Sampling and Analysis of Sediments from Drogheda Port, February 2019

Produced by

AQUAFACT International Services Ltd
On behalf of

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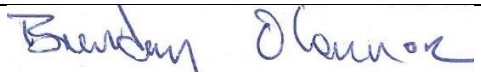
1	Draft	25.6.19	JN1537 Sediment Sampling & Analysis Report	CR	
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1. Introduction

Drogheda Port Company contracted AQUAFACT International Services Ltd. to carry out sediment sampling throughout Drogheda Harbour in order to evaluate the sediment for the purposes of Disposal at Sea (DaS). Sediment characterisation of the harbour area was carried out in line with Cronin *et al*. (2006) 'Guidelines for the assessment of dredge material for disposal in Irish waters'.

2. Sampling Methodology

2.1. Sampling Procedure and Processing

On the 28th February 2019, 17 stations in the harbour and 1 station in each of the dumpsites A1 and A2 were sampled for physical and chemical analysis as per a request from the Marine Institute (see Appendix 1). A 0.025m^2 van Veen grab sampler was used to collect surface sediment samples from AQUAFACT's RIB. Appendix 2 contains a photograph of each sediment sample.

Figure 2.1 shows the station locations and Table 2.1 shows the station coordinates. Samples suitable for analysis could not be retrieved from stations 1 and 2 due to the coarse nature of the seabed in these areas.

One grab sample was taken at each of the stations and the samples were divided as follows:

1. Into 500ml plastic pots for metal, total organic carbon, carbonate analysis, dry solids, density, moisture and particle size analysis;
2. Into 120ml amber glass jars for PAH (polycyclic aromatic hydrocarbon), TBT (tributyl tin), DBT (dibutyl tin), organochlorine, PCB (polychlorinated biphenyl) and total extractable hydrocarbon analyses
3. Into 500ml plastic container for radiological analysis.

Table 2.1: Coordinates of stations sampled for physical and chemical analysis.

Station	Latitude	Longitude	Depth (m)
DP1	53.71368	-6.34867	2.7
DP2	53.71398	-6.34765	2.5
DP3	53.71445	-6.34546	0.5
DP4	53.71548	-6.34072	0.6
DP5	53.71647	-6.33674	0.6
DP6	53.71760	-6.33588	1.5
DP7	53.71768	-6.33136	4.1
DP8	53.71775	-6.32787	1.6
DP9	53.71878	-6.32497	4
DP10	53.71976	-6.31018	0.5
DP11	53.71919	-6.30870	0.5
DP12	53.72077	-6.30672	9.6
DP13	53.72092	-6.30375	6.9
DP14	53.72236	-6.29117	5.1
DP15	53.73202	-6.26432	5.1
DP16*	53.73127	-6.26124	0.8
DP17	53.72144	-6.23868	5
DP18	53.74047	-6.17646	17.3
DP19	53.76240	-6.22285	6.7

* Station 16 was relocated to 53.73088 N; -6.26193 E as the seabed was shell and gravel at the original site.

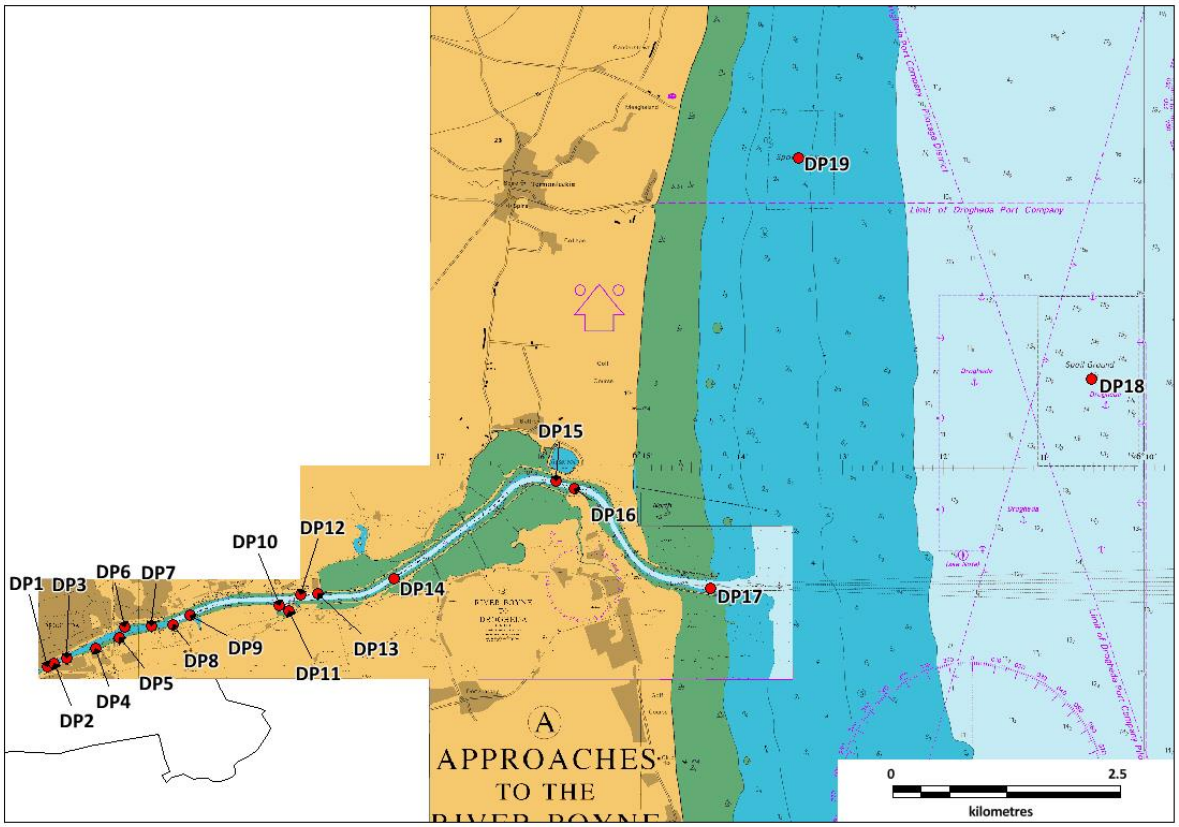

Figure 2.1: Sampling locations in Drogheda Harbour and dumpsites.

2.2. Sample Processing

Once back in the lab, all sediment samples were sent to the SOCOTEC Laboratories in Burton on Trent and physical and chemical analysis and the sample for radiological analysis was sent to the Office of Radiological Protection and Environmental Monitoring.

Table 2.2 shows the Limits of Detection (LOD) and analysis method for each parameter.

Table 2.2: Dumping at sea sediment analysis

Determinand	Limit	Method
Moisture Content	0.2%	Oven drying @105°C to constant weight
Metals Suite Sieving <2mm: As, Cd, Cr, Cu, Pb, Mn, Ni, Zn ,Al, Li,	0.1-10 mg/kg	HF/Boric extraction & ICP analysis
Sieving <2mm:Mercury	0.01mg/kg	Nitric/Peroxide extraction & ICPMS
Total Organic Carbon (TOC)	0.02%	Sulphurous acid/combustion at 800°`C/NDIR
Organotins (DBT, TBT)	1µg/kg	Solvent extraction and derivatisation followed by GC-MS analysis.
PCBs (ICES 7)	0.1µg/kg	Solvent extraction and clean up followed by GC-MS-MS analysis.

Determinand	Limit	Method
Total Hydrocarbon Content	1µg/kg	Solvent extraction and clean up followed by GC-FID analysis.
PAHs by GCMS	1µg/kg	Solvent extraction and clean up followed by GC-MS analysis.
Particle Size Analysis	%	Distribution by wet & dry sieving and laser detraction
Organochlorine Pesticides	0.1µg/kg	Solvent extraction and clean up followed by GC-MS-MS analysis.
Carbonate	0.04%	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7
Radiological testing	-	High resolution Gamma Spectrometry with appropriate density correction

3. Dumping at Sea (DaS) Results

Appendix 3 contains the laboratory report showing the full set of results from SOCOTEC.

3.1. Parameter Code 1 Visual Inspection

Table 3.1 shows the visual inspection information, which includes colour and sediment type.

Table 3.1: Visual Inspection

Station	Description
DP3	Brown slightly sandy slightly gravelly organic SILT
DP4	Black slightly sandy organic SILT
DP5	Black slightly sandy organic SILT
DP6	Black slightly sandy organic SILT
DP7	Black slightly sandy slightly gravelly organic SILT
DP8	Black slightly sandy organic SILT
DP9	Black slightly sandy organic SILT
DP10	Dark brown slightly sandy organic SILT
DP11	Black slightly sandy organic SILT
DP12	Black slightly sandy organic SILT with rare rootlets
DP13	Light brown slightly sandy organic SILT
DP14	Light grey slightly sandy SILT
DP15	Black slightly sandy slightly gravelly organic SILT
DP16	Brown slightly gravelly slightly silty SAND
DP17	Brown SAND with rare shell
DP18	Dark brown SAND with rare shell

DP19	Light brown SAND with rare shell

3.2. Parameter Code 2 Water Content, Density, Solubility and Specific Gavity

The moisture and density results can be seen in Table 3.2. Moisture values ranged from 22.4 (DP19) to 70.8% (DP4). Density values range from 2.55 (DP4) to 2.71% (DP19).

With regard to solubility and specific gravity as marine sediment are mostly fine grains of sediment, they are not soluble and specific gravity ranges from 2.00 – 2.60.

Table 3.2: Moisture and Density results

Station	Total Moisture (%)	Density (%)
DP3	63.7	2.61
DP4	70.8	2.55
DP5	61.8	2.59
DP6	62.4	2.61
DP7	44.3	2.67
DP8	65.7	2.59
DP9	64.4	2.61
DP10	67.5	2.56
DP11	63.6	2.60
DP12	61.6	2.57
DP13	63.4	2.62
DP14	52.6	2.66
DP15	47.6	2.67
DP16	38.0	2.68
DP17	26.0	2.67
DP18	28.9	2.67
DP19	22.4	2.71

3.3. Parameter Code 3 Granulometry

Table 3.3 shows the sediment grain size results obtained from SOCOTEC, results are broken down into % gravel (>2mm), sand (<2mm >63μm) and mud (<63μm). Gravel ranged from 0 (DP4 -6, 8-14, 17 and 19) to 39.6% (DP3). Sand ranged from 12% (DP 3) to 99.2% (DP19) and silt-clay ranged from 0.8% (DP19) to 86% (DP6).

Table 3.3: Granulometric results

Station	% Gravel (>2mm)	% Sand (<2mm - > 63µm)	% Silt-Clay (<63µm)
DP3	39.6	12	48.3
DP4	0.0	17.5	82.5
DP5	0.0	31.0	69.0
DP6	0.0	14.0	86.0
DP7	12.1	46.5	41.5
DP8	0.0	20.4	79.6
DP9	0.0	21.7	78.3
DP10	0.0	22.5	77.5
DP11	0.0	30.8	69.2
DP12	0.0	24.7	75.3
DP13	0.0	25.5	74.5
DP14	0.0	38.3	61.7
DP15	8.4	34.1	57.5
DP16	13.9	45.1	41.0
DP17	0.0	98.8	1.2
DP18	3.4	82.5	14.1
DP19	0.0	99.2	0.8

3.4. Parameter Code 4

3.4.1. Code 4a Total Organic Carbon

Table 3.4 shows the total organic carbon results. Values ranged from 0.09 (DP19) to 4.51% (DP3).

Table 3.4: Total organic carbon results

Station	TOC %
DP3	4.51
DP4	2.16
DP5	2.45
DP6	2.34
DP7	1.28
DP8	2.33
DP9	2.18
DP10	2.79
DP11	2.63
DP12	2.27
DP13	2.19
DP14	1.61
DP15	1.50

DP16	0.93
DP17	0.14
DP18	0.30
DP19	0.09

3.4.2. Code 4b Carbonate

Table 3.5 shows the carbonate results. Values ranged from 2.2 (DP19) to 17.3% (DP4).

Table 3.5: Carbonate results

Station	Carbonate %
DP3	12.2
DP4	17.3
DP5	8.16
DP6	9.12
DP7	6.72
DP8	7.44
DP9	14.9
DP10	12.5
DP11	7.20
DP12	10.6
DP13	12.0
DP14	8.40
DP15	7.44
DP16	10.3
DP17	4.08
DP18	2.40
DP19	2.16

3.4.3. Code 4c Metals

Table 3.6 shows the metal results, along with the upper and lower guidance values for metals (Cronin *et al.,* 2006). Mercury, Aluminium, Chromium, Lithium and Manganese were all below the lower level guidance value. Arsenic was above the lower action level at stations DP3-6 and PD8-15. Cadmium was above the lower action limit for stations DP6 and 11. Copper was above the lower action limit for stations DP3 and 8. Lead was above the lower action limit for station DP11. Nickel was above the lower action limit for stations DP3-9 and 11-15. Zinc was above the lower action limit for station DP11.

Table 3.6: Metal results and guidance values (mg/kg)

Determinand (mg/kg)	As	Cd	Cr	Cu	Pb	Mn	Hg	Ni	Zn	Al	Li
Lower Action Limit	**9***	**0.7**	**120**	**40**	**60**	**N/A**	**0.2**	**21**	**160**	**N/A**	**N/A**
Upper Action Limit	**70#**	**4.2**	**370**	**110^**	**218**	**N/A**	**0.7**	**60**	**410**	**N/A**	**N/A**
DP3	12.9	0.7	92.2	58.3	44.8	12102	0.05	32.9	77.7	54700	34.5
DP4	12.2	0.4	52.9	35.7	27.1	1489	0.05	27.5	124	64900	26.9
DP5	9.1	0.7	51.3	24.3	36.7	761	0.06	27.8	135	65000	26.6
DP6	12.2	0.9	65.4	29.2	36.3	824	0.06	32.7	148	65200	36.0
DP7	7.8	0.4	48.9	24.3	23.7	456	0.04	28.0	129	45800	26.5
DP8	10.8	0.7	64.6	46.7	31.9	641	0.07	39.1	139	77600	43.5
DP9	9.9	0.5	56.9	23.1	28.1	567	0.05	28.4	128	61600	32.8
DP10	9.6	0.4	36.3	13.9	21	632	0.05	19.1	93.1	44200	21.7
DP11	11.7	1.4	57.7	32.1	105	646	0.09	30.4	247	56900	31.4
DP12	9.6	0.5	59.9	22.9	35.9	869	0.05	31.1	138	54600	27.6
DP13	9.4	0.4	46.5	21.6	25.3	741	0.04	25.3	114	54800	29.2
DP14	10.8	0.4	57.1	16.2	28.3	594	0.05	27.8	113	57000	34.3
DP15	9.5	0.4	46.5	13.1	23.7	426	0.04	22.6	92.9	47400	33.0
DP16	8.1	0.3	36.1	10.7	15.8	464	0.02	17.3	64.3	26600	20.7
DP17	4.6	<0.1	16.7	6.4	7.5	216	<0.01	8.0	34.7	15900	12.0
DP18	5.3	<0.1	24.2	6.6	11.8	266	<0.01	10.1	53.4	21000	16.2
DP19	4.2	<0.1	17	4	7.5	229	<0.11	7.1	33.7	15600	11.1

Exceeds Lower Limit | Exceeds Upper Limit

* ERL (rounded up) – No background Irish data ^ PEL as ERM considered high.

In some locations natural levels of arsenic will exceed this value and in such instances, this guidance value will not be appropriate.

3.4.4. Code 4d Organochlorines, PCBs & DDT metabolites

Tables 3.7 and 3.8 show the organochlorines including ɣ-HCH (Lindane) and PCB results, along with the upper and lower guidance values (Cronin *et al.,* 2006). All stations were below the lower action limit for all organochlorine results. With regard to PCBs, station DP16 was above the lower action limit for PCBs 52, 101, 118, 138, 153, 180 and Σ 7PCBs.

Table 3.7: Organochlorine results (ug/kg)

Determinand (ug/kg)	p,p'-DDE	p,p'-DDT	p,p'-DDD	Dieldrin	alpha-HCH	beta-HCH	gamma-HCH	HCB
Lower Action Limit	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.3**	**0.3**
Upper Action Limit	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**1**	**1**
DP3								
DP4	0.373	<0.1	0.426	0.435	<0.1	<0.1	<0.1	0.147
DP5	0.441	<0.1	0.399	0.359	0.113	<0.1	0.133	0.190
DP6	1.19	<0.1	2.12	0.391	<0.1	<0.1	<0.1	0.125
DP7	0.159	<0.1	0.179	0.126	<0.1	<0.1	<0.1	0.058
DP8	0.414	0.111	0.623	0.361	<0.1	<0.1	<0.1	0.115
DP9	0.348	<0.1	0.333	0.322	<0.1	<0.1	<0.1	0.119
DP10	0.303	<0.1	0.321	0.266	<0.1	<0.1	<0.1	0.176
DP11	0.299	<0.1	0.329	0.362	<0.1	<0.1	<0.1	0.094
DP12	0.282	<0.1	0.316	0.158	<0.1	<0.1	<0.1	0.184
DP13	0.271	<0.1	0.415	0.191	<0.1	<0.1	<0.1	0.159
DP14	0.136	<0.1	0.244	<0.1	<0.1	<0.1	<0.1	0.105
DP15	0.153	<0.1	0.223	0.142	<0.1	<0.1	<0.1	<0.1
DP16	<0.1	<0.1	0.160	<0.1	<0.1	<0.1	<0.1	<0.1
DP17	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
DP18	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
DP19	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table 3.8: PCB Results (ug/kg)

Determinand (ug/kg)	PCB 028	PCB 052	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB (Σ ICES 7)*
Lower Action Limit	1	1	1	1	1	1	1	7
Upper Action Limit	180	180	180	180	180	180	180	1260
DP4	0.419	0.386	0.228	0.254	0.270	0.292	0.110	1.959
DP5	0.401	0.364	0.241	0.256	0.323	0.301	0.112	1.998
DP6	0.491	0.449	0.264	0.277	0.313	0.319	0.129	2.242
DP7	0.139	0.132	0.089	0.091	0.111	0.103	<0.08	0.745
DP8	0.366	0.285	0.204	0.317	0.305	0.337	0.111	1.925
DP9	0.329	0.276	0.210	0.235	0.304	0.275	0.149	1.778
DP10	0.367	0.303	0.183	0.263	0.253	0.282	0.106	1.757
DP11	0.298	0.241	0.146	0.176	0.185	0.205	0.094	1.345
DP12	0.509	0.438	0.224	0.246	0.271	0.266	0.105	2.059
DP13	0.395	0.299	0.186	0.231	0.252	0.245	0.115	1.723
DP14	0.269	0.184	0.108	0.151	0.147	0.144	1.083	2.086
DP15	0.246	0.166	0.109	0.151	0.176	0.162	<0.08	1.083
DP16	0.373	1.35	2.56	2.08	3.44	3.60	1.85	15.253
DP17	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.560
DP18	0.162	0.161	<0.08	<0.08	<0.08	<0.08	<0.08	0.723
DP19	0.092	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.572

Exceeds Lower Limit	Exceeds Upper Limit

3.4.5. Code 4e Total Extractable Hydrocarbons

Table 3.9 shows the total extractable hydrocarbon results, along with the lower guidance values for hydrocarbons (Cronin *et al.,* 2006). Values ranged from 0.003 (DP19) to 0.56 g/kg (DP4). All were below the lower guidance level.

Table 3.9: Total extractable hydrocarbon results (g/kg)

Determinand (g/kg)	THC (g/kg)
Lower Action Limit	1
Upper Action Limit	-
DP4	0.56
DP5	0.548
DP6	0.303
DP7	0.128
DP8	0.232
DP9	0.205
DP10	0.28
DP11	0.271
DP12	0.21
DP13	0.158
DP14	0.111
DP15	0.128
DP16	0.0792
DP17	0.00693
DP18	0.0119
DP19	0.00349

3.4.6. Code 4f Tributyl and Dibutyl Tin

Table 3.10 shows the dibutyl and tributyl tin results, along with the upper and lower guidance values (Cronin *et al.,* 2006). The sum of DBT and TBT was below the lower action limit for all stations.

Table 3.10: Dibutyl and tributyl tin results (mg/kg).

Determinand (mg/kg)	Dibutyltin (DBT)	Tributyltin (TBT)	Σ TBT & DBT
Lower Action Limit	-	-	0.1
Upper Action Limit	-	-	0.5
DP4	<0.005	<0.005	0.010
DP5	<0.005	<0.005	0.010
DP6	<0.005	<0.005	0.010
DP7	<0.005	<0.005	0.010
DP8	<0.005	<0.005	0.010
DP9	<0.005	<0.005	0.010
DP10	<0.005	<0.005	0.010
DP11	<0.005	<0.005	0.010
DP12	<0.005	0.016	0.021
DP13	<0.005	<0.005	0.010
DP14	<0.005	<0.005	0.010
DP15	<0.005	<0.005	0.010
DP16	<0.005	<0.005	0.010
DP17	<0.005	<0.005	0.010
DP18	<0.005	<0.005	0.010
DP19	<0.005	<0.005	0.010

3.4.7. Code 4g Polycyclic Aromatic Hydrocarbons

Table 3.11 shows the PAH results and lower guidance values for the sum of 16 PAH's. The sum of the 16 PAH's was below the lower action limit for all stations except DP16.

Table 3.11: PAH results (ug/kg)

Determinand (ug/kg)	PAH Acena-phthene	PAH Acena-phthylene	PAH Anthr-acene	PAH Benzo (a) anthracene	PAH Benzo (a) pyrene	PAH Benzo (b) fluor-anthene	PAH Benzo (ghi) perylene	PAH Benzo (k) fluor-anthene	PAH Chryse ne	PAH Dibenz (a,h) anthracene	PAH Floure ne	PAH Fluor-anthene	PAH Indeno (1,2,3–cd) pyrene	PAH Naphthal ene	PAH Phenant hrene	PAH Pyrene	Σ PAH
Lower Action Limit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4000
Upper Action Limit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DP4	10.40	5.84	18.00	55.00	64.00	73.50	67.20	43.10	91.70	12.00	18.90	120.00	61.20	26.60	87.30	111.00	865.74
DP5	8.99	8.76	29.50	107.00	106.00	131.00	91.90	68.10	140.00	22.20	20.50	204.00	96.00	26.30	110.00	170.00	1340.25
DP6	7.64	6.67	16.10	54.20	71.20	108.00	80.60	40.90	78.00	17.60	21.10	102.00	81.00	27.10	67.90	91.70	871.71
DP7	4.24	2.74	9.71	27.10	32.90	41.40	31.50	19.90	38.70	6.43	8.89	51.80	34.00	13.60	30.40	51.80	405.11
DP8	8.74	6.92	19.50	63.70	75.40	99.70	68.60	43.70	84.00	15.70	21.40	127.00	70.3	30.10	73.50	112.00	920.26
DP9	7.17	6.18	15.80	54.50	67.30	77.20	62.90	45.80	81.80	14.40	16.40	118.00	64.40	24.4	77.4	99.2	832.85
DP10	8.26	6.15	15.80	69.30	72.80	100.00	74.00	47.30	113.00	16.90	19.70	130.00	75.3	29.40	78.70	116.00	972.61
DP11	10.00	5.73	17.50	60.50	70.90	91.60	79.40	44.60	90.90	15.60	24.90	135.00	82.60	29.70	80.10	115.00	954.03
DP12	63.6	7.93	34.00	34.00	42.80	72.90	49.70	36.80	59.20	11.10	61.90	266.00	52.6	27.5	522	130	1472.03
DP13	11.60	5.49	16.30	50.90	55.70	77.30	59.60	33.20	73.10	12.30	22.20	107.00	64.90	28.90	86.70	91.50	796.69
DP14	9.33	8.95	29.60	93.80	102.00	123.00	84.10	51.60	119.00	19.80	18.50	165.00	95.90	27.70	93.20	139.00	1180.48
DP15	50.9	99.9	81.90	177.00	449.00	552.00	387.00	318.00	647.00	70.30	69.50	1660.00	422	248	2020	1240	8492.50
DP16	11.40	11.70	30.00	111.00	113.00	115.00	78.20	55.80	127.00	20.70	16.50	191.00	86.00	28.60	90.20	173.00	1259.10
DP17	<1	<1	<1	1.16	1.38	1.69	1.83	1.42	1.96	<1	<1	2.63	1.97	<1	2.10	2.27	24.41
DP18	<1	<1	1.29	4.91	5.55	7.61	5.93	4.45	7.08	1.17	1.33	9.16	6.65	2.38	4.95	8	72.46
DP19	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.06	<1	<1	<1	<1	16.06

Exceeds Lower Limit | Exceeds Upper Limit

3.5. Radiological Analysis

Appendix 4 contains the laboratory report from the Office of Radiological Protection and Environmental Monitoring. Table

Table 3.12: Radiological analysis results (Bq/kg, dry)

Station	K-40	I-131	Cs-134	Cs-137	Am-241	Ra-226	Ra-228	U-235
DP4	499 ± 57.1	nd	nd	21 ± 2.4	7 ± 0.9	23 ± 4.7	24 ± 3.6	
DP12	472 ± 54.1	nd	nd	18 ± 2.1	8 ± 1	23 ± 4.7	23 ± 3.4	
DP14	405 ± 46.2	nd	nd	13 ± 1.5	4± 0.6	19 ± 4	19 ± 2.9	
DP15	369 ± 42.4	nd	nd	11 ± 1.2	5 ± 0.6	15 ± 2.7	18 ± 2.8	
DP17	227 ± 26.2	nd	nd	2 ± 0.3	1 ± 0.2	6 ± 1.5	6 ± 1.1	0.4 ± 0.1

4. Discussion

The sediment in Drogheda Harbour is characterised below.

Approximately 352,000 tonnes of material will be dredged each year from Drogheda Harbour (inclusive of a contingency figure of 160,000 tonnes). The material consists of silt with varying proportions of sand and gravel. Gravel ranged from 0 to 39.6%. Sand ranged from 12% to 99.2% and silt-clay ranged from 0.8% to 86%.

The material is in solid form.

Moisture values ranged from 22.4 to 70.8%. Density values range from 2.55 to 2.71%.

Organic carbon values ranged from 0.09 to 4.51%. Carbonate values ranged from 2.2 to 17.3%. Regarding other chemical/biochemical properties *e.g.* BOD and nutrients, values these depend to a

great extent on the level of organic enrichment/levels of pollution that occur at the sampling site. The River Boyne flows through areas of relatively high intensity farm lands and it is likely that there are numerous non-point sources of input to the river all along its length. The EPA record BOD values of water samples as high 8.3 mg/l but such a value is regarded as being unlikely for sediments. A range of 2 – 3 mg/g is considered more likely. With regard to nutrients, N and P are not routinely analysed for marine sediments as they are not biologically limiting. Organic carbon is the nutrient that is analysed for and it has been reported on above.

The sediment in not likely to contain any viruses, bacteria, yeasts, parasites of concern.

The Office of Radiological Protection have stated that the dumping of these materials at sea will not result in a radiological hazard.

The sediments analysed for disposal at sea were below the upper action limit for all parameters at all stations. Mercury, Aluminium, Chromium, Lithium and Manganese were all below the lower level guidance value. Arsenic was above the lower action level at stations DP3-6 and 8-15. Cadmium was above the lower action limit for stations DP6 and 11. Copper was above the lower action limit for stations DP3 and 8. Lead was above the lower action limit for station DP11. Nickel was above the lower action limit for stations DP3-9 and 11-15. Zinc was above the lower action limit for station DP11. All stations were below the lower action limit for all organochlorines including ɣ-HCH (Lindane). Six of the PCBs plus the Σ 7PCBs were above the lower action limit at station DP16. Total extractable hydrocarbons ranged from 0.003 to 0.56 g/kg and all stations were below the lower guidance level. TBT and DBT were below the lower action limit for all stations. The sum of the 16 PAH's was below the lower action limit for all stations except DP16.

As the results of the suite of analyses on the range of analytes examined showed that none of them exceeded the upper limits, measurable physical, chemical or biological persistence is considered very unlikely.

As the results of the suite of analyses on the range of analytes examined showed that none of them exceeded the upper limits, accumulation and biotransformation in biological materials or sediments is considered very unlikely.

The disposal of these dredged sediments will not give rise to the formation of new compounds.

The disposal of these sediments resulting in a reduction of the saleability of shellfish or fish collected in the area is considered highly improbable.

5. References

Cronin, M., McGovern, E., McMahon, T. & R. Boelens. 2006. Guidelines for the assessment of dredge material for disposal in Irish waters. Marine Environmental and Health Series, No. 24, 2006.

Appendix 1
Marine Institute
Sampling Protocol

Marine Institute
Foras na Mara

Rinville
Oranmore
Co Galway
Tel: 091 387200

Captain Martin Donnelly
Drogheda Port Company
Harbourville
Mornington Road
Drogheda
Co. Meath

22 January 2019

Re: Sampling and Analysis Plan – Drogheda Port Company

Dear Martin,

A proposed sampling and analysis plan is detailed below to cover dredging of the estuary at Drogheda Port. Seventeen samples along the river/estuary plus a sample in each of the active dumpsites are listed.

You should give your contractor a copy of this plan. You will need to draw their attention especially to recent changes in Section 3 and Section 4, to confirm that they are capable of meeting the quality assurance standards required.

The EPA will specify additional sampling over the duration of the permit.

If you need clarification on anything, please don't hesitate to contact me.

Best regards,

MCronin

Margot Cronin
Marine Environment Chemist

Sample location and analyses required:

The following surface samples, as listed in Table 1 (below) should be taken[1]. Sample locations for the estuary/river are also illustrated in Figure 1.

Table 1. Locations and details of proposed samples

Sample No.	Longitude (°W) *	Latitude (°N) *	Parameters for analysis
1	-6.34867	53.71368	1, 2, 3, 4a, 4b, 4c
2	-6.34765	53.71398	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
3	-6.34546	53.71445	1, 2, 3, 4a, 4b, 4c
4	-6.34072	53.71548	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
5	-6.33674	53.71647	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
6	-6.33588	53.71760	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
7	-6.33136	53.71768	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
8	-6.32787	53.71775	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
9	-6.32497	53.71878	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
10	-6.31018	53.71976	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
11	-6.30870	53.71919	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
12	-6.30672	53.72077	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
13	-6.30375	53.72092	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
14	-6.29117	53.72236	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
15	-6.26432	53.73202	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
16	-6.26124	53.73127	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
17	-6.23868	53.72144	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
18	Mid Dumpsite A1		1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
19	Mid Dumpsite A2		1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g

* Positions in decimal degrees, WGS84

[1] Further sampling and analysis, at depth if necessary, may be required in the event that problem areas of heavy contamination are identified as a result of the initial testing.

2.0 Parameter Code:

1. Visual inspection, to include colour, texture, odour, presence of animals etc
2. Water content, density (taking into account sample collection and handling)
3. Granulometry including % gravel (> 2mm fraction), % sand (< 2mm fraction) and % mud (< 63µm fraction).
4. The following determinants in the sand-mud (< 2mm) fraction * :
   a) total organic carbon
   b) carbonate
   c) mercury, arsenic, cadmium, copper, lead, zinc, chromium, nickel, lithium, aluminium.
   d) organochlorines HCH and γ-HCH, PCBs (to be reported as the ICEΣ7 CB congeners: 28, 52, 101, 118, 138, 153, 180) and DDT metabolites (pp'DDT, pp'DDE, pp'DDD).
   e) total extractable hydrocarbons.
   f) tributyltin (TBT) and dibutyltin (DBT)
   g) Polycyclic aromatic hydrocarbons (PAH) - Acenaphthene, Acenaphthylene, Anthracene, Benzo (a) anthracene, Benzo (a) pyrene, Benzo (b) fluoranthene, Benzo (ghi) perylene, Benzo (k) fluoranthene, Chrysene, Dibenz (a,h) anthracene, Flourene, Fluoranthene, Indeno 1,2,3 – cd pyrene, Naphthalene, Phenanthrene, Pyrene.
   h) Toxicity tests (Microtox or whole sediment bioassay) using appropriate representative aquatic species. (This requirement will depend on the results of the chemical analyses.)

**where the gravel fraction (> 2mm) constitutes a significant part of the total sediment, this should be taken into account in the calculation of the concentrations.*

3.0 Important notes:

3.1 The required detection limits for the various determinants are given in Table 2. below.

3.2 Details of the methodologies used must be furnished with the results. This should include sampling, sub sampling and analytical methods used for each determinant.

3.3 Appropriate marine CRM are to be analysed during each batch of analyses and the results to be reported along with sample results.

3.4 Blanks & in-house references to be run with each sample batch, and reported with sample results.

Table 2. Maximum limits of detection required

Contaminant	Concentration	Units (dry wt)
Mercury	0.05	mg kg^{-1}
Arsenic	1.0	mg kg^{-1}
Cadmium	0.1	mg kg^{-1}
Copper	5.0	mg kg^{-1}
Lead	5.0	mg kg^{-1}

Contaminant	Concentration	Units (dry wt)
Zinc	10	mg kg^{-1}
Chromium	5.0	mg kg^{-1}
Nickel	5.0	mg kg^{-1}
Total extractable hydrocarbons	10.0	mg kg^{-1}
TBT and DBT (not organotin)	10	µg kg^{-1}
PCB – individual congener	0.1	µg kg^{-1}
OCP – individual compound	0.1	µg kg^{-1}
DDT metabolite	0.1	µg kg^{-1}
PAH – individual compound	10	µg kg^{-1}

4.0 Reporting requirements

Reports should include the following information

4.1 Results of testing should be reported in EPA spreadsheet format, which can be found here.

4.2 Spreadsheet results to include:

- 4.2.1 Tabulated geophysical/chemical test results
- 4.2.2 Clear expression of units
- 4.2.3 Indication of wet weight or dry weight basis
- 4.2.4 Location of samples in decimal degrees WGS84 (latitude/longitude).
- 4.2.5 Date of sampling
- 4.2.6 Treatment of samples and indication of sub sampling, compositing etc.
- 4.2.7 Summary method details
- 4.2.8 CRM results
- 4.2.9 QA /QC
- 4.2.10 Other quality assurance information (e.g. accreditation status)
- 4.2.11 Project details.

4.3 If determinant is not detected, report less than values, and indicate LoD/ LoQ used.

4.4 Testing laboratories may be asked to provide additional details of method performance including limit of detection, precision, bias.

Appendix 2
Sediment Sample Photographs

Station	Sample Photograph
Station: S1 Water Depth: 2.7m @ 12:15 Description: Gravel and rock, no silt/clay	
Station: S2 Water Depth: 2.5m @ 12:10 Description: Gravel and rock, no silt/clay.	No Image as river bed coarse
Station : S3 Water Depth: 0.5m @ 11:55 Black mud and stone	
Station: S4 Water Depth: 0.6m @ 11:45 Description: Soft black/grey mud. Light olive silt clay layer on surface. No H_2S smell	

Station: S5 Water Depth: 0.6m @ 11:40 Description: Soft black/grey mud. Light olive silt clay layer on surface. No H_2S smell	
Station: S6 Water Depth: 1.5m @ 11:30 Description: Soft black mud. No H_2S smell.	
Station: S7 Water Depth: 4.1m @ 11:20 Description: Soft black/grey mud. Light olive silt clay layer on surface. Some gravel under surface. No H_2S smell	
Station: S8 Water Depth: 1.6m @ 11:10 Description: Soft black/grey mud. Light olive silt clay layer on surface. Slight H_2S smell	

Station: S9 Water Depth: 4.0m @ 11:00 Description: Soft black/grey mud. Light olive silt clay layer on surface. No H_2S smell	
Station: S10 Water Depth: 0.5m @ 10:50 Description: Soft grey mud. Light olive silt clay layer on surface. No H_2S smell	
Station: S11 Water Depth: 0.5m @ 10:45 Description: Soft black mud. Light olive silt clay layer on surface. Slight H_2S smell	
Station: S12 Water Depth: 9.6m @ 10:40 Description: Black sticky mud. Light olive silt clay layer on surface. Slight H_2S smell.	

Station: S13 Water Depth: 6.9m @ 10:35 Description: Soft black/grey mud. Light olive silt clay layer on surface. Slight H_2S smell	
Station: S14 Water Depth: 5.1m @ 10:30 Description: Soft grey/brown mud. Light olive layer on surface. No H_2S smell	
Station: S15 Water Depth: 5.1m @ 10:25 Description: Soft black/grey mud. Light olive layer on surface. Slight H_2S smell	
Station: S16 Water Depth: 0.8m @ 10:20 Description: Fine sand, gravel and mud mix. No H_2S smell Station moved to 53.73088, -6.26913 as bottom at original coordinates was shell and gravel	No Image

Station: S17 Water Depth: 5.0m @ 10:15 Description: Clean fine sand. No H_2S smell	
Station: S18 Water Depth: 17.3m @ 9:32 Description: Muddy fine sand, some shell particles. No H_2S smell	
Station: S19 Water Depth: 6.7m @ 9:15 Description: Clean fine sand. No H_2S smell	

Appendix 3
Dumping at Sea SOCOTEC Laboratory Certs

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	**MAR00221**
Issue Version	2
Customer	Aquafact International Services Ltd, 12 Kilkerrin Park, Liosbaun, Tuam Rd, Galway, H91 FW7V
Customer Reference	Drogheda DaS Sediment
Date Sampled	28-Feb-19
Date Received	06-Mar-19
Date Reported	05-Apr-19
Condition of samples	Cold Satisfactory

This is a revised report containing the additional CRM information and replaces all previously issued versions

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	MAR00221
Issue Version	2
Customer Reference	Drogheda DaS Sediment

Client Reference:	SOCOTEC Ref:	Matrix	Visual Description
ST.3	MAR00221.001	Sediment	Brown slightly sandy slightly gravelly organic SILT
ST.4	MAR00221.002	Sediment	Black slightly sandy organic SILT
ST.5	MAR00221.003	Sediment	Black slightly sandy organic SILT
ST.6	MAR00221.004	Sediment	Black slightly sandy organic SILT
ST.7	MAR00221.005	Sediment	Black slightly sandy slightly gravelly organic SILT
ST.8	MAR00221.006	Sediment	Black slightly sandy organic SILT
ST.9	MAR00221.007	Sediment	Black slightly sandy organic SILT
ST.10	MAR00221.008	Sediment	Dark brown slightly sandy organic SILT
ST.11	MAR00221.009	Sediment	Black slightly sandy organic SILT
ST.12	MAR00221.010	Sediment	Black slightly sandy organic SILT with rare rootlets
ST.13	MAR00221.011	Sediment	Light brown slightly sandy organic SILT
ST.14	MAR00221.012	Sediment	Light grey slightly sandy SILT
ST.15	MAR00221.013	Sediment	Black slightly sandy slightly gravelly organic SILT
ST.16	MAR00221.014	Sediment	Brown slightly gravelly slightly silty SAND
ST.17	MAR00221.015	Sediment	Brown SAND with rare shell
ST.18	MAR00221.016	Sediment	Dark brown SAND with rare shell
ST.19	MAR00221.017	Sediment	Light brown SAND with rare shell

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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		Units	%	%	%	%	%	%
		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**	**Total Solids**	**Gravel (>2mm)**	**Sand (63-2000 µm)**	**Silt (<63 µm)**	**Density**
ST.3	MAR00221.001	Sediment	63.7	36.3	39.6	12	48.3	2.61
ST.4	MAR00221.002	Sediment	70.8	29.2	0.0	17.5	82.5	2.55
ST.5	MAR00221.003	Sediment	61.8	38.2	0.0	31.0	69.0	2.59
ST.6	MAR00221.004	Sediment	62.4	37.6	0.0	14.0	86.0	2.61
ST.7	MAR00221.005	Sediment	44.3	55.7	12.1	46.5	41.5	2.67
ST.8	MAR00221.006	Sediment	65.7	34.3	0.0	20.4	79.6	2.59
ST.9	MAR00221.007	Sediment	64.4	35.6	0.0	21.7	78.3	2.61
ST.10	MAR00221.008	Sediment	67.5	32.5	0.0	22.5	77.5	2.56
ST.11	MAR00221.009	Sediment	63.6	36.4	0.0	30.8	69.2	2.60
ST.12	MAR00221.010	Sediment	61.6	38.4	0.0	24.7	75.3	2.57
ST.13	MAR00221.011	Sediment	63.4	36.6	0.0	25.5	74.5	2.62
ST.14	MAR00221.012	Sediment	52.6	47.4	0.0	38.3	61.7	2.66
ST.15	MAR00221.013	Sediment	47.6	52.4	8.4	34.1	57.5	2.67
ST.16	MAR00221.014	Sediment	38.0	62.0	13.9	45.1	41.0	2.68
ST.17	MAR00221.015	Sediment	26.0	74.0	0.0	98.8	1.2	2.67
ST.18	MAR00221.016	Sediment	28.9	71.1	3.4	82.5	14.1	2.67
ST.19	MAR00221.017	Sediment	22.4	77.6	0.0	99.2	0.8	2.71
		Reference Material (% Recovery)	N/A	N/A	N/A	N/A	N/A	N/A
		QC Blank	N/A	N/A	N/A	N/A	N/A	N/A

* See Report Notes

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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		Units	%	% M/M
		Method No	SOCOTEC Env Chem*	SOCOTEC Env Chem*
		Limit of Detection	0.12	0.02
		Accreditation	N	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Carbonate %**	**TOC**
ST.3	MAR00221.001	Sediment	12.2	4.51
ST.4	MAR00221.002	Sediment	17.3	2.16
ST.5	MAR00221.003	Sediment	8.16	2.45
ST.6	MAR00221.004	Sediment	9.12	2.34
ST.7	MAR00221.005	Sediment	6.72	1.28
ST.8	MAR00221.006	Sediment	7.44	2.33
ST.9	MAR00221.007	Sediment	14.9	2.18
ST.10	MAR00221.008	Sediment	12.5	2.79
ST.11	MAR00221.009	Sediment	7.20	2.63
ST.12	MAR00221.010	Sediment	10.6	2.27
ST.13	MAR00221.011	Sediment	12.0	2.19
ST.14	MAR00221.012	Sediment	8.40	1.61
ST.15	MAR00221.013	Sediment	7.44	1.50
ST.16	MAR00221.014	Sediment	10.3	0.93
ST.17	MAR00221.015	Sediment	4.08	0.14
ST.18	MAR00221.016	Sediment	2.40	0.30
ST.19	MAR00221.017	Sediment	2.16	0.09
		Reference Material (% Recovery)	N/A	98
		QC Blank	N/A	<0.02

* 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	MAR00221
Issue Version	2
Customer Reference	Drogheda DaS Sediment

		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	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*
		Limit of Detection	1	0.1	0.5	2	2	1	0.01
		Accreditation	UKAS	N	N	UKAS	UKAS	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Arsenic (HF-MS)**	**Cadmium (HF-MS)**	**Chromium (HF-MS)**	**Copper (HF-MS)**	**Lead (HF-MS)**	**Manganese (HF-MS)**	**Mercury (Tot.MS)**
ST.3	MAR00221.001	Sediment	12.9	0.7	92.2	58.3	44.8	12102	0.05
ST.4	MAR00221.001	Sediment	12.2	0.4	52.9	35.7	27.1	1489	0.05
ST.5	MAR00221.001	Sediment	9.1	0.7	51.3	24.3	36.7	761	0.06
ST.6	MAR00221.001	Sediment	12.2	0.9	65.4	29.2	36.3	824	0.06
ST.7	MAR00221.001	Sediment	7.8	0.4	48.9	24.3	23.7	456	0.04
ST.8	MAR00221.001	Sediment	10.8	0.7	64.6	46.7	31.9	641	0.07
ST.9	MAR00221.001	Sediment	9.9	0.5	56.9	23.1	28.1	567	0.05
ST.10	MAR00221.001	Sediment	9.6	0.4	36.3	13.9	21	632	0.05
ST.11	MAR00221.001	Sediment	11.7	1.4	57.7	32.1	105	646	0.09
ST.12	MAR00221.001	Sediment	9.6	0.5	59.9	22.9	35.9	869	0.05
ST.13	MAR00221.001	Sediment	9.4	0.4	46.5	21.6	25.3	741	0.04
ST.14	MAR00221.001	Sediment	10.8	0.4	57.1	16.2	28.3	594	0.05
ST.15	MAR00221.001	Sediment	9.5	0.4	46.5	13.1	23.7	426	0.04
ST.16	MAR00221.001	Sediment	8.1	0.3	36.1	10.7	15.8	464	0.02
ST.17	MAR00221.001	Sediment	4.6	<0.1	16.7	6.4	7.5	216	<0.01
ST.18	MAR00221.001	Sediment	5.3	<0.1	24.2	6.6	11.8	266	<0.01
ST.19	MAR00221.001	Sediment	4.2	<0.1	17	4	7.5	229	<0.11
		Certified Reference Material 2702 (% Recovery)	97	100	95	94	91	101	99
		Certified Reference Material 2702	35.8	~ 2	~ 279	81.9	105	~ 1356	~ 0.02
		QC Blank	<1	<0.1	<0.5	<2	<2	<1	<0.01

* See Report Notes

~ Indicates result is for an In-house Reference Material

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	MAR00221
Issue Version	2
Customer Reference	Drogheda DaS Sediment

		Units	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)	mg/Kg (Dry Weight)
		Method No	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*	SOCOTEC Env Chem*
		Limit of Detection	0.5	3	10	0.5
		Accreditation	N	N	UKAS	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Nickel (HF-MS)**	**Zinc (HF-MS)**	**Aluminium(HF-OES)**	**Lithium (HF-OES)**
ST.3	MAR00221.001	Sediment	32.9	77.7	54700	34.5
ST.4	MAR00221.001	Sediment	27.5	124	64900	26.9
ST.5	MAR00221.001	Sediment	27.8	135	65000	26.6
ST.6	MAR00221.001	Sediment	32.7	148	65200	36.0
ST.7	MAR00221.001	Sediment	28.0	129	45800	26.5
ST.8	MAR00221.001	Sediment	39.1	139	77600	43.5
ST.9	MAR00221.001	Sediment	28.4	128	61600	32.8
ST.10	MAR00221.001	Sediment	19.1	93.1	44200	21.7
ST.11	MAR00221.001	Sediment	30.4	247	56900	31.4
ST.12	MAR00221.001	Sediment	31.1	138	54600	27.6
ST.13	MAR00221.001	Sediment	25.3	114	54800	29.2
ST.14	MAR00221.001	Sediment	27.8	113	57000	34.3
ST.15	MAR00221.001	Sediment	22.6	92.9	47400	33.0
ST.16	MAR00221.001	Sediment	17.3	64.3	26600	20.7
ST.17	MAR00221.001	Sediment	8.0	34.7	15900	12.0
ST.18	MAR00221.001	Sediment	10.1	53.4	21000	16.2
ST.19	MAR00221.001	Sediment	7.1	33.7	15600	11.1
		Certified Reference Material 2702 (% Recovery)	102	101	107	104
		Certified Reference Material 2702	~ 60	~ 426	84900	~ 57
		QC Blank	<0.5	<3	<10	<0.5

* See Report Notes

~ Indicates result is for an In-house Reference Material

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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		Units	µg/Kg (Dry Weight)	
		Method No	ASC/SOP/301	
		Limit of Detection	1	1
		Accreditation	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Dibutyltin (DBT)**	**Tributyltin (TBT)**
ST.4	MAR00221.002	Sediment	<5	<5
ST.5	MAR00221.003	Sediment	<5	<5
ST.6	MAR00221.004	Sediment	<5	<5
ST.7	MAR00221.005	Sediment	<5	<5
ST.8	MAR00221.006	Sediment	<5	<5
ST.9	MAR00221.007	Sediment	<5	<5
ST.10	MAR00221.008	Sediment	<5	<5
ST.11	MAR00221.009	Sediment	<5	<5
ST.12	MAR00221.010	Sediment	<5	16.4
ST.13	MAR00221.011	Sediment	<5	<5
ST.14	MAR00221.012	Sediment	<5	<5
ST.15	MAR00221.013	Sediment	<5	<5
ST.16	MAR00221.014	Sediment	<5	<5
ST.17	MAR00221.015	Sediment	<5	<5
ST.18	MAR00221.016	Sediment	<5	<5
ST.19	MAR00221.017	Sediment	<5	<5
Certified Reference Material BCR-646 (% Recovery)			80	67
Certified Reference Material BCR-646			614	320
QC Blank			<1	<1

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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303
		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**
ST.4	MAR00221.002	Sediment	10.4	5.84	18.0	55.0	64.0	73.5
ST.5	MAR00221.003	Sediment	8.99	8.76	29.5	107	106	131
ST.6	MAR00221.004	Sediment	7.64	6.67	16.1	54.2	71.2	108
ST.7	MAR00221.005	Sediment	4.24	2.74	9.71	27.1	32.9	41.4
ST.8	MAR00221.006	Sediment	8.74	6.92	19.5	63.7	75.4	99.7
ST.9	MAR00221.007	Sediment	7.17	6.18	15.8	54.5	67.3	77.2
ST.10	MAR00221.008	Sediment	8.26	6.15	15.8	69.3	72.8	100
ST.11	MAR00221.009	Sediment	10.0	5.73	17.5	60.5	70.9	91.6
Certified Reference Material CRM180013 1941b (% Recovery)			68	99	70	72	62	96
Certified Reference Material CRM180013 1941b			25.9	52.9	128	241	223	433
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.

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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303
		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**
ST.4	MAR00221.002	Sediment	67.2	43.1	91.7	12.0	120	18.9
ST.5	MAR00221.003	Sediment	91.9	68.1	140	22.2	204	20.5
ST.6	MAR00221.004	Sediment	80.6	40.9	78.0	17.6	102	21.1
ST.7	MAR00221.005	Sediment	31.5	19.9	38.7	6.43	51.8	8.89
ST.8	MAR00221.006	Sediment	68.6	43.7	84.0	15.7	127	21.4
ST.9	MAR00221.007	Sediment	62.9	45.8	81.8	14.4	118	16.4
ST.10	MAR00221.008	Sediment	74.0	47.3	113	16.9	130	19.7
ST.11	MAR00221.009	Sediment	79.4	44.6	90.9	15.6	135	24.9
Certified Reference Material CRM180013 1941b (% Recovery)			72	87	100	105	87	51
Certified Reference Material CRM180013 1941b			222	196	397	55.7	567	43.6
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

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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303
		Limit of Detection	1	1	1	1	100
		Accreditation	UKAS	UKAS	UKAS	UKAS	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
ST.4	MAR00221.002	Sediment	61.2	26.6	87.3	111	560000
ST.5	MAR00221.003	Sediment	96.0	26.3	110	170	548000
ST.6	MAR00221.004	Sediment	81.0	27.1	67.9	91.7	303000
ST.7	MAR00221.005	Sediment	34.0	13.6	30.4	51.8	128000
ST.8	MAR00221.006	Sediment	70.3	30.1	73.5	112	232000
ST.9	MAR00221.007	Sediment	64.4	24.4	77.4	99.2	205000
ST.10	MAR00221.008	Sediment	75.3	29.4	78.7	116	280000
ST.11	MAR00221.009	Sediment	82.6	29.7	80.1	115	271000
Certified Reference Material CRM180013 1941b (% Recovery)			75	60	76	76	116~
Certified Reference Material CRM180013 1941b			257	507	310	444	N/A
QC Blank			<1	<1	<1	<1	<100

For full analyte name see method summaries
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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	MAR00221
Issue Version	2
Customer Reference	Drogheda DaS Sediment

		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	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303
		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**
ST.12	MAR00221.010	Sediment	63.6	7.93	34.0	34.0	42.8	72.9
ST.13	MAR00221.011	Sediment	11.6	5.49	16.3	50.9	55.7	77.3
ST.14	MAR00221.012	Sediment	9.33	8.95	29.6	93.8	102	123
ST.15	MAR00221.013	Sediment	50.9	99.9	81.9	177	449	552
ST.16	MAR00221.014	Sediment	11.4	11.7	30.0	111	113	115
ST.17	MAR00221.015	Sediment	<1	<1	<1	1.16	1.38	1.69
ST.18	MAR00221.016	Sediment	<1	<1	1.29	4.91	5.55	7.61
ST.19	MAR00221.017	Sediment	<1	<1	<1	<1	<1	<1
Certified Reference Material CRM180013 1941b (% Recovery)			68	99	70	72	62	96
Certified Reference Material CRM180013 1941b			25.9	52.9	128	241	223	433
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries

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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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303
		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**
ST.12	MAR00221.010	Sediment	49.7	36.8	59.2	11.1	266	61.9
ST.13	MAR00221.011	Sediment	59.6	33.2	73.1	12.3	107	22.2
ST.14	MAR00221.012	Sediment	84.1	51.6	119	19.8	165	18.5
ST.15	MAR00221.013	Sediment	387	318	647	70.3	1660	69.5
ST.16	MAR00221.014	Sediment	78.2	55.8	127	20.7	191	16.5
ST.17	MAR00221.015	Sediment	1.83	1.42	1.96	<1	2.63	<1
ST.18	MAR00221.016	Sediment	5.93	4.45	7.08	1.17	9.16	1.33
ST.19	MAR00221.017	Sediment	<1	<1	<1	<1	1.06	<1
Certified Reference Material CRM180013 1941b (% Recovery)			72	87	100	105	87	51
Certified Reference Material CRM180013 1941b			222	196	397	55.7	567	43.6
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries
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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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303	ASC/SOP/303
		Limit of Detection	1	1	1	1	100
		Accreditation	UKAS	UKAS	UKAS	UKAS	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
ST.12	MAR00221.010	Sediment	52.6	27.5	522	130	210000
ST.13	MAR00221.011	Sediment	64.9	28.9	86.7	91.5	158000
ST.14	MAR00221.012	Sediment	95.9	27.7	93.2	139	111000
ST.15	MAR00221.013	Sediment	422	248	2020	1240	128000
ST.16	MAR00221.014	Sediment	86.0	28.6	90.2	173	79200
ST.17	MAR00221.015	Sediment	1.97	<1	2.10	2.27	6930
ST.18	MAR00221.016	Sediment	6.65	2.38	4.95	8.00	11900
ST.19	MAR00221.017	Sediment	<1	<1	<1	<1	3490
Certified Reference Material CRM180013 1941b (% Recovery)			75	60	76	76	106~
Certified Reference Material CRM180013 1941b			257	507	310	444	N/A
QC Blank			<1	<1	<1	<1	<100

For full analyte name see method summaries
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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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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/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
		Date Analysed	25/03/2019	25/03/2019	25/03/2019	25/03/2019	25/03/2019	25/03/2019
		Accreditation	N	N	N	N	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**PCB28**	**PCB52**	**PCB101**	**PCB118**	**PCB138**	**PCB153**
ST.4	MAR00221.002	Sediment	0.419	0.386	0.228	0.254	0.270	0.292
ST.5	MAR00221.003	Sediment	0.401	0.364	0.241	0.256	0.323	0.301
ST.6	MAR00221.004	Sediment	0.491	0.449	0.264	0.277	0.313	0.319
ST.7	MAR00221.005	Sediment	0.139	0.132	0.089	0.091	0.111	0.103
ST.8	MAR00221.006	Sediment	0.366	0.285	0.204	0.317	0.305	0.337
ST.9	MAR00221.007	Sediment	0.329	0.276	0.210	0.235	0.304	0.275
ST.10	MAR00221.008	Sediment	0.367	0.303	0.183	0.263	0.253	0.282
ST.11	MAR00221.009	Sediment	0.298	0.241	0.146	0.176	0.185	0.205
ST.12	MAR00221.010	Sediment	0.509	0.438	0.224	0.246	0.271	0.266
ST.13	MAR00221.011	Sediment	0.395	0.299	0.186	0.231	0.252	0.245
ST.14	MAR00221.012	Sediment	0.269	0.184	0.108	0.151	0.147	0.144
ST.15	MAR00221.013	Sediment	0.246	0.166	0.109	0.151	0.176	0.162
ST.16	MAR00221.014	Sediment	0.373	1.35	2.56	2.08	3.44	3.60
ST.17	MAR00221.015	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ST.18	MAR00221.016	Sediment	0.162	0.161	<0.08	<0.08	<0.08	<0.08
ST.19	MAR00221.017	Sediment	0.092	<0.08	<0.08	<0.08	<0.08	<0.08
Certified Reference Material SRM 1941b (% Recovery)			73	103	104	102	118	102
Certified Reference Material SRM 1941b			3.30	5.42	5.34	4.33	4.24	5.59
QC Blank			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08

For full analyte name see method summaries

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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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

		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	0.1	0.1	0.1	0.1	0.1	0.1
		Date Analysed	25/03/2019	25/03/2019	25/03/2019	25/03/2019	25/03/2019	25/03/2019	25/03/2019
		Accreditation	N	N	N	N	N	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**PCB180**	**AHCH**	**BHCH**	**GHCH**	**DIELDRIN**	**HCB**	**DDE**
ST.4	MAR00221.002	Sediment	0.110	<0.1	<0.1	<0.1	0.435	0.147	0.373
ST.5	MAR00221.003	Sediment	0.112	0.113	<0.1	0.133	0.359	0.190	0.441
ST.6	MAR00221.004	Sediment	0.129	<0.1	<0.1	<0.1	0.391	0.125	1.19
ST.7	MAR00221.005	Sediment	<0.08	<0.1	<0.1	<0.1	0.126	0.058	0.159
ST.8	MAR00221.006	Sediment	0.111	<0.1	<0.1	<0.1	0.361	0.115	0.414
ST.9	MAR00221.007	Sediment	0.149	<0.1	<0.1	<0.1	0.322	0.119	0.348
ST.10	MAR00221.008	Sediment	0.106	<0.1	<0.1	<0.1	0.266	0.176	0.303
ST.11	MAR00221.009	Sediment	0.094	<0.1	<0.1	<0.1	0.362	0.094	0.299
ST.12	MAR00221.010	Sediment	0.105	<0.1	<0.1	<0.1	0.158	0.184	0.282
ST.13	MAR00221.011	Sediment	0.115	<0.1	<0.1	<0.1	0.191	0.159	0.271
ST.14	MAR00221.012	Sediment	<0.08	<0.1	<0.1	<0.1	<0.1	0.105	0.136
ST.15	MAR00221.013	Sediment	<0.08	<0.1	<0.1	<0.1	0.142	<0.1	0.153
ST.16	MAR00221.014	Sediment	1.85	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
ST.17	MAR00221.015	Sediment	<0.08	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
ST.18	MAR00221.016	Sediment	<0.08	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
ST.19	MAR00221.017	Sediment	<0.08	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Certified Reference Material SRM 1941b (% Recovery)			102	119~	117~	127~	157~	132	103
Certified Reference Material SRM 1941b			3.32	N/A	N/A	N/A	N/A	7.73	3.32
QC Blank			<0.08	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

For full analyte name see method summaries

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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	MAR00221
Issue Version	2
Customer Reference	Drogheda DaS Sediment

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/302	ASC/SOP/302
		Limit of Detection	0.1	0.1
		Date Analysed	25/03/2019	25/03/2019
		Accreditation	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**DDT**	**DDD**
ST.4	MAR00221.002	Sediment	<0.1	0.426
ST.5	MAR00221.003	Sediment	<0.1	0.399
ST.6	MAR00221.004	Sediment	<0.1	2.12
ST.7	MAR00221.005	Sediment	<0.1	0.179
ST.8	MAR00221.006	Sediment	0.111	0.623
ST.9	MAR00221.007	Sediment	<0.1	0.333
ST.10	MAR00221.008	Sediment	<0.1	0.321
ST.11	MAR00221.009	Sediment	<0.1	0.329
ST.12	MAR00221.010	Sediment	<0.1	0.316
ST.13	MAR00221.011	Sediment	<0.1	0.415
ST.14	MAR00221.012	Sediment	<0.1	0.244
ST.15	MAR00221.013	Sediment	<0.1	0.223
ST.16	MAR00221.014	Sediment	<0.1	0.160
ST.17	MAR00221.015	Sediment	<0.1	<0.1
ST.18	MAR00221.016	Sediment	<0.1	<0.1
ST.19	MAR00221.017	Sediment	<0.1	<0.1
		Certified Reference Material SRM 1941b (% Recovery)	113~	122
		Certified Reference Material SRM 1941b	N/A	5.69
		QC Blank	<0.1	<0.1

For full analyte name see method summaries

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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 MAR00221
Issue Version 2
Customer Reference Drogheda DaS Sediment

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*	MAR00221.001-.017	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
SUB_01*	MAR00221.001-.017	Analysis was conducted by an approved subcontracted laboratory.
SUB_02*	MAR00221.001-.017	Analysis was conducted by an approved subcontracted laboratory.
ASC/SOP/301	MAR00221.001-.017	The matrix of this sample has been found to interfere with the result for this test. The sample has therefore been diluted to improve the signal to noise ratio but in doing so, the detection limit for this test has been elevated.
ASC/SOP/303	MAR00221.001-.017	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	Devation 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

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	MAR00221
Issue Version	2
Customer Reference	Drogheda DaS Sediment

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 105°C to constant weight.
Total Organic Carbon (TOC)	Air dried and seived to <2mm	Carbonate removal and sulphurous acid/combustion at 800°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	HF/Boric extraction followed by ICP analysis.
Mercury	Air dried and seived to <2mm	Nitric/peroxide extractin followed by ICPMS analysis.
Organotins	Wet Sediment <2mm	Solvent extraction and derivatisation followed by GC-MS analysis.
Polyaromatic Hydrocarbons (PAH)	Wet Sediment <2mm	Solvent extraction and clean up followed by GC-MS analysis.
Total Hydrocarbon Content (THC)	Wet Sediment <2mm	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	CHRYSENE	Chrysene	THC	Total Hydrocarbon Content
ACENAPHY	Acenaphthylene	DBENZAH	Diben[ah]anthracene	AHCH	alpha-Hexachlorcyclohexane
ANTHRACN	Anthracene	FLUORANT	Fluoranthene	BHCH	beta-Hexachlorcyclohexane
BAA	Benzo[a]anthracene	FLUORENE	Fluorene	GHCH	gamma-Hexachlorcyclohexane
BAP	Benzo[a]pyrene	INDPYR	Indeno[1,2,3-cd]pyrene	DIELDRIN	Dieldrin
BBF	Benzo[b]fluoranthene	NAPTH	Naphthalene	HCB	Hexachlorobenzene
BENZGHIP	Benzo[ghi]perylene	PHENANT	Phenanthrene	DDE	p,p'-Dichorodiphenyldicloroethylene
BKF	Benzo[k]fluoranthene	PYRENE	Pyrene	DDT	p,p'-Dichorodiphenyltrichloroethane
				DDD	p,p'-Dichlorodiphenyldichloroethane

Appendix 4
Office of Radiological Protection
Laboratory Report

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

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Laboratory Test Report

Report Date: 12th June 2019

Samples Tested on Behalf of: AQUAFACT International Services Ltd

Laboratory Analysis: High Resolution Gamma Spectrometry with appropriate density correction

Sample Type: Marine Sediment Drogheda

Date of Receipt: 7th March 2019

Date of Analysis May 2019

Results:

ORP Reference	Client Reference	Coordinates	Nuclide	Activity Concentration (Bq/kg, dry)[1]
ES1900217	JN1527 ST4	Not Provided	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228	499 ± 57.1 nd nd 21 ± 2.4 7 ± 0.9 23 ± 4.7 24 ± 3.6
ES1900218	JN1527 ST12	Not Provided	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228	472 ± 54.1 nd nd 18 ± 2.1 8 ± 1 23 ± 4.7 23 ± 3.4

ES1900219	JN1527 ST14	Not Provided	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228	405 ± 46.2 nd nd 13 ± 1.5 4 ± 0.6 19 ± 4 19 ± 2.9
ES1900220	JN1527 ST15	Not Provided	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228	369 ± 42.4 nd nd 11 ± 1.2 5 ± 0.6 15 ± 2.7 18 ± 2.8
ES1900221	JN1527 ST17	Not Provided	K-40 I-131 Cs-134 Cs-137 Am-241 Ra-226 Ra-228 U-235	227 +/- 26.2 nd nd 2 +/- 0.3 1 +/- 0.2 6 +/- 1.5 6 +/- 1.1 0.4 +/- 0.1

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

The Office of Radiation Protection and Environmental Monitoring received five grab sediment samples from AQUAFACT International Services Ltd. These samples were taken at Drogheda Port 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.

Lorraine Currivan
Laboratory Manager

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

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 lab manager: Mr Simon O'Toole, Dr Chris Burbidge.**
- **Where applicable, the number following the symbol ± is the combined standard uncertainty and not a confidence interval.**