

Stonehaven Harbour Best Practicable Environmental Option (BPEO) Report



February 2023

Stonehaven Harbour Best Practicable Environmental Option (BPEO) Report

Client: Aberdeenshire Council
Document number: 13081
Project number: 374702
Status: Final
Author: Fraser Russell
Reviewer: Campbell Stewart
Date of issue: 27 February 2023
Filename: Stonehaven BPEO 2023

EnviroCentre Limited Office Locations:

Glasgow

Edinburgh

Inverness

Banchory

Registered Office: Craighall Business Park 8 Eagle Street Glasgow G4 9XA
Tel 0141 341 5040 info@envirocentre.co.uk www.envirocentre.co.uk

This report has been prepared by EnviroCentre Limited with all reasonable skill and care, within the terms of the Contract with Aberdeenshire Council (“the Client”). EnviroCentre Limited accepts no responsibility of whatever nature to third parties to whom this report may be made known.

No part of this document may be altered without the prior written approval of EnviroCentre Limited.

EnviroCentre Limited is registered in Scotland under no. SC161777.

VAT no. GB 348 6770 57.



Contents

| | | |
|-----|--|----|
| 1 | Introduction | 1 |
| 1.1 | Background | 1 |
| 1.2 | Scope of Report | 1 |
| 1.3 | Action Levels – AL1 vs AL2 | 2 |
| 1.4 | Report Usage | 2 |
| 2 | Sampling Locations and Methodology | 3 |
| 2.1 | Sample Locations & Collection | 3 |
| 2.2 | Analysis Requirements | 3 |
| 3 | Results | 4 |
| 3.1 | Physical Analysis | 4 |
| 3.2 | Chemical Analysis | 4 |
| 3.3 | Asbestos | 5 |
| 4 | Discussion of Available Disposal Options | 6 |
| 4.1 | Identification and Screening of Available Disposal Options | 6 |
| 4.2 | Summary of Identified BPEO Options | 9 |
| 5 | Further consideration of remaining disposal options | 11 |
| 5.1 | Detailed BPEO Assessment | 11 |
| 5.2 | Conclusion | 16 |
| 6 | Further Assessment | 17 |
| 6.1 | Dredge and Disposal Site | 17 |
| 6.2 | Analytical Data Review | 18 |
| 6.3 | Averages | 18 |
| 6.4 | Chemical Assessment Conclusions | 18 |
| 6.5 | Water Framework Directive Assessment | 19 |
| 6.6 | Potential Risk to Water Quality and Habitats/Protected Areas | 22 |
| 7 | BPEO Conclusions and Recommendations | 25 |
| | References | 26 |

Appendices

- A Figures
- B Summary Tables

Figures

Appendix A:

- 374702-QGIS001 Dredge Area
- 374702-QGIS002 Stonehaven B Disposal Site

Tables

| | |
|--|----|
| Table 3-1: Particle Size Analysis Data | 4 |
| Table 3-2: Exceedances of Revised Action Levels | 5 |
| Table 3-3: Exceedances above RAL 1 by Sample Station..... | 5 |
| Table 4-1: Initial Best Practicable Available Options | 7 |
| Table 5-1: BPEO Detailed Assessment Criteria | 11 |
| Table 5-2: BPEO Strategic Assessment | 12 |
| Table 5-3: BPEO Environmental Assessment..... | 13 |
| Table 5-4: BPEO Cost Analysis (based on 10,000 tonnes) | 15 |
| Table 5-5: BPEO Summary | 16 |
| Table 6-1: Receptor Risk Assessment..... | 20 |
| Table 6-2: Averaged PSA Data for Dredge Area | 22 |
| Table 6-3: Garron Point SSSI Features | 23 |
| Table 6-4: Fowlsheugh SPA Features | 23 |

1 INTRODUCTION

1.1 Background

Aberdeenshire Council has appointed EnviroCentre Ltd to complete a Marine Licence application for dredging at Stonehaven Harbour in Aberdeenshire. As part of the application, a Best practicable Environmental Option (BPEO) assessment requires to be undertaken. This has been informed using sediment quality results from sampling undertaken in June 2020. As the data is less than three years old, it is considered valid for use to inform the BPEO.

The site was previously licenced under MS-00008915, which expired on 2nd June 2022. As such, this project is considered to be a maintenance dredge.

The proposed dredge depth will not exceed 1 metre and a maximum volume of 5,000 m³ will be dredged across both dredge areas, as shown in Drawing No. 374702-QGIS001 in Appendix A.

The purpose of these the samples analysis is to provide supporting information to Marine Scotland during the licensing process on sediment quality within the proposed dredge areas to assess the suitability for sea-based disposal should that be identified as a viable option. The dredging and disposal activities are regulated by Marine Scotland under the Marine (Scotland) Act 2010. The licensing conditions require representative samples to be collected and the nature (i.e. physical composition), quality and contamination status to be determined.

The results of the 2020 sediment analysis will then be used to compare the best practicable environmental options (BPEO) for each of the available potential disposal options for the dredged materials.

1.2 Scope of Report

The following report details the sampling methodology, field and laboratory analysis and provides a summary of the sediment quality present within the proposed dredge areas.

The report will then use the available sediment analysis results to compare the best practicable environmental options (BPEO) for each of the available potential disposal options for the dredged materials. The options which are not considered to be practicable are rejected and the reasons for doing so are explained.

Those options which are practicable are examined in detail and assessed against the following considerations:

- Environmental;
- Strategic; and
- Cost.

The report then compares the practicable disposal options and draws a conclusion on the BPEO.

1.3 Action Levels – AL1 vs AL2

Two action levels are currently used to assess the suitability of sea-based disposal of dredged sediment material: Revised Action Level 1 (RAL1) and Revised Action Level 2 (RAL2).

Sediment with contaminant concentrations below RAL1 is generally considered to be below background levels for contamination and is suitable for disposal at sea.

For samples between RAL1 and RAL2, additional risk assessment may be required including further sampling and testing to fully identify pockets of contamination or implementation of bioassays to assess the materials suitability for sea disposal.

Material above RAL2 is generally considered to be unsuitable for disposal to sea. If the sea disposal route is to be pursued, further testing along the lines of bioassay accompanied by a robust justification for selecting sea disposal as the BPEO may be required. This would need to be supported further with additional information regarding any mitigation measures which could be put in place as part of these works. This would require further discussion and agreement with Marine Scotland.

1.4 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

Whilst the Client has a right to use the information as appropriate, EnviroCentre Ltd retains ownership of the copyright and intellectual content of this report. Any distribution of this report should be controlled to avoid compromising the validity of the information or legal responsibilities held by both the Client and EnviroCentre Ltd (including those of third party copyright). EnviroCentre does not accept liability to any third party for the contents of this report unless written agreement is secured in advance, stating the intended use of the information.

EnviroCentre accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre has confirmed it is appropriate for the new context.

2 SAMPLING LOCATIONS AND METHODOLOGY

2.1 Sample Locations & Collection

Sediment sampling was undertaken in June 2020. Three grab samples were collected from within the harbour.

Results used in the assessment have been provided to EnviroCentre by Aberdeenshire Council.

2.2 Analysis Requirements

The laboratory analysis undertaken as part of this assessment was as follows:

- Metals - Arsenic, Chromium, Cd, Copper, Mercury, Nickel, Lead, Zn;
- Organotins - Tributyl Tin & Dibutyl Tin (TBT);
- Polycyclic Aromatic Hydrocarbons (PAH USEPA 16);
- Polychlorinated Biphenyls (PCB ICES 7);
- Pesticides;
- Total Hydrocarbons (THC);
- Moisture Content;
- Total Organic Carbon (TOC);
- Particle Size Analysis (PSA);
- Specific Gravity;
- Total Organic Carbon (TOC); and
- Asbestos (presence/absence).

Samples were dispatched to Socotec's Marine Laboratory for analysis, which holds UKAS accreditation.

3 RESULTS

Results of the June 2020 sediment analysis are detailed in the following section. Summary tables highlighting exceedances above RALs are provided in Appendix B.

3.1 Physical Analysis

3.1.1 Particle Size Analysis (PSA) and Specific Gravity

The Particle Size Analysis data set for each sample is given in Table 3-3 below.

Table 3-1: Particle Size Analysis Data

| Sample ID | Gravel % (>2 mm) | Sand % (>63 µm<2 mm) | Silt % (<63 µm) |
|-----------|------------------|----------------------|-----------------|
| Grab 1 | 4 | 92.9 | 3.1 |
| Grab 2 | 0 | 21.4 | 75.6 |
| Grab 3 | 1.2 | 68.2 | 30.6 |

Sediment comprises mainly sand and silt sized particles with a negligible proportion of gravel.

3.2 Chemical Analysis

3.2.1 Chemical Analysis Assessment Criteria

All chemical analytical results were assessed against Revised Action Levels (RAL) criteria as adopted by Marine Scotland. The results are summarised in sections 3.2 and 3.3. Summary reports detailing exceedances in the Marine Scotland format have been submitted along with the supporting information for the application.

Where contaminants have RALs as adopted by Marine Scotland, recorded exceedances above these criteria are summarised in Table 3-2.

Table 3-2: Exceedances of Revised Action Levels

| Contaminant | No. of Exceedances (of 3 samples) | |
|-------------------|--------------------------------------|-------|
| | RAL 1 | RAL 2 |
| Arsenic | 0 | 0 |
| Cadmium | 0 | 0 |
| Copper | 0 | 0 |
| Chromium | 2 | 0 |
| Lead | 0 | 0 |
| Mercury | 0 | 0 |
| Nickel | 0 | 0 |
| Zinc | 0 | 0 |
| PAH (All Species) | 2 | 0 |
| PCBs | 0 | 0 |
| TBT | 0 | 0 |
| THC | 0 | 0 |

Two exceedances were noted for one or more PAH species and for chromium, with no exceedances above RAL 2. There were no exceedances of the RALs for PCBs, TBT or THC.

Parameters that exceeded RAL 1 are given for each sample location in Table 3-3.

Table 3-3: Exceedances above RAL 1 by Sample Station

| Sample Station | Parameters Exceeding RAL 1 |
|----------------|----------------------------|
| Grab 1 | PAH |
| Grab 2 | Chromium, PAH |
| Grab 3 | Chromium |

3.3 Asbestos

Asbestos was not detected in any of the samples analysed.

4 DISCUSSION OF AVAILABLE DISPOSAL OPTIONS

The BPEO process is geared towards identifying a preferred overall strategy from the perspective of the environment as a whole, as opposed to detailed optimisation of any one selected scheme. It is a structured and systematic process to identify and compare strategic options in a transparent manner. Alternatives are evaluated in terms of their projected implications for the environment together with consideration of practicability, social and economic issues as well as within a wider strategic context.

The key stages of a BPEO are:

- Identification of options;
- Screening of options;
- Selection of assessment criteria;
- Analysis and evaluation of criteria; and
- Evaluation of BPEO.

Further details on methodology are provided within each section.

4.1 Identification and Screening of Available Disposal Options

A number of options are available for disposal of dredged sediments. The options considered are provided in Table 4-1 along with justification for screening out those options which have not been taken forward for further consideration.

Table 4-1: Initial Best Practicable Available Options

| Location | Options | Screening Assessment | Carry forward? |
|-----------|---|---|----------------|
| Coastline | Leave in situ | Not an option due to the requirements to maintain depth to allow vessels to access the harbours. | No |
| | Infilling of an existing dry dock/harbour facility (re-use) | No current or proposed dock/harbour infilling projects are known within a reasonable distance of the dredge site. In addition, given the relatively small volume of sediment to be dredged (~5,000 m ³), it is most likely that this would not be a sufficient amount of material to complete any infilling project and would provide only part of the total amount of sediment that would be required. Once material is brought on to land it falls under the jurisdiction of SEPA. Further geotechnical and chemical testing would likely be required before it is permitted for use on any such development. | No |
| | Beach Nourishment | Particle size analysis concluded that the sediment predominantly comprises sand therefore the material may be suitable to supply a beach nourishment project. This disposal route would be considered as beneficial re-use of sediment. Aberdeenshire Council have successfully used dredged material as part of beach nourishment projects at other harbours in the past. Certain areas of the Aberdeenshire coast are designated sites (SSSI, SAC, SPA) and hold both national and international importance to nature conservation. Specific beach nourishment projects may require to be supported by Environmental Assessments to inform how the project could affect the environment as a result of disturbance to the intertidal area, changes to the sediment levels, the variable composition and quality of the material and measures devised from the assessment outcomes to minimise impacts on the environment. There would be strategic challenges to overcome if this was to be a viable option, particularly relating to accessibility challenges in and around the harbour. Dredging requires to be undertaken using marine-based plant (<i>i.e.</i> grab or cutter suction unit mounted to a dredger). Dredged material would require to be transferred to shore for onward transport by HGV to a receiving beach. The number of HGV movements required on the narrow, busy streets around the harbour is likely to be seen as a significant disadvantage. Moreover, no specific beaches have been identified by Aberdeenshire Council in the local area to receive sediment at present. In light of the above noted points, beach nourishment is not proposed to be carried forward for further consideration. | No |

| | | | |
|-------------|------------------------------------|---|-----|
| Land | Landfill Disposal | This is possible but it is unlikely that this option will offer a long-term solution due to lack of space at landfills, with other waste types likely to be prioritised. Landfill space is currently at a premium and does not offer a sustainable solution either financially or environmentally for the disposal of dredged arisings. Dredged material is likely to require treatment first in a dewatering facility. Significant cost associated with set up of dewatering facility at the quayside plus transportation and additional costs associated with gaining the necessary planning and regulatory consents. | Yes |
| | Land Incineration | The dredged material consists of non-combustible material (silts, sands, gravels, shells) with a low combustible component. | No |
| | Application to Agricultural Land | The dredged material would need to be treated to reduce salt concentrations to acceptable levels. Would require detailed chemical analysis and assessment as well as a Waste Management License Exemption. Would require special precautions during spreading in relation to the risk of odour and watercourses / aquifers. Disposal of sediments in this manner would potentially have a detrimental effect on existing terrestrial habitats. | No |
| | Recycling | Material to be dredged predominantly comprises sand, which would be ideal for recycling. However, EnviroCentre have not been made aware by the harbour authority of an established disposal and reuse route in Aberdeenshire at present. In addition, given the relatively small volume of sediment, and the logistics involved, this unlikely to be a cost-effective option. | No |
| Sea | Aquatic disposal direct to seabed. | The closest spoil grounds are Stonehaven B (FO007) and Stonehaven (FO003), 1.7km south-east and 3.6km west respectively. The proposed dredge method is to utilise a deck-mounted grab or cutter section unit on a bottom-emptying barge. Overall disposal costs associated with sea disposal are generally lower than land-based disposal, with low environmental risk due to appropriate sediment quality screening measures applied during the licensing process. This practice has been undertaken during previous dredging campaigns. | Yes |

4.2 Summary of Identified BPEO Options

Following review of the available options, two options were identified for further detailed BPEO assessment which are as follows:

- Landfill Disposal; and
- Sea Disposal.

A brief summary of the necessary works or methodology for each option being taken forward for detailed BPEO assessment is provided below.

4.2.1 Landfill Disposal

Dredged material is considered to be controlled waste for the purpose of transport, storage and disposal as per Section 34 (7) of the Environmental Protection Act 1990. The Landfill (Scotland) Regulations 2003 require the classification and characterisation (*i.e.* inert, non-hazardous or hazardous) of the dredged material to be determined prior to landfill acceptance.

Disposal to landfill would require several stages in material handling operations:

- Dredging by deck-mounted grab or cutter suction unit;
- Transfer of material from hopper of dredger on to land;
- Transfer to a dewatering facility or temporary storage on land until it had dried to a suitable moisture content for landfilling;
- Dewatering;
- Transfer of dewatered material to storage area for stockpiling;
- Loading of lorries and transport to landfill site; and
- Disposal at Landfill site.

It is anticipated that dredging will be undertaken using a deck-mounted grab or cutter suction unit on a bottom-emptying barge. The material will then be off-loaded to land. The material would then require to be transferred to the dewatering facility.

The dewatering facility would most likely require to be purpose built and capable of receiving up to 5,000 m³ of material. We understand that no facility currently exists in Aberdeenshire. Settlement tanks, with the aid of sluices and rotational management, would allow solids to settle out and the water element drain off and return to the sea. Temporary mobilisation of bespoke mechanical dewatering equipment could also be utilised but at greater cost. Alternatively, the material could be temporarily stored until the material dried out, resulting in a reduced cost assuming that suitable temporary storage space is readily available. The dewatered dredged sediment would then be removed from the facility and stockpiled for transfer via lorry to a suitably licensed landfill. This is dependent on space being available close to the harbour and given the close proximity of residential housing and commercial property to the harbour, it is likely to be disruptive to the local community and to visitors to the town.

We understand that the type of vehicle most suitable for transporting the dewatered dredged material is either a rigid bodied tipper or an articulated tanker both with a 16-tonne load capacity. The dredge volume will be a maximum of ~10,000 tonnes¹ of material and approximately 625 return trips would typically be required to transport the dewatered dredged material to landfill.

¹ Maximum volume of dredged material is 5,000m³. Assumed 1m³ = 2 tonnes.

Using information from the SEPA Waste Sites and Capacity Tool, it is understood that the closest operational landfill to the site is at Park Quarry near Durriss, approximately 12 miles from Stonehaven by road. Approximately 625 return trips of 24 miles each would result in an approximate total of 15,000 miles of road transport to dispose of the sediment at this location. In addition, the available capacity of each site is limited by the amount of material it can receive per annum. The Park Quarry landfill is an inert landfill and is licenced to accept up to 75,000 tonnes of waste per annum. The disposal of 10,000 tonnes of material at this location would constitute a significant proportion of the site's annual capacity, therefore it is possible that not all of the material may be able to be accommodated at this site, with some (or potentially all) of the material having to be transported to a site a greater distance from Stonehaven.

4.2.2 Sea Disposal

Two licensed sea disposal sites are located within relatively close proximity of Stonehaven – Stonehaven B (FO007) and Stonehaven (FO003), 1.7km south-east and 3.6km west respectively. Sea disposal is the traditionally accepted sediment disposal method which generally has a low cost and low environmental impact. Disposal to sea directly from the dredging vessel also means that there would be no double handling of material.

5 FURTHER CONSIDERATION OF REMAINING DISPOSAL OPTIONS

5.1 Detailed BPEO Assessment

Each of the identified options was assessed against the criteria detailed in Table 5-1 below.

Table 5-1: BPEO Detailed Assessment Criteria

| Primary Criteria | Description and Attributes |
|-------------------------|--|
| Strategic | <ul style="list-style-type: none"> • Operational aspects, including handling, transport etc. • Availability of suitable sites/facilities • General Public/local acceptability • Legislative Implications • Summary of the outcome of consultation with third parties |
| Environmental | <ul style="list-style-type: none"> • Safety Implications • Public Health Implications • Pollution/ Contamination Implications • General Ecological Implications • Interference with other legitimate activities <i>e.g.</i> fishing • Amenity/Aesthetic Implications |
| Costs | <ul style="list-style-type: none"> • Operating costs <i>e.g.</i> labour, site operations, environmental monitoring • Capital <i>e.g.</i> Transport, equipment hire |

5.1.1 BPEO Strategic Assessment

Table 5-2 below provides details of the strategic assessment for each option taken forward for the detailed BPEO assessment:

Table 5-2: BPEO Strategic Assessment

| Criteria | Landfill | Sea Disposal |
|--|--|--|
| Operational Aspects (inc. handling and transport) | Would involve double handling of material through dewatering and transportation to landfill. A facility would need to be built for dewatering purposes. Would also increase the number of HGV's on the road network. | There would be no double handling of the dredged material. Transportation to the disposal site would be by dredger or barge(s) depending on methodology. |
| Availability of suitable sites/facilities | The geotechnical composition of the dewatered dredged material is considered to be suitable for disposal via this route. However, there are a limited number of landfills in the area. There is, however, a licenced inert landfill ~12 miles from Stonehaven but the site has a relatively small annual permitted capacity. As a result, there is no guarantee that it would be able to accept all of the dredged material, with some (or all) having to be disposed at a different site. In the case of non-hazardous landfills, it is possible that municipal waste will be prioritised over dredge material where other disposal routes are available. | Marine disposal sites nearby have been designed to accommodate the quantities of material typically generated by dredging operations. The total dredge volume for this project is considered to be relatively low. The chemical analysis of the sediments from the proposed dredge sites would indicate that the material is likely to be acceptable for testing pending further risk assessment for contaminants present at levels between Action Level 1 and Action Level 2. |
| General Public /Local acceptability | Increased traffic/HGV movements on the narrow but busy streets around Stonehaven Harbour have potential to result in public complaints. | Traditionally accepted disposal route for dredged material with limited public impact. |
| Legislative Implications | Contravenes the principles of minimising waste and long-term commitments by the government to reduce landfilling. | This is an accepted disposal route as long as a Marine Licence is obtained. |

5.1.2 BPEO Environmental Assessment

Table 5-3 details the environmental assessment for each option taken forward for detailed BPEO assessment.

Table 5-3: BPEO Environmental Assessment

| Criteria | Landfill | Sea Disposal |
|--|--|--|
| Safety Implications | Double handling of material increases the potential for accidents to occur. Work would be undertaken in accordance with H&S legislation. | Low amount of material handling required as it is directly placed at the disposal site. Work would be undertaken in accordance with H&S legislation. |
| Public Health | Measures will be required to limit human contact during transfer of material from dredger to dewatering facility/stockpile and transportation to landfill. Security measures typically employed at licensed landfills which will minimise human contact once accepted and emplaced at site. | Low potential for human contact during dredging and disposal operations. Once deposited at disposal site pathways for human contact greatly reduced. |
| Pollution/contamination | Transfer to dewatering facility and transportation to landfill will all require significant energy. Road transport increases the carbon footprint of this disposal option and would result in localised reduction in air quality in Stonehaven town centre. Potential for spillages to occur. | Pollutant concentrations in dredged material to be disposed are limited to acceptable levels through regulatory licensing processes. Information with regards to the type of disposal site with regards to its effects on sediments has not been provided. Correspondence with Marine Scotland has previously concluded that disposal sites in Scotland are Dispersive. Transport by sea to disposal site would increase the project carbon footprint. Access/tidal restrictions in harbour mean that specialist marine plant may have to be brought in from further afield, further increasing carbon footprint. |
| General Ecological Implications | Licensed landfill would be away from protected species and habitats with measures in place to prevent or minimise pollution of the surrounding environment. | Stonehaven (FO003) and Stonehaven B (FO007) are licensed disposal sites for dredged material. |

| Criteria | Landfill | Sea Disposal |
|--|--|---|
| Interference with other legitimate activities | Potential from limited short term local impact to residents and commercial operations in the area of the dredged material handling and road hauling principally related to noise and dust potential. | The Stonehaven and Stonehaven B disposal sites are licenced disposal sites. It is likely that interference with other activities (such as commercial vessels or fishing) will have been considered as part of the licencing process. Therefore, the likelihood of significant disruption is considered to be low. |
| Amenity / Aesthetic Implications | <p>Potential for odour release from dewatering facility. Increase traffic noise during transportation from dewatering facility to landfill facility.</p> <p>Potential for spillages on haul route.</p> <p>No significant additional visual/odour/noise effects as using an existing landfill site.</p> | Some potential for temporary visual / odour / noise effects while marine plant is in the harbour. However, no significant additional visual/odour/noise effects following disposal as this occurs at sea. |

5.1.3 BPEO Cost Assessment

Costs were assessed for each of the options taken forward for detailed BPEO assessment. The BPEO assessment considered the typical costs associated with dredging, transportation to the disposal site, construction of treatment facilities (where applicable) and methods employed to protect the environment for each of the identified options. As costs are generally “commercially sensitive” the rates are based on best estimates and experience within industry, as opposed to formal quotations.

For the purposes of comparing costs associated with each option a benchmark of 10,000 tonnes (approximately 5,000m³) of dredged material has been set.

The assumptions to calculate the costs are as follows:

- Dredging costs are estimated to be £3.21 per m³;
- Ship transportation costs from the dredged area to disposal / transfer site have been calculated based on £4 per tonne;
- Due to the relatively small volume, and anticipated free draining nature of the material, *i.e.* sand, no cost has been included for the establishment and operation of a dewatering facility. It has been assumed that dewatering would be undertaken by temporary storage of sediment until it dried out;
- Costs associated with transfer of dewatered material to lorry are based on a wheeled shovel (costing £47 per hour) operating for 2 hours per day for 6 days (although a minimum hire charge may make this cost higher);
- Transportation costs of dewatered material to landfill are estimated to be £4.85 per tonne;
- Landfill gate fees are estimated to be £30 per tonne for a non-hazardous landfill (Note: dredged material is currently exempt from landfill tax as defined in Section 7 of the Landfill Tax (Scotland) Act 2014²).

Table 5-4 provides details on the Cost assessment for each option taken forward for detailed BPEO assessment:

Table 5-4: BPEO Cost Analysis (based on 10,000 tonnes)

| Activity | Landfill Disposal (£) | Sea Disposal (£) |
|--------------------------------------|-----------------------|------------------|
| Dredging | 16,050 | 16,050 |
| Transport by vessel to disposal site | - | 40,000 |
| Transfer of material to lorry | 564 | - |
| Transportation Cost to Landfill | 48,500 | - |
| Landfill Gate Fee | 300,000 | - |
| Total Costs | 365,114 | 56,050 |

Note that the above costs do not take into account the cost of additional environmental assessments, or cost associated with gaining planning or licensing consents or potentially to purchase land (where applicable). They also do not take account of the influence volumes will have on costs (economies of scale).

² <https://www.revenue.scot/scottish-landfill-tax/guidance/slft-legislation-guidance/whether-tax-payable/slft3005/slft3006>

5.1.4 BPEO Assessment Discussion

For each of the above assessment criteria, the options were qualitatively and semi-quantitatively (for costs) assessed against feasibility/preference and awarded a ranking ranging from 1 to 4; 1 being the most acceptable and 4 being the least acceptable option. The assignment of rank was on the basis of professional judgement.

The individual assessment criteria rankings for each option were added up to give an overall hierarchy of preference. Table 5-5 provides a summary of the BPEO assessment.

Table 5-5: BPEO Summary

| Criteria | Landfill Disposal | Sea Disposal |
|--------------------|-------------------|--------------|
| Environment | 4 | 2 |
| Strategic | 4 | 2 |
| Costs | 4 | 1 |
| TOTAL SCORE | 12 | 5 |

Disposal to landfill is considered to be the least suitable option for the dredged material. It contravenes the principles of minimising waste and reducing landfilling. Several stages in material handling operations would be required to dispose of the material by this route. The cost associated with transport and disposal of the dredged material is significant. Transportation of material by road is also undesirable as a result of increased traffic and the potential for accidental spillages. Landfill capacity is also typically limited.

Deposition of the dredged material at a licensed marine disposal site has traditionally been deemed acceptable. The nearby licensed marine disposal sites have been designed to allow easy access as well as being capable of accommodating the quantities of material typically generated by dredging activities. Material handling is limited to transportation thereby reducing the risk for pollution incidences occurring. Pollutant concentrations within sediments are also limited to acceptable levels through regulatory requirements. On comparison with other disposal options considered (specifically landfill) the cost associated with sea disposal of the dredged material is considered to be the most financially viable.

5.2 Conclusion

The Best Practicable Environmental Option for disposal of the Stonehaven Harbour dredged material has therefore been assessed as sea disposal.

As identified in the sediment chemical quality section, further assessment is deemed necessary to confirm the suitability of the sediment for disposal to sea. The following section details this assessment.

6 FURTHER ASSESSMENT

As detailed in Section 5.2, on the basis of the exceedances of Action Level 1, further assessment to determine the suitability of the material for sea disposal is deemed a requirement.

The approach for this further assessment is outlined as follows:

- Provide an overview of the proposed dredge works and the identified disposal site including existing chemical monitoring data for the site where available; and
- Compare existing chemical data with other recognised sediment assessment criteria including those listed below. Summary tables are provided in Appendix B.

Background Assessment Concentration (BAC) - BACs were developed by the OSPAR Commission (OSPAR) for testing whether concentrations are near background levels. Mean concentrations significantly below the BAC are said to be near background. However, it should be noted that river catchments have their own unique geochemical fingerprints and are also governed by the geology within the catchment, so in theory one set of background level values is not applicable to all situations;

Effects Range Low (ERL) - ERLs were developed by the United States Environmental Protection Agency (USEPA) for assessing the ecological significance of sediment concentrations. Concentrations below the ERL rarely cause adverse effects in marine organisms. Concentrations above the ERL will often cause adverse effects in some marine organisms;

Probable Effects Level (PEL) – PELs (Marine) have been adopted from the Canadian Environmental Quality Guidelines (http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/). If a concentration is recorded above the PEL this is the probable effect range within which adverse effects frequently occur. The Threshold Effect levels (TELs) have been included in the summary table in Appendix B, but have not been used as part of the further assessment as they typically fall below the RAL1.

The following section contains a review of potential risks to the list of receptors identified in “Water Framework Directive Assessment: estuarine and coastal waters” (<https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>). The conclusions drawn from the available information will provide a recommendation on proposed disposal routes.

6.1 Dredge and Disposal Site

The dredge is to be undertaken within Stonehaven Harbour, within the areas shown on Drawing No. 374702-QGIS001 in Appendix A.

Dredged material is proposed to be taken the “Stonehaven B” (FO007) disposal site, approximately 1.7km south-east of the harbour. Its location is shown on Drawing No. 374702-QGIS002 in Appendix A.

Marine Scotland have noted in the past that in Scotland the preference for disposal site selection is those which are dispersive, and as such it is assumed that the Stonehaven B disposal ground is dispersive.

6.2 Analytical Data Review

Existing analytical data for the proposed dredge site is provided in Summary Table A in Appendix B. This data has been summarised against RAL 1 & 2, the BAC, ERL and PEL. As detailed previously, the data has not been reviewed against the Canadian TEL as these numbers are typically lower than RAL1. A summary of the exceedances is detailed below:

6.2.1 Action Level 1

Exceedances of RAL1 can be summarised as follows:

- Chromium – 2 of 3 samples recorded chromium concentrations above RAL1; and
- PAHs – 2 of 3 samples recorded at least one PAH species above RAL1.

6.2.2 BAC Review

Exceedances of the BAC can be summarised as follows:

- Mercury – 1 of 3 samples recorded mercury concentration above the BAC;
- PAHs – all 3 samples recorded at least one PAH species above the BAC.

6.2.3 ERL & PEL Review

No exceedances of the ERL or PEL (where values are available) were recorded in any of the samples analysed.

6.2.4 Action Level 2

No exceedances of RAL2 were recorded in any of the samples analysed.

6.3 Averages

Review of the averaged data for all the samples has been undertaken *i.e.* considering the material as a single volume for disposal. The review of average data against the available adopted assessment criteria can be summarised as follows:

- Averaged concentrations of chromium marginally exceeded RAL1;
- All other parameters recorded averaged concentrations below RAL1 where they exist;
- Averaged concentrations exceeded the BAC for one or more PAH species;
- All samples recorded averaged concentrations below the ERL where one is available;
- All samples recorded averaged concentrations below the PEL where one is available; and
- All samples recorded averaged concentrations below RAL2 where they exist.

6.4 Chemical Assessment Conclusions

Two of three samples recorded exceedances of RAL1 for chromium. Averaged concentrations, which account for the dredged material as a single volume for disposal, also exceeded RAL1, although the exceedance of the averaged concentration is noted to be marginal. Furthermore, two of three samples recorded exceedances of RAL1 for one or more PAH species. The PAH exceedances are noted to be

marginal and averaged concentrations did not exceed RAL1. No samples recorded contaminant levels in exceedance of RAL2.

One of three samples marginally exceeded the BAC for mercury, although averaged concentrations for mercury did not exceed the BAC. Several exceedances of the BAC were also noted for one or more PAH species across all three samples. Averaged concentrations which consider the dredge as a single volume for disposal also exceeded the BAC for one or more PAH species.

No individual samples or averaged concentrations were noted to exceed either the ERL or PEL.

No background chemical data for the proposed disposal site is available for review, therefore a comparison between sediment sample results and disposal site data cannot be made.

Further consideration of the potential risks associated with the proposed disposal with regards to the water environment is considered in the following sections.

6.5 Water Framework Directive Assessment

As outlined in the Water Framework Directive Assessment: estuarine and coastal waters guidance (Environment Agency, 2017), there are several key receptors which can be impacted upon including the following:

- Hydromorphology;
- Biology – habitats;
- Biology – fish;
- Water quality; and
- Protected areas

Each of these points are considered in Table 6-1 below, in the context of disposal of dredged material at the Stonehaven B licenced disposal site.

Table 6-1: Receptor Risk Assessment

| Key Receptor ³ | Brief Summary of Potential Effects on Receptor | Further Consideration Required? | Comment |
|---|--|---------------------------------|---|
| Hydromorphology (Source Area and Disposal Site) | Morphological conditions, for example depth variation, the seabed and intertidal zone structure tidal patterns, for example dominant currents, freshwater flow and wave exposure | No | <p>Stonehaven Harbour has previously been subject to routine maintenance dredging. The dredge areas are on the North Sea coast, within the Garron Point to Downie Point coastal water body, which is classified as having a “Good” overall status and a classification of “Good” for hydromorphology⁴.</p> <p>The Stonehaven B disposal site is located within the Downie Point to Big Rob’s Cove coastal water body, which has an overall classification status of “High”, and a classification of “High” for hydromorphology. The classification of this water body takes into account the presence of the disposal site, so no further assessment is considered to be required.</p> |
| Biology - habitats | Included to assess potential impacts to sensitive/high value habitats. | No | <p>The dredge areas and disposal areas are noted to have a classification for overall ecology of “Good” and “High” respectively. Both areas have a classification of “High” for invertebrates.</p> <p>The proposed material to be deposited as part of the dredging campaign is similar in nature with material previously deposited. No further assessment is considered necessary.</p> |
| Biology – fish | Consideration of fish both within the estuary and also potential effects on migratory fish in transit through the estuary | No | <p>Stonehaven and the surrounding area does not have a WFD classification for fish. However, the proposed material to be deposited as part of the dredging campaign is similar in nature with material previously deposited.</p> <p>In addition, there is no estuary in close proximity to the site in which migratory fish would be migrating towards. Immediately out with the harbour lies open sea with no obvious constraints. No further assessment is considered necessary.</p> |

³ <https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>

⁴ <https://www.sepa.org.uk/data-visualisation/water-classification-hub/>

| | | | |
|------------------------|--|------------|---|
| <p>Water Quality</p> | <p>Consideration must be given to water quality when contaminants are present in exceedance of CEFAS RAL1.</p> | <p>Yes</p> | <p>Neither the dredge or disposal areas have a classification status for priority substances or specific pollutants. The classification status at both areas for general water quality is “High”.</p> <p>A number of sediment samples recorded results in exceedance of CEFAS RAL1. It is noted that material from Stonehaven Harbour has been dredged and deposited at the Stonehaven B disposal site in the past, and this has not affected the water quality classification status. Potential effects are considered to be both localised and temporary. Further consideration of potential effects are discussed in section 6.6.1 for completeness.</p> |
| <p>Protected Areas</p> | <p>If your activity is within 2km of any WFD protected area, include each identified area in your impact assessment.</p> <ul style="list-style-type: none"> • special areas of conservation (SAC) • special protection areas (SPA) • shellfish waters • bathing waters • nutrient sensitive areas | <p>Yes</p> | <p>The Garron Point Site of Special Scientific Interest (SSSI) is located approximately 750m north of the proposed dredge area at Stonehaven Harbour.</p> <p>The Fowlsheugh Special Protection Area (SPA) is located approximately 225m south of the outer radius of the proposed disposal site (Stonehaven B FO007); and approximately 1.7km south of the harbour to be dredged. There are no SACs or Ramsar sites within 2km of the dredge or disposal sites.</p> <p>Stonehaven beach is designated as a bathing water 220m north of the harbour to be dredged; and approximately 2km from the outer radius of the Stonehaven B disposal site.</p> <p>There are no shellfish harvesting waters within 2km of either the dredge or disposal sites.</p> <p>Further discussion with regard to protected areas is given in Section 6.6.2.</p> |

6.6 Potential Risk to Water Quality and Habitats/Protected Areas

The potential risks to water quality and habitats/protected areas at the dredge and disposal sites are further considered as all other receptors have been screened out of the assessment.

6.6.1 Water Quality

Neither coastal water body covering the dredge or disposal areas have a classification status for priority substances or specific pollutants. The classification status at both areas for general water quality is “High” (Garron Point to Downie Point; and Downie Point to Big Rob’s Cove respectively).

Although concentrations of some contaminants of concern were recorded above the RAL1 within the sediment for disposal, it is considered that these levels will not contribute to an overall degradation of water quality at the disposal site. While any effects are considered to be both localised and temporary, the potential for dilution in the open waters beyond the disposal site is considerable. The disposal site is assumed to be dispersive in nature. Additionally, when the sediment results are reviewed as an average to assess all of the dredged sediment as a single unit for disposal, then a marginal exceedance of RAL1 is present only for chromium. The average chromium concentration is 50.3 mg/kg, against the RAL1 level of 50.0 mg/kg. An exceedance of such a low magnitude is not considered to result in significant degradation to water quality. When considering the averaged results for PAHs, the BAC is exceeded for several species. Averaged concentrations do not exceed RAL1, nor do they exceed the ERL or PEL which are primarily for the protection of marine life. The BAC is intended to be used to determine if concentrations are near to background concentrations, rather than qualify any potential environmental impact. It should also be noted that the BACs for PAH are generally lower than the Marine Scotland RAL1, therefore it is considered to be a very conservative assessment criterion. In addition, PAHs are hydrophobic with low aqueous solubility and will naturally remain associated with organic sediment fractions, rather than become dissolved within the water column. On this basis, the risks associated with impact to water quality from chemical contaminants in sediment are considered to be low, with the associated dilution potential providing further mitigation.

The key risk to water quality is considered to be an increase in turbidity/suspended solids during the disposal activity (*i.e.* placement on the seabed at Stonehaven B disposal site). Although this is likely to cause localised increase in suspended solids at the disposal site, it is considered that this will be both local and temporary in nature.

The sediment material primarily comprises sand and silt and negligible quantities of gravel. Table 6-2 summarises the average physical sediment type from all three samples from the dredge area.

Table 6-2: Averaged PSA Data for Dredge Area

| Gravel % (>2 mm) | Sand % (>63 µm<2 mm) | Silt % (<63 µm) |
|------------------|----------------------|-----------------|
| 1.7 | 61.8 | 36.4 |

The dominant grain size in the material to be dredged is sand. Sands and gravel will fall from suspension quickly, along with any clumps of cohesive material. Silts and clays, being finer grained will suspend and have the potential for dispersal due to longer times in suspension, however it is expected that the majority will quickly fall quickly to the seabed. It is noted that the Stonehaven B disposal site has been utilised for the maintenance dredge disposal from Stonehaven Harbour in the past and the SEPA water quality classification remains as “high”. As a result, it is considered unlikely that this dredging campaign (which is being undertaken in line with previous campaigns), is unlikely to result in a change in the classification status of coastal water bodies at both the dredge and disposal sites.

6.6.2 Protected Areas

The following section gives further discussion on each of the designated protected areas that have been identified within 2km of the dredge and disposal areas, namely:

- Garron Point SSSI;
- Fowlsheugh SPA; and
- Stonehaven Bathing Water.

The potential impacts for each protected area are considered in turn below.

Garron Point SSSI

The Garron Point SSSI lies approximately 750m north of the proposed dredge area at Stonehaven Harbour. The designated features at Garron Point are summarised in Table 6-3.

Table 6-3: Garron Point SSSI Features⁵

| Feature Type | Feature | Latest Assessed Condition |
|----------------|---|---------------------------|
| Earth sciences | Dalradian | Favourable recovered |
| | Non-marine Devonian | Favourable maintained |
| | Ordovician igneous | Unfavourable no change |
| | Silurian – Devonian Chordata | Favourable maintained |
| Coast | Maritime cliff | Favourable maintained |
| Invertebrates | Narrow-mouthed whorl snail (<i>Vertigo angustior</i>) | Favourable declining |
| | Northern brown argus butterfly (<i>Aricia Artaxerxes</i>) | Favourable maintained |

The designated features primarily constitute geological features and rock formations. As such, negative impacts on these features as a result of dredging activity is highly unlikely. Similarly, given the nature of the works and the distances involved, combined with the fact that dredging works will be undertaken in a contained area within the harbour walls, negative impacts on invertebrate species is also considered to be unlikely.

The disposal site is greater than 2km away from the SSSI, therefore does not require to be considered with regard to the SSSI.

Fowlsheugh SPA

The Fowlsheugh SPA lies approximately 225m south of the outer radius of the proposed disposal site (Stonehaven B); and approximately 1.7km south of the harbour to be dredged. The designated features are summarised in Table 6-4.

Table 6-4: Fowlsheugh SPA Features⁶

| Feature Type | Feature | Latest Assessed Condition (1999) |
|--------------|--|----------------------------------|
| Birds | Fulmar (<i>Fulmarus glacialis</i>), breeding | Favourable maintained |
| | Guillemot (<i>Uria aalge</i>), breeding | Favourable maintained |
| | Herring gull (<i>Larus argentatus</i>), breeding | Unfavourable declining |
| | Kittiwake (<i>Rissa tridactyla</i>), breeding | Favourable maintained |
| | Razorbill (<i>Alca torda</i>), breeding | Favourable maintained |
| | Seabird assemblage, breeding | Favourable maintained |

⁵ <https://sitelink.nature.scot/site/674>

⁶ <https://sitelink.nature.scot/site/8505>

The SPA is a protected area for breeding birds. Neither the dredging or disposal activities are considered likely to result in a significant negative impact to breeding bird populations, primarily due to the distances involved from the SPA and also from the localised and temporary nature of the works. In addition, the SPA listing does not specify dredging activities as a negative pressure impacting protected features, despite the disposal ground being in the vicinity of the SPA. Moreover, it is assumed that the presence of the SPA was taken into account when the Stonehaven B disposal site was approved for use. In summary, there are unlikely to be significant negative impacts on protected features as a result of dredging and disposal activities.

Stonehaven Bathing Water

The area of water around Stonehaven beach is a designated bathing water and is located approximately 220m north of the harbour to be dredged; and approximately 2km from the outer radius of the Stonehaven B disposal site.

The bathing water quality for the 2022 season was classified as “good”. The classification for the 2021 season was “sufficient”.⁷

As discussed in Section 6.6.1, potential effects on water quality are not anticipated to be significant or prolonged, although there will be localised and temporary increases in suspended solids/turbidity at the dredge and disposal sites. Given that dredging works will be undertaken in an enclosed area within the harbour walls; and that disposal will be undertaken a considerable distance away from the boundary of the bathing water, the potential for increased suspended solids/turbidity to impact the bathing water is considered to be limited.

The Bathing Water Profile published by SEPA for Stonehaven lists several risks to water quality, but the potential risks on water quality from dredging and sediment disposal is not listed as a potential risk. In terms of the disposal of dredged material, it is assumed that the presence of the Stonehaven disposal sites have been taken into account when the bathing water was designated; and vice-versa in that the presence of the bathing water would have been considered when establishing a disposal site.

Moreover, it is noted that dredging and disposal works undertaken during the spring of 2022 did not result in a reduction in the bathing water quality classification during the June to September bathing water season.

In summary, the dredging and disposal activity is considered unlikely to result in a degradation in bathing water quality and a reduction in quality classification.

⁷ <https://www2.sepa.org.uk/BathingWaters/ViewResults.aspx?id=233617>

7 BPEO CONCLUSIONS AND RECOMMENDATIONS

Aberdeenshire Council has appointed EnviroCentre Ltd. to complete a Marine Licence application and BPEO assessment for dredging at Stonehaven Harbour in Aberdeenshire. This has been informed using sediment quality results from sampling undertaken in June 2020.

The site was previously licenced under MS-00008915, which expired on 2nd June 2022. As such, this project is considered to be a maintenance dredge. Dredging is required to keep the Harbour operational and to provide safe navigation for harbour users.

The proposed dredge depth will not exceed 1 metre and a maximum volume of 5,000 m³ will be dredged across both dredge areas in the harbour.

Results from analysis of sediment samples from across the harbour recorded chromium and PAHs in exceedance of RAL 1. However, assessment of key receptors identified from the Water Framework Directive assessment for estuarine and coastal waters concluded that there is a low risk of the sediments impacting upon the overall ecological or chemical status upon disposal.

Based on the multiple lines of evidence approach adopted to further assess the exceedances identified in the sediment assessment, the material as a whole is considered to be suitable for disposal at sea, specifically at the Stonehaven B disposal site (FO007). This option is considered to have no significant long-term impact on the marine environment, is readily accessible from the harbour and has been assessed as the most cost-effective option.

REFERENCES

Environment Agency (2017). Water Framework Directive assessment: estuarine and coastal waters. <https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>

Marine Scotland (2017). *Pre-Dredge Sampling Guidance Version 2*: Scottish Government.

Marine Scotland (2015). *Guidance for Marine Licence Applicants Version 2*: Scottish Government.

APPENDICES

A FIGURES

387600 387700 387800 387900 388000

785600

785500

785400

785300

785600

785500

785400

785300



Legend

 Dredge Areas

Do not scale this map

Client
Aberdeenshire Council

Project
Stonehaven Harbour
Dredge Licence Application

Title
Dredge Areas

Status
FINAL

| | | |
|--------------------------------------|------------------------|----------------------------|
| Drawing No. 374702-QGIS001 | Revision - | Date 09 Sep 2022 |
| Drawn FR | Checked CCAS | Approved CCAS |

Scale
1:1,500 @ A3

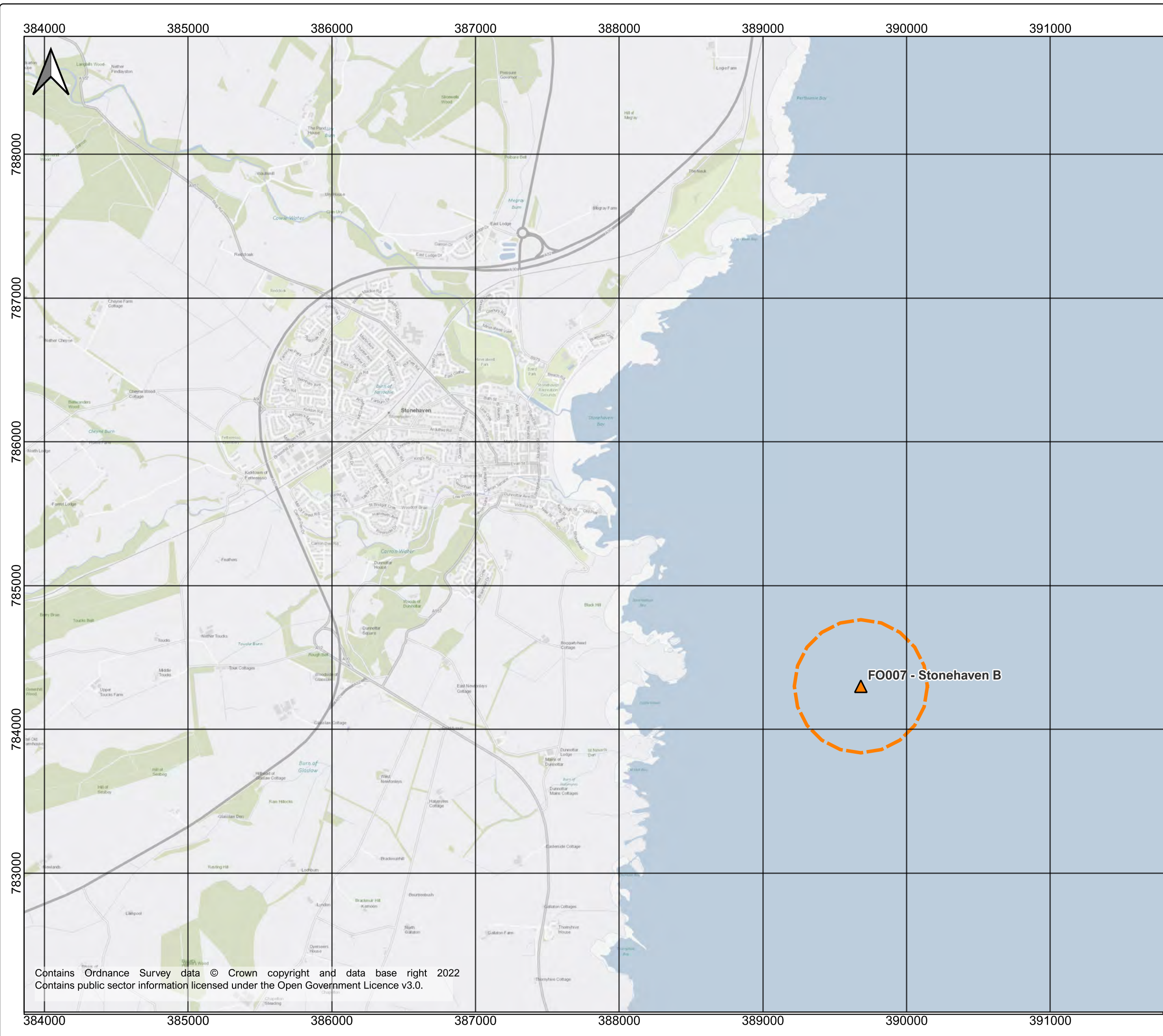
| Rev | Date | Amendment | Initials |
|-----|------|-----------|----------|
| - | - | - | - |



Banchory Business Centre, Burn o' Bennie Road,
Banchory, AB31 5ZJ. T: 01330 826596
E: info@envirocentre.co.uk W: www.envirocentre.co.uk

© OpenStreetMap and contributors; Creative Commons Share Alike Licence (CC-BY-SA)
Imagery Source: Bing Maps. Image courtesy of Ordnance Survey © 2022 TomTom

387600 387700 387800 387900 388000



Legend

- FO007 Stonehaven B Disposal Site
- 0.25 Nautical Mile Buffer Zone

Do not scale this map

Client
Aberdeenshire Council

Project
Stonehaven Harbour
Dredge Licence Application

Title
Stonehaven B Disposal Site

Status
FINAL

| | | |
|--------------------------------------|------------------------|----------------------------|
| Drawing No. 374702-QGIS002 | Revision - | Date 09 Sep 2022 |
| Drawn FR | Checked CCAS | Approved CCAS |

Scale
1:25,000 @ A3

| Rev | Date | Amendment | Initials |
|-----|------|-----------|----------|
| - | - | - | - |

Banchory Business Centre, Burn o' Bennie Road,
Banchory, AB31 5ZU. T: 01330 826596
E: info@envirocentre.co.uk W: www.envirocentre.co.uk

Contains Ordnance Survey data © Crown copyright and data base right 2022
Contains public sector information licensed under the Open Government Licence v3.0.

B SUMMARY TABLES

Summary Table A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

| Source | Stonehaven Harbour | | | | | | | | | | AVERAGE | No. Exceed RAL 1 | No. Exceed RAL 2 | No. Exceed BAC7 | No. Exceed ERL | No. Exceed PEL7 |
|------------------------|--------------------|------|-------|-------|--------|---------|---------|---------|--------|---|---------|------------------|------------------|-----------------|----------------|-----------------|
| | AL1 | AL2 | BAC | | ERL | PEL | Grab 1 | Grab 2 | Grab 3 | | | | | | | |
| | | | CSEMP | CSEMP | Canada | | | | | | | | | | | |
| Arsenic | 20 | 70 | 25 | | 41.6 | 4 | 10.2 | 5.3 | 6.50 | 0 | 0 | 0 | - | 0 | | |
| Cadmium | 0.4 | 4 | 0.31 | 1.2 | 4.2 | 0.09 | 0.16 | 0.09 | 0.11 | 0 | 0 | 0 | 0 | 0 | | |
| Chromium | 50 | 370 | 81 | 81 | 160 | 46.9 | 50.4 | 53.6 | 50.30 | 2 | 0 | 0 | 0 | 0 | | |
| Copper | 30 | 300 | 27 | 34 | 108 | 26.4 | 18.3 | 9.6 | 18.10 | 0 | 0 | 0 | 0 | 0 | | |
| Mercury | 0.25 | 1.5 | 0.07 | 0.15 | 0.7 | 0.03 | 0.08 | 0.03 | 0.05 | 0 | 0 | 1 | 0 | 0 | | |
| Nickel | 30 | 150 | 36 | - | - | 11.8 | 22.3 | 11.9 | 15.33 | 0 | 0 | 0 | N/A | N/A | | |
| Lead | 50 | 400 | 38 | 47 | 112 | 10.6 | 19.6 | 8.5 | 12.90 | 0 | 0 | 0 | 0 | 0 | | |
| Zinc | 130 | 600 | 122 | 150 | 271 | 60 | 78 | 40 | 59.73 | 0 | 0 | 0 | 0 | 0 | | |
| Napthalene | 0.1 | | 0.08 | 0.16 | 0.391 | 0.037 | 0.019 | 0.006 | 0.02 | 0 | - | 0 | 0 | 0 | | |
| Acenaphthylene | 0.1 | | | | 0.128 | 0.006 | 0.006 | 0.002 | 0.00 | 0 | - | N/A | N/A | 0 | | |
| Acenaphthene | 0.1 | | | | 0.0889 | 0.006 | 0.006 | 0.004 | 0.01 | 0 | - | N/A | N/A | 0 | | |
| Fluorene | 0.1 | | | | 0.144 | 0.009 | 0.009 | 0.004 | 0.01 | 0 | - | N/A | N/A | 0 | | |
| Phenanthrene | 0.1 | | 0.032 | 0.24 | 0.544 | 0.069 | 0.058 | 0.032 | 0.05 | 0 | - | 2 | 0 | 0 | | |
| Anthracene | 0.1 | | 0.05 | 0.085 | 0.245 | 0.024 | 0.017 | 0.009 | 0.02 | 0 | - | 0 | 0 | 0 | | |
| Fluoranthene | 0.1 | | 0.039 | 0.6 | 1.494 | 0.110 | 0.088 | 0.041 | 0.08 | 1 | - | 3 | 0 | 0 | | |
| Pyrene | 0.1 | | 0.024 | 0.665 | 1.398 | 0.115 | 0.090 | 0.041 | 0.08 | 1 | - | 3 | 0 | 0 | | |
| Benzo(a)anthracene | 0.1 | | 0.016 | 0.261 | 0.693 | 0.059 | 0.047 | 0.021 | 0.04 | 0 | - | 3 | 0 | 0 | | |
| Chrysene | 0.1 | | 0.02 | 0.384 | 0.846 | 0.059 | 0.046 | 0.022 | 0.04 | 0 | - | 3 | 0 | 0 | | |
| Benzo(b)fluoranthene | 0.1 | | - | - | - | 0.052 | 0.073 | 0.027 | 0.05 | 0 | - | N/A | N/A | N/A | | |
| Benzo(k)fluoranthene | 0.1 | | - | - | - | 0.029 | 0.033 | 0.013 | 0.02 | 0 | - | N/A | N/A | N/A | | |
| Benzo(a)pyrene | 0.1 | | 0.03 | 0.384 | 0.763 | 0.070 | 0.063 | 0.025 | 0.05 | 0 | - | 2 | 0 | 0 | | |
| Indeno(1,2,3cd)pyrene | 0.1 | | 0.103 | 0.24 | - | 0.057 | 0.071 | 0.025 | 0.05 | 0 | - | 0 | 0 | N/A | | |
| Benzo(ghi)perylene | 0.1 | | 0.08 | 0.085 | - | 0.073 | 0.066 | 0.023 | 0.05 | 0 | - | 0 | 0 | N/A | | |
| Dibenzo(a,h)anthracene | 0.01 | | - | - | 0.135 | 0.011 | 0.012 | 0.005 | 0.01 | 2 | - | N/A | N/A | 0 | | |
| TPH | 100 | | - | - | - | 29.00 | 90.80 | 36.00 | 51.93 | 0 | - | N/A | N/A | N/A | | |
| PCBs | 0.02 | 0.18 | - | - | 0.189 | 0.00057 | 0.00056 | 0.00057 | 0.0006 | 0 | 0 | N/A | N/A | 0 | | |
| TBT | 0.1 | 0.5 | - | - | - | 0.01 | 0.005 | 0.005 | 0.0067 | 0 | 0 | N/A | N/A | N/A | | |

Note: Underlined Values are < LOD

PEL Data Source: <http://cegg-rcqe.cme.ca/en/index.html#void>

Summary Table B

Stonehaven Average Concentrations

All units in mg/kg

| Source | AL1 | AL2 | BAC CSEMP | <ERL CSEMP | PEL Canada | Dredge Average | Exceed AL1? | Exceed AL2? | Exceed BAC? | Exceed ERL ? | Exceed PEL? |
|------------------------|------|------|--------------|---------------|---------------|----------------|-------------|-------------|-------------|--------------|-------------|
| Arsenic | 20 | 70 | 25 | - | 41.6 | 6.5 | No | No | No | N/A | No |
| Cadmium | 0.4 | 4 | 0.31 | 1.2 | 4.2 | 0.1 | No | No | No | No | No |
| Chromium | 50 | 370 | 81 | 81 | 160 | 50.3 | Yes | No | No | No | No |
| Copper | 30 | 300 | 27 | 34 | 108 | 18.1 | No | No | No | No | No |
| Mercury | 0.25 | 1.5 | 0.07 | 0.15 | 0.7 | 0.05 | No | No | No | No | No |
| Nickel | 30 | 150 | 36 | - | - | 15.3 | No | No | No | N/A | N/A |
| Lead | 50 | 400 | 38 | 47 | 112 | 12.9 | No | No | No | No | No |
| Zinc | 130 | 600 | 122 | 150 | 271 | 59.7 | No | No | No | No | No |
| | | | | | | | | | | | |
| Napthalene | 0.1 | - | 0.08 | 0.16 | 0.319 | 0.02 | No | N/A | No | No | No |
| Acenaphthylene | 0.1 | - | - | - | 0.128 | 0.005 | No | N/A | N/A | N/A | No |
| Acenaphthene | 0.1 | - | - | - | 0.0889 | 0.01 | No | N/A | N/A | N/A | No |
| Fluorene | 0.1 | - | - | - | 0.144 | 0.01 | No | N/A | N/A | N/A | No |
| Phenanthrene | 0.1 | - | 0.032 | 0.24 | 0.544 | 0.05 | No | N/A | Yes | No | No |
| Anthracene | 0.1 | - | 0.05 | 0.085 | 0.245 | 0.02 | No | N/A | No | No | No |
| Fluoranthene | 0.1 | - | 0.039 | 0.6 | 1.494 | 0.08 | No | N/A | Yes | No | No |
| Pyrene | 0.1 | - | 0.024 | 0.665 | 1.398 | 0.08 | No | N/A | Yes | No | No |
| Benzo(a)anthracene | 0.1 | - | 0.016 | 0.261 | 0.693 | 0.04 | No | N/A | Yes | No | No |
| Chrysene | 0.1 | - | 0.02 | 0.384 | 0.846 | 0.04 | No | N/A | Yes | No | No |
| Benzo(b)fluoranthene | 0.1 | - | - | - | - | 0.05 | No | N/A | N/A | N/A | N/A |
| Benzo(k)fluoranthene | 0.1 | - | - | - | - | 0.02 | No | N/A | N/A | N/A | N/A |
| Benzo(a)pyrene | 0.1 | - | 0.03 | 0.384 | 0.763 | 0.05 | No | N/A | Yes | No | No |
| Indeno(1,2,3cd)pyrene | 0.1 | - | 0.103 | 0.24 | - | 0.05 | No | N/A | No | No | N/A |
| Benzo(ghi)perylene | 0.1 | - | 0.08 | 0.085 | - | 0.05 | No | N/A | No | No | N/A |
| Dibenzo(a,h)anthracene | 0.01 | - | - | - | 0.135 | 0.01 | No | N/A | N/A | N/A | No |
| | | | | | | | | | | | |
| PCBs | 0.02 | 0.18 | - | - | 0.189 | 0.001 | No | No | N/A | N/A | No |
| TBT | 0.1 | 0.5 | - | - | - | 0.0067 | No | No | N/A | N/A | N/A |