Appendix 10: Benthic Assessment Report

MERC Consultants
environmental and conservation services

Aughinish

Dumping at Sea Application/Marine Usage Licence: Benthic Survey Technical Report 2023

MERC Consultants Ltd, Loughaunbeg, Inverin, Co. Galway.
www.mercenvironmental.ie

Client name	MWP
Address	Reen Point, Blennerville, Tralee, Co. Kerry, Ireland

Document control			
Rev	**Revision Date**	**Details**	**Name**
0.3	24/10/2023	Final	[redacted]

Contents

1. INTRODUCTION

Aughinish Alumina Ltd operates a jetty which facilitates the delivery of raw materials for the alumina refining process and also for export of finished product, alumina. The jetty was constructed in the early 1980's and ongoing maintenance dredging has occurred since 2016.

In 2016 a Dumping at sea permit (Nr. S0026-01) and Foreshore Licence (Nr. FS006578) was granted to provide for ongoing maintenance dredging activity, and this covered an 8-year period which expires in August 2024.

In order to avail of the Dumping at Sea (DAS) permitting process the first step is to confirm that the proposed dredge material is clean and un-contaminated. In that regard the Marine Institute were consulted to agree a sampling and testing campaign. This process was completed by MERC and the results were reviewed against the required standards and the results were within all required levels. Accordingly, the material was deemed suitable for dredging and dumping at sea.

There now is a need for a new permit to allow for ongoing maintenance dredging and this will seek a DAS permit for a further period of 8 years. A new Marine Usage Licence (MUL) from the Maritime Area Regulatory Authority (MARA) will also be required.

The previous DAS permit allowed for dredging by means of plough dredging at three defined locations (A-C) as shown on Figure 1 below.

- Area A is the main jetty berth where the larger ships berth to discharge raw materials
- Area B is what is called the Cells which is the land-based area where the work boats that transfer crew is based.
- Area C is known as the inner berth and this is used for smaller ships for the delivery of process materials and the shipping of the product, alumina.

The current permit allows for two dredge periods per year, and each period has a duration of 4- 5 days and can only take place when the main jetty berth is free, due to a shut down for maintenance. This is a challenging window to dredge within. In addition, having only the plough dredge technology restricted the process of maintenance dredging in a marine environment, which is very dynamic.

The new application, which is the subject of this report and assessment, seeks to give better flexibility to the maintenance dredging process via a range of dredging technologies, wider periods for dredging, larger areas to accommodate dredging and dumping activities and the introduction of a new dredge/dump site adjacent to the jetty approach bridge (Area D, Figure 1), along with a dedicated dumpsite in the estuary to receive material dredged by means of a trailing suction hopper dredger (TSHD).

This report presents an assessment of the benthic habitat at the proposed dredge and dump sites (Figure 1) to support the application.

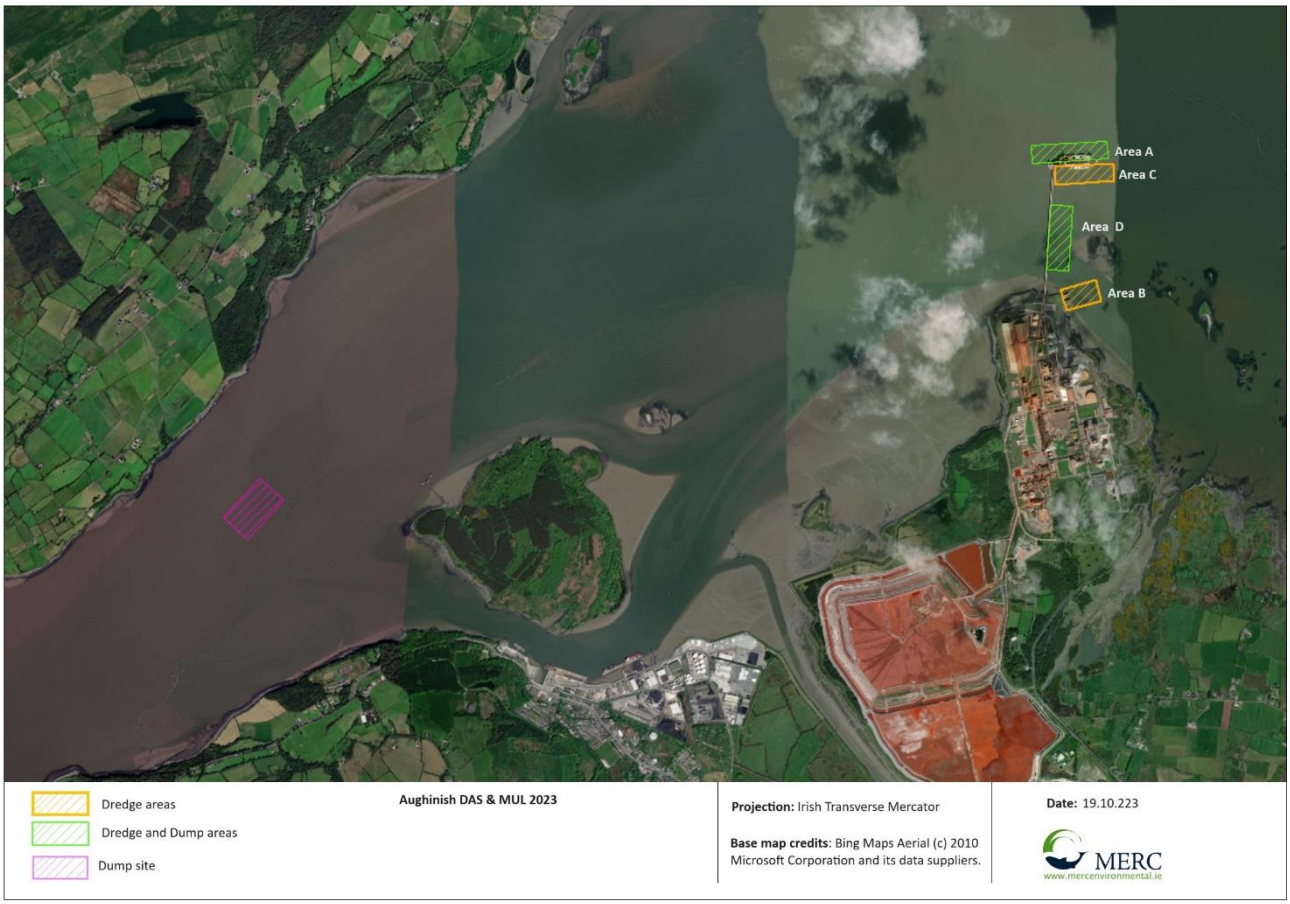

Figure 1. Locations of proposed dredge and dump areas.

2. Methods

2.1 Preliminary mapping

Following collation of the available literature a GIS project (ESRI ARCGIS®) was developed to allow the available spatial data for the dredge and dump sites to be mapped. The location of previous survey data was also mapped, this included:

- Aquafact (2005). Environmental survey and sediment transport model for a proposed dump site in Shannon Estuary. A report to Shanonn Foynes Port company NPWS marine monitoring 2016-2019
- NPWS Conservation Objectives marine community types. Revision date 2019.
- Water Framework Directive (WFD) benthic monitoring data.

2.2 Sediment sampling

The exact sampling locations of all samples collected is given in table 1 and shown in figure 2. All samples collected for macrofaunal and radiation analysis were collected by MERC. Samples collected for chemical analysis were taken by Hydrographic Surveys Ltd.

- Benthic macrofaunal, organic content and particle size analysis was carried out by Hebog Environmental Ltd. Wales.
- Chemical analysis was carried out by SOCOTEC Ltd. UK.
- Radiation analysis was carried out by the EPA Radiation Monitoring Laboratory, Dublin.

2.2.1 Macrofauna

A total of 9 stations were sampled using a 0.1 m^2 Day grab. Three (3) replicate samples were collected from each station and a separate sample was collected for organic content and particle size analysis.

The stations were located in and around the four dredge and dump areas (areas A,B,C and D). Sampling at the dump site off Foynes Island , to the west, was not conducted as the ground at this location is known, from previous surveys by the authors of this report and INFOMAR bathymetric data, to be comprised of a rocky seabed without a significant overburden of sediment.

The exact location of each station was recorded by dGPS

- Grab samples containing a depth of < 7 cm for sand sediments and < 10 cm for mud sediments were rejected and resampled.
- Following removal of a sub-sample for particle size distribution and organic content analysis, the remaining sediment was sieved through a 1mm sieve and preserved in 4% buffered formalin for macrofaunal identification.
- All sediment samples were frozen (<-18°C) in screw top containers, within 4 hours of collection.
- A digital image of each sample was taken on deck.
- Available ancillary *in situ* environmental observations were recorded for each sampling location.

On receipt of samples, the analysing laboratory (HEBOG Environmental Ltd) processed all samples as per standard NE Atlantic Marine Biological Analytical Quality Control (NMBAQC) Scheme protocols for macrofaunal organic content and granulometry analysis.

2.2.2 Chemistry

Four (4) separate samples were collected for chemical analysis. The locations of these stations were specified by the Marine Institute in advance of survey. All chemistry samples were collected by Hydrographic Surveys Ltd and analysed by SOCOTEC Ltd.

2.2.3 Radiation

Three (3) separate samples were collected for radiation analysis. The samples were collected using a 0.1 m^2 Day grab, held in a cool box with ice packs and delivered to the radiation testing laboratory at the EPA Dublin the day following collection.

Table 1. Locations of macrofauna, chemistry and radiation sample stations

Station ID	Easting (ITM)	Northing (ITM)	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Sample type
Aughinish 1	528397	654491	52.63690	9.05787	Macrofauna/TOC/PSA
Aughinish 2	528331	655118	52.64250	9.05898	Macrofauna/TOC/PSA
Aughinish 3	528280	655438	52.64539	9.05982	Macrofauna/TOC/PSA
Aughinish 4	528533	655262	52.64385	9.05603	Macrofauna/TOC/PSA
Aughinish 5	528891	655237	52.64367	9.05074	Macrofauna/TOC/PSA
Aughinish 6	528760	655645	52.64728	9.05279	Macrofauna/TOC/PSA
Aughinish 7	528310	655875	52.64930	9.05950	Macrofauna/TOC/PSA
Aughinish 8	527881	655687	52.64762	9.06580	Macrofauna/TOC/PSA
Aughinish 9	527901	654989	52.64132	9.06530	Macrofauna/TOC/PSA
F1	528478	655455	52.64558	9.05688	Chemistry
F2	528392	654492	52.63691	9.05795	Chemistry
F3	528477	655396	52.64505	9.05688	Chemistry
F4	528302	654941	52.64094	9.05938	Chemistry
Aughinish 1R	528397	654491	52.63690	9.05787	Radiation
Aughinish 2R	528331	655118	52.64250	9.05898	Radiation
Aughinish 3R	528533	655262	52.64385	9.05603	Radiation

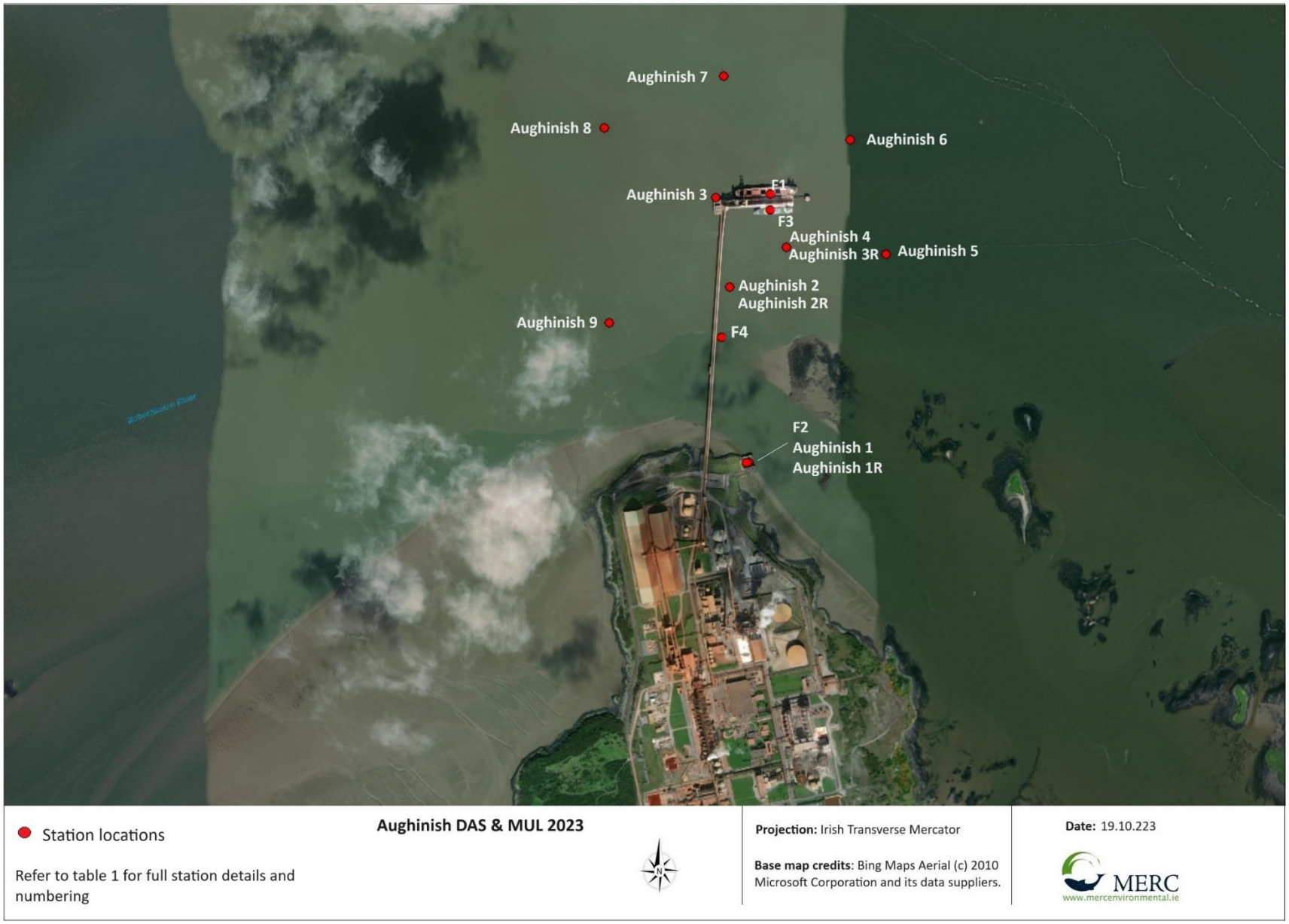

Figure 2. Station locations. R = Radiation sample station, F = Chemistry sample station. Remaining stations are macrofauna/PSA/TOC

3. Results

3.1 Macrofauna, particle size and organic carbon

The results of the macrofaunal analysis are given in Appendix 1 and those for the Particle Size analysis and Total Organic Carbon are given in Appendix 2.

Mixed sediments dominated the stations sampled around the jetty and surrounding area at Aughinish Island. Sediments were defined as slightly gravelly muddy sands or gravelly muddy sands. Silt/clay particles (<63µm) contributed between 40-48% of the sediments at stations 1, 2, 4, 5, 6, 7 & 8 and 19% and 29% respectively at stations 3 & 9. Sands of all size fractions were present at all stations but very fine (63-125µm) and fine (125-249µm) sands tended to dominate. Gravels (>2mm) contributed small amounts, less than 4.5%, at the majority of stations but were recorded at 37% and 10% at stations 3 & 9 respectively. Total organic carbon was moderate, ranging from 5.6% at station 6 to 12.2% at station 2. These results were as expected for the sediment type and position of the stations within an estuary.

Faunal data was fourth root transformed and a dummy value added (as there were a low number of taxa recorded per replicate). A Bray-Curtis similarity test was performed upon the resultant data to determine clustering of replicates and stations, significance testing further showed whether these differences were significant. A dendrogram showing these results is given in Figure 3. A shade plot was produced based on relatively taxa abundance to illustrate where these differences lay in terms of community composition and the taxa which contributed to similarities and differences (Figure 4).

Faunal communities were characteristic of muddy estuarine habitats. Number of taxa and diversity was low for the majority of samples. Generally, fewer than 10 taxa were recorded per replicate and Shannon-Weiner diversity was less than 2. However, evenness tended to be high (>0.5) which showed that communities were not dominated by one taxa and numbers were spread evenly across those taxa recorded.

Stations 2, 3, 5, 6, 7 & 8 formed the major cluster of samples. The polychaete *Nephtys hombergii* and the bivalve *Macoma balthica* were commonly recorded at these stations. Also found were the tube-dwelling polychaete *Pygospio elegans* and the capitellid *Heteromastus filiformis*. These are all typically estuarine species. Whilst these species were also present in samples from stations 4 and 9, the estuarine polychaete *Aphlochaeta marioni* were more abundant in these communities. Samples from station 1 were dominated by the amphipod *Corophium volutator*. This species is typical of very shallow muddy banks.

Sediments and total organic carbon varied only slightly between stations and it was therefore likely that the small differences seen between communities was due to position, depth and closeness to the shore rather than any measured physical attribute.

Two of the samples, at stations 1 & 3 did contain a large amount of plastic.

No unusual or non-native taxa were recorded during this survey.

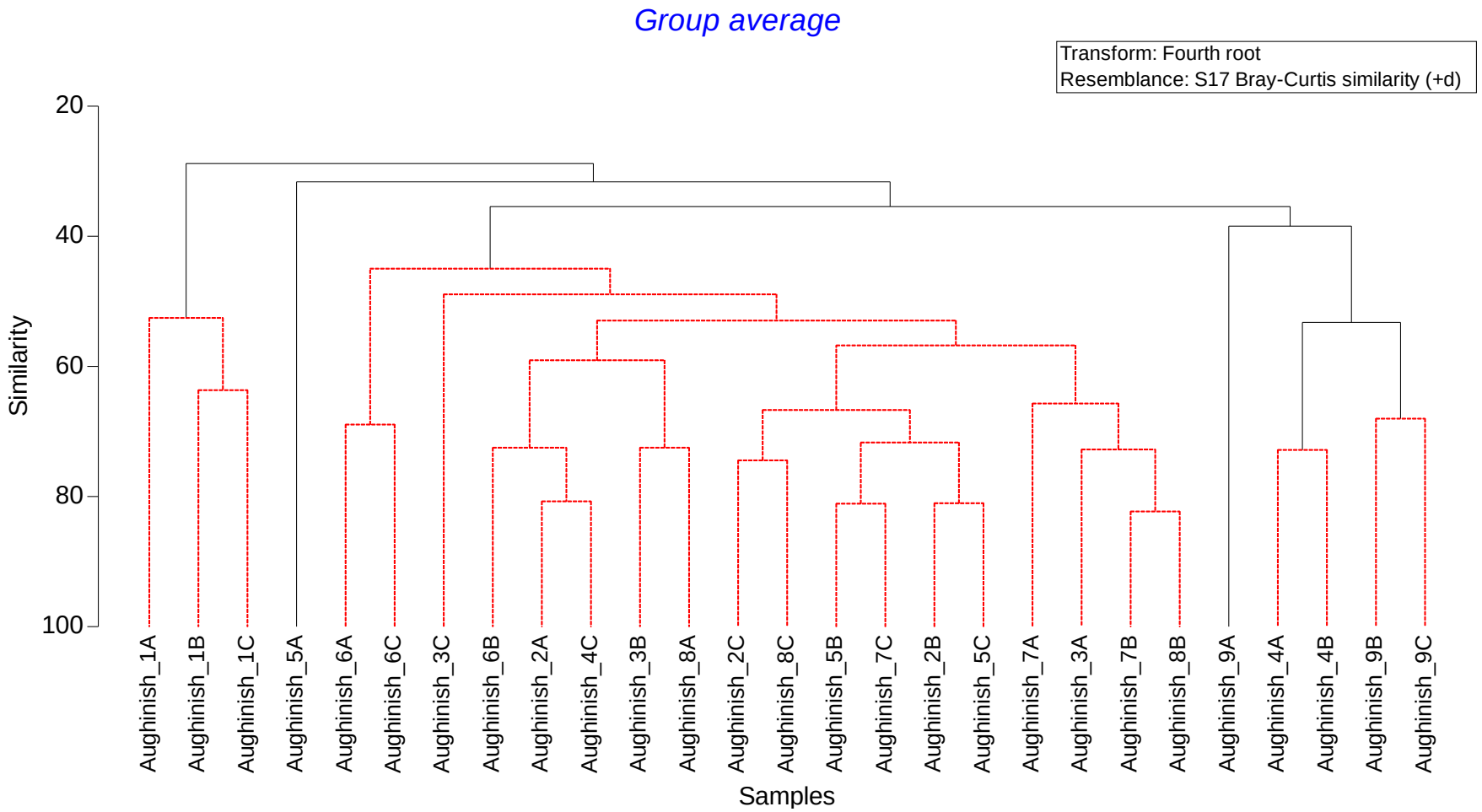

Figure 3. Dendrogram showing the Bray-Curtis similarities between samples from each station at Aughinish 2023. Black lines indicate significant differences.

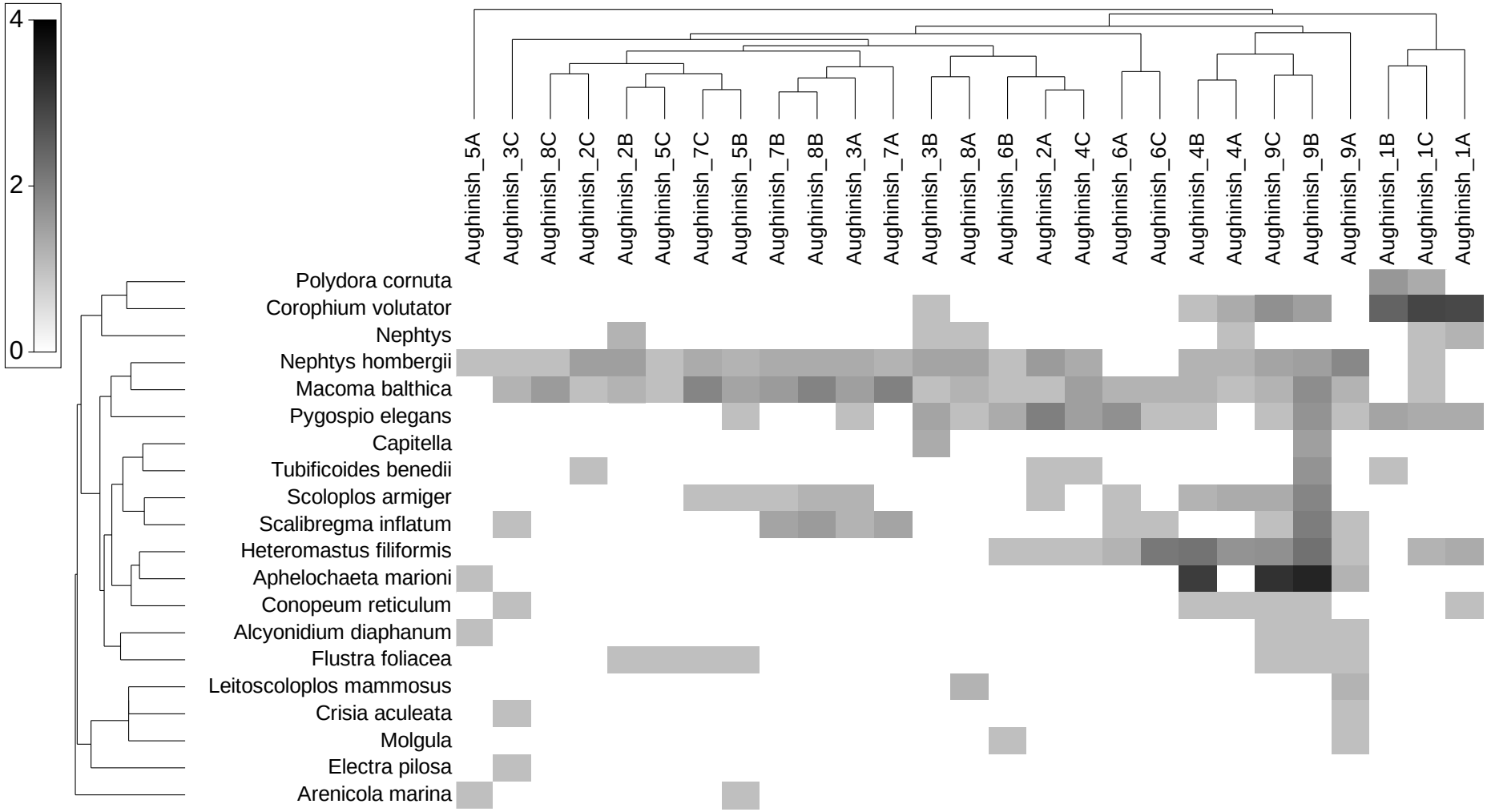

Figure 4. A shade plot illustrating the relative abundance of the numerically most important taxa for each replicate sampled at Aughinish station 2023.

3.2 Chemistry

The results of the chemical analysis are given in Appendix 3. The results indicate these samples are within the agreed limits for DAS.

3.3 Radiation

The results of the Radiation analysis are given in Appendix 4. The results indicated that dumping of these materials at sea will not result in a radiological hazard.

4. Discussion

4.1 Overview

The benthic habitat of the Shannon Estuary is characterised by a scour channel formed from the inflow of the River Shannon together with a number of subtidal sediment communities. The intertidal area supports large expanses of mudflats and sandflats which vary in character depending on their location relative to exposure. The following marine community types are present within the Lower River Shannon SAC:

- Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community
- Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex
- Estuarine subtidal muddy sand to mixed sediment with gammarids community complex
- Subtidal sand to mixed sediment with *Nucula nucleus* community complex
- Subtidal sand to mixed sediment with *Nephtys* spp. community complex
- Fucoid-dominated intertidal reef community complex
- Mixed subtidal reef community complex
- Faunal turf-dominated subtidal reef community
- Anemone-dominated subtidal reef community
- *Laminaria*-dominated community complex

NPWS Conservation Objectives Marine Community mapping for the area indicates the scour channel as being comprised of two Marine Community Types (MCT), a *Faunal turf-dominated subtidal reef community* and an *Anemone-dominated subtidal reef community.* However, it should be noted that the NPWS mapping is based on highly interpolated data. More recent data e.g. INFOMAR bathymetry and data collected as part of more recent NPWS marine monitoring and WFD monitoring has indicated the central scour channel extends over a much larger footprint than mapped for NPWS Conservation Objective mapping.

Figure 5 below provides an overview of the Bathymetric data in the area of the dump site, showing rough ground indicative of reef habitat at the dump site. Figure 6 provides an overview of the NPWS marine community mapping data over the same area.

Figure 5. Dredge and dump sites overlaid on bathymetry.

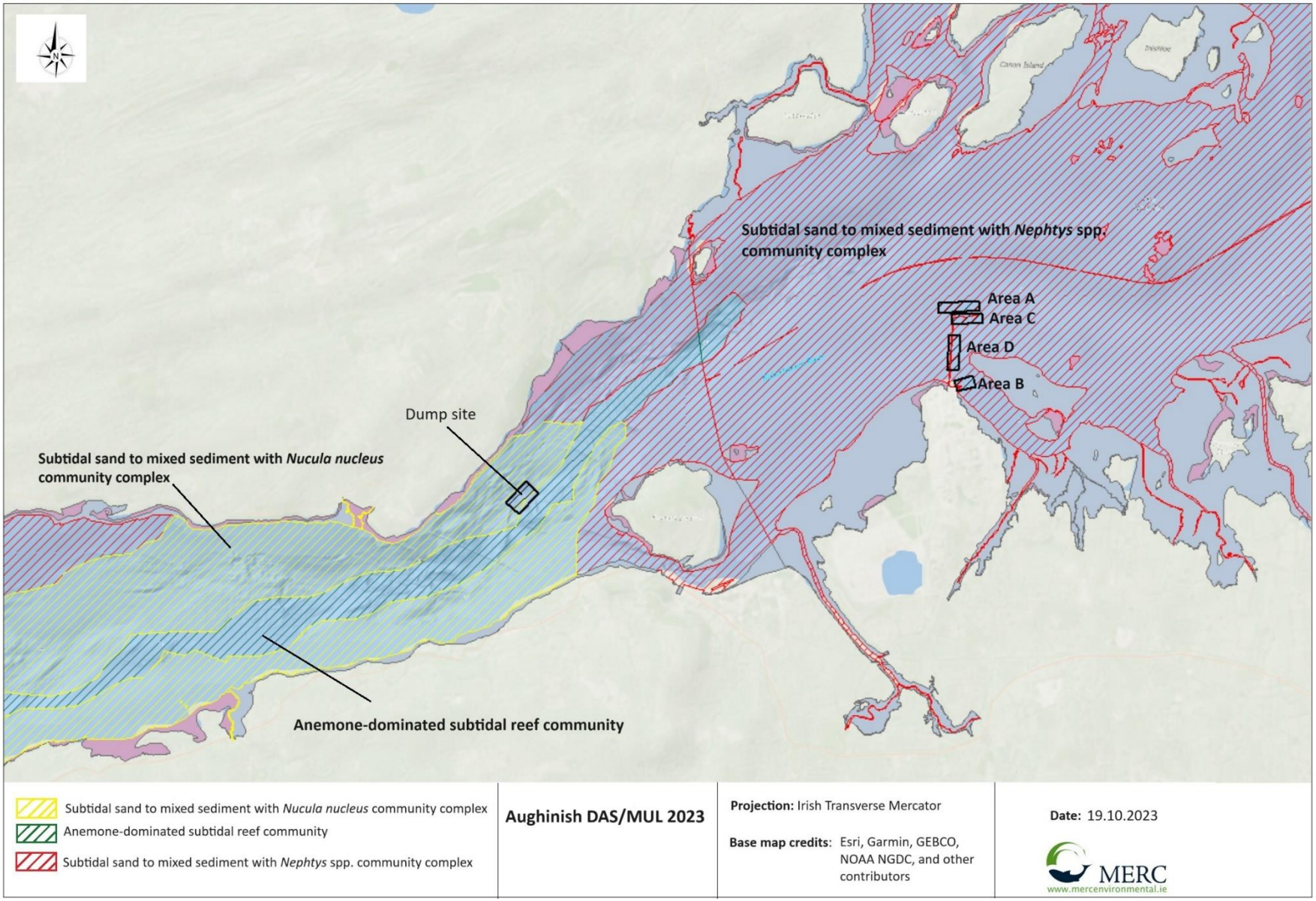

Figure 6. NPWS community mapping

Dredge and dump areas

The area surrounding the dredge and dump sites (Areas A, B, C and D) shown in figure 6 is mapped by NPWS as being comprised of:

- Subtidal sand to mixed sediment with *Nephtys* spp. community complex.

This MCT is characterised by very shallow sands with *Nephtys cirrosa* (not *Nephtys hombergii*) and Bathyporeia amphipods. Neither of these species were present in the samples collected from the dredge areas. In addition, a far greater proportion of mud was present at the dredge/dump areas. All the stations sampled are characteristic of estuarine muddy mixed sediments. Most similar to the MCT "*Intertidal sand to mixed sediment with polychaete, molluscs and crustaceans complex*" also described in Lower Shannon SAC but not entirely corresponding to that MCT, as here the habitat is subtidal.

A dive survey of this area conducted in 2005 (Aquafact, 2005) described the high turbidity levels of the water column in this area. This is consistent with dive surveys conducted throughout the estuarine areas of the Lower River Shannon SAC carried out by MERC in 2018 on behalf of the NPWS (Scally *et al*, 2020).

Dump site

The existing designated dump site is located in an area that straddles two NPWS mapped MCT's. These are:

- Anemone-dominated subtidal reef community
- Subtidal sand to mixed sediment with *Nucula nucleus* community complex

However, the INFOMAR bathymetry for this area shows it to be entirely comprised of the rough ground associated with the scour channel. As such it would likely correspond more closely to the Anemone-dominated subtidal reef community. Deposition from the inflow of the River Shannon does not occur in this area due to hydrodynamic scour.

Grab sampling at this location is not an appropriate survey technique due to the nature of the hard ground present. Multiple attempts to conduct grab sampling of this area to support WFD sampling and NPWS marine monitoring has failed to collect grab samples due to the hard substrate present. However, surveys of the area using dropdown video during NPWS marine monitoring surveys in 2018, provides an overview of the habitat present. Figures 7 and 8 show the central scour channel within the "Anemone-dominated subtidal reef community". Data from this survey indicated that the habitat was comprised of cobble reef with sparse epifauna, supporting only robust specialists such as *Actinothoe sphyrodeta*, *Echinus esculentus*, *Alcyonidium diaphanum*, and hydroids (e.g. *Nermertesia antennina*) capable of withstanding the scouring effect and sediment load.

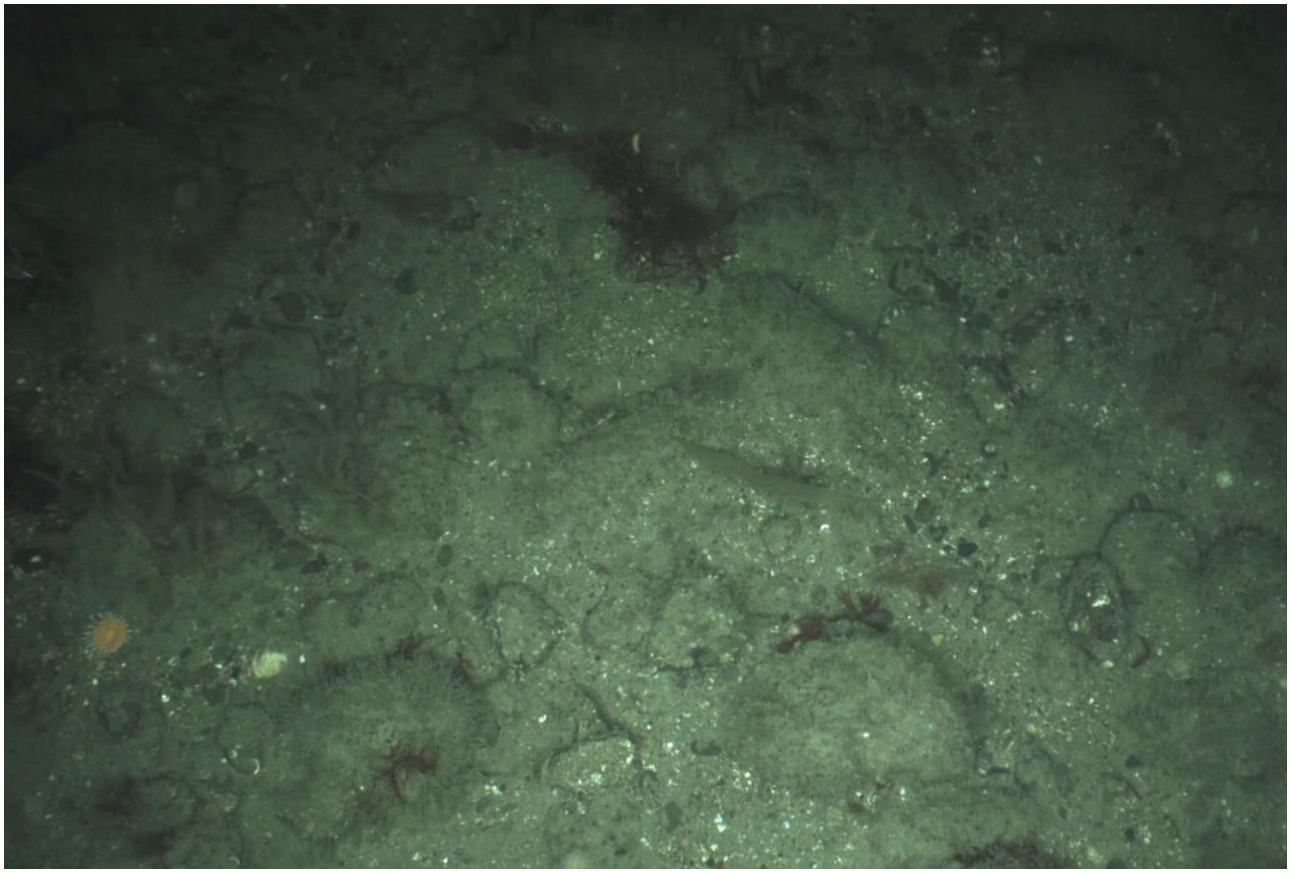

Figure 7. Central scour channel, showing cobble reef with "anemone-dominated community". Imagery collected during NPWS marine monitoring in 2018.

Figure 8. Central scour channel, showing cobble reef with "anemone-dominated community". Imagery collected during NPWS marine monitoring in 2018.

4.2 Potential for impact

Dredge and dump sites

The results of the benthic sampling have shown the sediment community at the dredge/dump sites to be similar to the "*Intertidal sand to mixed sediment with polychaete, molluscs and crustaceans complex"* described for the majority of the intertidal areas within Lower River Shannon SAC, although with obvious variations due to it being subtidal. Aquafact (2005) describes it as corresponding to the MNCR biotope estuarine sublittoral muds (IMU.EstMu), currently classified as Sublittoral mud in variable salinity (estuaries) (SS.SMU.SMuVS) (O'Connor *et al*, 2004). This sediment community has resulted from deposition in the shallow areas of the River Shannon outside of the scour channel.

Dredging of this area will not result in any long-term change to the benthic community present or lead to any impact on the conservation objectives to any of the benthic sediment communities for which the Lower River Shannon SAC is designated for. Similarly, the dredged sediment from Areas A and D which will be deposited within the same localised area here and on the same habitat type, therefore no impact on the conservation objectives to any of the benthic sediment communities for which the Lower River Shannon SAC is designated for is predicted.

Dump site off Foynes Island

At the dump site off Foynes Island, it is considered that, due to the scouring effect of the River Shannon any sediment from the dredge sites, which is dominated by fine (63-125µm) and very fine (125-249µm) sands, will be washed away over a relatively short period of time (< 1 year). It is further considered that any smothering of the epifaunal species present at the location of this dump site will recolonise from upstream populations within a similar time period and no significant change to the conservation objectives of the Anemone-dominated subtidal reef community present at this location will occur.

5. REFERENCES

Aquafact (2005). Environmental survey and sediment transport model for a proposed dump site in Shannon Estuary. A report to Shanonn Foynes Port company.

David W. Connor, James H. Allen, Neil Golding, Kerry L. Howell, Louise M. Lieberknecht, Kate O. Northen and Johnny B. Reker (2004). The Marine Habitat Classification for Britain and Ireland Version 04.05 JNCC, Peterborough. ISBN 1 861 07561 8 (internet version)

INFOMAR Bathymetric maping available at: https://www.infomar.ie/maps/interactive-maps.

NPWS (2012) Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Scally, L., Pfeiffer, N. and Hewitt, E. (2020) The monitoring and assessment of six EU Habitats Directive Annex I Marine Habitats. *Irish Wildlife Manuals*, No. 118. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Appendix 1. Macrofaunal data for each station and replicate

			1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C
Taxa	**Qualifier**	**Authority**															
Hydrallmania falcata		(Linnaeus, 1758)															
Sertularia		Linnaeus, 1758															
Nemertea				1	1												
Tubificoides benedii		(d'Udekem, 1855)		1		1		1						1			
Tubificoides pseudogaster		(Dahl, 1960)															
Nephtys	Juvenile	Cuvier, 1817	2		1		2			1		1					
Nephtys hombergii		Savigny in Lamarck, 1818			1	6	5	5	3	4	1	2	2	3	1	2	1
Eunereis longissima		(Johnston, 1840)															
Eteone longa	Aggregate	(Fabricius, 1780)															
Polydora cornuta		Bosc, 1802		7	3												
Pygospio elegans		Claparède, 1863	3	4	3	16			1	4			1	5		1	
Scolelepis (Scolelepis) foliosa		(Audouin & Milne Edwards, 1833)															
Ampharete lindstroemi	Aggregate	Hessle, 1917															
Aphelochaeta marioni		(Saint-Joseph, 1894)											86		1		
Tharyx robustus		Blake & Göransson, 2015										1	1				
Arenicola marina		(Linnaeus, 1758)													1	1	
Capitella	Species complex	Blainville, 1828								3							
Heteromastus filiformis		(Claparède, 1864)	3		2	1						8	23	1			
Mediomastus fragilis		Rasmussen, 1973											3				
Leitoscoloplos mammosus		Mackie, 1987															
Scoloplos armiger		(Müller, 1776)				1			2			3	2			1	
Aricidea (Aricidea) minuta		Southward, 1956															
Scalibregma inflatum		Rathke, 1843							2		1						
Corophium volutator		(Pallas, 1766)	67	35	71					1		3	1				
Gammarus	Juvenile	Fabricius, 1775	1						1								
Gammarus salinus		Spooner, 1947															

			1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C
Gammarus zaddachi		Sexton, 1912															
Balanus crenatus		Bruguière, 1789															
Austrominius modestus		(Darwin, 1854)			1												
Cerastoderma edule		(Linnaeus, 1758)															
Macoma balthica		(Linnaeus, 1758)			1	1	2	1	5	1	2	1	2	5		4	1
Mytilus edulis	Juvenile	Linnaeus, 1758															
Bivalvia	Damaged	Linnaeus, 1758				1											
Retusa obtusa		(Montagu, 1803)															
Bicellariella ciliata		(Linnaeus, 1758)							P								
Bugulidae		Gray, 1848	P														
Amphiblestrum		Gray, 1848															
Conopeum reticulum		(Linnaeus, 1767)	P								P	P	P				
Einhornia crustulenta		(Pallas, 1766)			P							P	P				
Electra pilosa		(Linnaeus, 1767)									P						
Escharella immersa		(Fleming, 1828)	P														
Flustra foliacea		(Linnaeus, 1758)					P									P	P
Alcyonidioides mytili		(Dalyell, 1848)															
Alcyonidium diaphanum		(Hudson, 1778)													P		
Amathia		Lamouroux, 1812															
Vesicularia spinosa		(Linnaeus, 1758)															
Crisia aculeata		Hassall, 1841									P						
Molgula		Forbes, 1848															

			6A	6B	6C	7A	7B	7C	8A	8B	8C	9A	9B	9C
Taxa	**Qualifier**	**Authority**												
Hydrallmania falcata		(Linnaeus, 1758)											P	P
Sertularia		Linnaeus, 1758											P	
Nemertea														
Tubificoides benedii		(d'Udekem, 1855)											8	
Tubificoides pseudogaster		(Dahl, 1960)										2	16	
Nephtys	Juvenile	Cuvier, 1817							1					

Nephtys hombergii		Savigny in Lamarck, 1818		1		2	3	3	4	3	1	12	5	4
			6A	**6B**	**6C**	**7A**	**7B**	**7C**	**8A**	**8B**	**8C**	**9A**	**9B**	**9C**
Eunereis longissima		(Johnston, 1840)				1								
Eteone longa	Aggregate	(Fabricius, 1780)											1	
Polydora cornuta		Bosc, 1802												
Pygospio elegans		Claparède, 1863	9	3	1				1			1	8	1
Scolelepis (Scolelepis) foliosa		(Audouin & Milne Edwards, 1833)										1		
Ampharete lindstroemi	Aggregate	Hessle, 1917										2	1	
Aphelochaeta marioni		(Saint-Joseph, 1894)										2	136	108
Tharyx robustus		Blake & Göransson, 2015								1			15	2
Arenicola marina		(Linnaeus, 1758)												
Capitella	Species complex	Blainville, 1828											5	
Heteromastus filiformis		(Claparède, 1864)	2	1	20							1	24	9
Mediomastus fragilis		Rasmussen, 1973											12	2
Leitoscoloplos mammosus		Mackie, 1987							2			2		
Scoloplos armiger		(Müller, 1776)	1				1	1		2			13	3
Aricidea (Aricidea) minuta		Southward, 1956											1	
Scalibregma inflatum		Rathke, 1843	1		1	4	4			6		1	17	1
Corophium volutator		(Pallas, 1766)											5	9
Gammarus	Juvenile	Fabricius, 1775												1
Gammarus salinus		Spooner, 1947										2	3	1
Gammarus zaddachi		Sexton, 1912			2									
Balanus crenatus		Bruguière, 1789											1	1
Austrominius modestus		(Darwin, 1854)										3		
Cerastoderma edule		(Linnaeus, 1758)												
Macoma balthica		(Linnaeus, 1758)	2	1	2	15	6	13	2	14	6	2	10	2
Mytilus edulis	Juvenile	Linnaeus, 1758										1	2	
Bivalvia	Damaged	Linnaeus, 1758												
Retusa obtusa		(Montagu, 1803)				2							3	
Bicellariella ciliata		(Linnaeus, 1758)											P	
Bugulidae		Gray, 1848												
Amphiblestrum		Gray, 1848											P	
Conopeum reticulum		(Linnaeus, 1767)											P	P
Einhornia crustulenta		(Pallas, 1766)			P								P	

Electra pilosa		(Linnaeus, 1767)												
Escharella immersa		(Fleming, 1828)												
Flustra foliacea		(Linnaeus, 1758)						P				P	P	P
Alcyonidioides mytili		(Dalyell, 1848)											P	
Alcyonidium diaphanum		(Hudson, 1778)										P	P	P
Amathia		Lamouroux, 1812											P	P
Vesicularia spinosa		(Linnaeus, 1758)								P			P	P
Crisia aculeata		Hassall, 1841										P		
Molgula		Forbes, 1848		1								1		

Appendix 2. Particle Size analysis and Total Organic Carbon

		Station Number								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Medium pebble (gravel)	**>8 mm**	0.00	0.00	11.37	0.00	0.00	0.00	0.00	0.00	0.00
Small pebble (gravel)	**4-8 mm**	0.00	0.20	13.12	0.09	0.12	0.00	0.88	0.00	2.92
Granule	**2-4 mm**	2.24	1.63	12.58	2.26	0.88	0.88	3.44	0.85	7.17
Sand - very coarse	**1-2 mm**	10.61	7.73	8.88	8.21	3.87	6.01	6.82	3.50	7.09
Sand - coarse	**500-999 um**	11.86	13.69	7.92	8.41	9.35	6.94	5.55	8.51	6.31
Sand - medium	**250-499 um**	6.90	9.93	6.27	5.53	7.13	4.33	3.60	7.43	4.88
Sand - fine	**125-249 um**	7.84	9.64	7.64	7.51	9.25	7.55	13.89	16.44	17.40
Sand - very fine	**63-125 um**	17.69	13.04	12.65	24.73	21.43	30.41	18.51	22.15	24.64
Silt & Clay	**<63 um**	42.86	44.15	19.55	43.26	47.98	43.88	47.32	41.11	29.59
Folk classification		Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Muddy Sandy Gravel	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Gravelly Muddy Sand
TOC by LOI (%)		8.10	12.27	8.91	6.38	7.24	5.68	6.84	6.35	7.34

Appendix 3. Chemistry

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 MAR01828

Issue Version: 2

Customer: Hydrographic Surveys Ltd, Unit 12 Owenacurra Business Park, Midleton, Co. Cork, P25 C563

Customer Reference: Aughinish Sediments

Date Sampled: 11-Apr-23

Date Samples Received: 13-Apr-23

Test Report Date: 06-Jul-23

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

This is a revised report containing additional Iron and Titanium results as requested

[redacted]

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		Method No	SUB_02*
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Visual Description**
F1	MAR01828.001	Sediment	Greyish brown clayey SILT
F2	MAR01828.002	Sediment	Greyish brown clayey SILT
F3	MAR01828.003	Sediment	Brown silty CLAY
F4	MAR01828.004	Sediment	Brown silty CLAY

* See Report Notes

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		Units	%	%	%	%	%	Mg/m3
		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	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Total Moisture @ 120°C**	**Total Solids**	**Gravel (>2mm)**	**Sand (63-2000 µm)**	**Silt (<63 µm)**	**Particle Density**
F1	MAR01828.001	Sediment	51.6	48.4	0.00	27.65	72.35	2.61
F2	MAR01828.002	Sediment	62.5	37.5	0.00	18.99	81.01	2.61
F3	MAR01828.003	Sediment	52.6	47.4	0.00	32.94	67.06	2.62
F4	MAR01828.004	Sediment	45.0	55.0	0.00	42.79	57.21	2.64
		Reference Material (% Recovery)	NA	NA	NA	NA	NA	NA
		QC Blank	NA	NA	NA	NA	NA	NA

* See Report Notes

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		Units	% m/m	%m/m
		Method No	WSLM59*	ANC*
		Limit of Detection	0.02	0.12
		Accreditation	UKAS	No
Client Reference:	SOCOTEC Ref:	Matrix	TOC	Carbonate Equivalent (%CO3)
F1	MAR01828.001	Sediment	1.27	17.0
F2	MAR01828.002	Sediment	1.67	14.4
F3	MAR01828.003	Sediment	1.31	21.8
F4	MAR01828.004	Sediment	1.32	19.7
		Reference Material (% Recovery)	104	100
		QC Blank	<0.02	<0.12

* See Report Notes

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		Units	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)
		Method No	ICPMS-MWSED*	ICPMS-MWSED*	ICPMS-MWSED*	ICPMS-MWSED*	ICPMS-MWSED*	ICPMS-MWSED*	ICPMS-MWSED*
		Limit of Detection	0.14	0.03	1	0.7	0.6	0.01	0.4
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	SOCOTEC Ref:	Matrix	Arsenic as As	Cadmium as Cd	Chromium as Cr	Copper as Cu	Lead as Pb	Mercury as Hg	Nickel as Ni
F1	MAR01828.001	Sediment	12.5	0.30	46.0	10.3	20.2	0.08	22.8
F2	MAR01828.002	Sediment	13.5	0.36	52.8	11.2	23.6	0.12	26.2
F3	MAR01828.003	Sediment	12.7	0.34	48.8	10.1	21.9	0.08	24.5
F4	MAR01828.004	Sediment	11.4	0.37	42.7	9.0	20.0	0.06	21.1
		Certified Reference Material 2702 (Measured Value)	43.48	1.13	288.9	102.2	117	0.535	69.86
		Certified Reference Material 2702 (Certified Value)	45.3	0.817	352	117.7	132.8	0.447	75.4
		Certified Reference Material 2702 (% Recovery)	92	110	88	88	90	115	100
		QC Blank	<0.14	<0.03	<1	<0.7	<0.6	<0.01	<0.4

* See Report Notes

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		Units	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)
		Method No	ICPMS-MWSED*	ICPOES-MWSED*	ICPOES-MWSED*	ICPOES-MWSED*	ICPOES-MWSED*
		Limit of Detection	3.5	1750	2	860	82.4
		Accreditation	UKAS	UKAS	N	UKAS	UKAS
Client Reference:	SOCOTEC Ref:	Matrix	Zinc as Zn	Aluminium as Al	Lithium as Li	Iron as Fe	Titanium as Ti
F1	MAR01828.001	Sediment	97.9	36400	29.4	19951	1842
F2	MAR01828.002	Sediment	77.7	43500	35.0	23539	2264
F3	MAR01828.003	Sediment	74.5	39200	31.6	21322	1981
F4	MAR01828.004	Sediment	68.6	34200	27.6	19073	1941
		Certified Reference Material 2702 (Measured Value)	427.6	88932	71.6	–	7817
		Certified Reference Material 2702 (Certified Value)	485.3	84000	78.2	–	8840
		Certified Reference Material 2702 (% Recovery)	89	100	92	99	98
		QC Blank	<3.5	<1750	<2	<860	<82.4

* See Report Notes

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		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)
F2	MAR01828.002	Sediment	<5	<5
F3	MAR01828.003	Sediment	<5	<5
Certified Reference Material BCR-646 (Measured Value)			573	471
Certified Reference Material BCR-646 (Certified Value)			770	480
Certified Reference Material BCR-646 (% Recovery)			74	98
QC Blank			<1	<1

* See Report Notes

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		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
F1	MAR01828.001	Sediment	1.11	<1	2.90	9.80	11.6	15.4
F4	MAR01828.004	Sediment	1.33	1.41	3.59	17.2	20.1	20.1
Certified Reference Material Nist 1941b (Measured Value)			36.2	62.7	126	223	213	385
Certified Reference Material Nist 1941b (Certified Value)			38.4	53.3	184	335	358	453
Certified Reference Material Nist 1941b (% Recovery)			94	118	68	67	60	85
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

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		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
F1	MAR01828.001	Sediment	12.0	14.9	11.9	2.45	20.3	2.85
F4	MAR01828.004	Sediment	16.3	19.4	18.0	3.08	29.7	2.75
Certified Reference Material Nist 1941b (Measured Value)			239	342	325	59.2	532	52.2
Certified Reference Material Nist 1941b (Certified Value)			307	225	399	53.0	651	85.0
Certified Reference Material Nist 1941b (% Recovery)			78	152	81	112	82	61
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

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		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**
F1	MAR01828.001	Sediment	13.5	3.25	11.2	15.6	3390
F4	MAR01828.004	Sediment	17.7	3.30	14.3	22.7	25700
Certified Reference Material Nist 1941b (Measured Value)			276	519	314	407	1326~
Certified Reference Material Nist 1941b (Certified Value)			341	848	406	581	1400~
Certified Reference Material Nist 1941b (% Recovery)			81	61	77	70	95~
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

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		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**
F1	MAR01828.001	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
F4	MAR01828.004	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Certified Reference Material Nist 1941b (Measured Value)			3.57	4.87	4.72	3.96	4.10	4.78	3.31
Certified Reference Material Nist 1941b (Certified Value)			4.52	5.24	5.11	4.23	3.60	5.47	3.24
Certified Reference Material Nist 1941b (% Recovery)			79	93	92	94	114	87	102
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, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

		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)	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	ASC/SOP/302
		Limit of Detection	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**AHCH**	**BHCH**	**GHCH**	**DIELDRIN**	**HCB**	**DDE**	**DDT**	**DDD**
F1	MAR01828.001	Sediment	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
F4	MAR01828.004	Sediment	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Certified Reference Material Nist 1941b (Measured Value)			41.3	42.2	40.0	68.3	5.61	2.96	1.55	3.04
Certified Reference Material Nist 1941b (Certified Value)			40~	40~	40~	40~	5.83	3.22	1.12	4.66
Certified Reference Material Nist 1941b (% Recovery)			103~	107~	100~	171	96	92	138	65
QC Blank			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

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, Advanced Chemistry and Research, Etwall House, Bretby Business Park, Ashby Road, Burton-upon-Trent DE15 0YZ

Test Report ID MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

REPORT NOTES

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
WSLM59*	MAR01828.001 & 004	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
ANC*	MAR01828.001 & 004	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
ICPMS-MWSED*	MAR01828.001 & 004	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
ICPOES-MWSED*	MAR01828.001 & 004	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
SUB_01*	MAR01828.001 & 004	Analysis was conducted by an approved subcontracted laboratory.
SUB_02*	MAR01828.001 & 004	Analysis was conducted by an approved subcontracted laboratory.
ASC/SOP/301	MAR01828.002-003	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	MAR01828.001 & 004	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	MAR01828.001 & 004	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

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 MAR01828
Issue Version 2
Customer Reference Aughinish Sediments

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 seived to <2mm	Carbonate removal and sulphurous acid/combustion at 1600°C/NDIR.
Carbonate	Air dried and seived to <2mm	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7
Metals	Air dried and seived to <2mm	Microwave assisted HF/Boric 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.
Organochlorine Pesticides (OCPs)	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		

Appendix 4. Radiation

Laboratory Test Report

Report Date: 3rd August 2023

Samples Tested on Behalf of: MERC Consultants Ltd

Laboratory Analysis: High Resolution Gamma Spectrometry with appropriate density correction

Sample Type: Marine Sediment

Date of Receipt: 28th April 2023

Date of Analysis May - July 2023

Results:

ORM Reference	Client Reference	Coordinates	Nuclide	Activity Concentration (Bq/kg, dry)[1]
CT2300114	Aughinish 1	n/a	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228 U-235 U-238	337 ± 7 nd nd 2.9 ± 0.1 < 0.3 19.1 ± 1.0 19.1 ± 0.9 1.1 ± 0.1 33.1 ± 1.7
CT2300115	Aughinish 2	n/a	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228 U-235 U-238	348 ± 7 nd nd 2.9 ± 0.1 0.7 ± 0.1 17.5 ± 0.9 16.9 ± 0.8 1.1 ± 0.1 29.8 ± 1.5

Page 1 of 2

CT2300116	Aughinish 3	n/a	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228 U-235 U-238	176 ± 4 nd nd 1.1 ± 0.0 < 0.3 12.1 ± 0.7 10.7 ± 0.5 0.7 ± 0.1 18.1 ± 1.0

Note:
(1) Quoted uncertainties are ±1 SD counting statistics
(2) Nd = not detected

The Office of Radiation Protection and Environmental Monitoring received three grab sediment samples from Aughinish. These samples were taken in support of application for a Capital/Maintenance Dredging Permit.

The samples were prepared by placing an aliquot in a well-defined counting geometry and then measured on a high-resolution gamma spectrometer. Appropriate density corrections were applied to the resultant spectra to take account of the differences in sample density. Dry to wet weight ratio was determined for the sample. Results are quoted on a dry weight basis.

The results indicate that dumping of these materials at sea will not result in a radiological hazard.

[redacted]

[redacted]
Laboratory Manager

Notes:
- This report relates only to the samples tested.
- This report shall not be reproduced except in full, without the approval of the Agency
- The following scientific officers may sign test reports on behalf of the laboratory manager: Mr [redacted], Ms [redacted]
- Where applicable, the number following the symbol ± is the combined standard uncertainty and not a confidence interval.

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781
W: www.element.com

Marine and Environmental Resource Conservation Consultants Limited
Loughaunbeg
Inverin
Galway
Ireland
H91Y890

Attention :	A.N. Other
Date :	16th June, 2023
Your reference :	Aughinish
Our reference :	Test Report 23/7011 Batch 1
Location :	River Shannon Ireland
Date samples received :	4th May, 2023
Status :	Final Report
Issue :	3

Four samples were received for analysis on 4th May, 2023 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

[redacted]

[redacted]
Project Manager

Element Materials Technology

Client Name: Marine and Environmental Resource Conservation Consultants Limited
Reference: Aughinish
Location: River Shannon Ireland
Contact: A.N. Other
EMT Job No: 23/7011

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	4-6	7-9	10-12							LOD/LOR	Units	Method No.
Sample ID	1	2	3	4									
Depth	4.40	14.20	16.30	15.60									
COC No / misc													
Containers	V J T	V J T	V J T	V J T									
Sample Date	27/04/2023	27/04/2023	27/04/2023	27/04/2023									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	04/05/2023	04/05/2023	04/05/2023	04/05/2023									
Arsenic #	9	13	10	8							<2	mg/kg	TM203/PM15
Cadmium #	0.276	0.341	0.284	0.267							<0.040	mg/kg	TM203/PM15
Chromium #	82.1	106.4	85.0	91.0							<4.0	mg/kg	TM203/PM15
Copper #	11.5	17.5	9.2	7.7							<4.0	mg/kg	TM203/PM15
Lead #	18.9	35.9	16.7	14.2							<5.0	mg/kg	TM203/PM15
Mercury #	0.052	0.081	0.046	0.040							<0.015	mg/kg	TM203/PM15
Nickel #	23.5	30.4	20.1	18.8							<2.0	mg/kg	TM203/PM15
Zinc #	68.7	195.6	65.9	53.8							<13.0	mg/kg	TM203/PM15
Aluminium	10990	13220	9294	8352							<50	mg/kg	TM30/PM15
Lithium	25	30	21	20							<5	mg/kg	TM30/PM15
EPH (C8-C40) (EH_1D_Total) #	<30	<30	178	<30							<30	mg/kg	TM5/PM8
Natural Moisture Content	81.2	128.7	85.2	69.6							<0.1	%	PM4/PM0
Total Organic Carbon	1.27	1.94	1.20	0.88							<0.03	%	TM21/PM24
% Passing 75mm	100	100	100	100							<0	%	TM202/PM0
% Passing 63mm	100	100	100	100							<0	%	TM202/PM0
% Passing 50mm	100	100	100	100							<0	%	TM202/PM0
% Passing 37.5mm	100	100	100	100							<0	%	TM202/PM0
% Passing 28mm	100	100	100	100							<0	%	TM202/PM0
% Passing 20mm	100	100	100	100							<0	%	TM202/PM0
% Passing 14mm	100	100	100	100							<0	%	TM202/PM0
% Passing 10mm	100	100	100	100							<0	%	TM202/PM0
% Passing 6.3mm	100	100	100	100							<0	%	TM202/PM0
% Passing 5mm	100	100	100	100							<0	%	TM202/PM0
% Passing 3.35mm	100	100	100	100							<0	%	TM202/PM0
% Passing 2mm	100	100	100	100							<0	%	TM202/PM0
% Passing 1.18mm	100	100	100	99							<0	%	TM202/PM0
% Passing 600um	96	89	97	97							<0	%	TM202/PM0
% Passing 425um	93	85	96	95							<0	%	TM202/PM0
% Passing 300um	89	81	95	93							<0	%	TM202/PM0
% Passing 212um	87	77	93	91							<0	%	TM202/PM0
% Passing 150um	82	67	88	85							<0	%	TM202/PM0
% Passing 63um	56	42	50	27							<0	%	TM202/PM0
% Passing <63um to 20um	22	27	21	13							<0	%	TM202/PM0
% Passing <20um to 6um	8	10	10	8							<0	%	TM202/PM0
% Passing <6um to 2um	2	4	5	4							<0	%	TM202/PM0
% Passing <2um	<0	<0	0	<0							<0	%	TM202/PM0
Cobbles (>75mm to 63mm)	0.0	0.0	0.0	0.0							<0.0	%	TM202/PM0
Gravel (<63mm to 2mm)	0.0	0.0	0.0	0.0							<0.0	%	TM202/PM0
Sand (<2mm to 63um)	43.8	58.2	49.8	73.0							<0.0	%	TM202/PM0

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Marine and Environmental Resource Conservation Consultants Limited
Reference: Aughinish
Location: River Shannon Ireland
Contact: A.N. Other
EMT Job No: 23/7011

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	4-6	7-9	10-12							LOD/LOR	Units	Method No.
Sample ID	1	2	3	4									
Depth	4.40	14.20	16.30	15.60									
COC No / misc													
Containers	V J T	V J T	V J T	V J T									
Sample Date	27/04/2023	27/04/2023	27/04/2023	27/04/2023									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	04/05/2023	04/05/2023	04/05/2023	04/05/2023									
Silt (<63um to 2um)	53.8	38.1	44.9	22.6							<0.0	%	TM202/PM0
Clay (<2um)	2.4	3.7	5.3	4.4							<0.0	%	TM202/PM0
Acid Soluble Carbonate Gravimetric	17.4	24.8	19.2	18.3							<0.1	%	TM98/PM56
PCB and OC in Marine Sediment by GC HES MSMS													
Alpha-HCH	<0.1	<0.1	<0.1	<0.1							<0.1	ug/kg	
Hexachlorobenzene	<0.1	0.100	0.126	<0.1							<0.1	ug/kg	
Gamma-HCH	<0.1	<0.1	<0.1	<0.1							<0.1	ug/kg	
4,4'-DDE	<0.1	<0.1	0.166	<0.1							<0.1	ug/kg	
Dieldrin	<0.1	<0.1	0.130	<0.1							<0.1	ug/kg	
4,4'-DDD (4,4'-TDE)	<0.1	<0.1	<0.1	<0.1							<0.1	ug/kg	
4,4'-DDT	0.123	0.172	0.208	<0.1							<0.1	ug/kg	
PCB 18	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 28	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 31	<0.08	<0.08	0.123	<0.08							<0.08	ug/kg	
PCB 52	<0.08	<0.08	0.097	<0.08							<0.08	ug/kg	
PCB 49	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 47	0.223	0.364	0.669	0.197							<0.08	ug/kg	
PCB 44	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 66	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 101	<0.08	<0.08	0.110	<0.08							<0.08	ug/kg	
PCB 110	<0.08	<0.08	0.083	<0.08							<0.08	ug/kg	
PCB 151	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 149	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 118	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 153	<0.08	<0.08	0.082	<0.08							<0.08	ug/kg	
PCB 105	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 141	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 138	<0.08	<0.08	0.088	<0.08							<0.08	ug/kg	
PCB 158	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 187	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 183	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 128	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 156	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 180	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 170	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	
PCB 194	<0.08	<0.08	<0.08	<0.08							<0.08	ug/kg	

Please see attached notes for all abbreviations and acronyms

Client Name: Marine and Environmental Resource Conservation Consultants Limited
Reference: Aughinish
Location: River Shannon Ireland
Contact: A.N. Other
EMT Job No: 23/7011

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	4-6	7-9	10-12							LOD/LOR	Units	Method No.
Sample ID	1	2	3	4									
Depth	4.40	14.20	16.30	15.60									
COC No / misc													
Containers	V J T	V J T	V J T	V J T									
Sample Date	27/04/2023	27/04/2023	27/04/2023	27/04/2023									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	04/05/2023	04/05/2023	04/05/2023	04/05/2023									
PAH													
Naphthalene	<0.01	<0.01	<0.01	<0.01							<0.01	mg/kg	
Acenaphthylene	<0.01	<0.01	<0.01	<0.01							<0.01	mg/kg	
Acenaphthene	<0.01	<0.01	<0.01	<0.01							<0.01	mg/kg	
Fluorene	<0.01	<0.01	0.0198	0.01305							<0.01	mg/kg	
Phenanthrene	0.0171	0.012	0.02295	0.015							<0.01	mg/kg	
Anthracene	<0.01	<0.01	<0.01	<0.01							<0.01	mg/kg	
Fluoranthene	0.030	0.014	0.033	0.01905							<0.01	mg/kg	
Pyrene	0.024	<0.01	0.028	0.01455							<0.01	mg/kg	
Benz(a)anthracene	0.019	<0.01	0.020	0.0138							<0.01	mg/kg	
Chrysene	0.019	<0.01	0.021	0.0111							<0.01	mg/kg	
Benzo(b,k)fluoranthene	0.035	0.022	0.030	0.0213							<0.01	mg/kg	
Benzo(e)pyrene	0.023	0.017	0.022	0.01455							<0.01	mg/kg	
Benzo(a)pyrene	0.016	0.011	0.016	<0.01							<0.01	mg/kg	
Perylene	<0.01	0.031	0.022	0.01995							<0.01	mg/kg	
Indeno(123,cd)pyrene	0.013	0.010	<0.01	<0.01							<0.01	mg/kg	
Dibenzo(ah)anthracene	<0.001	<0.001	<0.001	<0.001							<0.01	mg/kg	
Benzo(ghi)perylene	0.013	<0.01	<0.01	<0.01							<0.01	mg/kg	
Benzo(b)fluoranthene	0.025	0.016	0.022	0.015							<0.01	mg/kg	
Benzo(k)fluoranthene	0.010	0.006	0.008	0.006							<0.01	mg/kg	
Organotins													
DBT	<10	<10	<10	<10							<10	ug/kg	
TBT	37.400	<10	<10	<10							<10	ug/kg	
TeBT	<10	<10	<10	<10							<10	ug/kg	
TPhT	<10	<10	<10	<10							<10	ug/kg	

Please see attached notes for all abbreviations and acronyms

All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Marine and Environmental Resource Conservation Consultants Limited
Reference: Aughinish
Location: River Shannon Ireland
Contact: A.N. Other

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/7011						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/7011

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/7011

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Preparation of Soil and Marine Sediment Samples for Total Organic Carbon.			AD	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM98	Acid Soluble Carbonate Gravimetric	PM56	Preparation of sample for Acid Soluble Carbonate			AD	Yes
TM202	Particle Size Distribution (PSD) based on ISO 11277 3rd Ed 2020-04 carried out by sieving for >63um fractions and pipette sedimentation for <63um fractions. Assumed particle density 2.65Mg/m3.	PM0	No preparation is required.			AD	Yes
TM203	Analysis of Marine Sediment for Trace Metals by ICP-MS	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes