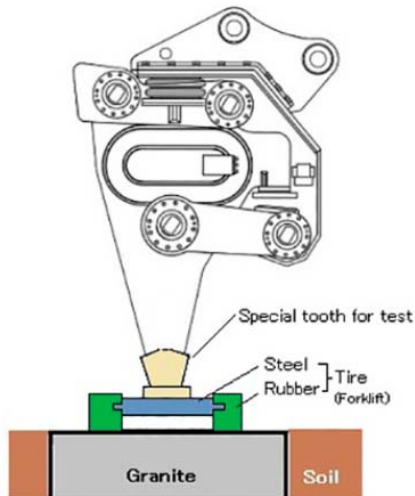
14) Model plate

Contains information on the model, production date, serial number, etc.

15) Safety instruction sticker

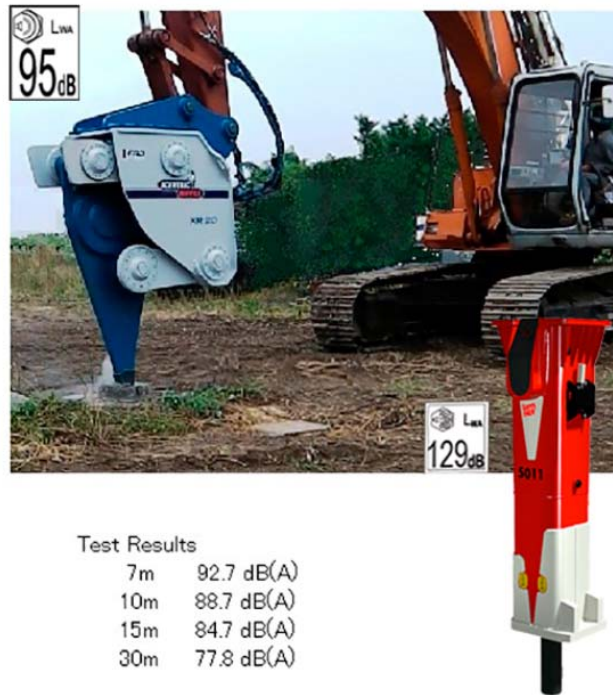
Safety instructions and precautions.

Noise Level Comparison



Test Conditions

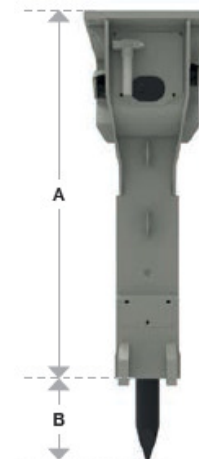
XR20: S/N 12012403
 Excavator: FX200 (HITACHI EX200)
 Oil flow: around 160 L/min
 Working Pressure: around 15 MPa
 Weather: Cloudy, windless



Test Results

7m	92.7 dB(A)
10m	88.7 dB(A)
15m	84.7 dB(A)
30m	77.8 dB(A)

Noise levels measured in onshore situation, significant reduction expected when used offshore. However no measured field data available at present.



HB range		HB 2000	HB 2500	HB 3100	HB 3600	HB 4100	HB 4700	HB 5800	HB 7000	HB 10000
Carrier weight class ¹⁾	t	22-38	27-46	32-52	35-63	40-70	45-80	58-100	70-120	85-140
Service weight ²⁾	kg	2,000	2,500	3,100	3,600	4,100	4,700	5,800	7,000	10,000
Tool diameter	mm	145	155	165	170	180	190	200	210	240
Max. hydraulic input power	kW	57	66	81	90	96	108	117	135	159
Oil flow rate	l/min	150-190	170-220	210-270	240-300	250-320	260-360	310-390	360-450	450-530
Operating pressure	bar	160-180	160-180	160-180	160-180	160-180	160-180	160-180	160-180	160-180
Impact rate	bpm	300-625	280-580	280-560	280-560	280-550	280-540	280-480	280-450	250-380
Sound power level guaranteed ³⁾	dB(A)	120	121	120	123	124	126	121	121	123
Standard version										
A	mm	1,861	2,042	2,209	2,274	2,359	2,454	2,580	2,855	-
B	mm	635	640	675	700	750	790	815	835	-
DustProtector II version										
A	mm	1,926	2,087	2,254	2,318	2,404	2,509	2,635	2,905	3,142
B	mm	570	600	630	650	705	730	760	785	800

¹⁾ Weights apply to standard carriers only. Any variances must be agreed with Epiroc and/or the carrier manufacturer prior to attachment.

²⁾ Attachment with standard working tool & average-sized adapter plate.

³⁾ EN ISO 3744 in accordance with directive 2000/14/EC