Macduff Harbour
Best Practicable Environmental Option (BPEO) Report

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1 INTRODUCTION

1.1 Terms of Reference

Aberdeenshire Council has appointed EnviroCentre Ltd to complete a Marine Licence application for dredging at Macduff 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 November 2023, and from additional samples collected in February 2024.

The site was previously licenced under number: MS-00008763, which expired in May 2024. As such, this project is considered to be a maintenance dredge.

Dredging will be undertaken to a maximum depth of 1.0m or less across the dredge areas to be licenced. A maximum quantity of 5,000m^3 is proposed to be dredged. The proposed dredge area is shown in Drawing No. 374702-QGIS008.

The purpose of the sample 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 November 2023 and February 2024 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.

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2 SAMPLING LOCATIONS AND METHODOLOGY

Initial sampling works (comprising collection of three grab samples) were undertaken on 30th November 2023, as per the Sampling Plan (EnviroCentre Document No. 13721) agreed with Marine Directorate Licensing Operations Team (MD-LOT). Chemical results were reviewed following this exercise and exceedances of RAL2 were recorded at a location within the inner basin (Princess Royal Basin). In light of this, the Princess Royal Basin and its approach from the Middle Basin was subject to additional investigation. Additional sampling works were undertaken on 13th February 2024, with a further five grab samples being collected.

The following section details the sampling methodology used to retrieve sediment samples.

2.1 Sample Locations

Grab samples were collected from three locations during the November 2023 sampling round. A further five samples were collected in February 2024, as outlined in Table 2-1 below.

Table 2-1: Sample Locations Obtained in November 2023 and February 2024

Sample Station ID	Latitude	Longitude	Sample Type	Sub-Area
Grab A	57° 40.344’	-002° 29.888’	Grab	Princess Royal Basin
Grab B	57° 40.275’	-002° 29.908’	Grab	Middle Basin
Grab C	57° 40.209’	-002° 29.924’	Grab	West Basin & Channel
Grab A-1	57° 40.290’	-002° 29.936’	Grab	Middle Basin
Grab A-2	57° 40.327’	-002° 29.915’	Grab	Princess Royal Basin
Grab A-3	57° 40.337’	-002° 29.871’	Grab	Princess Royal Basin
Grab A-4	57° 40.355’	-002° 29.826’	Grab	Princess Royal Basin
Grab A-5	57° 40.373’	-002° 29.849’	Grab	Princess Royal Basin

All sampling locations and the area subject to additional investigation are shown in Drawing No. 374702-GIS008, included in Appendix A.

2.2 Navigation and Sample Location

Pre-determined sample station locations were programmed into a Trimble TDC100 GPS device. However, some sample locations were slightly re-sited during site works, owing to hard seabed conditions and deposits of seaweed in places. Upon successful recovery of sample, the location was logged on the GPS device before moving to the next location.

2.3 Sample Collection

Grab samples were obtained using a 0.045m^2 stainless steel Van Veen grab sampler. Grab samples were collected by hand from the Macduff Harbour Pilot Vessel, *Sea Helper,* operated by Aberdeenshire Council. Where required, the grab was deployed multiple times to ensure enough sample was recovered for testing. Recovered material was emptied into a plastic bucket ready for sub-sampling.

2.4 Field Information

The following field data was recorded for each sample obtained:

- A unique sample ID;
- Sample location;
- Sample coordinate in latitude and longitude in degrees, minutes and decimals of minutes;
- Date, time and depth of collection;
- Sampler's ID;
- Sediment description;
- Sample photographs; and,
- Details of any deviation from sampling protocol.

2.5 Sample Preparation

Grab samples were photographed and logged prior to sub-sampling.

Samples for metals and particle size analysis were sub-sampled using a plastic spoon and stored in plastic tubs. Samples for organic analysis were collected using stainless steel spoons and stored in amber glass jars.

Sampling equipment (spoons etc.) were cleaned with fresh water between samples to minimise the risk of cross contamination.

Once samples had been placed within appropriate containers, they were labelled and placed immediately into cool boxes. Samples were dispatched to the project laboratory (Socotec) on the day after sampling.

2.6 Analysis Requirements

The laboratory analysis required by Marine Scotland (MD-LOT), and undertaken as part of this investigation, was as follows:

- Moisture Content;
- Organic Matter (TOC);
- Metals- As, Cr, Cd, Cu, Hg, Ni, Pb, Zn;
- Tributyl Tin;
- PAHs – USEPA 16;
- PCBs – ICES 7;
- Total Hydrocarbons;
- Asbestos Screen; and
- Particle Size Distribution.

Additional grab samples (Grabs A-1 to A-5) were subject to analysis of the Metals suite only.

Samples were sent to the Socotec Marine Laboratory for analysis.

3 RESULTS

The following section details sample results. Sediment sample logs are provided in Appendix B. The laboratory certificates are provided in Appendix D and a summary sheet highlighting exceedances above the RALs in Excel format accompanies this report in the submission to Marine Scotland.

3.1 Sediment Summary

Sediment generally comprised of soft black/dark greyish brown silt and sand. Leaf litter and vegetation was noted in most samples. Hydrocarbon blooms were noted at a number of samples.

The exception to this was Grab C (in the West (outer) Basin) which comprised light brown fine sand.

Anthropogenic inputs were noted in some sediment samples collected within the Princess Royal Basin, including metal items, paint chips, cloth and rope.

Full descriptions and photographs for each sample station are provided in Appendix B.

3.2 Physical Analysis

3.2.1 Particle Size Analysis (PSA)

Sediment in the Princess Royal Basin (represented by Grab A) was noted to primarily comprise sand and silt sized particles. Sediment from Grab B (located in the Middle Basin) was noted to comprise primarily sand with roughly equal proportions of gravel and silt. Sediment in the West Basin (represented by Grab C) predominantly comprised sand with a small quantity of silt.

The Particle Size Analytical data sets for each sample is included within Appendix C.

3.3 Chemical Analysis

3.3.1 Chemical Analysis Assessment Criteria

All chemical analysis results were assessed against Revised Action Levels (RAL) criteria as adopted by Marine Scotland. The results are summarised in sections 3.3 and 3.4. Summary reports detailing exceedances in the Marine Scotland format have been submitted along with the supporting information for the application. The laboratory certificates are provided in Appendix D.

Where contaminants have RALs as adopted by Marine Scotland, exceedances above these criteria are summarised in Table 3-1, along with the maximum concentration recorded for each parameter.

Table 3-1: Exceedances of Revised Action Levels and Maximum Concentrations

Contaminant	No. Exceedances (of 3 samples[1])		Maximum Concentration (mg/kg) and Location
	RAL1	RAL2	
Arsenic	3	0	33.3 at Grab A-5
Cadmium	7	0	1.8 at Grab A-4
Copper	7	**5**	3,960 at Grab A-5
Chromium	5	0	115 at Grab A-5
Lead	4	0	89.9 at Grab A-5
Mercury	0	0	0.18 at Grab A-3
Nickel	4	0	69.4 at Grab A-5
Zinc	6	**4**	2,633 at Grab A-5
PAH (All Species)	3	N/A	1.25 (Fluoranthene) at Grab C
PCBs	0	0	0.0028 at Grab A
TBT	1	0	0.362 at Grab A
THC	2	N/A	3,370 at Grab A

All but one sample recorded an exceedance of at least one metal above RAL1. All three of the samples analysed for the full suite recorded exceedances above RAL1 for at least one PAH species, with two samples recording an exceedance of RAL1 for THC. Sample Grab A also recorded an exceedance above RAL1 for TBT.

Of the eight samples analysed for the metals suite, five recorded exceedances above RAL2 for copper; and four recorded exceedances above RAL2 for zinc. Note that in the sediment results in the Marine Scotland Excel template, which accompanies this submission, a formatting error means that one sample (Grab C) is incorrectly highlighted as being in exceedance of RAL2 for DBT.

Visible paint chips were noted to be present in all but two of the samples which exceeded RAL2 for copper and zinc (see logs in Appendix B). Copper and zinc can be attributed to spent antifouling paints and therefore this may be the primary source of elevated copper and zinc in the sediment samples.

Contaminants of concern exceeding RAL1 and RAL2 for each sample are detailed in Table 3-2 and Table 3-3 respectively.

Table 3-2: Exceedances Above RAL1 by Sample

Sample Station ID	Parameters Exceeding RAL 1
Grab A	Arsenic, Cadmium, Chromium, Copper, Nickel, Zinc, PAH and TBT.
Grab B	Cadmium, Copper, Zinc and PAH.
Grab C	PAH.
Grab A-1	Cadmium, Copper and Zinc
Grab A-2	Cadmium, Chromium, Copper, Lead and Zinc.
Grab A-3	Cadmium, Chromium, Copper, Nickel, Lead and Zinc.
Grab A-4	Arsenic, Cadmium, Chromium, Copper, Nickel, Lead and Zinc.
Grab A-5	Arsenic, Cadmium, Chromium, Copper, Nickel, Lead and Zinc.

[1] The additional grab samples collected in February 2024 meant that 8 samples were analysed for the Metals suite.

Table 3-3: Exceedances Above RAL 2 by Sample

Sample Station ID	Parameters Exceeding RAL 2
Grab A	Copper and Zinc.
Grab A-2	Copper.
Grab A-3	Copper and Zinc.
Grab A-4	Copper and Zinc.
Grab A-5	Copper and Zinc.

3.4 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 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 and berth in the harbour. The harbour is also used for vessels to obtain access to and from Macduff Shipyard.	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	Much of the Aberdeenshire and Moray coast are designated sites (SSSI, SPA) and hold both national and international importance to nature conservation. Specific beach nourishment projects may require to be supported by Environmental Impact Assessment 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. The sediment type across the dredge area mostly contains silt with the inclusion of anthropogenic materials in several of the samples obtained. Therefore, the material within the dredge area is unlikely to be considered suitable for reuse for beach nourishment. 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

Location	Options	Screening Assessment	Carry forward?
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. However, it is noted that several samples recorded exceedances for metals above RAL2, which generally means that this material would be unsuitable for disposal at sea and a land-based disposal route would require to be found for this material and landfill may offer a solution.	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. It would require detailed chemical analysis and assessment as well as a Waste Management Licence Exemption. It 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	Recycling of dredged material is theoretically possible, however, due to the varied lithology there would need to be either segregation during dredging works, or energy and water rich processing on land. EnviroCentre have not been made aware by the harbour authority of an established disposal and reuse route in Aberdeenshire and Moray 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 dredge spoil disposal ground is Macduff (CR050), 2.5km north-east of Macduff Harbour. The proposed dredge method is to utilise a grab dredger with a split hull hopper or similar, as per previous dredging campaigns. 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.	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 m^3 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, to visitors to the town and to industrial operations around the harbour.

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 tonnes[2] of material and approximately 625 return trips would

[2] Maximum volume of dredged material is 5,000m^3. Assumed 1m^3 = 2 tonnes.

typically be required to transport the dewatered dredged material to landfill. This assumes that all of the dredged material will be directed to landfill.

Using information from the SEPA Waste Sites and Capacity Tool, it is understood that the closest operational landfill to the site is at Loch Hills Quarry, near Dyce, approx. 38.2 miles from Macduff by road. Approximately 625 return trips of 76.4 miles each would result in an approximate total of 47,750 miles of road transport to dispose of the sediment at this location. Again, this assumes that all of the dredged material will be disposed of at landfill. In addition, the available capacity of each site is limited by the amount of material it can receive per annum. The Loch Hills Quarry landfill is an inert landfill and is licenced to accept up to 100,000 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 Macduff. It also assumes that the material will be suitable for disposal at an inert landfill. The waste classification status will require to be further assessed prior to disposal. Where material is brought on to land, the Scottish Environment Protection Agency (SEPA) will be the enforcing authority.

4.2.2 Sea Disposal

A licenced sea disposal site is located within close proximity of Macduff Harbour – Macduff (CR050) is located 2.5km north-east of the harbour to be dredged.

It is anticipated that dredging will be undertaken using a grab dredger with a split hull hopper, or a similar configuration. This would mean that dredging and disposal can take place without the need for double handling of material or bringing the dredged material ashore.

This practice has previously been accepted as a disposal route for dredged material from Macduff Harbour.

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	• 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	• Safety Implications • Public Health Implications • Pollution/ Contamination Implications • General Ecological Implications • Interference with other legitimate activities *e.g.* fishing • Amenity/Aesthetic Implications
Costs	• Operating costs *e.g.* labour, site operations, environmental monitoring • Capital *e.g.* 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 dredging vessel without the need to bring the material on to land. The proposed disposal site is only 2.5km away by sea.
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 ~38.2 miles from Macduff 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 within the 'Middle Basin' and the 'West Basin and Channel' would indicate that the material is likely to be acceptable for disposal 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 around Macduff Harbour have potential to result in public complaints and disruption to industrial operations.	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 Disposal	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 are 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 Macduff village. Potential for spillages to occur. This disposal route may provide a suitable disposal route for dredged material with contaminant concentrations recorded in excess of RAL2.	Pollutant concentrations in dredged material to be disposed are limited to acceptable levels through regulatory licensing processes. Sediment with contaminant concentrations in excess of RAL2 would not typically be permitted for sea disposal. Information with regards to the type of disposal site and its effects on sediments has not been provided. Correspondence with Marine Scotland has previously concluded that disposal sites in Scotland are typically dispersive. Transport by sea to disposal site would increase the project carbon footprint, however this is limited due to the relatively short distance (2.5 km) to the nearest sea disposal site.
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.	Macduff (CR050) is a licensed disposal site for dredged material. The disposal site is located within the Southern Trench MPA which amongst its designated features are mike whales. Therefore there may be a requirement for a Marine Mammal Observer (MMO) to be present during disposal operations.

Criteria	Landfill Disposal	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 Macduff disposal site is licensed by Marine Scotland for the disposal of dredging spoil. 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	Potential for odour release from dewatering facility. Increase traffic noise during transportation from dewatering facility to landfill facility. Potential for spillages on haul route. No significant additional visual/odour/noise effects as using an existing landfill site.	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 5,000m^3) of dredged material has been set.

The assumptions to calculate the costs are as follows:

- Dredging costs are estimated to be £3.21 per m^3;
- Ship transportation costs from the dredged area to disposal 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 £3.00 per mile, with 625 return trips of 38.2 miles required between the Harbour and the nearest operational landfill. This equates to a total of 23,875 miles and a cost of £71,625;;
- 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 2014[3]).

Table 5-4 below 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	2,250	-
Transportation Cost to Landfill	71,625	-
Landfill Gate Fee	300,000	-
Indicative Total Costs	**389,925**	**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

[3] https://www.revenue.scot/scottish-landfill-tax/guidance/slft-legislation-guidance/whether-tax-payable/slft3005/slft3006

applicable). They also do not take account of the influence volumes will have on costs (economies of scale).

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: BPEO Summary

Criteria	Landfill Disposal	Sea Disposal
Environment	4	2
Strategic	4	2
Costs	4	2
TOTAL SCORE	**12**	**6**

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, and using this disposal route is likely to be cost prohibitive. 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. However, given that material is present within the harbour with concentrations of metals in exceedance of RAL2, disposal to landfill would offer a suitable solution to this material, as it is unable to be disposed or re-used in the marine environment. However, an alternative land-based disposal solution (at lower cost) is likely to be preferred for material that is unsuitable for sea disposal.

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. One other benefit of sea deposition of suitable material is that it retains it within the coastal sediment transport system. 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 Macduff Harbour dredged material has therefore been assessed as sea disposal. Initial review of the sediment quality results suggests that material from the Middle Basin and the West Basin and Channel may be suitable for sea disposal. It is acknowledged that material from the Princess Royal Basin is not suitable sea disposal.

Additional sampling has allowed for further characterisation of sediment from the Princess Royal Basin. Analytical results for the material to be dredged from this area recorded exceedances of RAL2 for

Copper and Zinc, meaning that sea disposal is not considered to be viable disposal route for these sediments. The additional sampling has allowed the area earmarked for land-based disposal to be delineated as the entirety of the Princess Royal Basin. Grab A-1, collected in the Middle Basin near to its access to the Princess Royal Basin, nor any others within the Middle Basin or West Basin, did not record any exceedances above RAL2. Landfill disposal has been considered as a 'worst case' disposal route for this material, but disposal to landfill is likely to be cost prohibitive. It is recommended that an alternative land-based disposal solution is sought for material dredged form the Princess Royal Basin. In this instance, SEPA would become the enforcing authority. The area earmarked for land-based disposal, shown with RAL2 exceedances, is shown in Drawing No. 374702-QGIS009 in Appendix A.

The Princess Royal Basin makes up approximately 40% of the total dredge area. On the basis that the maximum total annual dredge volume is 5,000m^3, it is estimated that a maximum of 2,000m^3 will be subject to land-based disposal (i.e. 40% of 5,000m^3).

For the material in the Middle and West Basins, further assessment is required to determine its suitability for sea disposal due to exceedances of RAL1. This assessment is provided in the following section.

6 FURTHER ASSESSMENT

As detailed in Section 1.3, 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 C.

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 C, 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 Macduff Harbour, within the areas shown on Drawing No 374702-QGIS008.

Dredged material from the Middle Basin and the West Basin and Channel is proposed to be taken the Macduff (CR050) disposal site, which is located 2.5km north-east of the harbour to be dredged. Its location is shown on Drawing No 374702-QGIS010.

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 Macduff 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 C. 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 in the sections below. Note that the summaries below consider the material only from Middle Basin, and West Basin and Channel (represented by Grabs B, C and A-1 only), for which the BPEO has been identified as sea disposal.

6.2.1 Action Level 1

Exceedances of RAL1 at all locations are summarised in Table 3-1. Exceedances accounting only for the material earmarked for sea disposal are listed below:

- Cadmium – 2 of 3 samples recorded cadmium concentrations above RAL1;
- Copper - 2 of 3 samples recorded copper concentrations above RAL1;
- Zinc – 2 of 3 samples recorded zinc concentrations above RAL1;
- PAH (All Species) – 2 of 2 samples analysed for PAH recorded concentrations above RAL1; and
- THC – 1 of 2 samples analysed for THC recorded concentrations above RAL1.

6.2.2 BAC Review

Exceedances of the BAC for the material earmarked for sea disposal is be summarised as follows:

- Cadmium – 2 of 3 samples recorded cadmium concentrations above BAC;
- Copper – 2 of 3 samples recorded copper concentrations above BAC;
- Mercury - 1 of 3 samples recorded mercury concentrations above BAC;
- Zinc - 2 of 3 samples recorded zinc concentrations above BAC; and
- PAH (All Species) – 2 of 2 samples analysed for PAH recorded concentrations above BAC.

6.2.3 ERL Review

Exceedances of the ERL for the material earmarked for sea disposal is be summarised as follows:

- Copper – 2 of 3 samples recorded copper concentrations above ERL;
- Zinc - 2 of 3 samples recorded zinc concentrations above ERL; and
- PAH (All Species) – 2 of 2 samples analysed for PAH concentrations above ERL.

6.2.4 PEL Review

Exceedances of the PEL for the material earmarked for sea disposal is be summarised as follows:

- PAH - 1 of 2 samples analysed for PAHs recorded concentrations above PEL (specifically for Phenanthrene and Anthracene).

6.2.5 Action Level 2

It is noted that exceedances of RAL2 were recorded in the Princess Royal Basin. This material has been earmarked for land-based disposal and is not considered further in the context of assessing suitability for sea disposal.

No exceedances of RAL2 were recorded in the areas being considered for sea disposal (*i.e.* Middle Basin or West Basin and Channel).

6.3 Averages

A review of the averaged data for samples taken from the Middle Basin and West Basin and Channel has been undertaken *i.e.* considering the material as a single volume for disposal. Material from the Princess Royal Basin has not been considered in the averaged concentrations, The review of average data against the available adopted assessment criteria can be summarised as follows in Table 6-1 below:

Table 6-1: Average Dredge Area (Middle Basin and West Basin and Channel) Exceedances of Assessment Criteria

Parameter	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
Arsenic	No	No	No	N/A	No
Cadmium	No	No	Yes	No	No
Chromium	No	No	No	No	No
Copper	Yes	No	Yes	Yes	No
Mercury	No	No	No	No	No
Nickel	No	No	No	N/A	N/A
Lead	No	No	No	No	No
Zinc	Yes	No	Yes	Yes	No
Napthalene	No	N/A	No	No	No
Acenaphthylene	No	N/A	N/A	N/A	No
Acenaphthene	No	N/A	N/A	N/A	No
Fluorene	No	N/A	N/A	N/A	No
Phenanthrene	Yes	N/A	Yes	Yes	No
Anthracene	Yes	N/A	Yes	Yes	No
Fluoranthene	Yes	N/A	Yes	Yes	No
Pyrene	Yes	N/A	Yes	Yes	No
Benzo(a)anthracene	Yes	N/A	Yes	Yes	No
Chrysene	Yes	N/A	Yes	No	No
Benzo(b)fluoranthene	Yes	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	Yes	N/A	N/A	N/A	N/A
Benzo(a)pyrene	Yes	N/A	Yes	No	No
Indeno(1,2,3cd)pyrene	Yes	N/A	Yes	No	N/A
Benzo(ghi)perylene	Yes	N/A	Yes	Yes	N/A
Dibenzo(a,h)anthracene	Yes	N/A	N/A	N/A	No
Total Hydrocarbons (THC)	Yes	N/A	N/A	N/A	N/A
PCBs	No	No	N/A	N/A	No

Parameter	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
TBT	No	No	N/A	N/A	N/A

Further detailing can be found in Appendix C.

6.4 Chemical Assessment Conclusions

All three samples representing material being considered for sea disposal recorded exceedances of RAL1 for either metals, PAHs or THC.

Two of three samples representing material being considered for sea disposal exceeded the BAC and ERL for at least one metal; and two of two samples exceeded the BAC and ERL for at least one PAH species, were applicable.

One of two samples representing material being considered for sea disposal exceeded the PEL for at least one PAH species.

Average dredge area data analysis for material being considered for sea disposal outlined exceedances of the RAL1 for copper, zinc, PAHs and THC. The average dredge area data exceeded the BAC for cadmium, copper, zinc, and PAHs. The average dredge area data exceeded the ERL for copper, zinc, and PAHs. The average dredge area data did not exceed the PEL or RAL2.

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 6-2 below, in the context of disposal of dredged material at the Macduff (CR050) licenced disposal site.

Table 6-2: Receptor Risk Assessment

Key Receptor[4]	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	The dredge areas and the Macduff (CR050) licenced disposal site are on the North Sea coast, within the Banff and Macduff is a coastal water body (ID: 200498) which is classified as having a "Good" overall status and a classification of "High" for hydromorphology[5]. It is noted that sea disposal will take place in a Marine Protection Area (MPA). This is considered separately below. The classification for hydromorphology will have taken into account the presence of the Macduff disposal site, therefore no further assessment is considered necessary.
Biology - habitats	Included to assess potential impacts to sensitive/high value habitats.	No	The Banff and Macduff coastal water body at the dredge areas and disposal site is noted to have a classification for overall ecology of "Good". The water body has a classification of "Good" for invertebrates[5]. It is noted that sea disposal will take place in a Marine Protection Area (MPA). This is considered separately below. The establishment of the Macduff disposal site will have taken the potential presence of sensitive/high value habitats into account. No further assessment is considered necessary. Macduff Harbour is a commercial/industrial harbour that is subject to routine maintenance dredging and is unlikely to be a sensitive habitat.

[4] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters
[5] https://www.sepa.org.uk/data-visualisation/water-classification-hub/

Biology – fish	Consideration of fish both within the estuary and also potential effects on migratory fish in transit through the estuary	No	Macduff and the surrounding area does not have a WFD classification for fish. In addition, there is no estuary in close proximity to the site in which migratory fish would be travelling towards. Immediately out with the harbour lies open sea with no obvious constraints. Dredged material will be deposited in the same way as per previous dredging campaigns. Therefore no further assessment is considered necessary.
Water Quality	Consideration must be given to water quality when contaminants are present in exceedance of CEFAS RAL1.	Yes	Neither the dredge or disposal areas (within the Banff and Macduff coastal water body) have a classification status for priority substances or specific pollutants. The classification status at both areas for general water quality is "High". A number of sediment samples recorded results in exceedance of CEFAS RAL1. It is noted that material from Macduff Harbour has been dredged and deposited at the Macduff 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.

Protected Areas	If your activity is within 2km of any WFD protected area, include each identified area in your impact assessment. • special areas of conservation (SAC) • special protection areas (SPA) • shellfish waters • bathing waters • nutrient sensitive areas	Yes	Sections of the Whitehills and Melrose Coast Special Scientific Interest (SSSI) are located approximately 10m west and 130m east of the proposed dredge area at Macduff Harbour. The dredging site is located ~650m south of the Southern Trench Marine Protected Area (MPA). The sea disposal site is located within the MPA. The MPA was designated in December 2020 with its features are noted to include: burrowed mud, Minke whale, thermal fronts, shelf deeps, submarine mass movements and Quaternary geology. There are no bathing waters within 2km of either the dredge or disposal sites. There are no shellfish harvesting waters within 2km of either the dredge or disposal sites. Further discussion with regard to protected areas is given in Section 6.6.2.

6.6 Potential Risk to Water Quality and Protected Areas

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

Exceedances of the RAL2 for copper and zinc were recorded within the Princess Royal Basin at five sampling locations; material from which is earmarked for disposal on land and will not be disposed of at sea.

6.6.1 Water Quality

The coastal water body covering the dredge and disposal areas have a classification status for priority substances, but a "pass" for specific pollutants. The classification status for this coastal water body for general water quality is "Good" (Banff and Macduff coastal water body).

Dredge material from the Middle Basin and the West Basin and Channel at Macduff Harbour are being considered for disposal at the Macduff (CR050) licenced sea disposal site. 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. No exceedances above RAL2 were recorded in samples collected from material earmarked for sea disposal. 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.

When considering averaged concentrations from the Middle Basin and West Basin, which considers the material as a single unit for sea disposal, exceedances above RAL1 were recorded for copper, zinc, PAHs and THC. When considering the dilution potential in North Sea, despite these exceedances a significant degradation to water quality is considered unlikely. Averaged concentrations also exceeded the BAC and ERL for several metals and PAHs. 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 metals and PAH are generally lower than the Marine Scotland RAL1, therefore it is considered to be a very conservative assessment criterion.

The key contaminants for impacting water quality are considered to be metals as these have the potential to dissolve or desorb from sorption sites within the sediment. However, the overall concentrations of metals are generally low and natural geochemical processes will limit their solubility along with the large dilution potential it is not expected that these would have a long-term impact on water quality.

In addition, PAHs and hydrocarbons 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 of sediment on receiving beach and potential subsequent dispersal by tides). Although this is likely to cause localised increase in suspended solids, it is considered that this will be both local and temporary in nature.

The sediment material primarily comprises mostly of sand, with Grab B (Middle Basin) having low quantities of gravel and silt and Grab C (West Basin and Channel) having no gravel and negligible

quantities of silt. The average physical sediment type from the two samples from the dredge area are outlined in Table 6-3 below.

Table 6-3: Averaged PSA Data for Proposed Dredge Area

Sampling Area	Sample Location	Total Solids	Gravel (>2mm) %	Sand (63-2000 µm) %	Silt (<63 µm) %
Middle Basin	Grab B	27.5	14.96	64.80	20.24
West Basin and Channel	Grab C	72.6	0.00	95.41	4.59
Average		**50.10**	**7.48**	**80.11**	**12.42**

Sand and gravel particles will generally fall out of suspension quickly with minimal lateral spread. Given that majority of the sediment to be disposed comprises sand, it is unlikely that there will be a prolonged significant increase in suspended solids/turbidity.

Any silts and clays (in this case an average of 12.42% of material) will 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 should be noted that both Macduff disposal sites are classified as having 'Good' water quality although being ongoingly utilised as a site for disposal. As a result, it is considered unlikely that this dredging campaign (max. 5,000 m^3 annually) will result in a change in the classification status of coastal water bodies at both the dredge and disposal sites.

6.6.2 Protected Areas

This section gives further discussion on each of the designated protected areas that have been identified within 2km of the dredge and disposal areas, namely the Whitehills and Melrose Coast SSSI and Southern Trench MPA.

6.6.2.1 Whitehills and Melrose Coast SSSI

The Whitehills and Melrose Coast SSSI is designated for Dalradian geology[6]. This designated area is located approx. approximately 10m west and 130m east of the proposed dredge area at Macduff Harbour covering much of the North Aberdeenshire Coastline, either side of Banff and Macduff. This designation is assigned for Dalradian structural and metamorphic geology. Given the nature of the designated rock features, negative impacts on these features as a result of dredging and disposal 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 and breakwater, negative impacts on the SSSI are considered highly unlikely.

6.6.2.2 Southern Trench MPA

Macduff Harbour is located ~650m south of the boundary of the Southern Trench MPA. The Macduff sea disposal site is located within the MPA.

The Conservation and Management Advice document for the MPA[7] has been reviewed as part of this assessment. The document notes the protected features within the MPA, along with the latest assessment condition. This information is summarised in Table 6-4.

[6] Scottish National Heritage (2011). Whitehills to Melrose Coast Site of Special Scientific Interest - SITE MANAGEMENT STATEMENT. Available at: https://apps.snh.gov.uk/sitelink-api/v1/sites/1631/documents/3
[7] https://sitelink.nature.scot/site/10477

Table 6-4: Southern Trench MPA - Protected Features and Conditions (NatureScot, 2020)

Protected Feature	Feature Type	Feature Condition (2019)
Burrowed mud	Inshore sublittoral sediment (Marine)	Favourable
Fronts	Large-scale feature (Marine)	Favourable
Minke whale *(Balaenoptera acutorostrata)*	Mammals (Marine)	Favourable
Shelf deeps	Large-scale feature (Marine)	Favourable
Quaternary of Scotland (subglacial tunnel valleys and moraines)	Quaternary geology and geomorphology	Favourable
Submarine Mass Movement (slide scars)	Geomorphology	Favourable

Each of the protected features noted in Table 6-4 will be considered in turn, with the risk of negative impacts on the feature assessed in the context of sea disposal works. Features of the MPA are not considered to be at risk as a result of dredging works due to the relative small-scale of the works and distances involved. Therefore, these are not considered any further.

Burrowed Mud

The Conservation and Management Advice for the MPA states that burrowed mud habitats are "highly sensitive to physical disturbance."

Table 2 of the Advice document provides specific management advice for marine deposit sites and burrowed mud:

"Minimise the likely effects of new disposal sites where there would be likely to be an impact upon burrowed mud habitats. Early pre-application discussions are recommended and these should focus on the appropriate siting of new disposal sites and any pre-submission surveys to avoid impacts within areas of burrowed mud habitat."

The specific management advice refers only to the establishment of new disposal sites and therefore it is considered likely that the presence of the Macduff disposal site was taken into account upon the designation of the MPA, and that the existing disposal site would not be situated in an area of burrowed mud habitat. No further assessment is considered necessary.

Minke Whale

The Conservation and Management Advice for the MPA notes that minke whales are "sensitive to entanglement and incidental bycatch." The sea disposal activity is not considered to cause a risk to minke whales in those regards.

Minke whales are also noted to be sensitive to underwater noise, collision and water pollution. There may be some short-lived, temporary effects on underwater noise as a result of the disposal activity may be experienced. Secondly, it is considered that the risk of underwater collision between a minke whale and the dredging vessel is no greater than any other vessel passing through the MPA area. Finally, the effects on water quality as a result of the disposal to sea have been considered above. Effects on water quality are likely to be localised and temporary.

It is considered likely that the presence of the dredge spoil disposal site will have been taken into account when the MPA was designated, and on that basis the potential risks to minke whale are considered to be acceptable.

Table 2 of the MPA document provides specific management advice for marine deposit sites and minke whales:

"Minimise the potential impact of new deposit sites (including disused/closed sites if to be reopened) on the habitat of sandeels. Early pre-application discussions are recommended and these should consider the appropriate siting of new deposit sites and any pre-submission surveys to ensure that the habitat of sandeels is maintained in extent and suitability."

The specific management advice refers only to the establishment of new disposal sites (or re-opening of old ones) and therefore it is considered likely that the presence of the Macduff disposal site was taken into account upon the designation of the MPA, and that the existing disposal site would not be situated in an area of sandeel habitat (which are feeding grounds for minke whale).

If considered necessary through statutory consultation with NatureScot, then a Marine Mammal Observer (MMO) could be deployed to the dredging vessel to monitor minke whale activity at the disposal ground.

Fronts
The Conservation and Management Advice for the MPA states that thermal fronts states that "the MPA could be sensitive to pressures such as changes in tidal flow or physical changes to the seabed." The deposition of sediment at the Macduff disposal ground will cause a change in the seabed topography as deposited material settles.

However, it is known that sediment disposal sites in Scotland are generally dispersive, therefore any changes to seabed topography are likely to be temporary. Moreover, the Advice document also states: *"Currently most pressures associated with human activities in the marine environment are considered unlikely to cause significant risk of impact on the fronts feature within the MPA."* It is also assumed that the dredge spoil disposal site would have been taken into account when the MPA was designated. No further assessment is considered necessary,

Shelf Deeps
The Conservation and Management Advice for the MPA states that: *"Shelf deeps are considered to be robust, entirely natural in origin and are not considered to be at risk of significant damage from human activity."* Therefore the dredging and disposal activity is considered unlikely to have a negative impact on shelf deeps.

Quaternary of Scotland
According to the Conservation and Management Advice for the MPA, subglacial tunnel valleys are "highly resistant" and are "not sensitive or have a low sensitivity" to human activities. Further assessment with regard to subglacial tunnel valleys is not considered necessary.

Moraines are stated to have a *"medium sensitivity to sub-surface abrasion and changes in tidal flow, and a high sensitivity to physical removal."* The deposition of sediment at the Macduff disposal site is not considered likely to have a negative impact on the moraines. It is considered unlikely that a licensed disposal site would have been permitted in an area known to have protected moraine features susceptible to sub-surface abrasion. Further assessment is not considered necessary.

Submarine Mass Movement
The Conservation and Management Advice for the MPA states that slide scars have a "medium sensitivity… to any activities that could cause obscuring". The deposition of dredged sediment at the Macduff disposal site may cause temporary obscuring of slide scars, if present at the disposal site.

However, it is known that sediment disposal sites in Scotland are dispersive, therefore any obscuring by deposited sediment is likely to be temporary. In addition, the licenced disposal site has been

present at Macduff since at least 1995[8] (although the exact opening date of the site is not currently known). It is considered unlikely that the disposal site would continue to remain open for sediment deposits if there was likely to be a significant risk of damage to the protected slide scar features. Further assessment is not considered necessary.

8 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/197331/TR_SEA2_ExistingActivities.pdf (See Table 6)

7 BPEO CONCLUSIONS AND RECOMMENDATIONS

Aberdeenshire Council has appointed EnviroCentre Ltd. to complete a Marine Licence application and BPEO assessment for proposed dredging at Macduff Harbour. This has been informed using sediment quality results from sampling undertaken in November 2023 and February 2024.

Results from analysis of sediment samples recorded various metals, PAH species, and TPH 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 from dredged materials within the Middle Basin and the West Channel and Basin areas.

Results from analysis of sediment samples within the Princess Royal Basin recorded copper and zinc concentrations in exceedances of the RAL2 for each parameter. The material within this dredge area requires a land-based disposal solution and is not suitable for disposal at sea. This area is shown on Drawing No. 374702-QGIS009 in Appendix A. The final disposal route for this material will require to be agreed between Aberdeenshire Council and SEPA.

Based on the multiple lines of evidence approach adopted to further assess the exceedances identified in the sediment assessment, the material within the Middle Basin and the West Channel and Basin is considered suitable for disposal at sea at the Macduff licenced disposal site. 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 practicable 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 DRAWINGS

370250

370500

864750

864500

Princess Royal Basin

Middle Basin

West Basin and Channel

Grab A-5

Grab A-4

Grab A

Grab A-3

Grab A-2

Grab A-1

Grab B

Grab C

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Legend

- Dredge Area
- Grab Sample
- Additional Grab Samples
- Area Subject to Additional Investigation

Do not scale this map

Client
Aberdeenshire Council

Project
Macduff Harbour Dredging

Title
Dredge Areas and
Sediment Sampling Locations

Status
FINAL

Drawing No.	Revision	Date
374702-QGIS008	-	25 Mar 2024
Drawn	**Checked**	**Approved**
FR	CCAS	CCAS

Scale
1:2,000 @ A3

Rev	Date	Amendment	Initials
-	-	-	-

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

370250

370500

864750

864500

Princess Royal Basin

Middle Basin

West Basin and Channel

Grab A-5

Grab A-4

Grab A

Grab A-3

Grab A-2

Grab A-1

Grab B

Grab C

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Legend

- Dredge Area

Grab Samples

- AL2 Exceeded
- AL2 Not Exceeded
- Area for Land-Based Disposal

Do not scale this map

Client
Aberdeenshire Council

Project
Macduff Harbour Dredging

Title
Sediment Samples - Heavy Metals Exceedances Above Revised Action Level 2 and Area for Land-Based Disposal

Status
FINAL

Drawing No.	Revision	Date
374702-QGIS009	-	25 Mar 2024
Drawn	**Checked**	**Approved**
FR	CCAS	CCAS

Scale
1:2,000 @ A3

Rev	Date	Amendment	Initials
-	-	-	-

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370000 371000 372000 373000

868000 867000 866000 865000 864000

Macduff CR050

Macduff Harbour

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Do not scale this map

Legend

- CR050 Macduff
- Disposal Site Buffer
- Macduff Dredge Area

Client
Aberdeenshire Council

Project
Macduff Harbour Dredging

Title
CR050 Macduff Sea Disposal Site

Scale
1:15,000 @ A3

Status
Final

Drawing No.	Revision	Date
374702-QGIS010	-	25 Mar 2024
Drawn	**Checked**	**Approved**
FR	CCAS	CCAS

Rev	Date	Amendment	Initials
-	-	-	-

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B SEDIMENT SAMPLE LOGS

envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour	**Location ID**
	Project No.	374702	**A**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	30/11/2023	**Latitude**	57° 40.344'
Dredge Area	-	**Longitude**	-002° 29.888'
Method	0.045m² Van Veen Grab Sampler	**Sampled/logged by**	AK

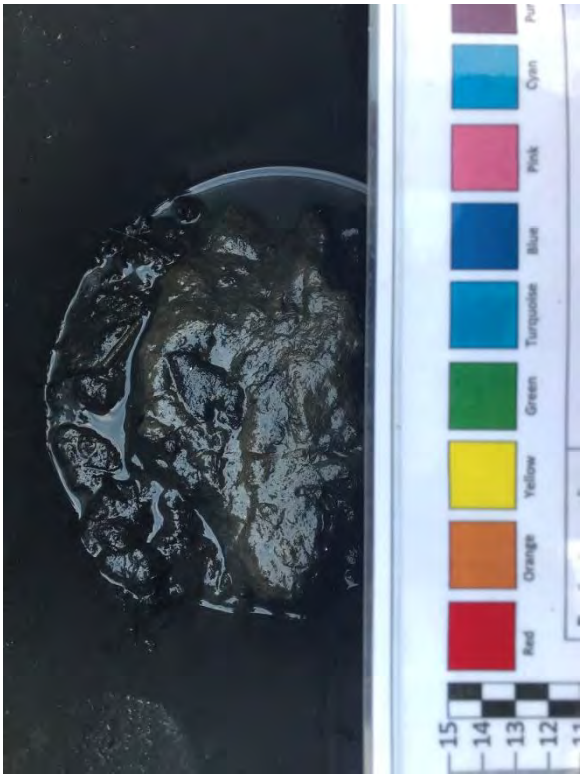
Remarks: Soft black/dark greyish-brown silt.

Biota: None noted.

Odours: Moderate to strong H_2S odour.

Anthropogenic Inputs: Paint flakes.

Notes: Hydrocarbon sheen can be seen on waters' surface.



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour	**Location ID**
	Project No.	374702	**B**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	30/11/2023	**Latitude**	57° 40.275'
Dredge Area	-	**Longitude**	-002° 29.908'
Method	0.045m^2 Van Veen Grab Sampler	**Sampled/logged by**	AK

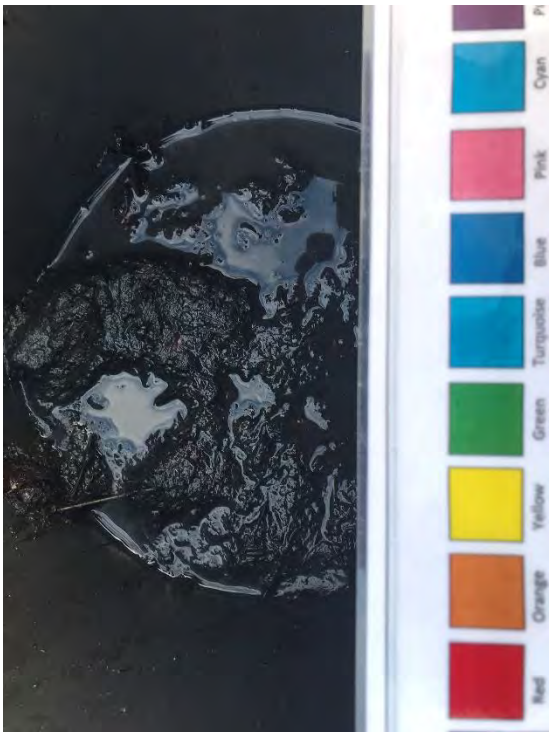
Remarks: Black silty sand with frequent organic matter / leaf litter.

Biota: None noted.

Odours: Very strong H_2S odour.

Anthropogenic Inputs: None noted

Notes: Hydrocarbon sheen can be seen on waters' surface.



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour	**Location ID**
	Project No.	374702	**C**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	31/11/2023	**Latitude**	57° 40.209'
Dredge Area	-	**Longitude**	-002° 29.924'
Method	0.045m² Van Veen Grab Sampler	**Sampled/logged by**	AK

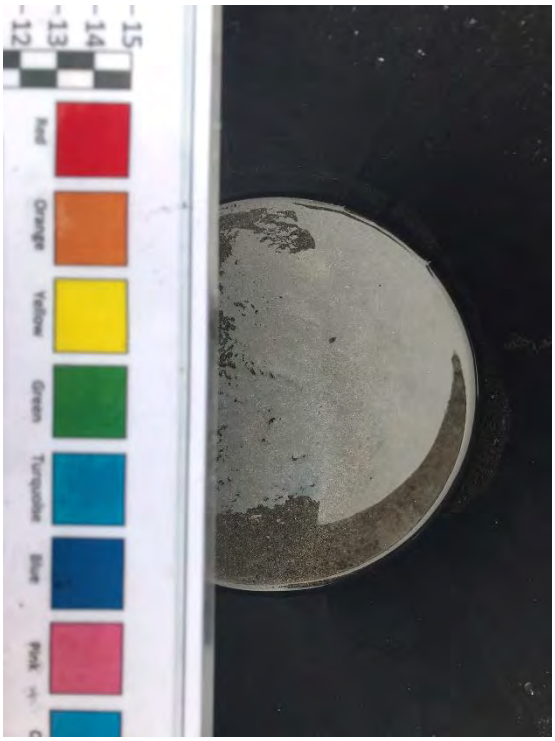
Remarks: Light brown fine sand.

Biota: Crab leg.

Odours: None noted.

Anthropogenic Inputs: None noted.

Notes: Hydrocarbon sheen can be seen on waters' surface.



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour - Additional Sediment Sampling	**Location ID**
	Project No.	374702	**A-1**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	13/02/2024	**Latitude**	57° 40.28847
Dredge Area	-	**Longitude**	-2° 29.91115
Method	0.045m^2 Van Veen Grab Sampler	**Sampled/logged by**	FR

Remarks: Soft black/dark greyish-brown silt with frequent seaweed/vegetation. A few hydrocarbon blooms.

Biota: None noted.

Odours: Strong H_2S odour.

Anthropogenic Inputs: None noted.

Notes: -

envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour - Additional Sediment Sampling	**Location ID**
	Project No.	374702	**A-2**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	13/02/2024	**Latitude**	57° 40.32725
Dredge Area	-	**Longitude**	-2° 29.91477
Method	0.045m^2 Van Veen Grab Sampler	**Sampled/logged by**	FR

Remarks: Soft dark grey/black slightly gravelly silt. Gravel is medium to coarse and angular. Rare leaf litter.

Biota: None noted.

Odours: Moderate H_2S odour.

Anthropogenic Inputs: Piece of rope. Rare paint chips throughout sample.

Notes: -

envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour - Additional Sediment Sampling	**Location ID**
	Project No.	374702	**A-3**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	13/02/2024	**Latitude**	57° 40.33675
Dredge Area	-	**Longitude**	-2° 29.87083
Method	0.045m^2 Van Veen Grab Sampler	**Sampled/logged by**	FR

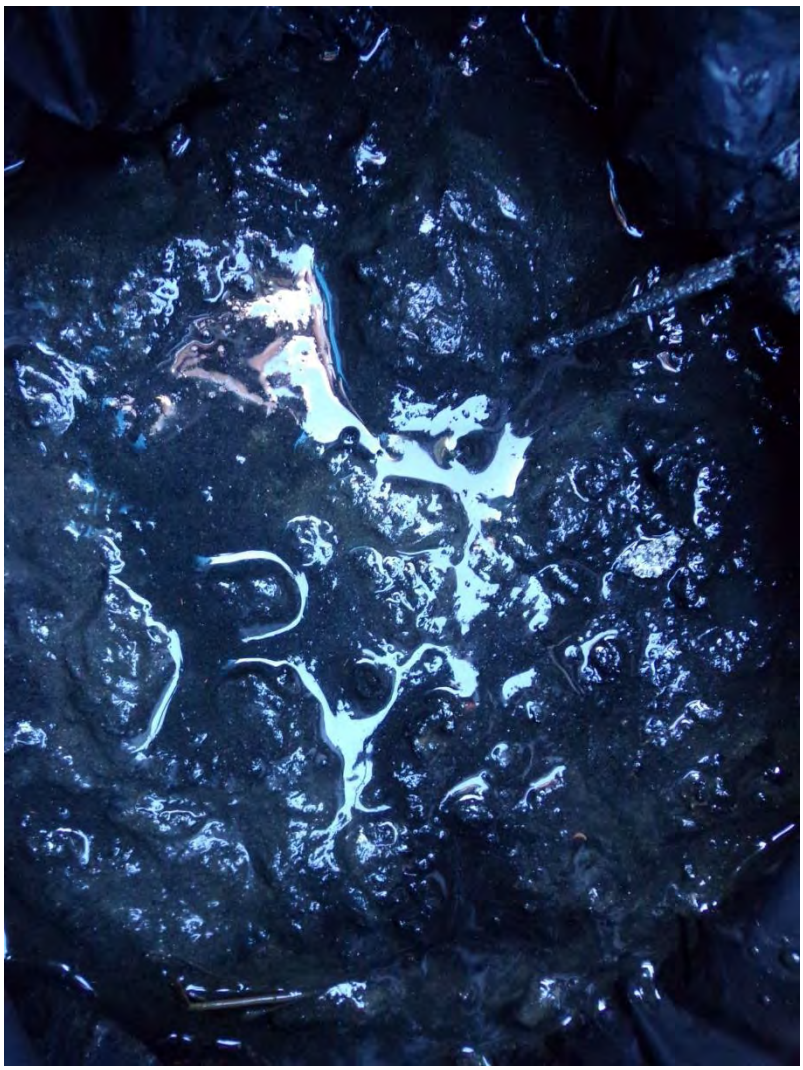
Remarks: Dark grey/black very gravelly silt. Gravel is medium to coarse and angular. Rare twigs.

Biota: None noted.

Odours: Moderate H_2S odour.

Anthropogenic Inputs: Singular metal shackle. Singular paint chip.

Notes: -



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	Macduff Harbour - Additional Sediment Sampling	**Location ID**
	Project No.	374702	**A-4**
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	13/02/2024	**Latitude**	57° 40.35531
Dredge Area	-	**Longitude**	-2° 29.82618
Method	0.045m^2 Van Veen Grab Sampler	**Sampled/logged by**	FR

Remarks: Soft black/dark grey slightly gravelly silt. Gravel is medium to coarse and angular. Rare vegetation/twigs.

Biota: None noted.

Odours: Moderate H_2S odour.

Anthropogenic Inputs: Singular large paint chip/sheet (~10cm in length). A few silver small paint chips. Singular lifting sling. Metal wire.

Notes: -

envirocentre	Project Name	Macduff Harbour - Additional Sediment Sampling	Location ID
8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project No.	374702	A-5
	Client	Aberdeenshire Council	

GRAB SAMPLE LOG

Date/Time	13/02/2024	**Latitude**	57° 40.373053
Dredge Area	-	**Longitude**	-2° 29.848571
Method	0.045m^2 Van Veen Grab Sampler	**Sampled/logged by**	FR

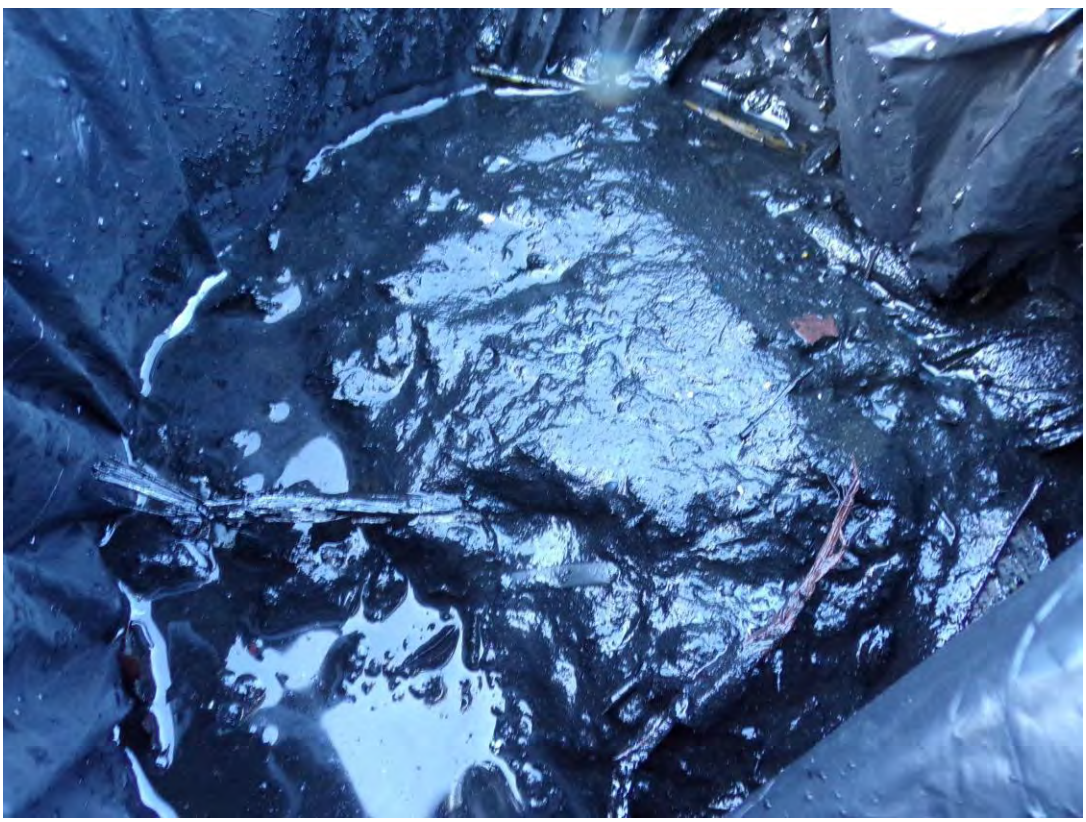
Remarks: Soft black slightly gravelly silt Gravel is medium to coarse and angular. Rare vegetation. A few hydrocarbon blooms and a singular mussel shell.

Biota: None noted.

Odours: Moderate H_2S odour.

Anthropogenic Inputs: Piece of cloth, cable tie, metal juice can and metal wire.

Notes: -



C DATA SUMMARY TABLES

Summary Table A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

						Nov 2023 Samples			Feb 2024 Additional Samples										
	AL1	AL2	BAC	ERL	PEL	Grab A	Grab B	Grab C	Grab A-1	Grab A-2	Grab A-3	Grab A-4	Grab A-5		AVERAGE	No. Exceed RAL 1	No. Exceed RAL 2	No.Exceed BAC?	No. Exceed ERL	No. Exceed PEL?
Source			CSEMP	CSEMP	Canada															
Arsenic	20	70	25		41.6	23.3	11.2	2.9	9.3	13.2	13	22.8	33.3	33.3	16.13	3	0	1	-	0
Cadmium	0.4	4	0.31	1.2	4.2	0.97	0.53	0.08	0.41	0.62	0.45	1.82	1.16	1.8	0.76	7	0	7	1	0
Chromium	50	370	81	81	160	62.7	26	9.7	27.2	52.1	76.3	83.6	115	115.0	56.58	5	0	2	2	0
Copper	30	300	27	34	108	506	107	7.4	97.2	318	304	566	3960	3960.0	733.20	7	5	7	7	5
Mercury	0.25	1.5	0.07	0.15	0.7	0.13	0.05	0.02	0.12	0.13	0.18	0.13	0.17	0.2	0.12	0	0	6	2	0
Nickel	30	150	36	-	-	37.8	18.2	7.1	18.8	28.5	49.4	45.8	69.4	69.4	34.38	4	0	4	N/A	N/A
Lead	50	400	38	47	112	43.1	19.4	3.9	23.7	65	68	89.3	89.9	89.9	50.29	4	0	5	4	0
Zinc	130	600	122	150	271	792.0	227.0	32.4	221	574.0	675.0	1209.0	2633.0	2633.0	795.43	7	4	7	7	5
														0.0						
Napthalene	0.1		0.08	0.16	0.391	0.041	0.057	0.051						0.1	0.05	0	-	0	0	0
Acenaphthylene	0.1				0.128	0.043	0.005	0.041						0.0	0.03	0	-	N/A	N/A	0
Acenaphthene	0.1				0.0889	0.033	0.005	0.021						0.0	0.02	0	-	N/A	N/A	0
Fluorene	0.1				0.144	0.070	0.005	0.068						0.1	0.05	0	-	N/A	N/A	0
Phenanthrene	0.1		0.032	0.24	0.544	0.347	0.078	0.738						0.7	0.39	2	-	3	2	1
Anthracene	0.1		0.05	0.085	0.245	0.160	0.040	0.299						0.3	0.17	2	-	2	2	1
Fluoranthene	0.1		0.039	0.6	1.494	0.502	0.246	1.250						1.3	0.67	3	-	3	1	0
Pyrene	0.1		0.024	0.665	1.398	0.886	0.310	1.110						1.1	0.77	3	-	3	2	0
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.231	0.107	0.473						0.5	0.27	3	-	3	1	0
Chrysene	0.1		0.02	0.384	0.846	0.323	0.140	0.508						0.5	0.32	3	-	3	1	0
Benzo(b)fluoranthene	0.1		-	-	-	0.225	0.125	0.308						0.3	0.22	3	-	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1		-	-	-	0.243	0.131	0.383						0.4	0.25	3	-	N/A	N/A	N/A
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.267	0.163	0.456						0.5	0.30	3	-	3	1	0
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.159	0.114	0.231						0.2	0.17	3	-	3	0	N/A
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.178	0.114	0.221						0.2	0.17	3	-	3	3	N/A
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.030	0.021	0.045						0.0	0.03	0	-	N/A	N/A	0
THC	100		-	-	-	3370	1020	63						3370.0	1484.37	2	-	N/A	N/A	N/A
														0.0						
PCBs	0.02	0.18	-	-	0.189	0.00282	0.00056	0.00147						0.0	0.0016	0	0	N/A	N/A	0
TBT	0.1	0.5	-	-	-	0.362	0.036	0.005						0.4	0.1342	1	0	N/A	N/A	N/A

Note: Underlined Values are < LOD

PEL Data Source: http://ceqg-rcqe.ccme.ca/en/index.html#void

Summary Table B

Macduff Harbour Average Concentrations

Excludes All Samples from Princess Royal Basin (>RAL2)

All units in mg/kg

	AL1	AL2	BAC	<ERL	PEL	Dredge Average	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
Source			CSEMP	CSEMP	Canada						
Arsenic	20	70	25	-	41.6	7.8	No	No	No	N/A	No
Cadmium	0.4	4	0.31	1.2	4.2	0.3	No	No	**Yes**	No	No
Chromium	50	370	81	81	160	21.0	No	No	No	No	No
Copper	30	300	27	34	108	70.5	**Yes**	No	**Yes**	**Yes**	No
Mercury	0.25	1.5	0.07	0.15	0.7	0.1	No	No	No	No	No
Nickel	30	150	36	-	-	14.7	No	No	No	N/A	N/A
Lead	50	400	38	47	112	15.7	No	No	No	No	No
Zinc	130	600	122	150	271	160.1	**Yes**	No	**Yes**	**Yes**	No
					-						
Napthalene	0.1	-	0.08	0.16	0.319	0.05	No	N/A	No	No	No
Acenaphthylene	0.1	-	-	-	0.128	0.02	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	0.04	No	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	0.24	0.544	0.41	**Yes**	N/A	**Yes**	**Yes**	No
Anthracene	0.1	-	0.05	0.085	0.245	0.17	**Yes**	N/A	**Yes**	**Yes**	No
Fluoranthene	0.1	-	0.039	0.6	1.494	0.75	**Yes**	N/A	**Yes**	**Yes**	No
Pyrene	0.1	-	0.024	0.665	1.398	0.71	**Yes**	N/A	**Yes**	**Yes**	No
Benzo(a)anthracene	0.1	-	0.016	0.261	0.693	0.29	**Yes**	N/A	**Yes**	**Yes**	No
Chrysene	0.1	-	0.02	0.384	0.846	0.32	**Yes**	N/A	**Yes**	No	No
Benzo(b)fluoranthene	0.1	-	-	-	-	0.22	**Yes**	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	0.26	**Yes**	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.763	0.31	**Yes**	N/A	**Yes**	No	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	0.17	**Yes**	N/A	**Yes**	No	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	0.17	**Yes**	N/A	**Yes**	**Yes**	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.135	0.03	**Yes**	N/A	N/A	N/A	No
Total Hydrocarbons (THC)	100	-	-	-	-	541.55	**Yes**	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.001	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	0.0204	No	No	N/A	N/A	N/A

D LABORATORY CERTIFICATES

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR02141

Issue Version: 1

Customer: EnviroCentre Ltd, Craighall Business Park, 8 Eagle Street, Glasgow, G4 9XA

Customer Reference: 374702 - Macduff Harbour

Date Sampled: 30-Nov-23

Date Samples Received: 05-Dec-23

Test Report Date: 10-Jan-24

Condition of samples: Ambient Satisfactory

Opinions and Interpretations expressed herein are outside the scope of our UKAS accreditaion
The results reported relate only to the sample tested
The results apply to the sample as received

Authorised by: Jane Colbourne

Position: Customer Service Specialist

UKAS TESTING 1252

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

		Units	%	%	%	%	%	N/A
		Method No	ASC/SOP/303	ASC/SOP/303	SUB_01*	SUB_01*	SUB_01*	SUB_02*
		Limit of Detection	0.2	0.2	N/A	N/A	N/A	N/A
		Accreditation	UKAS	UKAS	N	N	N	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Total Moisture @ 120°C**	**Total Solids**	**Gravel (>2mm)**	**Sand (63-2000 µm)**	**Silt (<63 µm)**	**Asbestos**
Grab A	MAR02141.001	Sediment	68.4	31.6	0.00	69.51	30.49	NAIIS
Grab B	MAR02141.002	Sediment	72.5	27.5	14.96	64.80	20.24	NAIIS
Grab C	MAR02141.003	Sediment	27.4	72.6	0.00	95.41	4.59	NAIIS
		Reference Material (% Recovery)	N/A	N/A	N/A	N/A	N/A	N/A
		QC Blank	N/A	N/A	N/A	N/A	N/A	N/A

* See Report Notes

NAIIS - No Asbestos Identified In Sample

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Certificate of Analysis

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Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

		Units	% M/M
		Method No	WSLM59*
		Limit of Detection	0.02
		Accreditation	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**TOC**
Grab A	MAR02141.001	Sediment	5.45
Grab B	MAR02141.002	Sediment	5.96
Grab C	MAR02141.003	Sediment	0.41
		Reference Material (% Recovery)	99
		QC Blank	<0.02

* See Report Notes

NAIIS - No Asbestos Identified In Sample

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Certificate of Analysis

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Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

		Units	mg/Kg (Dry Weight)							
		Method No	ICPMSS*							
		Limit of Detection	0.5	0.04	0.5	0.5	0.01	0.5	0.5	2
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Mercury**	**Nickel**	**Lead**	**Zinc**
Grab A	MAR02141.001	Sediment	23.3	0.97	62.7	506	0.13	37.8	43.1	792
Grab B	MAR02141.002	Sediment	11.2	0.53	26.0	107	0.05	18.2	19.4	227
Grab C	MAR02141.003	Sediment	2.9	0.08	9.7	7.4	0.02	7.1	3.9	32.4
Certified Reference Material SETOC 768 (% Recovery)			110	110	110	108	108	109	103	106
QC Blank			<0.5	<0.04	<0.5	<0.5	<0.01	<0.5	<0.5	<2

* See Report Notes

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

		Units	µg/Kg (Dry Weight)	
		Method No	ASC/SOP/301	
		Limit of Detection	1	1
		Accreditation	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Dibutyltin (DBT)**	**Tributyltin (TBT)**
Grab A	MAR02141.001	Sediment	147	362
Grab B	MAR02141.002	Sediment	17.2	35.7
Grab C	MAR02141.003	Sediment	<5	<5
Certified Reference Material BCR-646 (% Recovery)			74	64
QC Blank			<1	<1

* See Report Notes

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR02141
Issue Version 1
Customer Reference 374702 - Macduff Harbour

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304
		Limit of Detection	1	1	1	1	1	1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**ACENAPTH**	**ACENAPHY**	**ANTHRACN**	**BAA**	**BAP**	**BBF**
Grab A	MAR02141.001	Sediment	33.1	42.5	160	231	267	225
Grab B	MAR02141.002	Sediment	<5	<5	39.6	107	163	125
Grab C	MAR02141.003	Sediment	20.5	40.9	299	473	456	308
Certified Reference Material Nist 1941b (% Recovery)			100	116	66	66	64	89
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.
As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.
*See report notes

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304
		Limit of Detection	1	1	1	1	1	1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**BENZGHIP**	**BKF***	**CHRYSENE ***	**DBENZAH**	**FLUORANT**	**FLUORENE**
Grab A	MAR02141.001	Sediment	178	243	323	30.3	502	70.0
Grab B	MAR02141.002	Sediment	114	131	140	20.7	246	<5
Grab C	MAR02141.003	Sediment	221	383	508	44.7	1250	67.8
Certified Reference Material Nist 1941b (% Recovery)			65	79	88	111	80	58
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries

~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

*See report notes

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Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR02141
Issue Version 1
Customer Reference 374702 - Macduff Harbour

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/306
		Limit of Detection	1	1	1	1	100
		Accreditation	UKAS	UKAS	UKAS	UKAS	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
Grab A	MAR02141.001	Sediment	159	41.3	347	886	3370000
Grab B	MAR02141.002	Sediment	114	56.7	78.1	310	1020000
Grab C	MAR02141.003	Sediment	231	50.5	738	1110	63100
Certified Reference Material Nist 1941b (% Recovery)			78	63	77	69	111~
QC Blank			<1	<1	<1	<1	<100

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.
As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.
*See report notes

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302
		Limit of Detection	0.08	0.08	0.08	0.08	0.08	0.08	0.08
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**PCB28**	**PCB52**	**PCB101**	**PCB118**	**PCB138**	**PCB153**	**PCB180**
Grab A	MAR02141.001	Sediment	0.20	0.23	0.41	0.48	0.41	0.71	0.38
Grab B	MAR02141.002	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Grab C	MAR02141.003	Sediment	0.14	0.13	0.19	0.32	0.29	0.31	0.09
Certified Reference Material Nist 1941b (% Recovery)			78	97	104	109	114	99	96
QC Blank			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08

For full analyte name see method summaries

~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.

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Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR02141
Issue Version 1
Customer Reference 374702 - Macduff Harbour

REPORT NOTES

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
WSLM59*	MAR02141.001-003	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
ICPMSS*	MAR02141.001-003	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
SUB_01*	MAR02141.001-003	Analysis was conducted by an approved subcontracted laboratory.
SUB_02*	MAR02141.001-003	Analysis was conducted by an approved subcontracted laboratory.
ASC/SOP/301	MAR02141.003	The matrix of this sample has been found to interfere with the result for this test. The sample has therefore been diluted, but in doing so, the detection limit for this test has been elevated.
ASC/SOP/303/304	MAR02141.002	The matrix of this sample has been found to interfere with the result for this test. The sample has therefore been diluted, but in doing so, the detection limit for this test has been elevated.
ASC/SOP/303/304	MAR02141.001-003	Benzo[k]fluoranthene is known to coelute with Benzo[j]fluoranthene and these peaks can not be resolved. It is believed Benzo[j]fluoranthene is present in these samples therefore it is suggested that the Benzo[k]fluoranthene results should be taken as a Benzo[k]fluoranthene (inc. Benzo[j]fluoranthene). Benzo[j]fluoranthene is not UKAS accredited. This should be taken into consideration when utilising the data.
ASC/SOP/303/304	MAR02141.001-003	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene).This should be taken into consideration when utilising the data.

DEVIATING SAMPLE STATEMENT

Deviation Code	Deviation Definition	Sample ID	Deviation Details. The following information should be taken into consideration when using the data contained within this report
D1	Holding Time Exceeded	N/A	N/A
D2	Sample Contaminated through Damaged Packaging	N/A	N/A
D3	Sample Contaminated through Sampling	N/A	N/A
D4	Inappropriate Container/Packaging	N/A	N/A
D5	Damaged in Transit	N/A	N/A
D6	Insufficient Quantity of Sample	N/A	N/A
D7	Inappropriate Headspace	N/A	N/A
D8	Retained at Incorrect Temperature	N/A	N/A
D9	Lack of Date & Time of Sampling	N/A	N/A
D10	Insufficient Sample Details	N/A	N/A
D11	Sample integrity compromised or not suitable for analysis	N/A	N/A

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR02141
Issue Version	1
Customer Reference	374702 - Macduff Harbour

Method	Sample and Fraction Size	Method Summary
Total Solids	Wet Sediment	Calculation (100%-Moisture Content).Moisture content determined by drying a portion of the sample at 120°C to constant weight.
Particle Size Analysis	Wet Sediment	Wet and dry sieving followed by laser diffraction analysis.
Total Organic Carbon (TOC)	Air dried and ground	Carbonate removal and sulphurous acid/combustion at 1600°C/NDIR.
Metals	Air dried and seived to <63µm	Aqua-regia extraction followed by ICP analysis.
Organotins	Wet Sediment	Solvent extraction and derivatisation followed by GC-MS analysis.
Polyaromatic Hydrocarbons (PAH)	Wet Sediment	Solvent extraction and clean up followed by GC-MS analysis.
Total Hydrocarbon Content (THC)	Wet Sediment	Solvent extraction and clean up followed by GC-FID analysis.
Polychlorinated Biphenyls (PCBs)	Air dried and seived to <2mm	Solvent extraction and clean up followed by GC-MS-MS analysis.

Analyte Definitions

Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name
ACENAPTH	Acenaphthene	C2N	C2-naphthalenes	THC	Total Hydrocarbon Content
ACENAPHY	Acenaphthylene	C3N	C3-naphthalenes	AHCH	alpha-Hexachlorcyclohexane
ANTHRACN	Anthracene	CHRYSENE	Chrysene	BHCH	beta-Hexachlorcyclohexane
BAA	Benzo[a]anthracene	DBENZAH	Dibenzo[ah]anthracene	GHCH	gamma-Hexachlorcyclohexane
BAP	Benzo[a]pyrene	FLUORANT	Fluoranthene	DIELDRIN	Dieldrin
BBF	Benzo[b]fluoranthene	FLUORENE	Fluorene	HCB	Hexachlorobenzene
BEP	Benzo[e]pyrene	INDPYR	Indeno[1,2,3-cd]pyrene	DDD	p,p'-Dichlorodiphenyldichloroethane
BENZGHIP	Benzo[ghi]perylene	NAPTH	Naphthalene	DDE	p,p'-Dichlorodiphenyldichloroethylene
BKF	Benzo[k]fluoranthene	PERYLENE	Perylene	DDT	p,p'-Dichlorodiphenyltrichloroethane
C1N	C1-naphthalenes	PHENANT	Phenanthrene		
C1PHEN	C1-phenanthrene	PYRENE	Pyrene		

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR02212

Issue Version: 1

Customer: Envirocentre, Craighall Business Park, 8 Eagle Street, Glasgow, G4 9XA

Customer Reference: 374702 MacDuff Harbour

Date Sampled: 13-Feb-24

Date Samples Received: 15-Feb-24

Test Report Date: 07-Mar-24

Condition of samples: Cold Satisfactory

Opinions and Interpretations expressed herein are outside the scope of our UKAS accreditaion
The results reported relate only to the sample tested
The results apply to the sample as received

[Redacted]

Authorised by: Jane Colbourne

Position: Customer Service Specialist

UKAS TESTING 1252

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Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR02212
Issue Version	1
Customer Reference	374702 MacDuff Harbour

		Units	mg/Kg (Dry Weight)							
		Method No	ICPMSS*							
		Limit of Detection	0.5	0.04	0.5	0.5	0.01	0.5	0.5	2
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Mercury**	**Nickel**	**Lead**	**Zinc**
Grab A-1	MAR02212.001	Sediment	9.3	0.41	27.2	97.2	0.12	18.8	23.7	221
Grab A-2	MAR02212.002	Sediment	13.2	0.62	52.1	318	0.13	28.5	65.0	574
Grab A-3	MAR02212.003	Sediment	13.0	0.45	76.3	304	0.18	49.4	68.0	675
Grab A-4	MAR02212.004	Sediment	22.8	1.82	83.6	566	0.13	45.8	89.3	1209
Grab A-5	MAR02212.005	Sediment	33.3	1.16	115	3960	0.17	69.4	89.9	2633
Certified Reference Material SETOC 768 (% Recovery)			99	103	114	106	118	110	103	107
QC Blank			<0.5	<0.04	<0.5	<0.5	<0.01	<0.5	<0.5	<2

* See Report Notes

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Certificate of Analysis

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Test Report ID MAR02212
Issue Version 1
Customer Reference 374702 MacDuff Harbour

REPORT NOTES

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
ICPMSS*	MAR02212.001-005	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.

DEVIATING SAMPLE STATEMENT

Deviation Code	Deviation Definition	Sample ID	Deviation Details. The following information should be taken into consideration when using the data contained within this report
D1	Holding Time Exceeded	N/A	N/A
D2	Sample Contaminated through Damaged Packaging	N/A	N/A
D3	Sample Contaminated through Sampling	N/A	N/A
D4	Inappropriate Container/Packaging	N/A	N/A
D5	Damaged in Transit	N/A	N/A
D6	Insufficient Quantity of Sample	N/A	N/A
D7	Inappropriate Headspace	N/A	N/A
D8	Retained at Incorrect Temperature	N/A	N/A
D9	Lack of Date & Time of Sampling	N/A	N/A
D10	Insufficient Sample Details	N/A	N/A
D11	Sample integrity compromised or not suitable for analysis	N/A	N/A

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Certificate of Analysis

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Test Report ID	MAR02212
Issue Version	1
Customer Reference	374702 MacDuff Harbour

Method	Sample and Fraction Size	Method Summary
Metals	Air dried and seived to <63µm	Aqua-regia extraction followed by ICP analysis.

Analyte Definitions					
Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name
ACENAPTH	Acenaphthene	C2N	C2-naphthalenes	THC	Total Hydrocarbon Content
ACENAPHY	Acenaphthylene	C3N	C3-naphthalenes	AHCH	alpha-Hexachlorcyclohexane
ANTHRACN	Anthracene	CHRYSENE	Chrysene	BHCH	beta-Hexachlorcyclohexane
BAA	Benzo[a]anthracene	DBENZAH	Dibenzo[ah]anthracene	GHCH	gamma-Hexachlorcyclohexane
BAP	Benzo[a]pyrene	FLUORANT	Fluoranthene	DIELDRIN	Dieldrin
BBF	Benzo[b]fluoranthene	FLUORENE	Fluorene	HCB	Hexachlorobenzene
BEP	Benzo[e]pyrene	INDPYR	Indeno[1,2,3-cd]pyrene	DDD	p,p'-Dichlorodiphenyldichloroethane
BENZGHIP	Benzo[ghi]perylene	NAPTH	Naphthalene	DDE	p,p'-Dichlorodiphenyldichloroethylene
BKF	Benzo[k]fluoranthene	PERYLENE	Perylene	DDT	p,p'-Dichlorodiphenyltrichloroethane
C1N	C1-naphthalenes	PHENANT	Phenanthrene		
C1PHEN	C1-phenanthrene	PYRENE	Pyrene		

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