Environmental Impact Assessment Report
Volume 3, Appendix 7.2: Geophysical and Environmental Export Cable Corridor Survey Volume 4 of 8
Contaminants Report

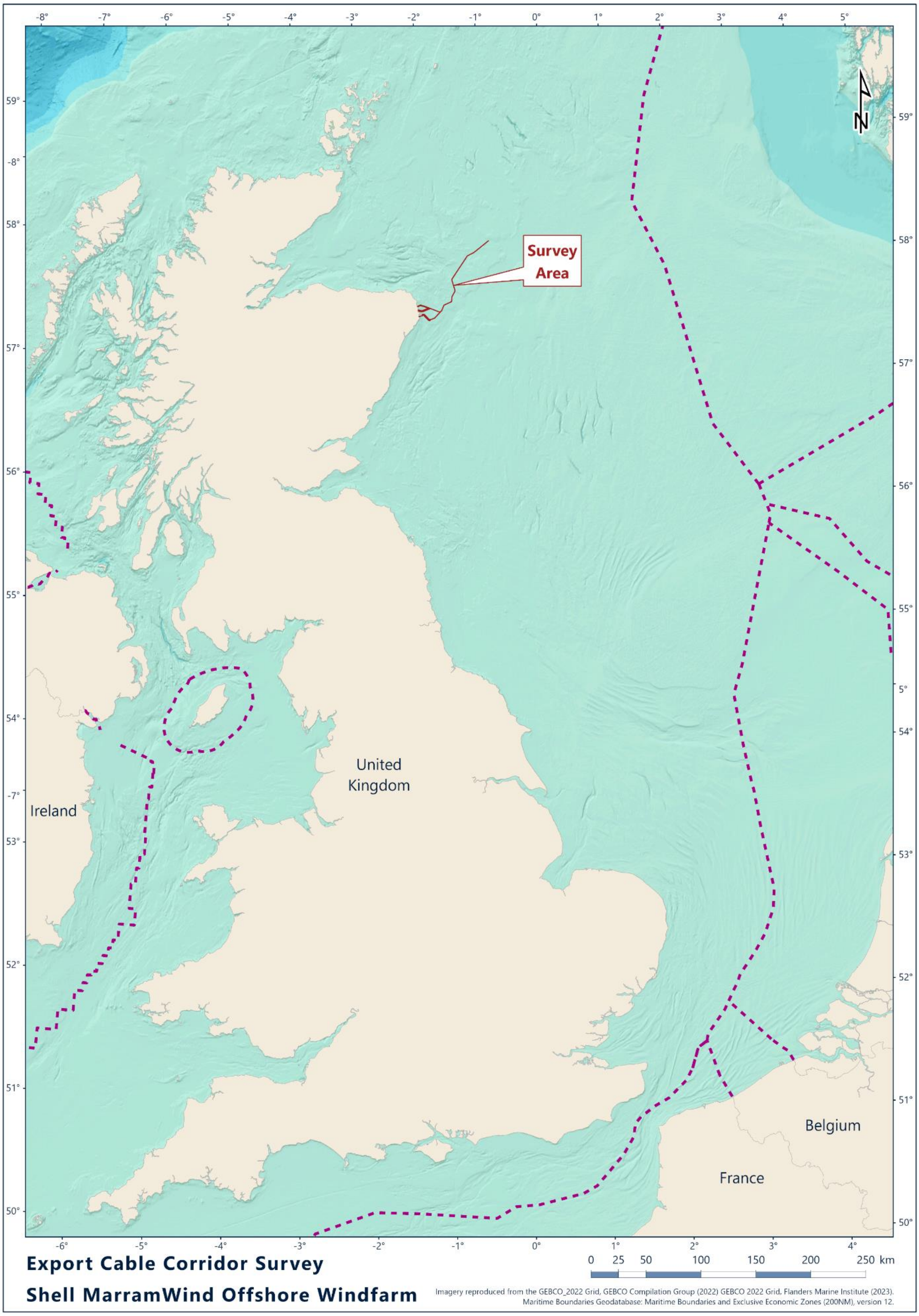
MarramWind Offshore Wind Farm

October 2025

MarramWind

Document code:	MAR-GEN-ENV-REP-WSP-000191
Version:	Final for Submission.
Date:	08/12/2025
Prepared by:	Fugro
Checked by:	MarramWind Limited
Approved by:	MarramWind Limited

Frontispiece



Executive Summary

Introduction

On the instruction of MarramWind Limited, Fugro performed a geophysical and environmental survey along the proposed MarramWind Floating Offshore Wind Farm Export Cable Corridor (MarramWind ECC). The survey area was located within the NE7 wind farm site in the central North Sea (CNS). Nearshore survey operations were performed onboard the MV Fugro Valkyrie during the survey period 18 May to 8 June 2023. Offshore survey operations were performed onboard the MV Fugro Galaxy during the survey period 12 May to 11 July 2023.

Survey Strategy

For the nearshore section of the survey area, two grab sampling stations were proposed. A full suite of grab samples were successfully acquired at both proposed stations.

For the offshore section of the survey area, eighty sediment grab sampling stations were proposed. Station ST58 was abandoned due to infrastructure exclusion zones prohibiting sampling. A full suite of samples was acquired from 74 of the 79 remaining proposed stations. Sediment samples were not obtained at five stations (ST19_a, ST43_a, ST45_a, ST49_a and ST49_b) and only faunal and particle size distribution (PSD) samples were collected at station ST46_a.

Subsamples from 25 representative grab stations were selected post-survey completion for contaminants analysis.

Vibrocore sediment sampling was undertaken at 25 stations across the survey area, with cores collected at each station for sediment chemistry analysis.

Sediment Chemistry

Sediment samples were analysed for polycyclic aromatic hydrocarbons (PAHs), metal content, polychlorinated biphenyls (PCBs) and organotins. Results were compared to the Marine Scotland Guideline Action Levels (AL1 and AL2).

The majority of individual and total PAH concentrations were below their respective AL1 levels in all the grab samples and core samples and therefore not considered to be detrimental to the marine environment. An exception to this was sample MRW_ECC_47-3, where AL1 values were exceeded for phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, benzo[ghi]perylene and dibenzo[ah]anthracene. However, the PAH values in the stratified layers above and below the sample, in the same core, were low.

The metals content of the sediments was analysed by aqua regia digest. The bioavailable metals concentrations in the grab samples were below the respective Marine Scotland guideline action levels (AL1 and AL2) and are therefore not considered to be of ecological concern. In the core samples, the

Marine Scotland guideline action levels (AL1) were exceeded for arsenic in one sample, cadmium in six samples, chromium in twenty-nine samples, copper in three samples and nickel in twenty-six samples.

The sum of the 7 PCB congeners in the grab and core samples were below the respective Marine Scotland guideline AL1 and AL2 values across the survey area.

All tributyltin (TBT) concentrations in the grab and core samples were below the Marine Scotland guideline AL1 and AL2 values and were therefore not considered to be of ecological concern.

Document Arrangement

Volume No.	Volume Title	Fugro Document No.
Volume 1	Geophysical Final Report	230308-ECC-01
Volume 2	Benthic Survey Interpretive Report	230308-ECC-02
Volume 3	Geophysical Benthic Interpretive Report	230308-ECC-03
Volume 4	**Contaminants Report**	**230308-ECC-04**
Volume 5	Seismic Data Processing Report	230308-ECC-05
Volume 6	Geophysical Field Operations Report	230308-ECC-06
Volume 7	Geotechnical Factual Data Report	230308-ECC-07
Volume 8	eDNA Data Report	230308-ECC-08

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Abbreviations

AL1/AL2	Action Level 1 or 2
BSL	Below sea level
CEMP	Coordinated Environmental Monitoring Programme
CM	Central meridian
CNS	Central North Sea
CS	Contaminant sample
DBT	Dibutyltin
DCM	Dichloromethane
DDV	Drop-down video
DG	Day grab
DTI	Department of Trade and Industry
DVV	Dual van Veen grab
ECC	Export Cable Corridor
eDNA	Environmental deoxyribonucleic acid
EOL	End of line
ETRS89	European Terrestrial Reference System 1989
FA	Faunal sample A
FWTG	Floating Wind Turbine Generator
GC	Gas chromatography
GC-FID	Gas chromatography-mass spectrometry
HC	Hydrocarbon
HG	Hamon grab
HM	Heavy metal
ICP-MS	Inductively coupled plasma–mass spectrometry
ICP-OES	Inductively coupled plasma – optical emission spectrometry
JNCC	Joint Nature Conservation Committee
MBT	Monobutyltin
MRV	Minimum reporting value
MS-LOT	Marine Scotland - Licensing Operations Team
MV	Motor vessel
NF	No fix
NS	No sample
OSPAR	Oslo and Paris Commission
OWF	Offshore Wind Farm
PAH	Polycyclic aromatic hydrocarbon
PC	Physico-chemical sample
PCB	Polychlorinated biphenyls
PMF	Priority Marine Features
PSD	Particle size distribution
RSD	Relative standard deviation
SD	Standard deviation
SOL	Start of line
SSS	Side scan sonar
TBT	Tributyltin
USBL	Ultra short baseline
US EPA	United States Environmental Protection Agency
US EPA 16	United States Environmental Protection Agency's 16 priority PAH pollutants

UTM	Universal Transverse Mercator
UV	Ultraviolet
VC	Vibrocore
VHF	Very high frequency
WBA	Wee Bankie Formation
WGF	Witch Ground Formation
WS	Water sample

1. Introduction

1.1 General Project Description

On the instruction of MarramWind Limited, Fugro performed a site survey including geophysical, geotechnical and environmental data acquisition along the MarramWind Floating Offshore Wind Farm Export Cable Corridor (ECC). The MarramWind Offshore Wind Farm (OWF) is in the Scottish Sectoral Marine Plan northeast 7 (NE7), off the northeast coast of Scotland in the central North Sea (CNS). The survey program was divided into nearshore and offshore areas. The MV Fugro Galaxy was assigned the offshore work and the MV Fugro Valkyrie for the nearshore work. Operations onboard the MV Fugro Galaxy were conducted during the survey period 12 May to 11 July 2023, whilst operations onboard the MV Valkyrie were conducted on the 18 May and 8 June 2023.

The proposed common ECC stretches approximately 85 km due north-east of Peterhead and terminates at the NE7 Offshore Wind Farm site. The nearshore sections split from the common ECC route and extend approximately 30 km to landfall.

The Floating Offshore Wind Farm ECC site survey was carried out to identify and map geological conditions and foundation feasibility for the ECC and for a Floating Wind Turbine Generator (FWTG). The environmental survey was conducted to establish whether any sensitive habitats and species occurred in the survey area, specifically those listed as Annex I habitats or Annex II species of the EU Habitats Directive (1992), habitats and species included in the Oslo and Paris Commission (OSPAR) list of threatened and/or declining habitats and species (OSPAR, 2008) and habitats and species that qualify as priority marine features (PMF) in Scotland's seas (Joint Nature Conservation Committee [JNCC], 2014a).

The environmental survey comprised a benthic sampling programme to collect drop-down video (DDV) footage and grab samples for the analysis of benthic fauna, particle size distribution (PSD), and sediment chemistry. In addition, eDNA water samples were collected to detect the presence of mobile species (e.g. marine fish and mammals) within the survey area at the time of the survey.

The results of sediment particle size and macrofaunal analysis with summaries of the habitats, biotope complexes and biotopes described within the survey area can be found in Volume 2 (Report No. 230308-ECC-02).

Full details of the analysis of photographic data analysis, including habitat classification and potentially sensitive habitats assessments, and further analysis of the macrofaunal grab data, including details of the methods applied to identify infaunal biotope complexes and biotopes, is presented in Volume 3, the Geophysical Benthic Interpretative Report (Report No. 230308-ECC-03).

The analysis of the environmental deoxyribonucleic acid (eDNA) water samples was carried out by Naturemetrics Ltd. and is presented in Volume 8 (Report No. 230308-ECC-08).

This report details the results of the contaminants analysis.

Appendix A outlines the guidelines for use of this report.

1.2 Contaminants Survey Scope of Work

The contaminants survey was conducted to establish whether any contaminant hotspots were present along the ECC survey area. Grab samples were taken as part of the geophysical and environmental campaign and vibrocore samples were taken as part of the geotechnical campaign. Subsamples for contaminant testing were taken from grab and vibrocore (VC) samples to establish the chemical properties of the sediment. The subsamples for laboratory analysis (contaminants only) from the grab stations were selected post-survey completion.

1.3 Environmental Quality Standards for Sediment Chemical Concentrations

The Marine Scotland Action Levels (ALs) are used to assess the contaminants concentrations at each station. These are non-statutory guidelines for assessment of disposal of dredged materials to sea. In general, concentrations below Marine Scotland AL1 values are of no concern, whilst concentrations above Marine Scotland AL2 values indicate that dredged material is unsuitable for disposal at sea. Values between Marine Scotland AL1 and AL2 may require further investigatory work prior to a disposal decision (Marine Scotland, 2017).

1.4 Coordinate Reference System

All geographic coordinates in this report are based on European Terrestrial Reference System 1989 (ETRS89) and Universal Transverse Mercator Zone 30N, Central Meridian 3° West. Table 1.1 provides the detailed geodetic and projection parameters.

Table 1.1: Project geodetic and projection parameters

Global Positioning System Geodetic Parameters *								
Datum:	International Terrestrial Reference Frame 2014 (epoch 2022.5)							
Ellipsoid:	GRS 1980							
Semi-major axis:	A=6 378 137.000 m							
Inverse flattening:	1/f = 298.257222101							
Local Datum Geodetic Parameters †								
Datum:	European Terrestrial Reference System 1989							
Ellipsoid:	GRS 1980							
Semi-major axis:	A = 6 378 137.000 m							
Inverse flattening:	1/f = 298.257222101							
Datum Transformation Parameters from ITRF2014 to ETRS89 – Coordinate Frame Rotation Convention ‡								
Shift dX:	+0.05595	m	Rotation rX:	-0.0027134″	arc sec	Scale Factor:	0.00349485	ppm
Shift dY:	+0.05345	m	Rotation rY:	-0.0164143″	arc sec			
Shift dZ:	-0.09785	m	Rotation rZ:	+0.0265309″	arc sec			
Project Projection Parameters								
Map Projection:	Universal Transverse Mercator (UTM)							
Grid System:	UTM Zone 30 N							
Central Meridian:	03° 00′ 00″ West							
Latitude of Origin:	00° 00′ 00″ North							
False Easting:	500 000 m							
False Northing:	0 m							
Scale factor on Central Meridian:	0.9996							
Units:	Metre							

Notes
* = Fugro Starfix navigation software uses WGS84 geodetic parameters as a primary datum for any geodetic calculations
† = Source: MarramWind Ltd
‡ = This is the right-hand coordinate frame rotation used by the Fugro Starfix navigation software

2. Survey Strategy

For logistical reasons the survey area was divided into nearshore and offshore areas.

For the nearshore area, after geophysical data had been acquired, the side scan sonar (SSS) and bathymetric data were reviewed by the onboard environmental scientist. Two environmental sampling stations were proposed by the onboard environmental scientist, with agreement from the client representative.

For the offshore area, 69 environmental sampling stations were predetermined by the client and selected to provide spatial coverage of the proposed MarramWind ECC. Eleven additional environmental sampling stations were also proposed by the onboard environmental scientist, with agreement from the client representative. Station ST58 was abandoned due to infrastructure exclusion zones prohibiting sampling, leaving a total of 79 proposed stations. If a station was moved from the pre-defined position, due to obstructions or to investigate features highlighted by the SSS, the new location was renamed with the addition of the suffix '_a'. Station ST58 was abandoned due to infrastructure exclusion zones prohibiting sampling. A full suite of samples was acquired from 74 of the 79 remaining proposed stations. Sediment samples were not obtained at five stations (ST19_a, ST43_a, ST45_a, ST49_a and ST49_b) and only faunal and particle size distribution (PSD) samples were collected at station ST46_a.

As per the scope of work, 25 vibrocore samples were collected for sediment chemistry analysis. This allowed for the maximum required volume of any potential future dredging activities required during the construction phase along the proposed ECC, in line with Marine Scotland - Licensing Operations Team (MS-LOT) guidance. The sampling stations were proposed after the geophysical survey results and aimed to target areas of large sand waves, from the seafloor to the maximum depth of interest, 6 m.

Table 2.1 and Table 2.2 provide the coordinates, data to be acquired and rationale for each sampling station and transect. Acceptable sampling accuracy was agreed with the client representative as within 10 m of the target location. Figure 2.1 provides a spatial display of the proposed survey locations overlaid on the SSS mosaic.

Table 2.1: Proposed grab sampling stations

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting	Northing	Rationale	Data and Sample Acquisition
Nearshore				
ST70*	571 785.8	6 381 466.8	Positioned within an area of low SSS reflectivity within the nearshore area. Moved 58 m SW to avoid trawling scar and 50 m away from the nearest interpreted magnetometer target	Video, stills, PC, FA, eDNA
ST73	572 694	6 377 568	Positioned within an area of low SSS reflectivity within the nearshore area	Video, stills, PC, FA, eDNA
Offshore				
ST01	593 164.4	6 378 078.7	Client pre-defined	Video, stills, PC, FA, water eDNA
ST02_a	594 013.3	6 380 129.0	Client pre-defined. Moved 160 m NE, away from 500 m pipeline exclusion zone. Moved to cover representative seafloor area of increased seafloor reflectivity and seafloor texture indicative of potential sensitive habitats	Video, stills, PC, FA, water eDNA
ST03_a	594 618.6	6 381 453.6	Client pre-defined. Moved 350 m S, away from 500 m pipeline exclusion zone. Seafloor is representative of surrounding seafloor habitat	Video, stills, PC, FA, water eDNA
ST04	595 597.4	6 383 431.9	Client pre-defined	Video, stills, PC, FA, water eDNA
ST05	597 375.3	6 384 348.5	Client pre-defined	Video, stills, PC, FA, water eDNA
ST06	599 153.0	6 385 264.7	Client pre-defined	Video, stills, PC, FA, water eDNA
ST07	600 930.8	6 386 181.7	Client pre-defined	Video, stills, PC, FA, water eDNA
ST08_a	601 947.7	6 387 381.9	Client pre-defined. Moved 170 m S away from 500 m zone pipeline exclusion zone	Video, stills, PC, FA, water eDNA
ST09_a	601 935.6	6 388 954.6	Client pre-defined. Moved 600 m S from 500 m zone pipeline exclusion zone. Moved to investigate potential change in seafloor reflectivity and elevation	Video, stills, PC, FA, water eDNA
ST10	602 212.6	6 391 495.3	Client pre-defined	Video, stills, PC, FA, water eDNA
ST11	603 084.6	6 393 296.2	Client pre-defined	Video, stills, PC, FA, water eDNA
ST12	603 956.8	6 395 096.1	Client pre-defined	Video, stills, PC, FA, water eDNA

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting	Northing	Rationale	Data and Sample Acquisition
ST13_a	604 872.9	6 396 883.0	Client pre-defined. Moved 289 m east to cover seafloor area of changed seafloor texture/reflectivity indicative of change in seafloor features	Video, stills, PC, FA, water eDNA
ST14_a	603 516.7	6 399 861.2	Client pre-defined. Moved 1 km away from 500 m pipeline exclusion zone. Moved to cover representative seafloor area of increased reflectivity and seafloor texture indicative of potential sensitive habitats	Video, stills, PC, FA, water eDNA
ST15	603 257.9	6 400 683.9	Client pre-defined	Video, stills, PC, FA, water eDNA
ST16	602 594.8	6 402 570.4	Client pre-defined	Video, stills, PC, FA, water eDNA
ST17_a	601 443.1	6 404 708.9	Client pre-defined. Moved 550 m NW away from 500 m pipeline exclusion zone. Moved to cover representative seafloor area of increased reflectivity and seafloor texture indicative of potential sensitive habitats	Video, stills, PC, FA, water eDNA
ST18	601 269.6	6 406 344.6	Client pre-defined	Video, stills, PC, FA, water eDNA
ST19_a	601 271.2	6 407 225.5	Client pre-defined. Moved 1072 m SW to cover representative seafloor area of increased reflectivity and seafloor texture indicative of potential sensitive habitats	Video, stills, PC, FA, water eDNA
ST20	602 921.0	6 409 816.2	Client pre-defined.	Video, stills, PC, FA, water eDNA
ST21	603 950.1	6 411 531.3	Client pre-defined	Video, stills, PC, FA, water eDNA
ST22	604 979.2	6 413 246.6	Client pre-defined	Video, stills, PC, FA, water eDNA
ST23_a	605 856.7	6 415 075.7	Client pre-defined. Moved 189 m NW to investigate potential pockmark feature. Pockmarks can indicate the presence of potential sensitive habitats	Video, stills, PC, FA, water eDNA
ST24	607 037.4	6 416 677.0	Client pre-defined	Video, stills, PC, FA, water eDNA
ST25	608 066.5	6 418 392.1	Client pre-defined	Video, stills, PC, FA, water eDNA
ST26_a	608 846.1	6 420 133.3	Client pre-defined. Moved 250 m W to investigate slightly increased variability in seafloor reflectivity representative of other patches in the area, indicating potential change in seafloor	Video, stills, PC, FA, water eDNA

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting	Northing	Rationale	Data and Sample Acquisition
ST27	610 124.8	6 421 822.2	Client pre-defined	Video, stills, PC, FA, water eDNA
ST28	611 153.9	6 423 537.1	Client pre-defined	Video, stills, PC, FA, water eDNA
ST29	612 182.9	6 425 252.3	Client pre-defined	Video, stills, PC, FA, water eDNA
ST30	613 212.0	6 426 967.8	Client pre-defined	Video, stills, PC, FA, water eDNA
ST31	614 241.1	6 428 683.6	Client pre-defined	Video, stills, PC, FA, water eDNA
ST32_a	616 733.0	6 430 050.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST33_a	617 572.0	6 430 876.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST34_a	619 289.0	6 431 866.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST35_a	620 896.0	6 432 985.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST36_a	622 560.3	6 434 104.5	Client pre-defined. Moved 130 m SE to investigate potential pockmark feature. Pockmarks can indicate the presence of potential sensitive habitats	Video, stills, PC, FA, water eDNA
ST37_a	624 597.0	6 436 380.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data and to cover area of slight seafloor elevation	Video, stills, PC, FA, water eDNA
ST38_a	625 415.0	6 436 947.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST39_a	627 022.0	6 438 164.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST40_a	628 516.0	6 439 493.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST41_a	630 007.0	6 440 824.0	Client pre-defined. Moved to avoid exclusion zone and to area confirmed clear by magnetometer data	Video, stills, PC, FA, water eDNA
ST42_a	631 478.0	6 442 159.0	Client pre-defined. Moved 1530 m E to area of representative seafloor approx. 2 km between stations	Video, stills, PC, FA, water eDNA

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting	Northing	Rationale	Data and Sample Acquisition
ST43_a	572 785.3	6 381 850.9	Client pre-defined. Moved 240 m E due to operational constraints. Seafloor is representative of the surrounding potential habitat	Video, stills, PC, FA, water eDNA
ST44_a	574 912.3	6 381 540.8	Client pre-defined. Moved 473 m SE away from 500 m pipeline exclusion zone. Moved to cover area at bottom edge of potential sediment slump zone, indicated by SSS reflectivity change and bathy elevation change	Video, stills, PC, FA, water eDNA
ST45_a	576 359.0	6 381 234.0	Client pre-defined. Moved 457 m S away from 550 m pipeline exclusion zone. Moved to area of representative seafloor comprising are of mottled reflectivity on SSS and slight roughness on bathy	Video, stills, PC, FA, water eDNA
ST46_a	579 289.0	6 380 580.0	Client pre-defined. Moved 1111 km away from 500 m pipeline exclusion zones. Moved to area of varied SSS mottling and moderate bathy roughness representative of similar patches in the area	Video, stills, PC, FA, water eDNA
ST47_a	580 237.4	6 380 379.8	Client pre-defined. Moved 137 m S to avoid fishing debris. Moved to area representative of surrounding seafloor SSS and bathy texture and reflectivity	Video, stills, PC, FA, water eDNA
ST48_a	573 540.0	6 376 511.0	Client pre-defined. Moved 615 m SE away from cable exclusion zones	Video, stills, PC, FA, water eDNA
ST49_a	575 130.0	6 377 334.0	Client pre-defined. Moved 535 m N away from cable exclusion zones. Moved to area of sandy area to capture representative seafloor	Video, stills, PC, FA, water eDNA
ST50_a	577 013.0	6 377 985.0	Client pre-defined. Moved 600 m N away from cable exclusion zones	Video, stills, PC, FA, water eDNA
ST51	578 885.8	6 378 235.0	Client pre-defined	Video, stills, PC, FA, water eDNA
ST52	580 699.8	6 379 078.0	Client pre-defined	Video, stills, PC, FA, water eDNA
ST53	582 523.6	6 379 737.4	Client pre-defined	Video, stills, PC, FA, water eDNA
ST54_a	583 327.6	6 379 394.5	Client pre-defined. Moved 1 132 m W away from cable exclusion zones. Moved to area of rippled sand texture and increased seafloor reflectivity to capture change in seafloor type, representative of surrounding potential seafloor areas	Video, stills, PC, FA, water eDNA
ST55	586 310.4	6 378 447.5	Client pre-defined	Video, stills, PC, FA, water eDNA

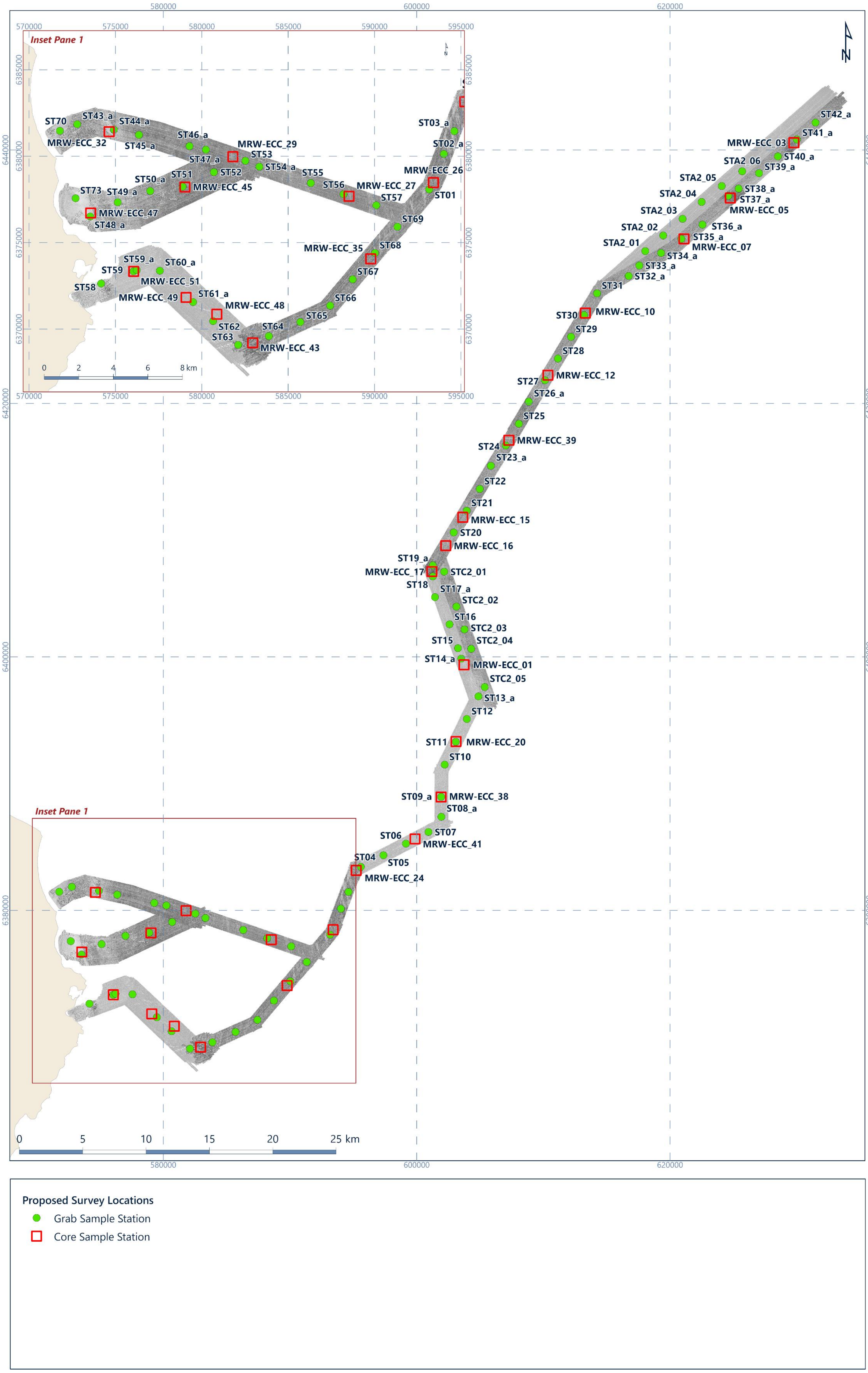
Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting	Northing	Rationale	Data and Sample Acquisition
ST56	588 203.8	6 377 803.3	Client pre-defined	Video, stills, PC, FA, water eDNA
ST57	590 097.2	6 377 158.8	Client pre-defined	Video, stills, PC, FA, water eDNA
ST58	574 170.9	6 372 633.6	Client pre-defined. Cannot be Sampled, inside exclusion zones	Video, stills, PC, FA, water eDNA
ST59	576 042.9	6 373 337.3	Client pre-defined	Video, stills, PC, FA, water eDNA
ST59_a	576 231.2	6 373 408.2	Relocated ST59 200 m ENE away from abundant debris viewed at ST59	Video, stills, PC, FA, water eDNA
ST60_a	577 570.0	6 373 373.0	Client pre-defined. Moved 291 m to NW to be 50 m outside of current infrastructure exclusion zone	Video, stills, PC, FA, water eDNA
ST61_a	579 490.0	6 371 559.0	Client pre-defined. Moved 400 m SE away from area of magnetometer returns	Video, stills, PC, FA, water eDNA
ST62	580 651.9	6 370 459.6	Client pre-defined	Video, stills, PC, FA, water eDNA
ST63	582 104.3	6 369 084.4	Client pre-defined	Video, stills, PC, FA, water eDNA
ST64	583 878.8	6 369 589.3	Client pre-defined	Video, stills, PC, FA, water eDNA
ST65	585 706.0	6 370 403.5	Client pre-defined	Video, stills, PC, FA, water eDNA
ST66	587 431.6	6 371 352.2	Client pre-defined	Video, stills, PC, FA, water eDNA
ST67	588 729.1	6 372 874.7	Client pre-defined	Video, stills, PC, FA, water eDNA
ST68	590 026.5	6 374 397.6	Client pre-defined	Video, stills, PC, FA, water eDNA
ST69	591 324.0	6 375 918.8	Client pre-defined	Video, stills, PC, FA, water eDNA
STA2_01	618 041.5	6 432 018.0	Client pre-defined	Video, stills, PC, FA, water eDNA
STA2_02	619 462.5	6 433 246.0	Client pre-defined	Video, stills, PC, FA, water eDNA
STA2_03	620 987.5	6 434 563.0	Client pre-defined	Video, stills, PC, FA, water eDNA
STA2_04	622 492.5	6 435 896.0	Client pre-defined	Video, stills, PC, FA, water eDNA
STA2_05	624 077.5	6 437 151.0	Client pre-defined	Video, stills, PC, FA, water eDNA
STA2_06	625 693.5	6 438 315.0	Client pre-defined	Video, stills, PC, FA, water eDNA

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	**Easting**	**Northing**	**Rationale**	**Data and Sample Acquisition**
STC2_01	602 171.0	6 406 718.0	Client pre-defined and located to avoid damaging areas of *Sabellaria spinulosa* tube aggregations	Video, stills, PC, FA, water eDNA
STC2_02	603 139.0	6 403 967.0	Client pre-defined and located to avoid damaging areas of *Sabellaria spinulosa* tube aggregations	Video, stills, PC, FA, water eDNA
STC2_03	603 770.0	6 402 165.0	Client pre-defined and located to avoid damaging areas of *Sabellaria spinulosa* tube aggregations	Video, stills, PC, FA, water eDNA
STC2_04	604 307.0	6 400 635.0	Client pre-defined and located to avoid damaging areas of *Sabellaria spinulosa* tube aggregations	Video, stills, PC, FA, water eDNA
STC2_05	605 367.0	6 397 621.0	Client pre-defined and located to avoid damaging areas of *Sabellaria spinulosa* tube aggregations	Video, stills, PC, FA, water eDNA

Notes
The suffix '_a' indicates stations moved from the predefined locations following discussion with the client representative.
* = Station moved from the location proposed by the onboard environmental scientist
FA = Faunal sample A
eDNA = Environmental deoxyribonucleic acid
PC = Physico-chemical sample
SSS = Side scan sonar

Table 2.2: Proposed vibrocore sampling stations

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting	Northing	Depth [m BSL]	Depth of Core recovery [m]
Offshore				
MRW-ECC_01	603 735.4	6 399 376.6	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_03	629 774.4	6 440 571.3	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_05	624 756.2	6 436 205.3	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_07	621 099.2	6 432 982.2	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_10	613 310.7	6 427 129.1	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_12	610 361.5	6 422 225.9	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_15	603 641.1	6 411 015.5	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_16	602 297.1	6 408 775.0	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_17	601 199.1	6 406 731.6	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_20	603 105.6	6 393 321.0	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_24	595 225.1	6 383 153.2	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_26	593 408.6	6 378 471.8	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_27	588 524.5	6 377 681.1	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_29	581 799.5	6 379 973.2	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_32	574 638.9	6 381 418.6	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_35	589 775.4	6 374 062.3	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_38	601 928.5	6 388 942.1	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_39	607 279.3	6 417 089.5	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_41	599 872.4	6 385 630.5	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_43	582 946.8	6 369 204.9	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_45	579 024.3	6 378 217.9	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_47	573 568.4	6 376 713.1	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_48	580 869.4	6 370 856.4	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_49	579 092.4	6 371 829.8	Client pre-defined	Contaminant vibrocore sub-sampling
MRW-ECC_51	576 056.1	6 373 337.4	Client pre-defined	Contaminant vibrocore sub-sampling



Coordinate System: ETRS 1989 UTM Zone 30N; **Caveats:** Esri, 2023

Figure 2.1: Proposed environmental survey locations

3. Methods

3.1 Survey Methods

3.1.1 Sediment Grab Sampling

Seafloor samples at the nearshore stations were acquired using a 0.1 m^2 Day grab. A 0.1 m^2 dual van Veen (DVV) grab was used at the offshore stations and a 0.1 m^2 mini-Hamon grab was used in areas of coarse sediments.

Operational procedures for grab sampling were as follows:

- The detailed suitable grab was prepared for operations prior to arrival on station. A USBL beacon was attached to the grab frame. The Bridge communicated to the deck via a very high frequency (VHF) radio when the vessel was steady and on location, and the grab was deployed from the starboard A-frame;
- When the engineer operating the winch observed that the grab had reached the seafloor (evidenced through a distinct slackening of the wire rope and snatch block), the online surveyor was informed (via VHF radio) and a fix was taken;
- On recovery to the deck, the sample was inspected and judged acceptable or otherwise (see below for rejection criteria);
- One accepted grab sample was retained for faunal analysis and one grab sample was retained and subsampled for physico-chemical analysis;
- Deck logs were completed for each sample acquired (including no samples) with: date, time, sample number, fix number, sediment type, depth and colour of strata in the sediment (if any) using Munsell colour codes, odour (i.e. H_2S), bioturbation or debris.

Samples were considered unacceptable in the following instances:

- Evidence of sediment washout caused through improperly closed grab jaws or inspection hatch;
- Sediment sample collected on an angle; the grab jaws were not parallel to the seafloor when the grab fired;
- Disruption of the sample through striking the side of the vessel;
- Sample represented less than approximately 7 cm bite depth of the grab (unless deemed acceptable by the client representative);
- The presence of a hagfish (*Myxine glutinosa*) and/or other mucous coagulants;
- Sample from more than 10 m from the target location (unless deemed acceptable by the client representative);
- Deemed unacceptable by the client representative for any other reason.

3.1.2 Physico-chemical Grab Sample Processing

- Redox, temperature and pH readings were taken using a Hanna Redox probe;

- Hydrocarbon (HC) samples were collected using a metal scoop to a nominal depth of 2 cm. Samples collected were HCA1 and HCA2. The samples were preserved in glass jars at approximately −20 °C;
- Heavy metal (HM) samples were collected using a plastic scoop to a nominal depth of 2 cm. Samples collected were HMA1 and HMA2. The samples were preserved in polythene bags at approximately −20 °C;
- PSD samples were collected using a plastic scoop to a nominal depth of 5 cm. Samples collected were PSDA1 and PSDA2. The samples were preserved in polythene bags at approximately −20 °C.

3.1.3 Vibrocore Sediment Sampling

- The vibrocorer was prepared for operations prior to arrival on station. A USBL beacon was attached to the frame. The Bridge communicated to the deck via a VHF radio when the vessel was steady and on location, and the corer was deployed from the stern A-frame;
- When the engineer operating the winch observed that the grab had reached the seafloor (evidenced through a distinct slackening of the wire and snatch block), the online surveyor was informed (via VHF radio) and a fix was taken;
- At this point the vibrocore mechanism was activated to drive the core tube into the sediment;
- On recovery to the deck, the core liner was removed from the corer tube. Penetration, determined by a marker on the barrel, was recorded and the length of sample recovered in the tube was also recorded;
- The core liner was then marked and cut into lengths dictated by the scope of work; 0.5 m lengths with the top 0.1 m section being retained for contamination analysis and the remaining 0.4 m being retained by the geotechnical engineers for field analysis and storage for further laboratory analysis;
- Deck logs were completed for each sample acquired. The information collected was date, time, depth within the core as a whole, sample depth and sediment type

3.1.4 Physico-chemical Vibrocore Sample Processing

- The vibrocore samples were preserved in a 0.1 m plastic core at approximately −20 °C.

3.2 Laboratory Methods

Brief analytical methodologies are described in the following subsections. Further descriptions of the analytical methodologies are detailed in Appendix B.

3.2.1 Sediment Hydrocarbons

The sediment samples were analysed for hydrocarbon content including polycyclic aromatic hydrocarbons (PAHs), specifically the United States Environmental Protection Agency's 16 priority PAH pollutants (US EPA 16 PAHs) and alkylated PAHs.

3.2.2 Sediment Metals

The sediment samples were analysed using an aqua regia digest technique. This provides a strong partial digest, releasing into solution metals associated with the fines fraction within the sediments (but does not extract all trace elements associated with the coarse fraction). The concentrations of metals released by an aqua regia digest are typically considered indicative of those influencing biological interactions, as the released metals are not incorporated into the mineral matrix and are therefore potentially available for biological uptake.

3.2.3 Sediment Polychlorinated Biphenyls

Sediment samples were analysed using accelerated solvent extraction.

Further details are presented in Appendix B.2.2.

3.2.4 Sediment Organotins

Sediment samples were analysed using solvent extraction and derivatisation.

Further details are presented in Appendix B.2.3.

3.3 Data analysis

Relative standard deviation (RSD) values have been provided to indicate the extent of variability in the dataset. For the purpose of this report, an RSD of less than 30 % will be considered low variability, 30 % to 70 % will be considered moderate variability, and more than 70 % will be considered high variability.

4. Results

4.1 Field Operations

4.1.1 Seafloor Sampling

In the nearshore survey area grab samples were successfully acquired at all proposed stations, with a complete suite of samples (one physico chemical and one macrofauna sample) retained at each station.

In the offshore survey area, grab samples were successfully acquired, with a complete suite of samples acquired at 75 of the 79 proposed stations. Sediment samples were not obtained at five stations (ST19_a, ST43_a, ST45_a, ST49_a and ST49_b):

- ST19_a: *Sabellaria* (Habitats Directive Annex I: Reefs) observed along the camera transect. The transect was extended by 50 m, with patchy *Sabellaria* observed. Review of SSS showed seafloor was likely have similar patchy areas within the 50 m clearance area, so grab sampling was not attempted;
- ST43_a: No attempt was made. When the seafloor was reviewed from the video footage it was shown to be too rocky to grab safely and would be highly unlikely to provide samples;
- ST45_a: 2 DVV attempts and 2 Hamon attempts with no successful samples, so seafloor deemed too hard for either grab, so the station was abandoned;
- ST49_a: Station moved due to rocky seafloor -> ST49_b;
- ST49_b: 2 DVV attempts and 2 Hamon attempts with no successful samples.

The mini-Hamon grab was used at station ST46_a, with only faunal and PSD samples collected.

The subsamples for laboratory analysis (contaminants only) from the grab stations were selected post-survey completion. The suite of subsamples was set using the 'Pre-Disposal Sampling Guidance' provided by Marine Scotland (Marine Scotland, 2017), based on the results of the geophysical survey data, ensuring samples selected for analysis reflected an even distribution of soft sediment habitats across the ECC route. Samples from 25 stations were chosen.

Vibrocores were successfully acquired at all 25 proposed stations as part of the offshore survey. Coring at stations MRW-ECC_01, MRW-ECC_05, MRW-ECC_10A, MRW-ECC_12 and MRW-ECC_39 had to be repeated as the 80 % sample recovery criterion was not met on the initial attempt. Stations retested had the suffix 'a' added to the original station name. Operations at station MRW-ECC_15A failed due to an equipment malfunction. This station was repeated at the same location and a sample was obtained. Sub-bottom profiler data, the

Innomar data suggested that station MRW-ECC_45 was located on the site of an esker formation and therefore an alternative position (MRW-ECC_45Alt) was agreed in advance to provide additional data from this location. Contaminants samples were retained at all stations for the cores (Table 4.2).

Subsamples were taken from the top 0.10 m of the core and then every 0.5 m to a maximum depth of 6 m. A full suite of core samples was sent to the laboratory for contaminant analysis.

Figure 4.1 provides a spatial display of the actual survey locations overlain on the SSS mosaic.

Table 4.1: Completed grab sampling stations

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting*	Northing*	Depth [m BSL]	Sample Acquisition
Nearshore				
ST70	571 782.7	6 381 465.1	17	PC, FA
ST73	572 688.4	6 377 572.5	13	PC, FA
Offshore				
ST01	593 160.9	6 378 083.9	84	PC, FA
ST02_a	594 012.2	6 380 121.5	84	PC, FA
ST03_a	594 613.0	6 381 451.4	88	PC, FA
ST04	595 599.0	6 383 440.6	89	PC, FA
ST05	597 376.0	6 384 341.1	89	PC, FA
ST06	599 155.4	6 385 258.3	95	PC, FA
ST07	600 929.1	6 386 179.6	95	PC, FA
ST08_a	601 946.0	6 387 378.5	94	PC, FA
ST09_a	601 936.7	6 388 962.7	98	PC, FA
ST10	602 212.6	6 391 502.6	101	PC, FA
ST11	603 084.1	6 393 291.0	100	PC, FA
ST12	603 957.3	6 395 095.4	98	PC, FA
ST13_a	604 860.5	6 396 877.9	67	PC, FA
ST14_a	603 526.7	6 399 836.7	76	PC, FA
ST15	603 256.2	6 400 677.6	75	PC, FA
ST16	602 591.5	6 402 566.7	78	PC, FA
ST17_a	601 448.0	6 404 704.3	70	PC, FA
ST18	601 268.3	6 406 342.3	73	PC, FA
ST20	602 919.5	6 409 817.7	109	PC, FA
ST21	603 950.6	6 411 532.3	108	PC, FA
ST22	604 985.5	6 413 247.6	109	PC, FA
ST23_a	605 857.7	6 415 078.4	107	PC, FA
ST24	607 038.4	6 416 669.4	104	PC, FA
ST25	608 066.2	6 418 391.8	104	PC, FA
ST26_a	608 852.8	6 420 132.3	105	PC, FA
ST27	610 125.1	6 421 828.0	108	PC, FA
ST28	611 154.7	6 423 535.1	110	PC, FA
ST29	612 181.0	6 425 250.3	113	PC, FA
ST30	613 208.5	6 426 936.7	113	PC, FA
ST31	614 239.8	6 428 678.3	112	PC, FA
ST32_a	616 731.3	6 430 049.9	116	PC, FA

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting*	Northing*	Depth [m BSL]	Sample Acquisition
ST33_a	617 571.3	6 430 874.0	116	PC, FA
ST34_a	619 285.8	6 431 864.7	116	PC, FA
ST35_a	620 890.6	6 432 985.2	116	PC, FA
ST36_a	622 540.2	6 434 095.9	116	PC, FA
ST37_a	624 595.9	6 436 382.4	109	PC, FA
ST38_a	625 416.1	6 436 947.7	113	PC, FA
ST39_a	627 022.2	6 438 163.5	115	PC, FA
ST40_a	628 515.9	6 439 491.5	110	PC, FA
ST41_a	630 002.7	6 440 825.2	111	PC, FA
ST42_a	631 478.5	6 442 152.5	112	PC, FA
ST44_a	574 912.3	6 381 540.8	43	PC, FA
ST46_a	579 289.0	6 380 580.0	55	PC, FA
ST47_a	580 237.4	6 380 379.8	67	PC, FA
ST48_a	573 539.3	6 376 511.9	23	PC, FA
ST50_a	577 011.6	6 377 979.4	52	PC, FA
ST51	578 889.4	6 378 236.1	59	PC, FA
ST52	580 699.2	6 379 072.8	69	PC, FA
ST53	582 524.6	6 379 729.1	79	PC, FA
ST54_a	583 324.7	6 379 394.5	82	PC, FA
ST55	586 309.5	6 378 444.8	89	PC, FA
ST56	588 205.8	6 377 802.1	84	PC, FA
ST57	590 094.2	6 377 159.1	80	PC, FA
ST59_a	576 227.4	6 373 406.0	58	PC, FA
ST60_a	577 573.4	6 373 383.2	57	PC, FA
ST61_a	579 490.0	6 371 569.9	61	PC, FA
ST62	580 654.8	6 370 462.6	65	PC, FA
ST63	582 103.5	6 369 083.6	64	PC, FA
ST64	583 875.2	6 369 583.8	67	PC, FA
ST65	585 710.0	6 370 402.3	72	PC, FA
ST66	587 429.4	6 371 352.5	75	PC, FA
ST67	588 729.1	6 372 885.1	77	PC, FA
ST68	590 030.9	6 374 399.2	77	PC, FA
ST69	591 321.3	6 375 921.9	78	PC, FA
STA2_01	618 042.6	6 432 020.6	115	PC, FA
STA2_02	619 464.2	6 433 253.6	115	PC, FA

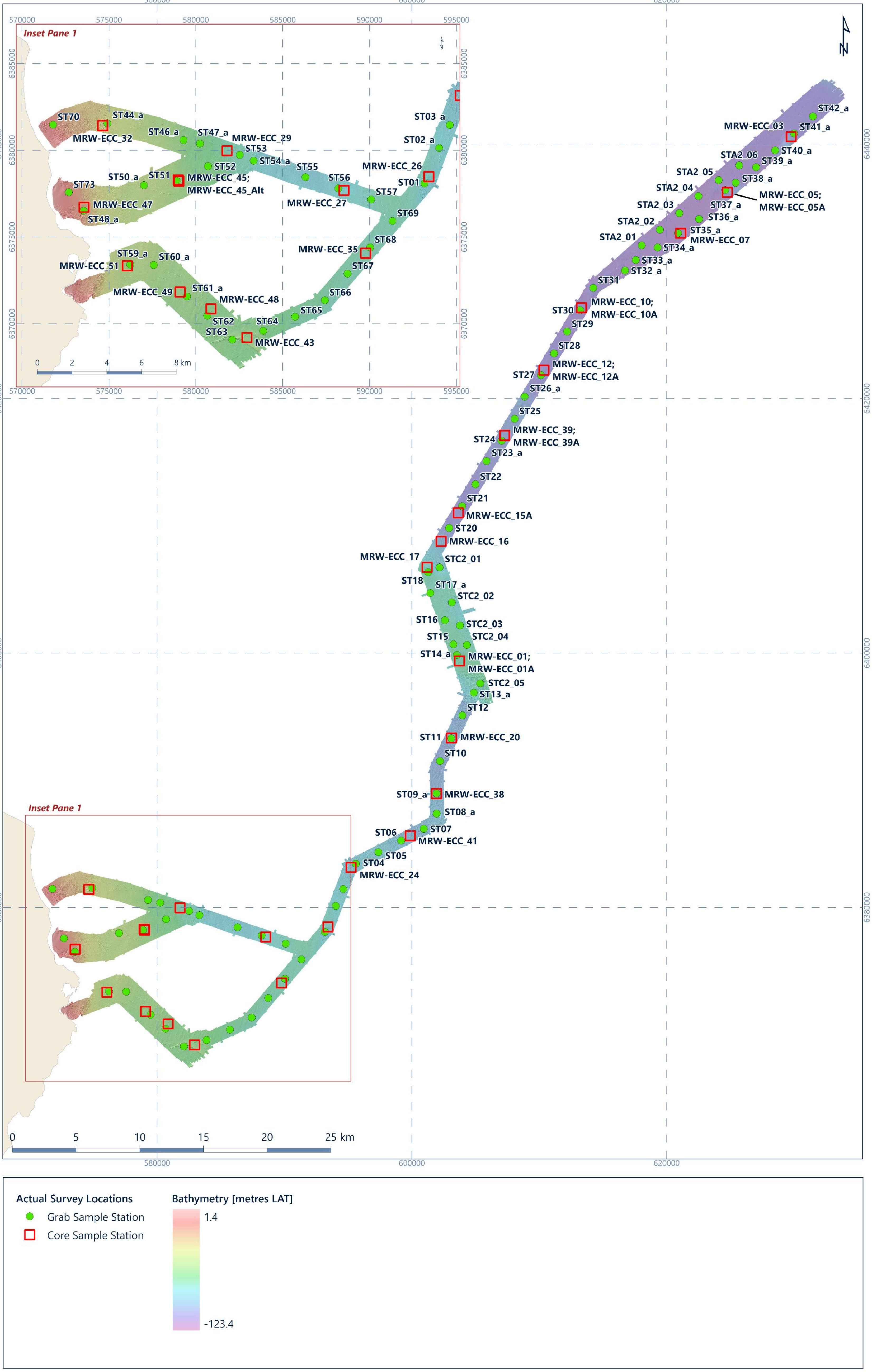
Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]				
Station	Easting*	Northing*	Depth [m BSL]	Sample Acquisition
STA2_03	620 989.5	6 434 556.1	115	PC, FA
STA2_04	622 494.0	6 435 895.7	116	PC, FA
STA2_05	624 077.5	6 437 144.7	115	PC, FA
STA2_06	625 692.9	6 438 310.4	114	PC, FA
STC2_01	602 173.2	6 406 726.3	87	PC, FA
STC2_02	603 143.0	6 403 967.4	80	PC, FA
STC2_03	603 773.1	6 402 163.6	79	PC, FA
STC2_04	604 308.9	6 400 635.2	77	PC, FA
STC2_05	605 363.4	6 397 617.5	77	PC, FA

Notes
* = Coordinates presented for the PC grab sample
BSL = Below sea level
PC = Physico-chemical sample
FA = Faunal sample A

Table 4.2: Completed vibrocore sediment sampling stations

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]					
Station	Easting	Northing	Depth [m BSL]	Depth of Core recovery [m]	Sample Acquisition
Offshore					
MRW-ECC_01	603 735.2	6 399 376.4	79	0.41	CS
MRW-ECC_01A	603 730.9	6 399 378.6	79	0.55	CS
MRW-ECC_03	629 774.9	6 440 570.1	110	2.70	CS
MRW-ECC_05	624 757.4	6 436 204.6	107	2.40	CS
MRW-ECC_05A	624 757.7	6 436 197.7	111	2.46	CS
MRW-ECC_07	621 099.7	6 432 982.4	120	5.40	CS
MRW-ECC_10	613 310.7	6 427 127.5	113	0.00	CS
MRW-ECC_10A	613 309.8	6 427 133.8	113	2.55	CS
MRW-ECC_12	610 363.5	6 422 222.3	109	0.72	CS
MRW-ECC_12A	610 360.2	6 422 226.6	109	2.57	CS
MRW-ECC_15A	603 641.9	6 411 019.0	110	4.60	CS
MRW-ECC_16	602 297.3	6 408 776.5	98	3.00	CS
MRW-ECC_17	601 198.9	6 406 732.2	83	1.75	CS
MRW-ECC_20	603 105.6	6 393 323.5	104	4.30	CS
MRW-ECC_24	595 227.4	6 383 152.8	91	3.00	CS
MRW-ECC_26	593 413.3	6 378 474.8	84	5.65	CS
MRW-ECC_27	588 524.8	6 377 681.5	84	2.60	CS

Geodetic Parameters: ETRS89, UTM Zone 30N, CM 3°W [m]					
Station	Easting	Northing	Depth [m BSL]	Depth of Core recovery [m]	Sample Acquisition
MRW-ECC_29	581 798.8	6 379 970.4	80	0.40	CS
MRW-ECC_32	574 638.9	6 381 420.4	40	2.25	CS
MRW-ECC_35	589 775.9	6 374 065.6	83	1.40	CS
MRW-ECC_38	601 928.8	6 388 946.7	99	4.15	CS
MRW-ECC_39	607 279.4	6 417 089.1	106	1.62	CS
MRW-ECC_39A	607 279.5	6 417 096.9	106	0.95	CS
MRW-ECC_41	599 871.6	6 385 634.2	98	2.80	CS
MRW-ECC_43	582 942.6	6 369 204.9	67	3.30	CS
MRW-ECC_45	579 023.7	6 378 219.3	62	1.15	CS
MRW-ECC_45_Alt	578 990.9	6 378 290.6	63	1.40	CS
MRW-ECC_47	573 566.9	6 376 712.9	30	1.60	CS
MRW-ECC_48	580 870.6	6 370 857.9	68	2.01	CS
MRW-ECC_49	579 092.9	6 371 831.8	66	2.40	CS
MRW-ECC_51	576 056.1	6 373 339.5	58	3.44	CS
Notes BSL = Below sea level CS = Contamination sample					



Coordinate System: ETRS 1989 UTM Zone 30N; **Caveats:** Esri, 2023

Figure 4.1: Actual environmental survey locations

4.2 Sediment Chemistry

4.2.1 Sediment Aromatic Hydrocarbon Content

Total 2 to 6 ring PAH concentrations are calculated as the sum of individual PAHs, some of which were less than the minimum reporting value (MRV). Consequently, the total 2 to 6 ring PAH concentration is assigned as a less than value. However, the concentrations of the individual PAHs that were less than the MRV are unlikely to significantly influence the total 2 to 6 ring PAH concentrations. Therefore, for the purposes of this report, total 2 to 6 ring PAH and US EPA 16 PAH concentrations are treated as absolute values to provide comparison between stations.

4.2.1.1 Grab samples

Table 4.3 summarises the total concentrations of aromatic hydrocarbons, including the US EPA 16 PAHs. Figure 4.2 shows the spatial distribution of total 2 to 6 PAHs across the survey area. Appendix D.1.1 presents the individual aromatic hydrocarbon and their alkyl homologue concentrations across the survey area, including the US EPA 16 PAH concentrations with threshold values where available.

Total 2 to 6 ring PAH concentrations ranged from < 7.0 ng/g (station STC2_04) to 144 ng/g (station ST36_a). All individual and total PAH concentrations were below their respective AL1 levels.

Total US EPA 16 PAH concentrations ranged from < 2.7 ng/g (station STC2_04) to 55.4 ng/g (station ST36_a).

Table 4.3: Summary of sediment aromatic hydrocarbon analysis for the grab samples

Stations	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
Nearshore																		
ST73	0.3	< 0.1	0.2	0.2	1.1	0.3	1.6	1.7	0.7	0.7	1.4	0.5	0.7	0.6	0.3	0.1	< 10.5	21.8
Offshore																		
ST01	0.2	< 0.1	< 0.1	0.1	0.4	< 0.1	0.4	0.3	0.2	0.3	1.1	0.3	0.2	0.8	0.5	0.1	< 5.2	< 16.4
ST04	0.2	< 0.1	< 0.1	0.1	0.6	0.1	1.2	1.0	0.5	0.5	2.4	0.7	0.7	2.2	1.8	0.3	< 12.5	< 32.5
ST07	0.2	< 0.1	< 0.1	0.1	0.4	< 0.1	0.7	0.6	0.3	0.3	2.2	0.6	0.4	2.1	1.8	0.3	< 10.3	< 25.8
ST10	0.7	< 0.1	< 0.1	0.1	0.9	0.1	0.9	0.7	0.4	0.4	2.7	0.8	0.6	2.7	2.3	0.4	< 13.9	42.5
ST12	0.4	< 0.1	< 0.1	0.1	0.8	0.1	1.0	0.8	0.4	0.5	3.3	0.9	0.8	3.3	2.7	0.4	< 15.7	44.1
ST13_a	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.2	0.3	0.1	0.1	0.8	0.2	0.2	0.7	0.5	0.1	< 3.8	< 10.1
ST17_a	0.3	< 0.1	0.1	0.2	1.8	0.4	3.3	3.4	1.3	1.3	2.5	0.8	1.4	1.9	2.0	0.3	< 21.1	44.7
ST20	0.4	< 0.1	0.1	0.2	1.2	0.1	1.7	1.9	0.8	0.8	3.7	1.1	1.1	3.7	3.5	0.5	< 20.9	< 51.1
ST23_a	0.5	< 0.1	< 0.1	0.2	1.1	0.1	1.2	1.4	0.5	0.4	3.4	1.0	0.8	3.6	3.5	0.5	< 18.4	< 51.0
ST26_a	1.2	< 0.1	0.1	0.3	2.9	0.2	2.1	1.8	0.7	0.7	4.6	1.3	1.1	4.9	4.4	0.6	< 27.0	76.8
ST28	0.7	< 0.1	0.1	0.3	1.8	0.2	1.7	1.3	0.9	0.8	5.5	1.6	1.3	5.5	4.7	0.8	< 27.3	71.1
ST31	0.5	< 0.1	0.1	0.3	1.4	0.1	1.5	1.0	0.7	0.7	5.3	1.6	1.2	5.5	4.6	0.7	< 25.3	70.8
ST36_a	1.1	0.1	0.1	0.5	3.1	0.4	3.8	2.6	1.9	1.8	11.1	3.4	2.8	11.7	9.5	1.5	55.4	144
ST39_a	0.8	0.1	0.1	0.4	2.5	0.2	2.4	1.8	1.2	1.1	7.9	2.3	1.8	8.1	6.7	1.0	38.4	109
ST42_a	0.6	< 0.1	< 0.1	0.3	1.6	0.2	1.6	1.1	0.8	0.7	7.0	2.0	1.3	6.4	4.4	0.7	< 28.9	79.6
ST44_a	0.4	< 0.1	< 0.1	0.1	0.9	0.2	0.5	0.5	0.2	0.2	0.6	0.2	0.2	0.2	0.1	< 0.1	< 4.6	< 17.4
ST50	6.3	< 0.1	0.1	0.3	5.1	0.3	1.3	1.1	0.6	0.8	1.6	0.4	0.4	0.7	0.6	0.1	< 19.8	93.1
ST53	0.4	< 0.1	0.1	0.2	1.1	0.2	1.4	1.2	0.7	0.8	2.7	0.8	0.8	2.0	1.4	0.3	< 14.2	40.0
ST56	0.3	< 0.1	0.1	0.2	1.1	0.2	1.5	1.2	0.7	0.7	2.4	0.7	0.6	1.2	0.8	0.2	< 12.0	33.1

Stations	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
ST64	0.4	< 0.1	0.5	0.7	4.8	0.5	4.2	3.1	0.9	1.1	1.4	0.5	0.5	0.4	0.2	0.1	< 19.4	30.3
ST67	0.4	< 0.1	< 0.1	0.2	0.9	0.1	1.1	0.9	0.5	0.7	2.6	0.7	0.6	1.6	1.0	0.2	< 11.7	34.7
STA2_01	0.6	< 0.1	< 0.1	0.3	1.5	0.2	1.7	1.3	0.8	0.7	5.5	1.7	1.1	5.0	3.9	0.6	< 25.1	68.5
STA2_05	1.2	< 0.1	0.1	0.3	1.8	0.2	1.8	1.3	0.9	0.8	5.7	1.8	1.2	5.1	3.7	0.6	< 26.6	72.1
STC2_04	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.2	0.1	0.1	0.6	0.2	0.1	0.3	0.2	< 0.1	< 2.7	< 7.0
Marine Scotland (2017)																		
AL1	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**10**	**–**	**–**

Notes
Concentrations expressed in ng/g dry sediment
US EPA 16 PAH = United States Environmental Protection Agency's 16 priority PAH pollutants

Key	Below AL1 value	Above AL1 value

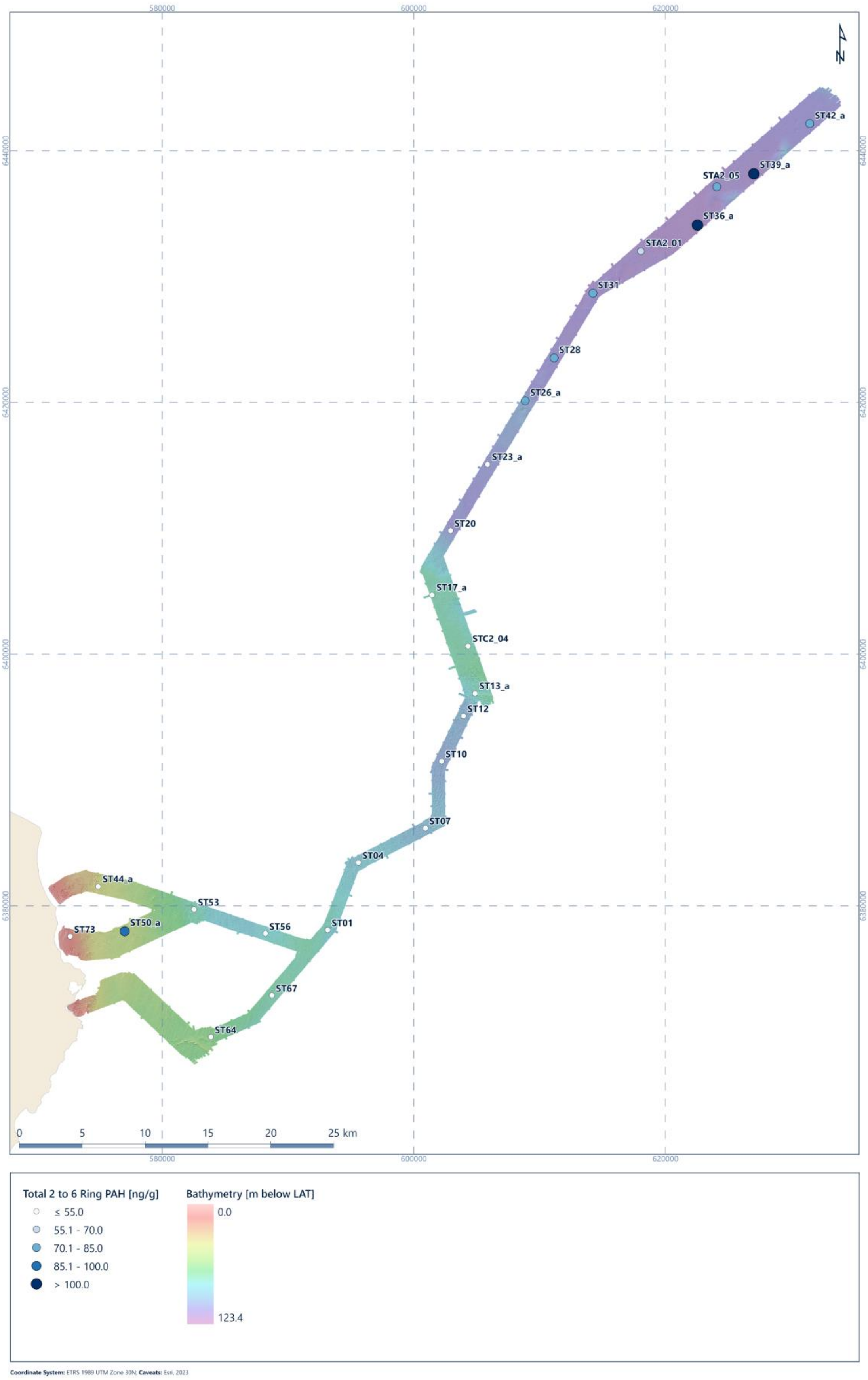


Figure 4.2: Spatial distribution of Total 2 to 6 PAH

4.2.1.2 Core samples

Table 4.4 summarises the total concentrations of aromatic hydrocarbons, including the US EPA 16 PAHs. Appendix D.1.2 presents the individual aromatic hydrocarbon and their alkyl homologue concentrations across the survey area, including the US EPA 16 PAH concentrations with threshold values where available.

In the core samples, the majority of PAH concentrations were below the Marine Scotland guideline action level (AL1) and therefore not considered to be detrimental to the marine environment with the exception of sample MRW_ECC_47-3 (50-60 cm), where AL1 values were exceeded for phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, benzo[ghi]perylene and dibenzo[ah]anthracene.

Total US EPA 16 PAH concentrations ranged from < 1.6 ng/g (samples MRW_ECC_45-5, MRW_ECC_45_ALT-3, MRW_ECC_45_ALT-5, MRW_ECC_48-3, MRW_ECC_48-5) to 4780 ng/g (sample MRW_ECC_47 50-60cm).

Total 2 to 6 ring PAH concentrations ranged from < 4.9 ng/g (sample MRW_ECC_48-3) to 9520 ng/g (sample MRW_ECC_47-3).

Table 4.4: Summary of sediment aromatic hydrocarbon analysis for the core samples

Stations	Core Depth	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
Offshore																			
MRW_ECC_VC_01-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	0.8	< 0.1	0.5	0.9	0.2	0.3	1.1	0.3	0.3	0.8	1.2	0.1	< 7.2	27.3
MRW_ECC_VC_01A-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	0.6	< 0.1	0.5	0.8	0.2	0.3	1.3	0.4	0.3	1.2	1.3	0.2	< 7.8	23.8
MRW_ECC_VC_03-1	0-10 cm	0.8	0.1	0.1	0.4	2.2	0.2	3.3	2.5	1.4	1.2	13.7	4.1	2.8	13.4	10.8	1.6	58.6	134
MRW_ECC_VC_03-3	50-60 cm	0.4	< 0.1	0.1	0.3	1.9	0.1	0.7	1.0	0.4	0.5	1.3	0.2	0.5	0.7	1.7	0.2	< 10.1	66.7
MRW_ECC_VC_03-5	100-110 cm	0.5	< 0.1	0.1	0.4	2.1	0.1	1.1	1.6	0.6	0.7	2.2	0.4	0.9	0.9	1.6	0.2	< 13.5	94.7
MRW_ECC_VC_03-7	150-160 cm	0.5	< 0.1	0.1	0.5	2.6	0.2	1.6	2.8	0.7	0.9	2.8	0.5	1.1	1.2	2.7	0.3	< 18.6	126
MRW_ECC_VC_03-9	200-210 cm	0.9	< 0.1	0.2	0.8	4.4	0.3	3.0	4.2	1.1	1.6	4.5	0.8	1.8	2.2	5.0	0.6	< 31.5	223
MRW_ECC_VC_03-11	250-260 cm	0.3	< 0.1	0.1	0.4	2.0	0.1	1.2	1.8	0.4	0.6	2.0	0.3	0.7	0.7	1.7	0.2	< 12.6	84.9
MRW_ECC_VC_05-1	0-10 cm	0.6	0.1	0.1	0.3	1.8	0.2	2.3	1.8	1.0	0.9	8.1	2.5	1.8	8.8	7.3	1.1	38.7	92.3
MRW_ECC_VC_05-3	50-60 cm	0.4	< 0.1	< 0.1	0.2	1.4	0.1	0.6	0.7	0.2	0.4	1.0	0.2	0.3	0.6	1.0	0.1	< 7.4	37.7
MRW_ECC_VC_05-5	100-110 cm	0.5	< 0.1	0.1	0.4	2.4	0.1	1.0	1.5	0.5	0.7	1.5	0.2	0.6	0.6	1.9	0.2	< 12.3	66.7
MRW_ECC_VC_05-7	150-160 cm	0.7	< 0.1	0.1	0.5	2.6	0.1	1.0	1.7	0.6	0.8	2.4	0.4	1.1	1.2	3.1	0.3	< 16.7	110
MRW_ECC_VC_05-9	200-210 cm	0.2	< 0.1	< 0.1	0.1	0.5	< 0.1	0.4	0.7	0.1	0.2	0.5	0.1	0.2	0.3	0.9	0.1	< 4.6	< 25.9
MRW_ECC_VC_05A-1	0-10 cm	1.0	0.1	0.1	0.4	2.0	0.2	3.0	2.5	1.3	1.2	11.5	3.4	2.4	11.5	9.4	1.3	51.3	118
MRW_ECC_VC_05A-3	50-60 cm	0.5	< 0.1	< 0.1	0.2	1.2	< 0.1	0.6	1.2	0.2	0.3	0.7	0.1	0.3	0.4	1.3	0.1	< 7.4	35.3
MRW_ECC_VC_05A-5	100-110 cm	0.4	< 0.1	0.1	0.1	0.8	< 0.1	0.6	1.1	0.2	0.3	0.6	0.1	0.3	0.4	1.1	0.1	< 6.4	41.6
MRW_ECC_VC_05A-7	150-160 cm	0.7	< 0.1	0.1	0.2	1.6	0.1	0.9	1.6	0.5	0.5	1.1	0.3	0.7	0.8	2.1	0.1	< 11.4	85.6
MRW_ECC_VC_05A-9	200-210 cm	0.2	< 0.1	0.2	0.1	0.3	0.1	1.1	2.0	0.2	0.3	1.1	0.2	0.6	1.3	2.1	0.2	< 10.1	140
MRW_ECC_VC_05A-11	250-260 cm	0.1	< 0.1	< 0.1	< 0.1	0.2	< 0.1	0.3	0.8	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	0.5	< 0.1	< 3.0	< 12.3
MRW_ECC_VC_07-1	0-10 cm	1.2	0.1	0.1	0.5	2.7	0.2	3.3	2.9	1.5	1.3	11.5	3.3	2.4	10.5	8.1	1.1	50.7	129
MRW_ECC_VC_07-3	50-60 cm	0.9	< 0.1	0.1	0.4	2.9	0.1	1.1	1.7	0.4	0.7	1.9	0.4	0.6	1.2	2.3	0.2	< 15.0	72.8
MRW_ECC_VC_07-5	100-110 cm	1.2	< 0.1	0.2	0.8	4.4	0.2	1.6	2.8	1.0	1.2	2.8	0.4	1.3	1.2	3.7	0.3	< 23.2	141
MRW_ECC_VC_07-7	150-160 cm	1.3	< 0.1	0.2	1.1	4.7	0.2	1.8	3.1	0.9	1.5	3.4	0.5	1.2	1.2	3.8	0.4	< 25.4	153
MRW_ECC_VC_07-9	200-210 cm	0.7	< 0.1	0.1	0.5	2.8	0.1	1.1	2.0	0.8	1.0	2.6	0.4	1.1	1.3	3.0	0.3	< 17.9	110
MRW_ECC_VC_07-11	250-260 cm	0.8	< 0.1	0.2	0.8	3.8	0.2	1.9	3.6	1.0	1.3	3.9	0.6	1.5	1.8	4.6	0.5	< 26.6	184
MRW_ECC_VC_07-13	300-310 cm	1.0	< 0.1	0.2	0.8	4.3	0.2	2.1	4.1	1.3	1.2	4.6	0.7	1.6	1.7	2.5	0.4	< 26.8	178
MRW_ECC_VC_07-15	350-360 cm	0.7	< 0.1	0.2	0.5	2.7	0.1	1.2	2.0	0.7	0.8	3.3	0.3	0.7	0.5	0.8	0.1	< 14.7	110
MRW_ECC_VC_07-17	400-410 cm	0.7	< 0.1	0.2	0.5	2.4	0.1	1.1	1.9	0.6	0.6	3.0	0.3	0.6	0.5	0.8	0.1	< 13.5	101
MRW_ECC_VC_07-19	450-460 cm	1.2	< 0.1	0.5	0.8	4.6	0.2	2.4	4.2	1.2	1.4	5.3	0.7	1.4	1.5	2.4	0.3	< 28.2	206
MRW_ECC_VC_07-21	500-510 cm	1.1	< 0.1	0.4	0.8	4.3	0.2	2.2	3.7	1.1	1.2	5.4	0.6	1.4	1.4	1.8	0.3	< 26.0	195
MRW_ECC_VC_10A-1	0-10 cm	0.7	0.1	0.1	0.3	2.0	0.2	2.9	1.8	1.5	1.3	11.2	3.3	2.3	9.0	7.2	1.0	44.9	112
MRW_ECC_VC_10A-3	50-60 cm	0.5	< 0.1	< 0.1	0.2	1.8	0.1	0.5	0.5	0.2	0.4	1.0	0.2	0.3	0.4	0.7	0.1	< 7.1	52.5
MRW_ECC_VC_10A-5	100-110 cm	0.4	< 0.1	0.1	0.3	1.4	0.1	0.6	0.8	0.4	0.5	1.7	0.3	0.6	0.9	1.8	0.2	< 10.2	80.5
MRW_ECC_VC_10A-7	150-160 cm	1.0	< 0.1	0.2	0.6	3.2	0.2	1.8	3.0	0.9	1.0	3.4	0.5	1.1	1.1	1.9	0.3	< 20.3	144

Stations	Core Depth	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
MRW_ECC_VC_10A-9	200-210 cm	0.4	< 0.1	0.1	0.3	1.4	0.1	1.0	1.7	0.4	0.6	2.1	0.4	0.8	1.4	2.4	0.2	< 13.4	145
MRW_ECC_VC_12-1	0-10 cm	1.5	< 0.1	0.1	0.3	2.1	0.1	1.9	1.7	0.8	0.7	7.6	2.3	1.6	6.3	5.6	0.8	< 33.5	94.4
MRW_ECC_VC_12-3	50-60 cm	0.3	< 0.1	< 0.1	0.2	0.9	< 0.1	0.3	0.4	0.2	0.3	1.0	0.2	0.2	0.3	0.6	0.1	< 5.3	30.5
MRW_ECC_VC_12A-1	0-10 cm	0.6	0.1	0.1	0.3	1.8	0.2	2.4	1.7	1.0	0.9	9.7	2.8	1.9	8.0	6.8	1.0	39.3	95.3
MRW_ECC_VC_12A-3	50-60 cm	0.4	< 0.1	< 0.1	0.2	1.6	0.1	0.3	0.6	0.2	0.4	1.1	0.2	0.3	0.5	1.0	0.1	< 7.2	42.2
MRW_ECC_VC_12A-5	100-110 cm	0.2	< 0.1	0.1	0.1	0.6	< 0.1	0.7	1.0	0.2	0.3	1.0	0.2	0.5	1.0	1.5	0.1	< 7.7	76.7
MRW_ECC_VC_12A-7	150-160 cm	0.4	< 0.1	0.1	0.4	1.8	0.1	1.0	1.8	0.7	0.7	2.2	0.4	0.8	1.3	2.8	0.4	< 15.0	110
MRW_ECC_VC_12A-9	200-210 cm	0.3	< 0.1	0.1	0.2	1.0	0.1	0.7	1.1	0.4	0.5	1.7	0.4	0.8	1.7	2.6	0.2	< 11.9	125
MRW_ECC_VC_15A-1	0-10 cm	1.3	< 0.1	0.1	0.3	2.8	0.1	1.7	2.0	0.8	0.8	6.5	1.5	1.0	2.8	2.2	0.3	< 24.3	89.5
MRW_ECC_VC_15A-3	50-60 cm	1.7	< 0.1	0.2	0.6	7.3	0.3	2.0	2.5	1.4	1.9	3.5	0.6	1.7	1.2	2.8	0.3	< 28.1	206
MRW_ECC_VC_15A-5	100-110 cm	2.0	< 0.1	0.2	0.6	7.6	0.3	2.2	2.5	1.5	2.0	3.5	0.6	1.9	1.4	3.6	0.4	< 30.4	203
MRW_ECC_VC_15A-7	150-160 cm	1.1	< 0.1	0.2	0.6	4.2	0.2	1.5	2.0	0.9	1.3	4.0	0.6	1.0	0.7	1.3	0.2	< 19.9	144
MRW_ECC_VC_15A-9	200-210 cm	0.7	< 0.1	0.2	0.6	3.2	0.2	2.4	3.1	1.0	1.2	4.8	0.7	1.2	1.5	2.2	0.3	< 23.4	207
MRW_ECC_VC_15A-11	250-260 cm	0.5	< 0.1	0.2	0.4	2.0	0.2	1.3	2.0	0.7	1.0	2.9	0.6	1.3	2.0	3.5	0.3	< 19.0	187
MRW_ECC_VC_15A-13	300-310 cm	0.7	< 0.1	0.2	0.6	3.2	0.2	2.2	2.9	0.9	1.1	4.6	0.7	1.2	1.3	2.0	0.2	< 22.1	205
MRW_ECC_VC_15A-15	350-360 cm	0.3	< 0.1	0.1	0.2	0.8	0.1	0.5	0.7	0.3	0.5	1.4	0.3	0.7	1.2	2.2	0.2	< 9.6	87.4
MRW_ECC_VC_15A-17	400-410 cm	0.3	< 0.1	0.1	0.2	0.8	0.1	0.4	0.6	0.3	0.4	1.3	0.3	0.7	1.1	2.0	0.2	< 8.9	76.4
MRW_ECC_VC_16-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	1.1	0.1	1.0	1.0	0.5	0.4	2.6	0.7	0.7	2.2	2.0	0.3	< 13.2	43.4
MRW_ECC_VC_16-3	50-60 cm	0.3	< 0.1	< 0.1	0.2	1.8	0.1	0.5	0.6	0.5	0.5	1.2	0.2	0.5	0.4	0.8	0.1	< 7.9	59.2
MRW_ECC_VC_16-5	100-110 cm	1.3	< 0.1	0.1	0.4	4.7	0.3	1.6	2.0	1.3	1.2	2.8	0.5	1.2	0.6	1.1	0.2	< 19.4	145
MRW_ECC_VC_16-7	150-160 cm	0.9	< 0.1	0.1	0.6	3.4	0.2	1.6	2.3	1.1	1.4	3.8	0.6	1.3	2.0	3.8	0.5	< 23.7	177
MRW_ECC_VC_16-9	200-210 cm	0.9	< 0.1	0.2	0.6	3.5	0.2	2.2	2.9	1.2	1.3	3.7	0.6	1.6	2.0	4.3	0.5	< 25.8	206
MRW_ECC_VC_16-11	250-260 cm	0.5	< 0.1	0.2	0.4	2.0	0.2	2.3	2.9	0.7	0.9	2.8	0.5	1.3	2.1	3.9	0.4	< 21.2	227
MRW_ECC_VC_17-1	0-10 cm	0.2	< 0.1	< 0.1	< 0.1	0.5	< 0.1	0.5	0.4	0.3	0.4	1.1	0.3	0.3	0.6	0.5	0.1	< 5.6	< 16.9
MRW_ECC_VC_17-3	50-60 cm	0.2	< 0.1	< 0.1	0.1	0.3	< 0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	< 0.1	< 2.2	< 13.3
MRW_ECC_VC_17-5	100-110 cm	0.2	< 0.1	< 0.1	0.1	0.5	< 0.1	0.1	0.2	0.1	0.1	0.5	0.1	0.1	0.1	0.1	< 0.1	< 2.6	15.8
MRW_ECC_VC_17-7	150-160 cm	0.5	< 0.1	0.2	0.3	2.2	0.1	1.3	2.1	0.8	0.8	2.4	0.4	1.2	1.4	2.6	0.3	< 16.7	150
MRW_ECC_VC_20-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	0.7	0.1	1.1	0.8	0.5	0.4	3.8	1.1	0.8	3.4	2.8	0.4	< 16.5	44.8
MRW_ECC_VC_20-3	50-60 cm	0.4	< 0.1	0.1	0.3	1.4	0.1	0.7	1.6	0.6	0.8	2.0	0.3	0.9	1.5	2.8	0.3	< 13.9	138
MRW_ECC_VC_20-5	100-110 cm	0.5	< 0.1	0.2	0.3	1.3	0.1	1.1	2.0	0.6	0.6	1.9	0.4	0.9	1.4	2.6	0.3	< 14.3	154
MRW_ECC_VC_20-7	150-160 cm	1.0	< 0.1	0.4	0.9	3.8	0.3	4.2	6.0	1.6	1.7	5.4	1.0	2.1	3.1	6.0	0.6	< 38.2	364
MRW_ECC_VC_20-9	200-210 cm	0.9	< 0.1	0.4	0.7	3.0	0.3	3.7	4.8	1.2	1.4	4.1	0.8	2.0	3.1	6.2	0.7	< 33.4	359
MRW_ECC_VC_20-11	250-260 cm	1.2	< 0.1	0.5	1.1	4.5	0.4	4.7	7.1	1.7	1.8	5.2	1.0	2.4	3.4	7.2	0.7	< 43.0	387
MRW_ECC_VC_20-13	300-310 cm	0.7	< 0.1	0.4	0.7	2.8	0.3	4.1	5.4	1.2	1.4	4.1	0.8	2.1	3.0	5.3	0.6	< 33.0	429
MRW_ECC_VC_20-15	350-360 cm	0.7	< 0.1	0.3	0.5	2.3	0.2	1.7	3.7	0.9	1.1	3.2	0.7	1.8	2.5	5.3	0.5	< 25.5	315
MRW_ECC_VC_20-17	400-410 cm	0.8	< 0.1	0.3	0.6	2.3	0.2	2.6	4.4	0.9	1.2	3.2	0.6	1.8	2.4	5.1	0.5	< 27.0	334

Stations	Core Depth	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
MRW_ECC_VC_24-1	0-10 cm	0.4	< 0.1	0.1	0.2	0.9	0.1	1.3	1.6	0.6	0.5	3.2	0.9	0.9	3.0	2.9	0.4	< 17.1	68.6
MRW_ECC_VC_24-3	50-60 cm	1.2	< 0.1	0.9	1.2	3.8	0.5	7.1	9.8	1.6	2.0	5.8	1.2	3.1	4.6	9.5	1.0	< 53.4	776
MRW_ECC_VC_24-5	100-110 cm	1.2	< 0.1	0.9	1.3	3.6	0.5	6.8	9.5	1.6	1.6	5.6	1.2	3.0	4.4	8.7	0.9	< 50.9	726
MRW_ECC_VC_24-7	150-160 cm	0.7	0.1	0.6	0.7	1.8	0.3	4.1	5.5	0.8	1.0	3.1	0.6	1.7	2.5	5.2	0.5	29.2	428
MRW_ECC_VC_24-9	200-210 cm	0.4	< 0.1	0.4	0.5	1.3	0.2	3.0	4.0	0.6	0.6	2.2	0.4	1.1	1.8	3.8	0.3	< 20.7	287
MRW_ECC_VC_24-11	250-260 cm	0.7	< 0.1	0.7	0.7	2.2	0.8	4.9	6.9	1.0	1.1	3.7	0.8	2.0	2.7	6.2	0.6	< 35.1	543
MRW_ECC_VC_26-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	0.6	0.1	1.0	0.8	0.5	0.4	2.5	0.7	0.5	1.3	1.1	0.2	< 10.3	33.6
MRW_ECC_VC_26-3	50-60 cm	0.1	< 0.1	< 0.1	< 0.1	0.3	0.1	0.1	0.1	< 0.1	0.1	0.2	< 0.1	< 0.1	0.1	0.1	< 0.1	< 1.9	< 8.5
MRW_ECC_VC_26-5	100-110 cm	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	0.1	0.1	0.2	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 1.7	< 7.2
MRW_ECC_VC_26-7	150-160 cm	0.2	< 0.1	< 0.1	0.1	0.5	< 0.1	0.1	0.2	0.1	0.1	0.5	0.1	< 0.1	0.1	0.1	< 0.1	< 2.6	18.0
MRW_ECC_VC_26-9	200-210 cm	0.2	< 0.1	< 0.1	0.1	0.4	< 0.1	0.1	0.1	0.1	0.1	0.5	< 0.1	< 0.1	0.1	0.1	< 0.1	< 2.4	< 20.3
MRW_ECC_VC_26-11	250-260 cm	0.1	< 0.1	< 0.1	0.1	0.3	< 0.1	0.1	0.1	0.1	0.1	0.4	< 0.1	0.1	0.1	0.1	< 0.1	< 2.1	< 14.9
MRW_ECC_VC_26-13	300-310 cm	0.3	< 0.1	< 0.1	0.2	1.1	0.1	0.4	0.5	0.3	0.4	1.0	0.2	0.3	0.3	0.4	0.1	< 5.8	38.2
MRW_ECC_VC_26-15	350-360 cm	0.2	< 0.1	< 0.1	0.1	0.4	< 0.1	0.1	0.2	0.1	0.1	0.5	0.1	0.1	0.1	0.1	< 0.1	< 2.5	< 18.3
MRW_ECC_VC_26-17	400-410 cm	0.2	< 0.1	< 0.1	0.1	0.3	< 0.1	0.1	0.2	0.1	0.1	0.4	0.1	0.1	0.1	0.2	< 0.1	< 2.4	< 25.2
MRW_ECC_VC_26-19	450-460 cm	0.8	< 0.1	0.8	0.9	2.2	0.4	7.0	9.5	1.2	1.2	4.5	0.9	2.6	3.3	7.7	0.6	< 43.7	722
MRW_ECC_VC_26-21	500-510 cm	0.4	< 0.1	0.5	0.6	1.5	0.3	5.9	8.2	0.9	1.0	3.3	0.7	1.9	2.5	5.4	0.5	< 33.7	540
MRW_ECC_VC_26-23	550-560 cm	0.7	< 0.1	0.6	0.9	3.0	0.3	6.1	8.2	1.2	1.3	4.3	0.9	2.3	3.1	7.0	0.7	< 40.7	558
MRW_ECC_VC_27-1	0-10 cm	0.3	0.1	< 0.1	0.1	0.7	0.1	1.3	1.4	0.8	0.9	3.0	0.9	1.0	2.5	2.3	0.4	< 15.9	< 53.6
MRW_ECC_VC_27-3	50-60 cm	0.6	< 0.1	0.8	0.8	2.1	0.4	5.5	8.0	1.1	1.0	4.0	0.8	2.2	2.9	6.2	0.6	< 37.1	627
MRW_ECC_VC_27-5	100-110 cm	0.5	< 0.1	0.7	0.7	1.8	0.3	5.0	6.9	1.0	0.9	3.7	0.8	2.1	2.9	6.3	0.6	< 34.3	601
MRW_ECC_VC_27-7	150-160 cm	0.5	< 0.1	0.7	0.7	2.0	0.4	5.7	8.1	1.1	1.1	4.1	0.8	2.4	3.3	7.2	0.6	< 38.8	680
MRW_ECC_VC_27-9	200-210 cm	0.5	< 0.1	0.6	0.6	1.7	0.7	5.1	6.8	0.9	1.1	3.7	0.7	2.0	2.7	5.9	0.6	< 33.7	590
MRW_ECC_VC_27-11	250-260 cm	0.5	< 0.1	0.7	0.7	1.9	0.4	5.4	7.4	1.0	1.0	3.8	0.8	2.2	3.0	6.5	0.7	< 36.1	614
MRW_ECC_VC_29-1	0-10 cm	2.6	0.2	1.1	1.4	9.2	2.4	9.5	9.0	4.3	4.1	7.2	2.4	4.1	4.4	3.9	0.7	66.5	151
MRW_ECC_VC_32-1	0-10 cm	0.2	< 0.1	1.3	0.8	4.0	0.5	6.1	4.5	2.2	1.7	3.6	1.1	1.3	1.0	0.6	0.2	< 29.2	47.8
MRW_ECC_VC_32-3	50-60 cm	0.3	0.1	0.1	0.2	1.9	0.4	2.3	1.8	0.8	0.7	1.5	0.4	0.5	0.4	0.2	0.1	11.7	< 25.2
MRW_ECC_VC_32-5	100-110 cm	1.0	< 0.1	0.1	0.2	1.5	0.3	1.3	1.8	0.8	0.7	1.9	0.5	0.5	0.4	0.1	0.1	< 11.3	46.8
MRW_ECC_VC_32-7	150-160 cm	3.0	0.5	1.0	1.5	15.1	4.5	28.4	28.1	14.5	12.2	25.3	8.3	15.9	12.9	7.7	0.3	179.0	387
MRW_ECC_VC_32-9	200-210 cm	0.2	< 0.1	0.1	0.1	0.6	0.2	1.0	0.9	0.5	0.5	2.3	0.6	0.4	0.4	0.1	0.1	< 8.1	< 23.8
MRW_ECC_VC_35-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	0.6	0.1	1.0	1.0	0.6	0.5	2.8	0.8	0.6	1.3	0.8	0.2	< 10.9	40.5
MRW_ECC_VC_35-3	50-60 cm	0.5	< 0.1	0.5	0.5	1.6	0.2	4.5	5.8	0.8	0.9	2.9	0.6	1.6	2.3	4.5	0.4	< 27.7	436
MRW_ECC_VC_35-5	100-110 cm	0.6	< 0.1	0.7	0.8	2.2	0.5	5.8	7.7	1.1	1.2	4.0	0.9	2.2	3.2	6.0	0.6	< 37.6	607
MRW_ECC_VC_38-1	0-10 cm	0.4	< 0.1	0.1	0.2	1.6	0.4	1.6	1.6	0.8	0.8	4.3	1.2	1.1	3.2	2.8	0.4	< 20.6	69.1
MRW_ECC_VC_38-3	50-60 cm	0.9	< 0.1	0.1	0.4	4.2	0.2	1.3	1.7	1.1	1.2	2.2	0.5	1.3	1.0	2.4	0.3	< 18.9	136
MRW_ECC_VC_38-5	100-110 cm	1.1	< 0.1	0.2	0.7	4.6	0.2	1.4	1.9	1.2	1.5	3.4	0.6	1.5	1.6	3.8	0.5	< 24.3	173

Stations	Core Depth	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
MRW_ECC_VC_38-7	150-160 cm	1.0	< 0.1	0.1	0.9	4.1	0.2	1.6	2.3	1.1	1.4	3.6	0.7	1.3	1.6	3.3	0.5	< 23.8	167
MRW_ECC_VC_38-9	200-210 cm	0.8	< 0.1	0.1	0.4	2.7	0.5	1.0	1.8	1.1	1.2	2.5	0.5	1.3	1.5	3.1	0.4	< 19.0	140
MRW_ECC_VC_38-11	250-260 cm	0.6	< 0.1	0.2	0.5	2.4	0.2	2.2	2.9	0.8	0.9	2.8	0.5	1.3	1.7	3.6	0.4	< 21.1	201
MRW_ECC_VC_38-13	300-310 cm	0.8	0.1	1.0	0.9	3.3	0.6	9.7	10.0	1.2	1.3	4.2	0.9	2.5	3.1	6.1	0.6	46.3	663
MRW_ECC_VC_38-15	350-360 cm	0.7	< 0.1	0.6	0.9	2.8	0.3	5.4	7.2	1.1	1.2	3.9	0.8	2.1	3.0	6.2	0.6	< 36.9	506
MRW_ECC_VC_39-1	0-10 cm	0.4	< 0.1	< 0.1	0.2	1.2	0.2	1.4	1.0	0.7	0.6	5.0	1.5	1.1	5.1	4.3	0.7	< 23.6	63.4
MRW_ECC_VC_39-3	50-60 cm	0.4	< 0.1	0.1	0.2	1.1	0.2	0.5	0.7	0.3	0.3	1.2	0.3	0.5	0.9	1.5	0.2	< 8.5	71.7
MRW_ECC_VC_39-5	100-110 cm	0.4	< 0.1	0.1	0.3	1.1	0.1	1.4	1.8	0.5	0.6	2.1	0.5	1.0	2.2	3.4	0.5	< 16.1	184
MRW_ECC_VC_39-7	150-160 cm	0.4	< 0.1	0.1	0.3	1.0	0.1	0.7	1.4	0.4	0.6	1.8	0.4	0.9	1.9	2.9	0.4	< 13.4	155
MRW_ECC_VC_39A-1	0-10 cm	0.4	< 0.1	0.1	0.3	1.2	0.1	1.6	1.0	0.7	0.6	5.5	1.7	1.1	4.9	4.0	0.6	< 23.9	65.0
MRW_ECC_VC_39A-3	50-60 cm	0.3	< 0.1	< 0.1	0.2	1.1	0.1	0.4	0.4	0.3	0.3	0.8	0.2	0.3	0.4	0.7	0.1	< 5.8	44.6
MRW_ECC_VC_41-1	0-10 cm	0.3	< 0.1	< 0.1	0.1	0.9	0.1	0.8	1.3	0.5	0.4	2.4	0.7	0.6	1.6	1.5	0.2	< 11.6	39.4
MRW_ECC_VC_41-3	50-60 cm	0.5	< 0.1	0.1	0.4	1.9	0.1	0.8	1.9	0.7	0.8	2.0	0.4	0.9	0.9	2.1	0.2	< 13.8	125
MRW_ECC_VC_41-5	100-110 cm	0.9	< 0.1	0.7	0.9	2.8	0.3	7.3	9.1	1.5	1.6	4.8	1.0	2.7	4.0	8.0	0.8	< 46.5	700
MRW_ECC_VC_41-7	150-160 cm	0.6	< 0.1	0.5	0.6	1.8	0.3	4.9	6.6	1.0	0.9	3.3	0.7	1.8	2.8	5.4	0.5	< 31.8	501
MRW_ECC_VC_41-9	200-210 cm	0.5	< 0.1	0.4	0.5	1.4	0.2	3.6	5.0	0.7	0.8	2.3	0.5	1.4	1.9	3.8	0.4	< 23.5	356
MRW_ECC_VC_41-11	250-260 cm	0.3	< 0.1	0.3	0.4	1.0	0.2	3.0	3.9	0.5	0.5	1.7	0.4	1.0	1.4	2.8	0.3	< 17.8	274
MRW_ECC_VC_43-1	0-10 cm	2.3	< 0.1	< 0.1	0.1	1.3	0.1	0.5	0.5	0.4	0.4	0.7	0.2	0.3	0.3	0.4	0.1	< 7.8	45.8
MRW_ECC_VC_43-3	50-60 cm	0.1	< 0.1	< 0.1	< 0.1	0.2	< 0.1	0.1	0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.7	< 5.4
MRW_ECC_VC_43-5	100-110 cm	0.1	< 0.1	< 0.1	< 0.1	0.2	< 0.1	0.1	0.1	< 0.1	< 0.1	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.8	< 7.6
MRW_ECC_VC_43-7	150-160 cm	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.2	0.2	0.4	< 2.3	< 41.4
MRW_ECC_VC_43-9	200-210 cm	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	< 0.1	0.1	0.2	< 0.1	0.1	0.4	0.2	< 0.1	< 2.1	< 77.5
MRW_ECC_VC_43-11	250-260 cm	0.3	< 0.1	< 0.1	0.2	0.7	< 0.1	0.2	0.3	0.2	0.2	0.8	0.1	0.1	0.1	0.2	< 0.1	< 3.8	46.0
MRW_ECC_VC_43-13	300-310 cm	0.1	< 0.1	< 0.1	< 0.1	0.2	< 0.1	0.1	0.1	< 0.1	0.1	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 1.7	< 18.4
MRW_ECC_VC_45-1	0-10 cm	0.2	< 0.1	< 0.1	0.1	0.8	0.2	1.6	1.5	0.8	0.8	1.5	0.5	0.7	0.7	0.7	0.2	< 10.5	< 33.3
MRW_ECC_VC_45-3	50-60 cm	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	0.1	0.1	0.2	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 1.7	< 13.6
MRW_ECC_VC_45-5	100-110 cm	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.6	< 10.3
MRW_ECC_VC_45_ALT-1	0-10 cm	0.6	< 0.1	0.2	0.2	1.9	1.5	3.3	2.9	2.0	1.9	3.2	1.0	1.9	2.1	2.1	0.5	< 25.4	93.6
MRW_ECC_VC_45_ALT-3	50-60 cm	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.6	< 8.9
MRW_ECC_VC_45_ALT-5	100-110 cm	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.6	< 10.7
MRW_ECC_VC_47-1	0-10 cm	1.4	0.3	0.8	1.1	9.3	2.6	14.0	14.5	7.4	6.1	10.7	3.5	7.1	6.5	5.6	1.7	92.6	214
MRW_ECC_VC_47-3	50-60 cm	37.9	5.3	54.1	51.7	392	145	653	647	356	257	545	205	507	480	333	109	4780	9520
MRW_ECC_VC_47-5	100-110 cm	0.1	< 0.1	< 0.1	< 0.1	0.2	< 0.1	0.3	0.2	0.1	0.1	0.8	0.1	0.1	0.1	0.1	< 0.1	< 2.7	< 25.5
MRW_ECC_VC_47-7	150-160 cm	0.2	< 0.1	< 0.1	< 0.1	0.3	0.1	0.5	0.4	0.2	0.1	0.6	0.1	0.1	0.1	0.1	< 0.1	< 3.2	< 16.9
MRW_ECC_VC_48-1	0-10 cm	0.1	< 0.1	< 0.1	< 0.1	0.2	< 0.1	0.1	0.1	0.1	0.1	0.3	0.1	< 0.1	0.1	0.1	< 0.1	< 1.9	< 7.2
MRW_ECC_VC_48-3	50-60 cm	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.6	< 4.9

Stations	Core Depth	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Benzo[ghi]perylene	Dibenzo[ah]anthracene	Total US EPA 16 PAH	Total 2 to 6 Ring PAH
MRW_ECC_VC_48-5	100-11 0cm	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.6	< 5.8
MRW_ECC_VC_48-7	150-160 cm	0.7	< 0.1	0.4	0.5	1.5	0.2	4.0	5.6	0.8	0.8	3.0	0.5	1.7	2.1	4.6	0.4	< 26.9	473
MRW_ECC_VC_49-1	0-10 cm	0.2	< 0.1	< 0.1	0.1	0.5	0.1	0.6	0.6	0.4	0.4	1.1	0.3	0.3	0.6	0.6	0.1	< 6.1	< 25.8
MRW_ECC_VC_49-3	50-60 cm	0.6	< 0.1	0.3	0.4	1.0	0.1	3.3	4.7	0.7	0.8	2.4	0.5	1.4	1.9	4.3	0.4	< 22.9	394
MRW_ECC_VC_49-5	100-110 cm	0.5	< 0.1	0.4	0.5	1.3	0.2	4.3	6.0	0.8	1.0	2.8	0.6	1.6	2.1	4.8	0.4	< 27.4	480
MRW_ECC_VC_49-7	150-160 cm	0.4	< 0.1	0.1	0.2	0.5	0.1	1.2	1.8	0.4	0.4	1.3	0.3	0.7	0.9	2.2	0.2	< 10.8	189
MRW_ECC_VC_49-9	200-210 cm	1.3	< 0.1	0.8	1.1	3.0	0.4	6.2	9.6	1.5	1.8	4.6	0.9	2.4	3.2	7.5	0.6	< 45.0	806
MRW_ECC_VC_51-1	0-10 cm	0.8	0.1	0.3	0.4	2.5	0.9	8.9	8.5	4.7	3.8	9.3	2.6	3.5	2.5	1.8	0.4	51.0	122
MRW_ECC_VC_51-3	50-60 cm	0.2	< 0.1	0.1	0.1	0.3	< 0.1	0.2	0.6	0.2	0.2	0.8	0.2	0.4	0.6	1.2	0.1	< 5.4	< 48.2
MRW_ECC_VC_51-5	100-110 cm	0.3	< 0.1	0.1	0.1	0.5	0.1	0.4	1.2	0.3	0.3	1.2	0.2	0.6	0.8	1.7	0.1	< 8.0	84.5
MRW_ECC_VC_51-7	150-160 cm	0.3	< 0.1	0.1	0.3	1.0	0.1	1.6	2.2	0.4	0.5	1.6	0.3	0.7	1.1	2.5	0.2	< 13.0	147
MRW_ECC_VC_51-9	200-210 cm	0.4	< 0.1	0.1	0.3	1.1	0.1	1.8	2.6	0.5	0.6	1.8	0.3	0.8	1.2	2.7	0.3	< 14.7	167
MRW_ECC_VC_51-11	250-260 cm	0.6	< 0.1	0.1	0.2	1.0	0.1	1.5	2.3	0.5	0.6	1.7	0.3	0.8	1.1	2.5	0.2	< 13.6	157
MRW_ECC_VC_51-13	300-310 cm	0.2	< 0.1	0.1	0.1	0.4	< 0.1	0.5	0.6	0.2	0.3	0.8	0.2	0.3	0.5	1.2	0.1	< 5.7	65.7
Marine Scotland (2017)																			
AL1		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10	–	–

Notes
Concentrations expressed in ng/g dry sediment
US EPA 16 PAH = United States Environmental Protection Agency's 16 priority PAH pollutants

Key	Below AL1 value	Above AL1 value

4.2.2 Sediment Metals

All the sediment samples were subject to a strong partial digest using aqua regia. A strong partial digest releases metals associated with the fines fraction within the sediments (but does not extract all trace elements associated with the coarse fraction). The concentrations of metals released by an aqua regia digest are typically considered indicative of those influencing biological interactions as the released metals are not incorporated into the mineral matrix and are therefore potentially available for biological uptake.

Appendix B provides full details of the analytical techniques employed.

4.2.2.1 Grab samples

Table 4.5 summarises the concentrations of the extractable metals in the sediment samples from an aqua regia digest. Figure 4.3 and Figure 4.4 show the spatial distribution of arsenic and chromium across the survey area.

All metals concentrations were below the respective Marine Scotland guideline action levels (AL1 and AL2).

Aluminium concentrations displayed low variability (RSD 21 %). Concentrations ranged from 3380 µg/g (station ST44_a) to 8410 µg/g (station ST53), with a mean of 6370 µg/g.

Arsenic concentrations displayed moderate variability (RSD 66 %). Concentrations ranged from 2.00 µg/g (station ST23_a) to 16.4 µg/g (station ST50_a), with a mean of 5.64 µg/g.

Cadmium concentrations displayed moderate variability (RSD 57 %). Concentrations ranged from < 0.01 µg/g (station ST13_a) to 0.07 µg/g (station ST50_a), with a mean of 0.03 µg/g.

Chromium concentrations displayed moderate variability (RSD 37 %). Concentrations ranged from 3.85 µg/g (station ST44_a) to 17.1 µg/g (station ST39_a), with a mean of 10.0 µg/g.

Copper concentrations displayed moderate variability (RSD 41%). Concentrations ranged from 0.6 µg/g (stations ST44_a and ST13_a) to 2.7 µg/g (station ST39_a) with a mean of 1.5 µg/g.

Iron concentrations displayed moderate variability (RSD 54%). Concentrations ranged from 1350 µg/g (station ST44_a) to 7450 µg/g (station ST36_a) with a mean of 3310 µg/g.

All mercury concentrations were below the MRV (< 0.03 µg/g), so no statistics were calculated.

Nickel concentrations displayed moderate variability (RSD 52 %). Concentrations ranged from 1.3 µg/g (station ST44_a) to 8.8 µg/g (station ST39_a), with a mean of 4.1 µg/g.

Lead concentrations displayed moderate variability (RSD 30 %). Concentrations ranged from 2.5 µg/g (station ST44_a) to 8.4 µg/g (station ST50_a), with a mean of 4.5 µg/g.

Zinc concentrations displayed moderate variability (RSD 31 %). Concentrations ranged from 5.1 µg/g (station ST44_a) to 15.9 µg/g (station ST39_a), with a mean of 10.5 µg/g.

Table 4.5: Summary of sediment metals analysis for the grab samples

Station	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
Nearshore										
ST73	4330	5.02	0.02	5.82	0.8	2240	< 0.03	2.1	2.6	7.3
Offshore										
ST01	5130	4.75	0.02	6.28	1.3	1740	< 0.03	2.3	3.4	6.7
ST04	5580	5.90	0.02	9.17	1.3	2540	< 0.03	3.0	4.9	9.2
ST07	7060	5.61	0.02	12.1	1.3	2830	< 0.03	3.3	5.3	11.8
ST10	7150	4.59	0.01	13.2	1.2	3050	< 0.03	3.4	4.2	12.7
ST12	5850	4.52	0.01	12.0	1.2	2690	< 0.03	3.2	4.6	11.6
ST13_a	5740	9.27	< 0.01	7.98	0.6	1520	< 0.03	2.0	4.3	6.0
ST17_a	6640	3.45	0.01	7.87	0.9	2320	< 0.03	2.5	3.4	6.9
ST20	5430	2.83	0.01	9.10	1.4	2800	< 0.03	3.2	3.9	8.8
ST23_a	4690	2.00	0.02	8.97	1.2	3350	< 0.03	3.5	2.8	7.8
ST26_a	5000	2.49	0.02	9.25	1.2	3420	< 0.03	3.4	3.2	7.5
ST28	4880	2.75	0.03	11.1	1.8	3900	< 0.03	4.6	3.5	9.8
ST31	6090	3.24	0.04	14.0	2.0	5430	< 0.03	6.2	3.9	12.1
ST36_a	7860	2.90	0.05	16.8	2.6	7450	< 0.03	7.9	4.7	15.8
ST39_a	7440	3.13	0.05	17.1	2.7	6850	< 0.03	8.8	5.0	15.9
ST42_a	7040	2.73	0.05	16.3	2.6	6520	< 0.03	8.2	4.7	15.2
ST44_a	3380	8.59	0.02	3.85	0.6	1350	< 0.03	1.3	2.5	5.1
ST50_a	8390	16.4	0.07	6.47	1.4	2520	< 0.03	3.4	8.4	12.4
ST53	8410	10.8	0.04	8.18	1.3	2290	< 0.03	3.5	6.8	11.2
ST56	6990	6.65	0.04	8.22	1.3	2230	< 0.03	2.9	6.3	12.4
ST64	6570	7.40	0.05	6.23	1.2	1710	< 0.03	3.7	4.8	9.4
ST67	6970	6.76	0.04	7.85	1.5	2130	< 0.03	3.0	6.1	12.5
STA2_01	7000	2.66	0.04	12.1	2.1	4790	< 0.03	6.4	4.4	13.0
STA2_05	7790	2.78	0.05	14.2	2.4	5630	< 0.03	7.8	4.9	14.6
STC2_04	7880	13.7	0.02	5.78	1.1	1520	< 0.03	2.6	5.1	6.5
Minimum	**3380**	**2.00**	**< 0.01**	**3.85**	**0.6**	**1350**	**–**	**1.3**	**2.5**	**5.1**
Maximum	**8410**	**16.4**	**0.07**	**17.1**	**2.7**	**7450**	**–**	**8.8**	**8.4**	**15.9**
Median	**6640**	**4.59**	**0.02**	**9.10**	**1.3**	**2690**	**–**	**3.4**	**4.6**	**11.2**
Mean	**6370**	**5.64**	**0.03**	**10.0**	**1.5**	**3310**	**–**	**4.1**	**4.5**	**10.5**
SD	**1330**	**3.69**	**0.017**	**3.71**	**0.60**	**1770**	**–**	**2.14**	**1.36**	**3.23**
RSD	**21**	**66**	**57**	**37**	**41**	**54**	**–**	**52**	**30**	**31**
Marine Scotland (2017)										
AL1	**–**	**20**	**0.4**	**50**	**30**	**–**	**0.25**	**30**	**50**	**130**
AL2	**–**	**70**	**4**	**370**	**300**	**–**	**1.5**	**150**	**400**	**600**

Notes
Concentrations expressed in µg/g dry sediment
Al = Aluminium
As = Arsenic
Cd = Cadmium
Cr = Chromium
Cu = Copper
Fe = Iron
Hg = Mercury
Ni = Nickel
Pb = Lead
Zn = Zinc
SD = Standard deviation
AL1 = Action level 1
AL2 = Action level 2
RSD = Relative standard deviation

Key	Below AL1 value	Above AL1 value	Above AL2 value

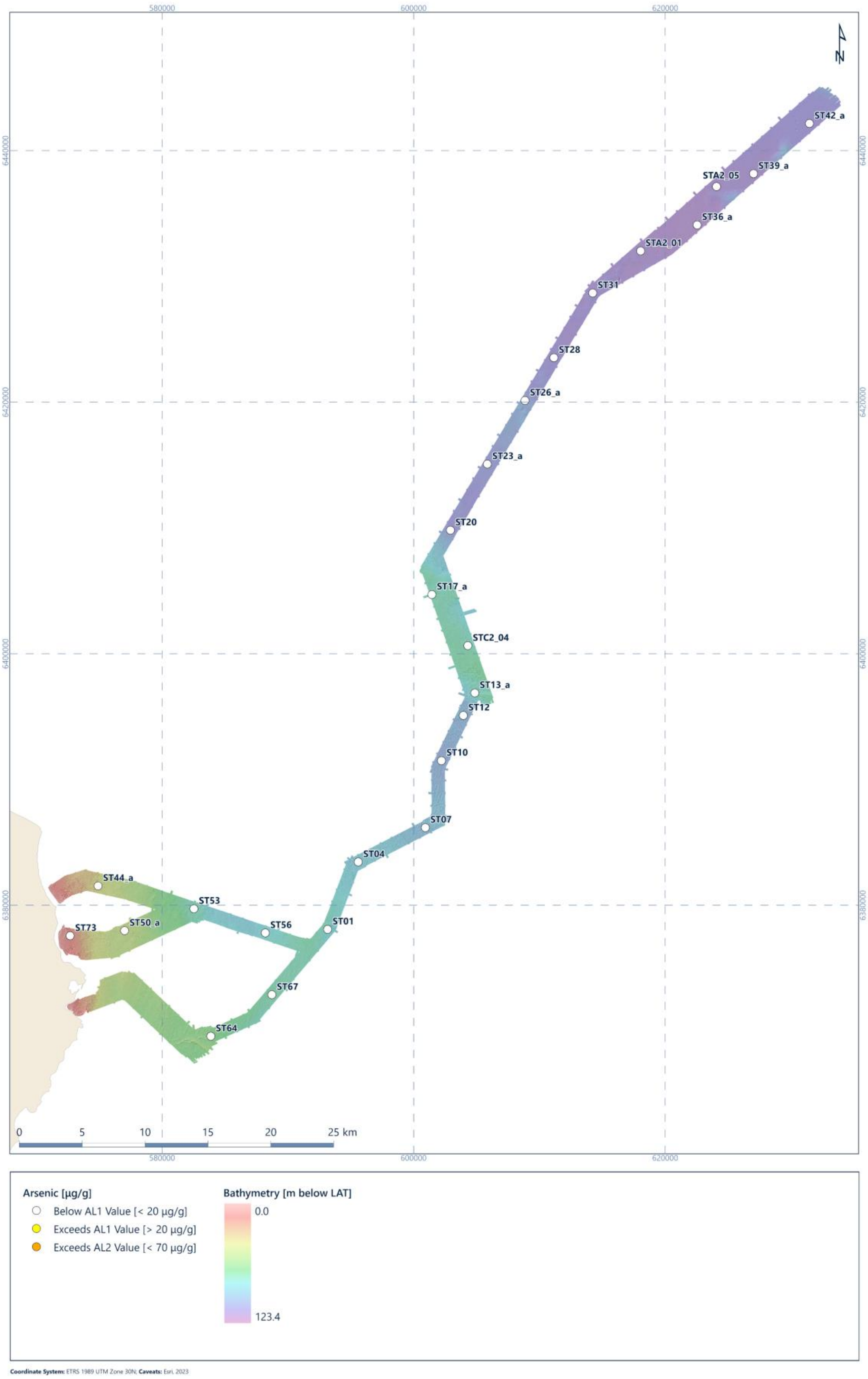


Figure 4.3: Spatial distribution of Arsenic

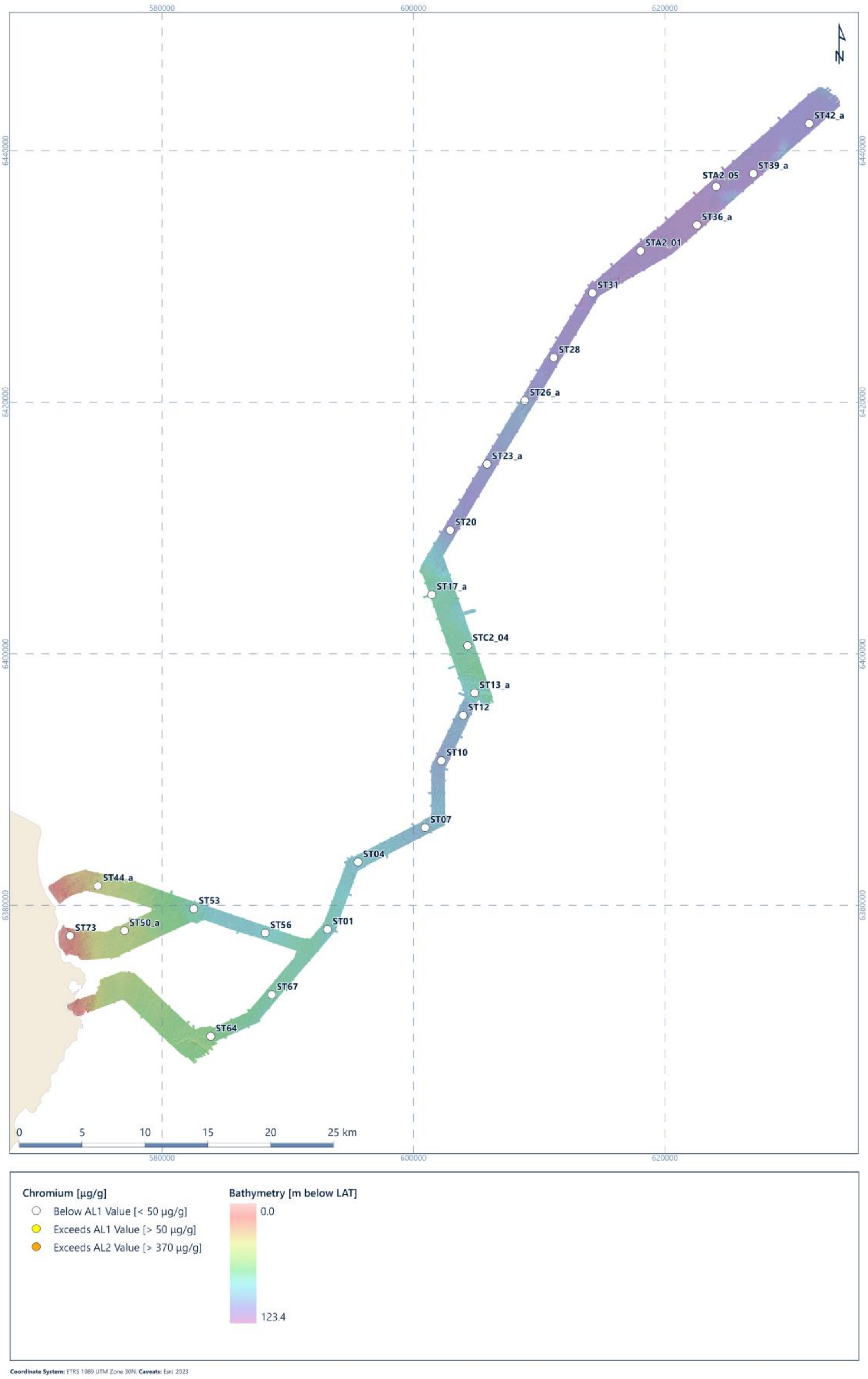


Figure 4.4: Spatial distribution of Chromium

4.2.2.2 Core samples

Table 4.6 summarises the concentrations of the extractable metals in the core sections from an aqua regia digest.

The Marine Scotland guideline action levels (AL1) were exceeded for arsenic in one sample (MRW_ECC_27-3), cadmium in six samples, chromium in twenty-nine samples, copper in three samples and nickel in twenty-six samples. All values were below the AL2 value.

Aluminium concentrations displayed high variability (RSD 95 %). Concentrations ranged from 999 µg/g (sample MRW_ECC_17-1) to 47100 µg/g (sample MRW_ECC_26-19), with a mean of 14200 µg/g.

Arsenic concentrations displayed moderate variability (RSD 63 %). Concentrations ranged from 1.86 µg/g (sample MRW_ECC_39-1) to 41.2 µg/g (sample MRW_ECC_27-3), with a mean of 6.89 µg/g.

Cadmium concentrations displayed high variability (RSD 105 %). Concentrations ranged from < 0.01 µg/g (sample MRW_ECC_47-1) to 0.48 µg/g (sample MRW_ECC_27-9), with a mean of 0.12 µg/g.

Chromium concentrations displayed high variability (RSD 81 %). Concentrations ranged from 3.61 µg/g (sample MRW_ECC_05A-11) to 78.7 µg/g (sample MRW_ECC_26-23), with a mean of 25.8 µg/g.

Copper concentrations displayed high variability (RSD 98 %). Concentrations ranged from < 0.4 µg/g (sample MRW_ECC_47-5) to 35.2 µg/g (sample MRW_ECC_51-9), with a mean of 9.2 µg/g.

Iron concentrations displayed high variability (RSD 72 %). Concentrations ranged from 3220 µg/g (sample MRW_ECC_43-5) to 38600 µg/g (sample MRW_ECC_51-7), with a mean of 14900 µg/g.

The majority of mercury concentrations were below the MRV (< 0.03 µg/g), with the exception of samples MRW_ECC_26-23, MRW_ECC_51-9 and MRW_ECC_51-11, therefore no statistics were calculated.

Nickel concentrations displayed high variability (RSD 84 %). Concentrations ranged from 1.3 µg/g (sample MRW_ECC_47-3) to 49.2 µg/g (sample MRW_ECC_51-9), with a mean of 14.7 µg/g.

Lead concentrations displayed moderate variability (RSD 69 %). Concentrations ranged from 1.1 µg/g (sample MRW_ECC_05A-11) to 20.9 µg/g (sample MRW_ECC_51-9), with a mean of 7.4 µg/g.

Zinc concentrations displayed high variability (RSD 82 %). Concentrations ranged from 3.7 µg/g (sample MRW_ECC_05A-11) to 97.8 µg/g (sample MRW_ECC_51-9), with a mean of 33.0 µg/g).

Table 4.6: Summary of sediment metals analysis for the core samples

Station	Core Depth	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
Offshore											
MRW_ECC_VC_01-1	0-10 cm	2870	6.05	0.03	8.14	1.1	5660	< 0.03	3.0	3.8	7.1
MRW_ECC_VC_01A-1	0-10 cm	2790	6.81	0.02	9.45	1.1	6350	< 0.03	3.2	4.5	8.1
MRW_ECC_VC_03-1	0-10 cm	5020	2.35	0.06	13.4	2.0	6100	< 0.03	6.6	4.3	12.4
MRW_ECC_VC_03-3	50-60 cm	7900	3.74	0.07	17.2	2.9	8660	< 0.03	8.9	4.3	14.9
MRW_ECC_VC_03-5	100-110 cm	20600	5.88	0.05	36.3	11.1	19000	< 0.03	18.5	9.9	40.7
MRW_ECC_VC_03-7	150-160 cm	22000	6.20	0.08	35.6	11.0	20600	< 0.03	18.5	9.5	45.5
MRW_ECC_VC_03-9	200-210 cm	25000	6.64	0.07	39.9	12.1	21700	< 0.03	20.9	10.6	45.4
MRW_ECC_VC_03-11	250-260 cm	14200	7.05	0.04	24.7	7.5	14700	< 0.03	13.3	7.1	27.7
MRW_ECC_VC_05-1	0-10 cm	4500	2.01	0.04	10.8	1.8	5400	< 0.03	5.7	3.7	10.6
MRW_ECC_VC_05-3	50-60 cm	5300	3.05	0.08	12.8	1.8	6690	< 0.03	6.8	2.7	10.8
MRW_ECC_VC_05-5	100-110 cm	11200	5.05	0.05	21.3	4.2	11800	< 0.03	12.0	5.3	23.4
MRW_ECC_VC_05-7	150-160 cm	23600	13.2	0.06	37.3	11.4	22400	< 0.03	29.3	10.2	45.8
MRW_ECC_VC_05-9	200-210 cm	2490	2.63	0.02	6.08	1.7	4010	< 0.03	2.8	1.7	5.0
MRW_ECC_VC_05A-1	0-10 cm	4880	2.31	0.04	12.9	3.9	6040	< 0.03	6.1	3.9	10.2
MRW_ECC_VC_05A-3	50-60 cm	4780	2.89	0.08	12.6	2.3	6910	< 0.03	6.5	2.4	9.7
MRW_ECC_VC_05A-5	100-110 cm	3190	3.11	0.04	8.17	1.7	5600	< 0.03	4.3	2.4	8.5
MRW_ECC_VC_05A-7	150-160 cm	2400	3.34	0.03	6.62	1.4	4720	< 0.03	3.5	2.1	8.4
MRW_ECC_VC_05A-9	200-210 cm	1850	4.53	0.16	5.57	2.7	5320	< 0.03	3.0	1.8	10.7
MRW_ECC_VC_05A-11	250-260 cm	1240	2.77	0.02	3.61	1.5	4440	< 0.03	2.1	1.1	3.7
MRW_ECC_VC_07-1	0-10 cm	6160	2.76	0.05	15.8	2.9	7550	< 0.03	8.2	4.9	14.1
MRW_ECC_VC_07-3	50-60 cm	8230	4.80	0.09	19.0	3.1	10100	< 0.03	10.4	3.7	15.6
MRW_ECC_VC_07-5	100-110 cm	17500	8.46	0.06	30.9	7.1	18700	< 0.03	17.0	8.0	30.7
MRW_ECC_VC_07-7	150-160 cm	32100	14.0	0.07	53.6	15.2	31400	< 0.03	30.4	14.1	56.2
MRW_ECC_VC_07-9	200-210 cm	27300	7.95	0.07	42.4	13.6	25200	< 0.03	21.1	12.4	44.6
MRW_ECC_VC_07-11	250-260 cm	39200	9.33	0.08	62.7	19.2	36200	< 0.03	32.8	16.8	75.8
MRW_ECC_VC_07-13	300-310 cm	29100	9.44	0.08	49.2	17.8	30300	< 0.03	27.1	14.7	61.8
MRW_ECC_VC_07-15	350-360 cm	28300	9.22	0.07	47.9	18.4	30700	< 0.03	26.6	14.3	64.8
MRW_ECC_VC_07-17	400-410 cm	30300	9.82	0.09	53.1	21.9	32100	< 0.03	28.9	15.5	68.3

Station	Core Depth	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
MRW_ECC_VC_07-19	450-460 cm	31800	10.0	0.09	55.0	20.6	33000	< 0.03	30.2	16.0	73.9
MRW_ECC_VC_07-21	500-510 cm	30400	10.2	0.09	57.4	20.5	31000	< 0.03	31.2	16.2	74.3
MRW_ECC_VC_10A-1	0-10 cm	3550	2.28	0.04	10.0	2.0	5490	< 0.03	5.0	3.7	10.6
MRW_ECC_VC_10A-3	50-60 cm	3960	3.17	0.07	10.4	2.3	6060	< 0.03	6.2	2.5	10.7
MRW_ECC_VC_10A-5	100-110 cm	10100	4.64	0.06	20.2	6.6	13200	< 0.03	11.9	5.9	30.2
MRW_ECC_VC_10A-7	150-160 cm	32900	7.25	0.10	51.8	19.1	29600	< 0.03	26.1	13.8	63.0
MRW_ECC_VC_10A-9	200-210 cm	16300	6.34	0.11	25.5	9.4	18600	< 0.03	15.9	6.8	36.1
MRW_ECC_VC_12-1	0-10 cm	2790	2.57	0.04	8.80	1.7	4500	< 0.03	4.4	3.1	9.2
MRW_ECC_VC_12-3	50-60 cm	5890	4.55	0.05	11.7	2.6	7250	< 0.03	6.1	4.0	11.6
MRW_ECC_VC_12A-1	0-10 cm	3130	2.61	0.03	9.03	1.7	4720	< 0.03	4.4	3.9	9.0
MRW_ECC_VC_12A-3	50-60 cm	3310	3.98	0.04	9.46	2.1	6110	< 0.03	5.2	3.3	9.4
MRW_ECC_VC_12A-5	100-110 cm	12200	4.85	0.10	22.9	9.0	14800	< 0.03	14.0	6.4	27.9
MRW_ECC_VC_12A-7	150-160 cm	19300	5.55	0.07	38.7	15.1	22900	< 0.03	22.5	12.8	51.9
MRW_ECC_VC_12A-9	200-210 cm	10400	5.28	0.12	21.5	11.3	13200	< 0.03	20.0	5.3	39.1
MRW_ECC_VC_15A-1	0-10 cm	2520	4.03	0.07	9.60	1.9	4840	< 0.03	4.4	4.1	9.7
MRW_ECC_VC_15A-3	50-60 cm	2730	2.99	0.02	6.90	2.2	4720	< 0.03	4.2	3.5	8.9
MRW_ECC_VC_15A-5	100-110 cm	3890	5.63	0.03	9.28	3.1	6770	< 0.03	5.6	4.2	11.9
MRW_ECC_VC_15A-7	150-160 cm	10500	6.58	0.04	23.4	8.7	13100	< 0.03	14.4	8.8	33.4
MRW_ECC_VC_15A-9	200-210 cm	26300	7.29	0.08	45.7	16.6	23700	< 0.03	24.4	14.6	55.9
MRW_ECC_VC_15A-11	250-260 cm	15200	6.42	0.09	29.4	11.1	16500	< 0.03	17.7	8.5	38.9
MRW_ECC_VC_15A-13	300-310 cm	24200	7.31	0.10	41.5	16.5	27000	< 0.03	23.9	12.6	57.4
MRW_ECC_VC_15A-15	350-360 cm	4670	3.10	0.09	10.1	4.6	8280	< 0.03	6.2	3.5	15.1
MRW_ECC_VC_15A-17	400-410 cm	7380	4.41	0.07	16.1	7.2	11500	< 0.03	10.4	6.3	24.9
MRW_ECC_VC_16-1	0-10 cm	1560	2.64	0.03	6.88	1.5	4650	< 0.03	2.9	3.0	7.3
MRW_ECC_VC_16-3	50-60 cm	1290	2.33	0.04	3.66	1.7	3750	< 0.03	2.6	2.8	8.1
MRW_ECC_VC_16-5	100-110 cm	1680	2.52	0.01	5.03	2.3	3960	< 0.03	3.4	3.0	11.0
MRW_ECC_VC_16-7	150-160 cm	17700	6.56	0.09	34.7	14.0	24000	< 0.03	21.2	14.9	51.2
MRW_ECC_VC_16-9	200-210 cm	13500	4.32	0.06	26.2	12.7	19100	< 0.03	17.2	9.5	40.9
MRW_ECC_VC_16-11	250-260 cm	6530	4.70	0.09	14.4	7.5	12900	< 0.03	11.3	5.5	25.4
MRW_ECC_VC_17-1	0-10 cm	999	4.36	0.01	5.92	0.9	4360	< 0.03	2.5	3.4	6.3
MRW_ECC_VC_17-3	50-60 cm	1620	3.77	0.02	5.19	1.6	4690	< 0.03	2.8	3.1	6.8

Station	Core Depth	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
MRW_ECC_VC_17-5	100-110 cm	1640	4.05	0.02	4.75	1.2	4600	< 0.03	3.9	3.2	7.3
MRW_ECC_VC_17-7	150-160 cm	11700	4.48	0.06	22.5	6.5	12900	< 0.03	12.4	5.4	27.1
MRW_ECC_VC_20-1	0-10 cm	3470	3.34	0.03	12.0	1.4	6740	< 0.03	3.6	3.7	12.1
MRW_ECC_VC_20-3	50-60 cm	18900	6.91	0.11	32.9	10.1	18100	< 0.03	16.5	7.6	37.5
MRW_ECC_VC_20-5	100-110 cm	27500	8.71	0.15	48.0	15.8	24500	< 0.03	22.0	10.4	52.1
MRW_ECC_VC_20-7	150-160 cm	36400	10.2	0.12	65.3	21.6	34500	< 0.03	31.0	15.4	70.3
MRW_ECC_VC_20-9	200-210 cm	37200	10.6	0.19	58.7	18.6	29700	< 0.03	26.8	13.6	62.5
MRW_ECC_VC_20-11	250-260 cm	38400	10.1	0.12	68.3	21.1	34900	< 0.03	32.2	15.9	73.5
MRW_ECC_VC_20-13	300-310 cm	29300	9.33	0.23	43.5	14.7	24600	< 0.03	21.5	10.5	57.1
MRW_ECC_VC_20-15	350-360 cm	21400	8.69	0.24	37.6	12.6	18700	< 0.03	18.0	8.5	48.3
MRW_ECC_VC_20-17	400-410 cm	23000	7.30	0.25	36.6	12.3	22800	< 0.03	18.6	8.7	50.1
MRW_ECC_VC_24-1	0-10 cm	4200	6.78	0.03	14.0	2.1	8400	< 0.03	4.8	5.0	13.3
MRW_ECC_VC_24-3	50-60 cm	39900	11.2	0.35	64.7	21.7	30900	< 0.03	32.4	13.7	69.8
MRW_ECC_VC_24-5	100-110 cm	34500	11.1	0.32	50.3	22.8	26900	< 0.03	31.5	13.9	70.1
MRW_ECC_VC_24-7	150-160 cm	29500	10.1	0.33	44.7	19.6	25600	< 0.03	28.4	12.5	63.2
MRW_ECC_VC_24-9	200-210 cm	30700	9.5	0.33	49.0	20.8	26600	< 0.03	29.5	13.3	67.3
MRW_ECC_VC_24-11	250-260 cm	28800	10.6	0.39	44.1	19.2	26600	< 0.03	28.5	12.4	68.2
MRW_ECC_VC_26-1	0-10 cm	2360	6.36	0.02	8.63	1.5	5610	< 0.03	4.5	3.8	11.2
MRW_ECC_VC_26-3	50-60 cm	2130	6.27	0.03	6.56	1.2	5710	< 0.03	2.9	2.5	7.3
MRW_ECC_VC_26-5	100-110 cm	2100	13.2	0.02	6.07	1.2	7630	< 0.03	8.2	3.0	9.8
MRW_ECC_VC_26-7	150-160 cm	2770	7.36	0.06	9.33	1.6	6660	< 0.03	6.2	3.5	12.4
MRW_ECC_VC_26-9	200-210 cm	2180	6.94	0.08	7.55	1.2	5300	< 0.03	4.5	3.2	8.6
MRW_ECC_VC_26-11	250-260 cm	2320	3.91	0.03	6.95	0.9	4930	< 0.03	4.0	2.3	7.8
MRW_ECC_VC_26-13	300-310 cm	3650	5.86	0.08	9.35	1.4	6430	< 0.03	5.0	3.0	10.5
MRW_ECC_VC_26-15	350-360 cm	2420	4.90	0.05	6.59	1.0	5090	< 0.03	4.6	2.8	7.9
MRW_ECC_VC_26-17	400-410 cm	3360	4.43	0.03	8.65	1.4	6310	< 0.03	4.0	3.1	11.2
MRW_ECC_VC_26-19	450-460 cm	47100	15.7	0.43	75.1	29.6	35300	< 0.03	45.4	17.4	88.3
MRW_ECC_VC_26-21	500-510 cm	44800	10.8	0.34	66.9	27.0	34600	< 0.03	36.1	15.7	78.7
MRW_ECC_VC_26-23	550-560 cm	46800	12.3	0.34	78.7	29.8	34400	< 0.03	44.5	18.2	90.2
MRW_ECC_VC_27-1	0-10 cm	4170	5.92	0.04	12.0	2.6	8030	< 0.03	5.0	5.3	14.9
MRW_ECC_VC_27-3	50-60 cm	36400	41.2	0.36	54.8	23.0	29700	< 0.03	32.7	13.7	71.3

Station	Core Depth	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
MRW_ECC_VC_27-5	100-110 cm	32100	11.8	0.38	54.6	23.2	27400	< 0.03	33.0	14.0	69.6
MRW_ECC_VC_27-7	150-160 cm	34700	11.9	0.43	52.3	22.5	29900	< 0.03	31.8	13.5	76.1
MRW_ECC_VC_27-9	200-210 cm	34300	11.9	0.48	52.8	22.7	28600	< 0.03	32.2	13.2	77.3
MRW_ECC_VC_27-11	250-260 cm	35700	11.5	0.37	53.3	22.9	29900	< 0.03	31.8	13.3	68.8
MRW_ECC_VC_29-1	0-10 cm	3210	7.83	0.04	11.3	2.1	7940	< 0.03	5.3	6.2	14.7
MRW_ECC_VC_32-1	0-10 cm	1250	7.62	0.02	4.91	0.9	3650	< 0.03	1.9	2.6	6.4
MRW_ECC_VC_32-3	50-60 cm	1720	7.72	0.03	4.60	0.8	4000	< 0.03	1.6	2.5	5.9
MRW_ECC_VC_32-5	100-110 cm	1670	7.29	0.03	4.84	1.6	3940	< 0.03	1.7	2.6	6.4
MRW_ECC_VC_32-7	150-160 cm	2930	6.76	0.05	8.04	1.6	5120	< 0.03	3.5	3.7	13.1
MRW_ECC_VC_32-9	200-210 cm	1830	10.1	0.03	5.91	0.9	5270	< 0.03	2.3	2.8	7.3
MRW_ECC_VC_35-1	0-10 cm	3440	4.62	0.04	9.88	1.8	7720	< 0.03	4.4	3.7	12.3
MRW_ECC_VC_35-3	50-60 cm	37200	12.6	0.37	62.6	24.7	27100	< 0.03	35.0	13.4	76.1
MRW_ECC_VC_35-5	100-110 cm	32400	12.7	0.37	62.8	24.9	23800	< 0.03	35.0	13.8	76.6
MRW_ECC_VC_38-1	0-10 cm	3220	5.49	0.04	9.22	1.7	6340	< 0.03	3.8	3.9	12.2
MRW_ECC_VC_38-3	50-60 cm	5800	4.57	0.04	10.3	3.5	7840	< 0.03	5.1	3.4	12.5
MRW_ECC_VC_38-5	100-110 cm	29100	9.62	0.09	46.1	13.4	24400	< 0.03	23.0	12.7	51.9
MRW_ECC_VC_38-7	150-160 cm	35600	10.2	0.10	61.8	18.1	29000	< 0.03	30.3	15.9	67.1
MRW_ECC_VC_38-9	200-210 cm	19200	5.18	0.08	31.9	9.3	17700	< 0.03	15.6	8.2	36.3
MRW_ECC_VC_38-11	250-260 cm	32200	7.98	0.21	50.6	17.0	27700	< 0.03	29.5	12.7	71.9
MRW_ECC_VC_38-13	300-310 cm	33400	11.2	0.33	51.7	20.6	27200	< 0.03	32.4	12.9	70.4
MRW_ECC_VC_38-15	350-360 cm	43700	13.8	0.40	57.0	21.8	34300	< 0.03	39.9	14.1	86.3
MRW_ECC_VC_39-1	0-10 cm	2470	1.86	0.03	8.01	1.0	4240	< 0.03	3.8	2.9	8.2
MRW_ECC_VC_39-3	50-60 cm	6360	4.02	0.07	12.6	3.1	7650	< 0.03	7.3	3.3	15.3
MRW_ECC_VC_39-5	100-110 cm	14800	5.02	0.10	24.1	7.9	15100	< 0.03	13.9	5.7	28.2
MRW_ECC_VC_39-7	150-160 cm	15800	5.17	0.13	26.6	8.1	15300	< 0.03	15.6	5.9	32.7
MRW_ECC_VC_39A-1	0-10 cm	3460	2.02	0.03	9.45	1.2	4650	< 0.03	4.0	3.2	8.9
MRW_ECC_VC_39A-3	50-60 cm	3990	2.85	0.06	9.45	1.6	5890	< 0.03	4.9	2.6	10.1
MRW_ECC_VC_41-1	0-10 cm	3950	5.05	0.04	12.3	1.7	7710	< 0.03	4.6	4.3	12.6
MRW_ECC_VC_41-3	50-60 cm	19300	5.22	0.08	32.0	10.5	18400	< 0.03	15.9	8.5	37.7
MRW_ECC_VC_41-5	100-110 cm	34600	16.9	0.36	50.8	20.8	29200	< 0.03	30.7	13.0	68.8
MRW_ECC_VC_41-7	150-160 cm	23800	10.3	0.40	43.5	20.9	24300	< 0.03	29.2	12.9	66.1

Station	Core Depth	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
MRW_ECC_VC_41-9	200-210 cm	20300	10.5	0.41	40.7	21.8	24900	< 0.03	29.2	13.5	66.6
MRW_ECC_VC_41-11	250-260 cm	25000	10.2	0.37	45.0	20.9	26100	< 0.03	27.7	13.2	65.6
MRW_ECC_VC_43-1	0-10 cm	1870	7.22	0.05	6.40	1.5	5600	< 0.03	8.6	3.4	10.4
MRW_ECC_VC_43-3	50-60 cm	2120	3.70	0.04	6.04	1.4	4610	< 0.03	4.0	2.2	10.2
MRW_ECC_VC_43-5	100-110 cm	1540	3.16	0.04	4.90	1.1	3220	< 0.03	3.4	2.2	7.9
MRW_ECC_VC_43-7	150-160 cm	1440	3.38	0.02	4.75	1.0	3490	< 0.03	3.1	2.2	7.2
MRW_ECC_VC_43-9	200-210 cm	1530	3.08	0.04	4.54	0.9	3890	< 0.03	3.4	2.2	7.3
MRW_ECC_VC_43-11	250-260 cm	2640	5.78	0.04	8.10	1.9	5570	< 0.03	5.0	3.4	11.4
MRW_ECC_VC_43-13	300-310 cm	1820	2.22	0.03	7.04	1.2	5210	< 0.03	4.2	2.5	9.0
MRW_ECC_VC_45-1	0-10 cm	1340	5.94	0.04	5.77	1.2	5140	< 0.03	2.7	3.5	8.9
MRW_ECC_VC_45-3	50-60 cm	1780	5.69	0.03	6.88	1.9	5520	< 0.03	3.9	2.6	10.3
MRW_ECC_VC_45-5	100-110 cm	2950	3.45	0.02	6.66	1.3	5630	< 0.03	2.4	2.2	8.1
MRW_ECC_VC_45_ALT-1	0-10 cm	3210	10.1	0.04	9.50	1.2	8650	< 0.03	2.6	5.5	12.7
MRW_ECC_VC_45_ALT-3	50-60 cm	2000	3.29	0.03	5.66	1.4	5160	< 0.03	2.7	1.8	7.7
MRW_ECC_VC_45_ALT-5	100-110 cm	2390	3.35	0.04	6.73	1.8	5070	< 0.03	6.8	1.4	10.8
MRW_ECC_VC_47-1	0-10 cm	2370	5.05	< 0.01	6.32	0.9	6020	< 0.03	2.2	4.3	9.3
MRW_ECC_VC_47-3	50-60 cm	1690	6.48	0.04	4.65	0.8	3670	< 0.03	1.3	4.2	6.3
MRW_ECC_VC_47-5	100-110 cm	2000	3.59	0.01	5.62	< 0.4	4140	< 0.03	1.7	1.5	5.4
MRW_ECC_VC_47-7	150-160 cm	2250	3.76	0.02	8.32	0.6	6200	< 0.03	2.1	2.0	7.2
MRW_ECC_VC_48-1	0-10 cm	3060	6.84	0.03	9.54	1.5	6290	< 0.03	5.1	2.7	11.0
MRW_ECC_VC_48-3	50-60 cm	2330	3.84	0.02	6.47	1.7	4730	< 0.03	4.8	2.3	9.0
MRW_ECC_VC_48-5	100-110 cm	3570	2.94	0.02	9.81	2.1	6850	< 0.03	5.3	2.1	12.2
MRW_ECC_VC_48-7	150-160 cm	26900	13.5	0.43	47.2	18.8	24400	< 0.03	27.0	11.3	69.8
MRW_ECC_VC_49-1	0-10 cm	2450	9.71	0.03	9.33	2.2	7980	< 0.03	4.6	5.0	12.5
MRW_ECC_VC_49-3	50-60 cm	11000	7.21	0.24	25.6	12.4	4400	< 0.03	19.3	7.9	44.2
MRW_ECC_VC_49-5	100-110 cm	14300	6.35	0.20	26.8	15.2	17700	< 0.03	19.2	8.0	42.1
MRW_ECC_VC_49-7	150-160 cm	5250	4.13	0.15	11.5	4.9	8770	< 0.03	7.5	3.8	22.4
MRW_ECC_VC_49-9	200-210 cm	27000	12.0	0.42	49.2	25.8	31500	< 0.03	36.0	15.4	78.0
MRW_ECC_VC_51-1	0-10 cm	4900	4.69	0.07	12.1	4.3	8800	< 0.03	6.7	4.6	19.5
MRW_ECC_VC_51-3	50-60 cm	10600	3.35	0.17	22.9	10.6	16800	< 0.03	14.4	6.5	37.9
MRW_ECC_VC_51-5	100-110 cm	11900	3.69	0.14	24.9	11.6	17700	< 0.03	16.1	6.3	40.4

Station	Core Depth	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
MRW_ECC_VC_51-7	150-160 cm	38100	10.3	0.22	65.0	31.8	38600	< 0.03	44.4	18.7	88.4
MRW_ECC_VC_51-9	200-210 cm	34400	11.6	0.30	70.7	35.2	38400	0.03	49.2	20.9	97.8
MRW_ECC_VC_51-11	250-260 cm	31300	11.6	0.29	64.7	33.0	36500	0.04	44.4	20.0	91.6
MRW_ECC_VC_51-13	300-310 cm	16000	6.59	0.13	35.3	18.6	23000	< 0.03	25.3	11.1	50.5
Minimum		**999**	**1.86**	**< 0.01**	**3.61**	**< 0.4**	**3220**	**< 0.03**	**1.3**	**1.1**	**3.7**
Maximum		**47100**	**41.2**	**0.48**	**78.7**	**35.2**	**38600**	**0.04**	**49.2**	**20.9**	**97.8**
Median		**6440**	**6.13**	**0.07**	**15.1**	**4.3**	**8720**	**–**	**8.8**	**5.3**	**17.6**
Mean		**14200**	**6.89**	**0.12**	**25.8**	**9.2**	**14900**	**–**	**14.7**	**7.4**	**33.0**
SD		**13500**	**4.34**	**0.123**	**20.8**	**9.00**	**10800**	**–**	**12.4**	**5.10**	**27.0**
RSD		**95**	**63**	**105**	**81**	**98**	**72**	**–**	**84**	**69**	**82**
Marine Scotland (2017)											
AL1		**–**	**20**	**0.4**	**50**	**30**	**–**	**0.25**	**30**	**50**	**130**
AL2		**–**	**70**	**4**	**370**	**300**	**–**	**1.5**	**150**	**400**	**600**

Notes
Concentrations expressed in µg/g dry sediment
Al = Aluminium As = Arsenic Cd = Cadmium Cr = Chromium
Cu = Copper Fe = Iron Hg = Mercury Ni = Nickel
Pb = Lead Zn = Zinc
SD = Standard deviation
AL1 = Action level 1
AL2 = Action level 2
RSD = Relative standard deviation

Key	Below AL1 value	Above AL1 value	Above AL2 value

4.2.3 Sediment Polychlorinated Biphenyls

4.2.3.1 Grab samples

Table 4.7 summarises the concentrations of PCBs in the sediment grab samples.

The sum of the 7 congeners ranged from < 0.140 ng/g at the majority of stations to < 0.153 ng/g at station ST39_a. All stations had concentrations below the Marine Scotland Guideline AL1 (20 ng/g).

Table 4.7: Summary of polychlorinated biphenyls (PCBs) analysis for the grab samples

Station	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
Nearshore								
ST73	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
Offshore								
ST01	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST04	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST07	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST10	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST12	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST13_a	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST17_a	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST20	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141
ST23_a	0.022	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.142
ST26_a	0.023	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.143
ST28	0.024	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.144
ST31	0.025	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.145
ST36_a	0.033	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.153
ST39_a	0.029	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.149
ST42_a	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST44_a	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST50	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST53	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
ST56	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141
ST67	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
ST64	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
STA2_01	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141
STA2_05	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
STC2_04	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
Minimum	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.140**
Maximum	**0.033**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.153**
Mean	–	-	-	-	-	-	-	-
SD	-	-	-	-	-	-	-	-
RSD	-	-	-	-	-	-	-	-
Marine Scotland Guideline Action Levels								
AL1	-	-	-	-	-	-	-	**20**
AL2	-	-	-	-	-	-	-	**180**

Notes
Concentrations expressed in ng/g dry weight
SD = Standard deviation
AL1 = Action Level 1
AL2 = Action Level 2

Key	Below AL1 value	Above AL1 value	Above AL2 value

4.2.3.2 Core samples

Table 4.8 summarises the concentrations of PCBs in the core sections.

The sum of the 7 congeners ranged from < 0.140 for the majority of samples to 0.881 ng/g for sample MRW_ECC_VC_32-7. The sum of the 7 congeners was below the Marine Scotland Guideline AL1 (20 µg/g) in all samples.

Table 4.8: Summary of polychlorinated biphenyls (PCBs) analysis for the core samples

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
Offshore									
MRW_ECC_VC_01-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_01A-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_03-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_03-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_03-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_03-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_03-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_03-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05A-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05A-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05A-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05A-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05A-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_05A-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_07-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-13	300-310 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-15	350-360 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-17	400-410 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-19	450-460 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_07-21	500-510 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_10A-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_10A-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_10A-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_10A-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_10A-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_12-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_12-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_12A-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_12A-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_12A-5	100-110 cm	< 0.020	0.025	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.145
MRW_ECC_VC_12A-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_12A-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_15A-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_15A-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_15A-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_15A-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_15A-9	200-210 cm	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141
MRW_ECC_VC_15A-11	250-260 cm	0.035	0.026	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.161
MRW_ECC_VC_15A-13	300-310 cm	0.030	0.024	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.154
MRW_ECC_VC_15A-15	350-360 cm	< 0.020	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141
MRW_ECC_VC_15A-17	400-410 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_16-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_16-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_16-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_16-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_16-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_16-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_17-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_17-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_17-5	100-110 cm	< 0.020	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_17-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-1	0-10 cm	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-3	50-60 cm	< 0.020	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141
MRW_ECC_VC_20-5	100-110 cm	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.141

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_20-7	150-160 cm	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-13	300-310 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-15	350-360 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_20-17	400-410 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_24-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_24-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_24-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_24-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_24-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_24-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-13	300-310 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-15	350-360 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-17	400-410 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-19	450-460 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_26-21	500-510 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_26-23	550-560 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_27-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_27-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_27-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_27-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_27-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_27-11	250-260 cm	< 0.020	0.044	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.164
MRW_ECC_VC_29-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_32-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_32-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_32-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_32-7	150-160 cm	0.082	0.108	0.222	0.102	0.121	0.197	0.049	0.881
MRW_ECC_VC_32-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_35-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_35-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_35-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_38-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-13	300-310 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_38-15	350-360 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_39-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_39-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_39-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_39-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_39A-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_39A-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_41-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_41-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_41-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_41-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_41-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_41-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_43-13	300-310 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_45-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_45-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_45-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_45_ALT-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_45_ALT-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_45_ALT-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_47-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_47-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_47-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_47-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_48-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_48-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_48-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_48-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_49-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_49-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_49-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_49-7	150-160 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_49-9	200-210 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_51-1	0-10 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_51-3	50-60 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_51-5	100-110 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140

Station	Core Depth	PCB - 28	PCB - 52	PCB - 101	PCB - 118	PCB - 138	PCB - 153	PCB - 180	Total ICES 7 PCBs
MRW_ECC_VC_51-7	150-160 cm	0.034	0.034	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.168
MRW_ECC_VC_51-9	200-210 cm	0.026	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.146
MRW_ECC_VC_51-11	250-260 cm	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
MRW_ECC_VC_51-13	300-310 cm	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.140
Minimum		**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.020**	**< 0.140**
Maximum		**0.082**	**0.108**	**0.222**	**0.102**	**0.121**	**0.197**	**0.049**	**0.881**
Mean		-	-	-	-	-	-	-	-
SD		-	-	-	-	-	-	-	-
RSD		-	-	-	-	-	-	-	-
Marine Scotland Guideline Action Levels									
AL1		-	-	-	-	-	-	-	**20**
AL2		-	-	-	-	-	-	-	**180**

Notes
Concentrations expressed in ng/g dry weight
SD = Standard deviation
AL1 = Action Level 1
AL2 = Action Level 2

Key	Below AL1 value	Above AL1 value	Above AL2 value

4.2.4 Sediment Organotins

4.2.4.1 Grab samples

Table 4.9 summarises the concentrations of organotins in the sediment samples. The organotins analysed included dibutyltin (DBT) and tributyltin (TBT).

DBT concentrations ranged from < 0.400 ng/g (at six stations) to 6.36 ng/g (station ST42_a), with a mean of 0.961 ng/g.

TBT concentrations were all below the MRV (< 0.400 ng/g). All TBT concentrations were below the Marine Scotland AL1 value (100 ng/g).

Table 4.9: Summary of organotins analysis for the grab samples

Station	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Nearshore		
ST73	1.94	< 0.400
Offshore		
ST01	0.648	< 0.400
ST04	1.14	< 0.400
ST07	1.23	< 0.400
ST10	1.50	< 0.400
ST12	1.05	< 0.400
ST13_a	0.454	< 0.400
ST17_a	< 0.400	< 0.400
ST20	0.508	< 0.400
ST23_a	< 0.400	< 0.400
ST26_a	0.491	< 0.400
ST28	< 0.400	< 0.400
ST31	< 0.400	< 0.400
ST36_a	0.408	< 0.400
ST39_a	< 0.400	< 0.400
ST42_a	6.36	< 0.400
ST44_a	2.06	< 0.400
ST50	1.34	< 0.400
ST53	0.669	< 0.400
ST56	0.658	< 0.400
ST64	0.447	< 0.400
ST67	0.960	< 0.400
STA2_01	0.472	< 0.400
STA2_05	0.478	< 0.400
STC2_04	< 0.400	< 0.400
Minimum	**< 0.400**	**–**

Station	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Maximum	6.36	–
Median	0.508	–
Mean	0.961	–
SD	1.25	–
RSD	130	–
Marine Scotland Guideline Action Levels		
AL1	–	100
AL2	–	500

Notes
Concentrations expressed as ng/g dry weight (as cation)
SD = Standard Deviation
AL1 = Action Level 1
AL2 = Action Level 2
Summary stats generated by MRV/2 for DBT

Key	Below AL1 value	Above AL1 value	Above AL2 value

4.2.4.2 Core samples

Table 4.10 summarises the concentrations of organotins in the core samples. The organotins analysed included DBT and TBT.

All DBT concentrations were below the MRV (< 0.400 ng/g), with the exception of MRW_ECC_07-19 (0.706 ng/g).

All TBT concentrations were below the MRV (< 0.400 ng/g). All TBT concentrations were below the Marine Scotland AL1 value (100 ng/g).

Table 4.10: Summary of organotins analysis for the core samples

Station	Core Depth	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Offshore			
MRW_ECC_VC_01-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_01A-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_03-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_03-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_03-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_03-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_03-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_03-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_05-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_05-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_05-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_05-7	150-160 cm	< 0.400	< 0.400

Station	Core Depth	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Offshore			
MRW_ECC_VC_05-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_05A-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_05A-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_05A-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_05A-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_05A-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_05A-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_07-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_07-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_07-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_07-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_07-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_07-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_07-13	300-310 cm	< 0.400	< 0.400
MRW_ECC_VC_07-15	350-360 cm	< 0.400	< 0.400
MRW_ECC_VC_07-17	400-410 cm	< 0.400	< 0.400
MRW_ECC_VC_07-19	450-460 cm	0.706	< 0.400
MRW_ECC_VC_07-21	500-510 cm	< 0.400	< 0.400
MRW_ECC_VC_10A-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_10A-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_10A-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_10A-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_10A-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_12-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_12-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_12A-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_12A-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_12A-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_12A-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_12A-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-13	300-310 cm	< 0.400	< 0.400
MRW_ECC_VC_15A-15	350-360 cm	< 0.400	< 0.400

Station	Core Depth	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Offshore			
MRW_ECC_VC_15A-17	400-410 cm	< 0.400	< 0.400
MRW_ECC_VC_16-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_16-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_16-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_16-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_16-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_16-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_17-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_17-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_17-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_17-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_20-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_20-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_20-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_20-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_20-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_20-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_20-13	300-310 cm	< 0.400	< 0.400
MRW_ECC_VC_20-15	350-360 cm	< 0.400	< 0.400
MRW_ECC_VC_20-17	400-410 cm	< 0.400	< 0.400
MRW_ECC_VC_24-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_24-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_24-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_24-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_24-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_24-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_26-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_26-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_26-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_26-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_26-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_26-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_26-13	300-310 cm	< 0.400	< 0.400
MRW_ECC_VC_26-15	350-360 cm	< 0.400	< 0.400
MRW_ECC_VC_26-17	400-410 cm	< 0.400	< 0.400
MRW_ECC_VC_26-19	450-460 cm	< 0.400	< 0.400
MRW_ECC_VC_26-21	500-510 cm	< 0.400	< 0.400
MRW_ECC_VC_26-23	550-560 cm	< 0.400	< 0.400

Station	Core Depth	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Offshore			
MRW_ECC_VC_27-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_27-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_27-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_27-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_27-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_27-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_29-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_32-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_32-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_32-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_32-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_32-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_35-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_35-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_35-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_38-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_38-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_38-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_38-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_38-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_38-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_38-13	300-310 cm	< 0.400	< 0.400
MRW_ECC_VC_38-15	350-360 cm	< 0.400	< 0.400
MRW_ECC_VC_39-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_39-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_39-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_39-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_39A-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_39A-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_41-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_41-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_41-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_41-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_41-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_41-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_43-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_43-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_43-5	100-110 cm	< 0.400	< 0.400

Station	Core Depth	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Offshore			
MRW_ECC_VC_43-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_43-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_43-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_43-13	300-310 cm	< 0.400	< 0.400
MRW_ECC_VC_45-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_45-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_45-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_45_ALT-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_45_ALT-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_45_ALT-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_47-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_47-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_47-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_47-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_48-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_48-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_48-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_48-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_49-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_49-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_49-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_49-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_49-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_51-1	0-10 cm	< 0.400	< 0.400
MRW_ECC_VC_51-3	50-60 cm	< 0.400	< 0.400
MRW_ECC_VC_51-5	100-110 cm	< 0.400	< 0.400
MRW_ECC_VC_51-7	150-160 cm	< 0.400	< 0.400
MRW_ECC_VC_51-9	200-210 cm	< 0.400	< 0.400
MRW_ECC_VC_51-11	250-260 cm	< 0.400	< 0.400
MRW_ECC_VC_51-13	300-310 cm	< 0.400	< 0.400
Minimum		**< 0.400**	–
Maximum		**0.706**	–
Median		–	–
Mean		–	–
SD		–	–
RSD		–	–
Marine Scotland (2017)			
AL1		–	**100**

Station	Core Depth	Dibutyl Tin (DBT)	Tributyl Tin (TBT)
Offshore			
AL2		–	500

Notes
Concentrations expressed as ng/g dry weight (as cation)
SD = Standard deviation
RSD = Relative standard deviation
AL1 = Action Level 1
AL2 = Action Level 2

Key	Below AL1 value	Above AL1 value	Above AL2 value

5. Discussion

5.1 Sediment Chemistry

5.1.1 Aromatic Hydrocarbons

PAHs are widely spread in the environment (Butler et al., 1984) with natural sources occurring primarily through synthesis by plants (Neff, 1979; Sims & Overcash, 1983), related to natural seeps of petroleum (NRC, 1983; Kennicutt et al., 1988) and to formation during natural forest and prairie fires (Youngblood & Blumer, 1975; Wakeham et al., 1980). By far the greatest proportion of PAHs released into the environment are formed during fossil fuel combustion and anthropogenic forest and agricultural fires (Edwards, 1983; Sims & Overcash, 1983; Haritash & Kaushik, 2009). PAHs primarily enter marine sediments from atmospheric and riverine inputs and tend to adsorb to suspended inorganic and organic particulate matter, ultimately settling on the seafloor where they accumulate to relatively high concentrations (Latimer & Zheng, 2003; Culotta et al., 2006).

Monitoring of aromatic hydrocarbon type and content is important due to the particularly toxic nature (mutagenic/carcinogenic) of several PAHs, particularly the heavier weight PAHs. The US EPA has identified 16 priority PAHs to be monitored (Keith, 2014) and the Coordinated Environmental Monitoring Programme (CEMP) specifies 9 PAHs of specific concern (OSPAR, 2014), which primarily reflect inputs from anthropogenic combustion sources.

In the grab samples, all the PAH concentrations were below the Marine Scotland guideline action level (AL1) and therefore not considered to be detrimental to the marine environment.

In the core samples, the majority of PAH concentrations were below the Marine Scotland guideline action level (AL1) and therefore not considered to be detrimental to the marine environment with the exception of sample MRW_ECC_47-3 (50-60 cm) where AL1 values were exceeded for phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, benzo[ghi]perylene and dibenzo[ah]anthracene. The source of the PAH values present in this sample is unknown. The values in the other stratified layers of the core, including the surface sample, MRW_ECC_VC_47-1 (0-10 cm), and the deeper samples, MRW_ECC_VC_47-5 (100-110 cm) and MRW_ECC_VC_47-7 (150-160 cm), were low. This indicated that the higher PAH values were isolated to the middle layer. This pattern was not observed in other parameters such as metals.

5.1.2 Sediment Metals

Metals and metalloids occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Some are essential to marine life while others have no biological function and therefore are toxic to numerous organisms at certain levels

(Paez-Osuna & Ruiz-Fernandez, 1995; Boening, 1999). Metals can enter the environment via natural methods such as riverine transport, coastal discharges, geological weathering and atmospheric fallout (Brady et al., 2015). Other routes into marine sediments are from anthropogenic activities such as direct discharges from industrial activities.

Trace metal contaminants in the marine environment tend to form associations with the non-residual phases of mineral matter, such as iron and manganese oxides and hydroxides, metal sulphides, clays, organics and carbonates (Warren & Zimmerman, 1993; Dang et al., 2015; Wang et al., 2015). Non-residual trace metals are associated with more reactive and available sediment components through processes such as adsorption onto mineral surfaces and organic complexation. Metals associated with these more reactive phases are prone to various environmental interactions and transformations (physical, chemical and biological) potentially increasing their mobility and biological availability (Tessier et al., 1979; Warren & Zimmerman, 1993; Du Laing et al., 2009). Residual trace metals are defined as those that are part of the crystal structure of the component minerals and are generally unavailable to organisms (de Orte et al., 2018). Therefore, in monitoring trace metal contamination of the marine environment, it is important to distinguish the more mobile non-residual trace metals from the residual metals held tightly in the sediment lattice (Chester & Voutsinou, 1981), which are of comparatively lesser environmental significance because of their low reactivity and availability.

In this study, an analytical procedure involving the digestion of sediment in aqua regia was employed to analyse the elemental content of the sediments. The aqua regia digest releases for analysis the 'non-residual' heavy metals, which are not incorporated in the mineral matrix and are therefore potentially available for biological uptake.

The bioavailable metals concentrations in the grab samples were below the respective Marine Scotland guideline action levels (AL1 and AL2) and are therefore not considered to be of ecological concern.

In the core samples, the Marine Scotland guideline action levels (AL1) were exceeded for arsenic in one sample (MRW_ECC_27-3), cadmium in six samples, chromium in twenty-nine samples, copper in three samples and nickel in twenty-six samples. All values were below the AL2 value.

5.1.3 Sediment Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are industrial chemicals used in electrical equipment. They are manufactured by reacting chlorine with biphenyl resulting in the formation of a complex mixture of compounds (known as congeners). The properties of the final product are modified by varying the proportion of chlorine to biphenyl present. In environmental samples PCBs are therefore present as technical mixtures rather than individual compounds. Polychlorinated biphenyls have entered the marine environment by leakage, discharge, recycling, transboundary influx via major rivers and long-range atmospheric transport

(Van Wezel et al., 2000). Although the use of PCBs has been banned for many years, they can persist in marine sediments owing to their resistance to degradation (Geyer et al., 1984).

The sum of the 7 congeners was below the MRV in all the grab and core samples across the area. The sum of the 7 congeners was below the Marine Scotland Guideline AL1 (20 µg/g) and AL2 (180 µg/g) in all the samples.

5.1.4 Sediment Organotins

Organotin compounds have historically been used in marine antifouling products; however, their use is now prohibited. Environmental monitoring conducted in the vicinity of locations where vessel maintenance was conducted identified a link between these compounds and the disruption of the reproductive capabilities of a number of gastropod species, leading to these compounds being gradually phased out of use during the 1980s and 1990s.

Since 2003, monitoring of imposex and related effects of TBT in marine snails in OSPAR Regions I, II, III and IV has been undertaken regularly. Although the overall status is improving, marine snails still show pollution effects from TBT over the large parts of the OSPAR area, especially Regions II, III and IV (OSPAR, 2014).

The environmental persistence and fate of TBT is correlated to the specific characteristics of the aquatic ecosystem such as temperature, salinity, pH, suspended matter, microbial populations, flushing rates, etc. Distribution of TBT among the different environmental compartments is regulated by biological, chemical and physical mechanisms. TBT undergoes degradation to DBT, monobutyltin (MBT) and ultimately inorganic tin in the marine environment through processes such as microbial and ultraviolet (UV) degradation, becoming progressively less toxic in the process. TBT is broken down very slowly in sediments, particularly those with low oxygen content where persistence is estimated at tens of decades (Dowson et al., 1996; Gadd, 2000). Since toxicity of the organotins is maximal for the tri-substituted compounds, degradation can essentially be considered a mechanism of detoxification (OSPAR, 2005).

The organotin compounds analysed in this study were DBT and TBT. TBT concentrations were below the Marine Scotland AL1 and AL2 across the survey area and were therefore not considered to be of ecological concern.

5.2 Limitations and Uncertainties

The data provided in this report represent seafloor conditions at the time of sampling only and may change as the result of depositional/erosional processes that can occur on a range of temporal scales. The principal transport pathway by which contaminants enter the benthic environment is by deposition along with fine sediments and, as such, remobilisation and subsequent deposition processes are a major source of natural variation in benthic contaminant levels. As these processes are likely to change over time, this introduces some uncertainty regarding the long-term validity of the data presented in this report. However, the water depths present at the survey area are likely to result in lower remobilisation rates than the more hydrodynamic, shallower areas of the North Sea.

Although the number and location of physico-chemical sampling points was designed to identify the range of contaminants within the survey area, it is possible that not all spatial variation in the contaminant concentrations has been captured by the sampling plan. Consequently, there may be locations within the survey area where contaminant levels fall outside of the ranges provided within this report.

A further source of uncertainty in the reported data relates to the sampling and subsampling methodologies utilised (sampling bias). To characterise a station, a single bulk sample (grab samples or vibrocores) were acquired, and these were then subsampled to obtain appropriate quantities of material for analysis. Although rigorous QC procedures were followed for all sampling and subsampling, it is possible that not all subsamples analysed were typical of the locality from which they were collected. Further sampling bias was minimised during the analytical process by either analysing subsamples in their entirety, or by homogenising the sediment prior to further subsampling.

6. Conclusions

The aim of this report has been to evaluate the presence of contaminants in the marine environment within the survey area. A review of the environmental data in context with estimated sediment effects threshold values (Marine Scotland, 2017) was also undertaken. Based on the overall assessment of the survey area, the following key conclusions can be stated:

The concentrations of the PAHs analysed in the grab samples and core samples were below the Marine Scotland AL1 guideline, with the exception of sample MRW_ECC_47-3 (50-60 cm). However, the PAH values in the stratified layers above and below the sample, in the same core, were low.

The bioavailable metals concentrations in the grab samples were below the respective Marine Scotland guideline action levels (AL1 and AL2). In the core samples, several bioavailable metals concentrations exceeded the AL1 guideline, but did not exceed the AL2 guideline.

The sum of the seven congeners was below the Marine Scotland Guideline AL1 in all grab and core samples for PCBs.

All TBT concentrations in the grab and core samples were below the Marine Scotland guideline AL1 value.

7. References

Boening, D.W. (1999). An evaluation of bivalves as biomonitors of heavy metals pollution in marine waters. *Environmental Monitoring and Assessment*, *55*(3), 459-470. https://doi.org/10.1023/A:1005995217901

Brady, J. P., Ayoko, G. A., Martens, W. N., & Goonetilleke, A. (2015). Development of a hybrid pollution index for heavy metals in marine and estuarine sediments. *Environmental Monitoring and Assessment*, *187*(5), 306. https://doi.org/10.1007/s10661-015-4563-x

Butler, J. D., Butterworth, V., Kellow, S. C., & Robinson, H. G. (1984). Some observations on the polycyclic aromatic hydrocarbon (PAH) content of surface soils in urban areas. *Science of The Total Environment*, *33*(1–4), 75–85. https://doi.org/10.1016/0048-9697(84)90382-6

Chester, R., & Voutsinou, F. G. (1981). The initial assessment of trace metal pollution in coastal sediments. *Marine Pollution Bulletin, 12*, 84-91. https://doi.org/10.1016/0025-326X(81)90198-3

Culotta, L., De Stefano, C., Gianguzza, A., Mannino, M. R., & Orecchio, S. (2006). The PAH composition of surface sediments from Stagnone coastal lagoon, Marsala (Italy). *Marine Chemistry*, *99*(1–4), 117–127. https://doi.org/10.1016/j.marchem.2005.05.010

Dang, D. H., Lenoble, V., Durrieu, G., Omanović, D., Mullot, J.-U., Mounier, S., & Garnier, C. (2015). Seasonal variations of coastal sedimentary trace metals cycling: Insight on the effect of manganese and iron (oxy)hydroxides, sulphide and organic matter. *Marine Pollution Bulletin*, *92*(1–2), 113–124. https://doi.org/10.1016/j.marpolbul.2014.12.048

de Orte, M. R., Bonnail, E., Sarmiento, A. M., Bautista-Chamizo, E., Basallote, M. D., Riba, I., DelValls, Á., & Nieto, J. M. (2018). Metal fractionation in marine sediments acidified by enrichment of CO_2: A risk assessment. *Marine Pollution Bulletin*, *131*, 611–619. https://doi.org/10.1016/j.marpolbul.2018.04.072

Department of Trade and Industry (DTI). (1993). *Conditions for the discharge of oil contaminated cuttings resulting from offshore drilling.* Department of Trade and Industry, Oil and Gas Division.

Dowson, P. H., Bubb, J. M., & Lester, J. N. (1996). Persistence and degradation pathways of tributyltin in freshwater and estuarine sediments. *Estuarine, Coastal and Shelf Science, 42*, 551-562. https://doi.org/10.1006/ecss.1996.0036

Du Laing, G., Rinklebe, J., Vandecasteele, B., Meers, E., & Tack, F. M. G. (2009). Trace metal behaviour in estuarine and riverine floodplain soils and sediments: A review. *Science of The Total Environment*, *407*(13), 3972–3985. https://doi.org/10.1016/j.scitotenv.2008.07.025

Edwards, N. T. (1983). Polycyclic aromatic hydrocarbons (PAHs) in the terrestrial environment – a review. *Journal of Environmental Quality*, *12*, 427-441. https://doi.org/10.2134/jeq1983.00472425001200040001x

Gadd, G.M. (2000). Microbial interactions with tributyltin compounds: Detoxification, accumulation, and environmental fate. *Science of The Total Environment 258*(1-2), 119-27. https://doi.org/10.1016/S0048-9697(00)00512-X

Geyer, H., Freitag, D., & Korte, F. (1984). Polychlorinated biphenyls (PCBs) in the marine environment, particularly in the Mediterranean. *Ecotoxicology and Environmental Safety*, *8*, 129-151. https://doi.org/10.1016/0147-6513(84)90056-3

Haritash, A. K., & Kaushik, C. P. (2009). Biodegradation aspects of polycyclic aromatic hydrocarbons (PAHs): A review. *Journal of Hazardous Materials*, *169*(1–3), 1–15. https://doi.org/10.1016/j.jhazmat.2009.03.137

Joint Nature Conservation Committee [JNCC]. (2014a). *Priority Marine Features in Scotland's seas*. https://hub.jncc.gov.uk/assets/151356a8-06cc-43fc-b724-c8212089a2da

Keith, L. H. (2014). The source of U.S. EPA's Sixteen PAH priority pollutants. *Polycyclic Aromatic Compounds*, *35*(2–4), 147–160. https://doi.org/10.1080/10406638.2014.892886

Kennicutt, M. C., Brooks, J. M., Bidigare, R. R., & Denoux, G. J. (1988). Gulf of Mexico hydrocarbon seep communities—I. Regional distribution of hydrocarbon seepage and associated fauna. *Deep Sea Research Part A. Oceanographic Research Papers*, *35*(9), 1639–1651. https://doi.org/10.1016/0198-0149(88)90107-0

Latimer, J.S., & Zheng, J. (2003). The sources, transport and fate of PAHs in the marine environment. In P. E. T. Douben (Ed.) *PAHs: An ecotoxicological perspective* (pp. 9-29). John Wiley & Sons.

Marine Scotland. 2017. *Pre-disposal sampling guidance. Version 2 – November 2017*. https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/02/marine-licensing-applications-and-guidance/documents/guidance/pre-disposal-sampling-guidance/pre-disposal-sampling-guidance/govscot%3Adocument/Pre-disposal%2Bsampling%2Bguidance.pdf

National Research Council [NRC]. (1983). *Drilling discharges in the marine environment*. National Academy Press.

Neff, J.M. (1979). *Polycyclic aromatic hydrocarbons in the aquatic environment. Sources, fates and biological effects*. Applied Science Publishers.

Oslo and Paris Commission [OSPAR]. (2005). *Assessment of data collected under the co-ordinated environmental monitoring programme (CEMP). Assessment and monitoring series.* (OSPAR Publication 2005/235). OSPAR Commission.

Oslo and Paris Commission [OSPAR]. (2008). *OSPAR List of threatened and/or declining species and habitats*. Reference Number: 2008-06. https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats

Oslo and Paris Commission [OSPAR] (2014). *Levels and trends in marine contaminants and their biological effects – CEMP assessment report 2013*. *Monitoring and Assessment Series.* OSPAR Publication No. 631/2014). OSPAR Commission.

Páez-Osuna, F., & Ruiz-Fernández, C. (1995). Comparative bioaccumulation of trace metals in Penaeus stylirostris in estuarine and coastal environments. *Estuarine, Coastal and Shelf Science*, *40*(1), 35–44. https://doi.org/10.1016/0272-7714(95)90011-x

Sims, R. C., & Overcash, M. R. (1983). Fate of polynuclear aromatic compounds (PNAs) in soil-plant systems. *Residue Reviews*, 88, 1-68. https://doi.org/10.1007/978-1-4612-5569-7_1

Tessier, A., Campbell, P. G. C., & Bisson, M. (1979). Sequential extraction procedure for the speciation of particulate trace metals. *Analytical Chemistry*, *51*(7), 844–851. https://doi.org/10.1021/ac50043a017

Van Wezel, A.P., Traas, T.P., Van der Weiden, M.E.J., Crommentuijn, T.H., & Sijm, D.T.H.M. (2000). Environmental risk limits for polychlorinated biphenyls in the Netherlands: Derivation with probabilistic food chain modelling. *Environmental Toxicology and Chemistry, 19*, 2140-2153. https://setac.onlinelibrary.wiley.com/doi/10.1002/etc.5620190826

Wakeham, S. G., Schaffner, C., & Giger, W. (1980). Polycyclic aromatic hydrocarbons in recent lake sediments—I. Compounds having anthropogenic origins. *Geochimica et Cosmochimica Acta*, *44*(3), 403–413. https://doi.org/10.1016/0016-7037(80)90040-x

Wang, Z., Wang, Y., Zhao, P., Chen, L., Yan, C., Yan, Y., & Chi, Q. (2015). Metal release from contaminated coastal sediments under changing pH conditions: Implications for metal mobilization in acidified oceans. *Marine Pollution Bulletin*, *101*(2), 707–715. https://doi.org/10.1016/j.marpolbul.2015.10.026

Warren, L.A., & Zimmerman, A.P. (1993). Trace metal-suspended particulate matter associations in a fluvial system: Physical and chemical influences. *Particulate and matter and aquatic contaminants* (pp. 127-155). Lewis Publishers.

Youngblood, W. W., & Blumer, M. (1975). Polycyclic aromatic hydrocarbons in the environment: homologous series in soils and recent marine sediments. *Geochimica et Cosmochimica Acta*, *39*(9), 1303–1314. https://doi.org/10.1016/0016-7037(75)90137-4

Appendices

Appendix A

Guidelines on Use of Report

This report (the "Report") was prepared as part of the services (the "Services") provided by Fugro GB Marine Limited ("Fugro") for its client (the "Client") under terms of the relevant contract between the two parties (the "Contract"). The Services were performed by Fugro based on requirements of the Client set out in the Contract or otherwise made known by the Client to Fugro at the time.

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Appendix B

Methodologies

B.1 Survey Methods

B.1.1 Grabs

Seafloor samples were acquired using a 0.1 m^2 dual van Veen grab. In areas that contained sediments that were too coarse for the dual van Veen grab to take a successful sample, a mini-Hamon grab was used instead.

Operational procedures for grab sampling were as follows:

- The 0.1 m^2 dual van Veen grab or mini-Hamon grab was prepared for operations prior to arrival on station. An ultra short baseline (USBL) beacon was attached to the grab frame. The Bridge communicated to the deck via a very high frequency (VHF) radio when the vessel was steady and on location, and the grab was deployed from the starboard A-frame;
- When the engineer operating the winch observed that the grab had reached the seafloor (evidenced through a distinct slackening of the wire rope and snatch block), the online surveyor was informed (via VHF radio) and a fix was taken;
- On recovery to the deck, the sample was inspected and judged acceptable or otherwise (see below for rejection criteria);
- One accepted grab sample was retained for faunal analysis and one grab sample was retained and subsampled for physico-chemical analysis;
- Deck logs were completed for each sample acquired (including no samples). The information collected included date, time, sample number, fix number, sediment type, depth and colour of strata in the sediment (if any) using Munsell colour codes, odour (i.e. H_2S), bioturbation or debris.

Samples were considered unacceptable in the following instances:

- Evidence of sediment washout caused through improperly closed grab jaws or inspection hatch;
- Sediment sample taken on an angle, where the grab jaws have not been parallel to the seafloor when the grab fired;
- Disruption of the sample through striking the side of the vessel;
- Sample represented less than approximately 7 cm bite depth of the grab (unless deemed acceptable by the client representative);
- The presence of a hagfish (*Myxine glutinosa*) and/or other mucous coagulants;
- Sample is more than 10 m from the target location (unless deemed acceptable by the client representative);
- Deemed unacceptable by the client representative for any other reason.

B.1.2 Cores

- The vibrocorer was prepared for operations prior to arrival on station. A USBL beacon was attached to the frame. The Bridge communicated to the deck via a VHF radio when the vessel was steady and on location, and the corer was deployed from the stern A-frame;

- When the engineer operating the winch observed that the grab had reached the seafloor (evidenced through a distinct slackening of the wire and snatch block), the online surveyor was informed (via VHF radio) and a fix was taken;
- At this point the vibrocore mechanism was activated to drive the core tube into the sediment;
- On recovery to the deck, the core liner was removed from the corer tube. Penetration, determined by a marker on the barrel, was recorded and the length of sample recovered in the tube was also recorded;
- The core liner was then marked and cut into lengths dictated by the scope of work; 0.5 m lengths with the top 0.1 m section being retained for contamination analysis and the remaining 0.4 m being retained by the geotechnical engineers for field analysis and storage for further laboratory analysis;
- Deck logs were completed for each sample acquired. The information collected was date, time, depth within the core as a whole, sample depth and sediment type.

B.2 Laboratory Analysis for Sediment Samples

B.2.1 Hydrocarbon Analysis in Sediments

B.2.1.1 General Precautions

To effectively eliminate all possible sources of hydrocarbon contamination from the analysis the following precautionary measures were taken prior to sample work-up:

- All solvents were purchased as high purity grade. Each batch was checked for purity by concentrating approximately 400 mL down to a small volume (< 1 mL) and analysing by gas chromatography (GC);
- All water used was distilled through an all glass still and dichloromethane extracted to minimise contamination from plasticisers;
- All glassware was cleaned using an acid/base machine wash. The glassware was rinsed with acetone then finally with dichloromethane prior to use;
- Procedural blanks, replicate analyses and laboratory reference material were run with each batch.

B.2.1.2 Ultrasonication Extraction for Hydrocarbons in Sediment

Sediment samples were thawed, homogenised and accurately weighed into a 250 mL conical flask. A solution containing an appropriate amount of the following internal standards was added to each sample using a microsyringe.

Aliphatic Standards	Aromatic Standards
Heptamethylnonane	D_8 Naphthalene
D_{34} Hexadecane	D_{10} Acenaphthene
D_{42} Eicosane	D_{10} Phenanthrene
Squalane	D_{10} Pyrene
	D_{12} Chrysene
	D_{12} Perylene

Methanol (50 mL) and solvent were mixed with the sediment. Dichloromethane (DCM; 60 mL) was then added and the sample mixed again. The flasks were then capped with solvent cleaned aluminium foil and ultrasonicated for 30 minutes.

After being allowed to settle the solvent was decanted through a GF-C filter paper into a 1 L separating funnel. The extract was then partitioned with 100 mL of DCM extracted distilled water and the DCM layer run-off into a clean 500 mL round-bottomed flask. The ultrasonic extraction was repeated a further two times using 50 mL DCM and 15 minutes of ultrasonication. Each time the filtered extract was partitioned with the remaining methanol/water in the separating funnel. The DCM extracts were bulked and reduced in volume to approximately 2 mL using a rotary evaporator, then further reduced to approximately 1 mL under a gentle stream of nitrogen prior to clean-up.

Correction factors for wet/dry sediments were obtained by drying a subsample of the homogenised sediment to constant weight at 105 °C.

B.2.1.3 Clean-Up of Extracts by Column Chromatography

Removal of polar material, including lipids was carried out using a silica gel column. The silica gel used was 70 to 230 mesh which was heated at 400 °C for at least 4 hours to remove impurities and residual moisture and then stored at 200 °C prior to use. The sample extract was added to the silica gel column, containing 5 g of adsorbent and eluted with 35 mL of DCM/pentane (1:2). The eluant was reduced in volume using the evaporator to approximately 2 mL, with activated copper powder (for removal of free sulphur), before being further reduced under a gentle stream of nitrogen to an appropriate volume and analysed by both GC and gas chromatography-mass spectrometry (GC-MS).

	Gas Chromatography [GC]	Gas Chromatography-Mass Spectrometry [GC-MS]
Instrument	HP 6890 Series GC with 7673 autoinjector	HP 7890 Series GC with autoinjector and 5977A MSD
Column	100 %-dimethylpolysiloxane bonded fused silica, 60 m, 0.25 µm film thickness, 0.32 mm internal diameter	(5 %phenyl)-methylpolysiloxane bonded fused silica, 60 m, 0.32 µm film thickness 0.25 mm internal diameter
Carrier Gas	Hydrogen (constant flow 3.5 mL/min)	Hydrogen (constant flow 1.4 mL/min)
Injector	On–column (2 µL injection)	Splitless, 280 °C, split flow 40 mL/min, vent time 1.5 min (1 µL injection)
Oven Temperature Programme	80 °C – 2 min 80 °C to 320 °C at 18 °C/min 320 °C – 13 min 320 °C to 350 °C at 30 °C/min	60 °C – 1 min 60 °C to 180 °C at 11 °C/min 180 °C to 260 °C at 6 °C/min 260 °C to 320 °C at 6 °C/min 330 °C – 7 min
Source/Detector Temperature	350 °C (FID)	230 °C
Electron Energy	-	70 eV
Selected Ion Monitoring (SIM)	-	9 groups - 6 ions per group
Dwell Time (per ion)	-	0.035 second

B.2.1.4 Polycyclic Aromatic Hydrocarbons

A full range of polycyclic aromatic hydrocarbon (PAH) and alkylated PAH were quantified as specified by Department of Trade and Industry (DTI) regulations (DTI, 1993).

Calibration was undertaken using a range of PAH standard solutions, a number of alkylated PAH, dibenzothiophene and a range of suitable internal standards. Individual response factors were calculated for each of the compounds present in the calibration solution.

Response factors for the non calibrated alkylated PAH were taken to be equivalent to closely related compounds. The MRV of individual and alkylated PAHs is 0.1 ng/g.

B.2.2 Polychlorinated Biphenyls (PCBs)

B.2.2.1 Accelerated Solvent Extraction Procedure

Polychlorinated biphenyls (PCBs) are extracted from sediment and soil samples using accelerated solvent extraction using a hexane/acetone (2:1, v/v) as the extraction solvent. Accelerated solvent extraction cells were prepared with 10 g sodium sulphate and 10 g 5 % deactivated alumina. Sediment samples were accurately weighed into cells, a known quantity of hexabromobiphenyl added as internal standard and extracted using an ASE 350. The ASE instrument parameters are shown in the following table.

Solvent	Hexane:acetone (2:1, v/v)
Extraction Temperature	100 °C
Pressure	1500 psi
Pre-heat Time	2 min
Cell Heat Time	5 min
Static Time	5 min
Flush Volume	60 %
Purge Time	60 secs
Cycles	4

B.2.2.2 Clean-up of Sediment Extracts by Column Chromatography

Sample extracts are cleaned up by column chromatography using 40 % (w/w) acid silica. The silica gel used was 70 to 230 mesh, muffled at 400 °C for at least 4 hours to remove impurities and activate it then stored at 200 °C. Prior to use, acid silica is prepared by the addition of sulphuric acid to silica. The sediment extract was added to the silica gel column, containing 5 g of adsorbent and eluted with 30 mL of hexane. The eluent was reduced in volume using the evaporator to approximately 2 mL before being further reduced under a gentle stream of nitrogen to an appropriate volume, approximately 1 g of activated copper powder (for removal of free sulphur) before being concentrated to 0.5 mL for analysis.

B.2.2.3 GC-MS Analysis of ICES 7 PCBs

Sample extracts were analysed by GC-MS for the Dutch 7 Congeners (PCBs 28, 52, 101, 118, 138, 153 and 180). The instrument parameters are shown in the following table:

	Gas Chromatography-Mass Spectrometry [GC-MS]
Instrument	HP 7890 Series GC with autoinjector and 5977B HES MSD
Column	(5 %phenyl)-methylpolysiloxane bonded fused silica, 30 m, 0.25 µm film thickness 0.25 mm internal diameter

Carrier Gas	Hydrogen (constant flow 1.3 mL/min)
Injector	Splitless, 280 °C, split flow 30 mL/min, vent time 1.5 min (2 µL injection)
Oven Temperature Programme	60 °C – 1 min 60 °C to 320 °C at 10 °C/min 320 °C – 8 min
Source/Detector Temperature	250 °C
Electron Energy	70 eV
Selected Ion Monitoring (SIM)	1 group - 11 ions
Dwell Time (per ion)	0.035 second

B.2.3 Organotins

B.2.3.1 Ultrasonic Extraction Procedure

Sediment samples were thawed, homogenised and accurately weighed into a 125 mL conical flask. A solution containing an appropriate amount of the internal standard (containing monoheptyltin, diheptyltin and tripropyltin) was added to each sample. Extraction solvent (acetic acid:methanol:water (1:1:1, v:v:v)) was added and the sample mixed again. The flasks were then capped with solvent cleaned aluminium foil and ultrasonicated for 30 minutes. The slurry was transferred to a centrifuge tube and centrifuged to separate the liquid and solid phases. The ultrasonication and centrifugation steps were repeated one further time. The two extraction solutions were combined, mixed and the pH adjusted to approximately 4.5 using a sodium hydroxide solution. The extract solution was derivatised using 5 % (w/v) sodium tetraethylborate in water solution, the solution left for 30 minutes before 5 mL of hexane was added. The solutions were mixed, left to separate and the hexane layer transferred to a 12 mL vial. The derivatisation step was repeated and a further 5 mL of hexane added. The hexane layers were combined and blown down to 1 mL.

B.2.3.2 Clean-up of Sediment Extracts by Column Chromatography

Sample extracts are cleaned up by column chromatography using 3 % de-activated silica. The silica gel used was 70 mesh to 230 mesh, muffled at 400 °C for at least 4 hours to remove impurities and activate it then stored at 200 °C. Prior to use, silica is deactivated by the addition of distilled water. The sediment extract was added to the silica gel column, containing 5 g of adsorbent and eluted with 30 mL of hexane/dichloromethane (4:1, v:v). The eluent was reduced in volume using the evaporator to approximately 2 mL before being further reduced under a gentle stream of nitrogen to an appropriate volume approximately 1 g of activated copper powder (for removal of free sulphur) before being concentrated to 0.5 mL for analysis.

B.2.3.3 GC-MS Analysis of Organotins

Sample extracts are analysed by GC-MS using selected ion monitoring for monobutyltin, dibutyltin, and tributyltin. The instrument parameters are shown on the following table.

	Gas Chromatography-Mass Spectrometry [GC-MS]
Instrument	HP 7890 Series GC with autoinjector and 5977B HES MSD
Column	(5 %phenyl)-methylpolysiloxane bonded fused silica, 30 m, 0.25 µm film thickness 0.25 mm internal diameter
Carrier Gas	Hydrogen (constant flow 1.3 mL/min)
Injector	Splitless, 280 °C, split flow 50 mL/min, vent time 1.0 min (2 µL injection)
Oven Temperature Programme	60 °C – 1 min 60 °C to 240 °C at 13 °C/min 240 °C to 320 °C at 45 °C/min 320 °C – 6 min
Source/Detector Temperature	250 °C
Electron Energy	70 eV
Selected Ion Monitoring (SIM)	3 groups - 6 ions per group
Dwell Time (per ion)	0.030 second

B.2.4 Heavy and Trace Metals in Sediments

Heavy and trace metal content was determined by Fugro. Sediment samples were dried at 40 °C and then sieved to the required size fraction (2000 µm). Samples were subjected to an aqua regia microwave digestion. This acid mixture allows a partial dissolution of metals, predominately releasing those associated with the sediment fines. The resulting digests were then analysed by inductively coupled plasma–mass spectrometry (ICP-MS) for arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. and inductively coupled plasma – optical emission spectrometry (ICP-OES) for aluminium and iron.

Appendix C

Logs

C.1 Survey Log

Click icon to open survey log.

Appendix C.1 Survey Log.xlsx

C.2 Grab Log

Click icon to open grab log.

Appendix C.2 Grab Log.xlsx

C.3 Vibrocore Log

Click icon to open vibrocore log.

Appendix C.3 Vibrocore Log.xlsx

Appendix D

Sediment Hydrocarbon Analysis

D.1 Aromatic Hydrocarbon Concentrations

D.1.1 Total 2 to 6 Ring PAH Concentrations

D.1.1.1 Grabs

Click icon to open grabs.

Appendix D.1.1 Total 2 to 6 Ring PAH Grab

D.1.1.2 Cores

Click icon to open cores.

Appendix D.1.2 Total 2 to 6 Ring PAH Core

MarramWind