Port of Grangemouth Maintenance Dredge Disposal

Best Practicable Environmental Option Report for 2025 Marine Licence Application

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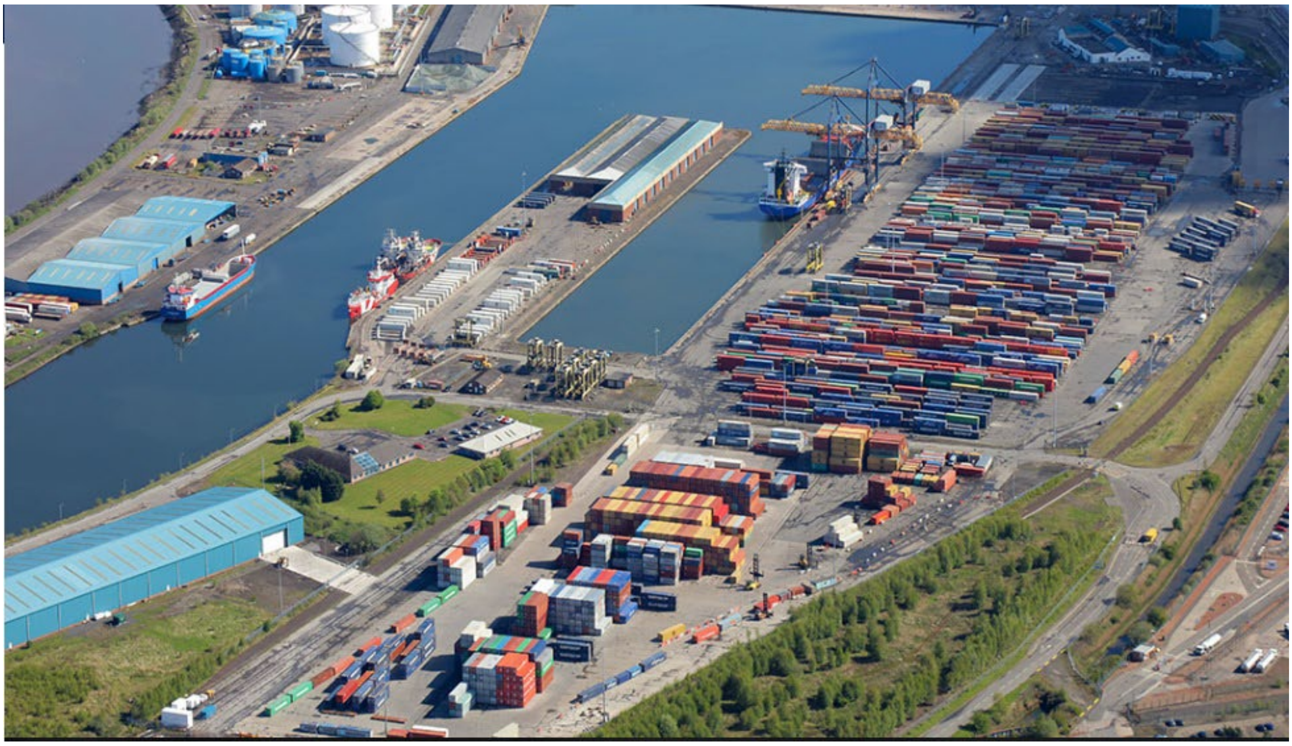

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1.1 BACKGROUND

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 the disposal of dredged sediments at sea from maintenance dredging activities at the Port of Grangemouth.

Under the *Marine (Scotland) Act, 2010,* Section 21(1), a Marine Licence issued by the Marine Directorate [(1)] is required for the deposit of substances or objects within waters adjacent to Scotland. Under Part 4, Section 27(2), the Marine Directorate 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 Practicable Environmental Option (BPEO) [(2)] 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 Grangemouth and identifies the BPEO.

Marine Licences for maintenance dredge spoil disposal activities are valid in Scotland for up to three years [(3)]. Forth Ports currently has a maintenance dredge disposal licence (MS-00010017) to maintain a safe navigable depth which expires on 31 January 2026. This application is therefore expected to cover dredge spoil disposal operations from 1 February 2026 to 31 January 2029.

1.2 THE NEED FOR DREDGE SPOIL DISPOSAL

The Port of Grangemouth is located on the south bank of the Forth Estuary; adjacent to the Grangemouth petrochemical complex where the principal cargos handled include:

- containers;
- grain and dry bulks;
- liquid bulks;
- oil and gas; and
- paper and forest products.

The entrance to the port is accessed from the Bellmouth, through lock gates and into the docks. The Bellmouth is protected by open piled lead-in jetties.

The Bellmouth lies immediately west of the Kinneil mudflats and east of the Skinflats mudflats. The resuspension of sediment from a variety of sources within the Firth of

1. Formerly named Marine Scotland. Guidance and standards produced by Marine Scotland are now referenced to the Marine Directorate in this report.
2. 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'.
3. Marine (Scotland) Act 2010, Part 4 Marine Licencing. General Guidance for Applicants. Available online http://www.scotland.gov.uk/Resource/0043/00435338.pdf

Forth and Forth Estuary, the action of the waves on the mudflats and turbulence created by the movement of the tide against the west lead-in jetty contribute to the movement of suspended sediments into the Bellmouth area (1). This causes the Bellmouth area to silt up and, if the maintenance dredging did not take place, the Bellmouth would silt up at a rate of approximately two metres per month, rapidly becoming un-navigable (2). To maintain access to the port, Forth Ports requires to dredge the Bellmouth area monthly.

Within the port, water is pumped in from the Forth Estuary to maintain a static dock level resulting in an accumulation of sediment over time within the port. An estimated 20,000 m^3 of silt accumulates within the locks and port annually and requires periodic dredging (in addition to the material from Bellmouth area) to maintain the passage through the channels to the docks (3).

In line with Section 13 of *Scotland's National Marine Plan (Marine Planning Policy Transport 4*), the dredging operations and disposal of the dredged material will continue to maintain and support the sustainable development of the Port of Grangemouth. The maintenance of the Port of Grangemouth is essential to enable it to continue to operate as Scotland's largest container port by allowing large vessels to safely navigate the shallower waters of the Forth Estuary, in turn supporting the national economy.

Forth Ports undertakes routine dredging at the Port of Grangemouth and requires the disposal of up to 1,700,000 m^3 of material per annum. Should Forth Ports consider the 'Do Nothing' option, and not undertake the maintenance dredging operations, a navigable depth would not be maintained. Consequently, this means the Port of Grangemouth would not be able to service current vessels, the economy of the local area would decrease, and there would be a wider national effect as organisations reliant on vessels accessing the Port of Grangemouth would not be able to sustain normal operations. Given Forth Port's statutory duty as the Harbour Authority to ensure safe navigation, there is an ongoing requirement for maintenance dredging and the need for disposal of the dredged material, therefore the do-nothing option is not considered further in this BPEO.

1.3 PREVIOUS MAINTENANCE DREDGE SPOIL DISPOSAL ACTIVITIES

The Port of Grangemouth has been dredged since the 1910s on a continual basis with Forth Ports taking over the port in the late 1960s. To maintain access to the Port of Grangemouth, Forth Ports previously dredged the Bellmouth area from Monday to Friday, early morning to late evening for 48 weeks of the year. Between 1967 and 2000 this was mainly undertaken using the trailing suction dredger *Abbotsgrange* or a chartered suction trailer dredger if the *Abbotsgrange* was not available.

Since January 2001, Forth Ports have contracted United Kingdom Dredging (UKD) for the majority of operations within the Forth Estuary. The *UKD Marlin* (Figure 1.1) is a trailing

(1) HR Wallingford, Forth Ports Siltation and Dredging Study, 1998.

(2) Forth Ports Ltd Pers Comm

(3) Forth Ports Ltd Pers Comm

suction dredger, with a hopper capacity of 3,000 m^3, which is double that of the *Abbotsgrange.* In addition, the smaller grab hopper dredger the Wyre Estuary may sometimes be used (see Figure 1.1).

FIGURE 1.1 DREDGE VESSEL - UKD MARLIN

Left: UKD Marlin. https://www.ukdredging.co.uk/UKD_Fleet/UKD_Marlin/

Right: Wyre Estuary. http://www.wyremarineservices.co.uk/fleet-and-equipment.html

1.4 PROPOSED DREDGE SPOIL DISPOSAL OPERATIONS

The dredging and dredged material disposal operations to maintain the Bellmouth, Eastern Channel and the Grange Dock areas currently require an average of four and a half 24-hour days per month (approximately 54 days per annum) with the *UKD Marlin* trailing suction dredger or similar sized vessel. The time required for one cycle (dredging - travelling - discharging - travelling) is approximately 1 hour and 50 minutes. There are time restrictions getting in and out of the lock and delays due to other shipping movements meaning that longer periods are required for some dredging loads.

For the current Marine Licence, issued in 2023, the Carron Dock and Western Channel, at the western end of the dock complex, were excluded from the licence application due to elevated levels of some metals in the sediments above Marine Scotland Action Levels (see *Appendix A* for explanation of Action levels) as identified in previous surveys in 2019 and 2022. In the current marine licence, one area in Grange Dock also has a dredging restriction applied by Forth Ports to avoid an area where elevated concentration of mercury was identified through sampling (no dredging is permitted within 25 m of the sample station). For the current application, Forth Ports propose to apply the same dredging restriction on the single sample station that had elevated concentrations of mercury in the 2025 survey in Grange Dock (Station G02-2025 on Figure A1.1 in *Appendix A*).

The boundary co-ordinates of the proposed dredge areas are presented in Table 1.1 and illustrated in Figure 1.3*.*

TABLE 1.1 COORDINATES OF PROPOSED DREDGE SITES AT GRANGEMOUTH

Node	Latitude	Longitude
A	56°1.382' N	3°42.140' W
B	56°1.498' N	3°42.396' W
C	56°1.665' N	3°41.852' W
D	56°1.853' N	3°41.716' W
E	56°2.015' N	3°41.753' W
F	56°2.114' N	3°41.447' W
G	56°2.296' N	3°41.395' W
H	56°2.403' N	3°40.503' W
I	56°2.280' N	3°39.899' W
J	56°2.045' N	3°41.136' W
K	56°1.657' N	3°41.598' W
L	56°1.565' N	3°41.552' W

Coordinates in WGS84, degrees and decimal minutes

It is proposed that the dredged material continues to be disposed of at sea at the existing licenced marine disposal site at Bo’ness. The Bo’ness spoil ground is situated approximately 1.5 nautical miles east of the Port of Grangemouth and has been used by Forth Ports for dredge spoil disposal from Grangemouth for over 28 years. The water depth within the spoil disposal ground ranges from 0.1 m below Chart Datum (CD) along the southern edge and increases to 17 m below CD along the northern edge. The boundary co-ordinates of the Bo’ness spoil ground are presented in Table 1.2 and illustrated in Figure 1.3*.*

TABLE 1.2 COORDINATES OF BO’NESS DISPOSAL SITE

Node	Latitude	Longitude
A	56°2.365' N	3°38.080' W
B	56°2.365' N	3°34.684' W
C	56°1.375' N	3°33.083' W
D	56°1.375' N	3°33.754' W
E	56°2.125' N	3°38.080' W

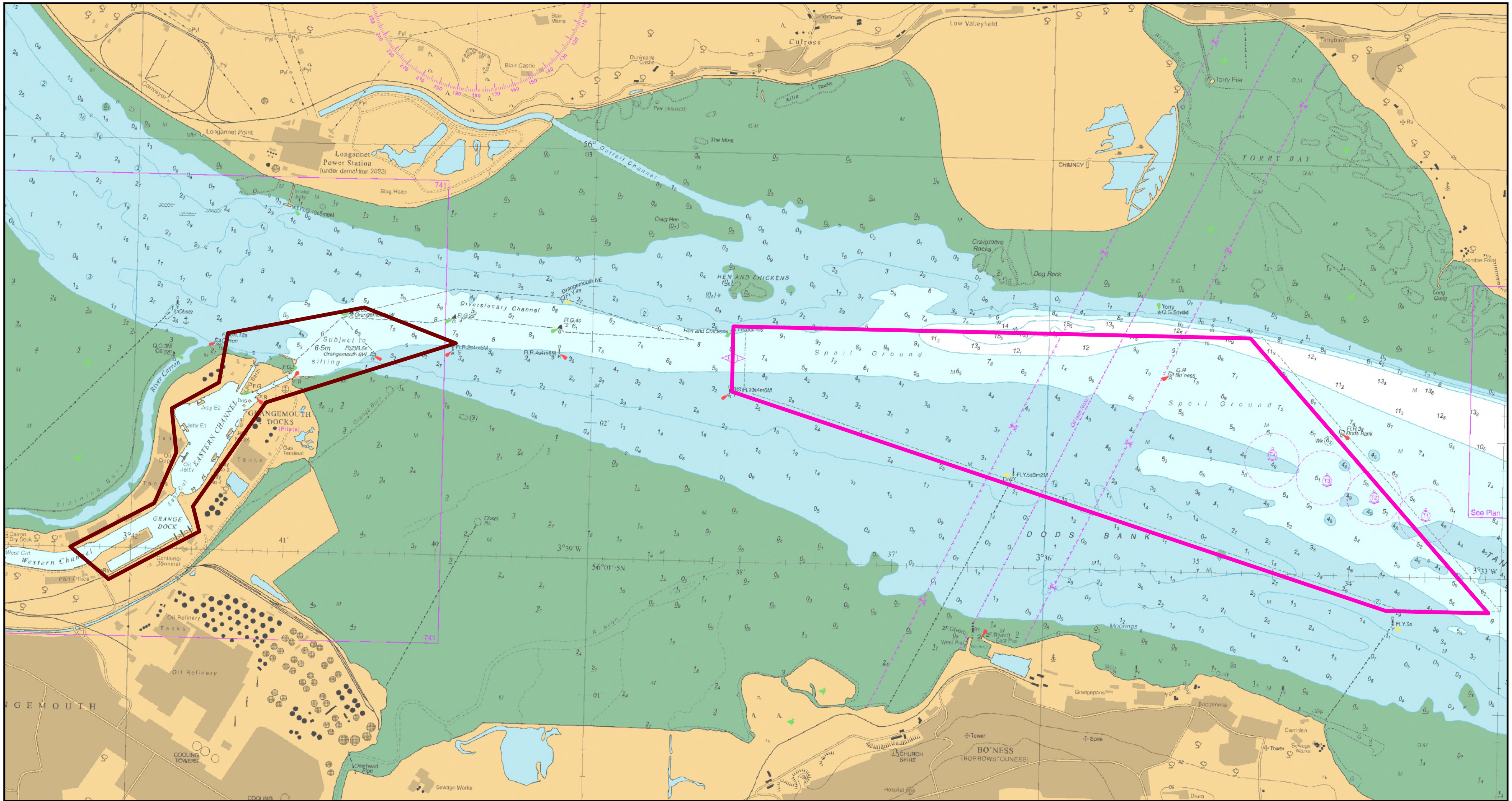
Coordinates in WGS84, degrees and decimal minutes.

The volume of dredged material deposited at the Bo’ness spoil ground from the Port of Grangemouth from 1997 to 2025 ranged from 781,967 to 1,253,600 m^3 per annum as presented in Table 1.4. Larger volumes may be required in some years due to variation in sediment deposition rates; hence a higher volume applied for than the previous maximum disposal volume. As the majority of sediments dredged annually are from the Bellmouth area, the exclusion of the Carron Dock and Western Channel from the planned dredge area has not decreased to total dredge disposal application volume.

TABLE 1.3 DREDGE SPOIL DISPOSAL AT BO'NESS SPOIL GROUND FROM GRANGEMOUTH (1997 TO APRIL 2025)

Year	Quantity (m^3)
1997	911,509
1998	921,670
1999	931,062
2000	967,801
2001	823,624
2002	781,967
2003	821,019
2004	834,131
2005	991,276
2006	801,209
2007	920,639
2008	979,537
2009	876,955
2010	808,744
2011	999,538
2012	1,084,760
2013	1,253,600
2014	1,029,611
2015	1,188,021
2016	1,231,497
2017	1,038,961
2018	987,594
2019	847,803
2020	881,917
2021	964,920
2022	857,989
2023	948,856
2024	913,913
2025 (to mid-May)	330,705

Data source: Forth Ports Ltd, May 2025



Maintenance Dredging Site

Boneless Disposal Site

0 200 400 600 800 1,000

Metres

N

Figure 1.2
Grangemouth Maintenance Dredging Site and Boneless Disposal Site

SCALE: See Scale Bar
SIZE: A4
PROJECT: 0396143
DATE: 10/04/2025

VERSION: A01
DRAWN: RW
CHECKED: MI
APPROVED: MI

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PROJECTION: British National Grid

Path: \\UKSPRDGISFS01\Data\London\Projects\0391463 - Forth Ports\MAPS\0396143 - Forth Ports.aprx\0396143 - Forth Ports - Grangemouth - Figure 1.3 - Proposed Dredge Area and Disposal Site - A01

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 27/28 January 2025 to sample the sediments within the Port of Grangemouth and the Bellmouth area.

A handheld van-Veen grab was used to take a surface sample from 13 stations within the Port of Grangemouth docks and 15 stations within Bellmouth area.

For each of the samples the following chemical analysis was undertaken.

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

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

The sediment to be dredged from the dock and Bellmouth area is material that has been deposited since previous maintenance dredging activities and is composed of soft, estuarine sandy mud with small fractions of gravel in some samples. The concentration of metals in some samples were above the Marine Scotland Action Level 1[2] but below Action Level 2, with the exception of mercury in one sample from the Grange Dock which was above Action Level 2. The mean concentrations of metals from all samples analysed were above Action Level 1 but below Action Level 2 (except for arsenic and cadmium which were below Action Level 1). TBT concentrations were above Action Level 1 in five stations sampled. PCB concentrations were above Action Level 1 in three stations sampled. Concentrations of THC most of the PAHs analysed for were above Action Level 1 for most samples.

Sediment analysis data from Bo'ness disposal site from 2011 and 2015 (the most recent data) is presented in *Appendix A,* along with data from other spoil disposal sites in the Forth Estuary and the Firth of Forth. Concentrations of metals and PCBs are found to be similar to those of other spoil disposal sites in the Firth of Forth.

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, THC and PAHs are used by the Marine Directorate to assess the suitability for disposal of sediments at sea.

1.6 SCOPE OF THE STUDY

This report provides an appraisal of available disposal options and short-lists those considered to be practicable. Options are reviewed according to the Waste Hierarchy as outlined in *Section 34* of the *Environmental Protection Act 1990* and *Waste (Scotland) Regulations 2012* [1]. The options on the short-list were then reviewed against strategic, health, safety and environmental, and cost considerations. The options were 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 short-listed disposal options.
- Section 5 identifies the BPEO.

Further supporting information is provided in the three Appendixes.

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

1. https://www.gov.scot/publications/guidance-applying-waste-hierarchy/pages/3/.

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;
  - health, safety and environmental considerations *i.e.* what the health, safety and 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.

Informal consultation by emailed letters, outlining the proposals and requesting any comments or relevant information, was undertaken with the following consultees.

- Crown Estate Scotland.
- Falkirk Council.
- Forth District Salmon Fisheries Board.
- Maritime and Coastguard Agency.
- NatureScot.
- Northern Lighthouse Board.
- Scottish Environment Protection Agency.

A summary of responses received are included in *Appendix C*. Formal consultations will be undertaken by the Marine Directorate following receipt of the Marine Licence application from Forth Ports.

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 regarding the required steps in the process and the availability of disposal sites.

2.4 ASSESSMENT OF OPTIONS

Following the preliminary appraisal, those options that were considered practicable were short-listed for a more 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 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 [(1)].
- **Ecological impact.** Assessing the significance of any potential impact on important habitats or species, including designated sites.
- **Interference with other legitimate activities**. Whether there are likely to be impacts on other activities, such as other users of the Port of Grangemouth, Forth Estuary, Firth of Forth or surrounding roads.

1.https://pubmed.ncbi.nlm.nih.gov/17027966/#:~:text=Contamination%20is%20simply%20the%20presence,not%20all%20contaminants%20are%20pollutants.

- **Amenity/aesthetic**. Assessing whether there is likely impact on local amenity *e.g.* visual, air quality 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) over the duration of the three-year licence. These are based on the maximum application volume each year. Whilst the maximum application volumes are not likely to be dredged each year, the maximum estimated costs provides a relative comparison between the options.

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) are also used where the assessment is 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 (within 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 commonly 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 the general 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 the general public to substances or activities potentially hazardous to health.
Safety	No significant safety risk to the 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 the general public and difficult to control.
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 Considerations			
Capital and maintenance	£10 m or less.	Between £10 m and £20 m.	More than £20 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 several 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:

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

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

3.2.1 LANDING THE DREDGED MATERIAL

All the land-based options require transport to on-shore facilities. This could be via a pumped discharge, conveyor or grab. As Forth Ports does not have suitable landing facilities at the Port of Grangemouth, or elsewhere within the Forth Estuary or Firth of Forth area, a new coastal landing facility would be required to enable the materials to be off-loaded.

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 to be constructed at the 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.

There are three approaches that could be used for dewatering marine sediments: construction of settling lagoons, use of a mobile centrifuge or hydrocyclone unit, and the use of a filter press, as described below.

3.2.3.1 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 site. 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.*

As some samples of the material analysed contains concentrations of metals, TBT, THC, PAHs and PCBs above Marine Scotland Action Level 1 (see *Appendix A*) 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.

3.2.3.2 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.

This is typically only an option for firmer sediments made up of fine sands and muds. If material can be dried at a rate of 150 m^3hr^{-1}, to dewater a total volume of approximately

1,700,000 m^3 would require approximately 67 weeks (operating 24 hours a day, 7 days a week). Other units with lower throughputs could take longer [(1)].

3.2.3.3 FILTER PRESS

A filter press is a tool used to separate solids and liquids using pressure. The press is filled with the dredge 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. Processing rates would be similar to that of a centrifuge.

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 treatment/disposal sites. The required infrastructure would include hard standing to allow a fleet of HGVs to be loaded by mechanical excavators. Although some areas of hard standing are available at the Port of Grangemouth, there are no storage or dewatering sites in Grangemouth.

Assuming the materials can be dried to a water content of 10% (by volume) at the Port of Grangemouth, the estimated 1,589,500 m^3 [(2)] 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 1,589,500 m^3 of dried (to 10% water content) material equates to approximately 1,827,925 tonnes [(3)]. Assuming 20 tonne capacity sealed HGVs are used, this would equate to 91,396 return trips or 182,793 vehicle movements.

The significance of the number of movements will be dependent upon the distance to the disposal/treatment site and the existing volume of HGVs on the haulage routes. The access road to the Port of Grangemouth exits onto the A904 trunk road network at the South Bridge Roundabout where the HGV counts are estimated as 385,805 HGV movements per year (based on averaged daily movements in both directions of 1,143 HGV using the latest published 2023 data [(4)]). The additional HGV movements as a result of the dredging operations would increase this current level by approximately 47% per year. The A904 /A905 enters the M9 motorway network outside Grangemouth, however there may also be local traffic issues with regard to an increase in HGV traffic flows if minor roads are used to reach disposal/treatment sites.

3.2.5 DISPOSAL/TREATMENT ISSUES

Neither method of the drying process (*e.g.* lagoons or centrifuge) is likely to reduce the concentration of metals, TBT, THC, PAHs, PCBs and salt present within the dredged

1. Maximum throughput of 120 m^3hr^{-1} http://www.euroby.com/services/mobilecontract-dewatering-units/

2 1,700,000 m^3 total spoil at 85% solids content equals 1,445,000 m^3 plus 144,500 m^3 (10% water content) equals 1,589,500 m^3.

3 Based on a weight of 1.15 tonnes per m^3 of dredge spoil.

4 Traffic counts Scotland. Data for the A904 at the South Bridge Roundabout outside the Port of Grangemouth. Latest data from 2023. https://roadtraffic.dft.gov.uk/local-authorities/30. Count point 40965. Accessed 10/06/2025.

material. This may restrict disposal and reuse options, and pre-treatment may be required 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 docks 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. Advice from the Scottish Environment Protection Agency (SEPA) (1) is that for landfill operations then a permit under the *Pollution Prevention and Control (Scotland) Regulations 2012* (PPC 2012) would be required.

Forth Ports advise that the potential to be able to find appropriate space to create settling lagoons close to the port is considered to be very low.

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 area generally comprises medium and coarse silts with the average silt content being 78.6% (range 49.4 to 90.9%). The sediment from the Port of Grangemouth is not suitable for beach recharge due to the particle size distribution and the presence of contaminants such as some metals, TBT, THC, PAHs and PCBs.

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 the Marine Directorate 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.

1 SEPA April 2025 (see summary of correspondence in Appendix C)

Guidance published by NatureScot [1] on managing coastal erosion in beach/dune systems refers 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 previous consultations regarding disposal of material dredged that it would only be appropriate to use material on a beach with a similar substrate and provided contaminant levels were not of concern.

No sites requiring beach nourishment have been identified through consultation (see *Appendix C*). Given the conservation status of the Firth of Forth, the lack of available beaches for nourishment, its particle size composition and the metal, TBT, THC, PAH and PCB contamination of the spoil, beach nourishment is not considered to be 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 the transfer of the dredged material to another vessel capable of direct pumping of the material to a shore reclamation site, or landing, storage, dewatering, possibly desalination and transport to a disposal site.

SEPA [2] advised that, where dredge spoil is used for land reclamation works then the regulation of the activity would depend on how it was constructed. For the deposition of material directly onto an intertidal area or within in a permeable bunded area, then a Marine Licence would be required. For deposition within an impermeable bunded area (*e.g* a sheet piled area) then a waste management permit (or an exemption, depending on the nature of the dredged material) from SEPA would be required.

3.4.2 SUITABLE SITES FOR RECLAMATION

Forth Ports and the coastal local authorities are the most likely bodies to be responsible for or aware of reclamation projects in the Forth Estuary and the Firth of Forth. No sites for coastal reclamation have been identified from these bodies 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 fine-grained sediments.

The spoil could be pumped into bunded lagoons at the edge of the Forth Estuary or Firth of Forth to create land that could be used for development, agricultural or other 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 Firth of Forth and the Firth of Tay. NatureScot has previously expressed the view on similar

1 Scottish Natural Heritage (2000). A Guide to Managing Coastal Erosion in Beach/dune Systems. Summary 7: Beach Nourishment.
2 SEPA April 2025 (see summary of correspondence in Appendix C).

BPEO assessments that further loss of intertidal habitats is not considered a realistic option.

3.4.3 CONSTRUCTION MATERIAL

Use of dredged material as construction fill in inland construction projects would not be appropriate because of low compressive strength properties of fine-grained sediments and the need for landing, drying and transport of the dredged material. If landing, drying and transporting the dredged material were feasible then it may be that the material could be used for quarry/landfill capping. However, the presence of some metals, TBT, THC, PAHs and PCBs in the samples and its high salt content make this option unattractive.

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, centrifugal drier or filter press would remove some of the salt, however it is likely that the 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 or Firth of Forth.

3.5.2 SUITABILITY FOR SPREADING ON AGRICULTURAL LAND

Approximately 200,000 tonnes of organic material, including 70,000 of sewage sludge, are recycled to agricultural land per annum across Scotland [(1)]. This is addition to approximately 50 million tonnes of animal manure/slurry spread on agricultural land each year. Forth Ports are seeking to dispose of approximately 1,589,500 of dewatered material (approximately 1,827,925 tonnes at 1.15 tonnes m^{-3}) of dried material per annum equating to approximately nine times the current volume of annually recycled sludge in Scotland.

As the material from the Port of Grangemouth has a low organic carbon content (an average of approximately 3.7% from the sediment sample analysis), spreading dredged material from the Port of Grangemouth on agricultural land is not considered a practicable option.

1. https://www.gov.scot/publications/review-storage-spreading-sewage-sludge-land-scotland-sludge-review-final/

The material sampled from the Port of Grangemouth has contamination from some metals, TBT, THC, PAHs and PCBs, therefore 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 in Section 3.2.5 above, it is understood that the waste would likely be classified as hazardous or non-hazardous rather than inert and therefore a suitably licensed landfill site with sufficient capacity would be 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 is currently two sites within approximately 1 hr drive from the Port of Grangemouth with the facilities to accept landfill wates. Only one, Avondale, can accept hazardous material, and both have limited capacities and are estimated to close within the Marine Licence application period [(1)].

- The Avondale Landfill at Polmont, approximately 7 km south-east of the Port of Grangemouth, has an annual capacity of 720,000 tonnes. It can accept both hazardous and non-hazardous material. By the end of 2023 it was reported that a capacity of 376,000 tonnes remained and the site was estimated to close by January 2025, however further applications for new capacity are pending decisions. Previous consultation with the operators confirmed that the site cannot accommodate dredged material due to the composition and volume not fitting with their site operations.
- West Carron Landfill, approximately 9 km west of the Port of Grangemouth, has an annual capacity of 77,400 tonnes of non-hazardous materials and by the end of 2023 it was reported to have a remaining capacity of 218,332 tonnes and was estimated to close by January 2027.

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.

1. https://informatics.sepa.org.uk/WasteSiteCapacity/ Accessed June 2025

The total organic content (TOC) of the dredged material is approximately 3.7% (based on the 2025 samples which had an average percentage of organic carbon of 3.7% and range of 1.9 to 4.8%) 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 of only 13.7% *i.e.*, 3.7% 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 contamination of some metals, TBT, THC, PAHs and PCBs. Following incineration, the leaching potential of metals would be reduced, however, the ash would still be contaminated. Pre-treatment is likely to be required for the removal of metals. Emissions to atmosphere from the incineration processes would also require to be controlled under the *Environmental Protection Act 1990.*

3.7.2 AVAILABLE INCINERATOR SITES

There were 15 operational waste incinerators in Scotland according to the SEPA report covering the calendar year 2023 (SEPA 2024) (2) processing 1.62 million tonnes of waste (mainly household wastes, sorting residues and wood wastes). No hazardous waste was incinerated in Scotland in 2023. There were no soils, mineral wastes or dredging spoils incinerated.

The nearest high temperature hazardous waste incinerator is at Ellesmere Port, Merseyside (approximately 408 km south of the Port of Grangemouth) and transport would be costly and is unlikely to be practicable. Based on 2024 data, of the 73,080 tonnes of waste material dealt with at this site there was no dredge spoil (3).

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

Re-injection would involve the construction of a pipeline to take the dredged material to a high tide point on the Kinneil mudflats and injecting it at velocity back into the mudflats. Re-injection of dredged material into nearby sedimentary areas has the advantage that it effectively returns the spoil to its source. 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 benthic fauna and associated ornithological interests that feed in the mudflats.

1. Baldovie Waste to Energy Plant, pers comm, January 2017.
2. SEPA 2024. Waste incinerated in Scotland- 2023. Official Statistics. https://data.gov.scot/sepa/waste/incinerated.html#revisions-policy. Accessed May 2025.
3. https://wikiwaste.org.uk/index.php?title=Ellesmere_Port_Incinerator. Accessed May 2025.

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 sealed into the bricks or aggregate, although there are issues with the salt content for brick making and concrete 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 or construction materials (see Section 3.2.3). 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 Grangemouth due to lack of necessary handling facilities and suitable storage areas. The salt and contaminant levels in the material to be disposed of would make using the material for brick-making, aggregates or 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 marine spoil ground in a dredging vessel. Disposal to sea is the normal practice for disposal of dredged spoil from the Port of Grangemouth and from other ports and harbours in the Forth Estuary and Firth of Forth. This approach takes place at sea and does not require the landing of any materials. It involves the dredger sailing to a licenced spoil ground and releasing the materials through bottom doors or by lowering the excavator head into the water. For the current dredgers, bottom door disposal is used.

A differential global positioning system (dGPS) would be used to position the vessel in the disposal area and record the spoil discharge locations. The time required for one cycle (dredging - travelling - discharging - travelling) from the Port of Grangemouth to the Bo’ness dredge spool disposal site is approximately 1 hour and 50 minutes. For the disposal of material from within the dock complex then cycle times may be longer due other vessels using the lock system.

3.9.2 AVAILABLE SITES

There are seven licenced marine spoil grounds 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 the Port of Grangemouth, Forth Ports propose to use the Bo’ness disposal site located approximately 1.4 nautical miles from the Port of Grangemouth. This site has historically been used for the disposal of dredged material from Grangemouth.

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

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

3.10 CONCLUSION

The description of the available options allows options that are evidently impracticable to be ruled out, for example due to the nature of the dredged material. This is summarised in Table 3.1. The assessment of the short-listed options taken forward for further consideration is presented in Section 4*.*

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 (c. 3.7%). 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 some local sites. There is 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 presence of some contaminants.	Short-list
Incineration	This option does not appear to be practicable. The material is not suited to incineration due to low organic content (c. 3.7%). 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 Grangemouth and other ports and harbours within the Forth Estuary and Firth of Forth.	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

4.2.1.1 OPERATIONAL FEASIBILITY

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

Classification: Low to Medium

4.2.1.2 AVAILABILITY OF SITES

No coastal sites within the Forth Estuary of 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

4.2.1.3 SECURITY OF OPTION

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

Classification: Low

4.2.1.4 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 mainly for dredged primary aggregate material such as sands and gravels and not dredge spoil.

Classification: Low to Medium

1. Hansom, J.D., Fitton, J.M., and Rennie, A.F. (2017) Dynamic Coast - National Coastal Change Assessment: Cell 1 - St Abb's Head to Fife Ness, CRW2014/2. https://www.dynamiccoast.com/files/reports/NCCA%20-%20Cell%201%20-%20St%20Abb's%20Head%20to%20Fife%20Ness.pdf. Accessed May 2025.

4.2.1.5 GENERAL PUBLIC ACCEPTABILITY

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

Classification: Medium

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

Classification: Medium to High

4.2.1.7 LEGISLATIVE IMPLICATIONS

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

Once the material has been removed from the Port of Grangemouth 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 may be due to the Crown Estate Scotland.

Classification: Medium to High

4.2.2 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

4.2.2.1 PUBLIC HEALTH

There may be localised and temporary deterioration in air quality as a result of intermittent increase in HGV movements.

Classification: Medium to High

4.2.2.2 SAFETY

Transferring the dredged material ashore has risks associated with operational activities. 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 to High

4.2.2.3 CONTAMINATION/POLLUTION

The 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.

Classification: Medium

4.2.2.4 ECOLOGICAL IMPACT

Ecological risks resulting from the use of dredged materials for reclamation are unlikely, 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 the creation of terrestrial habitat, then the salt levels would limit plant growth.

Classification: Medium to High

4.2.2.5 INTERFERENCE WITH OTHER LEGITIMATE ACTIVITIES

The disposal of dredged material is unlikely to interfere with other activities unless the reclamation site is in or close to port and harbour areas, in which case the dredger may interfere with other port and harbour users, or if the area to be reclaimed was used for recreation. If HGVs are used to transport the dredged material, they may affect other road users, particularly if minor roads are used.

Classification: Medium to High

4.2.2.6 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: £1.4 m per annum, £4.2 m over three years.
- Pumping material to site: approximately £17 million pumping costs (£10 per m^3 (1) for 1,700,000 m^3) per annum.

Total: £18.4 m per annum or £55.2 m over three years.

Classification: Low

If the dredged material was transported by road, the estimated costs below would apply.

- operational costs for the operation of the dredger: £1.4 m per annum, £4.2 m over three years.
- a discharge berth for the dredger with a storage facility: £3.5 m.

1 Based on previous consultation with contractors.

- lagoons to settle dredged material and possibly desalinate: £2.5 m, or a dockside centrifuge facility capable of dewatering and desalinating 1,700,000 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 £200/hour(1): £17 m per annum, £51 m over three years.

Total £61.2 m to £91.2 m over three years.

Classification: Low

4.3 SACRIFICIAL LANDFILL

4.3.1 STRATEGIC CONSIDERATIONS

4.3.1.1 OPERATIONAL FEASIBILITY

Disposal to landfill would require the landing, storage and drying of the dredged materials prior to transporting to a landfill facility. Approximately 1,827,925 tonnes of dried material would require transport. This option has practical difficulties relating to drying the dredged material and transport of material to a landfill site.

Classification: Low to Medium

4.3.1.2 AVAILABILITY OF SITES / FACILITIES

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

The nearest suitable site for potentially hazardous and non-hazardous material is located at Avondale Landfill, Polmont, approximately 7 km south-east of the Port of Grangemouth. Avondale had previously advised that it may be able to receive some of the material, however it would require a more in-depth analysis to include pH and contaminants before confirming acceptance and cost. It has been reported that the site is due to close. The West Carron Landfill, approximately 9 km from west of Grangemouth, is licensed to receive non-hazardous material and also has limited capacities. It has been reported that it is due to close within the next Marine Licence period.

Classification: Low

4.3.1.3 SECURITY OF OPTION

Forth Ports would have no control over the continued availability of landfill space for the material or the disposal route.

Classification: Low

1 Estimated cost based on consultation with HGV operator at £50/hour and estimated cost for travel and loading/unloading at £50/hour giving £200 per two-way trip.

4.3.1.4 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 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

4.3.1.5 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 by HGV from Grangemouth to potential landfill sites may be unacceptable to residents and other road users.

Classification: Medium to High

4.3.1.6 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 sites.

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

4.3.1.7 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* would 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

4.3.2.1 PUBLIC HEALTH

There may be localised and temporary deterioration in air quality because of intermittent increase in HGV movements.

Classification: Medium

4.3.2.2 SAFETY

There may be an increase in safety risks associated with the movement of materials for disposal, particularly if there are 182,793 tankers/sealed HGVs movements through populated areas and along minor roads each year.

Classification: Medium to High

4.3.2.3 CONTAMINATION/POLLUTION

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

Classification: Medium

4.3.2.4 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.

4.3.2.5 INTERFERENCE WITH OTHER LEGITIMATE ACTIVITIES

The significance of the number of movements will be dependent upon the distance to the disposal/treatment site and the existing volume of HGVs on the haulage routes. The access road to the Port of Grangemouth exits onto the A904 trunk road network at the South Bridge Roundabout. HGVs make up approximately 13.9% of all traffic at this location and traffic count data shows that there are 385,805 HGV movements per year (based on averaged daily movements in both directions of 1,143 HGV using the latest published (2023) data [(1)]). The additional HGV movements as a result of the dredging operations would increase this current level by approximately 47% per year. The A904 /A905 road enters the M9 motorway network just outside Grangemouth, however there may also be local traffic issues with regard to an increase in HGV traffic flows if minor roads are used to reach disposal/treatment sites.

Classification: Medium

4.3.2.6 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

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: £1.4 m per annum, £4.2 m over three years.
- A discharge berth for the dredger with a storage facility: £3.5 m.

1 Traffic counts Scotland. Data for the A904 at the South Bridge Roundabout outside the Port of Grangemouth. Latest data from 2023. https://roadtraffic.dft.gov.uk/local-authorities/30. Count point 40965. Accessed 10/06/2025.

- Lagoons to settle dredged material and possibly desalinate: £2.5 m, or a dockside centrifuge facility capable of dewatering and desalinating 1,700,000 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 £200/hour(1): £17 m per annum, £51 m over three years.

Total: £61.2 m to £91.2 m over three years

Classification: Low

4.4 OTHER DISPOSAL OPTIONS AND REUSE

4.4.1 STRATEGIC CONSIDERATIONS

4.4.1.1 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 1,827,925 tonnes of dried material would require transport.

There are practical difficulties relating to handling the dredged material at the Port of Grangemouth. The availability of suitable factories/facilities to process the dredged material and markets for the final products are also considerations.

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.

Classification: Low to Medium

4.4.1.2 AVAILABILITY OF SITES/FACILITIES

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

Classification: Low

4.4.1.3 SECURITY OF OPTION

Forth Ports would not have control over the continued acceptance of the materials for making bricks or aggregate.

Classification: Low to Medium

4.4.1.4 ESTABLISHED PRACTICE

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

1 Based on consultation with HGV operator: £50/hour for 4 hours for travel and loading/unload is £200 per two-way trip.

4.4.1.5 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

4.4.1.6 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 metal, TBT, THC, PAH and PCB contaminant levels in the samples would make using the material for topsoil unattractive.

Classification: Medium to High

4.4.1.7 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

4.4.2.1 PUBLIC HEALTH

There may be localised and temporary deterioration in air quality from an intermittent increase in HGV movements.

Classification: Medium

4.4.2.2 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 use of plant and manual handling of materials as well as the movement of materials, particularly if HGVs travel through settlements and along minor roads.

Classification: Medium

4.4.2.3 CONTAMINATION/POLLUTION

The contaminant levels in the dredged material would make using the material for topsoil unattractive. Pollution from plant emissions is not likely to be an issue provided emissions are controlled in accordance with licences.

Classification: Medium

4.4.2.4 ECOLOGICAL IMPACT

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

Classification: High

4.4.2.5 INTERFERENCE WITH OTHER LEGITIMATE ACTIVITIES

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

Classification: Medium to High

4.4.2.6 AMENITY/AESTHETIC

Transporting material by HGV may result in an impact to the amenities and aesthetics of the area through noise, vibration, visual impacts and road congestion.

Classification: Medium

4.4.3 COST CONSIDERATIONS

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: £1.4 m per annum, £4.2 m over three years.
- 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 a dockside centrifuge facility capable of dewatering and desalinating 1,700,000 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 £200/hour[(1)]: £17 m per annum, £51 m over three years.

Total: £61.2 m to £91.2 m over three years

Classification: Low

4.5 SEA DISPOSAL

4.5.1 STRATEGIC CONSIDERATIONS

4.5.1.1 OPERATIONAL FEASIBILITY

Operationally disposal at the Bo'ness disposal 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 Grangemouth, 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 and estimated cost for travel and loading/unloading at £50/hour giving £200 per two-way trip.

4.5.1.2 AVAILABILITY OF SITES / FACILITIES

The sites/facilities which are required for the sea disposal option at Bo'ness are already established. No other disposal sites have been indicated by Forth Ports as being preferred for the dredged spoil material from the Port of Grangemouth.

Classification: High

4.5.1.3 SECURITY OF OPTION

Forth Ports would have full control over all stages in the dredging and disposal process through its dredging contractors.

Classification: Medium to High

4.5.1.4 ESTABLISHED PRACTICE

Disposal at the Bo'ness licenced disposal site is the current practice for the disposal of the dredged spoil from the Port of Grangemouth is, therefore, established and proven as effective.

Classification: High

4.5.1.5 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 public comment. Disposal operations are unlikely to affect the general public, with the possible exception of some recreational users in the Forth Estuary when the vessel is transiting to and from the disposal site, however this would be continuing the practice that has been established over many years.

Classification: High

4.5.1.6 LIKELY AGENCY ACCEPTABILITY

Informal consultations with the regulatory bodies and other interested parties did not identify any objections to sea disposal at the Bo'ness disposal site. Responses to consultation letters were received from Crown Estate Scotland, Falkirk Council, NatureScot, Northern Lighthouse Board and the Scottish Environment Protection Agency (see *Appendix C*). Formal consultations will be undertaken by the Marine Directorate following submission of the Marine License application and Forth Ports will be required to respond to any issues raised by the Marine Directorate and its consultees.

Classification: Medium to High

4.5.1.7 LEGISLATIVE IMPLICATIONS

A Marine Licence will be required from the Marine Directorate 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 the Crown Estate Scotland for disposal of spoil to the Crown Estate Scotland owned seabed.

Classification: Medium to High

4.5.2 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

4.5.2.1 PUBLIC HEALTH

The risk of the general public being exposed to contamination from the dredged material deposited at the Bo'ness disposal site is considered to be low. Commercial species of demersal fish are not taken from the disposal area so no direct food chain links between the disposal site, fish and human consumers leading to impacts on public health are considered likely.

Classification: Medium to High

4.5.2.2 SAFETY

The operations are undertaken at sea, therefore the general public are not likely to be exposed to risk from the disposal activities. Forth Ports will have oversight of the dredging contractor's disposal operations.

Classification: High

4.5.2.3 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 objectives although based on available evidence this would be localised and short-term.

Classification: Medium

4.5.2.4 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 marine ecosystem as a whole given the scale and duration of effects.

There may be some localised and short-term effects such as displacement of migrating fish due to a short-term increase in turbidity caused by the discharge of dredged material into the water column, but these impacts are not predicted to cause mortality, significantly affect migration routes or affect 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.

The ecological impacts of disposal of dredged material to sea is addressed in *Appendix B.*

Classification: Medium to High.

4.5.2.5 INTERFERENCE WITH OTHER LEGITIMATE ACTIVITIES

The disposal activities may cause some disruption to other users of the estuary the dredging works contribute to the functioning of the Port of Grangemouth and are controlled directly by Forth Ports resulting in overall positive impacts. In addition, historic operations at Bo’ness have not resulted in any reported disruption to other Forth Estuary users.

Classification: High

4.5.2.6 AMENITY/AESTHETIC

The disposal activities may cause some short-term disruption to other users of the Forth Estuary, but the proposals will contribute to the normal functioning of the Port of Grangemouth and maintain its capacity to accommodate larger vessels.

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 are approximately £1.4 million per annum or £4.2 million over three years, depending on dredging volume 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 Grangemouth. These were reduced to a short-list of four options, based on operational and technical feasibility. 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 medium and coarse silt (sandy mud and slightly gravelly sandy mud). The fine sediment within the Bellmouth and port area has low compressive strength properties, making it unsuitable for most types of construction. In addition, the presence of some metals, TBT, THC, PAHs and PCBs in the sediments 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 therefore direct discharge from the dredger to a reclamation site is not feasible. The costs of using this material for an inland site 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 these types of sediments and a number of sites are scheduled to close within the licence period, 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 could be disposed of to landfill if there was capacity and the site would accept the material, 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). There would be a low risk of ecological disturbance.

The requirement for transport will result in some safety and public health risks and interference with other activities due to an increase in HGV traffic, along with slight elevated emission to air. 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.

5.2.3 OTHER DISPOSAL OPTIONS AND REUSE

Operationally, the option to supply the dredged material for other purposes such as brick making, construction aggregates and topsoil would be possible 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 maintenance dredged material for these purposes. It is likely to be viewed as an attractive option by the public and agencies and few legislative issues are anticipated.

Environmental and public health and safety concerns associated with this option are linked to transport of the materials and are anticipated to be low. There will be no significant impact on amenity and little interference with other legitimate users other than road users. The mineralogical composition and salinity of the material limits 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.

For other uses of the material, capital costs would be high because of the need for landing, storage and drying facilities and transport costs.

5.2.4 SEA DISPOSAL

Operationally few problems are anticipated with disposal at the Bo'ness disposal site which has been historically used for disposal of dredged materials from the Port of Grangemouth and other port and harbour areas. It is anticipated that this option will be generally acceptable to both the public and agencies, based on previous applications. Forth Ports would have full control over the disposal 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, in turn, 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 Sacrificial Landfill, Coastal Reclamation and Construction Fill, and Other Disposal Options and Reuse 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 Grangemouth, or elsewhere in the vicinity of the Port of Grangemouth.

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 Grangemouth and its navigational safety. Disposal at sea will keep the dredged material within the existing Forth Estuary sediment transport system, maintaining the sediment budget for the area. In line with guidance from the Marine Directorate, the Best Practicable Environmental Option is identified as the disposal at a licensed marine disposal site. The preferred site for this is the existing Bo'ness licenced disposal site.

TABLE 5.1 SUMMARY OF ASSESSMENT OF OPTIONS

Criteria	COASTAL RECLAMATION AND CONSTRUCTION FILL	SACRIFICIAL LANDFILL	OTHER DISPSOAL 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				
Pollution/contamination				
Ecological impact				
Interference with other users				
Amenity/aesthetic				
Cost considerations				

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

APPENDIX A SEDIMENT SAMPLE DATA

A1.1 INTRODUCTION

Samples of the seabed sediments to be dredged were collected from the Port of Grangemouth dock complex and Bellmouth area by Forth Ports on 27/28 January 2025 and were analysed by Socotec Ltd.

The sample plan followed the Marine Directorate guidance and was submitted to the Marine Directorate for review and approved on 3 December 2024. Based on the maximum dredge volumes and dredging depths applied for, grab samples from 28 sample stations were required.

Samples were taken using a van Veen grab and the sample retrieved from each survey station was subsampled on deck and stored in pre-cleaned sample containers provided by Socotec Ltd. Each sample was labelled with a unique sample ID and a field log was kept recording the sample location, date and time of the sample and a photograph of the sediment taken.

Sample station locations are presented in Table A1.1 and shown in Figure A1.1. Sediment photographs are presented in Figure A1.2.

TABLE A1.1 POSITIONS OF THE 2025 SAMPLE STATIONS

Station name	Latitude	Longitude
Grange Dock		
G01-2025	56° 1.437' N	3° 42.095' W
G02-2025	56° 1.505' N	3° 41.884' W
G03-2025	56° 1.556' N	3° 41.768' W
G04-2025	56° 1.483' N	3° 42.273' W
G05-2025	56° 1.559' N	3° 42.021' W
G06-2025	56° 1.660' N	3° 41.767' W
Eastern Channel		
G07-2025	56° 1.760' N	3° 41.664' W
G08-2025	56° 1.826' N	3° 41.576' W
G09-2025	56° 1.908' N	3° 41.511' W
G10-2025	56° 2.003' N	3° 41.389' W
G11-2025	56° 1.974' N	3° 41.567' W
G12-2025	56° 2.034' N	3° 41.445' W
G13-2025	56° 2.062' N	3° 41.356' W

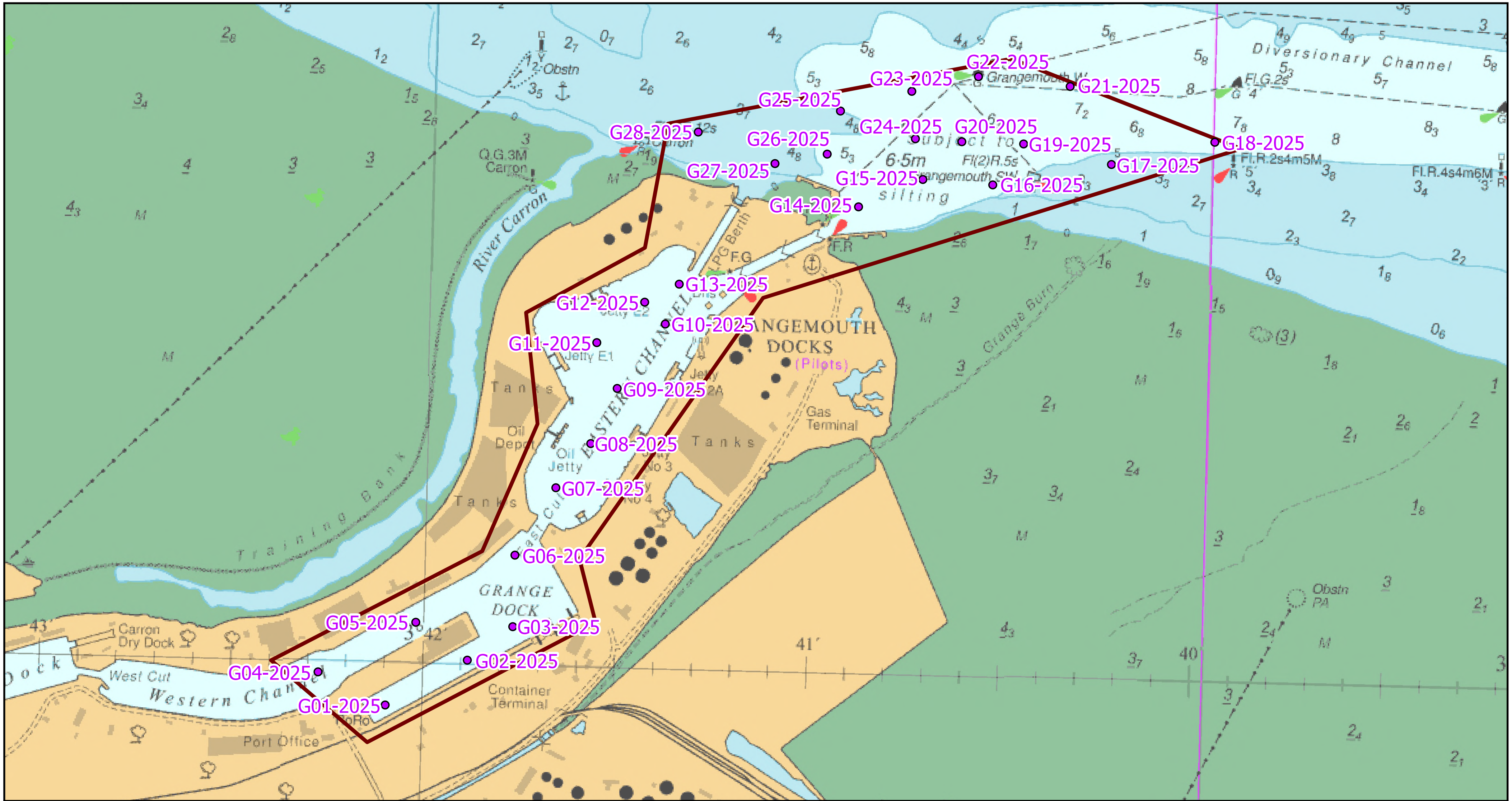
Station name	Latitude	Longitude
Bellmouth		
G14-2025	56° 2.181' N	3° 40.893' W
G15-2025	56° 2.224' N	3° 40.727' W
G16-2025	56° 2.218' N	3° 40.544' W
G17-2025	56° 2.252' N	3° 40.236' W
G18-2025	56° 2.288' N	3° 39.968' W
G19-2025	56° 2.279' N	3° 40.466' W
G20-2025	56° 2.280' N	3° 40.628' W
G21-2025	56° 2.365' N	3° 40.349' W
G22-2025	56° 2.376' N	3° 40.588' W
G23-2025	56° 2.352' N	3° 40.761' W
G24-2025	56° 2.283' N	3° 40.749' W
G25-2025	56° 2.321' N	3° 40.946' W
G26-2025	56° 2.257' N	3° 40.978' W
G27-2025	56° 2.241' N	3° 41.114' W
G28-2025	56° 2.285' N	3° 41.316' W

Coordinates in WGS84, degrees decimal minutes

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 Size Distribution (PSD).
- Presence of asbestos.

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



- Sediment Sample Position
- Maintenance Dredging Site

0 100 200 300 400 500
Metres

N

Figure A1.1
Grangemouth Surface Sediment Sample Locations

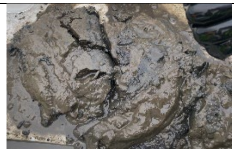
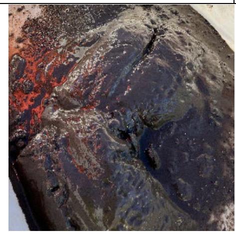
SCALE: See Scale Bar	VERSION: A01
SIZE: A4	DRAWN: RW
PROJECT: 0396143	CHECKED: MI
DATE: 13/06/2025	APPROVED: MI

ERM

PROJECTION: British National Grid

Path: \\UKSPRDGISFS01\Data\London\Projects\0391463 - Forth Ports\MAPS\0396143 - Forth Ports.aprx\0396143 - Forth Ports - Grangemouth - Figure A1.1 - Surface Sediment Sample Locations - A01

FIGURE A1.2 PHOTOGRAPHS OF SEDIMENT SAMPLES FROM THE PORT OF GRANGEMOUTH

						
G01-2025	**G02-2025**	**G03-2025**	**G04-2025**	**G05-2025**	**G06-2025**	**G07-2025**
						
G08-2025	**G09-2025**	**G10-2025**	**G11-2025**	**G12-2025**	**G13-2025**	**G14-2025**
						
G15-2025	**G16-2025**	**G17-2025**	**G18-2025**	**G19-2025**	**G20-2025**	**G21-2025**
						
G22-20255	**G23-2025**	**G24-2025**	**G25-2025**	**G26-2025**	**G27-2025**	**G28-2025**

A1.2 MARINE DIRECTORATE ACTION LEVELS

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

Based on the Marine Directorate guidance, contaminant levels in dredged material below Action Level 1 are generally of low concern and are unlikely to influence the licensing decision. Exceeding 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 DIRECTORATE ACTION LEVELS: METALS

Metal	AL1 (mg kg^{-1} dry weight)	AL2 (mg kg^{-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 DIRECTORATE ACTION LEVELS: PCBS, TBT, PAHS AND THC

Determinand	AL1 (mg kg^{-1} dry weight)	AL2 (mg kg^{-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	
Fluorene	0.10	
Naphthalene	0.10	
Phenanthrene	0.10	
Benzo[a]anthracene	0.10	
Benzo[b]fluoranthene	0.10	
Benzo[k]fluoranthene	0.10	
Benzo[a]pyrene	0.10	
Benzo[g,h,i]perylene	0.10	
Dibenzo[a,h]anthracene	0.01	
Chrysene	0.10	
Fluoranthene	0.10	
Pyrene	0.10	
Indeno(1,2,3cd)pyrene	0.10	
Total Hydrocarbons (THC)	100	

A1.3 METAL RESULTS

Concentrations of metals from the samples, along with the average and range of concentrations are presented in Table A1.4. Levels above Action Level 1 are highlighted in blue and concentrations above Action Level 2 are highlighted in red. (see Table A1.1 for Action Levels for metals).

Table A1.5 provides a comparison of metal data from samples analysed between 1988 and 2025. The ranges in results for all metals over the period for which there is available sample data are variable with the average concentrations of metals, other than arsenic (As) and cadmium (Cd), being above Action Level 1 in most years. Historically, mean mercury (Hg) levels were above Action Level 2 (1.5 mg kg^{-1}) on three occasions: 1989, 1999 and 2003.

In the current survey, concentrations of all metals were within the range observed in the previous surveys.

TABLE A1.4 METAL CONCENTRATIONS FROM PORT OF GRANGEMOUTH IN 2025

Station	Metal Concentration (mg kg^{-1} Dry Weight)							
	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Grange Dock								
G01-2025	16.4	0.36	76.5	124	1.19	38.2	103	216
G02-2025	19.2	0.36	95.9	152	2.0	63.2	94.4	202
G03-2025	11.6	0.26	56.5	65.1	0.81	31.3	59.5	166
G04-2025	14.6	0.29	73.4	120	1.32	30.9	93.4	234
G05-2025	15.4	0.22	73.4	121	1.21	35.8	78.3	208
G06-2025	14.6	0.26	61.8	97.4	0.92	32	69.8	182
Eastern Channel								
G07-2025	14.2	0.18	61.4	69.2	0.82	32	67.4	167
G08-2025	13.2	0.19	62.4	72.8	0.87	30.2	63.1	176
G09-2025	18.1	0.18	73.3	51.3	0.69	39.4	67.3	158
G10-2025	17.2	0.20	66.7	50.7	0.7	36	63.8	160
G11-2025	15.4	0.16	58.2	38.3	0.58	32.4	55.6	156
G12-2025	16.9	0.20	68.3	45.7	0.66	37.3	62.8	147
G13-2025	15.1	0.14	53.2	24.2	0.48	29.8	49.6	122
Bellmouth								
G14-2025	16.4	0.17	57.7	28.0	0.52	32.8	54.2	119
G15-2025	17.0	0.14	53.3	29.9	0.57	31	51.5	109
G16-2025	14.4	0.13	50.0	24.4	0.48	28.4	51.3	119
G17-2025	13.6	0.14	48.3	22.8	0.47	28.4	46.2	105
G18-2025	17.8	0.26	65.7	46.6	1.19	25.1	49.8	118
G19-2025	23.4	0.12	36.7	21.5	0.32	22.9	37.5	97.7
G20-2025	14.9	0.13	47.8	26.3	0.47	27.6	48.3	125
G21-2025	16.9	0.16	39.7	21.1	0.30	25.4	33.2	90.5
G22-2025	16.6	0.50	45.3	21.3	0.41	27.6	39.6	98.5
G23-2025	23.2	0.10	32.2	14.6	0.29	21.7	34.1	91.8
G24-2025	17.4	0.16	49.0	24.0	0.52	28.9	46.9	110
G25-2025	15.4	0.10	33.1	15.2	0.41	21.1	34.9	90.3
G26-2025	18.4	0.15	48.4	25.8	0.44	29.3	47.6	126
G27-2025	17.5	0.18	66.3	32.0	0.68	36.7	68.8	134
G28-2025	15.1	0.18	50.4	26.2	0.53	30.1	48	118
Mean	16.4	0.20	57.3	50.4	0.71	31.6	57.9	140.9
Range	11.6-23.4	0.10-0.50	32.2-95.9	14.6-152	0.29-2.0	21.1-63.2	33.2-103	90.3-234

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

TABLE A1.5 MEAN METAL CONCENTRATIONS FROM GRANGEMOUTH 1988-2025

Year		As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
1988	Mean	17.5	0.3	91.6	41.8	1.3	24.5	53.6	116.0
	Range	8.6-43.6	0.0-0.5	25.5-170.0	4.8-74.4	0.2-2.8	12.0-36.4	15.8-92.0	48.6-185.0
1989	Mean	13.0	0.1	120.6	65.4	1.8	29.1	72.8	173.7
	Range	0.1-29.8	0.0-0.7	19.1-211.0	8.1-94.1	0.2-3.8	9.6-36.8	23.5-93.4	69.5-337.0
1990	Mean	11.7	0.0	83.9	65.6	1.1	27.7	72.8	158.8
	Range	8.2-14.1	0.0	71.1-112.0	52.0-88.3	0.0-2.3	25.1-29.1	54.5-89.4	122.0-231.0
1991	Mean	7.7	0.5	64.8	47.5	ND	26.3	70.4	135.7
	Range	0.0-20.0	0.0-0.8	18.2-80.4	14.4-59.2	ND	10.3-34.3	37.2-83.3	84.0-156.0
1993	Mean	10.9	0.0	52.5	50.8	1.2	29.0	72.6	142.1
	Range	10.5-11.3	0.0	45.2-72.6	39.6-71.4	0.9-1.8	25.7-34.8	58.9-90.2	119.0-208.0
1994	Mean	7.2	0.1	67.1	50.6	1.2	33.0	70.5	130.7
	Range	3.6-18.1	0.1-0.1	20.4-94.6	14.6-65.8	0.3-1.6	19.6-40.3	49.1-86.8	89.4-176.0
1999	Mean	16.7	0.2	73.2	53.5	1.7	44.3	71.3	157.1
	Range	8.3-18.8	0.1-0.3	47.1-93.3	34.6-76.3	0.7-3.8	18.6-80.7	49.4-88.2	95.5-236.0
2000	Mean	14.4	0.1	67.4	47.4	1.1	30.8	63.8	124.5
	Range	3.4-17.3	0.0-0.3	11.9-102	10.9-79.9	0.0-2.0	14.2-37.8	9.3-79.9	28.9-197.0
2001	Mean	16.6	0.2	75.2	47.7	1.3	36.0	80.4	142.7
	Range	14.4-18.2	0.1-0.3	60.7-117	36.4-79.3	1.0-3.3	31.7-40.6	68.4-94.3	122.0-185.0
2003	Mean	15.8	0.2	69	48.9	1.5	33.4	74.5	144.5
	Range	14.7-17.5	0.2-0.2	62.4-80.7	41.4-63.7	1.4-1.6	30.5-37.4	67.6-84.5	127.4-181.7
2004	Mean	17.2	0.1	69.7	44.1	1.2	34.2	75.4	148.9
	Range	14.8-18.5	0.0-0.4	56.4-79.9	34.1-57.1	0.9-1.4	29.6-36.9	64.8-79.0	122.6-179.5
2006	Mean	17.3	BDL	56.7	32.2	0.5	25.9	55.2	111.1
	Range	11.4-37.3	BDL	10.7-86.9	3.0-55.6	0.1-0.7	7.6-35.9	17.5-76.8	36.1-167.6
2007	Mean	14.4	BDL	68.8	41.1	0.8	32.5	62.2	128.8
	Range	11.9-16.1	BDL	53.1-83.8	27.2-89.7	0.5-1.2	27.3-36.9	49.0-77.9	103.0-190.0
2008	Mean	15.0	BDL	72.5	41.2	0.9	36.3	69.5	142.5
	Range	14.8-15.1	BDL	69.4-75.5	34.7-47.6	0.7-1.0	34.6-37.9	65.0-74.0	127.0-158.0
2010	Mean	16.0	0.2	68.4	41.0	1.3	33.7	73.0	156.7
	Range	15.5-16.6	0.2-0.2	56.2-80.6	29.1-52.8	1.0-1.6	30.2-37.3	64.3-81.8	126.8-186.7
2011	Mean	16.6	0.2	78.5	37.4	1.2	35.4	81.3	157.9
	Range	16.4-16.8	0.2-0.2	75.8-81.3	35.7-40.2	1.1-1.2	34.4-36.9	79.9-83.6	153.5-166.2
2016	Mean	16.7	0.1	75.2	48.9	0.7	34.9	65.2	165.3
	Range	12.4-20.2	0.1-0.2	42.1-117	14.6-353	0.3-1.4	20.7-49.5	36.6-209	79.5-743.0
2019	Mean	16.9	0.3	64.2	86.8	0.9	33.0	73.6	213.7
	Range	12.5-33.2	0.1-1.2	29.0-121	15.8-326	0.2-3.1	18.5-41.3	30.0-174.0	82.3-549.0
2022	Mean	15.46	0.24	59.68	51.42	0.87	30.40	70.94	170.60
	Range	4.3-21.4	0.15-0.5	16.6-84.8	11.8-97	0.18-1.9	8.2-39.9	13.6-171	39.1-309
2025	Mean	16.4	0.20	57.3	50.4	0.71	31.6	57.9	140.9
	Range	11.6-23.4	0.1-0.5	32.2-95.9	14.6-152	0.29-2.0	21.1-63.2	33.2-103	90.3-234
1988-2025	**Mean**	**14.67**	**0.15**	**71.8**	**49.7**	**1.12**	**32.1**	**69.3**	**148.1**
	Range	**0.0-43.6**	**0.0-1.2**	**10.7-211**	**3.0-353**	**0.0-2.0**	**7.6-80.6**	**9.3-209**	**28.9-743**

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 in 2025 are presented in Table A1.6. Five stations from the Grange Dock had concentrations above Action Level 1. All samples were below Action Level 2. A comparison of data from 2003 to 2025 presented in Table A1.7. Mean concentrations of TBT from all samples above Action Level 1 (0.1 mg kg^{-1}) were recorded in 2016 and 2019.

TABLE A1.6 TBT CONCENTRATIONS FROM GRANGEMOUTH IN 2025

Station	TBT Concentration (mg kg^{-1} Dry Weight)
Grange Dock	
G01-2025	0.144
G02-2025	0.106
G03-2025	0.171
G04-2025	0.105
G05-2025	0.175
G06-2025	0.0828
Eastern Channel	
G07-2025	0.0281
G08-2025	0.0518
G09-2025	0.0184
G10-2025	0.0166
G11-2025	0.0186
G12-2025	<0.005
G13-2025	<0.005
Bellmouth	
G14-2025	<0.005
G15-2025	<0.005
G16-2025	<0.005
G17-2025	<0.005
G18-2025	0.0103

1 The development of male characteristics in females

Station	TBT Concentration (mg kg^{-1} Dry Weight)
G19-2025	<0.005
G20-2025	<0.005
G21-2025	<0.005
G22-2025	<0.005
G23-2025	<0.005
G24-2025	<0.005
G25-2025	<0.005
G26-2025	<0.005
G27-2025	<0.005
G28-2025	<0.005
Mean	**0.036**
Range	**<0.005 - 0.175**

Note: DBT was analysed for along with TBT. The DBT results are not reported here as there is no Action Level for DBT but have been provided in the Marine Directorate Pre-Disposal Sampling Results Form. To calculate the mean value, the concentrations below 0.005 mg kg^{-1} were taken as being 0.005 mg kg^{-1}.

TABLE A1.7 TBT CONCENTRATIONS FROM GRANGEMOUTH HARBOUR 2003-2025

Year	Mean TBT Concentration (mg kg^{-1} dry weight)
2003	0.042
2004	0.018
2006	0.034
2007	0.019
2008	<0.014
2016	0.309
2019	0.216
2022	0.0161
2025	0.036
Mean 2003-2025	**0.078**
Range 2003-2025	**<0.014 - 0.309**

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 2025 are presented in Table A1.8. Three stations exceeded Action Level 1 (0.02 mg kg^{-1}) for the sum of the ICES 7 PCBs, all of which were located in the Grange Dock (Stations G01-2025, G02-2025 and G04-2025). No ICES 7 PCB levels exceed Action Level 2 (0.18 mg kg^{-1}) in any of the samples. The mean concentration of PCBs in the samples analysed within the Marine Licence Application Area (Stations G01-2025 to G28-2025) is below Action Level 1.

TABLE A1.8 PCB (MG KG^{-1} DRY WEIGHT) FROM THE PORT OF GRANGEMOUTH 2025

Station	Sum of ICES 7 PCB Concentrations (mg kg^{-1} Dry Weight)
Grange Dock	
G01-2022	0.0362
G02-2022	0.0502
G03-2022	0.0154
G04-2022	0.0836
G05-2022	0.0195
G06-2022	0.0162
Eastern Channel	
G07-2022	0.012
G08-2022	0.0135
G09-2022	0.0102
G10-2022	0.00919
G11-2022	0.00921
G12-2022	0.0102
G13-2022	0.00944
Bellmouth	
G14-2022	0.00953
G15-2022	0.00719
G16-2022	0.0079
G17-2022	0.00667
G18-2022	0.0175
G19-2022	0.0044
G20-2022	0.00759
G21-2022	0.00567

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 (mg kg^{-1} Dry Weight)
G22-2022	0.00474
G23-2022	0.00363
G24-2022	0.00708
G25-2022	0.00397
G26-2022	0.00994
G27-2022	0.00769
G28-2022	0.00622
Men and Range	
Mean	**0.0144**
Range	**0.0036-0.0836**

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 presents a comparison of mean dry weight concentrations of ICES 7 PCBs from samples collected between 1994 and 2025. To calculate the mean values for data reported as less than the analytical method reporting limit then the reporting limit was used. Levels above Marine Scotland Action Level 1 for the mean PCB concentrations are highlighted in blue.

TABLE A1.9 PCBS FROM THE PORT OF GRANGEMOUTH 1994 – 2025

Year	Sum of ICES 7 PCB Concentrations (mg kg^{-1} Dry Weight)
1994	0.020
1999	0.016
2001	0.010
2004	0.013
2006	0.007
2007	0.012
2008	0.008
2010	0.020
2016	0.009
2019	0.030
2022	0.011
2025	0.014
Mean 1994-2025	**0.0142**
Range 1994-2025	**0.007 - 0.030**

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 the US EPA 16 PAHs are presented in Table A1.10. The US EPA 16 PAHs are generally considered to be of environmental concern because of their potential toxicity in humans and other organisms and their prevalence and persistence in the environment.

Levels above Action Level 1 for individual PAHs are highlighted in blue. There are no Action Level 2 standards for PAHs.

A comparison of mean dry weight concentrations of PAHs from samples collected between 2003 and 2025 are presented in Table A1.11. Concentrations of most individual EPA 16 PAHs above Action Level 1 were found in all years.

The total hydrocarbon (THC) concentrations were also analysed for and these are presented in Table A1.10. The concentrations of THC are above Action Level 1 for all samples. However, it is noted that the Action Level guidance is related to Total Petroleum Hydrocarbons (TPH) and not THC concentrations which were measured. The mean dry weight concentration of THCs in the 2025 samples was 419 mg kg^{-1} or 0.042% which corresponds to 0.017% converted to wet weights based on the average measured solids contents of the samples (41.4%). These wet weight concentrations are below the toxic (1%) and harmful (0.1%) classifications for ecotoxicology based on the UK country agency guidance [(1)].

1 NRW, SEPA, NIA, EA. 2015. Guidance on the Classification and Assessment of Waste. Technical guidance WM3. LIT 10121.

TABLE A1.10 ANALYSIS OF PAHS FROM THE PORT OF GRANGEMOUTH IN 2005 (UG KG-1 DRY WEIGHT)

Station	G01-202	G02-2025	G03-2025	G04-2025	G05-2025	G06-2025	G07-2025	G08-2025	G09-2025	G10-2025	G11-2025	G12-2025	G13-2025	G14-2025
LMW PAH														
Acenaphthene	124	112	94.4	98.5	103	106	116	95.2	55	52.3	54.8	75.7	60.3	46.9
Acenaphthylene	60.1	75.8	72.9	63.1	77.4	77.9	99.7	75.6	65	59.7	63.3	87.7	74.5	62.1
Anthracene	378	319	323	292	315	291	305	268	189	161	174	221	210	151
Fluorene	169	136	131	119	140	141	156	155	106	79.6	94.7	122	105	97.5
Naphthalene	277	262	257	205	232	269	350	276	261	190	234	272	253	204
Phenanthrene	763	584	553	563	524	638	597	697	437	337	378	482	450	351
HMW PAH														
Benzo(a) anthracene	478	471	439	345	306	453	382	288	272	238	260	268	270	266
Benzo(a)pyrene	678	751	650	436	479	728	437	353	344	259	300	330	331	332
Benzo(b) fluoranthene	608	679	583	463	453	673	499	344	365	252	304	386	304	340
Benzo(ghi) perylene	437	526	499	336	328	509	434	280	303	203	261	270	239	341
Benzo(k) fluoranthene	561	652	566	409	427	640	448	332	310	224	283	290	312	270
Chrysene	577	536	551	340	379	551	412	338	330	263	306	329	326	290
Dibenzo(ah) anthracene	91.1	112	93.9	64.3	71.3	92.7	77.3	54.9	53.3	38.4	45.3	44.3	44.6	66.1
Fluoranthene	907	912	753	694	600	828	816	801	536	434	499	621	569	501
Indeno(1,2,3-c,d)pyrene	403	407	432	268	269	417	367	214	223	141	171	195	174	305
Pyrene	1120	1090	1020	886	927	1070	958	814	651	494	586	708	683	559
THC (mg kg^{-1})	669	701	627	696	1030	606	529	446	476	447	487	419	416	354

TABLE A1.9 CONT

Station	G15-2025	G16-2025	G17-2025	G18-2025	G19-2025	G20-2025	G21-2025	G22-2025	G23-2025	G24-2025	G25-2025	G26-2025	G27-2025	G28-2025
LMW PAH														
Acenaphthene	36.3	42.9	31.4	49.1	69.1	38.5	19	26.9	25.4	36.1	13.2	35.2	34.7	37.6
Acenaphthylene	74.3	57.7	44.6	62.9	39	57.6	22.4	29.9	35.1	48.1	18.6	77.7	50	70.6
Anthracene	106	144	108	171	162	122	70.2	91.4	75.7	114	41	111	136	120
Fluorene	90.5	93.1	68.2	106	100	91.6	43.7	59.1	56	74.2	27.7	74.3	70.8	73.8
Naphthalene	175	231	171	208	155	202	111	148	119	183	67.1	164	152	156
Phenanthrene	291	358	243	349	443	302	166	219	184	284	97	278	259	257
HMW PAH														
Benzo(a)anthracene	215	258	173	193	244	228	110	135	133	211	70	235	208	217
Benzo(a)pyrene	280	326	215	280	274	308	134	168	164	264	94.1	369	271	425
Benzo(b)fluoranthene	289	339	242	262	257	345	134	191	193	264	90.6	335	239	377
Benzo(ghi)perylene	302	356	252	304	257	364	162	209	196	288	104	363	291	401
Benzo(k)fluoranthene	239	287	184	211	220	269	120	142	146	229	78	294	235	326
Chrysene	256	283	182	238	261	244	132	155	157	244	82.3	260	239	243
Dibenzo(ah)anthracene	52.7	62	43.8	52.2	45.9	49.1	28.3	35	34.1	42.2	17.4	66.6	52.5	73.7
Fluoranthene	389	483	319	383	490	427	216	260	252	389	138	401	465	363
Indeno(1,2,3-c,d)pyrene	249	286	201	196	198	265	119	153	155	234	79.2	320	241	349
Pyrene	476	562	388	733	550	524	253	324	300	462	162	466	510	426
THC (mg kg^{-1})	309	352	268	352	201	384	182	212	202	293	115	301	358	298

LMW = Low Molecular Weight. HMW = High Molecular Weight. THC = Total Hydrocarbons

TABLE A1.11 MEAN PAHS (µG KG^{-1} DRY WEIGHT) FROM THE PORT OF GRANGEMOUTH 2003 TO 2025

PAH	Sample Year								
	2003	2004	2006	2007	2010	2016	2019	2022	2025
LMW PAH									
Acenaphthene	-	-	-	-	-	96.6	334.6	497.8	60.3
Acenaphthylene	-	-	-	-	-	17.9	84.8	62.3	60.8
Anthracene	221.9	180.8	134.7	77.2	182.6	203.4	524.0	877.8	184.6
Fluorene	109.9	89.5	61.5	38.1	76.5	120.2	271.9	383.4	99.3
Naphthalene	280.8	277.1	190.0	123.5	185.5	226.1	353.1	659.2	206.6
Phenanthrene	522.4	449.8	310.8	172.5	389.5	577.9	1,366.2	2,388.6	395.9
HMW PAH									
Benzo(a)anthracene	355.1	370.2	230.4	125.8	343.6	433.2	977.2	1,602.1	263.1
Benzo(a)pyrene	371.0	241.2	277.0	166.0	364.6	448.2	1,181.5	1,680.5	356.4
Benzo(b)fluoranthene	-	-	-	-	-	-	1,068.1	1,439.0	350.4
Benzo(ghi)perylene	520.1	364.5	242.1	151.9	346.9	339.5	814.7	1,045.2	314.8
Benzo(k)fluoranthene	-	-	-	-	-	-	524.0	1,006.9	310.9
Chrysene + Triphenylene	480.8	390.4	269.4	132.2	375.7	333.1	-	-	-
Chrysene	-	-	-	-	-	-	1,029.0	1,597.4	303.7
Dibenzo(ah)anthracene	-	-	-	-	-	78.4	168.0	141.7	57.3
Fluoranthene	637.1	568.0	418.3	234.2	595.9	787.9	1,838.6	3,110.4	515.9
Indeno(1,2,3-c,d)pyrene	376.2	395.7	238.4	171.6	335.2	348.0	821.2	903.9	251.1
Pyrene	788.6	643.9	523.7	284.6	695.3	727.4	1,956.7	2,877.5	632.2

LMW = Low Molecular Weight. HMW = High Molecular Weight.

Note different PAHs were analysed for in historic surveys so for some years there is no data for some specific PAHs.

A1.7 ASBESTOS

No asbestos was reported from any of the samples.

A1.8 SEDIMENT PHYSICAL PROPERTIES

The physical properties of the sediment was analysed on the 28 sediment samples collected from the Port of Grangemouth in 2025. Sediments were predominantly muddy, with fractions of sand and gravel. The sandy-mud and gravelly mud material is typical of a relatively low energy port environment.

- 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 2025 data.

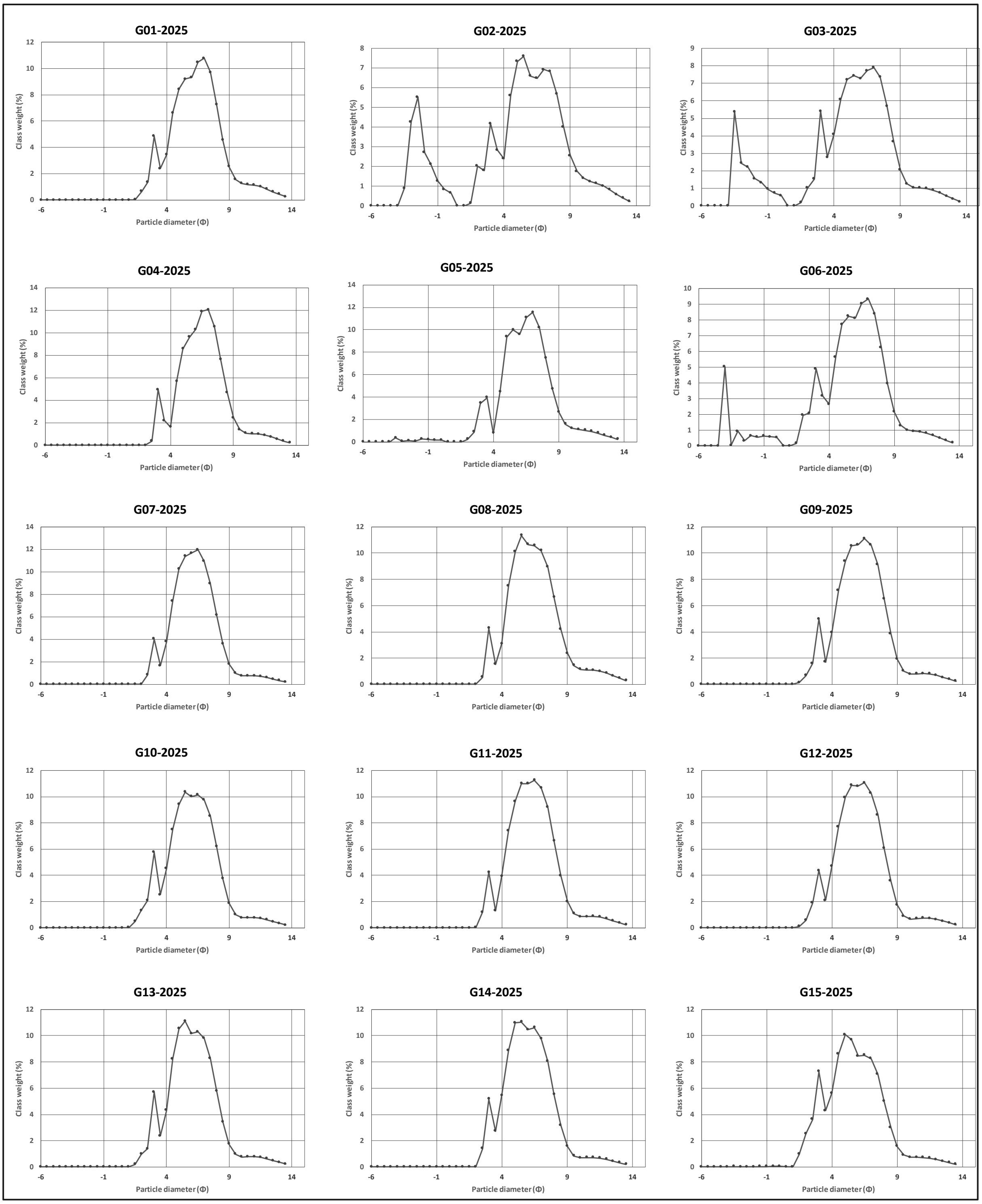
TABLE A1.12 PORT OF GRANGEMOUTH 2025 SEDIMENT DATA SUMMARY

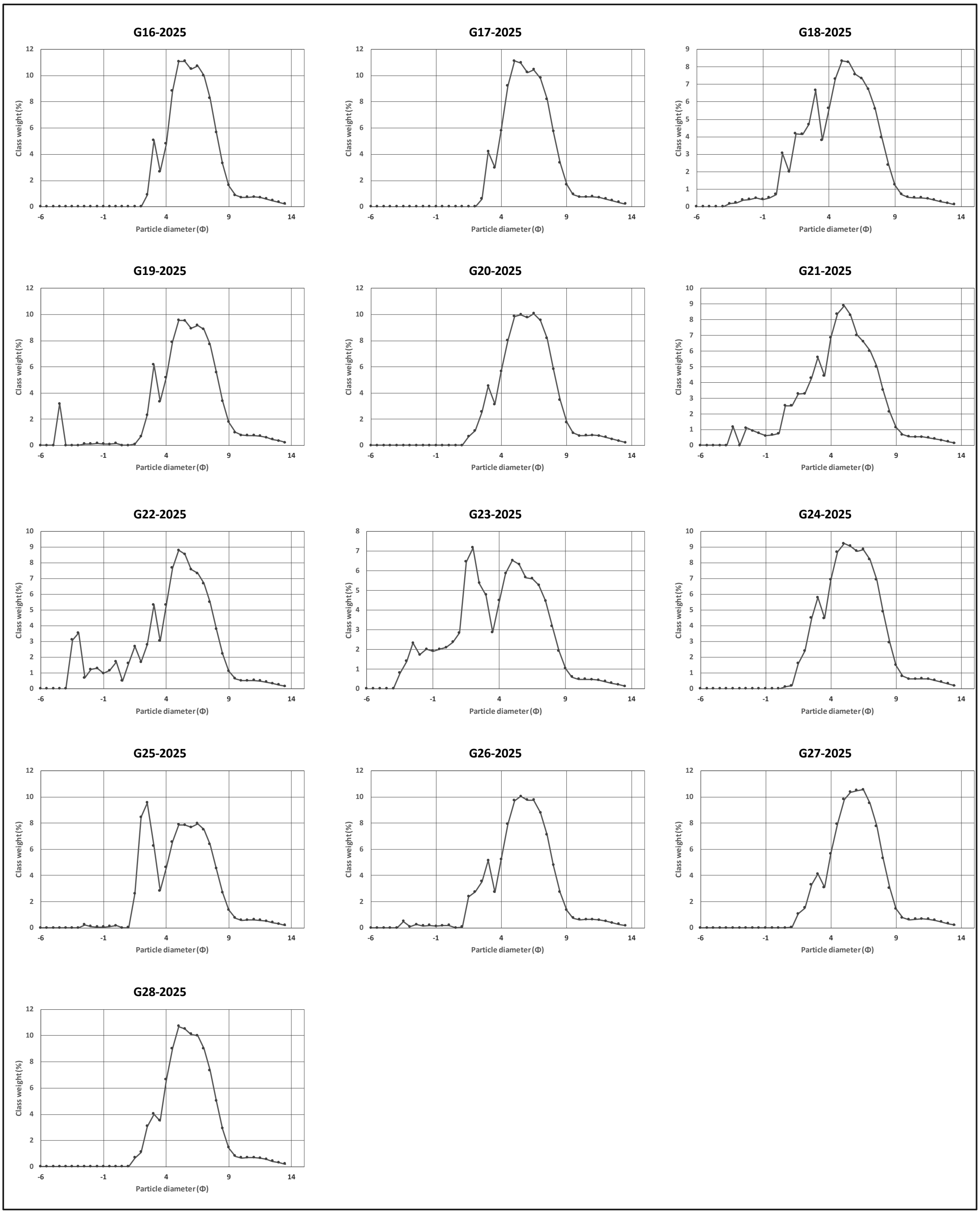
Parameter	Sample Station													
	G01-2025	**G02-2025**	**G03-2025**	**G04-2025**	**G05-2025**	**G06-2025**	**G07-2025**	**G08-2025**	**G09-2025**	**G10-2025**	**G11-2025**	**G12-2025**	**G13-2025**	**G14-2025**
Textural Group Classification	Sandy Mud	Gravelly Mud	Gravelly Mud	Mud	Slightly Gravelly Mud	Gravelly Mud	Sandy Mud	Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud
Folk and Ward Description	Medium Silt	Very Fine Sand	Very Coarse Silt	Medium Silt	Medium Silt	Coarse Silt	Coarse Silt	Medium Silt	Coarse Silt	Coarse Silt	Medium Silt	Coarse Silt	Coarse Silt	Coarse Silt
Folk and Ward Sorting	Very Poorly Sorted	Extremely Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted
Mean µm	14.288	62.633	31.605	13.137	13.083	23.349	15.825	14.278	16.109	18.156	15.253	17.193	17.985	18.564
Mean phi	6.129	3.997	4.984	6.250	6.256	5.421	5.982	6.130	5.956	5.783	6.035	5.862	5.797	5.751
Sorting Coefficient	2.057	4.314	3.537	1.890	1.960	3.332	1.759	1.958	1.908	1.954	1.872	1.850	1.890	1.807
Skewness	0.028	-0.353	-0.276	0.012	0.029	-0.310	0.048	0.120	0.027	0.021	0.059	0.031	0.062	0.064
Kurtosis	1.197	1.239	1.462	1.254	1.253	1.825	1.169	1.233	1.177	1.102	1.197	1.139	1.138	1.095
Gravel (%)	0.00	16.78	13.89	0.00	1.10	8.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand (%)	12.73	14.91	16.39	9.11	9.68	16.06	10.30	9.44	13.00	16.71	10.70	13.71	14.91	14.74
Mud (silts and clays) (%)	87.27	68.32	69.72	90.89	89.22	75.76	89.70	90.56	87.00	83.29	89.30	86.29	85.09	85.26
Total Organic Carbon (%)	3.25	3.69	2.7	3.36	3.92	3.59	4.49	4.62	4.62	4.7	4.73	4.81	4.39	4.35
Solids (%) @120°C	42.6	44.4	46.5	46.4	42.7	43.7	30.4	32.4	35.8	39.4	32.8	33.3	33.3	33.1
Density (mgm^{-3})	2.53	2.59	2.66	2.59	2.59	2.59	2.53	2.55	2.56	2.56	2.52	2.52	2.52	2.53

TABLE A1.13 CONT.

Parameter	Sample Station													
	G15-2025	G16-2025	G17-2025	G18-2025	G19-2025	G20-20252	G21-2025	G22-2025	G23-2025	G24-2025	G25-2025	G26-2025	G27-2025	G28-2025
Textural Group Classification	Slightly Gravelly Sandy Mud	Sandy Mud	Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Sandy Mud	Slightly Gravelly Sandy Mud	Gravelly Mud	Gravelly Mud	Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Sandy Mud	Sandy Mud
Folk and Ward Description	Coarse Silt	Coarse Silt	Coarse Silt	Very Coarse Silt	Coarse Silt	Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Fine Sand	Coarse Silt	Very Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt
Folk and Ward Sorting	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted
Mean µm	25.131	17.865	17.856	41.051	21.960	18.999	45.454	50.767	76.614	25.635	34.887	25.599	20.488	21.043
Mean phi	5.314	5.807	5.807	4.606	5.509	5.718	4.459	4.300	3.706	5.286	4.841	5.288	5.609	5.571
Sorting Coefficient	2.129	1.808	1.810	2.545	2.143	1.967	2.725	3.291	3.243	2.100	2.362	2.149	1.924	1.894
Skewness	0.034	0.070	0.095	-0.110	-0.001	0.034	-0.133	-0.312	-0.137	0.010	-0.031	-0.080	-0.011	0.049
Kurtosis	1.033	1.115	1.087	0.929	1.089	1.100	1.091	1.303	0.962	0.994	0.772	1.114	1.098	1.076
Gravel (%)	0.09	0.00	0.00	2.13	3.68	0.00	4.65	10.87	10.18	0.00	0.48	1.28	0.00	0.00
Sand (%)	24.40	13.44	13.59	35.34	18.11	17.69	34.27	25.88	40.44	26.05	34.60	22.13	18.78	18.97
Mud (silts and clays) (%)	75.51	86.56	86.41	62.53	78.21	82.31	61.08	63.25	49.39	73.95	64.92	76.59	81.22	81.03
Total Organic Carbon (%)	3.5	4.33	3.49	3.68	2.86	4.22	2.89	3.21	1.92	3.81	2.16	3.36	4.39	3.69
Solids (%) @120ºC	34.3	35.2	39.3	51.9	50.6	43.1	53.1	42.8	53.8	38.8	58.5	42	36.1	42.4
Density (mg m^{-3})	2.55	2.58	2.6	2.61	2.57	2.63	2.64	2.67	2.58	2.62	2.59	2.58	2.57	2.55

FIGURE A1.3 PORT OF GRANGEMOUTH 2025 SEDIMENT PSD GRAPHS





KEY: PHI =–Log_2 of the sediment particle size diameter in mm.

A2 SPOIL GROUND SEDIMENT SAMPLE DATA

Table A2.1 presents metal and PCB concentration data from sediment sampled from within Bo'ness spoil ground and from five other spoil ground sites within the Firth of Forth and Forth Estuary for comparison. Levels above Marine Scotland Action Level 1 for metals and PCBs are highlighted in blue and above Action Level 2 in red.

The metal data in Table A2.1 indicate that concentrations of metals and PCBs within sediment samples from the Bo'ness spoil ground are comparable with those from the other Forth Estuary and Firth of Forth spoil grounds sampled. Both metals and PCBs are lower than the original material dredged from Grangemouth (refer to Table A1.5, Table A1.7 and Table A1.8), which would be expected from a dispersive spoil ground such as Bo'ness.

Note that monitoring of spoil grounds is not mandatory therefore, the data presented in Table A2.1 are the most recent data available.

TABLE A2.1 CONCENTRATION OF METALS AND PCBS FROM SPOIL GROUNDS

Site Name/Date	Metals and PCB Concentrations (mg kg^{-1} Dry Weight)							
	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	Sum ICES 7 PCBs
Bo'ness 2011 (n=7)	14.5	0.1	50.8	23.3	0.8	23.6	56.9	95.7	0.005 (n=3)
Bo'ness 2015 (n=5)	18.6	0.1	59.6	26.5	0.7	27.5	54.2	114.0	0.004 (n=3)
Oxcars 2011 (n=6)	11.2	0.1	42.5	22.2	0.6	22.3	153.5	92.2	0.007 (2007, n=6)
Oxcars 2015 (n=3)	15.7	0.3	79.6	41.6	1.0	35.8	78.1	141.7	0.008
Narrow Deep 2011 (n=6)	9.5	0.2	42.9	21.6	0.49	22.9	53.4	109.4	0.008 (n=3)
Narrow Deep 2015 (n=4)	11.7	0.2	63.8	24.6	0.6	30.0	58.4	105.9	0.03 (n=3)
Kirkcaldy 2011 (n=3)	6.24	0.1	21.9	16.2	0.14	16.4	21.7	45.9	-
Kirkcaldy 2015 (n=3)	8.9	0.1	43.1	17.0	0.2	22.0	30.6	62.9	0.0025 (n=3)
Methil 1993 (n=1)	8.2	0.2	9.8	10.7	0.1	19.2	10.5	51.0	
Methil 2011 (n=3)	6.9	0.07	13.7	7.14	0.07	8.97	20.2	39.8	0.0004 (n=3)
Methil 2015 (n=1)	8.7	0.1	18.0	9.6	<0.06	11.2	14.5	72.8	0.003 (n=1)
Blae Rock 2007 (n=3)	13.4	BDL	59.7	32.4	0.8	28.2	63.9	108.6	0.008 (n=5)
Blae Rock 2011 (n=6)	17.2	0.1	39.6	21.9	0.5	21.4	52.1	80.3	0.01 (n=2)

* Data provided by Marine Scotland (2019). Key: n = the number of samples analysed (where known)

APPENDIX B ENVIRONMENTAL IMPACTS OF DISPOSAL OPERATIONS

B1.1 INTRODUCTION

This Appendix addresses the environmental impacts of the disposal of dredged material from the planned maintenance dredging work at the Port of Grangemouth at the Bo'ness licenced disposal site within the Forth Estuary. Impacts on water quality, sediment quality, and habitats and species are considered. Table B2.1 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 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 disposal operations are not considered to be significant as commercial traffic in this part of the Forth Estuary 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 good practice guidance from the Environment Agency, Clearing the Waters for All [(1)].

B1.2 MATERIAL TO BE DISPOSED

As described in Section 1.2, it is proposed that up to 1,700,000 m^3 (1,955,000 wet tonnes) of dredged material from the Port of Grangemouth would be disposed at Bo'ness. Current dredging and disposal operations are undertaken over a period of approximately four and a half days per month, totalling approximatley 54 days per annum.

The material to be dredged and disposed consists primarily of sandy mud, with some gravelly fractions. The concentrations of contaminants are presented in *Appendix A*. Sediment samples were collected at 28 stations (G01-2025 to G28-225). The results are summarised below.

- The concentrations of metals, except for arsenic and cadmium were above Action Level 1 in all the sediment samples. In one sample form the Grange Dock (G2-2025) the concentration of mercury was above Action Level 2.
- The concentration of TBT was above Action Level 1 in five sediment samples.
- The concentration of PCBs (sum of ICES 7 PCBs) was above Action Level 1 in three sediment samples.
- Most of the EPA 16 PAHs were above Action Level 1 in the 28 sediment samples.

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

- THC were above Action Level 1 in all the sediment samples.
- No asbestos was recorded.

Available metal and PCB concentration data from sediments sampled in the Bo'ness disposal site are presented in *Appendix A*. Concentrations of metals and PCBs are generally similar to those from samples from other spoil disposal sites within the Firth of Forth and Forth Estuary.

B1.3 IMPACTS ON WATER AND SEDIMENT QUALITY

Coastal water quality in the Firth of Forth and Forth Estuary is currently classified as Good [(1)]. The salinity in the Firth of Forth averages 33‰, decreasing into the Forth Estuary under the influence of freshwater inputs. Suspended solids levels in the inner Firth of Forth are usually low compared to levels in the upper estuary [(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 dredged spoil material to be disposed at the Bo'ness disposal site 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 Forth Estuary and the Firth of Forth vary with seasonal weather conditions and this contributes to the natural sedimentation levels in the Firth of Forth.

Although there are no reported studies on suspended sediment levels from the Bo'ness disposal site, there has been a number of studies within the Firth of Forth that provide an insight on the suspended sediment dynamics within the Forth Estuary and Firth of Forth and the effects of dredge spoil disposal activities.

- Studies undertaken by Transport Scotland (2009) for the Forth Replacement Crossing showed that increases in suspended sediment concentrations from dredging works were short-lived and localised [(5)].
- Data from Middle Bank in the Firth of Forth during dredging operations in 2008 [(6)] recorded baseline mean suspended solids concentrations between 8.87 mg l^{-1} and 10.3 mg l^{-1} (mean 9.1 mg l^{-1}), under calm conditions.

1. https://www.sepa.org.uk/data-visualisation/water-classification-hub/ Accessed March 2025.
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. Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.
6. ERM, 2008. Middle Bank Aggregate Production Licence: Monitoring Report. A report for Westminster Gravels Ltd.

- Studies undertaken by FugroEMU (2013) (1) to measure the suspended sediment concentrations in the sea outside the Port of Leith Outer Berth (with two sample locations about mid-way between the Port of Leith and the Narrow Deep spoil site) showed near bed concentrations of 10-50 mgl^{-1} in calm wave conditions, peaking at between 200-1000 mg l^{-1} during high wave conditions.
- Modelling studies were undertaken by Royal Haskoning (2022) (2) of the suspended sediment concentrations of dredge spoil disposal at Narrow Deep from the dredging associated with the development of the new Port of Leith Outer Berth. The Environmental Impact Assessment undertaken for the project concluded that the majority of the dredged material would rapidly descend to the seabed following discharge and that, at the worst case, some dispersion of fine material would take place, extending 3 km along the seabed toward east and west of the disposal location. The peak suspended sediment concentrations would be up to 150 mg l^{-1} but would be short-lived and would only occur at the seabed. Much lower concentrations of suspended sediments were predicted at the surface and mid-water depths. These predicted increases in suspended sediment concentrations were short-lived and would dissipate with tidal currents.

Significant increases in suspended sediments associated with the disposal operations are therefore likely to be confined to the immediate area of the spoil ground and for a short period.

Any increased nutrient levels from suspended sediments from disposal operations 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% (3). 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} would not be met (4). 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

1. FugroEMU. 2013. Normal Resolution Survey Report. Port of Leith Marine Ground Investigation. Report to Scottish Enterprise, March 2013.
2. Royal Haskoning DHV. UK Ltd. 2022. Port of Leith Renewable Energy Hub. Environmental Impact Assessment Report. PC2045-RHD-ZZ-XX-RP-EV-0007.
3. Brown C. 1968. Observations on Dredging and Dissolved Oxygen in a Tidal Waterway. Water Resources Research Vol 4, No 6, p1381.
4. 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

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 (3.7% based on the 28 surface samples analysed) and the extent of the area potentially affected.

Although there may be some release of contaminants such as metals, TBT, THC, PAHs and PCBs 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 seabed. Previous studies have shown that metal concentrations in the water column remained consistent following sediment disposal (1). In addition, the natural sedimentation in the Forth Estuary aids the removal of contaminants from the water column and incorporates them in the seabed sediments.

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 PAHs in the sediment samples comprised both low molecular weight (LMW) (two and three benzene rings) and high molecular weight (HMW) (more than 3 benzene rings) compounds. The HMW PAHs are generally the less water soluble, less acutely toxic and slower to biodegrade (*i.e.* more persistent) than the LMW PAHs. All 28 samples had some individual PAHs concentrations above Action Level 1 and these were both LMW and HMW PAHs. The exception being station G25-2025 which has the lowest PAH concentration and no LMW PAHs above Action Level 1.

The ratios of individual PAHs have been used to determine the likely anthropogenic source of PAHs in the environment: *e.g.* from petroleum hydrocarbons (petrogenic) or combustion sources (pyrolytic). Petrogenic PAHs are often characterised by phenanthrene to anthracene (Ph/An) ratios more than 10, whereas pyrolytic PAH from combustion processes are characterised by Ph/An ratios less than 10. Ratios of fluoranthene to pyrene (Fl/Py) of less than 1 generally indicates petrogenic sources while ratios more than 1 generally come from pyrolytic sources (1).

For the sediment samples analysed from the Port of Grangemouth in 2025, the Ph/An ratios were between 1.66 and 2.75 and the Fl/Py ratios were between 0.52 and 0.98. This suggests that these contaminants are from both combustion and petroleum hydrocarbon sources. This pattern has been identified in other ports in the Forth Estuary and the Firth of Forth indicating that the sources of PAHs in the sediments come from a range of sources and are in the wider Forth Estuary and Firth of Forth sediment circulation system.

There was a large reduction in point source discharges of metals and hydrocarbons within the Forth Estuary and the Firth of Forth between the mid-1980s and 1990s (2). 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

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

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. Metal and trace organic inputs have been reduced so that aqueous concentrations have fallen rapidly [(1)]. With efforts focussed on improving the water quality of the Forth Estuary and the Firth of Forth in more recent years, point source discharges have continued to decrease and the water quality of the Forth Estuary and the Firth of Forth has continued to improve as a result [(2)].

It is not anticipated that the disposal operation at the Bo'ness disposal site 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. The short-term, localised and intermittent increase in the levels of some contaminants in the water column, for a dredge spoil disposal process that has been going on for many years, is not considered likely to affect the overall Good water body quality status of the Forth Estuary and Firth of Forth with respect to the Water Framework Directive.

B1.4 IMPACTS ON BENTHIC ECOLOGY

The benthic macrofaunal communities present in proximity to the Bo'ness disposal site are expected to be typical for Firth of Forth 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 [(3)].

It is anticipated that the deposition of dredged material at the Bo'ness disposal site will result in the loss (burial) of the benthos within and in the immediate vicinity of the 'deposition zone' within the spoil ground. Localised impoverishment of the fauna (in terms of abundance and diversity) may occur along the axis of tidal flow from secondary impacts comprising sediment deposition subsequent to the disposal activities.

Bo'ness is an existing licenced spoil ground therefore the benthic communities in this area will have been impacted by the ongoing spoil deposition activities that have occurred there intermittently over the last 24 years. Given the relatively homogenous nature of benthic communities in this part of the Forth Estuary and the availability of similar habitat within the wider Forth Estuary and the Firth of Forth, the spatial extent of predicted sediment related impacts to benthos (and resultant impact on prey availability for foraging seabirds) are not considered to be significant.

1 Dobson, J., Edwards, A., Hill, A. et al. *Senckenbergiana maritima* (2001) 31: 187. https://doi.org/10.1007/BF03043028
2 SEPA, 2014. Scottish bathing waters 2013-2014. Available online http://www.sepa.org.uk/media/39125/scottish-bathing-waters-report-2013-2014.pdf
3 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

B1.5 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 (1) 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 Grangemouth and the disposal site during the four days per month dredging campaign, a round trip of approximately 3.0 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 spoil ground 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.

Bo'ness is an established and long-term spoil ground with disposal activities being ongoing at the time that the SPAs were designated. 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 SPAs.

B1.6 IMPACTS ON FISH

The River Teith Special Conservation Area (SAC), the Isle of May SAC and the Moray Firth SAC are designated (2) 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 Bo'ness disposal site. The Forth District Salmon Fishery Board has previously advised that smolts are likely to be passing through the lower Forth Estuary and Firth of Forth 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 fish for the following reasons.

1 The *Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations, 2019*.
2. The *Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations, 2019*.

- The concentration of suspended sediment at which the passage of salmonid fish is affected has been observed to be approximately 500 mg l^{-1} (1). 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) (2). The natural suspended sediment maxima in the Forth system is in the upper Forth Estuary with mean concentrations over forty times higher than in the Firth of Forth (130 mg l^{-1} at Kincardine (3) and average 3 mg l^{-1} at Gunnet Ledge (4)).
- The disposal activities will take place at the Bo'ness spoil ground within the Forth Estuary which represents a small area where sea lamprey and salmon smolts may be present or may pass through. The fish species that may be present are mobile and able to avoid the relativity small area of elevated suspended sediments during and immediately after disposal operations. The suspended sediment maxima in the Forth Estuary is in the upper estuary with mean concentrations approximately eight times higher than in the lower estuary (130 mgl^{-1} at Kincardine and 16 mgl^{-1} from Longannet) [5] and higher than the recorded elevation in suspended sediment concentrations recorded during the Middle Bank dredging and disposal operations.
- The dredging process is not continuous: the time required for one cycle (dredging - travelling - discharging - travelling) is approximately 1 hour and 30 minutes. 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 concentrations affecting a small proportion of the Forth Estuary 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 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. Seasonal restrictions to

1. 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.
2. 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.
3. Transport Scotland. 2009. Forth Replacement Crossing: Environmental Statement.
4. SEPA monitoring buoy data from Gunnet Ledge, Firth of Forth, 2020 data available online from http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/gunnet-ledge/

5 Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.

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]

operational requirements to dispose of dredged material at the Bo'ness spoil disposal ground are therefore not considered to be justified.

B1.7 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 Bo'ness 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 because of increased levels of suspended sediment at the spoil ground.

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 Bo'ness disposal site.
- The short duration of disposal activities (up to four days per month).
- 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 frequent summer visitors to the Firth of Forth, mainly between June and September [(1)] [(2)].

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 spoil ground. 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.
- The short duration of disposal activities each month (four days).
- The relatively low speed and direct line of travel of dredge vessel movements to and from the spoil disposal ground (*i.e.,* no fast moving and erratic vessel movements).
- The long-term existing disposal operations in the area which pre-date the site designation.

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).
2. https://www.hw.ac.uk/news/articles/2023/river-forth-s-whales-porpoises-dolphins-and.htm. Accessed April 2024.

B1.8 SUMMARY OF IMPACTS

Table B1.1 presents a summary of the impacts and an assessment of significance of the impacts in relation to the sensitivity/importance of the receiving site.

TABLE B1.1 SUMMARY OF SIGNIFICANCE OF IMPACTS

Receptor	Impact Significance Justification	Impact Significance
Water quality at spoil ground	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 spoil ground	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 spoil ground	Bo'ness is designated as a spoil ground and disposal operations have taken place there over 20 years. 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 short period each month and the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by. The SPAs were designated after the Bo'ness spoil 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 marine mammal and fish passage and foraging habitat close by. The volume of dredger vessel traffic will not be significant in relation to the existing traffic in the Forth Estuary and Firth of Forth. The SACs were designated after the Bo'ness disposal site was designated and have not been impacted by historic and ongoing disposal operations.	Not Significant

B2 CUMULATIVE EFFECTS WITHIN THE FIRTH OF FORTH

B2.1 INTRODUCTION

The potential impacts of the sea disposal option have been assessed within Section B1 in isolation from other activities within the Forth estuary and the Firth of Forth. 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 or cause disturbance to the qualifying interests of the SPAs and SACs. The other activities considered therefore include those that are at some distance from the activities at the Bo'ness disposal site but are within the foraging range of species that may utilise both areas.

B2.2 PAST AND CURRENT ACTIVITIES WITHIN THE FIRTH OF FORTH AND FORTH ESTUARY

B2.2.1 INTRODUCTION

The Firth of Forth and Forth Estuary has previously experienced pollution from a number of industrial sources and sewage discharges, such as the petrochemical 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 system as have the coal fired power stations, such as Longannet [2]. Over about the past 100 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 Forth 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.

B2.2.2 PETROCHEMICALS AND POWER GENERATION

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

The Longannet coal-fired power station on the north bank of the estuary closed in March 2016. The historic release of combustion related PAHs from this source will have

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
2. 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.

contributed to the PAH loading within the Forth Estuary and Firth of Forth [(1)]. 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.

B2.2.3 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 [(2)].

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 Docks to Joppa. This Order, implemented in March 2003 and reissued in 2006, still stands [(3)].

B2.2.4 OTHER DREDGING DISPOSAL ACTIVITIES

In addition to the planned maintenance dredging at the Port of Grangemouth with disposal at the Bo'ness disposal site, Forth Ports manages six other dredging operations and has one application pending within the Forth Estuary and Firth of Forth. The current operations comprise the following.

- Grab/backhoe dredging at Newhaven with disposal at Oxcars spoil disposal ground: maximum capacity for maintenance dredging is 15,000 m^3 per annum (19,500 wet tonnes), undertaken over four weeks, usually in spring.
- Trailer suction and grab/backhoe dredging in Rosyth with disposal at Oxcars disposal site: maximum capacity for maintenance dredging is 400,000 m^3 (520,000 wet tonnes) per annum, undertaken over three days per month, every other month.
- Trailer suction dredging in Leith with disposal at Narrow Deep disposal site: maximum volume for maintenance dredging is 200,000 m^3 (260,000 wet tonnes) per annum. The dredging operations to maintain the approach channel and docks are

1. 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.
2. 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 .
3. http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8499. Assessed March 2025.

estimated to occur for up to 3 to 4 days every three months (12 to 16 days per annum), subject to siltation rates and commercial requirements.

- Grab/backhoe dredger at Methil harbour and approach channel with disposal at Methil disposal site: maximum quantity of disposed material is 12,500 m^3 (17,500 wet tonnes) per annum. The dredging operations are undertaken during high water periods over up to ten days per annum.
- Grab dredger and plough at Kirkcaldy with disposal at Kirkcaldy disposal site: maintenance dredging of approximately 15,000 m^3 (21,000 wet tonnes) per annum. The work would be undertaken over ten to twenty days per annum.
- Plough and grab dredger for maintenance dredged material from Granton with disposal at the Oxcars disposal site. Maximum quantity of disposed material is 10,000 m^3 (14,000 wet tonnes) per annum. The work would be undertaken over one or two periods of ten to twenty days per annum. See also below for recent activity in Granton undertaken by the Royal Forth Yacht Club.

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 maintenance and capital dredging activities in the Firth of Forth and Forth Estuary 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).

- 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 [(1)] (although this has not been undertaken annually), with disposal at Bo’ness spoil ground.
- Maintenance dredging at Granton Harbour undertaken by the Royal Forth Yacht Club by agitation of 5,904 tonnes per annum between August 2021 and August 2023. The was also a previous licence to dredge 86,980 m^3 at Granton Harbour with disposal at Bo’ness or Narrow Deep spoil ground between August 2019 and July 2022 as part of the harbour development works.
- 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).
- 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.
- Dredging of up to 33,800 wet tonnes using a plough dredger at Port Edgar within the confines of the marina between April 2021 and February 2024 with disposal to the entrance to the marina.

1. 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 wet 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.
- 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 supports the new bridge. In total 180,000 m^3 silt and sand was dredged from the seabed to form access channels for bridge foundation works between 2011 and 2016. This spoil was disposed of at Oxcars [(1)].

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 ground, have been reported.

B2.2.5 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. The information provided below is based on the companies' and the Marine Directorate websites.

- **Levenmouth Demonstration Turbine/Fife Energy Park Offshore Demonstration Wind Turbine** [(2)] [(3)]. The Offshore Renewable Energy (ORE) Catapult's seven-megawatt wind turbine was completed in 2013 and is located 50 m from the coast at Methil connected to the land by a ramp. It is located approximately 15 km from the Kirkcaldy disposal site. 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 August 2018 the consent was varied to extend the operational life of the turbine for an additional 10 years to March 2029.
- **Forthwind Demonstration Project** [(4)] [(5)]. Forthwind Ltd (established by Cierco Ltd) 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 the Bo'ness disposal site (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

1. Hochtief (UK) Construction (2016). Forth Road Bridge Replacement - Queensferry Crossing. Available online http://www.hochtief-construction.co.uk/bridges_Forth_Road.shtml
2. https://marine.gov.scot/ml/levenmouth-demonstration-turbine. Accessed March 2025.
3. https://ore.catapult.org.uk/stories/ore-catapults-levenmouth-demonstration-turbine-2/. Accessed March 2025.
4. https://forthwind.co.uk/. Accessed March 2025.
5. https://marine.gov.scot/ml/scoping-forthwind-offshore-wind-demonstration-project-methil-firth-forth. Accessed March 2025.

windfarm sites to coastal substations within the Firth of Forth. Other potential windfarm sites in the outer Firth of Forth area are at the early operational phase, construction phase or at the planning phase. The information provided below is based on the companies' websites.

- **Seagreen Offshore Wind Farm** [(1)]

  Scottish and Southern Electric (SSE) Renewables and TotalEnergies 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. The 1075 MW from the 114 turbines installed in 2022 became fully operational in October 2023 with the power exported 19 km by cable to Carnoustie in Angus. Montrose port is the location of the operations and maintenance base.

- **Neart na Gaoithe Offshore Wind Farm** [(2)]

  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. It is being developed by EDF renewables and ESB. Construction commenced in 2020 with seabed preparations being undertaken prior to piling works. An onshore operations and maintenance base at Eyemouth received planning permission in September 2020. First power was generated in October 2024 and the wind farm is expected to be fully operational in 2025.

- **Inch Cape Offshore Wind Farm** [(3)]

  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 via an 85 km cable to a new substation at Cockenzie. In October 2023 onshore enabling works were completed and the main civil engineering works commenced in early 2024 with construction commencing in 2025. Once fully operational the wind farm will have an export capacity of approximately 1.1 gigawatts. It will be operated out of a base in Montrose Port.

1. https://www.seagreenwindenergy.com/. Accessed March 2025.
2. https://nngoffshorewind.com/project/. Accessed March 2025.
3. https://www.inchcapewind.com/. Accessed March 2025.

- **Berwick Bank Offshore Windfarm** [1]

  The Berwick Bank Wind Farm is a proposed offshore wind farm located in the outer Firth of Forth and Firth of Tay, approximately 37.8 km east of St. Abb's Head and 47.6 km from the East Lothian coastline. It has a design capacity of 4.1 GW which is sufficient to power 6 million homes. There are two electricity grid connection points one at Branxton in East Lothian and one ay Cambois near Blyth in Northumberland. A planning application for the offshore array and grid connection to east Lothian was submitted in late 2022 to the Marine Directorate and are currently being evaluated. The planning application for the grid connection to Blyth was submitted in July 2023.

B2.3 CONCLUSIONS

Potential cumulative impacts associated with the above activities can be broadly categorised as comprising suspension of sediments during dredge spoil disposal operations and construction activities 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. These other activities are at some distance from the Bo'ness 'disposal site and no cumulative impacts from suspended sediments and other vessel movements are considered likely.

The dredge spoil disposal operations at the Bo'ness disposal site pre-date the SPA and SAC designations and there is no evidence to suggest that the past and current disposal operations at Bo'ness, 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. Any new developments within the Forth Estuary and the Firth of Forth are likely to be subject to assessment of significant environmental effects through the appropriate consenting processes.

1 https://www.berwickbank.com/

APPENDIX C SUMMARY OF CONSULTEE RESPONSES

1 CROWN ESTATE SCOTLAND

Thanks for your letter on the Grangemouth proposal.

I can confirm that these works (to a depth of 7m below Chart Datum) would be covered under an existing agreement between Crown Estate Scotland and Forth Ports, which includes the disposal of dredged material at designated spoil grounds in the Firth of Forth.

With regard to your BPEO query, I am not aware of any potential re-use opportunities in the area at this time.

Peter Galloway, Bidwells, on behalf of the Crown Estate

2 NATURESCOT

Thank you for consulting NatureScot on the disposal of maintenance dredging material from the Port of Grangemouth for the renewal of the current Marine Licence (MS-00010017).

We note the proposal to remove up to 1,700,000 m^3 of sandy-silt material per annum in the Grangemouth Dock complex and the Bellmouth area outside the docks.

At present, disposal at the Bo'ness spoil disposal ground continues to be the best practicable environmental option.

Should any other beneficial uses of the dredged material arise in future, we will update you and Forth Ports.

Ian Stewart, Operations Officer – Coastal Infrastructure, NatureScot South

3 NORTHERN LIGHTHOUSE BOARD

Thank you for your e-mail correspondence dated 15th April 2025 regarding the proposal by Forth Ports Ltd for maintenance dredging and disposal operations at Port of Grangemouth, Firth of Forth.

We note that the works are for a 3 year period and focus on maintaining safe navigable water depth within the port and approach channel.

Northern Lighthouse Board has no objections to the proposed dredging and/ or disposal of dredged spoil to the charted and approved spoil ground at Bo'ness, 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, Northern Lighthouse Board.

4 SCOTTISH ENVIRONMENT PROTECTION AGENCY

Thank you for your enquiry. As a starter, I have gathered some initial formation from SEPA's permitting department regarding this activity (below):

Waste material, which includes dredge spoil, deposited above the low water mark is subject to Waste Management Licensing controls regulated by SEPA unless it is subject to a licence issued under Part 4 of the Marine (Scotland) Act 2010 (which can extend to Mean High Water Spring Tide including within estuaries, rivers and channels), in which case it is excluded from such controls. However, if the waste deposition could constitute a landfill, then PPC not Waste Management Licensing would apply, and in this situation no Marine Licence exclusion is provided for. Where dredge spoil is used for land reclamation works or harbour works then the method of construction will determine how the activity is regulated. If the works are conducted by way of deposit of material directly onto the intertidal zone or within a permeable bunded area (for example a bund made of placed stones) then the works will be considered to be occurring in the marine environment and will be regulated by Marine Directorate. If the works are constructed by way of initially creating an impermeable bund (such as a sheet piled metal wall) then the use of waste such as dredge spoil for infill works will be occurring above mean high water springs and therefore will be controlled by SEPA. Such works would require either a waste management licence or a waste management exemption.

Grant Alston, Senior Environment Protection Officer, Scottish Environment Protection Agency

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