REPORT

Port of Leith Outer Berth Development

Approach Channel Deepening: Environmental Scoping Report

Client: Forth Ports Limited

Reference: PC4514-RHD-YY-XX-RP-EV-0013

Status: Final/1.0

Date: 28 June 2023

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Acronyms

Acronym	Acronym description
BHD	Back Hoe Dredger
CD	Chart Datum
CIA	Cumulative Impact Assessment
EIA	Environmental Impact Assessment
ESR	Environmental Scoping Report
HES	Historic Environment Scotland
HRA	Habitats Regulations Appraisal
MS-LOT	Marine Scotland Licensing Operations Team
MWRs	The Marine Works (EIA) (Scotland) Regulations 2017
NMP	National Marine Plan
PMF	Priority Marine Feature
SAC	Special Area of Conservation
SPA	Special Protection Area
TSHD	Trailer Suction Hopper Dredger

1 Introduction

1.1 Proposed amendments to the Outer Berth development

Forth Ports Limited ("Forth Ports") is improving the Outer Berth at the Port of Leith ("the Port") to support the offshore renewable energy industry. In December 2022, marine licences were granted by Marine Scotland's Licensing Operations Team (MS-LOT) for improvement works to the Outer Berth (MS-00009818) as well as the disposal of associated dredged material (MS-00009819). An Environmental Impact Assessment (EIA) was undertaken on the Outer Berth development (herein referred to as "the Outer Berth EIA") and an EIA Report produced to support the licence applications (Royal HaskoningDHV, 2022).

The current water depth of the Leith approach channel (between -6.5m Chart Datum (CD) and -7.0m CD) significantly limits the tidal window during which deep-drafted vessels can transit in or out of the Port and, on some neap tides, access is not possible at all. Given this, the increased water depth required by the evolving offshore renewables industry, limited vessel availability and the increasing draft of construction vessels associated with this industry, Forth Ports is now proposing to deepen the approach channel to the Port.

The proposed deepening would increase the depth of the approach channel to -8.0m CD and extend the offshore extent to the current -8m CD contour within the Firth of Forth. The Outer Berth berth pocket, most of which will have been deepened to -9.0m CD as part of the consented Outer Berth development, would also be repositioned northwards and deepened to -12.0m CD. The footprint of the proposed deepening can be seen in **Figure 1.1**.

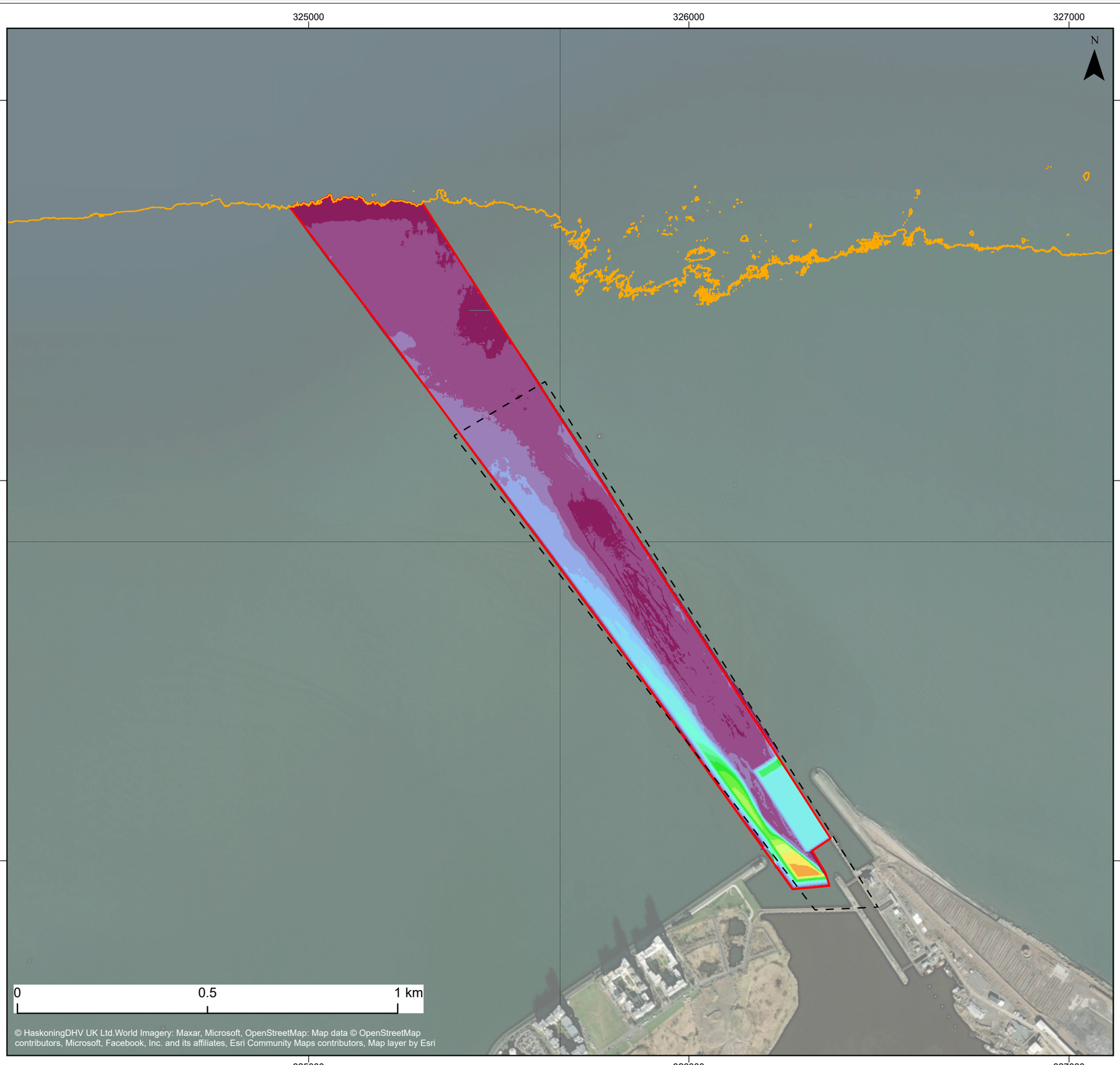
As can be seen in **Figure 1.1**, much of the deepening footprint is within an area that is subject to periodic maintenance dredging, with only the section nearest to the -8.0m CD contour not previously dredged, and the dredge depth would be relatively shallow (i.e. less than 1.0m). It is anticipated that the capital dredge would be completed within approximately three months, with around 575,000m^3 of material removed (inclusive of 1:4 side slopes; *c.* 695,000m^3 if inclusive of a uniform 0.25m over-dredge). This volume is additional to that removed from the Outer Berth berth pocket during the consented development. Disposal is likely to be at Narrow Deep B Spoil Disposal Ground (FO038), though a Best Practicable Environmental Option assessment will be undertaken to determine the most appropriate disposal option.

In order to ensure the stability of the Eastern Breakwater following the repositioning and deepening of the berth pocket, a short retaining wall would be installed between the dredge pocket and the toe of the breakwater, as indicated in **Figure 1.2**.

To summarise, the Proposed Scheme comprises the following elements:

- Deepening of the approach channel to -8.0m CD;
- Deepening of the Outer Berth berth pocket to -12.0m CD;
- Disposal of dredge material at a suitable location; and
- Installation of a retaining wall at the toe of the Eastern Breakwater.

Further detail of the Proposed Scheme is provided in **Chapter 2**.



Legend

- Dredge Areas
- Maintenance Dredge Area
- -8mCD contour

Depth of excavation (m)

- -7.9 - -7.5
- -7.4 - -7
- -6.9 - -6.5
- -6.4 - -6
- -5.9 - -5.5
- -5.4 - -5
- -4.9 - -4.5
- -4.4 - -4
- -3.9 - -3.5
- -3.4 - -3
- -2.9 - -2.5
- -2.4 - -2
- -1.9 - -1.5
- -1.4 - -1
- -0.9 - -0.5
- -0.4 - 0

Client: Forth Ports Limited

Project: Proposed Deepening of the Leith Approach Channel – Environmental Scoping Report

Title: Footprint of the Proposed Deepening at the Port of Leith

Figure: 1.1

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Co-ordinate system: British National Grid

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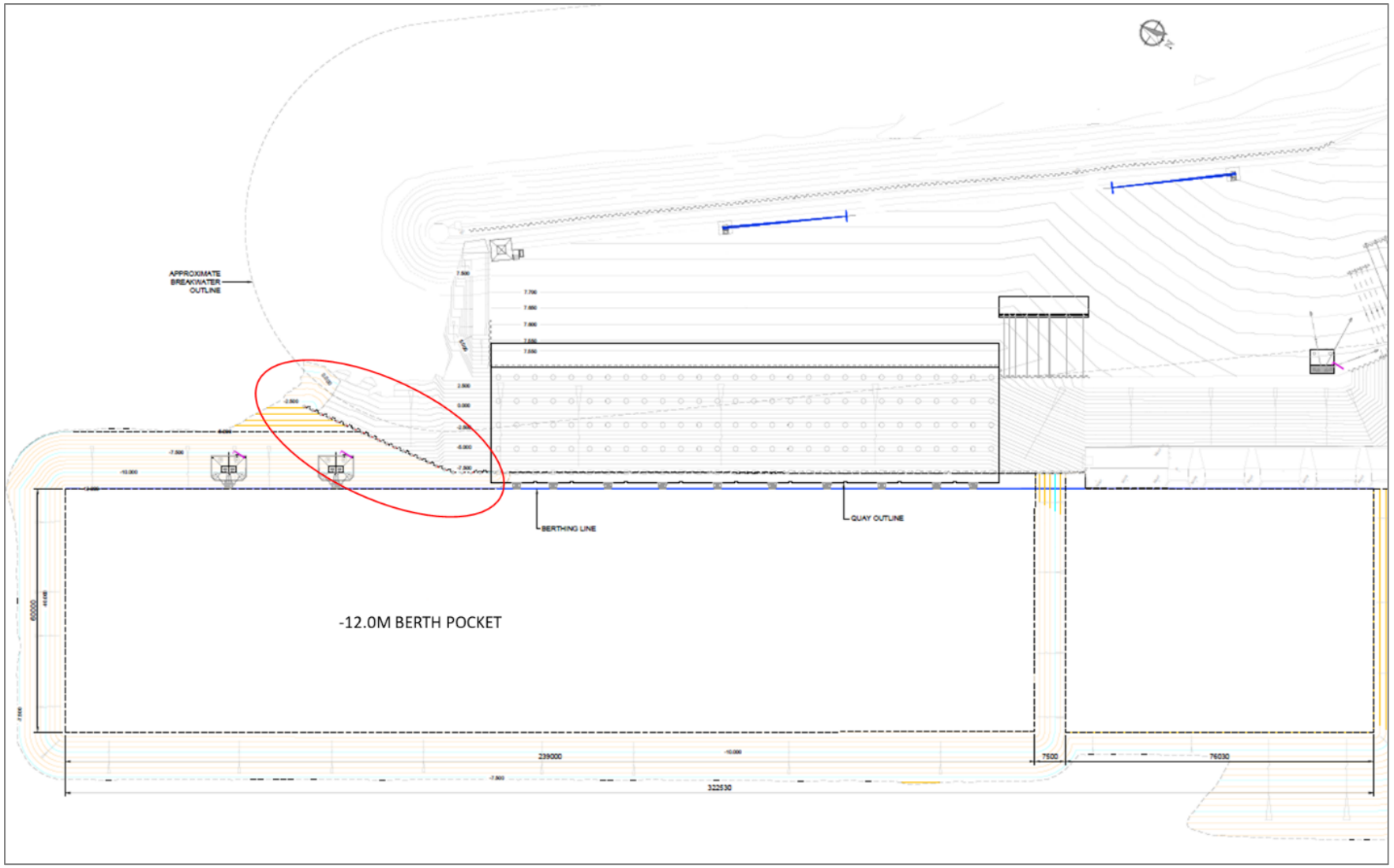


Figure 1.2 Location of the proposed piled retaining wall (circled)

1.2 Requirement for EIA

The Outer Berth development was confirmed EIA Development by MS-LOT under the Marine Works (EIA) (Scotland) Regulations 2017 (as amended) (the MWRs), as:

> *"Construction of harbours and port installations, including fishing harbours (unless included in Schedule 1)."*

Given the Proposed Scheme forms part of an EIA Development, its environmental effects, either alone or cumulatively with the Outer Berth Development, are considered to have the potential to give rise to significant environmental effects. It has therefore been determined that the Proposed Scheme is also an EIA Development and an EIA is required to support a request for a variation to the Outer Berth development's Marine Licences.

1.3 Marine Licence variation

A request for a variation to the Outer Berth marine construction licence (MS-00009818) and the Outer Berth disposal licence (MS-00009819) will be sought from MS-LOT to permit the installation of the short retaining wall and disposal of the additional volume of material associated with the Proposed Scheme.

The variation request would be accompanied by a 'supplementary' report to the Outer Berth EIA Report, herein referred to as 'the Supplementary EIA Report', which will update the relevant assessments presented in the Outer Berth EIA Report to take account of the Proposed Scheme. The EIA methodology will remain the same as that presented in Chapter 5 of the Outer Berth EIA Report.

1.4 Purpose of this Environmental Scoping Report

This Environmental Scoping Report (ESR) has been submitted to MS-LOT to confirm the scope of work required to revise the Outer Berth EIA to include the proposed deepening of the approach channel and associated works. It sets out the topics, receptors and potential impacts that would be assessed within the Supplementary EIA Report.

1.5 Structure of the ESR

This ESR is structured as follows:

Chapter 1 (this chapter) provides an introduction to the Proposed Scheme, the requirement for EIA and approach to the request for a variation to the marine licences.

Chapter 2 provides a project description for the Proposed Scheme, including information on the construction methodology and an overview of the operational phase.

Chapter 3 provides an overview of the environmental / consenting legislation of relevance to the Proposed Scheme and the variation application.

Chapter 4 forms the bulk of the report and describes the scope of the assessment that would be presented in the Supplementary EIA Report. Specifically, it identifies the key environmental sensitivities for consideration, the data gaps that need to be filled in order to assess impacts on those sensitivities and the impacts that require assessment.

Chapter 5 provides a list of other projects / plans that would be considered in a cumulative impact assessment (CIA).

Chapter 6 provides a list of references used in the compiling of this ESR.

2 Description of the Proposed Scheme

2.1 Construction phase

2.1.1 Dredging and disposal

It is anticipated that the majority of dredging would be undertaken by trailer suction hopper dredger (TSHD). In areas where the water depth is greater than 4.0m CD, it is likely that a large TSHD with a hopper capacity of *c.*4,500m^3 would be employed (production rate of *c.*55,000m^3 per week in the berth pocket and *c.*80,000m^3 per week in the approach channel). At shallower depths a smaller TSHD with a hopper capacity of *c.*1,500m^3 would be employed (production rate of *c.*20,000m^3 per week). It is anticipated that the TSHDs may work concurrently. In the berth pocket and Port area, the TSHD would be supported by a plough vessel to remove sediment from corners and level out ridges.

It is possible that some areas may also be dredged using back hoe dredging (BHD), particularly within areas difficult for a TSHD to access or where hard rock or consolidated sediment is present. Production rate using BHD would range from *c.*5,000 to *c.*10,000m^3 per week for hard rock, and *c.*30,000m^3 to *c.*50,000m^3 per week for consolidated material.

Should offshore disposal be considered the most appropriate disposal option, the dredged arisings would be transported to Narrow Deep B within the hopper of the TSHD (or support barge in the case of material from BHD). Over the course of the dredge / disposal campaign, it is anticipated that there would be in the region of 400 round trips to the disposal site (additional to trips undertaken for the consented development).

2.1.2 Installation of retaining wall

The retaining wall would be formed of a short length of sheet piling (similar in nature to the sheet piling installed as part of the improved Outer Berth's suspended deck), which would be installed by either vibratory or percussive means (or a combination thereof). Installation would most likely take place from land-based plant working from the Outer Berth. To get access for a crane, there may be a requirement for some minor infilling, depending on the size of the crane to be used. The infill would either be removed following completion of piling or suitably protected with rock armour and left *in-situ*. The retaining wall would be approximately 50m in length.

2.1.3 Anticipated programme

Overall, it is anticipated that the Proposed Scheme would commence in Q1 or (more likely) Q2 of 2024, for completion by Q3 of 2024. The dredging programme would be dependent on the dredging equipment scenario(s) employed (e.g. method, capacity); however, it is anticipated that the dredge would be completed within approximately three months. Installation of the retaining wall would take around 4 weeks and may be carried out concurrently with the dredging.

2.2 Operational phase

The Proposed Scheme would not increase the number of vessel movements to the Outer Berth. Instead, its purpose is to increase the frequency and length of the tidal windows when deeper drafted vessels can access the Outer Berth.

To deepen the approach channel to -8.0m CD and the Outer Berth berth pocket to -12.0m CD will require removal of about 575,000m^3 of sediment, which would increase the potential for deposition of sediment from suspension. It is likely that a larger approach channel and Outer Berth would induce larger volumes of

suspended sediment to accumulate, because they would provide more space for sediment to deposit (i.e. the dredged areas would act as larger sinks for sediment).

Historic annual dredging volumes over the last two decades (2001 to 2020) have ranged up to 48,000m^3, with an average of 20,000m^3. Upon completion of the consented Outer Berth development (the baseline for the Proposed Scheme), the maintenance dredge requirement for the entire channel is predicted to increase by 22% (Royal HaskoningDHV, 2022). This will equate to an annual predicted average dredge volume of about 25,000m^3, to a maximum of about 59,000m^3. These volumes can be used as a proxy for the rate of sediment transport and deposition in the existing approach channel, and in combination with the change in its dimensions following the Proposed Scheme can be used to estimate the future maintenance dredging requirement.

The removal of about 575,000m^3 of sediment means that the accommodation space in the future channel configuration would increase by this volume. If this volume is averaged across the entire dredge footprint (an area of about 482,000m^2), it equates to about 1.19m of sediment. Assuming that the average seabed elevation outside the channel is about -6.0m CD, the accommodation space (from -6.0m CD to -8.0m CD) would increase from about 390,000m^3 to about 965,000m^3. This equates to an increase in accommodation space of about 247%. Using the predicted baseline average maintenance dredging volume of 25,000m^3, an increase in accommodation space of 247% means the estimated future average maintenance dredging requirement would be about 62,000m^3.

Further details on the prediction of future maintenance dredge requirements are provided in **Appendix A**.

3 Relevant Legislation and Policy

3.1 Marine (Scotland) Act 2010

Part 4 of the Marine (Scotland) Act 2010 provides a framework for the marine licensing system for those 'licensable marine activities' undertaken within Scottish waters below Mean High Water Springs. The Scottish Ministers are the licensing authority for most matters in Scottish inshore and offshore waters with MS-LOT responsible for issuing licences on their behalf.

Installation of the retaining wall would be classed as a licensable activity under paragraph (1)5 of Section 21 of the Marine (Scotland) Act:

> *"To construct, alter or improve any works within the Scottish marine area either (a) in or over the sea, or (b) on or under the seabed."*

Similarly, offshore disposal of dredged material would be classed as a licensable activity under paragraph (1)1 of Section 21 of the Act:

> *"To deposit any substance or object within the Scottish marine area, either in the sea or on or under the seabed, from…a vehicle, vessel, aircraft or marine structure."*

As such, a request for a variation of the Outer Berth marine licences would be sought from MS-LOT.

The dredging required for the Proposed Scheme would be undertaken under Forth Ports' powers as statutory harbour authority and as such does not require a marine licence (however, as the dredging required is a capital dredge, the Supplementary EIA Report would include an assessment of the potential effects of the dredging activity).

3.2 EIA legislation

Following the EIA screening, MS-LOT determined that the Outer Berth development classified as an EIA Development under Schedule 2, paragraph 10(g) of the MWRs:

> *"Construction of harbours and port installations, including fishing harbours."*

Given the Proposed Scheme forms part of an EIA Development, its environmental effects, either alone or cumulatively with the Outer Berth Development, are considered to have the potential to give rise to significant environmental effects. It has therefore been determined that the Proposed Scheme is also an EIA Development and rescreening for EIA is not considered necessary, as agreed with MS-LOT (see **Appendix B**) and in accordance with Part 2 Section 7 of the MRWs:

> *"If no screening opinion has been adopted by the Scottish Ministers, the submission…of a report referred to by the applicant as an EIA report…will determine for the purpose of these Regulations whether proposed works would be an EIA project."*.

The Supplementary EIA Report that accompanies the variation requests will fulfil the requirements of an EIA report as set out in Schedule 4 of the MWRs.

3.3 Other relevant legislation and policy

3.3.1 Conservation (Natural Habitats, &c.) Regulations 1994, as amended

In Scotland, the Habitats Directive is translated into specific legal obligations by the Conservation (Natural Habitats, &c.) Regulations 1994, as amended. These regulations ("the Habitats Regulations") transpose the Habitats and Birds Directives into Scottish legislation.

The Habitats Regulations place an obligation on 'competent authorities' to carry out an appropriate assessment of any proposal likely to affect a designated site, to seek advice from NatureScot and not to approve an application that would have an adverse effect on a designated site unless certain conditions are met (where there are no alternative solutions, the plan or project can only proceed if there are imperative reasons of over-riding public interest and if the necessary compensatory measures can be secured).

A Habitats Regulations Appraisal (HRA) will be undertaken on the Proposed Scheme.

3.3.2 Scotland National Marine Plan

Scotland's National Marine Plan (NMP) was published by the Scottish Government in March 2015. The plan covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles), setting out the Scottish Government's policies for the sustainable development of Scotland's seas (MSD, 2015).

The plan promotes an ecosystem-based approach, putting the marine environment at the heart of the planning process to promote ecosystem health, resilience to human induced change and the ability to support sustainable development and use. It adopts the guiding principles of sustainable development, which also ensures that any individual policy, plan, or activity is carried out within environmental limits.

Chapter 4 of the NMP sets out the General Planning Principles necessary to achieve sustainable development. Details of how the Proposed Scheme supports these principles, both of itself and as a component of the Outer Berth development, will be presented in the Supplementary EIA Report.

4 Scoping of Potential Environmental Impacts

4.1 Introduction

This chapter of the ESR details the key environmental sensitivities that may be affected by the Proposed Scheme and the potential impacts that should be scoped in and out of the EIA. Also detailed is the proposed approach towards the assessment for each relevant topic, including identification of any data gaps that would need to be addressed in order to support the assessment.

The Proposed Scheme has the potential to affect the following:

- Coastal processes;
- Marine sediment and water quality;
- Ornithology;
- Benthic ecology;
- Fish and shellfish ecology;
- Marine mammals;
- Marine archaeology; and
- Cumulative effects.

There would not be any significant change in operation-phase marine activity when compared with existing activity levels; therefore, with the exception of potential impacts as a result of changes to coastal processes, there would be no potential for impacts on marine receptors during the operational phase.

4.2 Topics scoped out of the EIA

The Proposed Scheme only differs from the Outer Berth development by way of the increased dredge footprint / volume and the (limited) additional piling associated with installation of the retaining wall. The following topics, which were scoped out of assessment in the Outer Berth EIA, remain scoped out of the EIA on the basis that i) there is no pathway for effect with the Proposed Scheme; and / or ii) any impacts could be controlled by standard measures already implemented for the Outer Berth development:

- Ground conditions;
- Water resources and flood risk;
- Traffic and transport;
- Noise and vibration;
- Air quality;
- Terrestrial ecology;
- Commercial fisheries;
- Infrastructure and other users;
- Commercial navigation;
- Landscape and visual;

- Tourism and recreation;
- Waste;
- Major accidents and disasters;
- Climate change; and
- Socioeconomics.

4.3 Coastal processes

4.3.1 Key environmental sensitivities and data gaps

Bathymetry

The existing bathymetry comprises a gradually deepening seabed from the coast to -8.0m CD offshore, intersected by the approach channel and Outer Berth pocket oriented north-northwest to south-southeast in the lee of the Eastern Breakwater (and adjacent to the consented Outer Berth development). Note that the Outer Berth pocket is currently in the process of being dredged and – once completed – will be at a level of -9.0m CD (this will form the baseline for the Proposed Scheme).

Waves and tidal currents

The predominant wave approach on this coast is from the east to east-northeast sector (from the North Sea). These waves drive longshore sediment transport to the west at the Proposed Scheme. Tidal streams run approximately parallel to the coast and are east-northeast to west-northwest (into the estuary) during the flood tide and west-northwest to east-northeast (out of the estuary) during the ebb tide. Currents are relatively strong in mid-channel (enough to transport and erode fine sediment) but are weaker in the nearshore zone close to the Proposed Scheme.

Sediment transport

Sediment transport at and adjacent to the Proposed Scheme is relatively benign with a weak net longshore bedload transport direction to the west. Sand has accreted along the outer face of the Eastern Breakwater since it was constructed, but limited deposition of bedload in the approach channel suggests that there is little flux of sediment in a westerly direction across the port entrance.

4.3.2 Potential impacts of the Proposed Scheme scoped into the EIA or require further assessment

The Proposed Scheme has the potential to change coastal processes directly and indirectly, both locally and regionally, through the construction and operation of the deepened approach channel and Outer Berth pocket. The following potential impacts on coastal processes are scoped in for further assessment in the Supplementary EIA Report because the significant increase in dredge volume associated with the Proposed Scheme may have a material effect on the conclusions of the Outer Berth EIA.

Potential construction impacts would include:

- Short term increases in suspended sediment concentrations during dredging of the approach channel and berth pocket. The mobilised sediment from this activity would be transported and dispersed by tidal currents (and waves) in suspension in the water column.
- Changes in seabed level due to deposition of the sediment suspended due to dredging activities. Any sediment that becomes entrained within the plume would have the potential to become deposited on the seabed as it settles through the water column.

4.3.3 Potential impacts of the Proposed Scheme scoped out of the EIA or require no further assessment

The potential impacts on coastal processes that are scoped out of the EIA or require no further assessment are:

- The enlarged approach channel would result in changes to bathymetry, which in turn, may change tidal currents. These changes could potentially affect the sediment transport mechanisms and / or seabed morphology, the scale of which would be dependent upon the scale of the proposed dredging and the local physical conditions. Potential changes in these parameters due to the Proposed Scheme have been assessed using a hydrodynamic model to predict tidal current velocities and bed shear stresses. The results of this modelling are provided in **Appendix A**. No further assessment is required.
- The berthing areas would potentially create a sink for deposition of fine sediment, and they may require maintenance dredging to maintain depth during the operational phase. A prediction of the potential increase in maintenance dredge requirements is provided in **Section 2.2**. No further assessment is required.
- The assessment of waves has been scoped out because they are relatively small across the approach channel and Outer Berth (see **Appendix A** for detail). Changes to waves caused by the Proposed Scheme would be very small and it is considered that there is a low level of risk of adverse effects on the seabed and at the coast.

4.3.4 Approach to assessment

Capital dredging would increase suspended sediment concentrations and therefore plume dispersion modelling linked to the hydrodynamic model outputs will be carried out. The model will predict increases in suspended sediment concentrations due to the dredging process and the subsequent thickness and distribution of deposition on the seabed from the plume.

4.4 Marine sediment and water quality

4.4.1 Key environmental sensitivities and data gaps

A review of marine sediment and water quality was undertaken to inform the Outer Berth EIA. The following information was identified:

- Water quality is managed through the Water Environment and Water Services (Scotland) Act 2003 (the WEWS Act) (as amended) which transcribes the Water Framework Directive (2000/60/EC) into Scottish law;
- The Proposed Scheme is within the Kinghorn to Leith Docks coastal water body (ID: 200041) which, as reported in the Outer Berth EIA, continues to hold a chemical status of ‘Pass’, an ecological status of ‘Good’ and an overall status of ‘Good’; and
- There are no Shellfish Waters within the Firth of Forth under The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013.

Sediment quality data are available from the Outer Berth pocket and entrance to the Port following a vibrocore sampling campaign undertaken in May 2022. The data from the sampling campaign are considered to remain valid. There is no sediment quality data available from the footprint of the proposed approach channel.

Suspended sediment concentration data was presented in the Outer Berth EIA, from backscatter sensors deployed by FugroEMU (2013). Baseline suspended sediment levels – typical of an estuarine environment – were highly variable, with ambient levels of around 5mg/l and near-bed suspended sediment concentrations of 200mg/l to 1,300mg/l recorded during high wave periods. The backscatter sensors were deployed within close proximity to (and therefore are representative of) the approach channel and surrounding marine areas; the baseline data presented in the Outer Berth EIA Report is considered to be valid for the Proposed Scheme.

4.4.2 Potential impacts of the Proposed Scheme scoped into the EIA or require further assessment

The following potential impact on water and sediment quality has been scoped into the EIA or requires further assessment:

- Potential release of contaminants due to sediment disturbance during dredging and disposal.

4.4.3 Potential impacts of the Proposed Scheme scoped out of the EIA or require no further assessment

The risk of accidental impacts, such as the potential for leakages / spills from construction vessels, is not considered to differ from that assessed for the Outer Berth EIA. Such impacts would be controlled using standard measures, including adherence to Port protocols for emergency situations. As such, leakages / spills require no further assessment.

4.4.4 Approach to assessment

To enable the risk of water borne contaminants to be assessed, chemical analysis of the sediment within the dredge footprint will be undertaken in accordance with the requirements of MS-LOT. A sediment sampling plan has been issued to MS-LOT for approval (see **Appendix C**).

4.5 Ornithology

4.5.1 Key environmental sensitivities and data gaps

The Firth of Forth is an internationally important resource for both breeding and non-breeding estuarine and coastal birds, as reflected by protected areas designated under international directives and conventions, such as the EU Birds Directive (Special Protection Areas, or SPAs) and the Ramsar Convention on Wetlands of International Importance (Ramsar sites).

The following designations have the potential to overlap with the zone of influence of the Proposed Scheme (see **Figure 4.1**):

- Firth of Forth SPA and Ramsar site (including the underpinning Firth of Forth Site of Special Scientific Interest);
- Outer Firth of Forth and St Andrews Bay Complex SPA;
- Forth Islands SPA; and
- Imperial Dock Lock, Leith SPA.

Baseline bird activity within the Port and surrounding marine areas was surveyed on a bi-monthly basis between April 2021 and April 2022, inclusive, as reported in the Outer Berth EIA Report. Given the recent and comprehensive nature of the 2021/22 survey, further surveys are not required.

4.5.2 Potential impacts of the Proposed Scheme scoped into the EIA or require further assessment

The following potential impacts on ornithology have been scoped into the EIA or require further assessment:

- Visual disturbance at the disposal site, as a result of the increased number of vessels visiting the disposal site compared to that considered by the current Outer Berth EIA; and
- Changes in water quality and prey availability as a result of the sediment plume.

4.5.3 Potential impacts of the Proposed Scheme scoped out of the EIA or require no further assessment

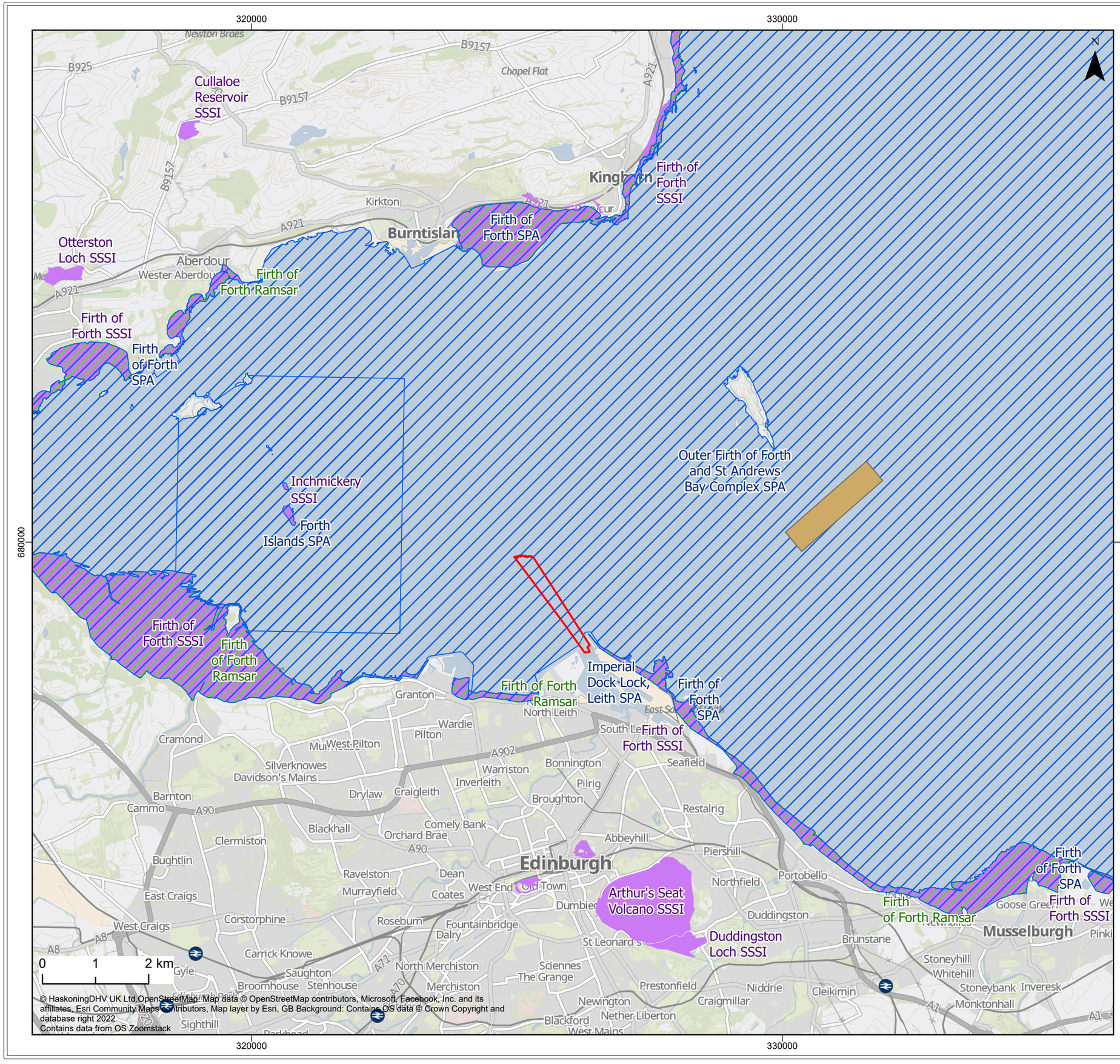
Piling noise from the Proposed Scheme would be of notably lower magnitude (in terms of both extent and duration) than that assessed as part of the Outer Berth EIA. The continued implementation of mitigation measures used for the impact piling associated with the Outer Berth – notably soft-start protocols and the use of piling shrouds – would be sufficient to avoid significant adverse effects on coastal and waterbird features. As such, it is proposed that further assessment of piling noise disturbance is not required.

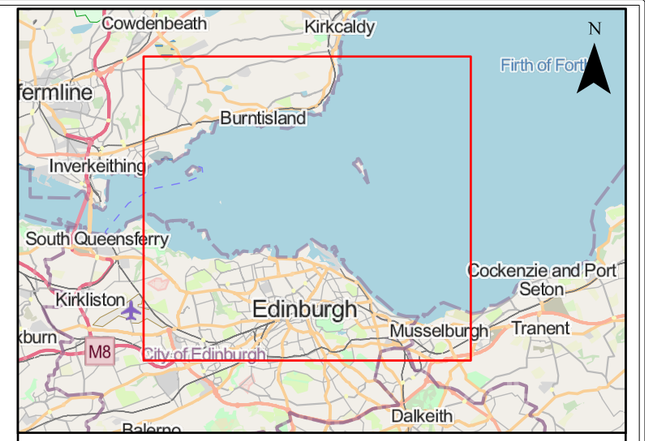
The proposed dredge footprint extends further into the Firth of Forth than the dredge footprint of the consented Outer Berth development, resulting in the potential for waterbirds to be disturbed by the dredging activity. However, this disturbance would not have a significant impact on waterbirds, as dredging vessels would be confined to the busy Port approach channel and established shipping routes, where regular vessel passage forms part of the baseline environment. As such, it is proposed that disturbance of dredging on waterbirds is scoped out of the EIA.

4.5.4 Approach to assessment

Given that the principal ornithological sensitivities that may be affected by the Proposed Scheme comprise features of the designations listed in **Section 4.5.1**, the HRA (undertaken in accordance with the Conservation (Natural Habitats, &c.) Regulations 1994, as amended) that supported the Marine Licence application for the Outer Berth development will be updated to consider the potential effects of the Proposed Scheme.

The updated HRA will assess the potential effects of the Proposed Scheme on ornithological receptors to ensure that there is no risk of adverse effect on the integrity of the listed designations. To prevent duplication of assessments, it is proposed that the Supplementary EIA Report presents the conclusions of the updated HRA, as per Regulation 6(4) of the MWRs.





Legend

- Dredge Areas
- Ramsar Sites
- Special Protection Area
- Sites of Special Scientific Interest (SSSI)
- Disposal Site Narrow Deep B

Data Sources: ©NatureScot 2023, ©CEFAS 2023

Client:	Project:
Forth Ports Limited	Proposed Deepening of the Leith Approach Channel – Environmental Scoping Report

Title: Ornithological Designations

Figure: 4.1

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Co-ordinate system: British National Grid

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4.6 Benthic ecology

4.6.1 Key environmental sensitivities and data gaps

Broadscale habitat mapping of the Port of Leith and surrounding marine areas, including the footprint of the Proposed Scheme, was presented within the Outer Berth EIA Report, taken from the 2021 EUSeaMap benthic mapping project. The approach channel, and adjacent areas that may be affected by sedimentation, comprises two uniform moderate energy seafloor habitats:

- MC42 infralittoral mixed sediments; and
- MB42 circalittoral mixed sediments.

Habitat type MC42 is characteristic of the nearshore areas (to a distance of *c.*1km from shore) either side of the approach channel. Habitat type MB42 is characteristic of areas slightly further offshore, and within the deeper sections of the channel itself. Both habitat types are ubiquitous throughout the local area within the Firth of Forth (see **Figure 4.2**).

There is no existing data on the benthic communities / biotopes present within the proposed dredge footprint or adjacent areas. It should be noted that the majority of the proposed dredge footprint is within the Port's existing approach channel, which is regularly dredged, and as such the benthic communities present are resilient to such disturbance.

Narrow Deep B is an existing licenced spoil disposal ground therefore benthic communities within the site and surrounding areas have been impacted by ongoing spoil deposition activities that have occurred there over more than 50 years.

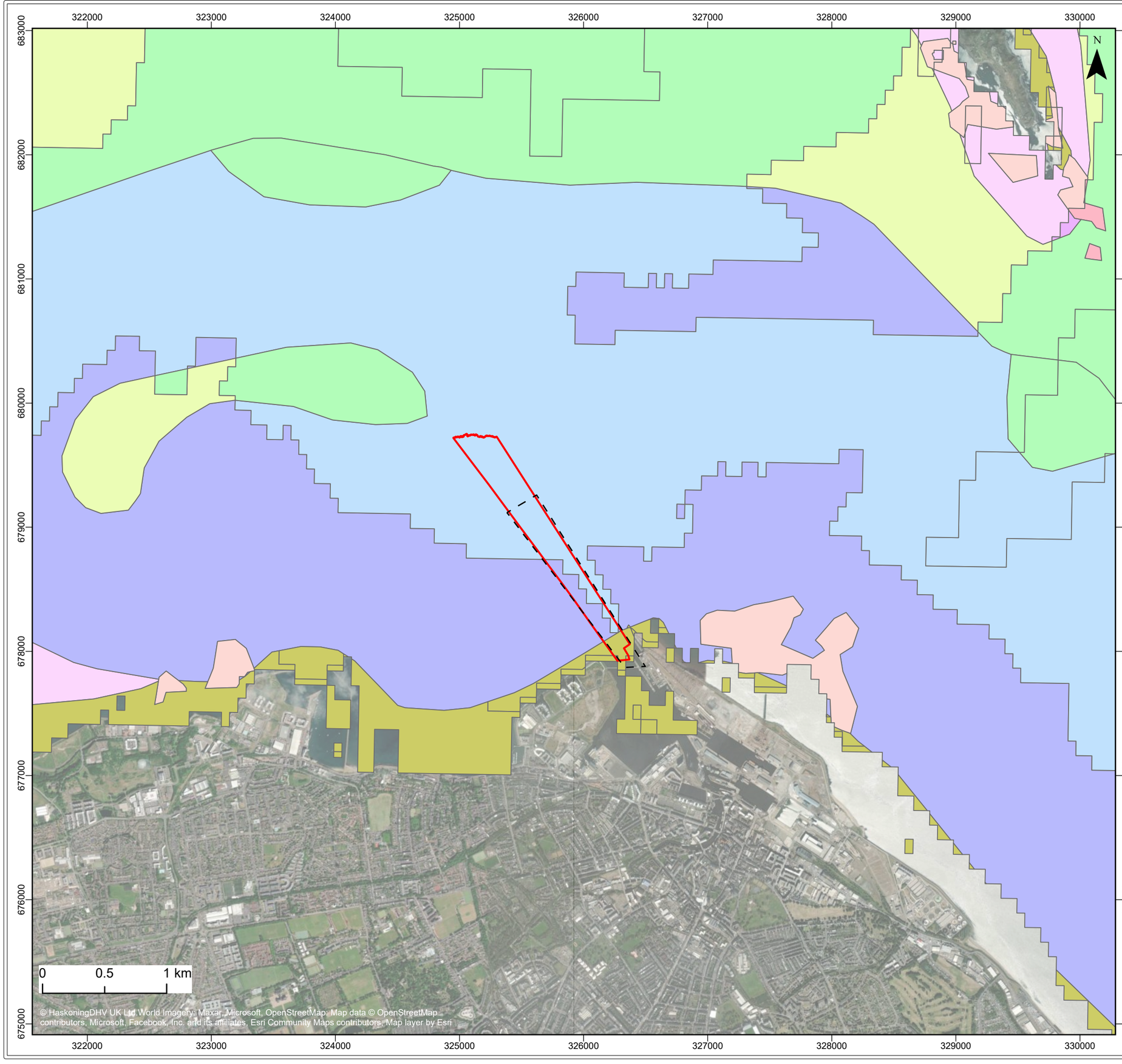
4.6.2 Potential impacts of the Proposed Scheme scoped into the EIA or require further assessment

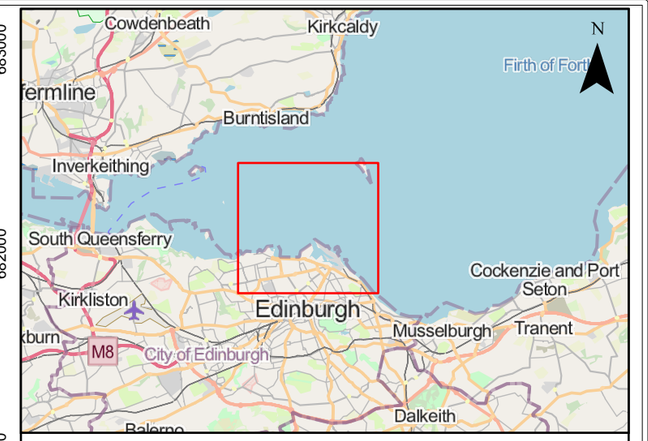
The following potential impacts on marine ecology have been scoped into the EIA or require further assessment:

- Direct loss of benthic habitat / communities within the proposed dredge footprint.
- Release of contaminants during dredging and disposal; and
- Smothering of benthic communities as a result of the deposition of suspended sediment during dredging and disposal.

4.6.3 Potential impacts of the Proposed Scheme scoped out of the EIA or require no further assessment

Potential impacts during the operational phase on benthic habitats can arise through changes in erosion and accretion patterns. Changes in erosion and accretion patterns are discussed in **Section 4.3.2**, which concludes that changes to bed shear stresses are predicted to be very localised and small in magnitude. As such, it is unlikely that there would be any discernible effect on bedload sediment transport and no impact on benthic habitats, therefore no further assessment is required.





Legend

- Maintenance Dredge Area
- Dredge Areas

Benthic Broad Habitat Types

- Circalittoral coarse sediment
- Circalittoral mixed sediment
- Circalittoral mud
- Circalittoral rock and biogenic reef
- Infralittoral coarse sediment
- Infralittoral mixed sediment
- Infralittoral mud
- Infralittoral rock and biogenic reef
- Na

Client: Forth Ports Limited

Project: Proposed Deepening of the Leith Approach Channel - Environmental Scoping Report

Title: Distribution of Broadscale Habitats (taken from EUSeaMap 2021)

Figure: 4.2

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
3	23/06/2023	GC	BH	A3	1:30,000
2	26/04/2023	TC	BH	A3	1:30,000

Co-ordinate system: British National Grid

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4.6.4 Approach to assessment

A subtidal benthic survey will be undertaken to provide baseline information on the habitats / biotopes and benthic communities present within the proposed dredge footprint and adjacent areas. The proposed sample locations are described in the benthic survey specification, provided as **Appendix D**. At each location, infaunal (i.e. grab sample) and epibenthic (i.e. drop-down video) data would be obtained; biotopes would be assigned based on a combination of infaunal / epifaunal and sediment data.

As described in **Section 4.4**, the maximum extent of the sediment plume would be modelled; the output from the model would be used in assessing the likely effect on benthic habitats and communities as a result of the dredging and disposal activities.

As described in **Section 4.4**, a sediment quality survey will be undertaken to determine the chemical characteristics of the material to be dredged.

4.7 Fish and shellfish ecology

4.7.1 Key environmental sensitivities and data gaps

The NatureScot guidance document (SNH, 2016) states there is the potential for connectivity with the River Teith Special Area of Conservation (SAC) due to the migration routes of Atlantic salmon *Salmo salar*, sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatilis*. These species are known to occur within the wider Forth Estuary during parts of their life cycle.

The Firth of Forth also supports a diverse range of marine fish species, and encompasses several areas reported to be spawning and nursery grounds for species including herring *Clupea harengus*, cod *Gadus morhua*, whiting *Merlangius merlangus*, plaice *Pleuronectes platessa*, sprat *Sprattus sprattus* and lemon sole *Microstomus kitt* (Ellis *et al.,* 2012; Coull *et al.,* 1998). An abundance of other species are also known to be present in the wider area.

Although not necessarily afforded protection by legislation or other designations, Scottish Ministers adopted a list of Priority Marine Features (PMF) that are considered to be marine nature conservation priorities in Scottish waters. In producing the list, species on existing conservation schedules were assessed against criteria that considered i) whether the species occurs in significant numbers in Scotland's seas; ii) whether the species is under threat or in decline; and iii) the functional role that the species plays. The list of PMFs includes a number of fish species that are understood to be potentially present in the estuary, as presented in Table 10-1 of the Outer Berth EIA Report.

4.7.2 Potential impacts of the Proposed Scheme scoped into the EIA or require further assessment

The following potential impacts on fish and shellfish ecology have been scoped into the EIA or require further assessment:

- Underwater noise during dredging activity, which could have physiological and / or behavioural response impacts;
- Increased suspended sediment concentration during dredging and disposal; and
- Release of contaminants during dredging and disposal.

4.7.3 Potential impacts of the Proposed Scheme scoped out of the EIA or require no further assessment

The Outer Berth EIA assessed the potential impact of changes in habitat availability on fish and shellfish species; this was determined to have a negligible effect. While the proposed dredge footprint is significantly larger than that of the consented Outer Berth development, it is considered that this conclusion remains valid for the following reasons:

- Dredging would represent a temporary loss of benthic habitat;
- The majority of the dredge area is within the existing approach channel, where maintenance dredging is undertaken on a routine basis; and
- As demonstrated in **Section 4.6**, habitat types present within the affected area are ubiquitous in this section of the Firth of Forth.

As such, no further assessment is required on changes in habitat availability on fish and shellfish species.

Piling noise from the Proposed Scheme would be of notably lower magnitude (in terms of both extent and duration) than that assessed as part of the Outer Berth EIA. As such, and with the continued implementation of the mitigation measures used for the impact piling associated with the Outer Berth (notably soft-start protocols), no further assessment is required.

4.7.4 Approach to assessment

As per the assessment presented in the Outer Berth EIA, it is proposed that the assessment would be based on the assumption that diadromous species and PMFs are present in the general area.

As described in **Section 4.4**, the sediment plume caused by dredging and disposal would be modelled; the output from the model would be used to assess the likely effect on fish and shellfish ecology.

As described in **Section 4.4**, a sediment quality survey will be undertaken to determine the chemical characteristics of the material to be dredged.

Assessments undertaken for the Outer Berth EIA included underwater noise modelling of the dredging activity. While fish / shellfish may exhibit varying behavioural reaction intensities as a result of exposure to dredging noise, the potential impacts are unlikely to be significant and a desk-based approach is proposed for the further assessment; a repeat of the underwater noise modelling is not considered necessary.

The updated HRA will consider potential impacts to the River Teith SAC. The conclusions of the updated HRA will be presented in the Supplementary EIA Report.

4.8 Marine mammals

4.8.1 Key environmental sensitivities and data gaps

The key marine mammal species in the Firth of Forth area, are:

- Harbour porpoise *Phocoena phocoena;*
- Bottlenose dolphin *Tursiops truncatus;*
- White-beaked dolphin *Lagenorhynchus albirostris*;

- Minke whale *Balaenoptera acutorostrata*;
- Grey seal *Halichoerus grypus*; and
- Harbour seal *Phoca vitulina*.

There are other species that, while relatively rare in the area, are recorded at an increasing frequency, such as humpback whale *Megaptera novaeangliae* and sei whale *Balaenoptera borealis.* Information on these species in the area is sparse, and they are not considered further herein.

Based on guidance specifically developed for the Firth of Forth area (SNH, 2016)1, designated sites that should be considered in assessments for marine mammals are:

- Isle of May SAC (grey seals) – located approximately 43km from the Proposed Scheme;
- Firth of Tay and Eden Estuary SAC (harbour seals) – located approximately 64km from the Proposed Scheme;
- Berwickshire and North Northumberland Coast SAC (grey seals) – located approximately 63km from the Proposed Scheme; and
- Moray Firth SAC (bottlenose dolphins) – located approximately 300km from the Proposed Scheme.

The nearest, Isle of May SAC, is located approximately 37km from the Narrow Deep B spoil disposal ground. As such, only long-ranging and migratory individuals could potentially be affected by the Proposed Scheme.

4.8.2 Potential impacts of the Proposed Scheme scoped into the EIA or require further assessment

The following potential impacts on marine mammals have been scoped into the EIA or require further assessment:

- Potential for auditory injury and / or behavioural impacts from underwater noise during dredging works; and
- Changes in water quality and prey availability as a result of sediment plume.

4.8.3 Potential impacts of the Proposed Scheme scoped out of the EIA or require no further assessment

Piling would be temporary and for a short period only and would be minimal in the context of the piling consented for the Outer Berth development. In terms of underwater noise, the Proposed Scheme does not represent a change to the parameters of the works that have been assessed – only a short increase in the duration of such noises.

Assessments undertaken for the Outer Berth EIA included underwater noise modelling, and mitigation take into consideration comprised the best practice guidance for minimising the risk of injury to marine mammals from piling noise provided by the JNCC[2] (JNCC, 2010). With the mitigation in place, the Outer Berth EIA concluded that the potential impacts on marine mammals were not significant in EIA terms. Identical measures would be kept in place during piling for the Proposed Scheme, thereby ensuring that the potential

[1] https://www.nature.scot/sites/default/files/2019-07/Habitats%20Regulations%20Appraisal%20%28HRA%29%20on%20the%20Firth%20of%20Forth%20-%20A%20Guide%20for%20developers%20and%20regulators_1.pdf
[2] https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf

impact ranges for instantaneous permanent auditory injury are mitigated for and therefore not significant. Therefore no further assessment of the potential impacts of impact piling on marine mammals is required.

4.8.4 Approach to assessment

Based on reviews of published sources of underwater noise during dredging activities (e.g. Thomsen *et al.,* 2006; CEDA, 2011; Theobald *et al.,* 2011; WODA, 2013; Todd *et al.,* 2014), sound levels that marine mammals may be exposed to during dredging activities are usually below auditory injury thresholds or permanent threshold shift exposure criteria; however, temporary threshold shift cannot be ruled out if marine mammals are exposed to noise for prolonged periods (Todd *et al.,* 2014), though noting marine mammals remaining in close proximity to such activities for long periods of time is unlikely.

Underwater noise as a result of dredging activity also has the potential to cause disturbance responses in marine mammals (Pirotta *et al.,* 2013). There is the potential for behavioural reactions and disturbance to marine mammals in the area during dredging activities for the entirety of the dredging campaign; therefore, it is necessary to consider this potential impact further. While marine mammals may exhibit varying behavioural reactions intensities as a result of exposure to noise (Southall *et al.,* 2007), the potential impacts are unlikely to be significant and a desk-based approach is proposed for the further assessment; a repeat of the underwater noise modelling is not considered necessary.

The potential for indirect impacts due to changes in water quality and prey availability are not considered to be significant; however, if the assessments on fish and shellfish resources indicates that there may be a significant effect to the relevant receptors the indirect impacts on marine mammals would have to be considered further.

If required, Forth Ports will apply for a variation of the Licence to Disturb Marine Species (EPS/BS-00009909) issued for the consented scheme. A review of baseline information for species would be performed to ensure the use of the most up-to-date information in the application. There is no change to the types of activities assessed under the licence, but the extended durations of individual activities and of the construction period as a whole would be evaluated. The mitigation outlined in the current licence would be adhered to, including the JNCC (2010) guidance for piling and the use of the Scottish Marine Wildlife Watching Code for transiting vessels.

4.9 Marine archaeology and cultural heritage

4.9.1 Key environmental sensitivities and data gaps

Marine archaeology and cultural heritage was scoped out of the Outer Berth EIA given the very limited extent of the marine environment that would be affected by the Outer Berth development. Given the extent of dredging required as a result of the Proposed Scheme, potential impacts on marine archaeology and cultural heritage have been included in this ESR.

In order to establish the archaeology and cultural heritage baseline, the following open-source datasets were accessed:

- GIS data for designated heritage assets available from Historic Environment Scotland (HES)[3];
- GIS data for non-designated heritage assets (including maritime records) from Canmore (National Record of the Historic Environment) maintained by HES[4]; and

[3] (https://portal.historicenvironment.scot/downloads)
[4] https://portal.historicenvironment.scot/downloads/canmore

- GIS data on charted, uncharted, live and dead wrecks and obstructions from the Admiralty Marine data portal[5].

The datasets show that there are no known designated or non-designated heritage assets within the boundary of the Proposed Scheme. There are, however, a number of reported losses of vessels recorded in the Canmore maritime data in the vicinity of Leith which record historic accounts of vessels lost but not subsequently found. This includes losses reported in the area of Leith Roads (an area now incorporated within the Outer Harbour at Leith Docks) as well as general loss locations 'off Leith'. The general locations are outside the proposed dredge footprint; however, they can provide an indication of the potential for previously unrecorded maritime remains to be present within the footprint.

With respect to the potential for *in-situ* deposits of palaeoenvironmental interest, Fugro Engineering Services completed 45 boreholes to the north-northwest of the eastern breakwater in 2012 (**Figure 4.3**). The general geological succession comprised bedrock of interbedded mudstone, siltstone and sandstone overlain by sandy gravelly clay with gravel bands (till) overlain by recent clay / silt / sand / gravel (Fugro Engineering Services, 2013). No *in-situ* deposits representing preserved prehistoric land surfaces, or deposits of palaeoenvironmental geoarchaeological interest, were identified in the boreholes.

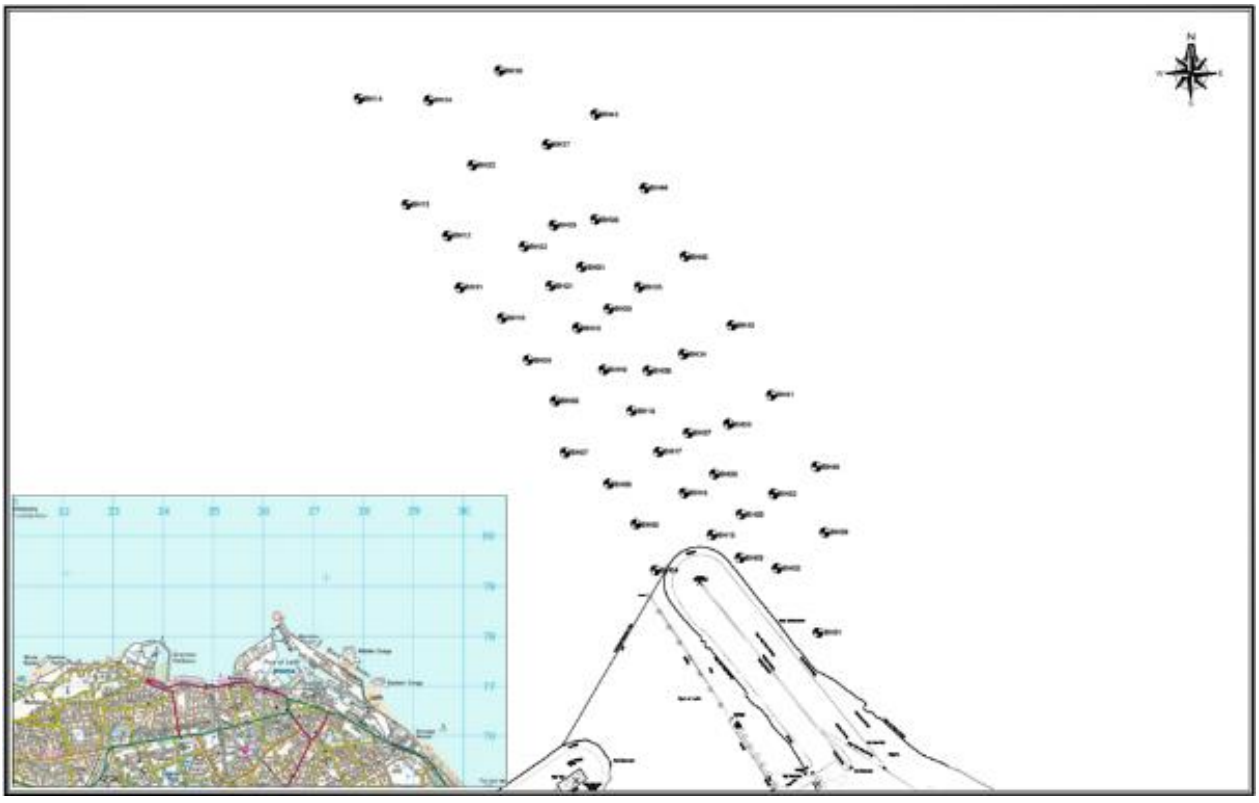

Figure 4.3 Location of borehole samples undertaken in 2012 (Fugro Engineering Services, 2013)

In 2021, Dunelm Geotechnical and Environmental completed eight vibrocores and three further marine boreholes to inform dredging requirements for the Outer Berth pocket (**Figure 4.4**). All three boreholes and six of the vibrocores show the same genal geological succession as above (bedrock overlain by till and recent bed sediments) (Dunhelm, 2022a). However, in VC01A a thin (0.10m) deposit of firm plastic dark grey to black slightly sandy pseudofibrous peat, containing leaf and twigs, was recorded between 1.44 and

[5] https://data.admiralty.co.uk/portal/apps/sites/#/marine-data-portal

1.54m below bed level. This peat was recorded with a deposit of very soft thinly to thickly laminated dark grey to black slightly sandy silt, with occasional thickly laminated peat lenses, recorded above and below.

Figure 4.4 Location of boreholes and vibrocore samples undertaken in 2021 (Dunelm, 2022a)

VC01a was located directly to the north west of a former pontoon, adjacent to the eastern breakwater, and now to the north west of the outer face of the suspended deck installed as part of the consented works at the Outer Berth. This could suggest that peat deposits may survive in isolated pockets in the vicinity of the port structures, which have not been impacted by previous activity; however, the results from geotechnical investigations suggest that this deposit is not *in-situ*, but reworked and redeposited.

This silt deposit with peat lenses was also recorded at the top of VC03 (very soft dark grey to black slightly sandy organic silt with occasional thickly laminated peat lenses) to a depth of 0.4m below bed level. This was noted as containing shell fragments indicative of a marine origin and suggesting reworking.

A further geotechnical survey in May 2022 comprised 17 vibrocores from Outer Berth (Dunelm, 2022b) (**Figure 4.5**). VCN08, located *c.*20m to the north of the location of VC01A, did not record any peat deposit, but did note the presence of medium, gravel-sized peat pockets with a dark grey to black slightly sandy silt from 0.25 to 0.48m below bed level, directly underlying the soft silts. These 'gravel-sized peat pockets' were also noted within silts in NVC06, and within the stiff clays (tills) in VCN12. This again suggests reworking and disturbance of the bed deposits. VCN16, *c.*15m to the south of VC03, did not record any peat, with silts directly overlying the tills at a depth of 0.25m below bed level.

Due to the requirements of engineering and design objectives, these samples are not available for geoarchaeological recording, sub-sampling or analysis.

Figure 4.5 Location of vibrocore samples completed in 2022 (Dunelm, 2022b)

4.9.2 Potential impacts of the Proposed Scheme

As much of the dredge footprint is already part of the maintained dredge area, previous disturbance from historic dredging activity suggests limited potential for the survival of *in situ* archaeological remains. The potential for encountering archaeological material during dredging, therefore, is anticipated to be limited to isolated and fragmentary finds rather than *in-situ* wrecks or submerged prehistoric sites. The potential for *in-situ* deposits of paleoenvironmental interest is also expected to be limited, with previous disturbance resulting in reworking and redeposition of deposits.

While changes in tidal currents may affect the stability of nearby archaeological features, and indirect impacts to heritage assets may occur if buried heritage assets become exposed to increased wave / tidal action, there will be no significant change to the local hydrodynamic and sedimentary processes (as described in **Section 4.3**). Conversely, increased sedimentation may result in an exposed site becoming buried, thereby adding some protection. Marine archaeology and cultural heritage has therefore been scoped out of the EIA.

4.9.3 Consultation with HES

Whilst marine archaeology and cultural heritage has been scoped out of the EIA, a geoarchaeological method statement will be produced and consulted on with HES, details of which are provided below.

In order to determine whether archaeological remains are located within the approach channel, marine geophysical data comprising multibeam echosounder (including backscatter), sub-bottom profiler and magnetometer data will be acquired encompassing the entire proposed dredge footprint. Sidescan sonar data will be acquired where multibeam echosounder data cannot provide the necessary resolution for archaeological assessment (likely where water depths are greater than 10m). Archaeological assessment of the data will be undertaken by a specialist archaeological contractor.

The geotechnical logs from the vibrocore survey that will be undertaken to provide physical and chemical analysis of the dredge sediment (see **Section 4.3**) will be reviewed by a marine geoarchaeological specialist to determine the potential for deposits of potential geoarchaeological interest and assessed as set out in the geoarchaeological method statement.

Following assessment of the data, a report would be produced setting out the results and making recommendations for any further mitigation, if required. As stated above, it is anticipated that any archaeological remains present within the dredge footprint would be limited to fragmentary and isolated finds. To this end, a Protocol for Archaeological Discoveries would be produced to allow any discoveries of archaeological material encountered during dredging to be efficiently reported and addressed.

4.10 Summary

Table 4.1 summarises the potential impacts to be taken forward for assessment in the Supplementary EIA Report.

Table 4.1 Summary of potential impacts of the Proposed Scheme to be assessed in the Supplementary EIA Report

Topic	Impact
Coastal processes	Short term increases in suspended sediment concentrations.
	Changes in seabed level due to deposition
Marine sediment and water quality	Release of contaminant due to sediment disturbance during dredging and disposal
Ornithology	Visual disturbance from the disposal of dredged material at the disposal site
	Changes in water quality and prey availability as a result of sediment plume
Benthic ecology	Direct loss of benthic habitat / communities within the proposed dredge footprint
	Smothering of benthic communities as a result of the deposition of suspended sediment during dredging and disposal
	Release of contaminants during dredging and disposal
Fish and shellfish ecology	Underwater noise disturbance during dredging activity
	Increase in suspended sediment concentrations during dredging and disposal
	Release of contaminants during dredging and disposal
Marine mammals	Potential for auditory injury and / or behavioural impacts from underwater noise during dredging works
	Changes in water quality and prey availability as a result of sediment plume

5 Cumulative Impact Assessment

Schedule 4 of the MWRs mandates consideration of cumulative effects of a project when producing an EIA Report. There is no legislation that prescribes a specific approach to CIA, though cumulative impacts are commonly accepted as:

> *"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project."* (European Commission, 1999)

Schedule 4, Paragraph 5(e) of the MWRs states that a *"description of the likely significant effects of the development on the environment resulting from…the cumulation of effects with other existing and / or approved projects…*" must be included in the EIA Report. In this regard the regulations are specific about the projects that should be considered to result in cumulative effects (i.e. existing and / or approved projects).

5.1 Cumulative effects with the consented Outer Berth development

The marine elements of the Outer Berth development (i.e. those with the potential for cumulative impacts with the Proposed Scheme) would be completed by the time the construction works for the Proposed Scheme begins. As such, the presence of the Outer Berth development forms part of the baseline upon which the Proposed Scheme will be assessed.

5.2 Cumulative effects with other projects / plans

In line with established practice, the CIA would be limited to the plans and projects for which there is sufficient information available to allow assessment of potential effects. In the absence of publicly available information (usually in the form of consent applications) or a defined 'scheme', it is not possible to undertake a proper consideration of cumulative effects (i.e. if proposals are speculative or where assumptions regarding the potential impacts may be contentious).

All topics / receptors considered as part of the EIA would initially be considered as part of the CIA, with a view to remove receptors from the scope where no pathway is predicted. The CIA would be undertaken using the same methodology used for the EIA. The approach to and scope of the CIA would be agreed through consultation with MS-LOT.

The following projects / developments (that have not already been completed and form part of the baseline for the Proposed Scheme) were considered in CIA in the Outer Berth EIA:

- Neart na Gaoithe Offshore Wind Farm (Revised Design);
- Inch Cape Offshore Windfarm Revised Design;
- Seagreen Alpha and Bravo Offshore Wind Farms (Optimised Project);
- Ardersier Port Development;
- NorthConnect HVDC Cable;
- Alexandra Parade Sea Wall Repair and Extension;
- Nigg Energy Park East Quay; and
- Moray East Offshore Windfarm.

In addition to the above, the following project / developments would also be considered in the CIA as, while the construction timeframes did not overlap with the consented Outer Berth development, there is potential for overlap with the Proposed Scheme:

- Grangemouth Flood Protection Scheme; and
- Moray West Offshore Windfarm.

6 References

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Appendix A Interpretation of hydrodynamic modelling results

Note / Memo

HaskoningDHV UK Ltd.
Water & Maritime

To:	Ben Hughes
From:	David Brew
Date:	23 June 2023
Copy:	Luke Evans-Jones
Our reference:	PC4514-RHD-YY-XX-FN-EV-0016
Classification:	Project related
Checked by	Click or tap here to enter text.

Subject: **Interpretation of Hydrodynamic Modelling Results at Leith**

1 Introduction

Hydrodynamic modelling of the existing layout and a future layout for the Port of Leith approach channel has been completed by Royal HaskoningDHV. This Technical Note provides an interpretation of the results from both physical (spring tide tidal currents) and sedimentary (spring tide bed shear stress) process perspectives, including an estimation of future maintenance dredging requirement changes because of the new configuration. The Note also provides a summary of the wave climate across the approach channel and berth pocket, using existing information.

2 Bathymetry

The existing layout bathymetry is a gradually deepening seabed from the coast to -8m CD offshore, intersected by the existing approach channel (deeper than -7m CD but shallower than -8m CD) and berth pocket oriented north-northwest to south-southeast in the lee of the eastern breakwater (Figure 2.1).

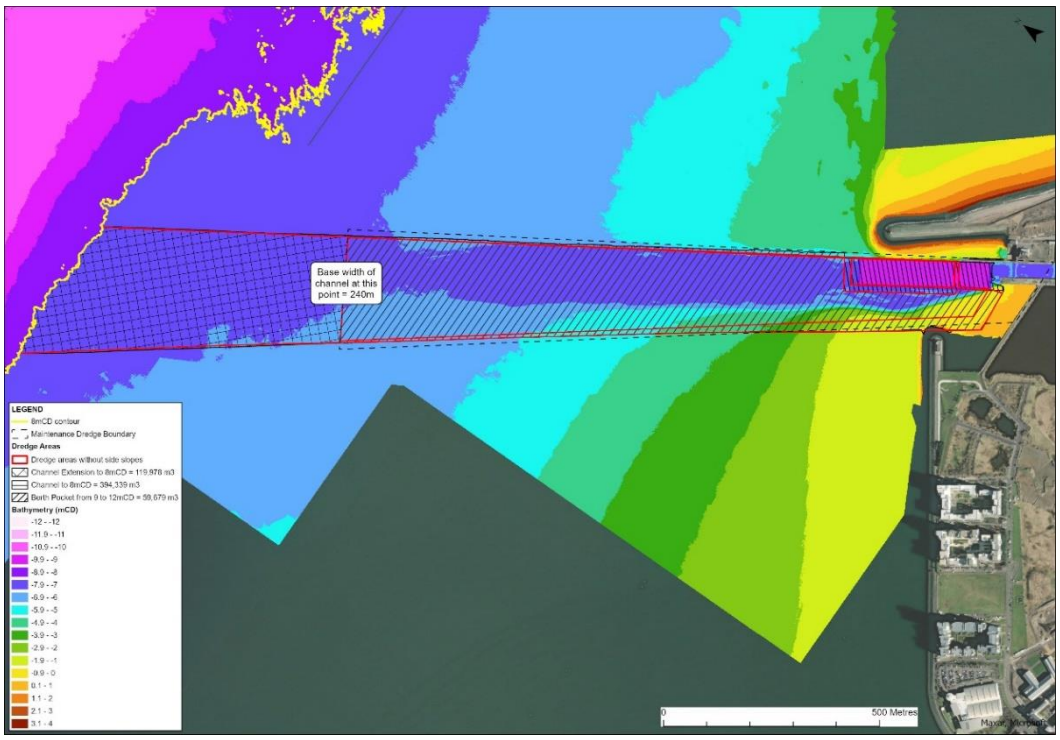

Figure 2.1. Existing bathymetry of the Port of Leith approach channel and berth pocket

The proposed future layout bathymetry would be an extension of the approach channel (Figure 2.2). The depth would increase to -8m CD across a wider section of the seabed, extending out to -8m CD offshore. The berth pocket would be deepened to -12m CD for the most part with a smaller inner area to -9m CD. The area of the future approach channel at -8m CD including the side slopes would be 456,309m^2 with a berth pocket of 25,518m^2. To create the future approach channel and berth pocket would require excavation of 573,995m^3 of sediment (Table 2.1). If this volume is averaged across the entire channel and berth pocket, it would equate to about 1.19m of sediment.

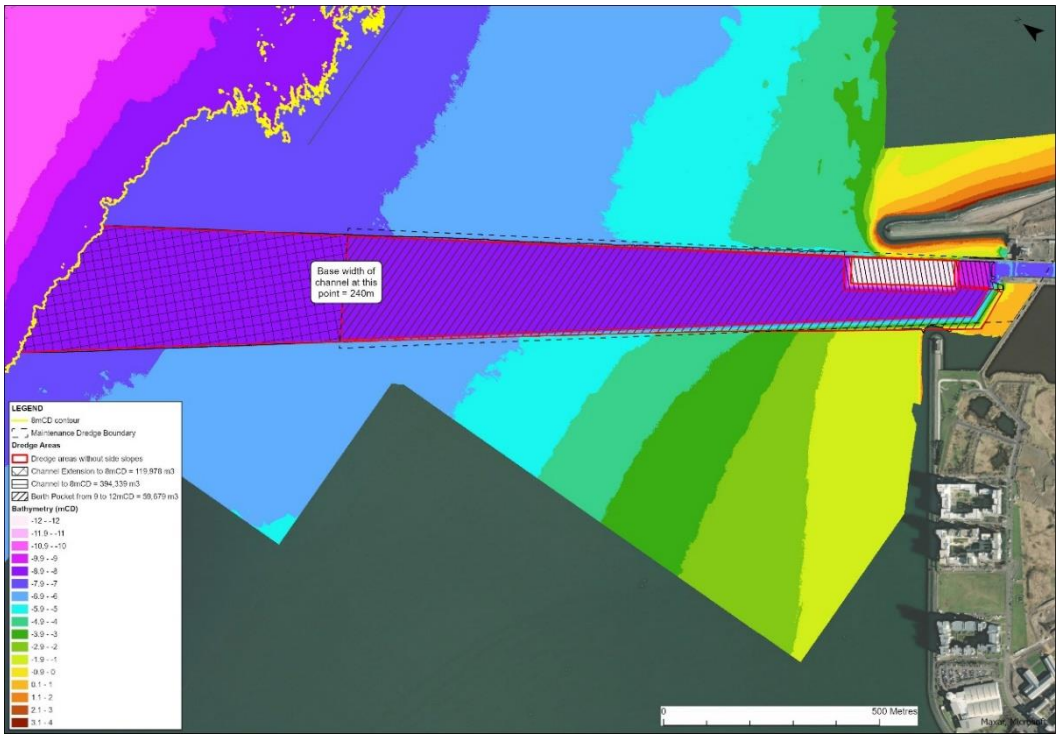

Figure 2.2. Future bathymetry of the Port of Leith approach channel and berth pocket

Table 2.1. Dredge volumes estimated by comparing the bathymetries of the existing layout and the future layout

Location	Volume (m^3)
Berth Pocket -12m CD and -9m CD (including side slopes)	59,679
Approach Channel -8m CD (including side slopes)	514,317
Total	573,995

The existing and future layouts as shown in Figure 2.1 and Figure 2.2 were input to the hydrodynamic model to predict existing tidal currents and bed shear stresses, and changes to them due to the changes in approach channel geometry. However, since the modelling has been completed a small length of piled wall has been added as a design feature on the inside of the eastern breakwater (Figure 2.3). The location, orientation and size of the wall is only a minor modification to the geometry of the future layout that was modelled and will have no material effect on the results of the modelling presented in this Technical Note.

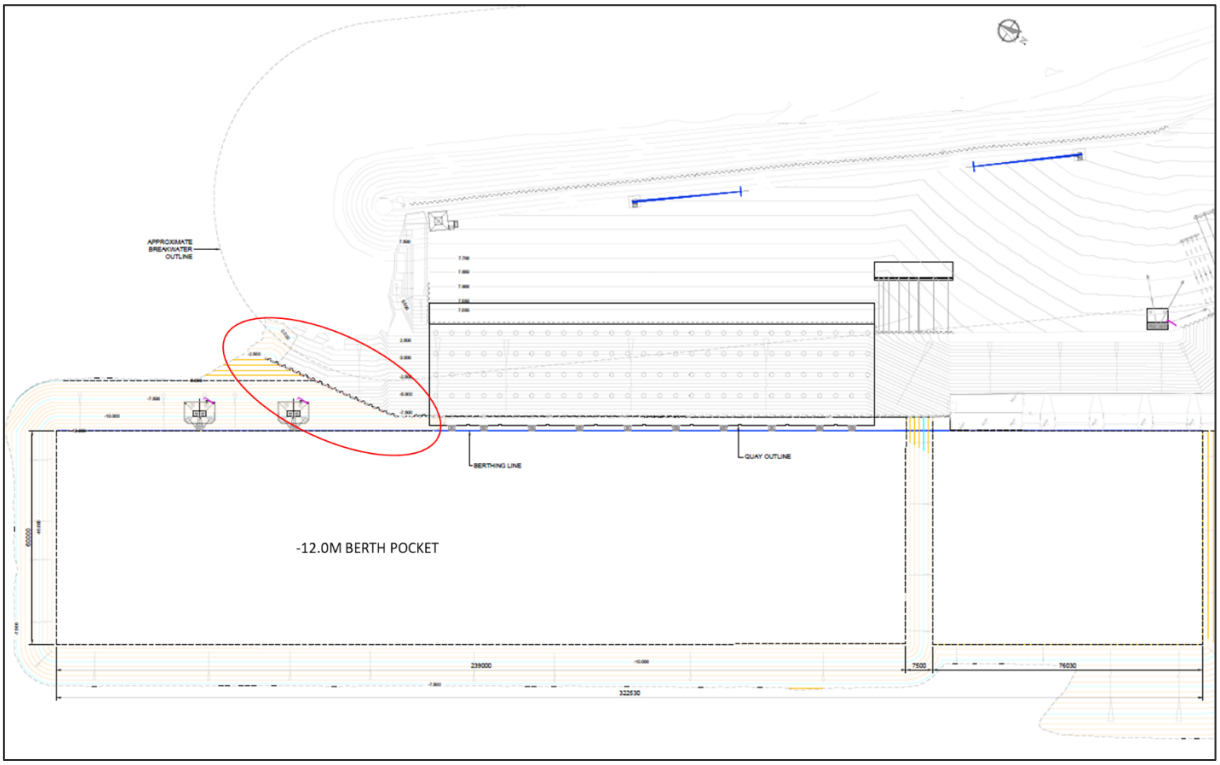

Figure 2.3. Short length of piled wall (circled in red) added as a design feature post modelling

3 Spring Tide Tidal Currents

3.1 Flow Distribution for the Existing Layout

For the existing layout, the predicted spring tide peak flood currents typically flow from east to west at speeds of 0.5-0.6m/s across the approach channel (Figure 3.1). Either side of the channel the velocities are slightly higher between 0.6m/s and 0.7m/s. The predicted velocities across the channel are slower because the water is deeper (Figure 2.1). There are local complexities in the port basin where tidal currents are slower between the eastern and western breakwaters. Here, there is a predicted reversal in flow direction (west to east, up to 0.5m/s) along the coast west of the berth pocket, and a predicted south to north flow (up to 0.3m/s) adjacent to the berth pocket. Elsewhere, in the port basin, flows are predicted to be less than 0.1m/s.

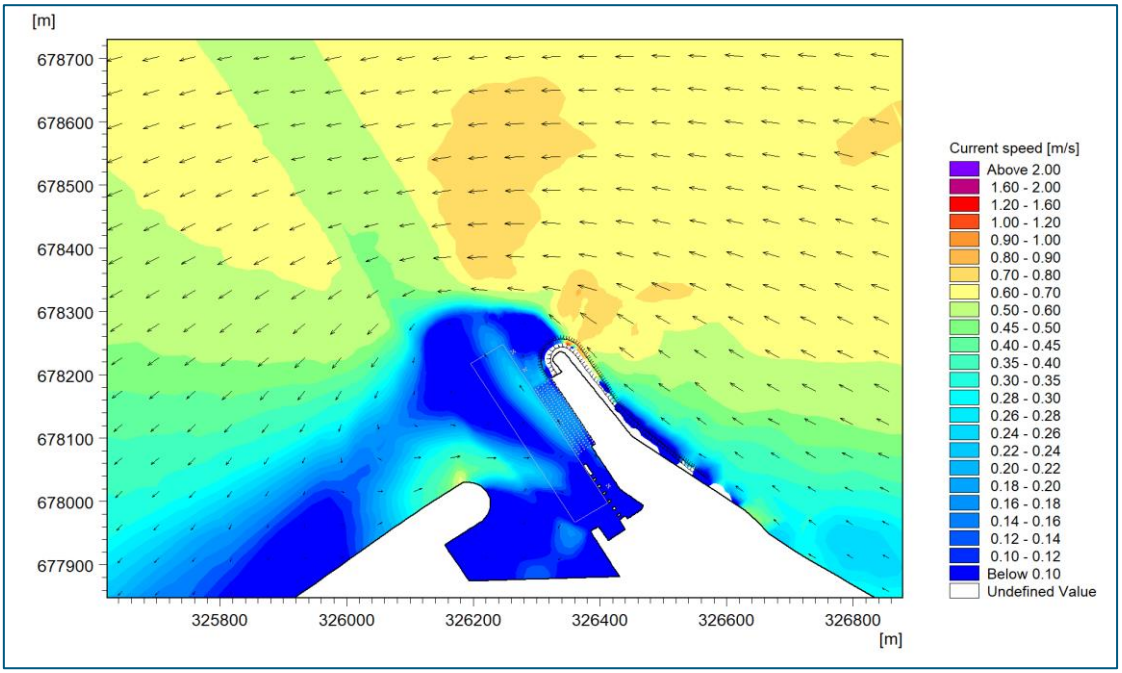

Figure 3.1. Predicted spring tide peak flood currents for the existing layout (inner approach channel and berth pocket)

The predicted spring tide peak ebb currents typically flow from west-southwest to east-northeast. Speeds reduce from 0.5-0.6m/s across the outer part of the existing approach channel to about 0.3m/s closer to the berth pocket (Figure 3.2). To the west of the channel, predicted velocities are like those across the outer channel and slightly higher (0.6-0.7m/s) to the east of the channel. Within the port basin and berth pocket, flows are predicted to be less than 0.1m/s. There is an increase in predicted current velocities to greater than 1.0m/s around the tip of the eastern breakwater.

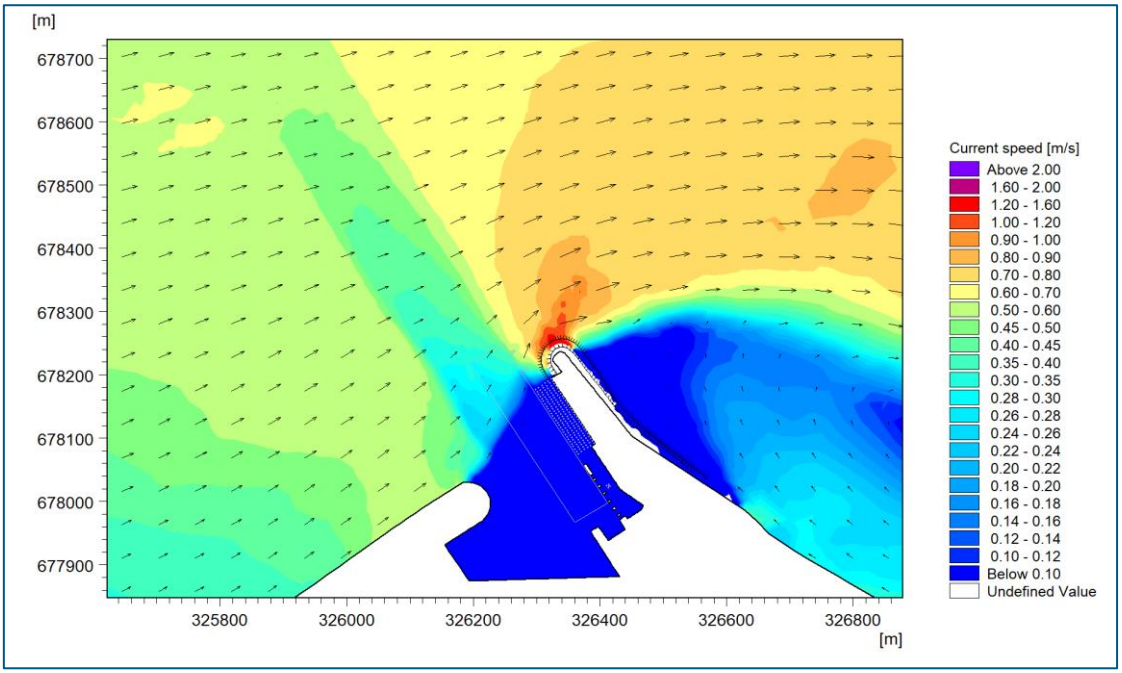

Figure 3.2. Predicted spring tide peak ebb currents for the existing layout (inner approach channel and berth pocket)

3.2 Flow Distribution for the Future Layout

For the future layout, the general distribution of predicted spring tide peak flood currents is like the flow distribution for the existing layout (Figure 3.3). The main change is the spatial extent of flows with velocities between 0.5m/s and 0.6m/s within the larger approach channel dimensions, and changes in the port basin and berth pocket due to its deepening. The general distribution of predicted spring tide peak ebb currents is also like the flow distribution for the existing layout (Figure 3.4), apart from the spatial extent of similar flow velocities within the larger approach channel dimensions.

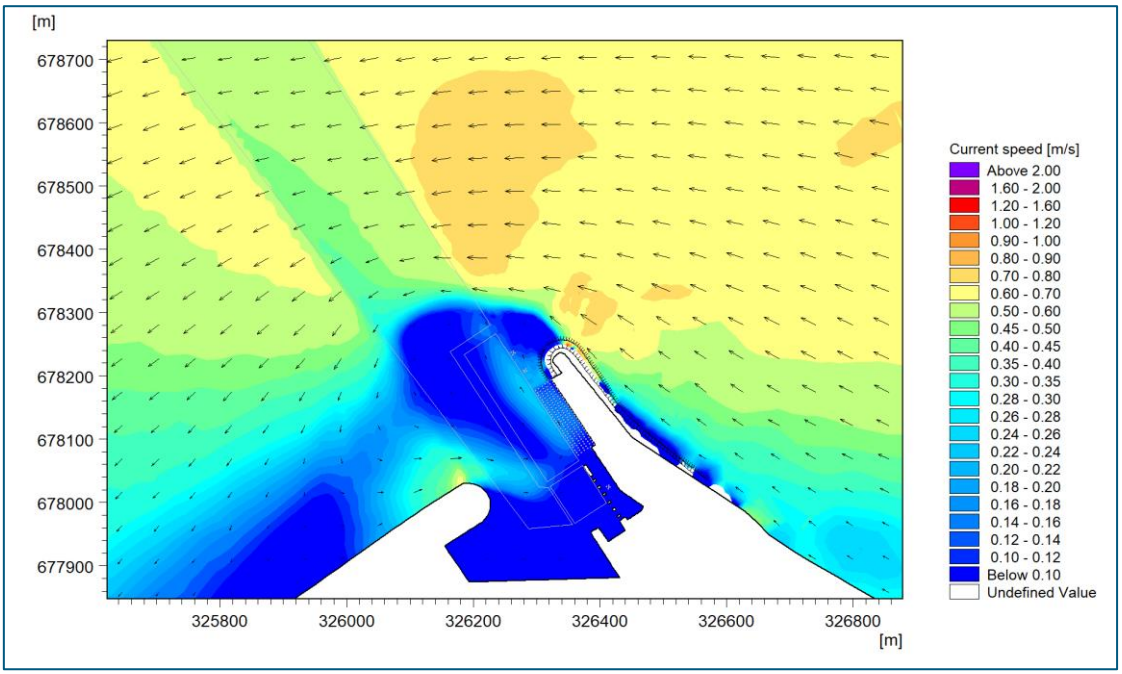

Figure 3.3. Predicted spring tide peak flood currents for the future layout (inner approach channel and berth pocket)

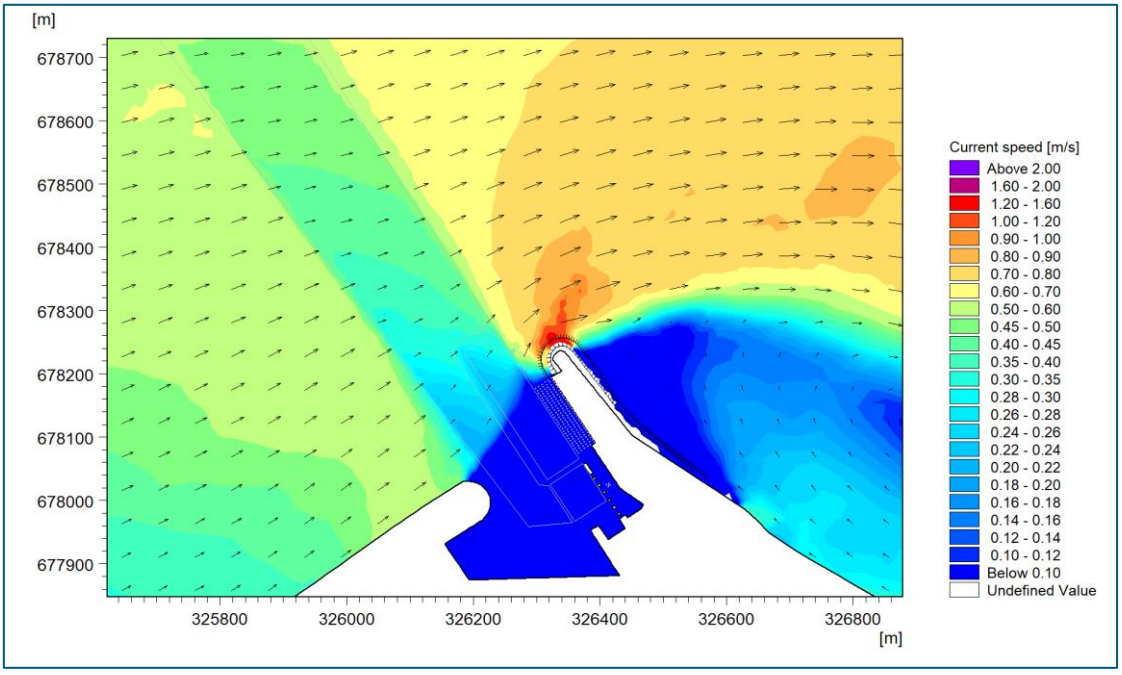

Figure 3.4. Predicted spring tide peak ebb currents for the future layout (inner approach channel and berth pocket)

3.3 Changes in Flow Distribution

The predicted differences in overall flow distribution between the existing layout and the future layout are reflected in predictions of how tidal current flows would change with implementation of the larger approach channel. Most of the changes are restricted to within the bounds of the future approach channel and are due to its increase in overall dimensions. Other changes occur within the port basin and parts of the deeper berth pocket.

Spring tide peak flood currents are predicted to reduce apart from small areas in the port basin (Figure 3.5). Speeds reduce mainly along the west side of the future approach channel, by 0.025-0.05m/s in the outer channel, 0.05-0.1m/s in the central part of the channel, and greater than 0.2m/s in the inner channel. Predicted changes to flows along most of the eastern side of the channel are less than 0.025m/s as are those within the berth pocket. Within the port basin, the flows are predicted to both decrease (up to 0.1-0.15m/s) and increase (up to 0.05-0.1m/s).

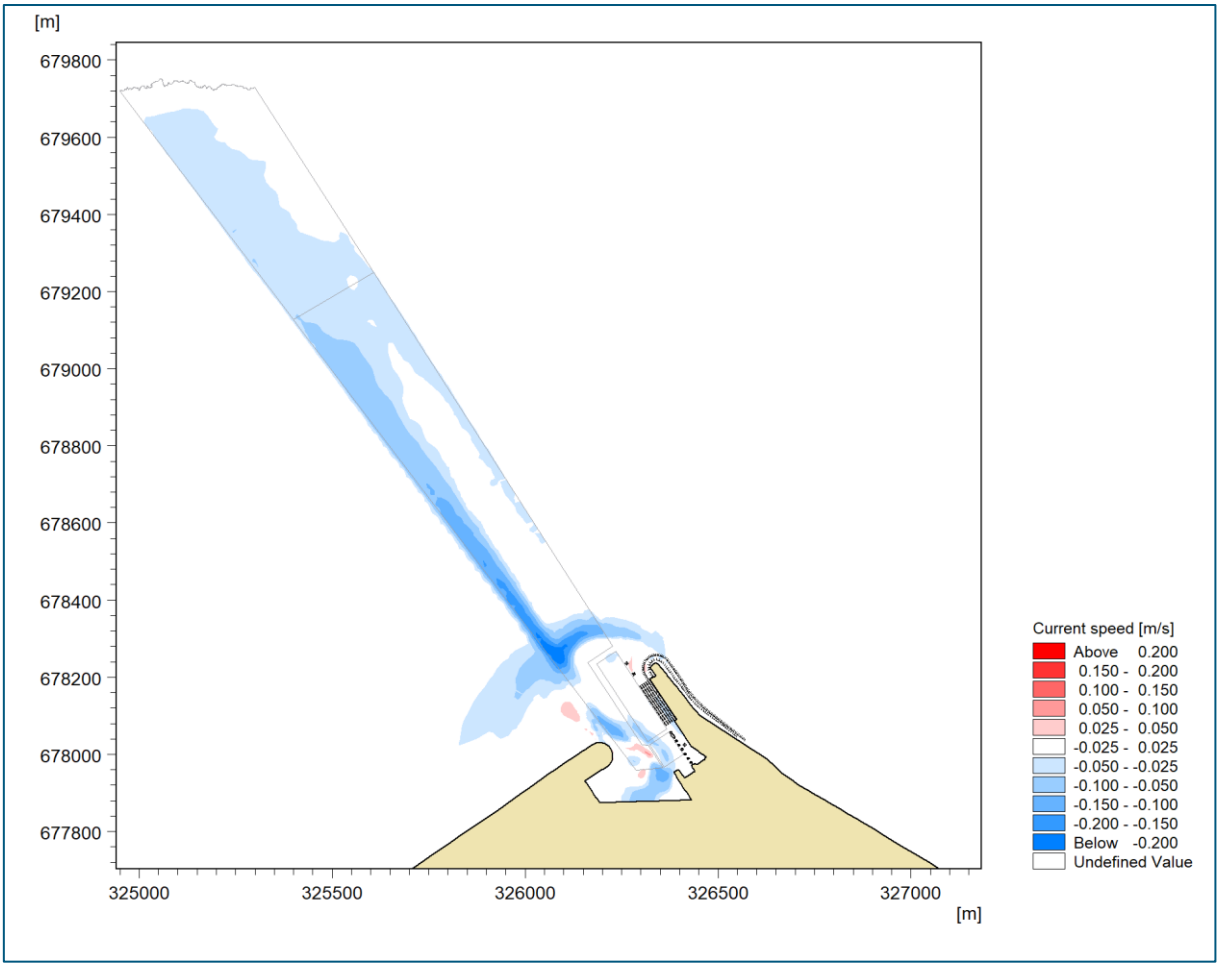

Figure 3.5. Predicted change in spring tide peak flood currents between the existing and future layouts

A similar distribution of change is predicted for the spring tide peak ebb currents, with the greatest changes along the west side of the future approach channel, although there are reductions (0.025-0.05m/s) along the east side of the central and inner channel which extend into the northern half of the berth pocket (Figure 3.6). There are no significant changes to predicted flow speeds within the port basin.

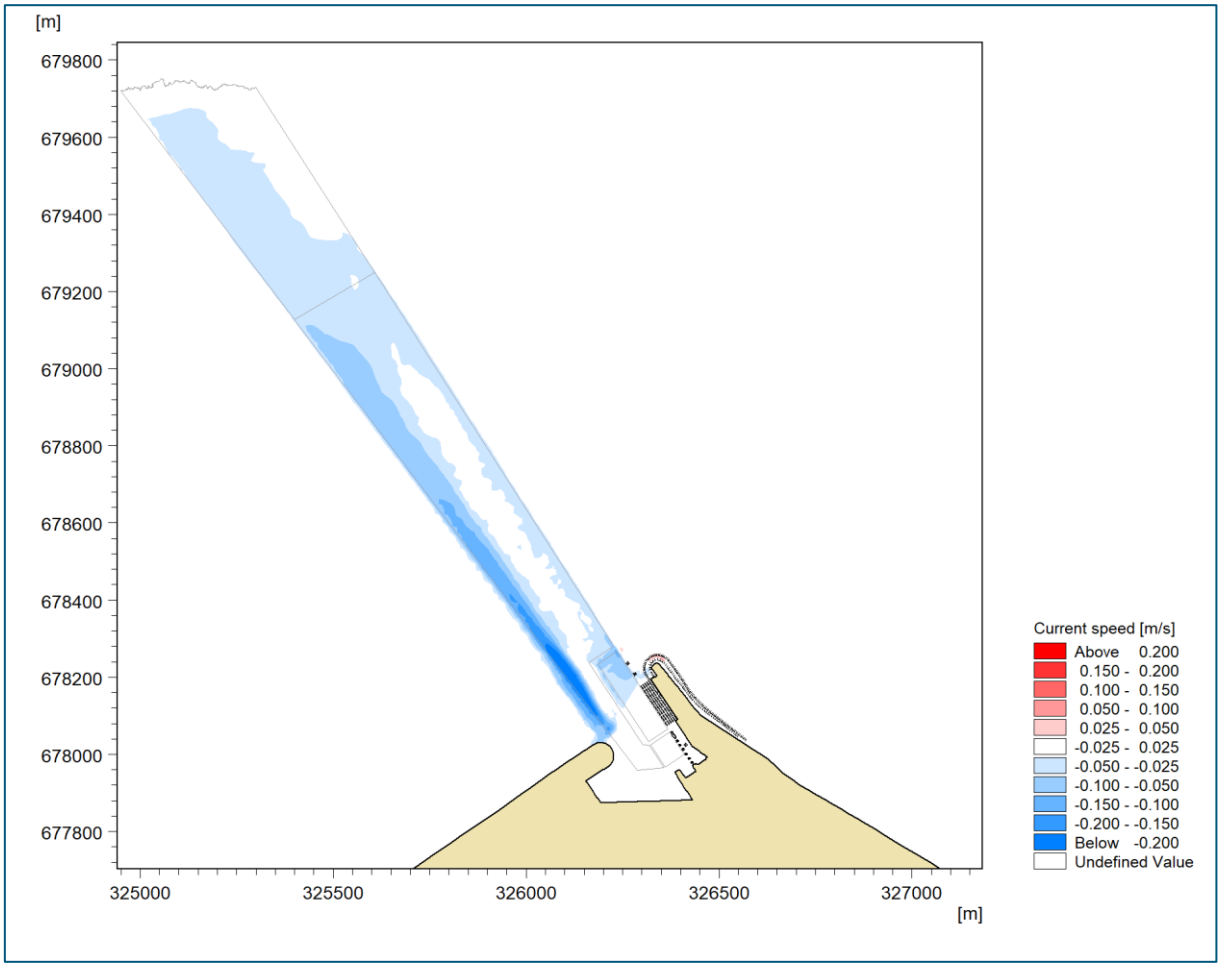

Figure 3.6. Predicted change in spring tide peak ebb currents between the existing and future layouts

These distributions of change are predicted to occur because the greatest change in water depth after dredging of the future approach channel is along its west side (Figure 2.1). The increase in water depth here would tend to reduce tidal current velocities. The bathymetry of the east side of the approach channel is only modified marginally (slightly deeper), and so the predicted reduction in tidal current velocities is less. For both spring tide flood currents and spring tide ebb currents, the speeds will universally decrease across the future layout approach channel compared to the existing currents.

4 Spring Tide Bed Shear Stress

The tidal current speeds have been transformed into bed shear stresses in the approach channel, port basin and berth pocket.

4.1 Bed Shear Stress Distribution for the Existing Layout

For the existing layout, the predicted spring bed shear stress on a peak flood tide is between 0.27N/m^2 and 0.50N/m^2 in the existing approach channel (Figure 4.1). These values reduce to less than 0.18N/m^2 in the port basin and berth pocket. Either side of the approach channel, the bed shear stress is higher at 0.50-1.23N/m^2. For the peak spring ebb tide, bed shear stresses are generally lower than the flood tide predictions (Figure 4.2). Bed shear stress is 0.27-0.50N/m^2 in the outer channel, reducing to 0.18-0.27N/m^2 in the central channel, and less than 0.18N/m^2 in the inner channel, port basin and berth pocket. In both

cases, the bed shear stress magnitudes mimic the flow speed magnitudes, whereby lower current speeds are associated with lower bed shear stresses.

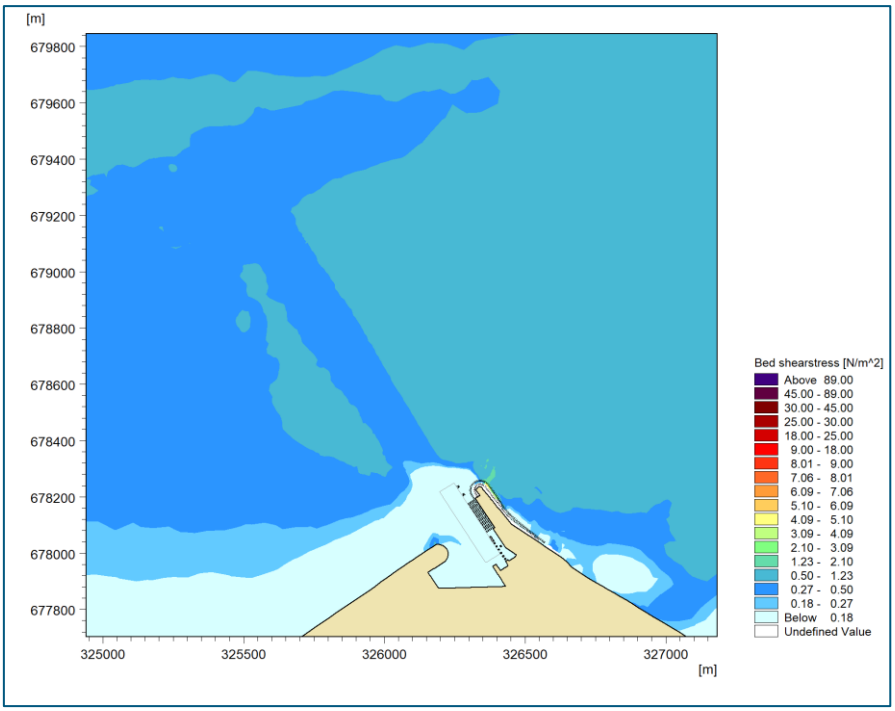

Figure 4.1. Predicted spring tide peak flood bed shear stress for the existing layout

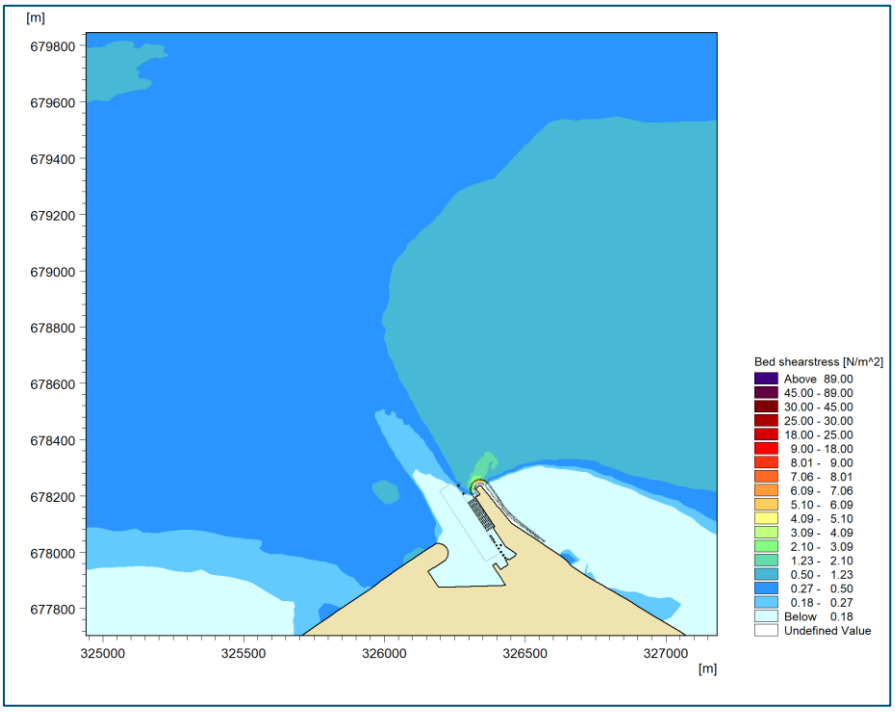

Figure 4.2. Predicted spring tide peak ebb bed shear stress for the existing layout

4.2 Bed Shear Stress Distribution for the Future Layout

For the future layout, the general distribution of predicted bed shear stress (for peak currents on both spring flood and spring ebb tides) is like the bed shear stress distribution for the existing layout (Figure 4.3 and Figure 4.4). The main change is the spatial extent of the bed shear stress magnitudes within the larger approach channel dimensions.

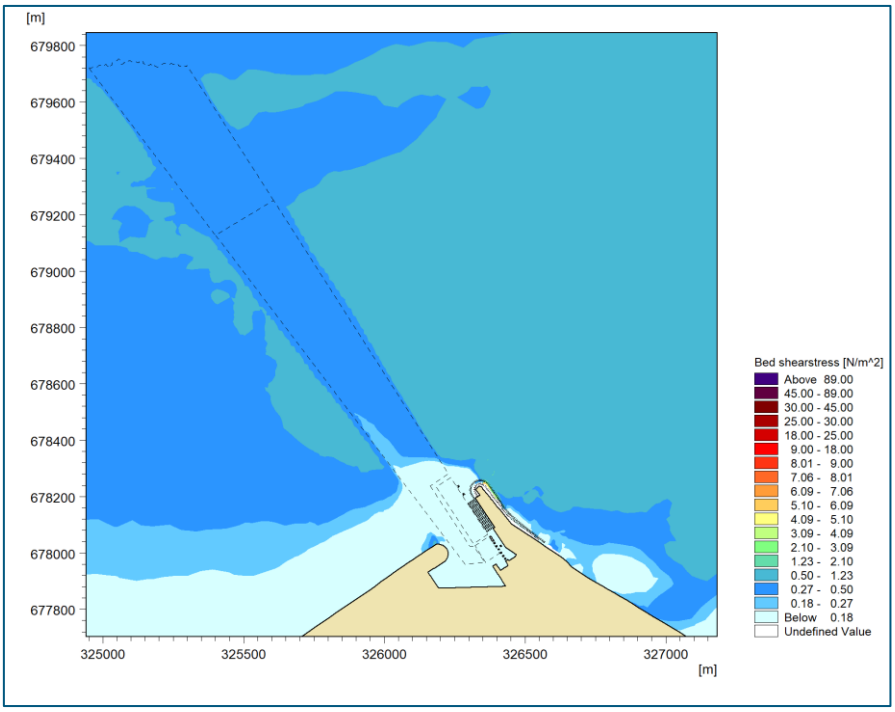

Figure 4.3. Predicted spring tide peak flood bed shear stress for the future layout

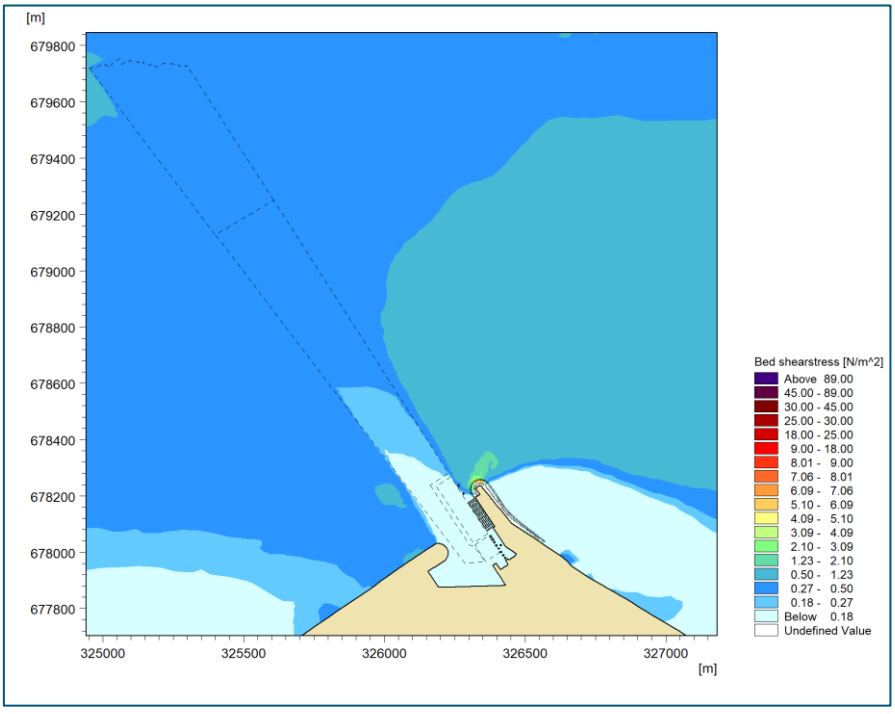

Figure 4.4. Predicted spring tide peak ebb bed shear stress for the future layout

4.3 Changes in Bed Shear Stress Distribution

The predicted differences in overall bed shear stress distribution between the existing layout and the future layout are reflected in predictions of how bed shear stress would change with dredging of the larger approach channel. Most of the changes are restricted to within the bounds of the future approach channel and are due to reductions in tidal current flows driven by the increase in overall dimensions of the channel. Smaller changes occur within the port basin and parts of the deeper berth pocket.

The dominant predicted change in bed shear stress is for a reduction across the entire future approach channel with minor areas of increase outside the channel (Figure 4.5 and Figure 4.6). For peak flows on both spring flood and ebb tides, the greatest reduction occurs along the west side of the inner channel (0.1N/m^2 to greater than 0.2N/m^2), mimicking the reduction in tidal current speeds in this area. Smaller reductions (0.025-0.1N/m^2) occur across the rest of the channel.

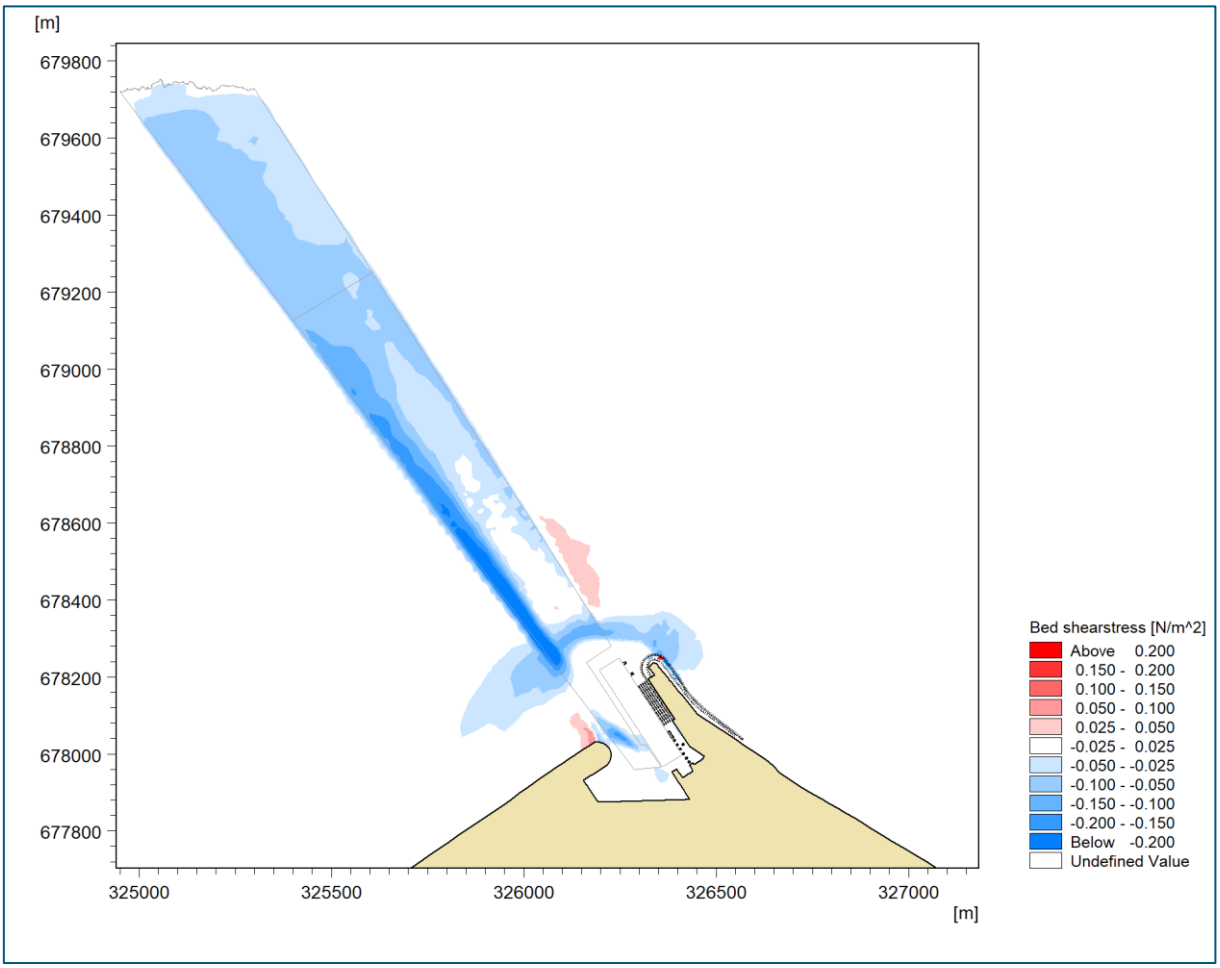

Figure 4.5. Predicted change in bed shear stress for spring tide peak flood currents between the existing and future layout

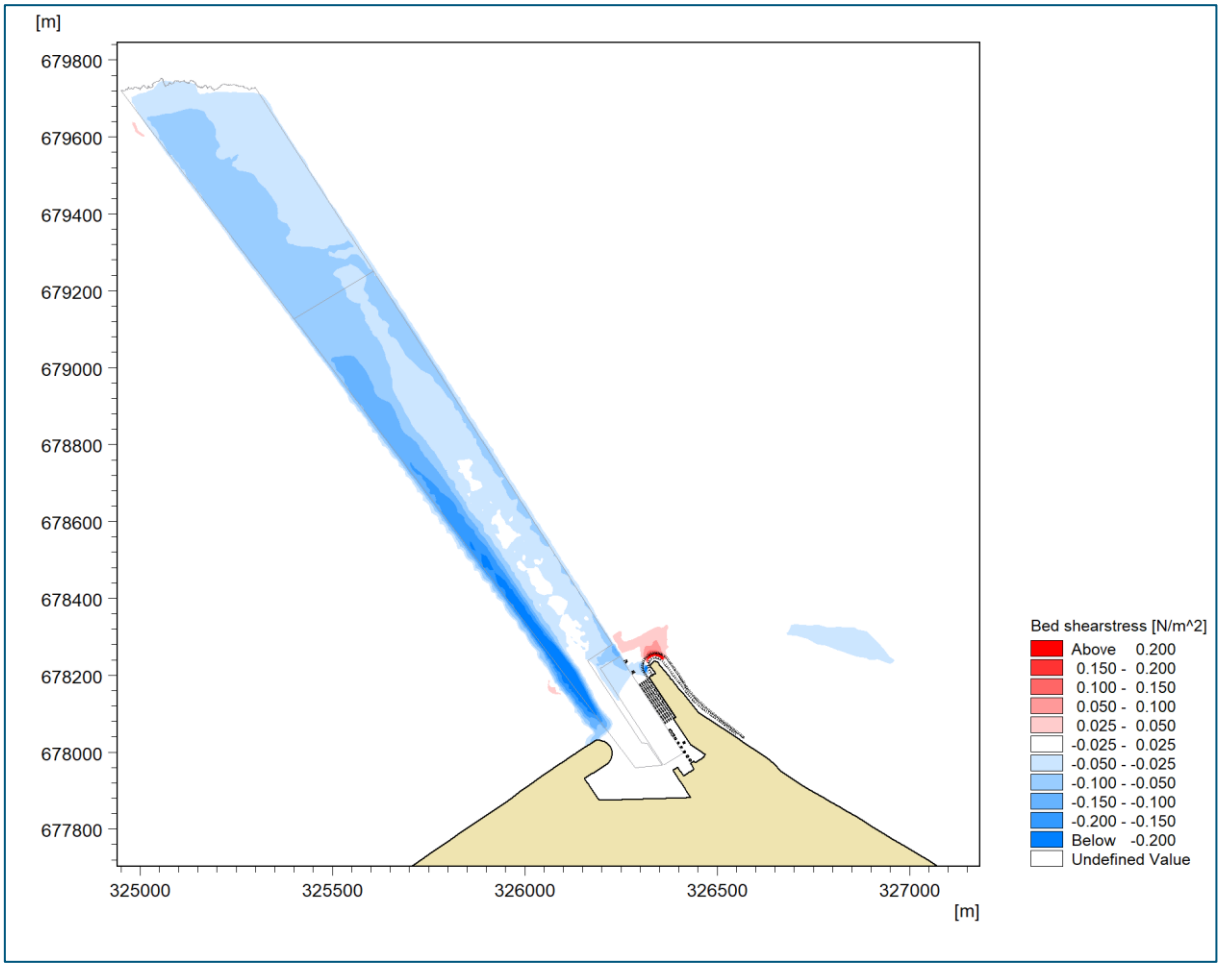

Figure 4.6. Predicted change in bed shear stress for spring tide peak ebb currents between the existing and future layout

5 Waves

The predominant waves approach the Port of Leith coast from the east to east-northeast sector (from the North Sea). These waves drive longshore sediment transport to the west. The waves are composed of two distinct components (HR Wallingford, 2007). These are short period waves generated by winds blowing across the Firth of Forth and longer period swell waves generated further offshore modified (reduced) by the sheltering effects of the adjacent coast and refraction as they propagate through the Firth of Forth.

HR Wallingford (2004) used hindcast wave data between 1987 and 2002 and showed that the largest incident wave conditions caused by wind are from the 45-75º offshore sector, which has long fetch lengths and one of the strongest wind speed sectors. For a one-summer (April to September) return period, the maximum significant wave height from this sector is 1.7m. The sectors either side (15-45º and 75-105º) have maximum significant wave heights of 1.3m and 1.4m, respectively. Swell waves approaching the site from the 30-120º degree sectors have significant wave heights of 0.6-0.9m for the one-summer return period. The combination of wind-wave and swell waves from the northeast results in maximum significant wave heights of 1.5-1.8m for the one-summer return period. Waves from the west have shorter fetches but higher wind speeds resulting in maximum significant wave heights of 1.3m for the one-summer return period. Waves from the north have a maximum significant wave height of 1.0m for the one-summer return period.

Using an extended hindcast dataset (1987-2006), HR Wallingford (2007) showed that the nearshore wave conditions are relatively benign with fewer than 0.1% of significant wave heights predicted to be greater than 2m. The larger waves (significant wave heights greater than 1.2m) had peak periods less than seven seconds. Longer period waves do penetrate the site, with peak periods as high as 17 seconds, but the longest waves (periods greater than 12 seconds) tend to be associated with relatively small waves (significant wave heights less than 0.6m).

FugroEMU (2013) collected wave data at Site 3 shown in Figure 5.1. General statements on wave conditions were provided. Maximum significant wave heights during calm conditions were less than 0.5m. Three periods of elevated wave heights were recorded, during which significant wave heights increased to up to 1m with maximums between 1.25m and 2.9m.

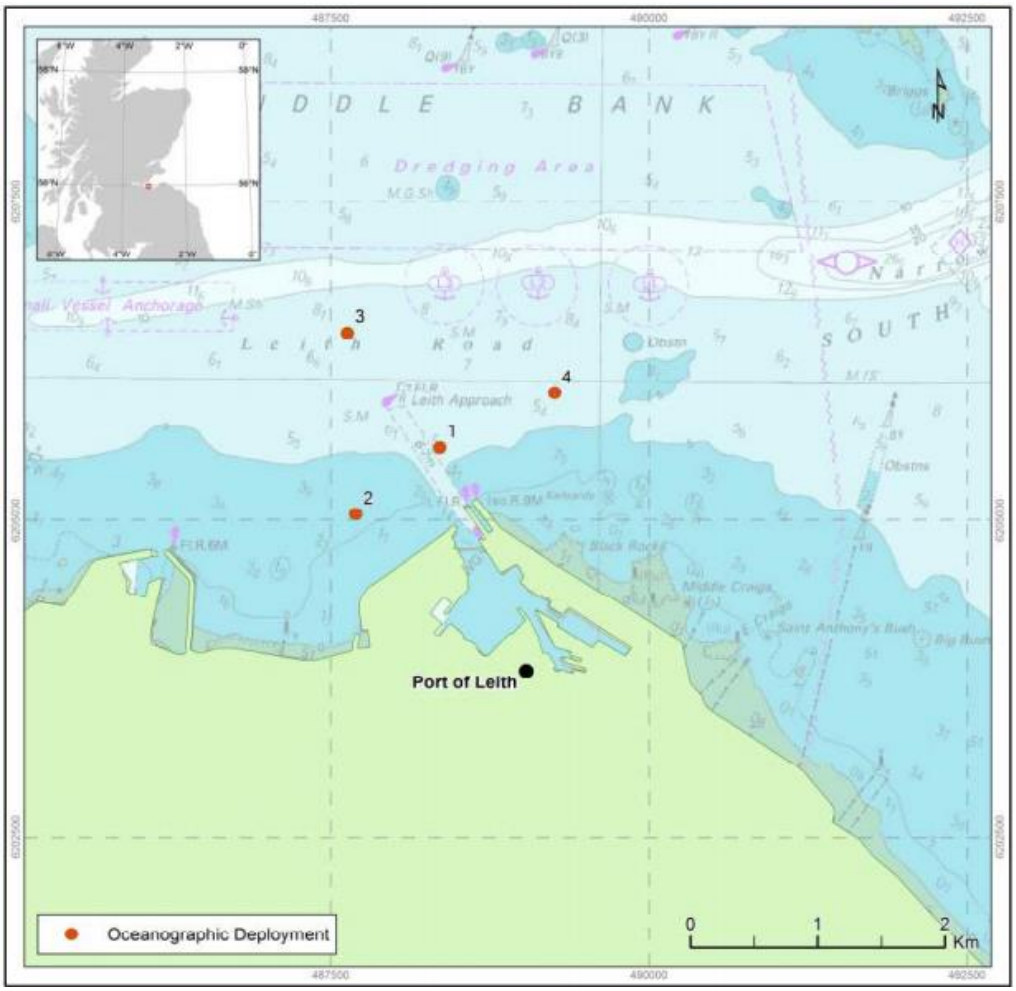

Figure 5.1. Locations of acoustic current profiler deployments in 2012 (FugroEMU, 2013a)

6 Implications for the Maintenance Dredging Requirement

6.1 Historic Dredge Volumes in the Approach Channel

The Port of Leith is licensed to dispose 250,000m^3 of dredged sediment annually in the Narrow Deep Channel, although actual volumes are much smaller. Forth Ports provided maintenance dredge volumes from the approach channel and from within the dock area between 2001 and 2021. Between 2001 and

2017, the recorded volumes were the combined dredging of the approach channel and inside the dock (Table 6.1), whereas between 2018 and 2021 the volumes are for the approach channel only (Table 6.2). Most of the deposition inside the dock was derived from supply from Water of Leith, whereas the sediment removed from the approach channel was supplied by marine/coastal sediment transport. The predominance of silty sand in the approach channel suggests that the deposition mechanism could be a combination of deposition from suspension in the water column and deposition by sediment transport processes along the bed. However, the proportion deposited by each mechanism is not known.

The annual combined (approach channel and inside the dock) volumes (2001 to 2017) range from 0 to 65,719m^3 with an average of 19,608m^3. The annual volumes dredged from the approach channel (2018 to 2020) range from 6,780m^3 to 28,342m^3 with an average of 19,197m^3. These volumes suggest that most of the sediment is removed from the approach channel with very small volumes from inside the dock. Hence, the longer-term average volume of maintenance dredging from the approach channel has been about 20,000m^3/year (but has been up to an annual maximum of 48,000m^3).

Table 6.1. Annual maintenance dredge volumes from the approach channel and dock combined (data from Forth Ports)

Year	Volume (m^3)
2001	65,719
2002	23,820
2003	21,689
2004	10,162
2005	0
2006	14,096
2007	3,173
2008	28,412
2009	28,241
2010	23,574
2011	21,597
2012	0
2013	0
2014	25,930
2015	18,966
2016	47,957
2017	0
Average 2001-2017	19,608

Table 6.2. Annual maintenance dredge volumes from the approach channel (data from Forth Ports)

Year	Volume (m^3)
2018	22,468
2019	6,780
2020	28,342
2021	8,523 (to September)
Average 2018-2020	19,197

Upon completion of the consented Outer Berth works (the baseline for the proposed future layout), the maintenance dredge requirement for the entire channel is predicted in the Outer Berth EIA (Royal HaskoningDHV, 2022). to increase by 22%. This equates to an annual predicted baseline average volume of about 25,000m^3, up to a maximum of about 59,000m^3.

6.2 Potential Future Dredge Volumes in the Approach Channel

In the design for the port, the geometry of the existing coastal structures (eastern and western breakwaters) is not going to change. This means that the bedload transport rates will not be affected. However, the change in bathymetry induced by dredging 575,000m^3 of sediment to create a larger and deeper channel and berth pocket would increase the potential for deposition of sediment from suspension. It is likely that a larger approach channel would induce larger volumes of suspended sediment to accumulate in it, because it is providing more accommodation space for sediment to deposit (the channel acts as a larger sink for sediment).

The predicted tidal current velocities and bed shear stresses across the future channel layout are similar in magnitude to the tidal current velocities and bed shear stresses across the existing channel layout. The predicted reductions in both these processes across parts of the future channel described by Figure 3.5, Figure 3.6, Figure 4.5 and Figure 4.6 relate to the significant lowering of the existing channel seabed post dredging (particularly in the west channel). Hence, the magnitude of the drivers of sediment transport are similar but operate over a larger area of channel, increasing the potential for deposition.

The predicted baseline average maintenance dredging rate of 25,000m^3 (but potentially up to 59,000m^3) can be used as a proxy for the rate of sediment transport and deposition in the existing approach channel. This is used here in combination with the change in dimensions of the approach channel in the future layout to estimate what the future maintenance dredging requirement may be.

The removal of about 575,000m^3 of sediment means that the accommodation space in the future channel compared to the existing channel would increase by this volume. The estimated average increase in depth of 1.19m (to -8m CD) over an area of about 482,000m^2 means that the accommodation space would increase from about 390,000m^3 (482,000m^2 x 0.81m) to about 965,000m^3 (390,000m^3 + 575,000m^3) assuming that the average seabed elevation outside the channel is about -6m CD (Figure 2.2). This equates to an increase in accommodation space of about 247%. Using the baseline average maintenance dredging volume of 25,000m^3 and an increase in accommodation space of 247% means the estimated future average maintenance dredging requirement would be about 62,000m^3.

7 References

FugroEMU. 2013. Port of Leith Outer Berth Marine Ground Investigation – Oceanographic Survey. Report to Scottish Enterprise, March 2013.

HR Wallingford. 2004. Leith Docks Development Framework. Leith Harbour cruise linear terminal and coastal protection. HR Wallingford Report EX5023 to Forth Ports, September 2004.

HR Wallingford. 2007. Leith Docks Cruise Berth wave disturbance and operability assessment. HR Wallingford Report EX 5458 to Forth Ports, January 2007.

Royal HaskoningDHV. 2022. Outer Berth Environmental Impact Assessment.

Appendix B Correspondence with MS-LOT

Ben Hughes

Subject: EPS Licence Application - Geophysical survey at Port of Leith approaches

From: Neil.MacLeod3@gov.scot <Neil.MacLeod3@gov.scot>
Sent: 31 May 2023 16:59
To: Ben Hughes <benjamin.hughes@rhdhv.com>; Judith.Horrill@gov.scot
Cc: Jamie Gardiner <jamie.gardiner@rhdhv.com>
Subject: RE: EPS Licence Application - Geophysical survey at Port of Leith approaches

Good Afternoon Ben,

Happy for you to work it through in this manner. I think I would just re-iterate our advice from the meeting in that if you have identified significant additional environmental effects from the variation and no mitigation can be used to negate these effects, then we moving straight to scoping would be advisable in that instance.

However, if you have not identified further effects or mitigation that can be used to negate the impacts, there is value is screening the proposal. If you are not sure if further significant impacts will be introduced, EIA screening would be beneficial, but it is essential that the screening request contains sufficient information on the further effects to allow stakeholders to provide accurate advice on any potential impacts.

Whatever the case is here, if you could let us know in advance what the plan is to be here so that we can prepare accordingly. I think good communication will be key here is trying to meet the timelines presented during the meeting.

Hope that helps, do get back in touch should you have any further questions.

Kind regards,

Neil

Marine Directorate – Licensing Operations Team

Scottish Government | Marine Laboratory | 375 Victoria Road | Aberdeen | AB11 9DB
General Email: MS.marinelicensing@gov.scot Mobile: [Redacted]

Website: http://www.gov.scot/Topics/marine/Licensing/marine

From: Ben Hughes <benjamin.hughes@rhdhv.com>
Sent: 31 May 2023 12:56
To: MacLeod N (Neil) (MARLAB) <Neil.MacLeod3@gov.scot>; Horrill J (Judith) <Judith.Horrill@gov.scot>
Cc: Jamie Gardiner <jamie.gardiner@rhdhv.com>
Subject: RE: EPS Licence Application - Geophysical survey at Port of Leith approaches

Hello Neil,

Just following up on the below – I'm keen to hear your thoughts.
Thanks,
Ben

Ben Hughes MSc
Senior Environmental Consultant (Marine) | Resilience & Maritime (NL & UK)

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From: Ben Hughes
Sent: 26 May 2023 15:28
To: Neil.MacLeod3@gov.scot; Judith.Horrill@gov.scot
Cc: Jamie Gardiner <jamie.gardiner@rhdhv.com>
Subject: RE: EPS Licence Application - Geophysical survey at Port of Leith approaches

Good afternoon Neil,
Hope you are well, I just tried to give you a quick ring. It was good to speak with you yesterday regarding the proposed deepening at Port of Leith.

Following yesterday's call, we are exploring the possibility of seeking a variation to the existing Outer Berth ML that would incorporate the deepening scheme.
If we were to go down this route, our proposed approach would be to submit a scoping report to MS-LOT on the assumption that the variation would represent an EIA development (given the Outer Berth was ascertained as an EIA development). Clearly, we would need to work around the MS-LOT process, so I just wanted to get your thoughts on this approach and whether it would be acceptable?

Thanks in advance for your thoughts.
Kind regards,
Ben

Ben Hughes MSc
Senior Environmental Consultant (Marine) | Resilience & Maritime (NL & UK)

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Please consider the environment before printing this e-mail

From: Neil.MacLeod3@gov.scot <Neil.MacLeod3@gov.scot>
Sent: 19 May 2023 10:51
To: Ben Hughes <benjamin.hughes@rhdhv.com>; Judith.Horrill@gov.scot
Cc: Jamie Gardiner <jamie.gardiner@rhdhv.com>
Subject: RE: EPS Licence Application - Geophysical survey at Port of Leith approaches

Good Morning Ben,

I believe it would be best to arrange a one-on-one meeting as it were to discuss this one further if that's alright?

Kind regards,

Neil

Marine Directorate – Licensing Operations Team

Scottish Government | Marine Laboratory | 375 Victoria Road | Aberdeen | AB11 9DB
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Website: http://www.gov.scot/Topics/marine/Licensing/marine

Frequently Asked Questions

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Appendix C Sediment Sampling Plan

Note

HaskoningDHV UK Ltd.
Water & Maritime

To:	Marine Scotland Licensing Operations Team
From:	Ben Hughes
Date:	09 May 2023
Copy:	Forth Ports Limited
Our reference:	PC4514-RHD-XX-YY-FN-EV-0009
Classification:	Project Related
Checked by	Jamie Gardiner

Subject: **Sediment Sampling Plan: Port of Leith Approaches and Outer Berth**

This note has been issued to Marine Scotland's Licensing Operations Team (MS-LOT) to confirm sediment sampling requirements within the proposed dredge footprint. The sediment sampling will inform the Marine Licence application.

1 Requirement for Dredging

Forth Ports Limited is proposing to undertake a capital dredge of the approaches to the Port of Leith for the purpose of accommodating large-drafted vessels through a wider tidal window, notably those associated with the construction and operation of offshore renewable energy installations. While capital dredging within the Leith harbour limits falls within Forth Ports Limited's jurisdiction as Statutory Harbour Authority, disposal of the material at sea is classed as a licensable activity under the Marine (Scotland) Act 2010.

A number of large-drafted vessels utilise the Port of Leith and will continue to do so once the newly-consented Outer Berth has been constructed and commissioned. To accommodate vessels with a draft up to 10.5m across a wider tidal window (thereby increasing vessel size and efficiency of port operations), Forth Ports Limited is proposing to undertake a capital dredge campaign to deepen the approach channel and Outer Berth's berth pocket, which is being moved slightly northwards.

Currently, the approach channel to the Port of Leith is dredged to a depth of c. -6.7m to -7.0m Chart Datum (CD). The proposed deepening would increase the depth to -8.0m CD and extend the offshore extent of the approach channel to the -8m CD contour. The berth pocket, most of which will have been deepened to -9.0m CD as part of the Outer Berth development, will be deepened to -12.0m CD. The total dredge volume, including 1:4 side slopes and an over-dredge allowance of 0.25m, would be approximately 700,000m^3.

Coordinates of the dredge area are provided in **Appendix 1**.

It is anticipated that all of the dredged material would be disposed of at Narrow Deep B Spoil Disposal Ground (FO038; 'Narrow Deep B'); however, a Best Practicable Environmental Option (BPEO) assessment will be undertaken to determine the most appropriate disposal option prior to submission of the marine licence application.

2 Proposed Sampling

Sampling already undertaken within the dredge footprint

A sediment sampling vibrocore campaign was undertaken in May 2022 at a number of stations adjacent to the Outer Berth, of which nine are located within the footprint of the proposed dredge (see **Figure 1** and **Table 1**). The May 2022 sampling campaign was undertaken for the purpose of supporting an earlier proposed dredge design which has since been discounted. Sampling was carried out in accordance with MS-LOT's guidance[1]. In all cases, cores penetrated to the depth of refusal, which was limited by the depth of the underlying glacial till layer.

Table 1 Coordinates for existing sediment sample locations

Sample station	Latitude	Longitude	Recovery depth (m)	Recovery level (m CD)	Subsample depths (m)
NVC01B	55.991439 N	3.1848566 W	1.20	-8.60	0.00, 0.50, 1.00
NVC02	55.990508 N	3.1853571 W	3.60	-5.30	0.00, 2.00, 3.50
NVC03A	55.989952 N	3.1833683 W	0.73	-8.03	0.0, 0.50
NVC04	55.989395 N	3.1834154 W	3.60	-4.50	0.00, 1.50, 2.00, 3.50
NVC05	55.989011 N	3.1830991 W	2.33	-2.63	0.00, 1.00, 2.00
VCN03A	55.991176 N	3.1841271 W	0.45	-8.20	0.00, 0.30
VCN04A	55.990776 N	3.1836981 W	0.50	-8.00	0.00, 0.35
VCN05A	55.990235 N	3.1828961 W	0.82	-8.52	0.00, 0.30, 0.65
VCN16	55.990547 N	3.1832102 W	0.45	-8.25	0.00, 0.30

In accordance with MS-LOT's guidance[1], where recovered cores exceeded 0.75m in length, undisturbed subsamples were taken at the surface, full recovery depth and at least one mid-depth layer; where cores were less than 0.75m in length, subsamples were taken at the surface and at full-depth.

The subsamples extracted in May 2022 were analysed for the required contaminants and by an MCERTS-accredited laboratory to specifications approved by MS-LOT[1] (as described in the Sediment Analysis section). As such, up-to-date contaminant and particle size data are available for these nine stations.

[1] Marine Scotland Pre-disposal Sampling Guidance V.2, November 2017

Further sample requirements and approach

For a dredge volume of up to 700,000m^3, MS-LOT's guidance[1] requires that 17 stations are sampled within the dredge footprint; however, to be conservative it is proposed that 18 stations are sampled. Given the existing up-to-date sediment samples that are available in and adjacent to the Outer Berth, as outlined above, it is proposed that a further nine sampling stations from the proposed dredge footprint are required (see **Figure 1**). Sampling stations have been located across the proposed dredge footprint. The coordinates for the proposed nine sampling locations are presented in **Table 2**.

Table 2 Coordinates for proposed sediment sample locations

Sample station	Latitude	Longitude
1	55.993173	3.1885969
2	55.995420	3.1903654
3	55.997273	3.1939017
4	55.999076	3.1960417
5	56.000851	3.1964173
6	56.001271	3.1994609
7	56.002649	3.1982368
8	56.004088	3.1999331
9	56.003949	3.2031361

Undisturbed samples will be collected using a vibro-core (or similar equipment). In accordance with the MS-LOT's guidance[1], subsamples will be taken from each station at the surface layer (0-150mm), full-depth (limited by the glacial till level) and at 500mm intervals between. All subsamples will be retained. Initially, surface, full-depth and one mid-layer subsample from each station will be sent for sediment analysis.

It is anticipated that sample collection will be undertaken during Spring/Summer 2023.

Given that Narrow Deep B is a licensed spoil ground that has historically received capital material, it is proposed that no sediment samples are required from the disposal site.

Sediment analysis

Sediment subsamples collected from the nine stations will be sent for analysis to a laboratory (as yet unspecified) that meets the standard requirements set out within the MS-LOT guidance. The laboratory will:

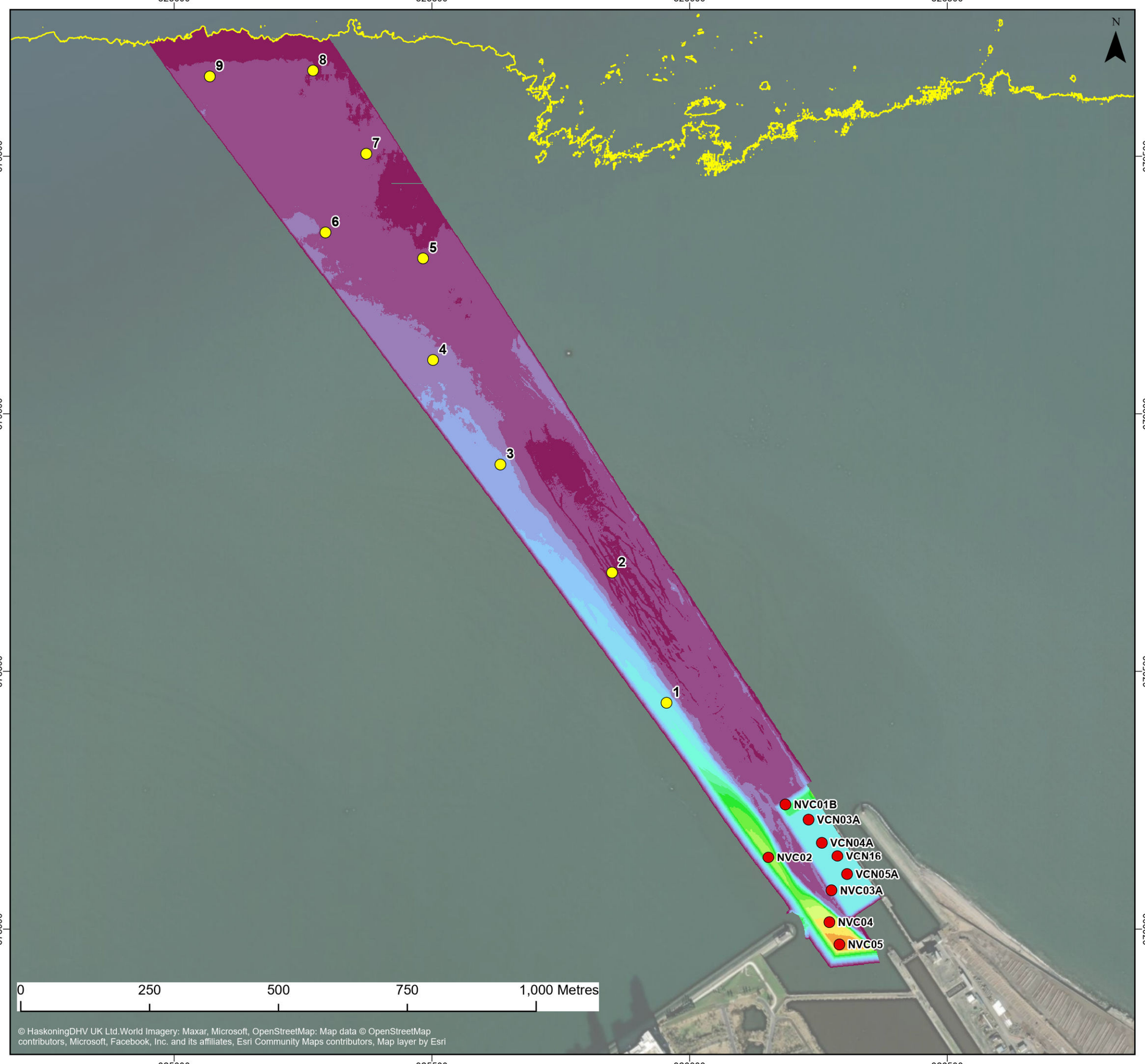
- Have ISO 17025 accreditation for marine sediment analysis;

- Employ analytical methods that meet the limit of detection and sensitivity requirements set out in the Clean Seas Environment Monitoring Programme green book; and
- Take part in intercomparison exercises (e.g. Quality Assurance of Information on Marine Environmental Monitoring in Europe).

The sediment samples will be sent for analysis following MS-LOT's guidance[1], including testing for:

- Particle size analysis
- Metals, including
    - Arsenic
    - Cadmium
    - Chromium
    - Copper
    - Mercury
    - Nickel
    - Lead
    - Zinc
- Polyaromatic hydrocarbons (PAHs), including
    - Acenaphthene
    - Acenaphthylene
    - Anthracene
    - Fluorene
    - Naphthalene
    - Phenanthrene
    - Benzo[a]anthracene
    - Benzo[b]fluoranthene
    - Benzo[k]fluoranthene
    - Benzo[a]pyrene
    - Benzo[g,h,i]perylene
    - Dibenzo[a,h]anthracene
    - Chrysene
    - Fluoranthene
    - Pyrene
    - Indeno(1,2,3cd)pyrene
- Total hydrocarbons
- Polychlorinated Biphenyls (PCBs)
- Organotins

In addition, total organic carbon will be included in the analysis.



Legend

- Proposed New Sediment Sampling Location
- Sediment Sampling Location from 2022 Campaign
- 8mCD contour

Depth of excavation (m)

- -7.9 - -7.5
- -7.4 - -7
- -6.9 - -6.5
- -6.4 - -6
- -5.9 - -5.5
- -5.4 - -5
- -4.9 - -4.5
- -4.4 - -4
- -3.9 - -3.5
- -3.4 - -3
- -2.9 - -2.5
- -2.4 - -2
- -1.9 - -1.5
- -1.4 - -1
- -0.9 - -0.5
- -0.4 - 0

Client:	Project:
Forth Ports Limited	Port of Leith Sampling Plan

Title:

Proposed Sediment Sampling Positions

Figure: 1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	04/05/2023	TC	BH	A3	1:7,500
1	26/04/2023	TC	BH	A3	1:7,500

Co-ordinate system: British National Grid

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Appendix 1 Dredge footprint coordinates

Note that the coordinates at the seaward end of the channel have been simplified; in reality, the seaward end would follow the 8m contour.

Lat.	Long.
55.99184	-3.18404
55.99179	-3.18419
55.99124	-3.18355
55.99061	-3.18277
55.98920	-3.18106
55.98920	-3.18113
55.98920	-3.18122
55.98909	-3.18148
55.98907	-3.18154
55.98905	-3.18154
55.98900	-3.18152
55.98899	-3.18155
55.98900	-3.18162
55.98903	-3.18165
55.98904	-3.18171
55.98901	-3.18175
55.98897	-3.18170
55.98877	-3.18159
55.98871	-3.18167
55.98860	-3.18337
55.98910	-3.18404
55.98909	-3.18410
55.98910	-3.18415
55.98929	-3.18419
55.98943	-3.18431
55.98950	-3.18437
55.98951	-3.18442
55.98956	-3.18455
55.98954	-3.18466
55.98953	-3.18474
55.98961	-3.18468
55.98978	-3.18488
55.99003	-3.18524
55.99060	-3.18604
55.99103	-3.18662
55.99211	-3.18798
55.99545	-3.19252
55.99659	-3.19408
56.00012	-3.19899
56.00173	-3.20123
56.00218	-3.20184
56.00296	-3.20294
56.00367	-3.20394
56.00420	-3.20466
56.00451	-3.20507
56.00460	-3.20474
56.00465	-3.20407
56.00472	-3.20369
56.00482	-3.20336
56.00478	-3.20268
56.00478	-3.20244
56.00480	-3.20217
56.00474	-3.20195
56.00468	-3.20152
56.00466	-3.20134
56.00462	-3.20107
56.00472	-3.20075
56.00471	-3.20031
56.00467	-3.19998
56.00464	-3.19982
56.00464	-3.19963
56.00465	-3.19945
56.00379	-3.19838
56.00326	-3.19775
56.00205	-3.19634
56.00112	-3.19518
55.99809	-3.19153
55.99743	-3.19079
55.99676	-3.18999
55.99646	-3.18962
55.99644	-3.18954
55.99639	-3.18954
55.99634	-3.18946
55.99586	-3.18890
55.99578	-3.18883
55.99573	-3.18875
55.99564	-3.18863
55.99555	-3.18850
55.99549	-3.18842
55.99547	-3.18844
55.99545	-3.18844
55.99544	-3.18840
55.99542	-3.18837
55.99538	-3.18831
55.99530	-3.18822
55.99509	-3.18796
55.99492	-3.18776
55.99457	-3.18733
55.99444	-3.18719
55.99356	-3.18613
55.99349	-3.18602
55.99343	-3.18594
55.99337	-3.18585
55.99315	-3.18561
55.99297	-3.18541
55.99284	-3.18523
55.99267	-3.18503
55.99262	-3.18500
55.99256	-3.18493
55.99252	-3.18487
55.99240	-3.18474
55.99230	-3.18459
55.99216	-3.18441
55.99184	-3.18404

Appendix D Benthic Survey Specification

Note

HaskoningDHV UK Ltd.
Water & Maritime

To:	Marine Scotland Licensing Operations Team
From:	Luke Evans-Jones
Date:	13 June 2023
Copy:	Forth Ports Limited
Our reference:	PC4514-RHD-YY-XX-FN-EV-0012
Classification:	Project related
Checked by	Jamie Gardiner

Subject: **Proposed Deepening of the Leith Approach Channel -Benthic Ecology Survey Specification**

---

1 Introduction

Forth Ports Limited is proposing to deepen the approach channel to the Port of Leith ('the Port') in the Firth of Forth. A subtidal benthic ecology survey is being proposed to provide baseline data suitable for undertaking a robust assessment of the potential effects of the channel deepening on benthic habitats and communities.

The objectives of the survey are as follows:

- Provide comprehensive information on epibenthic and infaunal communities present within the deepening footprint and adjacent areas of seabed;
- Classify habitat types and biotopes; and
- Identify any features of conservation interest, invasive non-native species and indicator species.

This note sets out the proposed specification for the benthic ecology survey. It has been issued to Marine Scotland and its advisers to confirm that the specification is appropriate to provide baseline date suitable to assess the potential effects of the proposed deepening on benthic habitats and communities.

2 Summary of the Proposed Deepening

The footprint of the proposed deepening is presented in **Figure 1** and extends from the Port to the -8.0m Chart Datum (CD) contour. The target dredge level within the approach channel is -8.0m CD (from a current level of between -6.5 and -7.5m CD). The target level within the Outer Berth pocket is -12.0m CD (from a depth of -9.0m CD). Most of the dredge footprint is within the maintained channel, which is periodically dredged, with the exception of the northern / western end of the dredge footprint (i.e. nearest to the -8.0m contour; see **Figure 1**).

The disposal of dredge material will likely occur at Narrow Deep B spoil disposal ground (FO038) (subject to a Best Practice Environmental Options study). This is a licensed spoil disposal ground used regularly by ports within the Firth of Forth, hence benthic communities there would be shaped by periodic sedimentation from disposal activities. As such, a survey of the disposal ground is not considered necessary in this instance.

To prevent erosion following the deepening of the berth pocket, a short length of piled retaining wall will be installed at the toe of the Eastern Breakwater (see **Figure 2**). Given the very small area affected, a survey of the location of the proposed wall is not considered necessary.

3 Proposed Benthic Ecology Survey specification

3.1 Proposed Station Locations

Existing broadscale habitat mapping in and around the footprint of the proposed deepening indicates a uniform seabed comprising infralittoral and shallow circalittoral mixed sediments in a moderate energy zone (EUNIS habitat codes MB42 and MC42)[1] (see **Figure 3**). Given the uniformity of the benthic habitats, 12 sampling stations are considered sufficient to characterise the benthic habitats and infaunal communities within the footprint of the proposed deepening, with station locations focused in areas outside of the existing maintenance dredging (see **Figure 1**). A further 10 stations are proposed around the footprint of the proposed deepening to provide details of the benthic communities that could potentially be affected by deposition of sediment during dredging (see **Figure 1**). Coordinates of the proposed stations are provided in **Table A1** in **Appendix A**.

At each station, a grab sample and video transect (drop-down video (DDV) or remote-operated vehicle (ROV)) would be taken. Exact positioning (corrected) of each grab sample and transect will be recorded on board the survey vessel. Details of the proposed sampling is provided below.

3.2 Infaunal sampling

A 0.1m² Day grab (or similar) would be used for infaunal sampling. To confirm acceptance of the sample, the depth of bite following retrieval would be measured to ensure the sample exceeded 100mm depth. If the sample is rejected, up to three additional attempts would be made at the same station. If no successful samples are achieved after three attempts, the station will be relocated 25m away and the process repeated.

A cut-off 100ml syringe will be used to remove sediment from the undisturbed surface of the grab sample, which will be retained for particle size analysis (PSA). If cobbles (>63 mm) are present in the sample, they will not be included as part of the PSA sub-sample. The remainder of the sample will be placed onto a 0.5mm mesh stainless sieve, photographed and information recorded (i.e. sample volume, visual characteristics of the sediment, presence of anoxia and epifauna, dimensions of cobbles) before being collected in a storage vessel where it will be preserved in formalin. Preserved samples will be transported to a suitable laboratory that adopts the procedures set out in the UK National Marine Biological Analytical Quality Control scheme.

Identification of infaunal specimens will be undertaken in the laboratory following the methodology below:

- Samples will be re-sieved over 0.5mm mesh and transferred to 70% alcohol;
- Fauna will be extracted from the sample, identified to the lowest taxonomic level possible and enumerated;
- Results will be entered into a spreadsheet in a format suitable for analysis;
- A photographic reference collection of species identified will be retained;

[1] *https://emodnet.ec.europa.eu/en/euseamap-2021-emodnet-broad-scale-seabed-habitat-map-europe*

- Any encrusting epifauna within the samples will be identified, presence/absence noted and also recorded on the spreadsheet;
- Individuals per species and ash-free dry weight biomass will be recorded; and
- A full taxa list will be produced.

3.2.1 Particle size analysis

Subsampling of sediments for PSA is an essential accompaniment to macrofaunal surveys. This allows the macrofaunal data to be accurately referenced against variations in particle size characteristics. The full particle size distribution (at 0.5 phi intervals) will be reported for each sample and sediment type classified for each station. Statistics will be calculated as follows:

- Full particle size distribution;
- Mean particle size;
- Sorting coefficient;
- Skewness;
- Modal size; and
- Kurtosis.

3.3 Video transects

Video imagery of epibenthic communities captured via ROV or DDV methods (or similar) will be used for identifying epifauna, epiflora and sediment type (plus incidental observations of non-epifaunal species, such as demersal fish etc.). At each station, a 50m-long video transect will run north to south along the environmental gradient. Regardless of methodology, a 1080p High Definition (HD) or Ultra HD 4k video camera will be equipped with subsea lights to ensure that the substrate can be adequately illuminated and the video is of sufficient quality to enable accurate identification. Video quality will be reviewed and suitability confirmed on-board the vessel.

Identification of epifaunal specimens will be undertaken following the methodology below:

- Epifauna will be identified (to the lowest possible taxa) and counted from the video transects, presence/absence of encrusting epifauna species will be noted.
- Results will be entered into a spreadsheet in a format suitable for analysis.
- A full taxa list will be produced.

3.4 Deliverables

The findings of the benthic ecology survey will be presented in a detailed report with multivariate and univariate statistical analyses of community metrics, including tables, figures and maps as appropriate. Reporting of infauna communities will include detail on characterising taxa, community differentiation (analysis of similarities) and analysis of biodiversity indices. Benthic fauna data will also be provided in a spreadsheet format alongside biomass values.

Habitats at each station will be classified based on infaunal and epifaunal composition and PSA results. Description of habitats will be based on the EUNIS 2019 classification system, to classification level 5 (biotopes) wherever data allow. The report will include a predicted habitat map of the study area.

Presence of protected features (including taxa / habitats classed as Priority Marine Features in Scotland), invasive non-native species and indicator species of contaminated or disturbed seabed will be highlighted in the report and significance discussed.

To summarise, the following will be included in the report:

- Detail of the methodology employed, including any limitations encountered, with coordinates of survey locations and other metadata;
- Detail of PSA, providing information on sediment types present at each station (e.g. in line with Folk 1954 classification or similar);
- Multivariate and univariate analysis of infauna community metrics at each station, plus between-station similarities and variability;
- Description of epifauna and epiflora presence in video imagery at each station;
- Mapping of habitat types across the survey area; and

Detail of any features of conservation interest, invasive non-native species and indicator species.

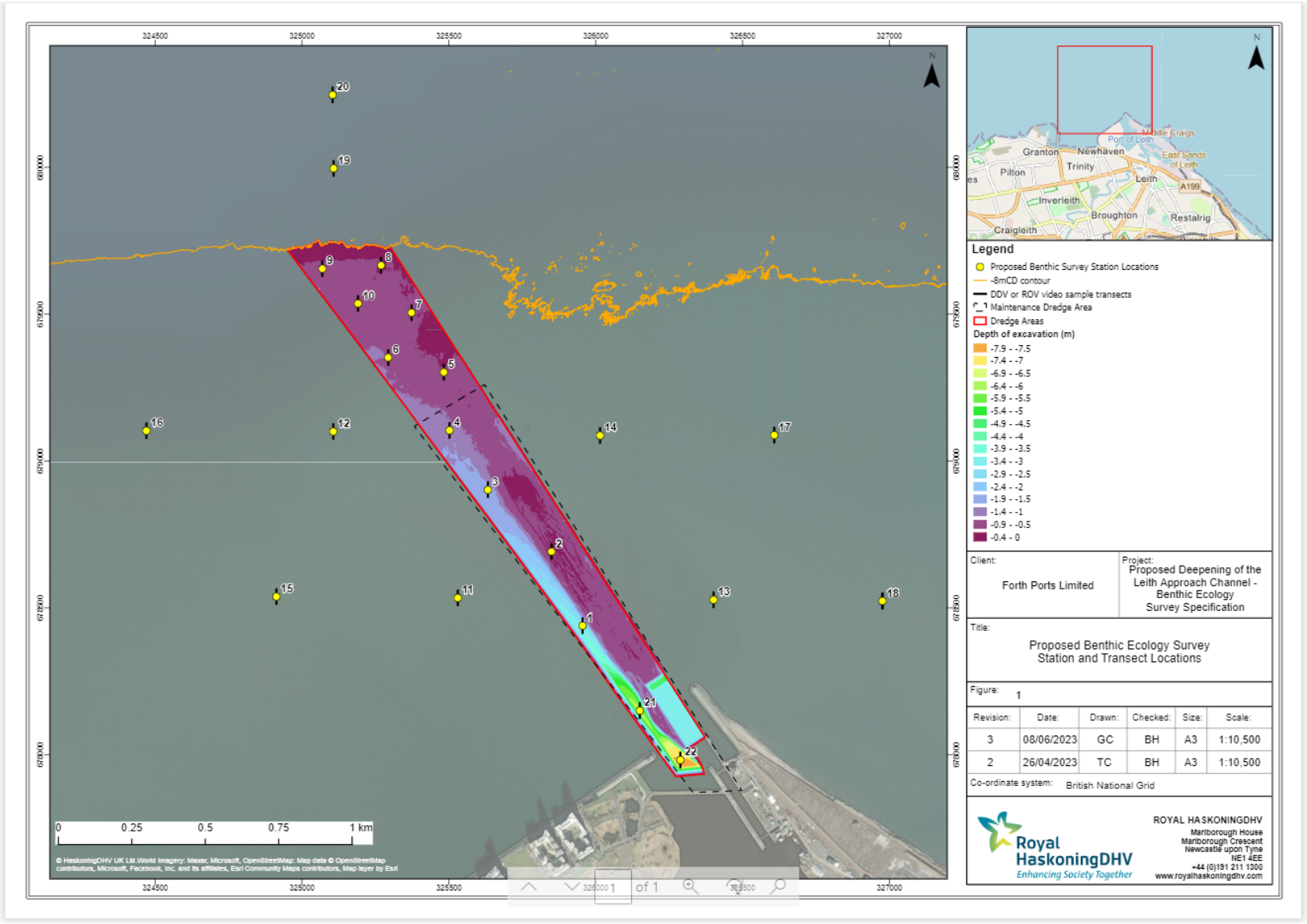

Figure 1 Proposed benthic ecology survey station and transect locations

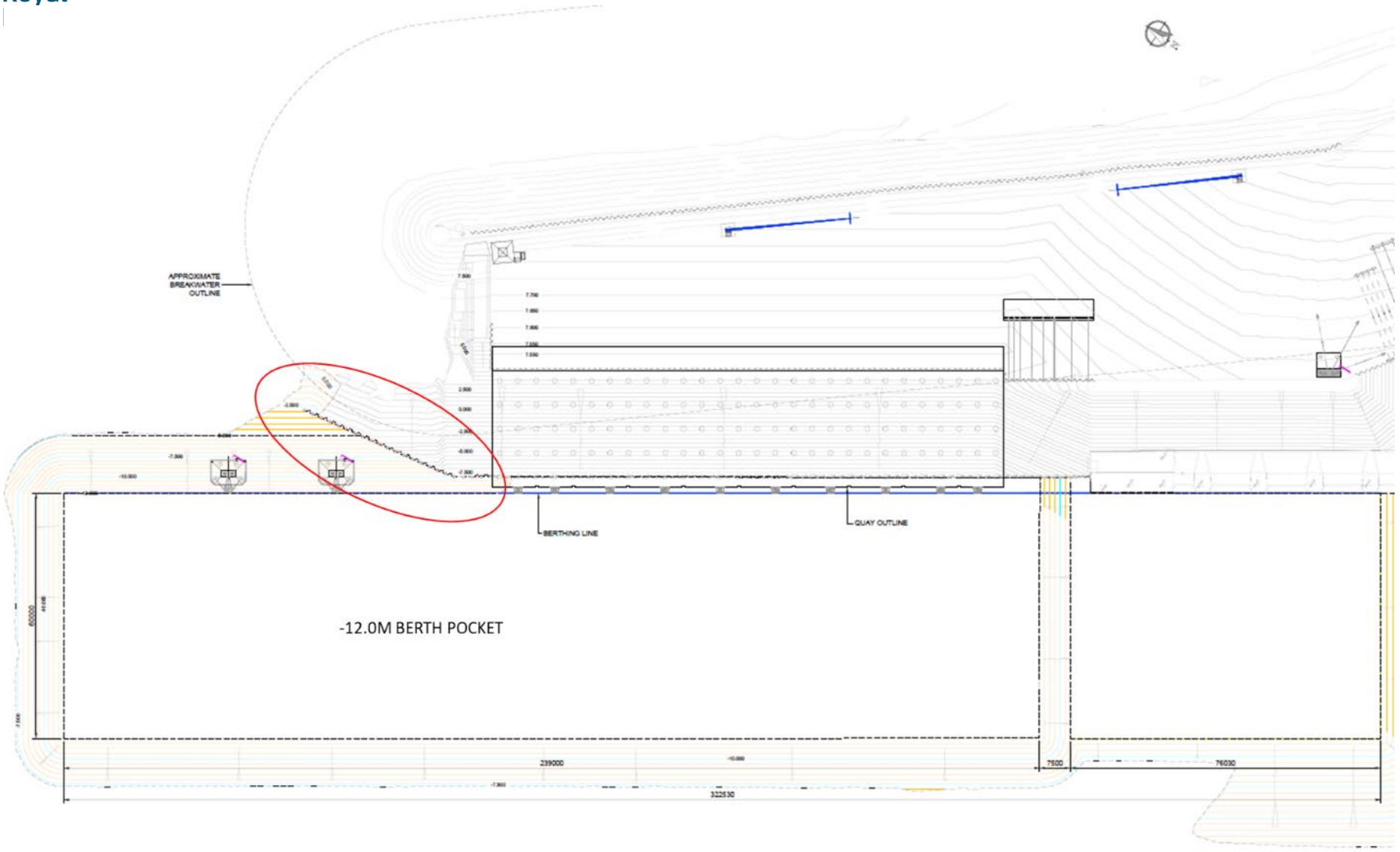

Figure 2 Location of the proposed piled retaining wall (circled)

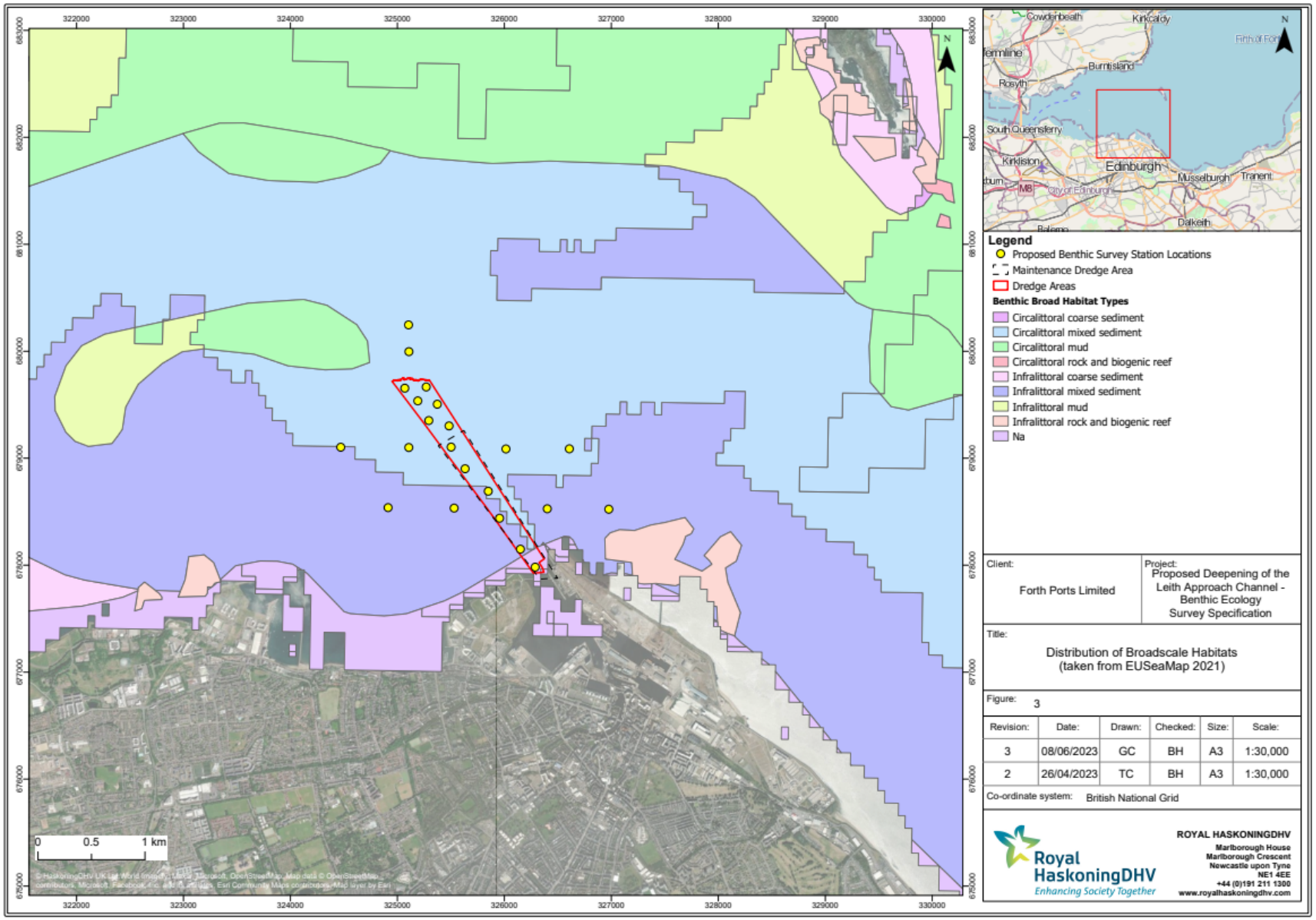

Figure 3 Distribution of broadscale habitats (taken from EUSeaMap 2021)

Appendix A

Table A1 Proposed benthic ecology survey station and transect coordinates

Station	Station Coordinates		Transect Start Coordinates		Transect End Coordinates	
	Lat	Long	Lat	Long	Lat	Long
1	55° 59' 35.404" N	3° 11' 18.940" W	55° 59' 36.212" N	3° 11' 18.965" W	55° 59' 34.595" N	3° 11' 18.915" W
2	55° 59' 43.504" N	3° 11' 25.293" W	55° 59' 44.313" N	3° 11' 25.318" W	55° 59' 42.696" N	3° 11' 25.268" W
3	55° 59' 50.184" N	3° 11' 37.998" W	55° 59' 50.992" N	3° 11' 38.023" W	55° 59' 49.375" N	3° 11' 37.974" W
4	55° 59' 56.661" N	3° 11' 45.743" W	55° 59' 57.469" N	3° 11' 45.768" W	55° 59' 55.853" N	3° 11' 45.718" W
5	56° 00' 03.049" N	3° 11' 47.057" W	56° 00' 03.858" N	3° 11' 47.082" W	56° 00' 02.241" N	3° 11' 47.032" W
6	56° 00' 04.567" N	3° 11' 58.034" W	56° 00' 05.375" N	3° 11' 58.059" W	56° 00' 03.758" N	3° 11' 58.009" W
7	56° 00' 09.541" N	3° 11' 53.614" W	56° 00' 10.350" N	3° 11' 53.639" W	56° 00' 08.733" N	3° 11' 53.589" W
8	56° 00' 14.699" N	3° 11' 59.743" W	56° 00' 15.507" N	3° 11' 59.768" W	56° 00' 13.890" N	3° 11' 59.717" W
9	56° 00' 14.216" N	3° 12' 11.287" W	56° 00' 15.024" N	3° 12' 11.312" W	56° 00' 13.408" N	3° 12' 11.261" W
10	56° 00' 10.447" N	3° 12' 04.144" W	56° 00' 11.255" N	3° 12' 04.169" W	56° 00' 09.638" N	3° 12' 04.119" W
11	55° 59' 38.225" N	3° 11' 43.551" W	55° 59' 39.034" N	3° 11' 43.576" W	55° 59' 37.417" N	3° 11' 43.526" W
12	55° 59' 56.308" N	3° 12' 08.574" W	55° 59' 57.117" N	3° 12' 08.600" W	55° 59' 55.500" N	3° 12' 08.549" W
13	55° 59' 38.508" N	3° 10' 53.299" W	55° 59' 39.316" N	3° 10' 53.323" W	55° 59' 37.699" N	3° 10' 53.274" W
14	55° 59' 56.379" N	3° 11' 16.151" W	55° 59' 57.187" N	3° 11' 16.176" W	55° 59' 55.571" N	3° 11' 16.126" W
15	55° 59' 38.021" N	3° 12' 19.178" W	55° 59' 38.830" N	3° 12' 19.203" W	55° 59' 37.213" N	3° 12' 19.152" W
16	55° 59' 56.034" N	3° 12' 45.292" W	55° 59' 56.842" N	3° 12' 45.317" W	55° 59' 55.225" N	3° 12' 45.266" W
17	55° 59' 56.747" N	3° 10' 41.928" W	55° 59' 57.556" N	3° 10' 41.952" W	55° 59' 55.939" N	3° 10' 41.903" W
18	55° 59' 38.691" N	3° 10' 20.111" W	55° 59' 39.500" N	3° 10' 20.136" W	55° 59' 37.883" N	3° 10' 20.087" W
19	56° 00' 25.284" N	3° 12' 09.413" W	56° 00' 26.093" N	3° 12' 09.438" W	56° 00' 24.476" N	3° 12' 09.387" W
20	56° 00' 33.372" N	3° 12' 09.867" W	56° 00' 34.181" N	3° 12' 09.892" W	56° 00' 32.564" N	3° 12' 09.842" W
21	55° 59' 26.162" N	3° 11' 07.408" W	55° 59' 26.970" N	3° 11' 07.432" W	55° 59' 25.353" N	3° 11' 07.383" W
22	55° 59' 20.804" N	3° 10' 59.271" W	55° 59' 21.612" N	3° 10' 59.296" W	55° 59' 19.996" N	3° 10' 59.247" W

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We focus on delivering added value for our clients while at the same time addressing the challenges that societies are facing. These include the growing world population and the consequences for towns and cities; the demand for clean drinking water, water security and water safety; pressures on traffic and transport; resource availability and demand for energy and waste issues facing industry.

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