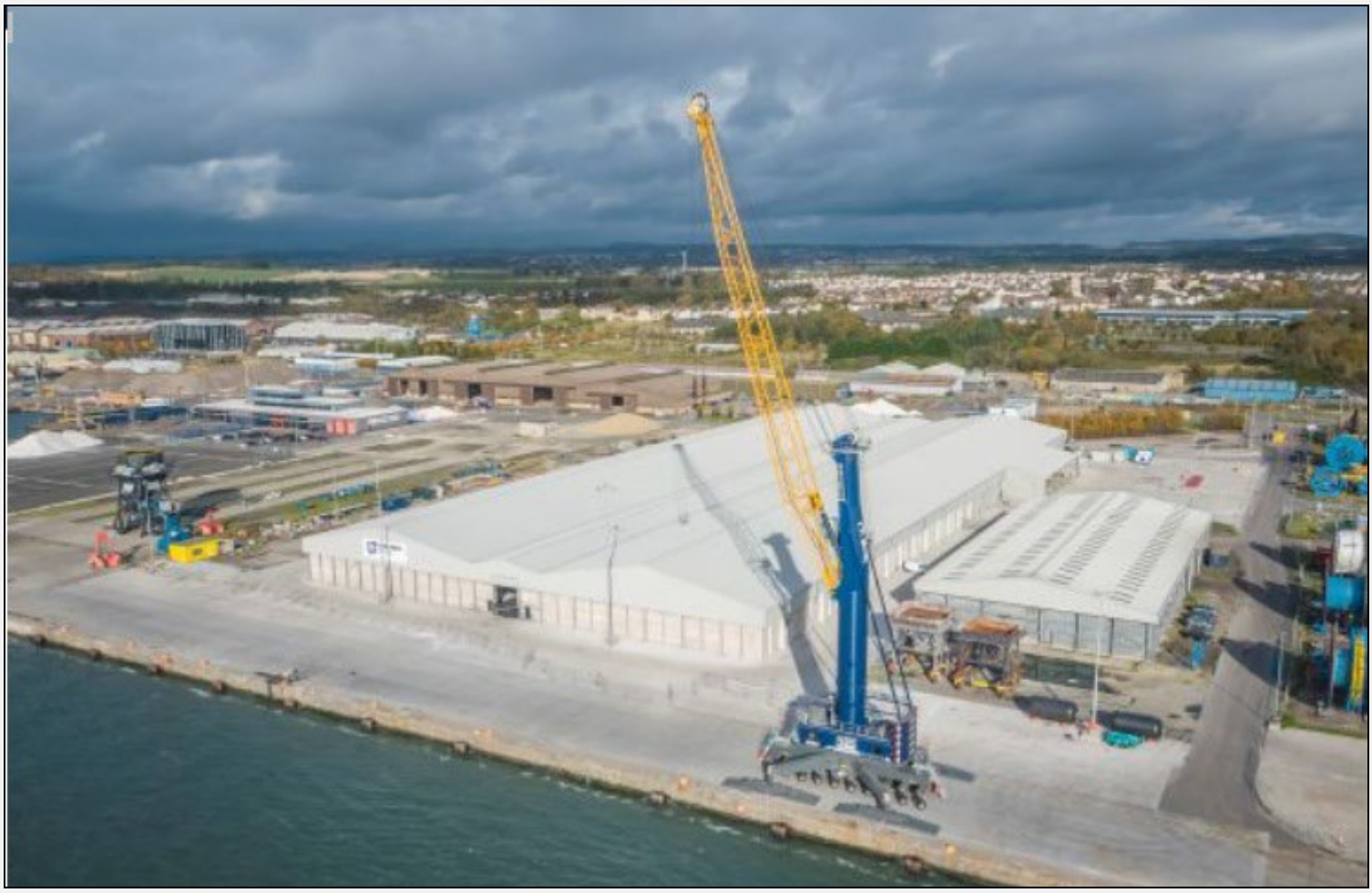

FORTH PORTS

Port of Rosyth Maintenance Dredge Disposal: Marine Licence Application

Best Practicable Environmental Option Report

6 June 2023

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The business of sustainability

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CONTENTS

List of Tables

List of Figures

1. INTRODUCTION

1.1 Background

This report has been prepared by Environmental Resources Management Ltd (ERM) on behalf of Forth Ports Ltd (Forth Ports) in support of a Marine Licence application for disposal of dredged material at sea from maintenance dredging from the Port of Rosyth.

Under the *Marine (Scotland) Act 2010, Section 21(1),* a Marine Licence issued by Marine Scotland is required for the dredging and the deposit of substances or objects within waters adjacent to Scotland. Under *Part 4, Section 27(2),* Marine Scotland has an obligation to consider the availability of practical alternatives when considering applications involving disposal of material at sea. Applications for a Marine Licence to dispose of dredged spoil at sea require a Best Practical Environmental Option (BPEO) (1) assessment, demonstrating that alternatives to sea disposal have been investigated and that sea disposal does not pose an unacceptable risk to the marine environment and other legitimate users.

This report compares various options for the disposal of maintenance dredge material from the Port of Rosyth and identifies the BPEO.

Marine Licences for maintenance dredging activities are currently valid in Scotland for up to three years (2). Forth Ports currently has a maintenance disposal licence (MS-00008987) to maintain a safe navigable depth which covers the period 11 March 2021 to 10 March 2024. This current application is to cover the period from 11 March 2024 to 10 March 2027.

1.2 The Need for Dredge Spoil Disposal

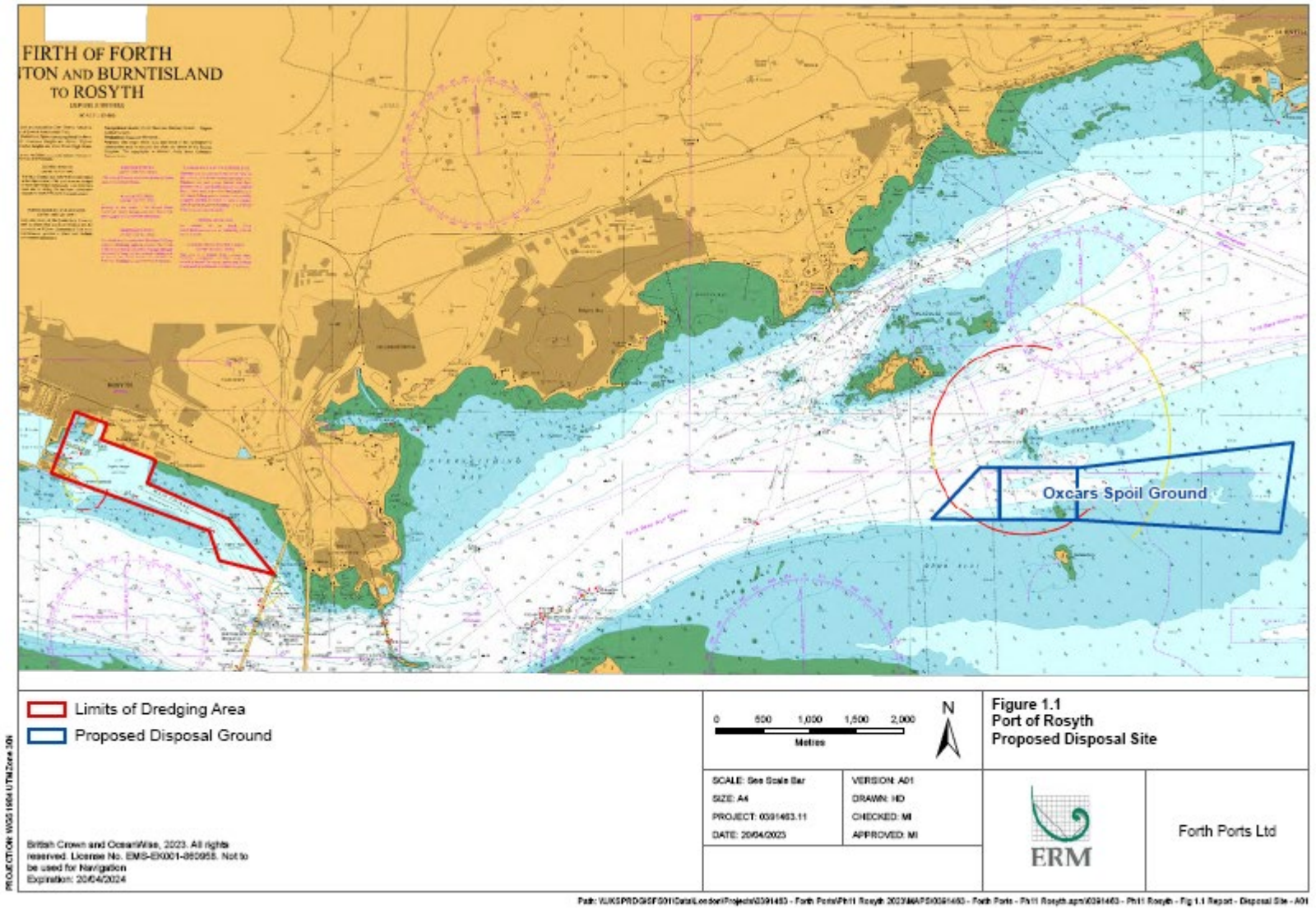
The Port of Rosyth is located on the north bank of the Forth Estuary approximately 2 km west of the Forth Road Bridge. Rosyth was formerly a Ministry of Defence (MoD) naval base. Rosyth 2000 bought the land and quays of the base in 1997 and Forth Ports, part of Rosyth 2000, has the responsibility for maintenance dredging in Forth Ports' area of jurisdiction. As confirmed by Forth Ports (3), the port has approximately 300 vessel movements per annum, including to and from the Rosyth Naval Dockyard.

In line with Section 13 of Scotland's National Marine Plan (Marine Planning Policy Transport 4), the planned dredging operations will continue to maintain and support the sustainable development of the Port of Rosyth. Forth Ports plans to continue the 1997 to 2023 regime of annually dredging the Port of Rosyth and the approach channel to the port. It is proposed that the dredged material resulting from the maintenance dredging will be disposed of at sea at the licenced marine disposal site at Oxcars. This site has been used for disposal of dredged material from the Port of Rosyth for over 25 years. *Figure 1.1* shows the proposed disposal site.

The port and approach channel naturally experience sediment accretion due to the deposition of riverine and estuarine material originating upstream. Should Forth Ports consider the 'Do Nothing' approach, and not undertake the maintenance dredging operations, a navigable depth would not be maintained and the Port of Rosyth would not be able to continue to service current vessels. Given Forth Port's statutory duty as the Harbour Authority to ensure safe navigation, there is an ongoing maintenance dredging requirement and the need for disposal of the dredged material, therefore the do nothing option is not considered further in this BPEO.

(1) The term BPEO was derived by the Royal Commission on Environmental Pollution who described it as a procedure which "establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at an acceptable cost, in the long term as well as in the short-term.
(2) Marine (Scotland) Act 2010, Part 4 Marine Licencing. General Guidance for Applicants. Available online http://www.scotland.gov.uk/Resource/0043/00435338.pdf
(3) Forth Ports pers comm May 2023.

Figure 1.1 Proposed Disposal Site



1.3 Previous Maintenance Dredge Spoil Disposal Activities

The MoD had previously dredged the port area every three years before Forth Ports took over annual dredging of the key berthing areas in 1997. From 1998 to the end of 2000 dredging was undertaken with the *Abbotsgrange*, a small trailing suction dredger that was owned by Forth Ports. Since January 2001, Forth Ports have contracted United Kingdom Dredging (UKD) for the majority of operations within the Forth Estuary. The *UKD Marlin* (shown in *Figure 1.2*) is a larger trailing suction dredger, with a hopper capacity of 3,000 m^3, double that of the *Abbotsgrange.*

Since 1998, Forth Ports have disposed of the majority of materials from the Port of Rosyth at the Oxcars disposal site approximately 5.5 nautical miles (nm) east of the port (see *Figure 1.1* for position of disposal site in relation to port). The exception to this was the disposal of dredged material from the port during 2001 at the Blae Rock disposal site located approximately 3.5 nm east of the Oxcars site (see Table 1.3). A larger than normal volume of material was dredged in 2001 within the inner part of the Port of Rosyth as well as ongoing maintenance dredging operations in the area, so the Blae Rock site was used as it is in deeper water and has the capacity to disperse a larger volume of dredged material.

It is likely that this or a similar vessel will be used for future dredging operations, subject to relevant contracting arrangements. In addition, the smaller Wyre Sand or Cherry Sand or similar will be used for the shallower areas where the larger dredging vessels cannot work (shown in Figure 1.3.

Figure 1.2 Dredge Vessel - UKD Marlin

Figure 1.3 Dredge Vessel – Wyre Sands and Cherry Sand

http://www.wyremarineservices.co.uk/fleet-and-equipment.html
https://www.ukdredging.co.uk/UKD_Fleet/Cherry_Sand/

1.4 Proposed Dredge Spoil Disposal Operations

Forth Ports wishes to apply for a licence from Marine Scotland for the disposal of dredge spoil to a maximum of 400,000 m^3 of dredged material per annum (up to 520,000 wet tonnes based on density of 1.3 (1)). This is required to ensure compliance with safe vessel berthing and to allow for any fluctuation in sediment deposition or contingencies.

To maintain access to the port, Forth Ports require to dredge the port and main approach channel, typically for 17 to 25 days (24 hrs) a year, depending on siltation levels and operational requirements, including the vessel requirements for access to and from Rosyth Naval Dockyard. The planned dredging operations would typically be undertaken in a number of campaigns lasting approximately three to five days each throughout the year using the *UKD Marlin* trailing suction dredger or similar vessel. Dredging has previously been undertaken in 3 to 9 months of the year.

The boundary co-ordinates of the planned dredge areas are presented in *Table 1.1* and illustrated in *Figure 1.1.*

Table 1.1 Co-ordinates of Planned Dredge Area at the Port of Rosyth

Node	Co-ordinates (WGS84)	
	Latitude	Longitude
A	56°1.494'N	3°26.638'W
B	56°1.427'N	3°26.307'W
C	56°1.334'N	3°26.368'W
D	56°1.225'N	3°25.833'W
E	56°1.213'N	3°25.802'W
F	56°1.084'N	3°25.889'W
G	56°0.880'N	3°25.050'W
H	56°0.563'N	3°24.573'W
I	56°0.640'N	3°25.140'W
J	56°0.811'N	3°25.248'W
K	56°1.138'N	3°26.881'W

Coordinates in WGS84, UTM Zone 30N, degrees decimal minutes

The water depth within the proposed Oxcars disposal site ranges from 2.1 m below Chart Datum (CD) at the centre of the site and increases to 13.7 m below CD towards the west of the site. The boundary co-ordinates of the disposal site are presented in and illustrated in *Figure 1.1.* The site has previously been extended to the west and the coordinates of these extensions are provided in *Table 1.2* and shown in *Figure 1.1.*

(1) Conversion factor used by Forth Ports for maintenance dredge sediments from the Port of Rosyth. Forth Ports pers comm May 2023.

Table 1.2 Coordinates of Oxcars Disposal site

Site	Coordinates (WGS84)	
	Latitude	Longitude
Oxcars Main	56° 01.20' N	003° 16.29' W
	56° 00.83' N	003° 14.19' W
	56° 01.35' N	003° 14.06' W
	56° 00.90' N	003° 16.29' W
Oxcars Extension A	56° 01.20' N	003° 17.09' W
	56° 00.90' N	003° 16.29' W
	56° 01.20' N	003° 16.29' W
	56° 00.90' N	003° 17.09' W
Oxcars Extension B	56° 01.20' N	003° 17.29' W
	56° 00.90' N	003° 17.09' W
	56° 01.20'N	003° 17.09' W
	56° 00.90'N	003° 17.79' W

Coordinates in WGS84, UTM Zone 30N, degrees decimal minutes

The volume of dredged material deposited at the Oxcars disposal site from the Port of Rosyth from 1998 to 2023 ranged from 35,540 m^3 to 380,589 m^3 per annum (see *Table 1.3*). The increase in volume in recent years was in response to changing siltation patterns in the area and for dredging works required for the current aircraft carrier construction and longer term maintenance at Rosyth.

Table 1.3 Volume and Disposal site from the Port of Rosyth (1998-2023)

Year	Quantity (m^3)	Disposal site
1998	60,000	Oxcars
1999	88,295	Oxcars
2000	35,540	Oxcars
2001	306,875	Blae Rock
2002	118,850	Oxcars
2003	91,301	Oxcars
2004	61,552	Oxcars
2005	73,365	Oxcars
2006	76,174	Oxcars
2007	45,010	Oxcars
2008	59,842	Oxcars
2009	98,141	Oxcars
2010	125,669	Oxcars
2011	198,755	Oxcars
2012	149,818	Oxcars
2013	184,861	Oxcars
2014	206,149	Oxcars
2015	174,569	Oxcars
2016	380,589	Oxcars
2017	195,474	Oxcars
2018	161,760	Oxcars
2019	214,878	Oxcars
2020	180,470	Oxcars
2021	170,346	Oxcars
2022	256,720	Oxcars
2023 (to end May)	99,192	Oxcars

Data source: Forth Ports May 2023.

1.5 Description of Sediment to be Dredged and Disposed

In line with Marine Scotland guidelines on pre-dredge sampling protocol (1), a survey programme was undertaken on 4th April 2023. Samples were taken at 13 stations using a van-Veen grab. For each of the samples the following physical and chemical analysis was undertaken by Socotec UK Ltd.

- Metals: arsenic, cadmium, chromium, copper, mercury, nickel, lead, and zinc.
- Tributyl Tin.
- Polycyclic Aromatic Hydrocarbons
- Total Hydrocarbon Content.
- Poly Chlorinated Biphenyls.
- Sediment moisture content and sediment particle density.
- Total Organic Carbon.
- Sediment particle distribution.
- Presence of asbestos.

The location of the sample stations and the results of the physico-chemical analysis are presented in *Appendix A.*

The sediment comprises sandy mud and slightly gravelly sandy mud with most samples being defined as coarse silts (using the Folk and Ward classification). The material to be dredged comprises recent infill sediments from the Forth Estuary.

There are concentrations of some metals and some polycyclic aromatic hydrocarbons (PAHs) above Marine Scotland Action Level 1 but below Action Level 2 (2). This is consistent with previous samples for this and other ports in the Forth Estuary and Firth of Forth and is associated with the historic industrial discharges to the Forth Estuary. Refer to *Table 3.2* for comparison of historic contaminant concentrations from the Port of Rosyth and other ports in the Firth of Forth and Forth Estuary. Samples from the Oxcars disposal site and other disposal sites in the Forth Estuary and Firth of Forth have been analysed by Marine Scotland. A summary of the historical sample analysis is provided in presented in *Appendix A.*

An assessment of potential impacts of sea disposal operations is provided in *Appendix B*.

1.6 Scope of the Study

This report provides an appraisal of available disposal options and short-lists those which are considered to be practicable. Options are reviewed according to the Waste Hierarchy, as outlined in the European Waste Framework Directive (2008/98/EC) (3). The options on the short-list are then reviewed against strategic, environmental and cost considerations. The options are then compared and the BPEO identified.

The remainder of this report is structured as follows.

- Section 2 describes the BPEO assessment method.
- Section 3 describes each of the available disposal options and summarises their respective advantages and disadvantages.
- Section 4 compares the disposal options.

(1) Guidance for the sampling and analysis of sediment and dredged material to be submitted in support of applications for sea disposal of dredged material. Available online http://www.scotland.gov.uk/Resource/0044/00443832.pdf
(2) Action Levels for metals, PCBs, TBT and PAHs are used by Marine Scotland to assess the suitability for disposal of sediments at sea.
(3) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/165851/l_31220081122en00030030.pdf

- Section 5 identifies the BPEO.

Further supporting information is provided in the three Appendixes.

- *Appendix A:* Sediment Sample Chemical Analysis Results.
- *Appendix B:* Environmental Impacts of Disposal Operations.
- *Appendix C:* Consultee Responses.

2. BPEO ASSESSMENT METHOD

2.1 Introduction

The BPEO study was undertaken using the following method.

- Identification of potential disposal options.
- Preliminary appraisal and short-listing of options based on practicability.
- Assessment of the short-listed options based on:
  - strategic considerations;
  - worker and general public health and safety considerations;
  - environmental considerations *i.e.* what the environmental impacts would be; and
  - cost, in terms of capital and maintenance/operating costs.
- Comparison of the relative merits and performance of the options and identification of the BPEO.

Information was obtained through literature review and the following consultees were requested to provide any relevant information they hold and any comment on the proposed sediment disposal operations.

- Crown Estate Scotland.
- Fife Council.
- Forth District Salmon Fisheries Board (FDSFD).
- Maritime and Coastguard Agency (MCA).
- Nature Scot (NS).
- Northern Lighthouse Board (NLB).
- Scottish Environment Protection Agency (SEPA).

2.2 Identification of Options

The following seven potential treatment/disposal options for the dredged material were identified:

- beach nourishment;
- coastal reclamation and construction fill;
- spreading on agricultural land;
- sacrificial landfill;
- incineration;
- other disposal options and reuse; and
- sea disposal.

2.3 Preliminary Appraisal

A preliminary appraisal of each of the options identified above was undertaken, including an assessment of the practicability of each option with regard to availability of disposal sites. Following the preliminary appraisal those options that are considered to be practicable were short-listed for further consideration.

2.4 Assessment of Options

The short-listed options were then subject to detailed assessment. The parameters which were used to assess the short-listed options are described below.

2.4.1 Strategic Considerations

Strategic considerations included the following.

- **Practicability.** Whether the option is technically and operationally practicable.
- **Availability of sites/facilities**. Whether there are any sites or facilities which can take the dredge spoil.
- **Security of option**. Whether Forth Ports will have control over all stages of the disposal.
- **Established practice**. Whether technologies and techniques proposed are established and therefore whether the performance and potential difficulties of the technologies and techniques can be anticipated.
- **General public acceptability**. Whether the public are likely to object to or support the proposals.
- **Likely agency acceptability**. Whether public agencies are likely to have any major concerns when consulted on the Marine Licence application.
- **Legislative implications.** Compliance with relevant legislation and the potential management control required.

2.4.2 Health, Safety and Environmental Considerations

The health, safety and environmental performance considerations are summarised below.

- **Public health**. Whether there would be any risk of a detrimental effect on public health, based on predicted pathways and receptors.
- **Safety.** Considering potential sources of hazard and probability that there would be any risk to the general public or workers.
- **Contamination/pollution.** Whether there is potential for pollution or contamination that could result in failure to meet Water Framework Directive (WFD) objectives and associated Environmental Quality Standards (EQSs: the amount or concentration of a substance that should not be exceeded in an environmental system). Contamination is defined as the presence of an unwanted constituent in the natural environment whilst pollution is the introduction of contaminants into the natural environment that causes adverse change.
- **Ecological impact.** Assessing the significance of any potential impact on important habitats or species, including designed sites.
- **Interference with other legitimate activities**. Whether there are likely to be impacts on other activities, such as other users of the port, firth or roads.
- **Amenity/aesthetic**. Assessing whether there is likely impact on local amenity *e.g.* visual, olfactory or noise impact resulting from the disposal activities.

2.4.3 Cost Considerations

Cost of disposing of dredged material was considered in terms of the capital costs (construction of facilities and equipment hire /purchase costs) and operational costs (transport costs and disposal costs, including site operation).

2.4.4 Comparison of Options

The performance of each option was evaluated on a scale from Low to High according to definitions presented in *Table 2.1*. Intermediate grades (Low to Medium and Medium to High) were also used where the assessment was marginal between Low, Medium or High. The results of the assessment process are presented in *Section 3* and *Section 4.*

Table 2.1 Definitions of Performance

Consideration	High	Medium	Low
Strategic Considerations			
Technical and Operational Practicality	Few practical difficulties, easy to undertake and process is proven to be straightforward and robust. Low number of stages and each stage easy to control.	Some practical difficulties. Moderate number of stages with some difficulties.	Major practical difficulties. Large number of steps with some major difficulties.
Availability of Sites/Facilities	Suitable site/facility available within 1 km of the docks by road and 10 km by sea.	Suitable site/facility available within 10 km of the docks by road and 20 km by sea.	No suitable sites/facilities within the vicinity (over 10 km by road and 20 km by sea).
Security of option	In complete operational control of Forth Ports.	Is mainly in control of Forth Ports with some outside involvement for which there are alternative sources of supply.	Has elements that are out of Forth Ports control for which there are no practical alternative sources of supply.
Established Practice	Technology and techniques are established and used for dredge spoil disposal.	Technology and techniques have been tested but not applied to dredge material.	Technologies and techniques are untested and unforeseen problems are likely.
General Public Acceptability	Likely to be generally acceptable to the public based on reaction to similar operations.	Unlikely to provoke a strong negative or positive reaction based on reaction to similar operations.	Likely to provoke a strong negative reaction based on reaction to similar operations.
Likely Agency Acceptability	Likely to be generally acceptable to statutory bodies after consultation.	Statutory bodies may have some concerns that may be overcome through further consultation and option development.	Statutory bodies may have major concerns that may not be overcome through consultation and option development.
Legislative Implications	Would comply with legislation with a low level of management control and intervention.	Requires some management control and intervention to achieve compliance.	Requires a high level of management control and intervention to achieve compliance.
Health, Safety and Environmental Considerations			
Public Health	Will not cause workers or public to be exposed to substances or activities potentially hazardous to health.	May cause some low-level intermittent exposure to substances or activities potentially hazardous to health.	Risk of exposing workers and general public to substances or activities potentially hazardous to health.
Safety	No significant safety risk to workers and the general public with no specific controls required.	Low safety risk to workers and the general public which is easily controlled.	Moderate to high safety risk to workers and general public and difficult to control.

Consideration	High	Medium	Low
Contamination/ Pollution	Compliant with emission standards and water/sediment/ground quality objectives. Low risk of harm from substances released to environment.	Environmental quality standards may be approached or breached occasionally. Some risk of harm to environment.	Environmental quality standards may be breached regularly and there is a moderate or high risk of harm to environment.
Ecological Impact	Priority species and habitats under the UK Biodiversity Framework (1) and qualifying features and species under the *Habitats Regulations, 2019* (2) will not be affected.	Priority species and habitats under the UK Biodiversity Framework and qualifying features and species under the *Habitats Regulations, 2019* may be slightly affected.	Priority species and habitats under the UK Biodiversity Framework and qualifying features and species under the *Habitats Regulations 2019*, are likely to be significantly affected.
Interference with other Legitimate Activities	Little potential for interference with other activities.	Some potential for interference with other activities.	High potential for interference with other activities.
Amenity/Aesthetic	No significant impact on local amenity or aesthetic qualities.	Potential for impacts of moderate significance on local amenity or aesthetic qualities.	Potential for impacts of high significance on local amenity or aesthetic qualities.
Cost			
Capital and maintenance	£1 m or less.	Between £1 m and £5 m.	More than £5 m.

(1). JNCC and Defra (on behalf of the Four Countries' Biodiversity Group). 2012. UK Post-2010 Biodiversity Framework. July 2012. Available from: http://jncc.defra.gov.uk/page-6189.

(2) The *Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations, 2019* apply to European sites (formerly Special Protection Areas and Special Areas of Conservation).

3. PRELIMINARY ASSESSMENT OF AVAILABLE DISPOSAL OPTIONS

3.1 Introduction

This section describes the identified disposal options and makes a preliminary assessment of each based on overall practicality. There are a number of steps that are common to some of the land-based options and these are described in *Section 3.2* to avoid repetition. The section concludes by identifying those options that are short-listed for further consideration in the BPEO process.

The seven identified disposal options are:

1. beach nourishment;
2. coastal reclamation;
3. spreading on agricultural land;
4. sacrificial landfill;
5. incineration;
6. other disposal options and reuse; and
7. disposal at sea.

3.2 Common Steps to Land-Based Disposal Options

The disposal options that have land-based components include:

- beach nourishment (if material transported by road);
- coastal reclamation and construction fill (if material transported by road);
- spreading on agricultural land;
- sacrificial landfill;
- incineration; and
- other disposal options and reuse (such as brick making/concrete aggregate/topsoil production).

The steps that are common to the land-based disposal options are:

- landing the dredge material;
- storage of dredge material;
- dewatering the dredge material; and
- loading and transport for disposal.
- disposal/treatment.

These steps are described below along with a discussion of the practicalities of undertaking these steps at the Port of Rosyth.

3.2.1 Landing the Dredged Material

All of the land-based options require transport to on-shore facilities. This could be via a pumped discharge, conveyor or grab. As there are no existing suitable landing facilities at Rosyth or elsewhere in the Forth Estuary/Firth of Forth area, a new coastal landing facility and storage area would be required at the port to enable the materials to be landed.

3.2.2 Storage of Dredged Material

Once the dredged material has been landed, it will require storage prior to onward transport for final disposal. A storage facility may therefore require construction at the landing site, capable of retaining the dredged material and associated run-off and dust.

3.2.3 Dewatering the Dredged Material

The land disposal options require dewatering of the dredged material either to make transport more feasible or to create a material which is suitable for disposal to land or incineration *i.e.* disposal of a more solid sludge rather than a liquid. Based on previous experience from dredging at this location the hopper contents are likely to average 20% solids (by volume) and range from 30% to 15% solids *i.e.*, solids to liquid ratio will decrease as dredging operations progress and only isolated pockets of sediments remain resulting in an increased uptake of water (1).

There are three approaches that are typically used for drying marine sediments: construction of settling lagoons, use of a mobile centrifuge unit and filter press as described below.

Settling Lagoons

Settling lagoons are large, ring-dammed structures into which the dredged material would be pumped. These could be built within the intertidal area or on land. The material would be piled up in the lagoon which would have a drainage system to collect the water and watery sludge from the dredged material for further treatment (e.g. by hydrocyclone, as described below) or to be transported offsite for disposal. The lagoons would need to be of sufficient size to contain the dredged material prior to transport. They would also need to be accessible by road and have facilities to load the dredged material into tankers or sealed heavy goods vehicles (HGVs) for movement to the disposal/treatment centre. To minimise the distance the wet dredged material would have to be transported from the dredger, the lagoon would need to be located near the landing site.

Setting up settling lagoons would require assessment to ensure that any leachate from them would not contaminate groundwater and a licence would be required from SEPA under the *Water Environment (Controlled Activities) Regulations (2011)*. Forth Ports advise that the potential to be able to find appropriate space to create lagoons close to the port is considered to be low.

Furthermore, as some samples of the material analysed contains metals and PAHs above Marine Scotland Action Level 1 (see *Appendix A* for sample analysis data) it might be additionally necessary to construct the lagoons with special liners to retain the contaminants and consider treatment of the supernatant water draining out of the lagoons.

Centrifuge or Hydrocyclone System

The use of a centrifuge or hydrocyclone system to dewater the material to a level suitable for disposal to landfill (approximately 10% water content) may be required, depending on the final water content of the recovered material. One mobile unit system was reported as being capable of treating up to 150 $m^3 hr^{-1}$ depending on unit size and material solids content. Other systems may be available that can process material at different rates, however, for the purposes of this assessment a rate of 150 $m^3 hr^{-1}$ has been used. If material can be dried at a rate of 150 $m^3 hr^{-1}$, to dewater a total volume of approximately 400,000 m^3 would require approximately 2,668 hours (111 days assuming working 24 hours a day, seven days a week). Other units with lower throughputs could take longer (2).

Filter Press

A filter press is a tool used to separate solids and liquids using the principle of pressure. The press is filled with the spoil, building up pressure before the spoil is strained through filter cloths by force. The remaining dried spoil can then be removed from the filter press and taken away for disposal. This drying process achieves the best level of dryness of the three options, however, can take significantly

(1) Forth Ports Ltd pers comm May 2023.
(2) Maximum throughput of 120 $m^3 hr^{-1}$ http://www.euroby.com/services/mobilecontract-dewatering-units/

longer than using a centrifuge and is considerably more expensive than either of the other two options.

3.2.4 Loading and Transport for Disposal

A loading facility would be required adjacent to the storage or dewatering area to load the material into covered HGVs for transport to disposal/treatment sites. The required infrastructure would include hard standing to allow a fleet of HGVs to be loaded by mechanical excavators. Although hard standing is already available at the Port of Rosyth, there are no storage or dewatering sites at Rosyth.

Assuming the materials can be dried to a water content of 10% (by volume) at or adjacent to the Port of Rosyth, the estimated 374,000 m^3 (1) per annum of dried materials would require transport for disposal, either to an incinerator, to agricultural land, to landfill or to a reclamation project. The length of journey required would depend on the location of the deposit/incineration sites.

A volume of 374,000 m^3 of dried (to 10% water content) material equates to approximately 486,200 tonnes (2). Assuming 20 tonne capacity HGVs/tankers are used, this would equate to 24,310 return trips or 48,620 vehicle movements per annum.

The levels of HGV movements in the Rosyth area are already high (the Port of Rosyth is approximately 3 km from the M90 motorway) so this level of movement may be acceptable at the collection end. However, there is more likely to be an issue with regard to increase in traffic flows on rural roads if they are used to reach disposal/treatment sites.

3.2.5 Disposal/Treatment

Neither method of the drying process (*e.g.* lagoons or centrifuge) is likely to reduce the concentration of metals, PAHs and salt present within the dredged material. This may restrict disposal and reuse options and pre-treatment may be required to reduce contaminant concentrations prior to disposal on land.

Where an option involves disposal on land there is an issue of classification of the dredged material. Once the material has been removed from the harbour for disposal on land it will be classed as waste. The waste then requires disposal at a licensed waste management facility and to be transported by a registered waste carrier. In the waste hierarchy set out in the *Waste Management Licensing (Scotland) Regulations, 2011*, dredged spoil is coded as 17 05 05 (Mirror Hazardous) or 17 05 06 (Mirror Non-hazardous), depending on the concentrations of particular contaminants. If landfill is identified as the disposal route for this waste, then further analysis may be required to ensure that the material meets the Waste Acceptance Criteria for hazardous landfill.

The saline nature of the sediment also restricts its application on land, as without going through a washing process it will not be able to support any form of terrestrial flora growth.

3.3 Beach Nourishment

3.3.1 Process Description

Beach nourishment involves the disposal of the dredged material on a beach directly from the dredging vessel or, if dewatering was required, the spoil would be brought ashore and dewatered prior to transport or placement on the beach using earth moving plant.

3.3.2 Suitable Sites for Beach Nourishment

Beach nourishment requires materials of a similar composition to the existing beach materials and usually involves clean sand or gravel. The sediment from within the proposed dredge zone generally comprises fine material (medium and coarse silts). The sediment from the Port of Rosyth is not

(1) 400,000 m^3 total spoil at 85% solids content equals 340,000 m^3 plus 34,000 m^3 (10% water content) equals 374,000 m^3.
(2) Based on a weight of 1.3 tonnes per m^3 of dredge spoil.

suitable for beach recharge due to the particle size distribution and the presence of contaminants such as metals and PAHs.

Due to the risk of direct exposure to contaminated sediment, spoil containing contaminants disposed of at the public recreational sites such as beaches is considered less suitable than if it were disposed of at sea. Action Levels provided by Marine Scotland are specific to the disposal of material to sea, where the sediment does not come into direct contact with the public, rather than at recreational areas. Guidance published by NatureScot (1) on managing coastal erosion in beach/dune systems makes reference to use of materials that *are not contaminated in any way* but does not provide equivalent action levels for contaminants. NatureScot has also confirmed during a previous consultation that it would only be appropriate to use material on a beach of similar substrate provided contaminant levels were not of concern.

This option is practicable, however no sites requiring beach nourishment have been identified through consultation (see *Appendix C*).

Given the conservation status of the Forth Estuary and Firth of Forth, the lack of available beaches for nourishment, the contamination of the spoil and its particle size composition, beach nourishment is not a practicable option.

3.4 Coastal Reclamation and Construction Fill

3.4.1 Process Description

This section considers the use of the dredged material in coastal reclamation projects or as fill material inland. Depending on the potential site, reclamation or fill could involve landing, storage, dewatering, transport and possibly desalination. Coastal use directly from the dredging vessel would be preferable as this would involve pumping or spraying the material directly from the dredger or barge to the site where it was needed and would avoid handling and transporting the material on land.

3.4.2 Suitable Sites for Reclamation

Forth Ports, Marine Scotland and the coastal local authorities are the most likely bodies to be responsible for or aware of reclamation projects in the Firth of Forth. No sites for coastal reclamation have been identified through the consultation process as requiring any of the dredged material. In addition, the dredged material would not be suitable for many reclamation sites due to the low compressive strength properties of predominantly muddy sediments. The spoil could be pumped into bunded lagoons at the edge of the Firth of Forth to create land that could be used for development, agricultural or similar purposes.

The majority of the intertidal area falls within the Firth of Forth Site of Special Scientific Interest (SSSI) and Outer Firth of Forth and St Andrews Bay Complex Special Protection Area (SPA). The SPA is a large estuarine/marine site consisting of the two adjacent Firths of Forth and Tay. NS has previously expressed the view on similar BPEO assessments that further loss of intertidal habitats is not considered a realistic option.

3.4.3 Construction Fill Material

Use of dredged material as construction fill in inland construction projects would not be appropriate because of low compressive strength properties of mud and the need for landing, drying and transport of the dredged material. If landing, drying and transport were feasible then it may be that the material could be used for quarry/landfill capping. However, the presence of contaminants in the dredged material and its high salt content make this option unattractive.

(1) Scottish Natural Heritage (2000). A Guide to Managing Coastal Erosion in Beach/dune Systems. Summary 7: Beach Nourishment.

3.5 Spreading on Agricultural Land

3.5.1 Process Description

SEPA has previously confirmed that the disposal or recycling of marine dredged material on agricultural land does not fall within the exemptions under Paragraph 7 of Schedule 1 of the *Waste Management Licensing (Scotland) Regulations 2011*, and the activity would therefore require to be licensed. Planning permission may also be required from the local authority. In support of the application to dispose of the dredged material to agricultural land, evidence that the material would not cause pollution of the environment or harm to human health would need to be provided.

The disposal of marine dredged material to agricultural land would involve landing, dewatering, possibly storage, desalination and transport for disposal. Dewatering the dredged material in lagoons or in a centrifugal drier would remove some of the salt; however it is likely that desalination would still be required. Desalination could be achieved by placing the spoil in lagoons, layering it with sharp sand, spraying water over the material and allowing leaching of the salt back into the Forth Estuary.

Approximately 200,000 tonnes of sludge are recycled to agricultural land per annum across Scotland (1). Forth Ports are seeking to dispose of up to 400,000 m^3 of material (approximately 520,200 tonnes at 1.3 tonnes m^{-3}) equating to approximately 250% of the current volume of annually recycled sludge in Scotland.

As the material from Rosyth has a low organic carbon content (an average of approximately 3.9% (range 3.29 to 5.02%) from the sediment sample analysis, spreading the dredged material from the Port of Rosyth on agricultural land is not considered a practicable option.

In addition, the material sampled at Rosyth has contamination from some metals and PAHs above Action Level 1 so the spoil cannot be applied to land without confirmation from SEPA that levels of these contaminants are acceptable.

3.6 Sacrificial Landfill

3.6.1 Process Description

The type of landfill site which can take the spoil is dependent upon the classification of the waste. As discussed above it is understood that the waste would likely be classified as non-hazardous rather than inert and therefore a suitably licensed landfill site with sufficient capacity is required.

3.6.2 Available Landfill Sites

Subsequent to implementation of the *Landfill Allowance Scheme (Scotland) Regulations 2005* and re-evaluation of landfill licences, there are currently two sites within an hour's drive from the Port of Rosyth able to accept such material. A suitable landfill site is located at Avondale Landfill, Polmont, approximately 19 miles south west of the Port of Rosyth. However, the Avondale site is not large enough to accommodate all of the dredged material, and would only consider taking some of the dredged material upon closure of one or all of the phases within the plant. Fife Council landfill site in Cupar, approximately 32 miles north of Rosyth, also has the capability to accept non-hazardous material. In 2021, it received 311,595 tonnes of wastes, including 118,722 tonnes of soil/stones. To receive dredge material from the Port of Rosyth, this would require an approximate 300% increase in the volume of similar waste material to the landfill site, if the full annual volume of material was dredged each year (2).

(1) https://www.gov.scot/publications/review-storage-spreading-sewage-sludge-land-scotland-sludge-review-final/
(2) PPC/E/0020085. Lower Melville Wood. LF, Cupar. 60. 50. 130.
PPC/E/0020001.https://consultation.sepa.org.uk/permits/lower_melville_wood_landfill_ppc_variation_app/

3.6.3 Taxes and Royalties

The material will be exempt from landfill tax under the terms of the Landfill Tax (Scotland) Act 2014 issued by the Scottish Government that specifies that dredged material from any inland waters, including harbours and their approaches, are not subject to landfill tax.

3.7 Incineration

3.7.1 Process Description

Incineration would involve landing the dredged material, dewatering, possibly storing it and transporting it to either an existing incinerator or a newly constructed incinerator. The ash would then require disposal. Options for disposal of ash include landfill, reclamation and spreading on agricultural land.

The organic content of the dredged material is assumed to be less than 5% (based on the 2023 samples which had an average percentage of organic carbon of 3.9% and range of 3.29 to 5.02%) and therefore there is only a small combustible component within the material. It is anticipated that incineration would result in a reduction in volume of the dried spoil by less than 15% *i.e.,* less than 5% organics plus 10% water content. Incinerator operators generally require material to have an organic content above 20% to ensure efficient combustion and would most likely reject material with an organic content below this threshold (1).

A further consideration is that the material to be dredged contains some metals and some PAHs above Action Level 1. In a typical thermal desorption incineration process it is likely that some of the contaminants would be removed and the leaching potential of metals would be reduced, however, the ash is likely to still be contaminated. Pre-treatment may be required for the removal of metals. Emissions to atmosphere from the incineration processes would also require to be controlled by SEPA/EA under the *Environmental Protection Act 1990.*

3.7.2 Available Incinerator Sites

There are no appropriate waste incinerators in Scotland that could accept the dredged material. The nearest incinerator is at Ellesmere Port, Merseyside (approximately 425 km south) and transport would be costly and therefore this option is not considered to be practicable.

3.8 Other Disposal Options and Reuse

The other disposal options are re-injection into the tidal flats via a pipeline and reuse in brick making, concrete aggregate or topsoil production processes.

3.8.1 Re-injection

This would involve the construction of a pipeline to take the dredged spoil to a high tide point on the Torry Bay mudflats and injecting it at a velocity back into the mudflats. The advantage of this is that it effectively keeps the sediment within the sediment cell. The disadvantage of this is that the re-injection at velocity would be likely to have an adverse impact on the protected mudflat habitat through disturbance and erosion and may affect the ornithological interest in the mudflats.

Due to the costs associated with the construction and maintenance of the pipeline and the disturbance during construction and operation of the pipeline on the ornithological interest of the mudflats this option is not considered to be practicable.

3.8.2 Brick Making/Concrete Aggregate/Topsoil Production

There are processes by which marine sediments can be made into bricks or can be used to form concrete aggregate. The advantage is that the materials can be beneficially used and metals are

(1) Baldovie Waste to Energy Plant, pers comm, January 2017

sealed into the bricks or aggregate. Previous consultations between Forth Ports and a brick making factory confirmed that the mineralogy of the material would not be appropriate for brick making and the contamination by salt would be unacceptable for any construction material.

Almost no agricultural species can grow in salty soils and very few in brackish soils. The salinity of the dredged sediment would require to be reduced naturally by rainwater or by a dewatering process before consideration for use as topsoil. The best topsoil is a mixture of sand, silt, clay and organic matter and must be clean for use in the production of food crops [(1)]. This option would not be feasible at the Port of Rosyth due to lack of necessary handling facilities and suitable storage areas. The contaminant levels in the samples would make using the material for topsoil unattractive.

In addition, there is no known demand for this material to be used in topsoil production.

3.9 Disposal to Sea

3.9.1 Process Description

Disposal at sea involves the dredge material being transported to a licensed disposal site in a dredging vessel. It involves the dredger sailing to a licenced disposal site and releasing the materials, usually by lowering the excavator head into the water or through bottom doors. A differential global positioning system (dGPS) would be used to position the vessel in the disposal area and record the spoil discharge locations. This approach takes place at sea and does not require the landing of any materials.

3.9.2 Available Sites

There are seven licenced marine disposal sites in the Forth Estuary and Firth of Forth: Bo'ness, Oxcars, Blae Rock, Kirkcaldy, Methil and two sites designated at Narrow Deep. For the dredging operations at Rosyth, Forth Ports would propose to use the Oxcars disposal site located approximately 5.5 nm east of Rosyth within the Firth of Forth. This site has historically been used for the disposal of the majority of the dredged material from Rosyth. The time required for one cycle (dredging - travelling - discharging - travelling) is approximately two hours.

The baseline environmental conditions and potential environmental impacts at the disposal site are described in *Appendix B*.

3.10 Conclusion

The description of the available options allows options that are evidently impracticable to be ruled out. This is summarised in *Table 3.3.* The assessment of the short-listed options taken forward for further consideration is presented in *Section 4.*

(1) Permanent International Association of Navigation Congresses. Permanent Technical Committee II. Working Group 19. 1992. Beneficial Uses of Dredged Material, Issue 19.

Table 3.1 Short-listing of Options

Option	Assessment	Result
Beach Nourishment	This option does not appear to be practicable. The material is not suited to beach nourishment in the Forth Estuary or the Firth of Forth; in addition there are no beaches within the Forth Estuary or the Firth of Forth, identified by Forth Ports, consultees or in the NCCA (2017) (1) report that require nourishment with this grade of material.	Discard
Coastal Reclamation and Construction Fill	This option may be practical. The salt content, poor load bearing properties and the potential concentration of contaminants limits the available options for reuse of the dredged material.	Short-list
Spreading on Agricultural Land	This option does not appear to be practicable. The material is not desirable for disposal on agricultural land due to potentially containing concentrations of contaminants and having a low organic content (<5%). Furthermore, desalination, storage, dewatering and transport of this material are impractical. Disposal on agricultural land would require a Waste Management Licence and evidence that there would be no harm to human health.	Discard
Sacrificial Landfill	This option may be practicable as there are local sites. There are a large number of steps involved in storage, dewatering and transport. Landfill site operators may be unwilling to accept the material due to the sediment composition and large volumes.	Short-list
Incineration	This option does not appear to be practicable. The material is not suited to incineration due to low organic content (<5%) and large volume of spoil involved. If incinerated, volume would only slightly reduce and there are no available incinerators in Scotland that could take this amount of material.	Discard
Other Uses	This option may be practicable in the form of brick making, concrete aggregate and topsoil production.	Short-list
Disposal at Sea	This option is practicable and has been the BPEO for previous dredging campaigns at the Port of Rosyth.	Short-list

(1) Fitton JM, Rennie AF and Hansom JD (2017). Dynamic Coast - National Coastal Change Assessment: Cell 2- Fife Ness to Cairnbulg Point. CRW1014/2.

4. ASSESSMENT OF SHORT-LISTED DISPOSAL OPTIONS

4.1 INTRODUCTION

This section presents an assessment of each option against the assessment definitions of performance listed in Table 2.1. A classification of likely performance is provided for each of the criteria and the assessment is then summarised in *Section 5*.

The environmental effects of disposal at sea are addressed in *Appendix B.*

4.2 COASTAL RECLAMATION AND CONSTRUCTION FILL

4.2.1 Strategic Considerations

Operational Feasibility

The reuse of the dredged material for reclamation will involve either direct pumping from the dredger into the disposal site or landing and drying the material and desalination prior to transporting the material for disposal on land. This option would be achievable if disposal sites were available adjacent to the Firth of Forth.

Classification: Medium

Availability of Sites

No coastal sites within the Firth of Forth requiring this grade of material for reclamation or construction fill have been identified by Forth Ports, consultees or in the latest Dynamic Coast – National Coastal Change Assessment (2017) (1).

Classification: Low

Security of Option

No sites have been identified as belonging to Forth Ports, so disposal to reclamation sites is outwith their control and could present practical problems, such as scheduling in sediment delivery with proposed dredging programme.

Classification: Low to Medium

Established Practice

The use of suitable dredged materials in coastal reclamation and construction fill is common practice and the technologies and techniques are well established, however, this is for dredged primary aggregate materials such as sands and gravels.

Classification: Low to Medium

General Public Acceptability

Use of the materials for reclamation is likely to be viewed as an acceptable option by the general public. Depending on the method of transporting the dredged material to the site requiring it will affect acceptability by the general public. Transport by sea is likely to be viewed as more favourable than transport by land, which may be viewed as unacceptable by local residents and road users.

Classification: Medium to High

Likely Agency Acceptability

Use of the dredged material for reclamation or construction fill is likely to be acceptable to public agencies. There may be some concerns regarding the contamination levels in the dredge spoil and

(1) Fitton, J.M., Rennie, A.F., and Hansom, J.D. (2017) Dynamic Coast - National Coastal Change Assessment: Cell 2 - Fife Ness to Cairnbulg Point, CRW2014/2

the volume of material to be transported by HGVs for reasons relating to air quality and proximity to residential areas.

Classification: Medium to High

Legislative Implications

The disposal of dredged material from the Port of Rosyth directly from the dredger to a reclamation site requires a Marine Licence from Marine Scotland under *Section 20(1) of the Marine (Scotland) Act 2010*.

Once the material has been removed from the harbour for disposal on land it will be classed as waste under the *Waste Management Licensing (Scotland) Regulations (2011)* and the disposal will therefore require a waste management licence and an exemption for reclamation works.

As well as a Marine Licence for the construction works, consent will be required from the planning authority and a levy paid to the Crown Estate Scotland.

Classification: Medium to High

4.2.2 Health, Safety and Environmental Considerations

Public Health

Low risks to public health are anticipated due to intermittent increase in HGV traffic.

Classification: Medium to High

Safety

Transferring the dredged material ashore has risks associated with operational activities, all of which have mitigation measures in place. Should the dredged material be transported by HGV, there may be an increase in safety risks associated with the movement of materials for disposal, particularly if tankers/sealed HGVs travel through populated areas and along minor roads.

Classification: Medium

Contamination/Pollution

The dredged material may be classified as hazardous or non-hazardous (*i.e*. not inert) due to the concentration of contaminants with respect to land based disposal, however, further analysis would be required to confirm this and run-off and leaching would need to be controlled. There may be localised and temporary deterioration in air quality as a result of HGV movements.

Classification: Medium

Ecological Impacts

There are unlikely to be any ecological risks resulting from the use of dredged materials for reclamation, assuming any contaminants are contained within the site and there would be no significant impact on national or local priority species or habitats. If the site was to be used for terrestrial habitat creation, then the salt levels would limit plant growth.

Classification: Medium to High

Interference with Other Legitimate Activities

The disposal of dredged material is unlikely to interfere with other activities unless the reclamation site is in the port area, in which case the dredger may interfere with other port users. If HGVs are used to transport the dredged material, they may affect other road users.

Classification: Medium to High

Amenity/Aesthetic

If the dredged material is disposed of directly from the dredger there are low risks to amenities/aesthetics. If disposed of by HGV, landing, storage and transport may result in an impact to both amenities and aesthetics of the area.

Classification: Medium to High

4.2.3 Cost Considerations

If the dredged material was pumped directly ashore there would be no further capital costs. The estimated operational costs below would apply.

- operational costs for the operation of the dredger: £0.5 to £1 m per annum;
- Pumping material to site: approximately £4 million pumping costs (£10 per m^3 (1) for 400,000 m^3).

Total: £4.5 to 5 m.

Classification: Medium

If the dredged material was landed, treated and then transported by road, the estimated costs below would apply.

- operational costs for the operation of the dredger: £0.5 m to £0.75 m per annum;
- a discharge berth for the dredger with a storage facility: £3.5 m;
- lagoons to settle dredged material and possibly desalinate: £2.5 m; or
- dockside centrifuge facility capable of dewatering and desalinating 400,000 m^3 of silt per annum: £20-30 m;
- loading and transport (sealed HGVs) – assuming the disposal site is less than one hour drive away and based on one HGV transporting 20 tonnes material at a cost of £100 per trip (2): £2.6 m.

Total £9.35 m to £36.85 m

Classification: Low

4.3 Sacrificial Landfill

4.3.1 Strategic Considerations

Operational Feasibility

Disposal to landfill would require the landing, storage and drying of the dredged materials prior to transporting to a landfill facility. Approximately 520,000 tonnes of material would require transport. This option has practical difficulties relating to drying the dredged material and transport of large volumes of material to a landfill site.

Classification: Low to Medium

Availability of Sites / Facilities

The nearest suitable site is located at Avondale Landfill, Polmont, approximately 32 km from Rosyth, however as discussed above, due to the dredged sediment composition and volume, Avondale would be unable to receive any of the material (3). There are no other sites identified that would be able to take the type and volume of dredged material from Rosyth.

Under the *Landfill (Scotland) Regulations, 2003* the presence of contaminants will classify the material as *non-hazardous* rather than *inert* and consequently reduces the number of available landfill sites capable of accepting this material.

(1) Based on previous consultation with contractors.

(2) Estimated cost based on consultation with HGV operator at £50/hour for two hours per load.

(3) Avondale pers comm, February 2016.

Classification: Low

Security of Option

Whilst Forth Ports have control over the dredging operations, it would have no control over the continued availability of landfill space for the material or the disposal route.

Classification: Low to Medium

Established Practice

Dredged material is sometimes disposed of to landfill for small one-off dredging operations, however it is not established practice to routinely dispose of large quantities of dredged material in this way. Landfill sites require the dredged material to be dried to 10% water content before acceptance. It is unlikely that this is a practice that would be acceptable if there are other viable alternatives.

Classification: Low to Medium

General Public Acceptability

Disposal of the material to landfill is likely to be acceptable to the general public. However, the transport of the dredged material from Rosyth to potential landfill sites may be unacceptable to residents and other road users.

Classification: Medium to High

Likely Agency Acceptability

Scotland's Zero Waste Plan (2010) establishes the direction of the Scottish Executive's policies for sustainable waste management. One such policy is to reduce landfilling of waste to 5% of all wastes by 2025 and as such there may be objection to dredged material routinely requiring space in landfill. Disposal to nearby landfill sites is likely to be acceptable to SEPA provided the materials are regarded as suitable for landfill, however, the acceptability would depend on the quantities to be disposed of and further assessment and classification of hazardous substances.

Classification: Medium to High

Legislative Implications

The material would be controlled waste material for the purposes of transport, storage and disposal. As such, Section 34(7) of *The Environmental Protection Act 1990* and Regulation 6 of the *Pollution Prevention and Control (Scotland) Regulations 2012* will apply, and compliance is likely to be possible. The disposal of the material will also require a waste management licence under *Waste Management Licensing (Scotland) Regulations 2011.*

Classification: Medium

4.3.2 Health, Safety and Environmental Consideration

Public Health

Low risks to public health are anticipated due to the intermittent increase in HGV traffic.

Classification: Medium

Safety

There may be an increase in safety risks associated with the movement of materials for disposal, particularly if tankers/sealed HGVs travel through populated areas and along minor roads.

Classification: Medium

Contamination/Pollution

There may be a small risk of leaching of contaminants that should be contained on site.

Classification: Medium to High

Ecological Impacts

Although there is a small risk of contaminants leaching out from the dredged material, this would be at very low concentrations and is unlikely to cause significant harm to the local ecology. The salt content in the material may prevent plant growth unless covered in a topsoil.

Classification: Medium to High

Interference with Other Legitimate Activities

The increase in HGV movements may interfere with other road users. Baseline traffic data for the A985 in the vicinity of the port indicates that approximately 5.7% of all road traffic in Rosyth is HGVs (1). As a result of the proposed disposal to landfill, the proportion of HGVs in the total traffic flow would increase by approximately 1.2% (2). In addition, depending on the landing and storage arrangements there may be potential for interference with other port users.

Classification: Medium

Amenity/Aesthetic

The movement of HGVs through the area will have an impact on local amenity through noise, vibration, visual impacts and road congestion. This risk also applies to the disposal site.

Classification: Medium

4.3.3 Cost Considerations

The estimated costs below would apply.

- operational costs for the operation of the dredger: £0.5 to £1m per annum;
- a discharge berth for the dredger with a storage facility: £3.5 m;
- lagoons to settle dredged material and possibly desalinate: £2.5 m; or
- dockside centrifuge facility capable of dewatering and desalinating 400,000 m^3 of silt per annum: £20-30 m;
- loading and transport (sealed HGVs) – assuming the disposal site is less than one hour drive away and based on one HGV transporting 20 tonnes material at a cost of £100/trip (3): £2.6 m; and
- a Waste Management Licence.

Total £9.1 m to £37.1 m

Classification: Low

4.4 OTHER DISPOSAL OPTIONS AND REUSE

4.4.1 Strategic Considerations

Operational Feasibility

Reuse for brick making, concrete aggregate or topsoil production would require the landing, storage and drying of the dredged materials prior to transporting to a landfill facility. Approximately 520,000 wet tonnes of material would require transport. There are practical difficulties relating to handling the

(1) UK Traffic Data, A985 Rosyth. 2021 data. Available online https://roadtraffic.dft.gov.uk/manualcountpoints/50801. Accessed May 2023.
(2) 2021 data present an average of 247,835 HGVs on the A985 at Rosyth per annum, which would increase to 299,835 HGV movements and the total annual vehicle movements from of 4,322,695 to 4,374,695 on the A985 at Rosyth) with the transport of dredged material from Rosyth by road. Based on 7 days a week.
(3) Estimated cost based on consultation with HGV operator at £50/hour for two hours per load.

dredged material at the Port of Rosyth. The availability of suitable factories/facilities to process the dredged material and markets for the final products are also considerations.

Classification: Low to Medium

Availability of Sites/Facilities

There are no known sites or facilities to receive the dredged material for other uses such as topsoil production or brick making.

Classification: Low

Security of Option

Although Forth Ports would have control over the dredging and landing, they would not have control over the continued acceptance of the materials for materials for aggregates or making bricks.

Classification: Low to Medium

Established Practice

Use of marine aggregates such as clean sands and gravels are used as a source of primary construction aggregates, but fine sediments are not used for this purpose. Whilst topsoil has been made from dredged material in the past it is not common practice.

Classification: Low to Medium

General Public Acceptability

Making bricks, concrete or topsoil is likely to be publicly acceptable depending on the end use. However, the transport of the material over a large distance may not be acceptable to residents and other road users.

Classification: Medium to High

Likely Agency Acceptability

It is likely that brick making, concrete production and topsoil production would be acceptable to agencies and considered a positive activity. However, the contaminant levels in the samples would make using the material for topsoil unattractive.

Classification: Medium to High

Legislative Implications

SEPA would control emissions from brick making factories under the provisions of the *Environmental Protection Act 1990.* A waste management licence would also be required for their transport and storage under the *Waste Management Licensing (Scotland) Regulations 2011*.

Classification: Medium

4.4.2 Health, Safety and Environmental Considerations

Public Health

Low risks to public health are anticipated due to the intermittent increase in HGV traffic.

Classification: Medium

Safety

There are unlikely to be any significant safety risks associated with making bricks, concrete or topsoil with the exception that there may be an increase in safety risks associated with the movement of materials, particularly if HGVs travel through settlements and along minor roads.

Classification: Medium

Contamination/Pollution

Pollution is not likely to be an issue provided emissions are controlled in accordance with licences.

Classification: Medium to High

Ecological Impacts

Making bricks or concrete should have no adverse ecological effects, provided the materials were decontaminated and desalinated before use.

Classification: High

Interference with Other Legitimate Activities

There is a slight risk that movement of the material would impact other road users.

Classification: Medium to High

Amenity/Aesthetic

The only impacts on amenity are likely to stem from the impact of HGVs from transporting the material.

Classification: Medium to High

4.4.3 Cost Considerations

The estimated costs below would apply.

- operational costs for the operation of the dredger: £0.5 to £1 m per annum;
- a discharge berth for the dredger with a storage facility: £3.5 m;
- lagoons to settle dredged material and possibly desalinate: £2.5 m; or
- dockside centrifuge facility capable of dewatering and desalinating 400,000 m^3 of silt per annum - £20 m - £30 m; and
- loading and transport (sealed HGVs) – assuming the disposal site is less than one hour drive away and based on one HGV transporting 20 tonnes material at a cost of £100/trip (1): £2.6 m.
- a Waste Management Licence.

Total £9.1 m to £37.1 m

Classification: Low

4.5 SEA DISPOSAL

4.5.1 Strategic Considerations

Operational Feasibility

Operationally disposal at the Oxcars site is comparatively simple as it does not require the landing, storage and drying of the spoil and all the necessary procedures are understood. As this is the present discharge route for the ongoing maintenance dredge operations at the Port of Rosyth, it has been proven as practicable and all the necessary procedures are understood and logistical arrangements in place.

Classification: High

(1) Estimated cost based on consultation with HGV operator at £50/hour for two hours per load.

Availability of Sites / Facilities

The sites/facilities which are required for the sea disposal option are those which are already used. No other disposal sites have been indicated by Forth Ports as available at this time for the dredged material from the Port of Rosyth.

Classification: High

Security of Option

Forth Ports will have full control over all stages in the dredging and disposal process assuming they receive a disposal licence.

Classification: Medium to High

Established Practice

Disposal at the Oxcars licenced disposal site is the current practice for the disposal of the dredged spoil from the Port of Rosyth. It is, therefore, established and proven as effective.

Classification: High

General Public Acceptability

Forth Ports has confirmed that similar disposal operations from other ports and harbours in the Firth of Forth and Forth Estuary have not attracted any appreciable comment. Dredging operations are unlikely to affect members of the general public, with the possible exception of some recreational users when the vessel is transiting to and from the disposal site.

Classification: High

Likely Agency Acceptability

Informal consultations with the regulatory bodies and other interested parties did not identify any objections to Sea Disposal at Oxcars Responses to consultation letters were received from Fife Council, NatureScot, the Maritime and Coastguard Agency, the National Lighthouse Board and the Crown Estate Scotland (see Appendix C). Formal consultations will be undertaken by Marine Scotland following submission of the Marine License application.

Classification: Medium to High

Legislative Implications

A Marine Licence will be required from Marine Scotland and provided that the BPEO is satisfactory, and the statutory consultees do not object, it is established practice that a Marine Licence will be issued. Compliance should not therefore demand significant management control. Permission will be required from Crown Estate Scotland for disposal of spoil to Crown Estate Scotland owned sea bed.

Classification: Medium to High

4.5.2 Health, Safety and Environmental Considerations

Public Health

The risk of members of the general public being exposed to contamination from the dredged material is regarded as low. Commercial species of demersal fish are not taken from the area and no food chain links between sediment contamination or contamination liberated into the water column, and human consumers leading to impacts on public health are considered likely.

Classification: Medium to High

Safety

The operations are undertaken at sea, therefore members of the public are not likely to be exposed to risk from the disposal activities. The contractor appointed to undertake the dredging and disposal may be subject to a health, safety and environmental audit by Forth Ports.

Classification: High

Contamination/Pollution

The effects on water quality of the disposal operations and the potential for impacts on sediment contamination may cause the occasional exceedance of Environmental Quality Standards and failure to meet Water Framework Directive (WFD) objectives although based on current evidence this would be localised and short-term.

Classification: Medium

Ecological Impacts

The disposal operations may affect the benthic fauna in proximity to the disposal site due to suspended sediments depositing on the seabed outside the disposal site. It is anticipated that there will not be any significant impact on the Forth Estuary and Firth of Forth marine ecosystem as a whole given the scale and duration of effects. There may be some short-term effects such as displacement on migrating fish due to increased turbidity caused by the discharge of dredged material into the water column but these impacts are not predicted to cause mortality or alter the viability of populations.

Under the proposed disposal proposals, cumulative impacts with other operations are not predicted to create a significant impact to the Firth of Forth SPA, Forth Islands SPA, Outer Firth of Forth and St Andrews Bay Complex SPA, Firth of Forth SSSI, SACs farther afield or marine ecosystems.

Classification: Medium to High.

Interference with Other Legitimate Activities

The transport and disposal activities may cause some disruption to other users of the Firth of Forth and Forth Estuary, however as the operations will only be occurring for a limited period of time and are controlled directly by Forth Ports it is not anticipated that there will be any significant interference. In addition, historic operations at Oxcars have not resulted in any reported disruption to other Firth of Forth and Forth Estuary users.

Classification: High

Amenity/Aesthetic

The disposal activities may cause some short-term disruption to other users of the Forth Estuary and Firth of Forth but the proposals will contribute to the normal functioning of the Port of Rosyth and maintain its capacity to provide access to the Navy Dockyard.

Classification: Medium to High

4.5.3 Cost Considerations

There would be no capital required to purchase new equipment. Operational costs for the operation of the dredger to dredge up to 400,000 m^3 per annum are approximately £0.5 to £1 m depending on requirements.

Classification: High

5. SUMMARY OF THE BPEO

5.1 INTRODUCTION

This section summarises the assessment of options against the criteria described in *Chapter 2*: *Table 2.1* and identifies the BPEO.

5.2 COMPARISON OF OPTIONS

Seven options were initially considered for the disposal of the dredged spoil from the Port of Rosyth. These were reduced to a short-list of four options based on practicality. A summary of the key considerations with regard to each of the four short-listed options is provided below and illustrated in *Table 5.1.*

5.2.1 Coastal Reclamation and Construction Fill

Operationally coastal reclamation and construction fill would be possible. The sediment is primarily sandy mud, with some gravel fractions with low compressive strength properties, making it unsuitable for most types of construction. In addition, the presence of some metals and PAHs classes it as non-hazardous (1) rather than inert which restricts its suitability for application on land.

Currently there are no significant areas of coastal reclamation planned in the Firth of Forth or Forth Estuary. The costs of this option would be high due to the requirement for construction of a landing and storage facility, a drying facility and transport costs.

5.2.2 Sacrificial Landfill

Operationally, disposal to landfill will be achievable but problematic. The dredged materials would require landing and drying in specially constructed facilities and would then require transport in sealed HGVs to an appropriate landfill site. There are limited sites available to take the material, and a full analysis of the contaminants in the material would be required by the operators before final acceptance.

Whilst small amounts of dredged sediment material are sometimes disposed of to landfill, it is not common practice and Forth Ports would not have the security of controlling the disposal route. The public and agencies are likely to find this disposal acceptable, but there may be concerns relating to transport and Scotland's Zero Waste Plan (2010) which favours a reduction in the volume of material disposed by landfill (to 5% of all wastes by 2025).

The requirement for transport will result in some safety and public health risks and interference with legitimate activities and there is low risk of ecological disturbance. There would be an increase in traffic volume due to HGV movements, along with elevated carbon dioxide emissions. The costs of this option outweigh the other short-listed options, due to the requirement for construction of a landing and storage facility, a drying facility and high transport costs.

5.2.3 Other Disposal Options and Reuse

Operationally this option would be achievable but there would be difficulties associated with the requirement to land, store, dry and transport the material. Forth Ports would have limited control over the option and it is not common practice to use marine dredged material for these purposes. It is likely to be viewed as an attractive option by the public and agencies and no legislative issues are anticipated. There would be potential for benefit through substitution of recycled material for primary minerals.

Environmental and public health and safety concerns associated with this option are linked to transport of the materials and are anticipated to be minimal. There will be no significant impact on amenity and little interference with other legitimate users. As with Sacrificial Landfill, Coastal

(1) Waste Classification (2015). Guidance on the classification and assessment of waste (1st edition 2015). Technical Guidance WM3.

Reclamation and Construction Fill, capital costs would be high because of the need for landing, storage and drying facilities and transport costs.

The mineralogical composition, low organic content and salinity of the material limit its suitability for use for brick making, as concrete aggregate or in topsoil production as it would require treatment to desalinate and decontaminate the material.

5.2.4 Sea Disposal

Operationally few problems are anticipated with disposal at Oxcars and this site is has been historically used for disposal of dredged materials from the Port of Rosyth. It is anticipated that this option will be acceptable to both public and agencies. Forth Ports would have full control over the dredging process through the appointment of contractors and risks to safety and public health are anticipated to be low.

There will be some short-term and localised effects on water quality during disposal, such as raised turbidity and suspended sediment levels, which may have slight ecological effects but these are considered to be not significant. There is unlikely to be interference with other legitimate activities and there is not anticipated to be any impact on local amenity or navigation.

5.3 IDENTIFICATION OF THE BPEO

The assessment of options highlights the major operational difficulties associated with the landfill and other use options that primarily relate to lack of available sites and facilities and the nature of the material. There are also major costs associated with the need to construct landing, storage and drying facilities at the Port of Rosyth.

The proposed disposal of dredged material at sea supports the objectives set out in Scotland's National Marine Plan and will support the planned dredging operations to safeguard the access to the Port of Rosyth and Naval dockyard and navigational safety.

Disposal at sea will keep the dredged material within the ecosystem, maintaining the sediment budget for the area. In line with guidance from Marine Scotland, the Best Practicable Environmental Option is identified as the disposal at a licensed sea disposal site. The preferred site for this is the Oxcars licenced disposal site.

Table 5.1 Summary of Assessment of Options

Consideration	Coastal Reclamation and Construction Fill	Sacrificial Landfill	Other Disposal Options and Reuse	Sea Disposal
Operational feasibility				
Availability of sites/facilities				
Security of option				
Established practice				
General public acceptability				
Likely agency acceptability				
Legislative implications				
Public health				
Safety				
Contamination/Pollution				
Ecological impact				
Interference with other activities				
Amenity / aesthetic				
Capital and maintenance costs	#			

#: Medium if pumped directly to site

Key: Performance of Options	
Low	
Low to Medium	
Medium	
Medium to High	
High	

APPENDIX A SEDIMENT SAMPLE CHEMICAL ANALYSIS

A1 PORT OF ROSYTH SEDIMENT SAMPLE DATA

A1.1 Introduction

Samples of the seabed sediments to be dredged were collected from the Port of Rosyth by Forth Ports on 4 April 2023 and were analysed by Socotec UK Ltd.

The survey plan followed the Marine Scotland guidance and was submitted to Marine Scotland for review and approved on 7th March 2023. Based on the maximum dredge volumes and dredging depths applied for, grab samples from thirteen stations were required. Sample station locations are presented in Table A1.1 and shown in *Figure A1.1*.

Table A1.1 Positions of the Rosyth 2023 Sample Stations

Sample Station	Latitude	Longitude
R23-01	56°1.406'N	3°26.658'W
R23-02	56°1.380'N	3°26.607'W
R23-03	56°1.353'N	3°26.414'W
R23-04	56°1.285'N	3°26.507'W
R23-05	56°1.159'N	3°26.570'W
R23-06	56°1.279'N	3°26.204'W
R23-07	56°1.098'N	3°26.365'W
R23-08	56°1.189'N	3°25.998'W
R23-09	56°1.047'N	3°26.097'W
R23-10	56°1.007'N	3°25.684'W
R23-11	56°0.885'N	3°25.387'W
R23-12	56°0.790'N	3°25.119'W
R23-13	56°0.674'N	3°24.983'W

Coordinates in WGS84, UTM Zone 30N, degrees decimal minutes

The grab samples retrieved from each survey station were photographed (shown in *Figure A1.2)* and subsampled on deck and stored in pre-cleaned sample containers provided by Socotec. Each sample was labelled with a unique sample ID and a field log was kept to record the sample location, date and time sample was taken. Samples were sent by overnight courier in coolboxes to the analytical laboratory. For each of the samples the following chemical analysis was undertaken.

- Metals (As, Cd, Cr, Cu, Hg, Ni, PB, Zn).
- Tributyl Tin (TBT).
- Polycyclic Aromatic Hydrocarbons (PAHs) (EPA 16).
- Total Hydrocarbon Content (THC).
- Poly Chlorinated Biphenyls (PCBs) (ICES 7).
- Sediment moisture content and sediment particle density.
- Total Organic Carbon (TOC).
- Sediment particle distribution (PSD).
- Presence of asbestos.

Marine Scotland Action Levels are discussed in Section A1.2 and the sediment sample data are presented in Section A1.3 to Section A1.8.

Figure A1.1 Sample Station Locations, Port of Rosyth 2023

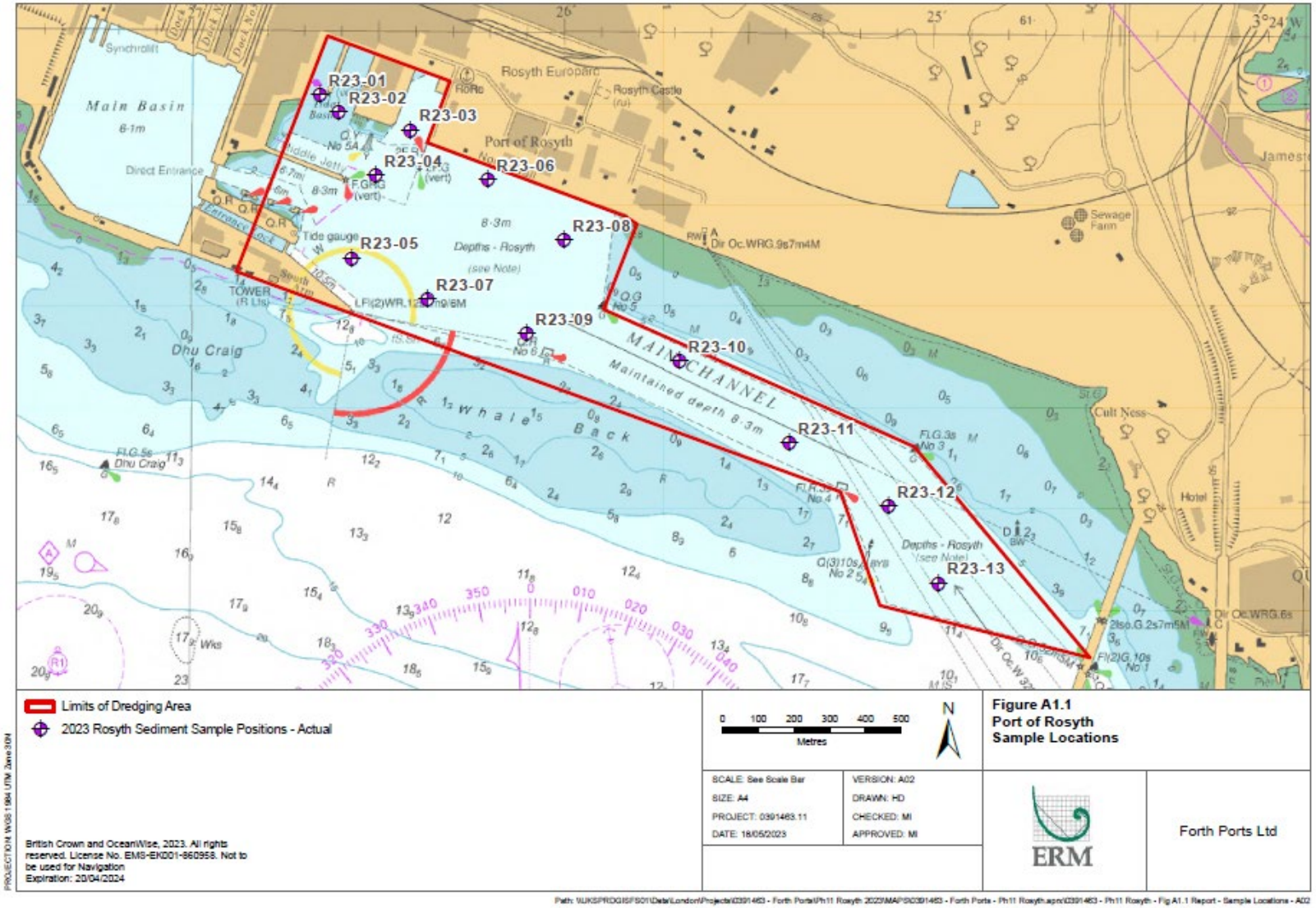


Figure A1.2 Photographs of Sediment Samples

		
R23-01	R23-02	R23-03
		
R23-04	R23-05	R23-06
		
R23-07	R23-08	R23-09

		
R23-10	R23-011	R23-12
		
R23-13		

A1.2 Marine Scotland Action Levels

Table A1.2 and *Table A1.3* set out the Action Levels for metals, PCBs, TBT and PAHs used by Marine Scotland to assess the suitability for disposal of sediments at sea.

Based on the Marine Scotland guidance contaminant levels in dredged material below Action Level 1 are generally of low concern and are unlikely to influence the licensing decision. A breach of Action Level 1 does not automatically preclude disposal at sea but usually requires further consideration before a decision can be made. Dredged material with contaminant levels above Action Level 2 is generally considered unsuitable for normal sea disposal, but may be suitable for other management options such as treatment or seabed burial/capping, unless a compelling case can be made for normal sea disposal.

Table A1.2 Marine Scotland Action Levels: Metals

Metal	AL1 (mgkg^{-1} dry weight)	AL2 (mgkg^{-1} dry weight)
Arsenic (As)	20	70
Cadmium (Cd)	0.4	4
Chromium (Cr)	50	370
Copper (Cu)	30	300
Mercury (Hg)	0.25	1.5
Nickel (Ni)	30	150
Lead (Pb)	50	400
Zinc (Zn)	130	600

Table A1.3 Marine Scotland Action Levels: PCBs, TBT and PAHs

Determinand	AL1 (mgkg^{-1} dry weight)	AL2 (mgkg^{-1} dry weight)
ICES 7 PCBs	0.02	0.18
TBT	0.10	0.50
PAHs		
Acenaphthene	0.10	
Acenaphthylene	0.10	
Anthracene	0.10	
Benz[a]anthracene	0.10	
Benzo[a]pyrene	0.10	
Benzofluoranthenes	0.10	
Benzoperylene	0.10	
Chrysene/Triphenylene	0.10	
Dibenz[a,h]anthracene	0.01	
Fluoranthene	0.10	
Fluorene	0.10	
Indenopyrene	0.10	
Naphthalene	0.10	
Phenanthrene	0.10	
Pyrene	0.10	
Total PAHs	100	

A1.3 Metal Results

Concentrations of metals are presented in *Table A1.4*. Levels above Marine Scotland Action Level 1 are highlighted in blue. No concentrations above Action Level 2 were recorded (see *Table A1.1* for Action Levels for metals).

Table A1.5 provides a comparison of metal data from samples analysed from 2000 to 2023. The ranges in results for all metals over the period for which there is available sample data are large and in the majority of cases most metal concentrations are above Action Level 1 with the mean concentration for Hg being above Action Level 2 in 2003 and the Cd and Zn concentrations of some samples being above Action Level 2 in 2017.

Table A1.4 Metal Concentrations from the Port of Rosyth (mg kg^{-1} Dry Weight) 2023

Station	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
R23-01	17.6	0.22	61.9	31.6	0.6	34.4	52.8	130
R23-02	21.2	0.18	74.2	37.4	0.68	41.1	59.6	158
R23-03	19.9	0.17	67.7	34.1	0.62	37.4	55.5	140
R23-04	18.2	0.1	63.4	31.9	0.6	34.8	51.9	134
R23-05	19.1	0.11	60.6	30.2	0.62	34.2	53.9	129
R23-06	19	0.11	63.8	31.4	0.62	35.8	54.7	134
R23-07	18	0.14	61	30.9	0.62	33.8	54.6	128
R23-08	19	0.13	62.6	30.8	0.64	34.4	58.3	131
R23-09	16.1	0.09	51.2	27	0.48	29.5	41.9	112
R23-10	16.2	0.18	49.4	26.3	0.48	29	41.4	106
R23-11	13.6	<0.04	44.6	20.7	0.46	25.2	40.4	97
R23-12	16.6	0.11	40.9	20.4	0.46	23.7	42.2	95.3
R23-13	15.7	<0.04	53.6	25	0.55	30	51.3	115
Mean	17.71	0.12	58.07	29.05	0.57	32.56	50.65	123.79
Range	13.6-21.2	<0.04-0.22	40.9-74.2	20.4-37.4	0.46-0.68	23.7-41.1	40.4-59.6	95.3-158

As = Arsenic, Cd = Cadmium, Cr = Chromium, Cu = Copper, Hg = Mercury, Ni = Nickel, Pb = Lead and Zn = Zinc.

Table A1.5 Metal Concentrations from the Port of Rosyth (mg kg^{-1} Dry Weight) 2000 to 2023

Year		As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
2000	Mean	16.5	0.2	68.0	42.5	1.2	32.1	68.3	147
	Range	16.5	0.2	68.0	42.5	1.2	32.1	68.3	147
2001	Mean	17.8	0.3	84.2	46.7	1.1	39.1	80.5	149.4
	Range	16.5-18.6	0.1-1.0	77.6-92.3	44.0-52.4	1.0-1.4	37.2-40.9	72.1-85.6	136-162
2003	Mean	18.3	0.2	78.5	57.9	1.6	35.9	89.6	156.3
	Range	13.5-21.9	0.0-1.0	51.4-105	30.9-189.9	0.9-2.6	24.7-43.4	58.2-137.5	102.5-229.7
2004	Mean	18.9	0.0	69.5	38.8	1.0	35.4	80.8	137.9
	Range	18.6-19.3	0.0	68.4-70.0	38.3-39.6	0.9-1.1	35.2-35.7	79.7-81.7	136.6-139
2007	Mean	14.7	N/A	58.7	29.4	0.6	30.0	58.9	105.9
	Range	12.5-17.0	N/A	46.3-71.6	23.8-34.8	0.4-0.7	24.6-35.3	46.6-70.2	88.4-126
2008	Mean	16.1	BDL	70.1	32.0	0.7	33.3	63.9	125.7
	Range	12.4-17.6	BDL	52.0-80.8	22.5-36.8	0.5-0.9	25.6-36.6	43.1-71.6	92.2-145
2012	Mean	16.5	0.1	65.8	38.7	1.1	31.5	73.3	135.5
	Range	16.5-16.6	0.1-0.2	65.0-66.5	37.6-40.8	1.0-1.1	31.4-31.7	69.4-76.3	133.1-137.1
2017	Mean	18.1	0.5	82.4	31.5	0.6	36.6	58.6	260.8
	Range	15.0-20.6	0.1-4.5	67.7-93.2	23.6-48.1	0.5-0.9	30.9-40.6	45.9-65.6	108.0-1,730
2020	Mean	16.46	0.32	91.61	31.44	0.65	31.91	56.05	132.5
	Range	15.2-17.8	0.13-1.86	74.6-106	24.9-42.7	0.47-0.85	26.5-38.6	44.2-72.5	104-210
2023	Mean	17.71	0.12	58.07	29.05	0.57	32.56	50.65	123.79
	Range	13.6-21.2	<0.04-0.22	40.9-74.2	20.4-37.4	0.46-0.68	23.7-41.1	40.4-59.6	95.3-158
2000-2023	**Mean**	**17.11**	**0.22**	**72.69**	**37.80**	**0.91**	**33.84**	**68.06**	**147.48**
	Range	**12.4-21.9**	**BDL-4.5**	**40.9-106**	**20.4-189.9**	**0.4-2.6**	**23.7-43.4**	**40.4-137.5**	**88.4-1,730**

BDL: Below Detection Levels. N/A: Not Applicable.

A1.4 Tributyltin

Tributyltin (TBT) is a highly toxic compound historically used as an anti-biofouling agent in paint used to coat the hulls of vessels. It is also toxic to non-target organisms and is linked to immune-suppression and imposex (1) in snails and bivalves. TBT was also used in various industrial processes as a biocide and can enter the marine environmental through effluent discharges. In some cases, TBT can also be persistent in the marine environment.

Mean dry weight concentrations of TBT from the samples collected are presented in *Table A1.6.* No samples were observed to have TBT concentrations above Marine Scotland Action Level 1 (0.1 mg kg^{-1}).

Table A1.6 TBT Concentrations (mg kg^{-1} Dry Weight) - Port of Rosyth 2023

Station	TBT Concentration
R23-01	<0.005
R23-02	<0.005
R23-03	<0.005
R23-04	<0.005
R23-05	<0.005
R23-06	<0.005
R23-07	<0.005
R23-08	<0.005
R23-09	<0.005
R23-10	<0.005
R23-11	<0.005
R23-12	<0.005
R23-13	<0.005
Mean	**<0.005**

Note: DBT was analysed for along with TBT, however there are no Action Levels for DBT. The DBT results are not reported here but have been provided in the Marine Scotland Pre-Disposal Sampling Results Form.

A comparison of TBT concentrations from samples collected in 2017, 2020 and 2023 (2) are presented in *Table A1.,* which shows that TBT concentrations are below Action Level 1 in all years.

(1) The development of male characteristics in females

(2) TBT has only been analysed for since 2017.

Table A1.7 Comparison of TBT Concentrations (mg kg^{-1} Dry Weight) - Port of Rosyth 2017-2023

Year		TBT Concentration
2017	Mean	<0.012
	Range	<0.002-0.059
2020	Mean	<0.0087
	Range	<0.005-0.0536
2023	Mean	<0.005
	Range	<0.005-<0.005
2017-2023	**Mean**	**<0.0086**
	Range	**<0.002-0.059**

A1.5 Polychlorinated Biphenyls Results

Polychlorinated biphenyls (PCBs) are organic compounds comprising a biphenyl group (composed of two benzene rings) with between one and ten bonded chlorine atoms. PCBs are highly toxic, persistent pollutants and are readily bioaccumulated in animals.

Although production in the UK ceased in the 1970s, PCBs still enter the marine ecosystem through the disposal of industrial plant, emissions from old electrical equipment and from landfill sites (1).

Dry weight concentrations of ICES 7 PCBs from samples collected in 2023 are presented in *Table A1.8*. No ICES 7 PCB levels exceed Action Level 1 (0.02 mg kg^{-1}) in any of the samples. *Table A1.9* presents a comparison of mean dry weight concentrations of ICES 7 PCBs from samples collected in 2000 to 2023.

Table A1.8 PCB Concentrations (mg kg^{-1} Dry Weight) - Port of Rosyth in 2023

Station	Sum of ICES 7 PCB Concentrations
R23-01	0.00108
R23-02	0.00104
R23-03	0.00082
R23-04	0.00097
R23-05	0.00097
R23-06	0.00083
R23-07	0.00093
R23-08	0.00073
R23-09	0.00058
R23-10	0.00058
R23-11	0.00059
R23-12	0.00068
R23-13	0.0006
Mean	**0.0008**

(1) Forth Replacement Crossing: Environmental Statement 2009. Available online from http://www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/j11223-081.htm

Station	Sum of ICES 7 PCB Concentrations
Range	**0.00058-0.00108**

ICES 7 PCB congeners (with IUPAC numbers): 28 - 2,4,4' - Trichlorobiphenyl, 52 - 2,2',5,5' - Tetrachlorobiphenyl, 101 - 2, 2', 4, 5, 5' - Pentachlorobiphenyl, 118 - 2, 3', 4, 4', 5 - Pentachlorobiphenyl, 138 - 2, 2', 3, 4, 4', 5' - Hexachlorobiphenyl, 153 - 2, 2', 4, 4', 5, 5' - Hexachlorobiphenyl, 180 - 2, 2', 3, 4, 4', 5, 5' - Heptachlorobiphenyl.

Table A1.9 Comparison of PCB Concentrations (mg kg^{-1} Dry Weight) - Port of Rosyth 2000 – 2023

Year	Mean Sum of ICES 7 PCB Concentrations (rounded to four decimal places
2000	0.0117
2003	0.0116
2004	0.0139
2012	0.0122
2017	0.0111
2020	0.0086
2023	0.0008
Range 2000-2023	**0.0008-0.0139**

ICES 7 PCB congeners (with IUPAC numbers): 28 - 2,4,4' - Trichlorobiphenyl, 52 - 2,2',5,5' - Tetrachlorobiphenyl, 101 - 2, 2', 4, 5, 5' - Pentachlorobiphenyl, 118 - 2, 3', 4, 4', 5 - Pentachlorobiphenyl, 138 - 2, 2', 3, 4, 4', 5' - Hexachlorobiphenyl, 153 - 2, 2', 4, 4', 5, 5' - Hexachlorobiphenyl, 180 - 2, 2', 3, 4, 4', 5, 5' - Heptachlorobiphenyl.

A1.6 Polycyclic Aromatic Hydrocarbons

Levels of PAHs are presented in *Table A1.10*. Levels above Marine Scotland Action Level 1 for individual PAHs (100 µg kg^{-1}) are highlighted in blue. The Total Hydrocarbon (THC) concentrations are also reported (in $mgkg^{-1}$). There are no Action Levels for THC. A comparison of mean dry weight concentrations of PAHs from samples collected between 2003 and 2023 are presented in *Table A1.11*. Levels above Marine Scotland Action Level 1 for individual PAHs are highlighted in blue.

Table A1.10 Analysis of PAHs and THC from the Port of Rosyth (µg kg^{-1} Dry Weight) 2023

PAH	Sample Station												
	R23-01	R23-02	R23-03	R23-04	R23-05	R23-06	R23-07	R23-08	R23-09	R23-10	R23-11	R23-12	R23-13
LMW													
Acenaphthene	42.9	40.5	43	27.3	27.2	40.5	33.5	36.3	41.1	32.5	41.9	32	28
Acenaphthylene	59.9	105	57.1	42.2	66.3	65.9	59.9	65.6	49.7	45.2	56.4	40.7	55.2
Anthracene	162	139	141	121	129	137	133	124	162	159	166	143	109
Fluorene	96.5	106	94.8	72.6	82.1	97.4	93.2	83.8	106	100	105	88.1	74.4
Naphthalene	211	219	219	198	205	202	242	210	316	335	279	227	173
Phenanthrene	364	314	395	279	322	378	341	305	456	398	414	325	255
HMW													
Benzo(a)anthracene	302	253	306	228	265	260	251	217	275	261	264	229	191
Benzo(a)pyrene	323	280	333	268	288	295	272	239	274	267	279	242	210
Benzo(b)fluoranthene	328	294	346	269	295	308	292	264	268	255	271	270	220
Benzo(ghi)perylene	344	311	349	293	318	326	316	284	282	278	288	263	234
Benzo(k)fluoranthene	314	285	316	261	266	301	245	225	255	224	253	221	195
Chrysene	305	262	315	235	272	276	254	223	275	260	259	239	190
Dibenzo(ah)anthracene*	46.9	46	61.5	49.9	51.8	56.6	50.6	41.5	48.6	37.5	41.6	41.4	39.2
Fluoranthene	525	461	583	390	448	497	426	380	513	428	454	416	325
Indeno(1,2,3-c,d)pyrene	289	254	304	239	257	278	246	224	230	206	234	210	196
Pyrene	623	545	650	481	546	558	541	468	629	534	552	500	399
Sum EPA 16 PAHs	4,336	3,915	4,513	3,454	3,838	4,076	3,796	3,390	4,180	3,820	3,958	3,487	2,894
Total Hydrocarbons THC	461,000	425,000	465,000	385,000	378,000	376,000	402,000	376,000	327,000	309,000	317,000	321,000	297,000

LMW = Low Molecular Weight. HML = High Molecular Weight
*: Action Level 1 is 0.1 mg kg^{-1}

Table A1.11 Comparison of PAHs from the Port of Rosyth (mg kg^{-1} Dry Weight) 2003 to 2023

Year	2003	2004	2007	2008	2012	2017	2020	2023
PAH	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
LMW								
Acenaphthene	BDL	BDL	BDL	BDL	0.046	0.029	0.053	0.036
Acenaphthylene	BDL	BDL	BDL	BDL	0.004	0.013	0.065	0.059
Anthracene	0.195	0.182	0.087	0.038	0.183	0.124	0.165	0.140
Fluorene	0.096	0.090	0.044	0.019	0.090	0.089	0.109	0.092
Naphthalene	0.262	0.263	0.194	0.052	0.273	0.221	0.245	0.234
Phenanthrene	0.491	0.465	0.236	0.100	0.473	0.290	0.402	0.350
HMW								
Benzo(*a*)anthracene	0.370	0.396	0.163	0.071	0.333	0.238	0.302	0.254
Benzo(*a*)pyrene	0.451	0.252	0.196	0.088	0.376	0.247	0.345	0.275
Benzo fluoranthenes	1.098	0.951	BDL	0.248	0.956	0.578	0.271	0.542
Benzoperylene	0.612	0.409	0.176	0.077	0.364	0.239	0.341	0.299
Chrysene/Triphenylene	0.507	0.417	0.193	0.083	0.360	0.240	0.314	0.259
Dibenz[*a,h*]anthracene*	BDL	BDL	0.0049	0.002	0.0124	0.050	0.066	0.047
Fluoranthene	0.625	0.601	0.293	0.133	0.571	0.394	0.497	0.450
Indenopyrene	0.471	0.447	0.165	0.071	0.325	0.177	0.286	0.244
Pyrene	0.747	0.708	0.362	0.157	0.686	0.440	0.596	0.540

*: Action Level 1 is 0.1 mg kg^{-1}

BDL = Below Detection Level

LMW = Low Molecular Weight. HMW = High Molecular Weight

Note only those 15 PAHs for which there are historic data are reported. Benzo fluoranthenes are the sum of Benzo(b)fluoranthene and Benzo(k)fluoranthene

A1.7 Asbestos

The presence of asbestos in the sediment was reported from one of the thirteen samples (R23-02).

A1.8 Sediment Physical Properties

The physical properties of the dredge sediment was analysed on the 13 sediment samples taken from the Port of Rosyth in 2023. Sediments comprised sandy mud and slightly gravelly sandy mud in one sample (R23-01).

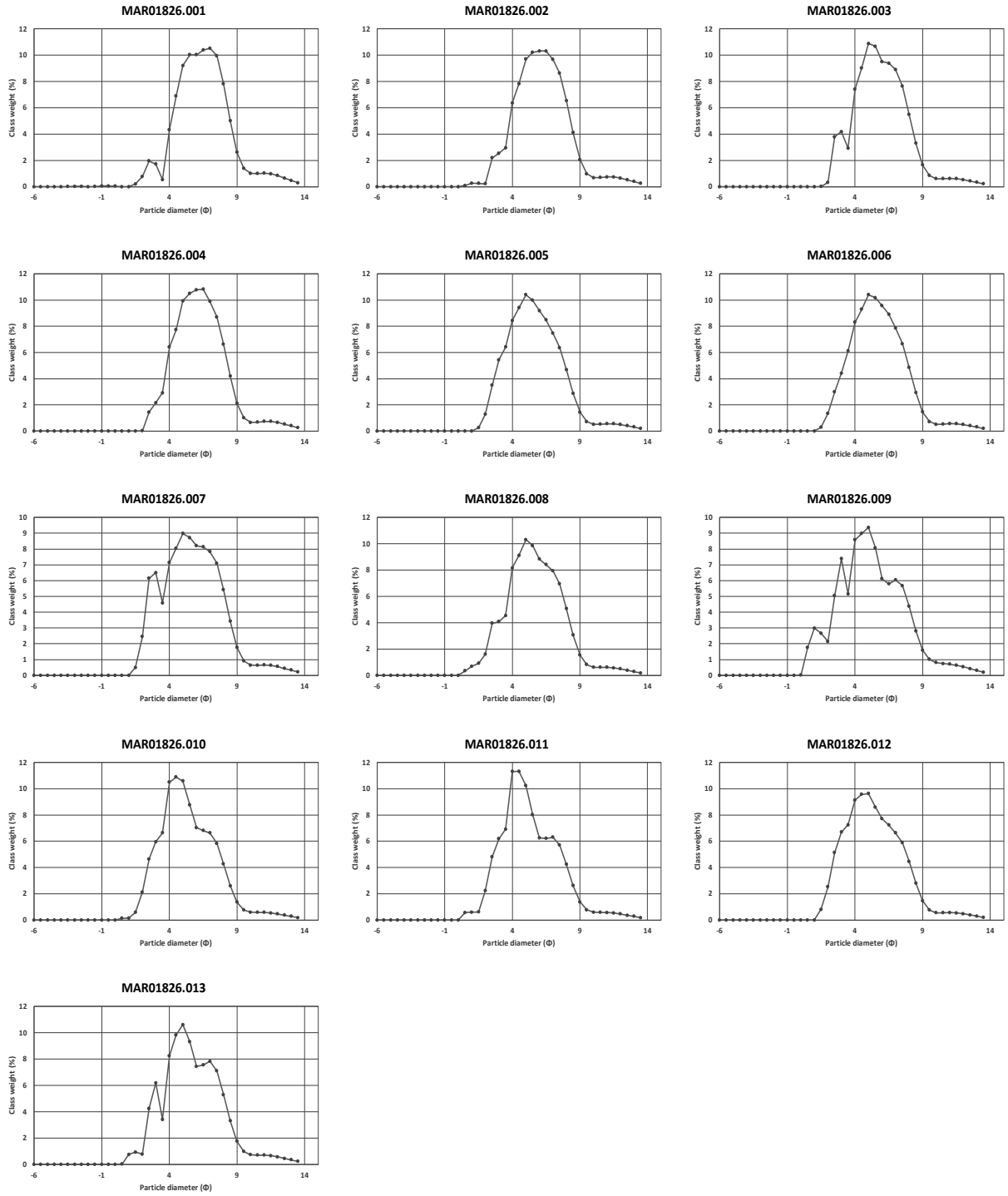
- Gravel is defined as >2 mm,
- Sand is defined as >63 µm<2 mm, and
- Mud (silts and clays) is defined as <63 µm.

Table A1.12 and Figure A1.3 present the 2023 data. Sediment contamination is typically higher in sediments less than 63 µm diameter *e.g.* silts and clays due to the increased surface area providing more adhesion sites for contaminants than the same volume of sand or gravel.

Table A1.6 Port of Rosyth 2023 Sediment Data Summary

Parameter	Sample Station												
	R23-01	R23-02	R23-03	R23-04	R23-05	R23-06	R23-07	R23-08	R23-09	R23-10	R23-11	R23-12	R23-13
Textural Group Classification	Slightly Gravelly Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud
Folk and Ward Description	Medium Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Very Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt
Folk and Ward Sorting	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted
Mean µm	13.56	17.05	20.52	16.32	24.99	23.64	25.69	23.77	33.32	29.20	30.93	29.35	23.62
Mean phi	6.20	5.87	5.61	5.94	5.32	5.40	5.28	5.39	4.91	5.10	5.01	5.09	5.40
Sorting Coefficient	1.950	1.891	1.874	1.805	1.918	1.888	2.151	1.987	2.429	2.006	2.048	2.054	2.056
Skewness	0.069	0.050	0.066	0.075	0.094	0.079	0.027	0.061	0.083	0.168	0.193	0.125	0.121
Kurtosis	1.181	1.065	1.030	1.040	0.966	0.977	0.934	1.008	1.021	0.968	0.965	0.934	0.999
Gravel (%)	0.14	0	0	0	0	0	0	0	0	0	0	0	0
Sand (%)	9.6	14.87	18.64	12.93	25.32	23.46	27.31	24.27	35.73	30.73	33.25	31.58	24.54
Mud (silts and clays) (%)	90.26	85.13	81.36	87.07	74.68	76.54	72.69	75.73	64.27	69.27	66.75	68.42	75.46
Total Organic Carbon (%)	3.72	4.36	4.23	3.6	4.4	4	4.09	5.02	3.41	3.29	3.6	3.97	3.31
Solids (%) @120°C	34.3	31.2	30.2	29.8	31	33.5	35.2	31.5	48.6	42	41.1	38.7	45.1
Density (mg m^{-3})	2.48	2.6	2.38	2.56	2.54	2.53	2.55	2.56	2.57	2.57	2.52	2.59	2.58

Figure A1.3 Port of Rosyth 2023 Sediment PSA



A2 DISPOSAL SITE SEDIMENT SAMPLE DATA

Table A1.13 presents the most recent available metal and PCB concentration data from sediment sampled from disposal site sites within the Firth of Forth and Forth Estuary. Levels above Marine Scotland Action Level 1 for metals and PCBs are highlighted in blue.

Table A1.7 Concentration of Metals and PCBs (mg kg^{-1}) from Forth Disposal sites

Site Name/Date	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	Sum ICES 7 PCBs
Oxcars 2011	11.2	0.1	42.5	22.2	0.6	22.3	153.5	92.2	0.007 (2007, n=6)
(n=6)									
Oxcars 2015	15.7	0.3	79.6	41.6	1.0	35.8	78.1	141.7	0.008
(n=3)									
Narrow Deep 2011	9.5	0.2	42.9	21.6	0.49	22.9	53.4	109.4	0.008 (n=3)
(n=6)									
Narrow Deep 2015	11.7	0.2	63.8	24.6	0.6	30.0	58.4	105.9	0.03 (n=3)
(*n=4*)									
Methil 2011	6.9	0.07	13.7	7.14	0.07	8.97	20.2	39.8	0.0004 (n=3)
(n=3)									
Methil 2015	8.7	0.1	18.0	9.6	BDL	11.2	14.5	72.8	0.003 (n=1)
(*n=1*)									
Kirkcaldy 2011	6.24	0.1	21.9	16.2	0.14	16.4	21.7	45.9	-
N=3									
Kirkcaldy 2015	8.9	0.1	43.1	17.0	0.2	22.0	30.6	62.9	0.0025 (n=3)
(*n=3*)									
Blae Rock 2007	13.4	BDL	59.7	32.4	0.8	28.2	63.9	108.6	0.008 (n=5)
n=3)									
Blae Rock 2011	17.2	0.1	39.6	21.9	0.5	21.4	52.1	80.3	0.01 (n=2)
(*n=6*)									
Bo'ness 2011	14.5	0.1	50.8	23.3	0.8	23.6	56.9	95.7	0.005 (n=3)
(n=7)									
Bo'ness 2015	18.6	0.1	59.6	26.5	0.7	27.5	54.2	114.0	0.004 (n=3)
(*n=5*)									

* Data provided by Marine Scotland (2019)

Key: n = the number of samples analysed (where known)

Note that monitoring of disposal sites is not mandatory therefore, the data presented in *Table A1.7* are the most recent data available. Metal concentrations in samples from Oxcars from 2011 and 2015 are generally lower or similar to the material dredged from the Port of Rosyth, with the exception of Pb which was high at Oxcars in 2011 (refer to *Table A1.4* for 2000 to 2023 mean metal concentrations).

APPENDIX B ENVIRONMENTAL IMPACTS OF DISPOSAL OPERATIONS

B1 INTRODUCTION

This Appendix addresses the environmental impacts of the maintenance dredging work at the Port of Rosyth and the disposal of dredged material at the licenced Oxcars disposal site. Impacts on water quality, sediment quality, and habitats and species are considered. *Table B1.1* presents the impact summary.

As the Marine Licence application is for disposal of the dredged material, impacts of the dredging activities are not addressed, other than in the context of Bathing Waters and cumulative impacts from existing and proposed dredging and disposal activities, and other activities and developments.

Potential impacts on general vessel movements and fishing due to the dredging operations and disposal operations are not considered to be significant as commercial traffic in the main channel is controlled by Forth Ports' standard operating procedures. The identification and assessment of environmental impacts of the disposal of dredged material in this Appendix follows guidance from the Environment Agency, Clearing the Waters for All [(1)].

B2 IMPACTS OF DISPOSAL

B2.1 Introduction

As described in *Section 1.3* it is proposed that up to 400,000 m^3 of material would be dredged from the Port of Rosyth and disposed at Oxcars disposal site within the Firth of Forth. The scheduling of the dredging and disposal operations will depend on operational requirements, including the requirements of vessel movements into and out of the Navy Dock. In previous years this has taken place for short periods of up to five days over between 3 and 9 months a year. Typically, dredging and disposal takes place over a period of approximately 17 to 25 days per annum. The cycle time from dredging to disposal and back to the dredging site is approximately 2 to 2.5 hours.

The material to be disposed consists primarily of sandy mud. The concentrations of contaminants are presented in *Appendix A*. Samples were taken at 13 stations (R23-01 to R23-13) and the results are summarised here.

- The mean concentrations of metals were all below Action Level 2, with mean concentrations of arsenic and cadmium below Action Level 1.
- TBT concentrations were below Action Level 1 at all stations.
- The concentration of all PCBs (sum of Ices 7 PCBs) were below Action Level 1 for all stations.
- The total PAH concentration at all survey stations was below Action Level 1. For individual PAHs, all were below Action Level 2 with the majority above Action Level 1.
- No asbestos was recorded in 12 of the 13 samples. The presence of asbestos was identified in sample R23-02

Metal and PCB concentration data from sediment sampled in the Oxcars disposal site are presented in *Appendix A* and show the concertation of some metals are above Action Level 1 but below Action Level 2, which is similar to other disposal sites within the Firth of Forth and Forth Estuary.

B2.2 Impacts on Water and Sediment Quality

There are no designated bathing waters with 2 km of the dredging area or disposal sites. The nearest is Aberdour Silversands on the north coast of the Firth of Forth which is approximately 4 km from the Oxcars disposal site.

(1)Best, M (2016). Clearing the Waters for All: WFD guidance for developers and regulators in estuarine and coastal waters. Environment Agency.

Coastal water quality in the Firth of Forth is currently Good in the outer Firth, with the exception of the area around Portobello and Musselburgh, which is classified as Poor. It is classified as Good in the lower estuary to Muirhouses and Moderate upstream in the estuary to Kincardine bridge (1).

The salinity in the Firth of Forth averages 33‰, decreasing into the Forth Estuary under the influence of freshwater inputs. Suspended solids levels are usually low, and average 3 mg l^{-1} (2). In the Firth of Forth, dissolved oxygen concentrations show little variation with depth and are approximately 90-95% but may be lower during periods of high summer water temperatures (3).

The material disposed at Oxcars will fall to the seabed by gravity and consists of cohesive lumps of dredged material. Fine sediment will be liberated as it sloughs off the descending material and when the clumps reach the seabed. Field measurements of suspended solids in surface waters following similar disposal operations indicate that less than 5% of the discharged material escapes the descending density jet (4).

The natural levels of suspended sediments in the Firth of Forth vary with seasonal weather conditions and this contributes to the natural sedimentation in the Firth of Forth. There is no available data for suspended sediment levels at the Oxcars disposal site, however, data from SEPA cited in the Transport Scotland (2009) report showed sediment concentrations from June, between 2000 and 2008 at Kincardine was 130 mgl^{-1} and from Longannet was 16 mgl^{-1}. Data available from Middle Bank, located approximately 2.3 nm downstream from Oxcars in 2008 (5) recorded the baseline mean suspended solids concentrations between 8.87 mg l^{-1} and 10.3 mg l^{-1} (mean 9.1 mgl^{-1}).

There are no data available on the concentration or dispersion of suspended solids from the disposal operations at Oxcars, however, the Forth Replacement Crossing studies (Transport Scotland 2009)[6] showed that increases in suspended sediment concentrations from dredging works were short-lived and localised (7). Comparison of mean baseline suspended solids concentrations with those recorded during dredging activities at Middle Bank indicated peak increases were approximately two and half times above background levels (1).

Increases in suspended sediments associated with the disposal operations at Oxcars are considered to be small scale in comparison with the range of suspended sediment concentrations in the Firth of Forth and will be confined to the immediate area of the disposal site. The fraction of the disposed material that suspended in the water column will disperse with the tidal currents at the disposal site and cumulative effects on water quality in the Firth of Forth from the disposal operations are not likely.

Any increase in nutrient levels may stimulate local algal production, although the effects are predicted to be short-term and confined to the immediate area of the disposal operations. Nitrogen is generally regarded to be the limiting nutrient in estuarine and marine systems and in its reduced form (ammoniacal nitrogen) is also toxic to fish. As a consequence of the reduced (oxygen demanding) nature of the seabed sediments, nitrogenous nutrients are likely to be in this form.

The oxidation of anoxic sediments released into the water column has been shown to reduce oxygen concentrations by up to 58% (8). Based on the background levels this may reduce the oxygen saturation to between 40 and 50% (equating to approximately 4 to 5 mg l^{-1}). Therefore, if the disposal operations occurred during a period of 'naturally' low dissolved oxygen it is possible that the Water Quality standards for EC Freshwater Fisheries Directive of oxygen concentration greater than 6 mg l^{-1}

(1)Water Framework Directive (WFD) Waterbody Classification 2007-2017 (SEPA)
https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=1110
(2) SEPA monitoring buoy data from Gunnet Ledge, Firth of Forth, available online from http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/gunnet-ledge/
(3) SEPA (1998). Winter Nutrient Distribution in the Firth of Forth, 1987 - 1997. Report TW 01/98, January 1998.
(4) Kennish M.J. 1992. Ecology of Estuaries Anthropogenic Effects Dredging and Dredged Spoil Disposal p357-397
(5) ERM, 2008. Middle Bank Aggregate Production Licence: Monitoring Report. A report for Westminster Gravels Ltd.
(6) Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.
(7) Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.
(8) Brown C. 1968. Observations on Dredging and Dissolved Oxygen in a Tidal Waterway. Water Resources Research Vol 4, No 6, p1381.

would not be met [1]. It is predicted that this would be short-lived, due to the limited period over which disposal is intended to occur, and localised based on previous dredge plume studies. The impacts are not considered to be significant given the generally high dissolved oxygen levels anticipated at the disposal site, the low levels of organic carbon in the dredged sediments (less than 5%) and the extent of the area potentially affected.

Although there may be some release of contaminants such as metals and PAHs into the water column during disposal operations the majority of the dredged material will descend to the seabed rapidly. Sediment bound contaminants liberated during the disposal operations will quickly become complexed with particulate matter in the water column and be re-deposited on the sea bed. Previous studies have shown that metal concentrations in the water column remained consistent following sediment disposal [1]. In addition, the natural sedimentation in the Firth of Forth aids the removal of contaminants from the water column and incorporates them in the seabed sediments.

The PAHs in the sediment comprise both low molecular weight (LMW) (two and three benzene rings) and high molecular weight (HMW) (more than 3 benzene rings) compounds. The individual PAHs that were in concentrations above Action Level 1 had both LMW and HMW PAHS, although there were higher average concentrations of HMW PAHs in all samples. PAHs tend not to be volatile and are poorly soluble and therefore readily absorb onto particulate matter in the water column and are incorporated into marine sediments. The HMW PAHs are generally less water soluble, less acutely toxic and slower to biodegrade (*i.e.,* more persistent) than the LMW PAHs.

The ratios of individual PAHs have been used to determine the likely anthropogenic source of PAHs in the environment: *e.g.* from combustion sources (pyrolytic) or petroleum hydrocarbons (petrogenic). Petrogenic PAHs are often characterised by phenanthrene to anthracene (Ph/An) values >10, whereas pyrolytic PAH from combustion processes are characterised by Ph/An ratios <10. The ratio of and fluoranthene to pyrene (Fl/Py) greater than 1 generally come from pyrolytic sources while ratios of less than 1 generally indicate petrogenic sources [2]. For all the sediment samples analysed from the Port of Rosyth in 2023 the Ph/An ratios were between 2.34 and 2.71 and the Fl/Py ratios were between 0.81 and 0.90. This suggests that these contaminants are from both combustion and petroleum hydrocarbon sources and are very similar to the results from the 2017 and 2020 sample analysis. This supports the view that recorded contamination in the sediments has been transported into the port with the accumulated sediments from the wider Forth Estuary and Firth of Forth sediment circulation system.

There was a large reduction in point source discharges of hydrocarbons and metals within the Forth Estuary and the Firth of Forth between the mid-1980s and 1990s [3]. Reduction and improved regulation of point source discharges has improved many aspects of the Forth system: inputs of organic material have declined and there has been an associated rise in dissolved oxygen during summer in the upper Forth Estuary. The rise in dissolved oxygen has led to increasing numbers of smelt caught in the upper estuary and to increasing inputs of nitrate generated by nitrification in the suspended sediment maxima of the estuary during summer. In winter, conservative mixing of nutrients is seen and there has been little change in winter nutrient concentrations in the Forth Estuary and Firth of Forth. Trace metal and trace organic inputs have been reduced so that aqueous concentrations have fallen rapidly [4]. With efforts focussed on improving the water quality of the Firth of Forth in more recent years, point source discharges have continued to decrease and the water quality of the Firth of Forth has continued to improve as a result [5].

(1) UKTAG 2010. Water Framework Directive: An approach to the Revoked Directives:- the Freshwater Fish Directive, the Shellfish Directive and the Dangerous Substances Directive. Available online from: http://www.wfduk.org/resources%20/approach-revoked-directives-%E2%80%93-freshwater-fish-directive-shellfish-directive-and-dangerous

(2)Y.W. Qiu, G. Zhang, G.Q. Liu, L.L. Guo, X.D. Li, O. Wai. Polycyclic aromatic hydrocarbons (PAHs) in the water column and sediment core of Deep Bay, South China. Estuar. Coast. Shelf Sci., 83 (1) (2009), pp. 60-66.

(3) SEPA, 1998. Trace Metals in the Forth 1986 - 1996. Available online from http://www.sepa.org.uk/science_and_research/data_and_reports/water/forth_estuary_trace_metals.aspx

(4) Dobson, J., Edwards, A., Hill, A. et al. Senckenbergiana maritima (2001) 31: 187. https://doi.org/10.1007/BF03043028

(5) SEPA, 2014. Scottish bathing waters 2013-2014. Available online http://www.sepa.org.uk/media/39125/scottish-bathing-waters-report-2013-2014.pdf

It is therefore not anticipated that the disposal operation at Oxcars will introduce significant amounts of contamination into the water column. Disposal of the dredged material may result in a localised and short term increase in the levels of some contaminants; however, the deposited sediment will disperse over time. Considering the short term, localised and intermittent increase in the levels of some contaminants in the water column will not affect the overall water body quality statuses of the Firth of Forth with respect to the Water Framework Directive.

B2.3 Impacts on Benthic Ecology

The benthic macrofaunal communities recorded in proximity to Oxcars disposal site are expected to be typical for estuarine conditions and not considered to be of high conservation significance due to the wide distribution, low diversity and lack of any rare or notable species (1).

The impact on benthic communities will depend on the comparative rates of natural deposition (currently unknown) and the deposition due to the dredging disposal operations. It is anticipated that the deposition of dredged material at the Oxcars disposal site will result in the loss (burial) of the benthos within and in the immediate vicinity of the 'deposition zone' within the disposal site. Localised impoverishment of the fauna (in terms of abundance and diversity) is likely along the axis of tidal flow as a result of secondary impacts comprising sediment deposition subsequent to the disposal activities. However, benthic communities in this area will be accustomed to a degree of sediment deposition from ongoing maintenance dredge spoil disposal operations, natural levels of suspended sediment deposition and current induced seabed sediment dispersion along the axis of tidal flow.

Given the relatively homogenous nature of benthic communities and their exposure to the naturally high levels of suspended levels during periods of low river flow and availability of similar habitat within the Firth of Forth, the spatial extent of predicted sediment related impacts to benthos (and resultant impact on prey availability for foraging seabirds) are unlikely to be significant. Dredge spoil from ports and harbours within the Firth of Forth has been deposited within the Oxcars disposal site for over 25 years and significant impacts on benthic ecology outside of the disposal site are not predicted.

B2.4 Impacts on Seabirds

The Firth of Forth Special Protection Area (SPA), Forth Islands SPA and the Outer Firth of Forth and St Andrews Bay Complex SPA are designated (2) for rare, vulnerable and regularly occurring migratory bird species.

There are three potential effects of the disposal of dredge material at sea on seabirds; increased suspended solids, release of contaminated particulates and physical disturbance of birds by the dredging vessel. These effects could potentially have a significant effect on the qualifying interests of the SPAs by reducing prey availability and disturbing bird behaviour and breeding patterns. The vessel used for disposal of the material will be travelling to and from the Port of Rosyth and the disposal site during a series of dredging campaigns lasting approximately five days each, a round trip of approximately 11 nautical miles.

The SPAs support breeding seabirds which forage over a wide area. The disposal of the dredged material will result in localised increases in suspended sediment which may reduce the ability of fish-eating birds to forage around the disposal site due to impaired visibility. However the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by.

It is noted that Oxcars is an established and long term disposal site with disposal activities being ongoing at the time that the area was designated as an SPA. Given that disposal was an existing activity and ongoing disposal is at a similar scale to previous disposal activities it is considered that the proposals will not have significant effects on the qualifying interest of the SPA.

(1) Elliot M & Kingston P F (1987). The Sublittoral Benthic Fauna of the Estuary and Firth of Forth, Scotland. Proceedings of the Royal Society of Edinburgh, 93B, pp 449-465
(2) European Communities (1979) Council Directive 79/409/EEC on the conservation of wild birds.

B2.5 Impacts on Fish

The River Teith Special Conservation Area (SAC), the Isle of May SAC and the Moray Firth SAC are designated under the Habitats Directive (1) for their habitats and fish and mammal species of European importance.

Atlantic salmon, river lamprey and sea lamprey inhabit and migrate up and down the Firth of Forth and Forth Estuary to reach spawning grounds in the River Teith SAC and may therefore pass the Oxcars disposal site. The Forth District Salmon Fishery Board has advised that smolts are likely to be passing through the lower estuary during June and July. The river lamprey grows to maturity in estuarine environments and between October and December moves into fresh water to spawn in clean rivers and streams. The sea lamprey spends most of its life at sea, only returning to freshwater to spawn around April and May.

A potential effect of disposal at sea is for increased levels of suspended solids to disturb fish migration routes and areas they occupy. The proposals are not likely to have a significant effect on grey seals for the following reasons.

- The concentration of suspended sediment at which the passage of salmonid fish is affected has been observed to be approximately 500 mg l^{-1} (2). Studies in the US, looking at a variety of salmonid species, illustrates that fatalities to smolts (50%) can occur at high suspended sediment concentrations over extended periods (*e.g.,* exposure of between 488 to 19,364 mg l^{-1} for 96 hrs) (3). The natural suspended sediment maxima in the Forth Estuary is in the upper estuary with mean concentrations over forty times higher than in the Firth of Forth (130 mg l^{-1} at Kincardine (4) and average 3 mgl^{-1} at Gunnet Ledge (5)).
- The disposal activities will take place within the main Firth of Forth which represents a small area where sea lamprey and salmon smolts may be present or may pass through. It is noted that the width of the Oxcars disposal site is between 7 and 12% of the width of the Firth of Forth at this location, which is approximately 8 km (4.3 nm) wide. The fish species will be able to avoid the area during the short periods of raised suspended sediment during disposal and migrate using an alternative route through the Firth of Forth.
- The dredging and disposal process is not continuous: the time required for one cycle (dredging - travelling - discharging - travelling) is approximately 2 hours. Additional delays to avoid interactions with other vessels are common, *e.g.*, the dredger returning from the disposal site may be instructed by Vessel Traffic Services to wait outside the harbour to allow other vessels to enter/leave. A localised, short-term and non- continuous increase in suspended sediment concentration is not anticipated to affect the migration of adult salmon, smolts or other fish species, based on the evidence of studies on the effects of suspended sediments on salmonids.

A localised, short-term and non-continuous increase in suspended sediment concentration affecting a small proportion of the width of the Firth of Forth is not anticipated to affect the migration of adult salmon, smolts or other fish species, based on the evidence of studies on the effects of suspended sediments on salmonids and the predicted suspended sediments concentrations resulting from the disposal operations.

It has been reported that Atlantic salmon numbers have been decreasing in Scotland and farther afield over the ten years from 2210 to 2019 (6), including in areas in Scotland where there have been no dredge spoil disposal operations. Forth Ports' dredge spoil disposal operations have been

(1) European Communities (1992) Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna.
(2) Redding M.J. and Schreck C.B. 1987, Physiological effects on coho salmon and steelhead of exposure to suspended solids, Transactions of the American Fisheries Society, Vol 116 pp737-747
(3) Bash J, Berman, C and Bolton S. 2001. Effects of Turbidity and Suspended Solids on Salmonids. Prepared for Washington State Transportation Commission, Department of Transportation and U.S. Department of Transportation, Federal Highway Administration
(4) Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.
(5) SEPA monitoring buoy data from Gunnet Ledge, Firth of Forth, available online from http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/gunnet-ledge/
(6) https://www.britishecologicalsociety.org/understanding-decline-atlantic-salmon-catches-scotland/#:~:text=The%20Scottish%20Government%20has%20collected,the%20previous%205%2Dyear%20average. [accessed February 2022]

ongoing at Bo'ness for over 25 years, covering the periods of much higher salmon numbers indicating that there is no causal link between the ongoing spoil disposal activities and a broad scale decline in salmon numbers. Any seasonal restrictions to operational requirements to dispose of dredged material at the Oxcars disposal site are therefore not considered to be justified.

B2.6 Impacts on Marine Mammals

The Isle of May SAC, in the outer Firth of Forth, is designated for its populations of grey seal. Grey seals forage widely and may forage at the Oxcars disposal site. Potential effects on grey seals resulting from the disposal activities are disturbance and noise due to vessel movements and disposal activities and displacement of prey species as a result of increased levels of suspended sediment at the disposal site.

The proposals are not likely to have a significant effect on grey seals for the following reasons.

- The small area of potential foraging affected by disposal activities at the Oxcars disposal site.
- The intermittent and short duration of disposal activities (typically up to five days over 3 to 9 months a year).
- The small increase in total vessel movements associated with the disposal activities in relation to total vessel movements within the Firth of Forth.
- The long term existing disposal operations in the area which pre-date the site designation.

Bottlenose dolphins are a Habitats Directive Annex II species and are resident in the Moray Firth SAC. They are infrequent summer visitors to the Firth of Forth, mainly between June and September (1).

Vessel movements and noise have the potential to disturb or displace marine mammals and disposal activities have the potential to displace prey species within and in the vicinity of the Oxcars disposal site. The proposals are not likely to have a significant effect on bottlenose dolphins for the following reasons.

- The distance between the disposal site and the SAC is large and the proportion of the bottlenose dolphin population anticipated to pass through the area affected by disposal activities is anticipated to be low.
- The extent of vessel movements associated with the disposal activities relative to total vessel movements within the Firth of Forth and Forth Estuary.
- The short duration of disposal activities each month (typically up to five days over 3 to 9 months a year).
- The relatively low speed and direct line of travel of dredge vessel movements to and from the disposal site (*i.e.,* no fast moving and erratic vessel movements).
- The long term existing disposal operations in the area which pre-date the site designation.

B2.7 Summary of Impacts

Table B1.8 presents a summary of the impacts and an assessment of significance of the impacts in relation to the sensitivity/importance of the receiving site.

(1) Evans P. G. H. Chapter 5.15 Whales, Dolphins and Porpoises. In Coasts and Areas of the United Kingdom. Region 4 South- East Scotland: Montrose to Eyemouth, ed by J H Barne, C F Robson, S S Kaznowska, J P Doody, N C Davidson and A L Buck, pp 129-132. JNCC (Coastal Directories Series).

Table B1.8 Summary of Significance of Impacts

Receptor	Impact Significance Justification	Impact Significance
Water quality at disposal site	Disposal will be periodic and sediment will descend to the seabed rapidly. Suspended sediments will disperse with the tide and any impacts will be localised and short-term.	Not Significant
Sediment quality at disposal site	Increase in the levels of some contaminants will be localised and short term and the deposited sediment will disperse within the open water system over time.	Not Significant
Benthic ecology at disposal site	Oxcars is designated as a disposal site. Disposal will occur over a relatively short period of time and similar habitat is available in close proximity to the site.	Not Significant
Seabirds	Proposed disposal operations are over a relatively short period of time each month and the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by. Both SPAs were designated after the Oxcars disposal site was designated and have not been impacted by historic and ongoing disposal operations.	Not Significant
Marine mammals and fish	Proposed disposal operations are over a short period of time and the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by. The volume of dredger vessel traffic will not be significant in relation to the existing traffic in the Firth of Forth and Forth Estuary.	Not Significant

B3 Cumulative Effects within the Firth of Forth and Forth Estuary

B3.1 Introduction

The potential impacts of the sea disposal option have been assessed within *Section B1.2* in isolation from other activities within the Firth of Forth and Forth Estuary. The impacts associated with the sea disposal option are not predicted to result in adverse effects on the integrity of the SPAs and SACs, however, it is possible that cumulative impacts with other projects could result in significant impacts.

For the purposes of this report a working definition of cumulative impacts as ‘impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions, together with the project(1) has been adopted. The assessment of potential cumulative impacts has been restricted to activities and proposed activities with the potential to directly impact the water and / or sediment quality within the SPAs and SACs. The other activities considered therefore include those that are at some distance from the activities at the Oxcars disposal site but are within the foraging range of species that may utilise both areas.

(1) European Union. Guidelines for the Assessment of Indirect and Cumulative Impacts, as well as Impact Interactions, DG XI Brussels Downloaded from http://ec.europa.eu/environment/eia/eia-support.htm

B3.2 Past and Current Activities within the Firth of Forth and Forth Estuary

B3.2.1 Introduction

The Firth of Forth and Forth Estuary has previously experienced pollution from a number of industrial sources and sewage discharges, such as the petro-chemical operations at Grangemouth and the sewage works at Seafield. The Imperial Chemical Industries (ICI) chemical plant previously based in Grangemouth is also known to have been a source of mercury into the Forth Estuary, as have the coal fired power stations, such as Longannet [(1)]. Over the past 40-50 years, however, most of these pollution sources have been controlled or eliminated altogether.

Additional improvements to sewage works and other effluent treatment plants upstream have improved the condition of the water coming down the estuary into the Firth of Forth.

In addition, there are unknown and diffuse sources of discharges into the Forth Estuary, Firth of Forth and riverine inputs to these areas, for example from agricultural run-off and unrecorded drainage outfalls.

B3.2.2 Petro-Chemicals and Power Generation

The INEOS refinery and wider petro-chemical complex at Grangemouth are historically a dominant source of oil related PAHs in the Forth Estuary and the Firth of Forth.

The Longannet coal-fired power station on the north bank of the estuary closed in March 2016 and is currently being demolished. The historic release of combustion related PAHs and mercury from this source will have contributed to the PAH and mercury loading within the Forth Estuary and Firth of Forth [(1)] [(2)]. Water from the Firth of Forth was abstracted and used as cooling water by the power station before being discharged back into the Firth of Forth.

Methil power station was a small base load coal slurry-fired power station, located on the south side of the mouth of the River Leven, where the river enters the Firth of Forth at Methil. The power station started operations in 1965 and was decommissioned in 2000, finally being demolished in 2011. Water from the Firth of Forth was abstracted and used as cooling water by the power station before being discharged back into the Firth of Forth.

Cockenzie power station was a coal-fired power station located on the southern shore of the Firth of Forth near to Cockenzie and Port Seaton. It generated electricity between 1967 and 2013, with demolition of the station completed in 2015. Water was abstracted from and discharged back into the Firth of Forth in the same way it was for Longannet and Methil.

B3.2.3 Commercial Fishing Activity

The sandeel fishery on the Wee Bankie, at the mouth of the Firth of Forth, has been closed since 2000 on seabird conservation grounds. The initial five-year period was reviewed and extended following the reduction in numbers of some seabird species observed during a 2004 count (reduced sandeel numbers may be linked) within the Firth of Forth [(3)].

Improved water quality in the Firth of Forth has led to a resumption of cockle fishing, particularly on the Fife coast. Uncontrolled cockling could impact upon wintering bird populations by causing loss of prey species, directly (removal of cockles) and indirectly (damage to non-target species). A Special Nature Conservation Order (SNCO) was implemented under the *Conservation (Natural Habitats) Regulations 1994* to the outer Firth of Forth, including Forth Bridge to Granton Harbour and from Leith

(1) Lee D.S., Nemitz, E., Fowler D., Hill P. and Clegg S. 2020. Sources Sinks and Levels of Atmospheric Mercury in the UK. DERA/AS/PTD/CR000114.
(2) Richardson D.M., Davies I.M., Moffat C.F., Pollard P. and Stagg R.M. 2001. Biliary PAH metabolites and EROD activity in flounder (*Platichthys flesus)* from a contaminated estuarine environment. J. Environ. Monit., **3**, 610-615.
(3) Marine Scotland (2012). The Distribution of Zooplankton Prey of Forage Fish in the Firth of Forth Area, East Coast of Scotland. Available online http://www.scotland.gov.uk/Publications/2012/08/2345/1 .

Docks to Joppa. This Order, implemented in March 2003, was revoked and reissued in 2006, and still stands [(1)].

B3.2.4 Other Dredging Disposal Activities

In addition to the intended maintenance dredging activities at Rosyth with disposal at Oxcars, Forth Ports manages five other dredging operations within the Forth Estuary and Firth of Forth. The operations comprise the following.

- Trailer suction dredging in Grangemouth: maximum capacity for maintenance dredging is 1,700,000 m^3 per annum, undertaken over four days every month.
- Grab/backhoe dredging at Newhaven with disposal at Oxcars disposal site: maximum capacity for maintenance dredging is 15,000 m^3 per annum, undertaken over four weeks, usually in Spring.
- Trailer suction dredging in Leith with disposal at Narrow Deep disposal site: maximum capacity for maintenance dredging is 90,000 m^3 per annum, undertaken over one to two days per month.
- Trailer suction or grab dredger Methil approach channel with disposal at Methil disposal site: maximum quantity of disposed material is 12,500 m^3. This is undertaken annually.
- Grab dredger and plough at Kirkcaldy with disposal at Kirkcaldy disposal site: maintenance dredging of approximately 5,000 m^3 undertaken annually.

The actual timing of dredging and volumes required to be dredged during each campaign depend on operational requirements and sedimentation rates (for example due to storm events, which can happen at any time of year).

Other recent, ongoing or planned licenced dredging activities in the Firth of Forth include the following (note these are based on planned or licenced activities so actual volumes dredged may be lower and dates may have been delayed due to Covid-19).

- Forth Ports currently has a planning application under consideration for the development of the Leith Outer Berth to accommodate vessels that are unable to enter the lock gates into the Port of Leith. The proposal would involve the removal of 101,000 m^3 of material from the Leith outer berth with disposal at the Narrow Deep B soil disposal ground.
- Babcock Marine at Rosyth had a Marine Licence for maintenance dredging of up to 100,000 tonnes between September 2022 and September 2023 with disposal at Oxcars B.
- Capital dredge of up to 33,800 tonnes using a plough dredger at Port Edgar within the confines of the marina between April 2021 and April 2022 with disposal to the entrance to the marina.
- Maintenance dredging at Pittenweem Harbour, with disposal of 27,334 tonnes at Anstruther spoil disposal ground between August 2019 and August 2020.
- Trailer suction and backhoe dredging with self-propelled barge at Defence Munitions Crombie, maximum quantity of disposed material is 22,000 m^3 per annum for maintenance [(2)] (although this has not been undertaken annually), with disposal at Bo'ness spoil disposal ground.
- Maintenance dredging at Granton Harbour by agitation of 5,904 tonnes per annum between August 2021 and August 2023. Previous licence to dredge 86,980 m^3 at Granton Harbour with disposal at Bo'ness or Narrow Deep spoil disposal ground between August 2019 and July 2022.
- Maintenance dredging using land-based plant of 1,200 tonnes over two years at Dysart Harbour, Fife, with disposal on the adjacent foreshore where it is dispersed on the incoming tide (July 2019 to July 2021).

(1)http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8499
(2) Rosyth International Container Terminal. Operational In-combination Assessment of Maintenance Dredging and Implications for the River Teith SAC. Jacobs, 2011.

- Capital dredging and sea disposal of 225,000 tonnes from deepening the berth pockets at one of the quays at the Fife Energy Park at Methil. The licence covered the period 10 April and 3 September 2021. Disposal of the dredged sediment material was disposed at the Narrow Deep disposal site with one load also being disposed at the Methil disposal site.

Ongoing maintenance dredging spoil disposal operations require licence renewals every three years by Marine Scotland. Potential impacts are therefore assessed and reviewed every three years prior to granting a Marine Licence. The historical disposal route for spoil from all listed dredging operations has been deposition at sea, and to date, no environmental impacts, other than direct impacts within the spoil disposal grounds, have been reported.

Work began on the Forth Replacement Crossing at the end of 2011, and capital dredging works for the bridge support foundations started at the beginning of 2012. The purpose of the dredging was to create access for the construction of the foundations for the structures which will support the new bridge. In total 180,000 m^3 of silt and sand was dredged from the seabed to form access channels for bridge foundation works between 2011 and 2016 (1) and the spoil was disposed of at the Oxcars spoil disposal ground. For the larger dredged rock material, the Blae Rock spoil disposal ground was used.

B3.2.5 Foreseeable Future Activities within and close to the Firth of Forth

There is one existing and one proposed single turbine wind farm developments in the Firth of Forth, offshore from Methil. The information provided below is based on the companies' websites.

- Levenmouth Demonstration Turbine

  The Offshore Renewable Energy (ORE) Catapult's seven megawatt wind turbine was completed in 2013 and is located 50 m from the coast connected to the land by a ramp. The tower stands at 110 m and is 195 m to the top of the blade. Samsung had previously owned the wind turbine demonstrator, before selling to ORE Catapult in December 2015.

  In March 2014 2-B Energy secured investment to fund the establishment of two full-scale test units at the site (two six megawatt turbines to be located approximately 1.5 km offshore standing at 109 m above the lowest tide, 186 m to top of blade). A marine Licence was granted in January 2017 and planning permission has been granted with a Section 36 consent variation awarded in August 2018 to operate the turbine to 2029. A scoping Report has been submitted to Marine Scotland to erect a further seven turbines. This extension would be subject to separate consenting.

- Forthwind Demonstration Project

  Forthwind has proposed to install a single turbine with a generating capacity of up to 20 megawatts and a meteorological mast 1.5 km offshore from the coast at Methil. The application replaced the previous two turbine scheme, approved in 2016. A Marine Licence and Section 36 consent was granted in March 2023.

There are three large scale offshore windfarm development sites in the outer Firth of Forth area. These sites are at some distance from Bo'ness spoil disposal ground (circa 75 to 115 km) but are within the foraging areas of the qualifying features of the SPAs and SACs. In addition, there will be power export cables laid on the seabed from the windfarm sites to coastal substations within the Firth of Forth. Other potential windfarm sites in the outer Firth of Forth area are at a concept/early planning stage. The information provided below is based on the companies' websites.

- Neart na Gaoithe Offshore Wind Farm

  NnG Offshore Wind was granted consent by the Scottish Government in 2018 to build a 448 megawatt offshore wind farm in the outer Firth of Forth comprising up to 54 wind turbines up to 208 m high occupying an area of approximately 105 km^2. Construction commenced in 2020 with

(1) Hochtief (UK) Construction (2016). Forth Road Bridge Replacement - Queensferry Crossing. Available online http://www.hochtief-construction.co.uk/bridges_Forth_Road.shtml

seabed preparations being undertaken prior to piling works. An onshore operations and maintenance base at Eyemouth received planning permission in September 2020. The wind farm is expected to be fully operational in 2023.

- Inch Cape Offshore Wind Farm

  Consent was granted for the proposed Inch Cape Offshore Wind Farm, located 15 km off the Angus coast, in October 2014. Consent was delayed following an objection lodged by the Royal Society for the Protection of Birds and final approval was given in 2017. A revised scope of design was granted by Scottish Ministers in June 2019. This scope reduced the number of wind turbine generators from 110 to 72. The turbines will occupy an area of 150 km^2. The windfarm will connect to the National Grid at Cockenzie. Once fully operational the wind farm will have an export capacity of approximately 1,000 megawatts. The Port of Dundee has been selected to be the site for pre-assembly and marshalling of the wind turbines.

- Seagreen Offshore Wind Farm

  Scottish and Southern Electric (SSE) and Fluor joint venture partnership Seagreen Wind Energy was awarded the exclusive development rights for the Firth of Forth Zone by Crown Estate Scotland. The zone covers an area of 2,852 km^2 in the outer Firth of Forth. Seagreen was awarded consent by the Scottish Government in October 2014 to develop the northern part of the Firth of Forth Zone to generate up to 1,050 megawatts of power from up to 150 turbines. The design was updated and approved in 2018 to comprise fewer, larger wind turbines. Currently the plan is for 1075 MW from 114 turbines which are currently under construction and are expected to be installed through 2023. The power will be exported by cable to Carnoustie in Angus. Montrose port is the preferred location for the operations and maintenance base and the export cable will go to Dundee. A further phase of 36 turbines in proposed with the export cable going to Cockenzie.

B3.3.3 Conclusions

Potential cumulative impacts associated with the above activities can be broadly categorised as comprising suspension of sediments during dredge spoil disposal operations resulting in loss or smothering of benthos, the discharge of contaminants with the potential to impact both water and sediment quality, and the disturbance to seabirds and mammals from piling operations and vessel movements.

In addition to the dredged material from Rosyth, the Rosyth Navel Dockyard has a current Marine Licence to dispose of up to 114,037 wet tonnes (approximately 87,750 m^2) at Oxcars by September 2023 and there is a current Marine Licence for dredged material from Newhaven (maximum 15,000 m^3 per annum). None of the other dredging operations listed in *Section B3.3* dispose of dredged material at Oxcars disposal site. Other dredging and disposal activities and the windfarm construction activities are at some distance from the Oxcars disposal site and no significant cumulative impacts from suspended sediments, noise and other vessel movements from these activities on the Oxcars site are considered likely.

The dredge spoil disposal operations at the Oxcars disposal site pre-date the SPA and SAC designations and there is no evidence to suggest that the past and current disposal operations at Oxcars disposal site managed by Forth Ports have impacted the integrity of designated sites, supported species, or resulted in other significant environmental impacts either alone or cumulatively with other activities in the area.

APPENDIX C CONSULTEE RESPONSES (EXTRACTS FROM LETTERS/EMAILS RECEIVED)

1 SNH

Port of Rosyth and its approach channel have been dredged annually since at least 1997. In May 2014 you [Marine Scotland] carried out an appropriate assessment in relation to several Natura sites, and concluded that dredging would not adversely affect the integrity of these sites. We support this conclusion. However, since 2014 the Outer Firth of Forth and St Andrews Bay Complex has now progressed to become a Special Protection Area (SPA). As such it gains full policy and legal protection. You [Marine Scotland] therefore need to consider this new site through appropriate assessment. Based on the information provided, and our own appraisal, our view is that the proposal will not adversely affect the integrity of the site.

Keith Dalgleish, Area Officer, Forth

2 NLB

Northern Lighthouse Board has no objections to the proposed dredging and/ or disposal of dredged spoil to the charted and approved disposal site at Oxcars, and will respond formally to the Marine Licence application, however we would advise the following:

- Forth Ports Ltd issue marine safety information as considered appropriate prior to the commencement of each dredge campaign.
- Forth Ports Ltd advise the UK Hydrographic Office (sdr@ukho.gov.uk) of any revised water depths in order that chart updates are completed.

Peter Douglas Navigation Manager

3 Crown Estate Scotland

We would have no objection to disposal of dredged material at the Oxcars site under the terms of a valid Marine Scotland licence. I have no current knowledge of alternative disposal options or re-use opportunities in the area.

Peter Galloway, Associate, Bidwells on behalf of the Crown Estate Scotland.

4 Fife Council

I can confirm that as Coast Protection Authority we have no objections to the proposals, and I can also confirm that at this time we have no plans for any beach nourishment / reclamation projects along the Fife coastline for beneficial re-use of the material.

Nicholas Williamson, Consultant Engineer, Flooding, Shoreline & Harbours, Fife Council, Assets, Transportation and Environment

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