Ardrishaig Harbour
BPEO Report –December 2020

December 2020

Ardrishaig Harbour
BPEO Report –December 2020

Client: Scottish Canals

Document number: 9403
Project number: 174117j
Status: Final

Author: Campbell Stewart
Reviewer: Graeme Duff

Date of issue: 15 December 2020
Filename: Adrishaig Harbour BPEO Working R2 Nov 24 A

Issue Record

Issue	Status	Author	Reviewer	Approver	Issue Date
1	Final	CCAS	GD	GD	15/12/2020
2	Final	CCAS	GD	GD	02/12/2024

Glasgow

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

Aberdeen

Banchory Business Centre
Burn O'Bennie Road
Banchory
AB31 5ZU
01330 826 596

Inverness

Alder House
Cradlehall Business Park
Inverness
IV2 5GH
01463 794 212

Edinburgh

1st Floor
Sirius Building
The Clocktower Estate
South Gyle Crescent
Edinburgh
EH12 9LB
0131 370 4070

Contents

Appendices

Tables

1 INTRODUCTION

1.1 Scope of Report

Scottish Canals Ltd (are required to undertake a Best Practicable Environmental Option (BPEO) assessment to undertake dredging of material within Adrishaig Harbour within Loch Gilp sea loch to maintain navigation to the Canal via the harbour. The dredging will involve the excavation of sediments using a barge mounted excavator to loosen the material prior to plough dredging of the material into the deep waters of Loch Gilp. At present the access is restricted during low tides, and the windows of access and egress from the canal into the harbour are limited. Two areas are to be deepened including one area to 3m below CD and the other 5m below CD as detailed in the drawings in Appendix A.

The purpose of this report is to review 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.

1.2 Background to Application

This report covers dredge areas which are detailed in the Figure in Appendix A and Table 1-1 below.

Table 1-1:Proposed Dredge Site and Approximate Dredge Volume

Site Name	Dredge Volume (m^3)
Ardrishaig Harbour	14,000m^3

1.3 Report Usage

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

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

Whilst the Client has a right to use the information as appropriate, EnviroCentre Limited retains ownership of the copyright and intellectual content of this report. Any distribution of this report should be managed to avoid compromising the validity of the information or legal responsibilities held by both

2 .NATURE OF MARINE SEDIMENTS

Samples from the proposed dredge area were collected in November 2020 and submitted for analysis in line with Marine Scotland's Guidance. The results from this exercise are provided in Appendix C and also accompanying the licence application in the appropriate template.

Sediments sampled within the proposed dredge areas are reported as a mixture of gravel, silt and sand with these constituents varying by sample location.

2.1 Chemical Analysis Assessment Criteria

All chemical analytical results were assessed against Revised Action Levels (RAL) criteria as adopted by Marine Scotland. The results are summarised in Table 2-1 below. Full summary reports detailing exceedances in the Marine Scotland format have been submitted along with the supporting information for the application. The full sediment sampling report is provided in Appendix B.

Where contaminants have RALs as adopted by Marine Scotland, exceedances above these criteria are summarised in Table 2-1, along with the maximum concentration recorded for each parameter.

Table 2-1: Exceedances of Revised Action Levels and Maximum Concentrations

Contaminant	No. of Exceedances (of 9 samples)*		Maximum Concentration (mg/kg) and Location
	RAL 1	RAL 2	
Copper	4	0	41.3 - BHA ES104 2.30-2.80m
Lead	2	0	78.1 - BHA ES101 0.00-0.15m
Mercury	2	0	0.45 - BHA ES101 0.00-0.15m
Nickel	4	0	42.7 - BHA ES104 2.30-2.80m
PAH (All Species)	1	-	Grab D ES101 0.00-0.15m
TPH	1	-	Grab D ES101 0.00-0.15m

Multiple exceedances above RAL 1 were noted for metals, TPH, and PAHs. There were no exceedances of RAL 1 for TBT.

All results were recorded below RAL 2 where they exist.

2.2 Physical Characteristics

Samples recovered were predominately gravel, sand and silt varying in content by both location and depth. Average percentages across the dredge area are 8.5% gravel, 54.6% sand and 36.8% silt. Sample logs are provided in Appendix B.

3 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.

3.1 Identification and screening of Available Disposal Options

A number of options are available for disposal of dredged sediments. The options considered are provided in Table 3-1 along with justification for screening out those options which have not been taken forward for further consideration.

Table 3-1: Initial Best Practicable Available Options

Location	Options	Screening Assessment	Carry forward?
Estuary/ Riverbank	Leave in situ	Not an option due to the project specific requirements to maintain the depth within the Harbour	No
	Infilling of an existing dry dock/harbour facility/development site (re-use)	The site is fairly isolated and no historic docks or other sites are available in proximity for reuse of the project. The use of the dredged material on a development site is dependent upon programme timing and the suitability of the location of the receiving site. Once material is brought on to land it falls under the jurisdiction of SEPA. Further chemical and geotechnical testing is likely to be required before it is permitted for use on a development site.	No
	Beach Nourishment	Specific beach nourishment projects would require to be supported by Environmental Assessments as a minimum 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 dredge material comprises a mixture of gravel, sand and silt. Fine sediments (i.e. silt) is not suitable for beach nourishment in the traditional sense.	No
Land	Landfill Disposal	This is possible but it is unlikely that this option will offer long term solution due to lack of space at landfills. 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 likely to require treatment first in a dewatering facility. Significant cost associated with set up of dewatering facility at the quayside plus transportation and additional costs associated with gaining the necessary planning and regulatory consents.	Yes
	Land Incineration	The dredged material consists of non-combustible material (silts, sands, gravels, shells) with a low combustible component and very high-water content.	No
	Application to Agricultural Land	The dredged material would need to be treated to reduce salt concentrations to acceptable levels. Would require detailed chemical analysis and assessment as well as a Waste Management License Exemption. Would require special precautions during spreading in relation to the risk of odour and watercourses / aquifers. The availability of land for this option will be limited within a reasonable haulage distance of the dredge arisings. Large volumes each year are unlikely to be viable to dispose of in this manner and 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 to minimise the entrainment of fine-grained material into the sands, or energy and water rich processing on land. This is not currently understood to be an established disposal and reuse route in proximity to the site and is not likely to be something which could be established in the project timeframes due to the requirement for various permitting requirements including waste management licencing, discharge consents for process water as well as increased road transportation for delivery of waste material and collection of processed material.	No
Sea	Aquatic disposal direct to seabed.	Relatively low cost, minimal transportation requirements compared to all other options and potential for low environmental risk. The current proposal, based on historic activities, is to excavate the material using a barge mounted excavator and then plough the dredge the material from the harbour to the deeper waters of Loch Gilp.	Yes

3.2 Summary of Identified BPEO Options

Four options were taken forward for further detailed BPEO assessment 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.

3.2.1 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 and transport to shore;
- Transfer to shore to a dewatering facility;
- Dewatering;
- Transfer of dewatered material to storage area for stockpiling;
- Loading of lorries and transport to landfill site; and
- Disposal at Landfill site.

Transport to the shore would require the identification of an available jetty facility suitable for receiving material directly to the dewatering facility. Two options are available for off-loading; namely grabbing the spoil from the barge or hopper or pumping directly ashore.

The dewatering facility would require being purpose built and capable of receiving large quantities of dredged material. 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. The dewatered dredged sediment would then be removed from the facility and stockpiled for transfer via lorry to a suitably licensed landfill. The closest landfill is c.4.5 miles to the east, Lochgilphead landfill Operated by Shanks and Argyll and Bute Council and is for domestic refuse.

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. It is estimated that approximately 1,600 return trips would be required to transport the dewatered dredged material to landfill.

The number of landfills within a viable distance of the site is considered to be very limited. In addition, the available capacity of each site is limited by the amount of material it can receive per annum. Due to the proposed quantity of material to be dredged it is therefore unlikely that any landfill within viable distance of the dredge site will have the capacity to receive the dredged material.

3.2.2 Sea Disposal through Plough Dredging

A long reach excavator, with a reach of 12 -16m, will be utilised on the Thistle Pontoon (14m x 6m) in the harbour itself.

The excavator will utilise a 1m wide x 1m deep skeleton bucket to mechanically dredge the compacted sediment in the harbour. 2 x tug boats will support the pontoon during the mechanical dredge to position it.

Following the initial dredging using the mechanical excavator, the plough dredger will remove the material via plough dredging.to the deeper waters of Loch Gilp away from the Harbour. It is understood that this method has historically been used with success. This method minimises the requirement for additional processing/treatment, handling and transportation.

4 FURTHER CONSIDERATION OF REMAINING DISPOSAL OPTIONS

4.1 Detailed BPEO Assessment

Each of the identified options was assessed against the criteria detailed in Table 4-1 below.

Table 4-1: 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

4.1.1 BPEO Strategic Assessment

Table 4-2 below provides details of the strategic assessment for each option taken forward and details the environmental assessment for each option taken forward for detailed BPEO assessment.

Table 4-2: 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. The material would be excavated in situ then ploughed away from the harbour into the deeper waters of Loch Gilp.
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 is typically a limit to the amount of waste that can be accepted both on a daily and annual basis at a landfill. The landfill capacity will therefore not be able to accommodate the quantity of material generated by the dredging activities and another disposal option will be required for the surplus material.	The chemical analysis of the sediments from the proposed dredge sites would indicate that the material would typically be acceptable for sea disposal pending further risk assessment for contaminants present at levels between Action Level 1 and Action Level 2.
General Public /Local acceptability	Increase traffic on haul routes therefore potential for increase in public complaints.	Traditionally accepted disposal route for dredged material and limited public impact. This method has historically been adopted.
Legislative Implications	Contravenes the principles of minimising waste and long term commitments by the government to reduce land filling.	Would need approval from Marine Scotland other relevant authorities.

Table 4-3:: BPEO Environmental Assessment

Criteria	Landfill	Sea Disposal
Safety Implications	Double handling of material increases the potential for accidents to occur. Work would be undertaken in accordance with H&S legislation.	Minimal handling of material required as it would be excavated and then dredged directly to Loch Gilp for dispersal 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 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. Plough dredging would not result in the material being raised above the surface of the water, therefore no public health potential.
Pollution/contamination	Pumping ashore to dewatering facility and transportation to landfill will all require energy. Road transport increases the carbon footprint of this disposal option. Potential for spillages to occur.	Pollutant concentrations in dredged material to be disposed are limited to acceptable levels through regulatory licensing processes. Further discussion with marine Scotland is likely to be required.
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.	Removal to Loch Gilp has previously been utilised with no previous ecological impact being identified. There are no designated sites adjacent to the harbour.
Interference with other legitimate activities	Potential for limited short term local impact to commercial operations in the area of the dredged material handling and road hauling principally related to noise and dust potential.	Works would be coordinated so as not to interfere with other activities.
Amenity / Aesthetic Implications	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 existing landfill site.	Limited short term visual / odour / noise effects as dredged material is transported by dredger to final resting place.

4.2 BPEO Cost Assessment

4.2.1 BPEO Cost Assessment

An operating budget estimate is provided in the table below. It should be noted that the rates in Table 4-4 are based on the dredged spoil being able to be transferred ashore in its as dug state and do not allow for placing within a bunded area, draining the material or transporting in watertight vehicles. If any of these are required, the costs would increase significantly.

14,000 m3 of material are to be dredged assuming it equates to 28,000 tonnes of material which has been used for the costings below.

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

Table 4-4: BPEO Cost Analysis

Disposal Option	Activity Description	Weight (Tons)	Unit Cost (Tonne)	Cost (£)
Landfill Disposal	Excavation	28,000	1.50	42,000
	Transport by barge	28,000	3.00	84,000
	Transfer to lorry	28,000	2.00	56,000
	Transport by lorry	28,000	8.00	224,000
	Disposal to land	28,000	2.50	70,000
	Total	28,000	**17**	**476,000**
Sea Disposal via Plough Dredging	**Plough Dredging Contractor Budgets based on 2020 tenders**	28,000	**1.42-2.14**	**40-60,000**

4.3 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 – 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 4-5 below provides a summary of the BPEO assessment.

Table 4-5: BPEO Summary

Criteria	Landfill Disposal	Sea Disposal
Environment	4	2
Strategic	4	1
Costs	4	1
TOTAL SCORE	**12**	**4**

4.4 Conclusions

The Best Practicable Environmental Option for disposal of the dredging from Adrishaig Harbour has therefore been assessed as sea disposal through plough dredging of material to Loch Gilp due to both strategic, logistic and cost benefits when compared against other available viable options, namely land based disposal.

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

5 FURTHER ASSESSMENT

As detailed in Section 2 on the basis of the exceedances of Action Level 1, further assessment to determine the suitability of the material for sea disposal is deemed a requirement.

The approach for this further assessment is outlined as follows:

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

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

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

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

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) to draw conclusions from available information and provide recommendation for proposed disposal routes.

5.1 Analytical Data Review

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 below:

Table 5-1: Exceedances of Revised Action Levels

Contaminant	No. of Exceedances (of 9 samples)*	
	RAL 1	RAL 2
Copper	4	0
Lead	2	0
Mercury	2	0

Contaminant	No. of Exceedances (of 9 samples)*	
	RAL 1	RAL 2
Nickel	4	0
PAH (All Species)	1	-
TPH	1	-

5.1.1 ERL & PEL Review

Exceedances of the ERL and PEL (where one is available) is summarised in Table 5-2. Full summary tables are provided in Table A in Appendix C : Note any contaminant of concern with N/A indicates no corresponding ERL or PEL value currently available.

Table 5-2: Exceedances of ERL and PEL

Contaminant	No. of Exceedances (of 44 samples)*	
	ERL	PEL
Copper	4	0
Lead	2	0
Mercury	2	0
Nickel	0	0
PAH (All Species)	1	1
TPH	N/A	N/A

5.2 Averages

Review of the averaged data for all the data has been undertaken i.e. considering the material as a single volume for disposal. The concentrations of the various contaminants of concern are quite variable, the review of average data against the available adopted assessment criteria are as follows:

- Averaged concentrations are below RAL1 for all contaminants of concern with the exception of several PAH species;
- There are no average concentrations in exceedance of the ERL where they exist;.
- There are no average concentrations in exceedance of the PEL where they exist; and .
- All samples recorded averaged concentrations below RAL2 where they exist.

5.3 Chemical Assessment Conclusions

RAL1 exceedances were recorded in up to 4 samples for metals and 1 sample for PAHs and TPH.

Up to 4 individual samples recorded exceedances of the ERL for metals copper and 1 sample for PAHs. One sample (Grab D) exceeds the PEL for individual PAH species.

When the averaged data is considered there are no exceedances recorded for either the RAL1, ERL, PEL of RAL2 where one is available for review.

In summary, the material that is earmarked for dredging is considered to represent a low potential chemical risk to marine life based on the levels of contaminants of concern present when reviewed in parallel with available screening criteria.

5.4 Water Framework Directive Assessment

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

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

Each of these points are considered in Table 5-3 below:

Table 5-3: Receptor Risk Assessment

Key Receptor[1]	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 areas proposed to be dredged have previously been subjected to routine maintenance dredging. The dredge sites are within the Outer Loch Fyne Basin which is classified as a High Class site.
Biology - habitats	Included to assess potential impacts to sensitive/high value habitats.	No	The Outer Loch Fyne Basin is classified as good for macroinvertebrates and there is no information available on the status of fish.
Biology – fish	Consideration of fish both within the estuary and also potential effects on migratory fish in transit through the estuary	No	There is no information available for the status of fish in the Outer Loch Fyne Basin. The proposed works are considered to be both short lived and any effects would be localised and temporary. There is plenty of room across Loch Gilp for migrating fish to migrate away from any works should the work coincide with any migration
Water Quality	Consideration must be given to water quality when contaminants are present in exceedance of CEFAS RAL1.	Yes	The Outer Loch Fyne Basin water quality status is classified as Pass with regards to specific pollutants. No information was available for priority substances. Contaminants are noted to exceed CEFAS RAL1 within sediment samples obtained at the harbour and further consideration of the potential effects is provided following this section.

[1] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

Key Receptor[1]	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
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	No	The proposed dredge site is not located within 2km of an SAC or SPA, marine protected area or Ramsar sites. The dredge site is within a designated as shellfish water. The site is not within 2km of a shellfish site with the closest noted as “Site 1” in excess of 6km due east and Ardcastle Bay over 14km north east. The dredge site is not within 2km of a designated bathing Water with the closest noted as c 36km south east at Ettrick Bay on the Isle of Bute.

5.5 Potential Risk to Water Quality and Marine Life

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

Although there are contaminants of concern above the RAL1 within the sediment for disposal, it is considered that these levels will not contribute to an overall degradation of water quality in proximity to the disposal site. While any effects are considered to be both localised and temporary, the potential for dilution in the Loch Gilp (Outer Loch Fyne Basin) is considerable when comparing the volume of material to be relocated through plough dredging in relation to the wider waterbody within the Outer Loch Fyne Basin.

The key contaminants for impacting water quality are considered to be metals as these have the potential to dissolve/desorb from sorption sites, whereas the organic contaminants (e.g. PAHs)have a greater affinity for the organic materials which they are bound to, and are more likely to remain strongly bound to the sediment, or if become dissolved, quickly adsorbed onto organic matter within the water column or sediments.

The key risk is considered to be an increase in turbidity/suspended solids during the plough dredging activity although this is likely to cause localised degradation in water quality, it is considered that this will be a local and temporary event.

The sediment material primarily has a variable grain size with the dominant fraction recorded as sand. Table 5-4 summarises the physical sediment type on average by each dredge area versus the proposed dredge volume.

Table 5-4: Summary of PSA Data

Dredge Area	Gravel (>2mm)	Sand (0.063mm<Sand<2mm)	Silt & Clay (<0.063mm)	Quantity to be dredged m^3
Ardishaig Harbour	8.5	54.6	36.8	14,000

Sands and gravel will settle quickly following ploughing, along with any clumps of cohesive material. Silts and clays, being finer grained will suspend and have the potential for dispersal due to longer times in suspension, however it is expected that the majority will quickly fall quickly to the seabed.

In addition, the associated risk with degradation of water quality directly associated with the proposed disposal is considered to be Low i.e. unlikely to cause a change in status of the waterbodies in question.

5.6 Conclusions and Recommendations

Review of available information has highlighted that although several contaminants of concern exceed RAL1 in sediment samples, 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. Additionally, the contaminants of concern levels recorded in the sediment are not considered likely to have a significant adverse impact when plough dredged from their current location in the harbour out to the deeper waters in Loch Gilp.

Overall, based on the multiple lines of evidence approach adopted to further assess the exceedances identified in the sediment assessment, the recommendation for sea disposal through plough dredging is considered to be the preferred option for dredge arisings.

REFERENCES

Marine Scotland (2017). Pre-Dredge Sampling Guidance Version 2: Scottish Government.
Marine Scotland (2015). Guidance for Marine Licence Applicants Version 2: Scottish Government.

APPENDICES

A FIGURES

Legend

- Sediment Sample
- Approximate Dredge Area

Do not scale this map

Client
Scottish Canals

Project
Ardrishaig Harbour

Title
Sediment Sample Locations and Dredge Areas

Status
Draft

Drawing No.	Revision	Date
174117-QGIS001	-	03 Dec 2020
Drawn	**Checked**	**Approved**
FR	##	##

Scale
1:1,500 @ A3

Rev	Date	Amendment	Initials
-	-	-	-

envirocentre
Craighall Business Park, Eagle Street, Glasgow, G4 9XA
T: 0141 341 5040 E: info@envirocentre.co.uk W: www.envirocentre.co.uk

185300E 185350E 185400E 185450E 185500E 185550E 185600E

685450N 685400N 685350N 685300N 685250N

Boatyard
Canal Office
Slipway
Shingle
PIER SQUARE
Bollard
MLWS
Pier
LB
Bollard
MLWS
MHWS
Harbour
Shingle
5.0m depth required
Area = ~6000m2
~10000m3 of material to be moved
3.0m depth required
Area = ~5600m2
~4000m3 of material to be moved
Lighthouse
(flashing white, red, green)
MLWS
Winch
MP
MLWS
SM
No 1 Lock
MP
Winch
MP
MP
Sand
Sloping masonry

Scale: 1 cm = 5.00 Meters
0 5 10 20 30 40 50

Legend

12_8	Depths relative to CHART DATUM.
	Sea-bed contour relative to CHART DATUM.
	Mean High Water Springs
	Mean Low Water Springs

Survey Parameters & Equipment	
Survey Vessel:	Coastal Sensor II (MCA Cat III)
Positioning System:	Trimble Applanix POS MV
GPS Correction Source:	Radio Corrections from Base Station
Echosounder:	R2Sonic 2024 Multibeam System 400kHz
Motion Compensator:	Trimble Applanix POS MV
Positioning System Spheroid & Datum:	ETRS89
Grid System:	National Grid of Great Britain
Geoid Model:	OSGM15
Transformation Paramaters:	OSTN15
Spheroid:	Airy
Semi Major Axis:	6377563.396
Flattening (1/f):	299.324964600
Vertical Datum (Topographic):	--
Vertical Datum (Hydrographic):	Chart Datum
Distance Unit:	Metre

Chart Datum is 1.62m below Ordnance Datum.

The datum was established using corrected OS Rinex data and post-processed using Trimble Business Centre Software.

Coloured Depth Bands:

< 0.00
0.00 - 0.49
0.50 - 0.99
1.00 - 1.49
1.50 - 1.99
2.00 - 2.49
2.50 - 2.99
3.00 - 3.49
3.50 - 3.99
4.00 - 4.49
4.50 - 4.99
5.00 - 5.49
5.50 - 5.99
6.00 - 6.49
6.50 - 6.99
7.00 - 7.49
7.50 - 7.99
>= 8.00

Notes:

The Bathymetric survey limits are MHWS, data is relative to Chart Datum.

Horizontal and vertical datums were referenced to control stations on site.

Heights in metres above Chart Datum (East Loch Tarbert)

MHWS	MHWN	MLWN	MLWS
3.6	2.9	1.0	0.3

CONTROL STATION COORDINATES (CD)

STN	EASTING	NORTHING	LEVEL
Base	185408.550	685383.133	4.966

Aspect
Land + Hydrographic Surveys
CHARTERED SURVEYORS
Thornhouse Business Centre
Ballot Road
Irvine
KA12 0HW
Tel : 01294 313399 Fax : 01294 313389
E-mail: mail@aspectsurveys.com
Web: www.aspectsurveys.com

Client :

SCOTTISH CANALS
CANAL HOUSE
1 APPLECROSS STREET
GLASGOW
G4 9SP

Project Title :

MULTIBEAM BATHYMETRIC SURVEY
ARDRISHAIG HARBOUR
ARGYLL

Project No: A7248_CD	Scale : 1:500
Surveyed date : 13th December 2019	Issued date : 17th December 2019
Surveyed by : EJS	Checked by: CKS
Sheet No. : 1 of 1	Plot Scale: 1:1 @ A1

B SAMPLE LOGS

STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:	Client:	Borehole:
Ardrishaig	**Scottish Canals**	**BHA**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	**02.01.20** End: **02.11.20**	**---**	**E:185368.0 N:685343.0**	**1** of **2**

Depth (m)	Samples & Testing: No	Type	Results	Backfill	Water	Description of Strata	Depth (Thickness)	Material Graphic Legend
0.00-0.15	101	ES	2xGV, 3xP			Brownish grey slightly gravelly silty fine to coarse SAND with low cobble content. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of schist. Contains frequent shell fragments. Organic odour.	0.25	
0.25-0.80	102	ES	2xGV, 3xP			. . . at 0.20m: becomes grey.	(0.55)	
							0.80	
0.80-2.00	103	ES	2xGV, 3xP			Grey gravelly silty fine to coarse SAND with shell fragments. Gravel is angular to subangular fine to coarse of mixed lithologies.		
						Grey silty fine to medium SAND.	(1.50)	
							2.30	
2.30-2.80	104	ES	2xGV, 2xP			Soft grey silty slightly sandy CLAY. Sand is fine to medium.	(0.50)	
							2.80	
						Borehole terminated at 2.80m depth as scheduled.		

Boring Progress and Water Observations

Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

General Remarks

1. 2 attempts taken to recover material to target depth.
2. 2 inch diameter barrel used.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Vibrocore	**Bespoke Rig**	**MField**	**ZCockburn**	

STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:		Client:		Borehole:
Ardrishaig		**Scottish Canals**		**BHA**
Contract Ref:	Start: **02.01.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	End: **02.11.20**	**---**	**E:185368.0 N:685343.0**	**2** of **2**

541765 BHA 0.00 - 2.80m

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Vibrocore	**Bespoke Rig**	**MField**	**ZCockburn**	

STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:	Client:	Borehole:
Ardrishaig	**Scottish Canals**	**BHB**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	**02.11.20** End: **02.11.20**	**---**	**E:185443.0 N:685364.0**	**1** of **2**

Depth (m)	Samples & Testing: No	Type	Results	Backfill	Water	Description of Strata	Depth (Thickness)	Material Graphic Legend
0.00-0.15	101	ES	2xGV, 3xP			Dark grey slightly clayey very sandy angular to subrounded fine to coarse GRAVEL of mixed lithologies and shell fragments. Sand is fine to coarse.	0.30	
0.30-0.80	102	ES	2xGV, 3xP			Dark grey slightly gravelly silty fine to coarse SAND containing shell fragments. Gravel is angular to subrounded fine to coarse of mixed lithologies.	(0.50) 0.80	
0.80-1.80	103	ES	2xGV, 3xP			Grey sandy slightly gravelly SILT with shell fragments. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed lithologies.	(1.00) 1.80	
1.80-2.50	104	ES	2xGV, 3xP			Grey slightly sandy slightly gravelly SILT. Sand is fine to medium. Gravel is rare subangular to subrounded fine to coarse of mixed lithologies.	(0.70) 2.50	
						Borehole terminated at 2.50m depth as scheduled.		

Boring Progress and Water Observations

Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

General Remarks

1. 2 attempts to recover target depth of material.
2. 2 inch diameter barrel used.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Vibrocore	**Bespoke Rig**	**MField**	**ZCockburn**	

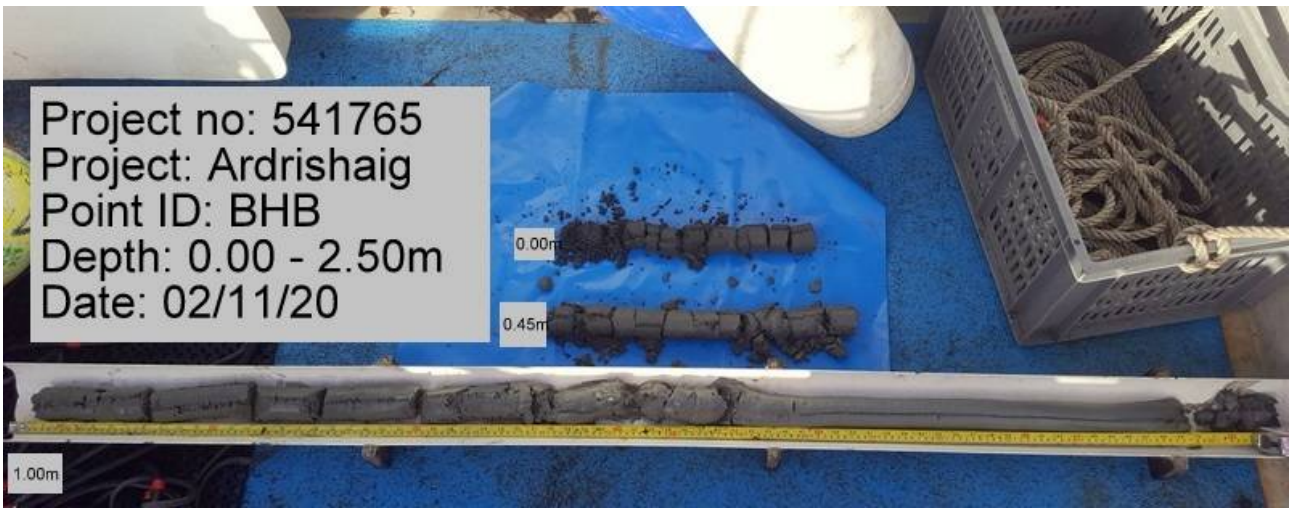
STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:		Client:		Borehole:
Ardrishaig		**Scottish Canals**		**BHB**
Contract Ref:	Start: **02.11.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	End: **02.11.20**	**---**	**E:185443.0 N:685364.0**	**2** of **2**

542765 BHB 0.00 - 2.50m



Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Vibrocore	**Bespoke Rig**	**MField**	**ZCockburn**	

STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:	Client:	Borehole:
Ardrishaig	**Scottish Canals**	**BHC**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	**02.11.20** End: **02.11.20**	**---**	**E:185474.0 N:685330.0**	**1** of **2**

Depth (m)	Samples & Testing: No	Type	Results	Backfill	Water	Description of Strata	Depth (Thickness)	Material Graphic Legend
0.00-0.15	101	ES	2xGV, 3xP			Greyish brown flecked black silty fine to medium SAND with occasional shell fragments. Organic odour.	(1.18)	
0.15-0.60	102	ES	2xGV, 3xP					
0.60-1.18	103	ES	2xGV, 3xP					
							1.18	
						Borehole terminated at 1.18m depth due to obstruction.		

Boring Progress and Water Observations

Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

General Remarks

1. 3 attempts to recover target depth of material.
2. 3 inch diameter barrel used.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Vibrocore	**Bespoke Rig**	**MField**	**ZCockburn**	

STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:		Client:		Borehole:
Ardrishaig		**Scottish Canals**		**BHC**
Contract Ref:	Start: **02.11.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	End: **02.11.20**	**---**	**E:185474.0 N:685330.0**	**2** of **2**

541765 BHC 0.00 - 1.18m

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Vibrocore	**Bespoke Rig**	**MField**	**ZCockburn**	

STRUCTURAL SOILS

PRELIMINARY

BOREHOLE LOG

Contract:	Client:	Borehole:
Ardrishaig	**Scottish Canals**	**Grab D**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
541765	**02.11.20** End: **02.11.20**	**---**	**E:185330.0 N:685291.0**	**1** of **1**

Depth (m)	Samples & Testing: No	Type	Results	Backfill	Water	Description of Strata	Depth (Thickness)	Material Graphic Legend
0.00-0.15	101	ES	2xGV, 3xP			Greyish black slightly sandy SILT with frequent shell fragments. Sand is fine to coarse (organic odour). Grab sample taken from seabed to 0.15m depth.	0.15	

Boring Progress and Water Observations

Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

General Remarks

1. A grab sample of sediment taken from seabed level to 0.15m depth.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Sampling Location	**Ekman Grab Sampler**	**???**	**ZCockburn**	

C DATA SUMMARY TABLES

Summary Table A - Adrishaig Harbour

Sampling Results Assessment Summary November 2020

	AL1 (mg/kg)	AL2 (mg/kg)	BAC (mg/kg)	ERL (mg/kg)	PEL (mg/kg)	BHA ES101 0.00-0.15m	BHA ES103 0.80-2.00m	BHA ES104 2.30-2.80m	BHB ES101 0.00-0.15m	BHB ES103 0.80-1.80m	BHB ES104 1.80-2.50m	BHC ES101 0.00-0.15m	BHC ES103 0.60-1.18m	Grab D ES101 0.00-0.15m	AVERAGE	Data No. Exceed RAL 1	Data No. Exceed RAL 2	2020 Data No.Exceed BAC?	2020 Data No. Exceed ERL	2020 Data No. Exceed PEL?
Source			CSEMP	CSEMP	Canada															
Arsenic	20	70	25	-	41.6	3.6	4.9	4.4	4	6.7	10.4	4.4	3.8	6.8	5.44	0	0	0	-	0
Cadmium	0.4	4	0.31	1.2	4.2	0.36	0.24	0.27	0.26	0.2	0.24	0.19	0.22	0.36	0.26	0	0	2	0	0
Chromium	50	370	81	81	160	25.6	40.6	47.6	36.7	35.9	43.2	21.8	21.4	26.1	33.21	0	0	0	0	0
Copper	30	300	27	34	108	23.3	37.8	41.3	21.5	17.2	37.1	16	19	36.3	27.72	4	0	4	4	0
Mercury	0.25	1.5	0.07	0.15	0.7	0.45	0.05	0.04	0.04	0.06	0.05	0.06	0.14	0.39	0.14	2	0	3	2	0
Nickel	30	150	36	-	-	21.9	37.4	42.7	31.9	28.1	39.4	19.2	19.1	21.2	28.99	4	0	3	N/A	N/A
Lead	50	400	38	47	112	78.1	13.8	12.4	62.1	13.4	22.8	12.8	28.7	37.6	31.30	2	0	2	2	0
Zinc	130	600	122	150	271	83.4	80	90.5	94	70.4	94.7	79.8	63.3	108	84.90	0	0	0	0	0
Napthalene	0.1		0.08	0.16	0.391	0.00462	0.001	0.001	0.001	0.001	0.001	0.00216	0.033	0.189	0.03	1	-	1	1	0
Acenaphthylene	0.1		-	-	0.128	0.00546	0.001	0.001	0.001	0.001	0.001	0.001	0.00461	0.0443	0.01	0	-	N/A	N/A	0
Acenaphthene	0.1		-	-	0.0889	0.00269	0.001	0.001	0.001	0.001	0.001	0.001	0.00581	0.12	0.01	1	-	N/A	N/A	0
Fluorene	0.1		-	-	0.144	0.00678	0.001	0.001	0.001	0.001	0.001	0.001	0.00925	0.118	0.02	1	-	N/A	N/A	0
Phenanthrene	0.1		0.032	0.24	0.544	0.0348	0.001	0.001	0.00175	0.00158	0.00116	0.00293	0.0613	0.831	0.10	1	-	3	1	1
Anthracene	0.1		0.05	0.085	0.245	0.0109	0.001	0.001	0.001	0.001	0.001	0.001	0.0162	0.276	0.03	1	-	1	1	0
Fluoranthene	0.1		0.039	0.6	1.494	0.0466	0.001	0.001	0.00224	0.001	0.001	0.00452	0.0567	2.17	0.25	1	-	3	1	1
Pyrene	0.1		0.024	0.665	1.398	0.0651	0.001	0.001	0.0024	0.001	0.001	0.00448	0.0668	2.07	0.25	1	-	3	1	1
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.0253	0.001	0.001	0.0011	0.001	0.001	0.00423	0.0354	1.05	0.12	1	-	3	1	1
Chrysene	0.1		0.02	0.384	0.846	0.0248	0.001	0.001	0.00119	0.001	0.001	0.0041	0.0381	1.03	0.12	1	-	3	1	1
Benzo(b)fluoranthene	0.1		-	-	-	0.0279	0.001	0.001	0.00161	0.001	0.001	0.00493	0.0458	0.872	0.11	1	-	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1		-	-	-	0.0112	0.001	0.001	0.00114	0.001	0.001	0.0023	0.0223	0.483	0.06	1	-	N/A	N/A	N/A
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.0313	0.001	0.001	0.00154	0.001	0.001	0.00585	0.0525	1.11	0.13	1	-	3	1	1
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.0234	0.001	0.001	0.00161	0.001	0.001	0.00422	0.0393	0.748	0.09	1	-	1	1	N/A
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.0378	0.001	0.001	0.00182	0.00111	0.001	0.004	0.042	0.715	0.09	1	-	1	1	N/A
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.00553	0.001	0.001	0.001	0.001	0.001	0.001	0.00853	0.145	0.02	1	-	N/A	N/A	1
TPH	100		-	-	-	9.51	2.13	5.18	16.5	6.89	4.91	12.8	27.7	231	35.18	1	-	N/A	N/A	N/A
PCBs (Sum ICES 7)	0.02	0.18	-	-	0.189	0.00058	0.00072	0.00062	0.00057	0.00067	0.00064	0.00056	0.00057	0.0021	0.0008	0	0	N/A	N/A	0
TBT	0.1	0.5	-	-	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0500	0	0	N/A	N/A	N/A

Note 1: All concentrations are recorded in mg/kg

Note 2: Underlined Values are < LOD

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

Certificate of Analysis

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

Test Report ID	**MAR00805**	
Issue Version	1	
Customer	EnviroCentre Ltd, Craighall Business Park, 8 Eagle Street, Glasgow, G4 9XA	
Customer Reference	Ardishaig	
Date Sampled	02-Nov-20	
Date Received	04-Nov-20	
Date Reported	24-Nov-20	
Condition of samples	Cold	Satisfactory

<Redacted>

Authorised by:	Marya Hubbard
Position:	Laboratory Manager

Any additional opinions or interpretations found in this report, are outside the scope of UKAS accreditation.

Certificate of Analysis

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

Test Report ID	MAR00805
Issue Version	1
Customer Reference	Ardishaig

		Units	%	%	%	%	%
		Method No	ASC/SOP/303	ASC/SOP/303	SUB_01*	SUB_01*	SUB_01*
		Limit of Detection	0.2	0.2	N/A	N/A	N/A
		Accreditation	UKAS	UKAS	N	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Total Moisture @ 120°C**	**Total Solids**	**Gravel (>2mm)**	**Sand (63-2000 µm)**	**Silt (<63 µm)**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	25.9	74.1	6.3	87.7	5.9
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	16.8	83.2	0.8	50.1	49.1
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	19.0	81.0	0.0	4.9	95.1
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	28.0	72.0	43.1	50.2	6.7
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	21.6	78.4	7.0	44.8	48.2
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	23.6	76.4	7.4	2.2	90.4
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	30.1	69.9	1.1	95.9	3.0
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	20.3	79.7	0.2	97.2	2.6
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	44.0	56.0	10.9	58.5	30.6
		Reference Material (% Recovery)	N/A	N/A	N/A	N/A	N/A
		QC Blank	N/A	N/A	N/A	N/A	N/A

* See Report Notes

NAIIS - No Asbestos Identified In Sample

Certificate of Analysis

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

Test Report ID	MAR00805
Issue Version	1
Customer Reference	Ardishaig

		Units	N/A	% M/M
		Method No	SUB_02*	SOCOTEC Env Chem*
		Limit of Detection	N/A	0.02
		Accreditation	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Asbestos**	**TOC**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	NAIIS	0.37
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	NAIIS	0.09
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	NAIIS	0.07
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	NAIIS	0.31
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	NAIIS	0.26
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	NAIIS	0.19
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	NAIIS	0.15
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	NAIIS	0.89
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	NAIIS	2.04
		Reference Material (% Recovery)	N/A	101
		QC Blank	N/A	<0.02

* See Report Notes

NAIIS - No Asbestos Identified In Sample

Certificate of Analysis

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

Test Report ID	MAR00805
Issue Version	1
Customer Reference	Ardishaig

		Units	mg/Kg (Dry Weight)							
		Method No	SOCOTEC Env Chem*							
		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**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	3.6	0.36	25.6	23.3	0.45	21.9	78.1	83.4
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	4.9	0.24	40.6	37.8	0.05	37.4	13.8	80.0
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	4.4	0.27	47.6	41.3	0.04	42.7	12.4	90.5
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	4.0	0.26	36.7	21.5	0.04	31.9	62.1	94.0
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	6.7	0.20	35.9	17.2	0.06	28.1	13.4	70.4
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	10.4	0.24	43.2	37.1	0.05	39.4	22.8	94.7
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	4.4	0.19	21.8	16.0	0.06	19.2	12.8	79.8
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	3.8	0.22	21.4	19.0	0.14	19.1	28.7	63.3
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	6.8	0.36	26.1	36.3	0.39	21.2	37.6	108
Certified Reference Material SETOC 774 (% Recovery)			100	107	103	106	101	99	96	100
QC Blank			<0.5	<0.04	<0.5	<0.5	<0.01	<0.5	<0.5	<2

* See Report Notes

Certificate of Analysis

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

Test Report ID	MAR00805
Issue Version	1
Customer Reference	Ardishaig

		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)**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	<5	<5
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	<5	<5
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	<5	<5
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	<5	<5
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	<5	<5
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	<5	<5
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	<5	<5
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	<5	<5
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	<5	<5
Certified Reference Material BCR-646 (% Recovery)			89	78
QC Blank			<1	<1

***** See Report Notes

Certificate of Analysis

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

Test Report ID MAR00805
Issue Version 1
Customer Reference Ardishaig

		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**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	2.69	5.46	10.9	25.3	31.3	27.9
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	<1	<1	<1	<1	<1	<1
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	<1	<1	<1	<1	<1	<1
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	<1	<1	<1	1.10	1.54	1.61
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	<1	<1	<1	<1	<1	<1
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	<1	<1	<1	<1	<1	<1
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	<1	<1	<1	4.23	5.85	4.93
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	5.81	4.61	16.2	35.4	52.5	45.8
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	120	44.3	276	1050	1110	872
Certified Reference Material QPH098MS (% Recovery)			110	130	110	87	85	84
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.

Certificate of Analysis

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

Test Report ID MAR00805
Issue Version 1
Customer Reference Ardishaig

		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**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	37.8	11.2	24.8	5.53	46.6	6.78
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	<1	<1	<1	<1	<1	<1
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	<1	<1	<1	<1	<1	<1
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	1.82	1.1	1.19	<1	2.24	<1
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	1.11	<1	<1	<1	<1	<1
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	<1	<1	<1	<1	<1	<1
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	4.15	2.30	4.10	<1	4.52	<1
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	42.0	22.3	38.1	8.53	56.7	9.25
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	715	483	1030	145	2170	118
Certified Reference Material QPH098MS (% Recovery)			92	88	94	95	97	110
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.

Certificate of Analysis

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

Test Report ID	MAR00805
Issue Version	1
Customer Reference	Ardishaig

			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**
BHA ES101 0.00-0.15m		MAR00805.001	Sediment	23.4	4.62	34.8	65.1	9510
BHA ES103 0.80-2.00m		MAR00805.002	Sediment	<1	<1	<1	<1	2130
BHA ES104 2.30-2.80m		MAR00805.003	Sediment	<1	<1	<1	<1	5180
BHB ES101 0.00-0.15m		MAR00805.004	Sediment	1.61	<1	1.75	2.40	16500
BHB ES103 0.80-1.80m		MAR00805.005	Sediment	<1	<1	1.58	<1	6890
BHB ES104 1.80-2.50m		MAR00805.006	Sediment	<1	<1	1.16	<1	4910
BHC ES101 0.00-0.15m		MAR00805.007	Sediment	4.22	2.16	2.93	4.48	12800
BHC ES103 0.60-1.18m		MAR00805.008	Sediment	39.3	33.0	61.3	66.8	27700
Grab D ES101 0.00-0.15m		MAR00805.009	Sediment	748	189	831	2070	231000
			Certified Reference Material QPH098MS (% Recovery)	80	87	100	98	108~
			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.

Certificate of Analysis

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

Test Report ID MAR00805
Issue Version 1
Customer Reference Ardishaig

		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**
BHA ES101 0.00-0.15m	MAR00805.001	Sediment	<0.08	0.10	<0.08	<0.08	<0.08	<0.08	<0.08
BHA ES103 0.80-2.00m	MAR00805.002	Sediment	0.14	0.18	<0.08	<0.08	<0.08	<0.08	<0.08
BHA ES104 2.30-2.80m	MAR00805.003	Sediment	0.11	0.11	<0.08	<0.08	<0.08	<0.08	<0.08
BHB ES101 0.00-0.15m	MAR00805.004	Sediment	<0.08	0.09	<0.08	<0.08	<0.08	<0.08	<0.08
BHB ES103 0.80-1.80m	MAR00805.005	Sediment	0.12	0.15	<0.08	<0.08	<0.08	<0.08	<0.08
BHB ES104 1.80-2.50m	MAR00805.006	Sediment	0.12	0.12	<0.08	<0.08	<0.08	<0.08	<0.08
BHC ES101 0.00-0.15m	MAR00805.007	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
BHC ES103 0.60-1.18m	MAR00805.008	Sediment	<0.08	0.09	<0.08	<0.08	<0.08	<0.08	<0.08
Grab D ES101 0.00-0.15m	MAR00805.009	Sediment	0.18	0.29	0.30	0.27	0.41	0.41	0.24
Certified Reference Material QOR136MS (% Recovery)			81	117	96	99	140	98	72
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.

Certificate of Analysis

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

Test Report ID MAR00805
Issue Version 1
Customer Reference Ardishaig

REPORT NOTES

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
SOCOTEC Env Chem*	MAR00805.001-009	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
SUB_01*	MAR00805.001-009	Analysis was conducted by an approved subcontracted laboratory.
SUB_02*	MAR00805.001-009	Analysis was conducted by an approved subcontracted laboratory.
ASC/SOP/301	MAR00805.001-009	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	MAR00805.001, .004, .007-009	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	Handling Time Exceeded	N/A	N/A
D3	Sample Contaminated through Damaged Packaging	N/A	N/A
D4	Sample Contaminated through Sampling	N/A	N/A
D5	Inappropriate Container/Packaging	N/A	N/A
D6	Damaged in Transit	N/A	N/A
D7	Insufficient Quantity of Sample	N/A	N/A
D8	Inappropriate Headspace	N/A	N/A
D9	Retained at Incorrect Temperature	N/A	N/A
D10	Lack of Date & Time of Sampling	N/A	N/A
D11	Insufficient Sample Details	N/A	N/A
D12	Sample integrity compromised or not suitable for analysis	N/A	N/A

Certificate of Analysis

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

Test Report ID	MAR00805
Issue Version	1
Customer Reference	Ardishaig

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'-Dichorodiphenyldichloroethane
BENZGHIP	Benzo[ghi]perylene	NAPTH	Naphthalene	DDE	p,p'-Dichorodiphenyldicloroethylene
BKF	Benzo[k]fluoranthene	PERYLENE	Perylene	DDT	p,p'-Dichorodiphenyltrichloroethane
C1N	C1-naphthalenes	PHENANT	Phenanthrene		
C1PHEN	C1-phenanthrene	PYRENE	Pyrene		