Cenos Offshore Windfarm Limited

Cenos EIA

Chapter 9 – Marine Water and Sediment Quality

ASSIGNMENT	A100907-S01
DOCUMENT	A-100907-S01-A-ESIA-010
CLIENT	CEN001-FLO-CON-ENV-RPT-0012

XODUS

Aberdeen

www.xodusgroup.com

5th Floor Capitol Building
429-431 Union Street . Aberdeen
AB11 6DA . UK

REVISIONS & APPROVALS

This document has been prepared by Xodus Group exclusively for the benefit and use of Cenos Offshore Windfarm Limited. Xodus Group expressly disclaims any and all liability to third parties (parties or persons other than Cenos Offshore Windfarm Limited) which may be based on this document.

The information contained in this document is strictly confidential and intended only for the use of Cenos Offshore Windfarm Limited. This document shall not be reproduced, distributed, quoted or made available – in whole or in part – to any third party other than for the purpose for which it was originally produced without the prior written consent of Xodus Group.

The authenticity, completeness and accuracy of any information provided to Xodus Group in relation to this document has not been independently verified. No representation or warranty express or implied, is or will be made in relation to, and no responsibility or liability will be accepted by Xodus Group as to or in relation to, the accuracy or completeness of this document. Xodus Group expressly disclaims any and all liability which may be based on such information, errors therein or omissions therefrom.

REV	DATE	DESCRIPTION	ISSUED	CHECKED	APPROVED	CLIENT
A01	17/12/24	Issued for Use	AH	AC	MD	Cenos
R02	14/11/24	Issued for Review	AH	AC	NB	Cenos
R01	16/09/24	Issued for Review	AH/GK	AC	LD	Cenos

CONTENTS

ACRONYMS

ACRONYM	DEFINITION
2D	Two-dimensional
3D	Three-dimensional
AHCH	alpha-Hexachlorocyclohexane
Al	Aluminium
AL	Action Levels
AL1	Action Level 1
AL2	Action Level 2
As	Arsenic
Ba	Barium
BAC	Background Assessment Concentration
BC	Background Concentrations
BEIS	Department of Business, Energy and Industrial Strategy
BGS	British Geological Survey
BHCH	beta-Hexachlorocyclohexane
°C	degrees Celsius
CAR	Controlled Activities Regulations
CCME	Canadian Council of Ministers of the Environment
Cd	Cadmium
CEDA	Central Dredging Association
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CNS	Central North Sea
Cr	Chromium
CREW	Centre of Expertise for Waters
CSEMP	Clean Seas Environmental Monitoring Programme
CTD	Conductivity, Temperature and Depth
Cu	Copper
DBT	Dibutyltin
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen

ACRONYM	DEFINITION
DoL	Depth of Lowering
DVV	Double Van Veen
EBS	Environmental Baseline Survey
E. coli	*Escherichia coli*
EEA	European Economic Area
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EICC	Export/Import Cable Corridor
ERL	Effect Range Low
EMP	Environmental Management Plan
ERM	Effect Range Median
EQS	Environmental Quality Standards
Fe	Iron
FEPA	Food and Environment Protection Act
FTU	Floating Turbine Unit
GES	Good Environmental Status
GHCH	gamma-Hexachlorocyclohexane
GPP	Guidance for Pollution Prevention
HDD	Horizontal Directional Drilling
HG	Hamon Grab
Hg	Mercury
HVDC	High Voltage Direct Current
IAC	Inter-Array Cable
IADC	International Association of Dredging Companies
ICES	International Council for the Exploration of the Sea
IE	*Intestinal enterococci*
IMO	International Maritime Organization
INNS	Invasive Non-Native Species
INNSMP	Invasive Non Native Species Management Plan
ISQG	Interim Sediment Quality Guidelines
kg/s	Kilogram per second
km	Kilometre
Li	Lithium

ACRONYM	DEFINITION
m	Metre
m/hr	Metre per hour
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder
MD-LOT	Marine Directorate – Licensing Operations Team
MD-SEDD	Marine Directorate – Science, Evidence, Data and Digital
MERMAN	Marine Environment Monitoring and Assessment National
µg	Microgram
mg/kg	Milligrams per kilogram
mg/l	Milligrams per litre
MHWS	Mean High Water Springs
mm	Millimetre
MMO	Marine Management Organisation
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive
NCMPA	Nature Conservation Marine Protected Area
Ni	Nickel
NM	Nautical Miles
NMPi	National Marine Plan Interactive
NOAA	National Oceanic and Atmospheric Administration
NVZ	Nitrate Vulnerable Zones
OCP	Organochlorine Pesticides
OSCP	Offshore Substation Converter Platform
OSPAR	Oslo-Paris Convention
OWF	Offshore Windfarm
%	Percent
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PBDE	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PEL	Probable Effect Level
PLGR	Pre-Lay Grapnel Run
PLONOR	Pose Little or No Risk

ACRONYM	DEFINITION
PSA	Particle Size Analysis
PSD	Particle Size Distribution
psu	Practical Salinity Units
RBMP	River Basin Management Plans
RIVM	Rijksinstituut voor Volksgezondheid en Milieu
SBP	Sub-bottom Profiler
SD	Standard Deviation
SEPA	Scottish Environment Protection Agency
SOPEP	Ship Oil Pollution Emergency Plan
∑PCB25	Sum of 25 congeners
∑PCB7	Sum of ICES 7
SPM	Suspended Particulate Matter
SSC	Suspended Sediment Concentrations
SSS	Side Scan Sonar
TBT	Tributyltin
TEL	Threshold Effect Level
THC	Total Hydrocarbon Content
TKE	Turbulent Kinetic Energy
TLP	Tension Leg Platform
TOC	Total Organic Carbon
TOM	Total Organic Matter
TSS	Total Suspended Solids
UHR	Ultra-High Resolution
UK	United Kingdom
UKCS	UK Continental Shelf
UKOOA	UK Offshore Operators Association
WFD	Water Framework Directive
WTG	Wind Turbine Generator
Zn	Zinc
ZoI	Zone of Influence

GLOSSARY

TERM	DEFINITION
2023 Scoping Opinion	Scoping Opinion received in June 2023, superseded by the 2024 Scoping Opinion.
2023 Scoping Report	Environmental Impact Assessment (EIA) Scoping Report submitted in 2023, superseded by the 2024 Scoping Report.
2024 Scoping Opinion	Scoping Opinion received in September 2024, superseding the 2023 Scoping Opinion.
2024 Scoping Report	EIA Scoping Report submitted in April 2024, superseding the 2023 Scoping Report.
Area of Opportunity	The area in which the limits of electricity transmission via High Voltage Alternating Current (HVAC) cables can reach oil and gas assets for decarbonisation. This area is based on assets within a 100 kilometre (km) radius of the Array Area.
Array Area	The area within which the Wind Turbine Generators (WTGs), floating substructures, moorings and anchors, Offshore Substation Converter Platforms (OSCPs) and Inter-Array Cables (IAC) will be present.
Cenos Offshore Windfarm ('the Project')	'The Project' is the term used to describe Cenos Offshore Windfarm. The Project is a floating offshore windfarm located in the North Sea, with a generating capacity of up to 1,350 Megawatts (MW). The Project which defines the Red Line Boundary (RLB) for the Section 36 Consent and Marine Licence Applications (MLA), includes all offshore components seaward of Mean High Water Springs (MHWS) (WTGs, OSCPs, cables, floating substructures moorings and anchors and all other associated infrastructure). The Project is the focus of this Environmental Impact Assessment Report (EIAR).
Cenos Offshore Windfarm Ltd. (The Applicant)	The Applicant for the Section 36 Consent and associated Marine Licences.
Cumulative Assessment	The consideration of potential impacts that could occur cumulatively with other relevant projects, plans, and activities that could result in a cumulative effect on receptors.

TERM	DEFINITION
Developer	Cenos Offshore Windfarm Ltd., a Joint Venture between Flotation Energy and Vårgrønn As (Vårgrønn).
Environmental Impact Assessment (EIA)	The statutory process of evaluating the likely significant environmental effects of a proposed project or development. Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and maintenance and decommissioning.
Environmental Impact Assessment Regulations	This term is used to refer to the Environmental Impact Assessment Regulations which are of relevance to the Project. This includes the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended); and the Marine Works (Environmental Impact Assessment) Regulations 2007.
Environmental Impact Assessment Report	A report documenting the findings of the EIA for the Project in accordance with relevant EIA Regulations.
Export/Import Cable	High voltage cable used to export/import power between the OSCPs and Landfall.
Export/Import Cable Bundle (EICB)	Comprising two Export/Import Cables and one fibre-optic cable bundled in a single trench.
Export/Import Cable Corridor (EICC)	The area within which the Export/Import Cable Route will be planned and the Export/Import Cable will be laid, from the perimeter of the Array Area to MHWS.
Export/Import Cable Route	The area within the Export/Import Export Corridor (EICC) within which the Export/Import Cable Bundle (EICB) is laid, from the perimeter of the Array Area to MHWS.
Floating Turbine Unit (FTU)	The equipment associated with electricity generation comprising the WTG, the floating substructure which supports the WTG, mooring system and the dynamic section of the IAC.
Flotation Energy	Joint venture partner in Cenos Offshore Windfarm Ltd.

TERM	DEFINITION
Habitats Regulations	The Habitats Directive (Directive 92/43/ECC) and the Wild Birds Directive (Directive 2009/147/EC) were transposed into Scottish Law by the Conservation (Natural Habitats &c) Regulations 1994 ('Habitats Regulations') (up to 12 NM); by the Conservation of Offshore Marine Habitats and Species Regulations 2017 ('Offshore Marine Regulations') (beyond 12 NM); the Conservation of Habitats and Species Regulations 2017 (of relevance to consents under Section 36 of the Electricity Act 1989); the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001; and the Wildlife and Countryside Act 1981. The Habitats Regulations set out the stages of the Habitats Regulations Appraisal (HRA) process required to assess the potential impacts of a proposed project on European Sites (Special Areas of Conservation, Special Protection Areas, candidate SACs and SPAs and Ramsar Sites).
Habitats Regulations Appraisal	The assessment of the impacts of implementing a plan or policy on a European Site, the purpose being to consider the impacts of a project against conservation objectives of the site and to ascertain whether it would adversely affect the integrity of the site.
High Voltage Alternating Current (HVAC)	Refers to high voltage electricity in Alternating Current (AC) form which is produced by the WTGs and flows through the IAC system to the OSCPs. HVAC may also be used for onward power transmission from the OSCPs to assets or to shore over shorter distances.
High Voltage Direct Current (HVDC)	Refers to high voltage electricity in Direct Current (DC) form which is converted from HVAC to HVDC at the OSCPs and transmitted to shore over longer distances.
Horizontal Directional Drilling (HDD)	An engineering technique for laying cables that avoids open trenches by drilling between two locations beneath the ground's surface.
Innovation and Targeted Oil & Gas (INTOG)	In November 2022, the Crown Estate Scotland (CES) announced the Innovation and Targeted Oil & Gas (INTOG) Leasing Round, to help enable this sector-wide commitment to decarbonisation. INTOG allowed developers to apply for seabed rights to develop offshore windfarms for the purpose of providing low carbon electricity to power oil and gas installations and help to decarbonise the sector. Cenos is an INTOG project and in November 2023 secured an Exclusivity Agreement as part of the INTOG leasing round.

TERM	DEFINITION
Inter-Array Cable (IAC)	The cables which connect the WTGs to the OSCPs. WTGs may be connected with IACs into a hub or in series as a 'string' or a 'loop' such that power from the connected WTGs is gathered to the OSCPs via a single cable.
Joint Venture	The commercial partnership between Flotation Energy and Vårgrønn, the shareholders which hold the Exclusivity Agreement with CES to develop the Cenos site as an INTOG project.
Landfall	The area where the Export/Import Cable from the Array Area will be brought ashore. The interface between the offshore and onshore environments.
Marine Licence	Licence required for certain activities in the marine environment and granted under the Marine and Coastal Access Act 2009 and/or the Marine (Scotland) Act 2010.
Marine Protected Area (MPA)	Marine sites protected at the national level under the Marine (Scotland) Act 2010 out to 12 NM, and the Marine and Coastal Access Act 2009 between 12-200 NM. In Scotland MPAs are areas of sea and seabed defined so as to protect habitats, wildlife, geology, underseas landforms, historic shipwrecks and to demonstrate sustainable management of the sea.
Marine Protected Area (MPA) Assessment	A three-step process for determining whether there is a significant risk that a proposed development could hinder the achievement of the conservation objectives of an MPA.
Mean High Water Springs (MHWS)	The height of Mean High Water Springs is the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	The height of Mean Low Water Springs is the average throughout a year of the heights of two successive low waters during periods of 24 hours (approximately once a fortnight).
Mitigation Measures	Measures considered within the topic-specific chapters in order to avoid impacts or reduce them to acceptable levels. • Primary mitigation - measures that are an inherent part of the design of the Project which reduce or avoid the likelihood or magnitude of an adverse environmental effect, including location or design; • Secondary mitigation – additional measures implemented to further reduce environmental effects to 'not significant' levels (where

TERM	DEFINITION
	appropriate) and do not form part of the fundamental design of the Project; and • Tertiary mitigation – measures that are implemented in accordance with industry standard practice or to meet legislative requirements and are independent of the EIA (i.e. they would be implemented regardless of the findings of the EIA). Primary and tertiary mitigation are referred to as embedded mitigation. Secondary mitigation is referred to as additional mitigation.
Mooring System	Comprising the mooring lines and anchors, the mooring system connects the floating substructure to the seabed, provides station-keeping capability for the floating substructure and contributes to the stability of the floating substructure and WTG.
Nature Conservation Marine Protected Area (NCMPA)	MPA designated by Scottish Ministers in the interests of nature conservation under the Marine (Scotland) Act 2010.
Offshore Substation Converter Platforms (OSCPs)	An offshore platform on a fixed jacket substructure, containing electrical equipment to aggregate the power from the WTGs and convert power between HVAC and HVDC for export/import via the Export/Import Cable to/from the shore. The OSCPs will also act as power distribution stations for the Oil & Gas platforms.
Onward Development	Transmission projects which are anticipated to be brought forward for development by 3rd party oil and gas operators to enable electrification of assets via electricity generated by the Project. All Onward Development will subject to separate marine licensing and permitting requirements.
Onward Development Area	The area within which oil and gas assets would have the potential to be electrified by the Project.
Onward Development Connections	Oil and gas assets located in the waters surrounding the Array Area will be electrified via transmission infrastructure which will connect to the Project's OSCPs. These transmission cables are referred to as Onward Development Connections.
Project Area	The area that encompasses both the Array Area and EICC.
Project Design Envelope	A description of the range of possible elements that make up the Project design options under consideration and that are assessed as part of the EIA for the Project.

TERM	DEFINITION
Study Area	Receptor specific area where potential impacts from the Project could occur.
Transboundary Assessment	The consideration of impacts from the Project which have the potential to have a significant effect on another European Economic Area (EEA) state's environment. Where there is a potential for a transboundary effect, as a result of the Project, these are assessed within the relevant EIA chapter.
Transmission Infrastructure	The infrastructure responsible for moving electricity from generating stations to substations, load areas, assets and the electrical grid, comprising the OSCPs, and associated substructure, and the Export/Import Cable.
Vårgrønn As (Vårgrønn)	Joint venture partner in Cenos Offshore Windfarm Ltd.
Wind Turbine Generator (WTG)	The equipment associated with electricity generation from available wind resource, comprising the surface components located above the supporting substructure (e.g., tower, nacelle, hub, blades, and any necessary power transformation equipment, generators, and switchgears).
Worst-Case Scenario	The worst-case scenario based on the Project Design Envelope which varies by receptor and/or impact pathway identified.

9 MARINE WATER AND SEDIMENT QUALITY

9.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents the Marine Water and Sediment Quality receptors of relevance to the Project and assesses the potential impacts from the construction, operation and maintenance and decommissioning of the Project on these receptors. Where required, mitigation is proposed, and the residual impacts and their significance are assessed. Potential cumulative and transboundary impacts are also considered.

Table 9-1 below provides a list of all the supporting studies which relate to and should be read in conjunction with the Marine Water and Sediment Quality impact assessment.

Table 9-1 Supporting studies

DETAILS OF STUDY	SUPPORTING STUDIES AND LOCATION (WHERE RELEVANT)
Benthic Survey Report: NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey	MMT Sweden AB ('MMT') (2018)
Environmental Baseline Report	EIAR Vol. 4, Appendix 10 EIAR Vol. 4, Appendix 11 EIAR Vol. 4, Appendix 12
OWF Geophysical Results Report	Rovco Ltd., (2024a)
EICC Geophysical Results Report	Rovco Ltd., (2024b)

The impact assessment presented herein draws upon information presented within other impact assessments within this EIAR, including:

- EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes – which assesses the impacts of the Project on water and sediment through the interaction with physical and coastal processes; and
- EIAR Vol. 3, Chapter 10: Benthic Ecology which characterises the invasive non-native species in the Project Area and provides the context for assessment on Marine Water and Sediment Quality receptors.

Where information from other chapters is used to inform the impact assessment, reference to the relevant EIAR chapter is given.

The following specialists have contributed to the assessment:

- Ashley Hecklinger, Xodus Group; and
- Anna Chaffey, Xodus Group.

9.2 Legislation, policy, and guidance

The wider marine planning, legislation, policy and guidance is discussed in EIAR Vol. 2, Chapter 3: Policy and Legislative Context. The following legislation, policy, and guidance are relevant to the assessment of impacts from the Project on Marine Water and Sediment Quality:

- Legislation:
  - Food and Environment Protection Act (FEPA) 1985;
  - Water Environment and Water Services (Scotland) Act 2003;
  - Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008;
  - Bathing Waters (Scotland) Regulations 2008;
  - Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended);
  - Marine Strategy Regulations 2010;
  - Pollution Prevention and Control (Scotland) Regulations 2012;
  - Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013; and
  - Environmental Authorisations (Scotland) Regulations 2018.
- Policy:
  - The following policies of Scotland's National Marine Plan[1] (Scottish Government, 2015a), which was prepared in accordance with the United Kingdom (UK) Marine Policy Statement, apply to this Marine Water and Sediment Quality assessment:
    - GEN 1 General planning principle: *There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan;*
    - GEN 10 Invasive non-native species: *Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made*;
    - GEN 12 Water quality and resource: *Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive (WFD), Marine Strategy Framework Directive (MSFD) or other related Directives apply*;
    - GEN 21 Cumulative effects: *Cumulative effects affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation*; and
    - The Good Environmental Status (GES) Descriptors provided in Annex B of the NMP, including GES 8: Concentrations of contaminants are at levels not giving rise to pollution effects.
- Guidance:
  - Scottish Environment Protection Agency (SEPA) Guidance for Pollution Prevention (GPPs) (NetRegs, 2024);
  - Supporting Guidance (WAT-SG-53) Environmental Quality Standards and Standards for Discharges to Surface Waters (SEPA, 2020a);
  - SEPA Position Statement on alteration of structures and Invasive Non-Native Species (INNS) (SEPA, 2023a); and
  - SEPA Land Use Planning System Guidance Note 13, Version 9 (SEPA, 2023b).

[1] *Following the most recent review of the NMP in 2021, the Scottish Ministers announced, in 2022, their intention to update the National Marine Plan. This update is underway but has not yet reached a draft consultation stage. A stakeholder engagement strategy and statement of public participation was published in August 2024.*

9.3 Scoping and consultation

Stakeholder consultation has been ongoing throughout the EIA and has played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the Project and the requirements of the regulators and their advisors.

The 2024 Scoping Report was submitted to Marine Directorate – Licensing Operations Team (MD-LOT) in April 2024, relevant stakeholders were consulted. The Scoping Opinion was received in September 2024. The 2024 Scoping Report and Scoping Opinion supersedes the 2023 Scoping Report and Scoping Opinion for the Project. Relevant comments from the Scoping Opinion specific to Marine Water and Sediment Quality are provided in Table 9-2 below, which provides a high-level response on how these comments have been addressed within the EIAR.

Further consultation has been undertaken throughout the pre-application phase. The list below summarises the consultation activities carried out relevant to Marine Water and Sediment Quality:

A Scoping Workshop was held on the 29th February 2024 (as detailed in EIAR Vol. 2, Chapter 1: Introduction). The Applicant sought feedback from stakeholders on the 2024 Scoping Report ahead of submission during this workshop, however, no responses were provided in relation to Marine Water and Sediment Quality.

Table 9-2 Comments from the Scoping Opinion relevant to Marine Water and Sediment Quality

CONSULTEE	COMMENT	RESPONSE
Scottish Ministers	The Developer considers the impact of the Proposed Development on marine water and sediment quality within chapter 8 of the Scoping Report. The Scottish Ministers are content with the study area and baseline characterisation as described in sections 8.3 and 8.5 of the Scoping Report respectively.	The baseline characterisation is presented in Section 9.4, with the Marine Water and Sediment Quality Study Area presented in Section 9.4.1 and the existing baseline detailed in Section 9.4.
Scottish Ministers	Table 8.7 of the Scoping Report sets out the impacts proposed to be scoped in and out of the EIAR. The Scottish Ministers are content with this approach and direct the Developer to the standing advice provided by SEPA and advise that this is fully considered in the EIAR.	With regards to accidental releases to the marine environment the embedded mitigation measures (Section 9.5.4) will ensure that the Project complies with good practice, applying strict environmental controls through the implementation of the Environmental Management Plan (EMP), which will include a MPCP. These plans will detail procedures in the event of an accidental release, characterise all sources for potential contaminant releases and provide key emergency contact details for use in the event of a release. Measures detailed in the EMP and MPCP will be in accordance with Oslo-Paris Convention (OSPAR) and Marine Pollution (MARPOL) Convention guidelines for preventing pollution at sea. Individual vessels will also have a Ship Oil Pollution Emergency Plan (SOPEP) in place. For these reasons, the potential for accidental release of contaminants is extremely unlikely and any incidents would be responded to quickly, with strict controls to effectively minimise the scale and impact of any accidental release on the marine environment.
Scottish Ministers	The Scottish Ministers note that the Developer has committed to undertaking further consultation with MD-LOT and MD-SEDD on Marine Water and Sediment Quality. The Scottish Ministers advise that any advice received should be reflected in the EIAR.	The Marine Water and Sediment Quality topic assessment was completed using best practice and expert judgement in light of the Project Design Envelope and the water and sediment quality properties across the wider region. A Study Area was defined based on physical processes as described in Section 9.4.1. Data sources applied included site-specific data and information from secondary sources (Sections 9.4.2 and 9.4.3). The assessment of potential impacts on designated waters considered five coastal waterbodies and three bathing waters that intersected the defined Study Area (Section

CONSULTEE	COMMENT	RESPONSE
		9.4.5.2). The assessment as completed in Section 9.6 entailed the use of analytical outputs from EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes, particularly information on increases in suspended sediment concentration and dispersion extents. The analytical results in addition to topic-specific baseline information from Project surveys (including water column sampling and profiling and sediment contaminant sampling) and secondary data sources were all used to evaluate the potential for impact to Marine Water and Sediment Quality receptors. During the quarterly updates with MD-LOT, priority topics have been discussed. This topic has not come up during those meetings and has therefore not had any further consultation.
Scottish Ministers	The Scottish Ministers agree that cumulative effects is scoped in and transboundary effects can be scoped out of the EIAR.	Cumulative effects have been scoped in and addressed in Section 9.7, while transboundary effects have been scoped out as stated in Section 9.10.
MD-SEDD	Do you agree that the data sources identified, including project specific surveys, are sufficient to inform the MCP baseline for the EIAR? The only mention of temperature and salinity data in Table 7-4 are climatologies from ICES. Whilst these are useful, MD-SEDD advise the use of conductivity, temperature, depth (CTD) data (e.g. from ICES, BODC, etc.) and existing 3D hydrodynamic model outputs (e.g. from Copernicus Marine, Met Office, or MD-SEDD). The use of the Scottish Shelf Model (SSM) and CTD data are mentioned in Table 7-8 though, as we suggest relevant citations are added to Table 7-4. The best SSM data are the SSW-RS 27-year reanalysis: https://doi.org/10.7489/12423-1.	The data used to inform the temperature and salinity properties across the Project, is presented in Sections 9.4.2 and 9.4.3. It comprises Project site-specific water column sampling and profiling. The water sampling acquired measurement of suspended solids, salinity and pH, while profiling using Conductivity, Temperature and Depth (CTD) and turbidity metres, acquired measurements of temperature, salinity, Dissolved Oxygen (DO), pH and turbidity. Additional information on salinity and temperature was acquired for 10 locations across the Project, with data acquired from the Copernicus Marine Service three-dimensional (3D mems_mod_nws_phy_anfc_0.027deg-3D_PT1H-m dataset from the NWSHELF_ANALYSISFORECAST_PHY_004_013 model (Tonani *et al.*, 2022; Aznar *et al.*, 2023). The characterisation of temperature and salinity across the Project is discussed in Section 9.4.5.1.1.
SEPA	Not sure why we have received this consultation? We understand that that this consultation request relates to the proposed Section 36 consent and marine licence applications for the OWF only and not the EICC or onshore elements of the works. In that case please refer to SEPA Standing Advice for Marine Scotland on marine consultations and the extracts as below.	The SEPA standing advice (SEPA, 2023b) has been used as guidance (Section 9.2) informing the baseline characterisation set out in 0 and completed impact assessment for all Project phases (Section 9.6), as detailed above. The Project will cover the EICC and the Array Area from MHWS to offshore waters.

CONSULTEE	COMMENT	RESPONSE
SEPA	I confirm that as the export cable corridor appears to relate only to the offshore proposals and not any onshore elements of the proposals we have no further comments.	Noted.

9.4 Baseline characterisation

This Section outlines the current baseline for water and sediment quality within Marine Water and Sediment Quality Study Area introduced in Section 9.4.1. A desk-based review of the publicly available data sources and literature (Section 9.4) in addition to the Project site-specific surveys and studies (Section 9.4.3) have all been used to establish the baseline and inform the impact assessments.

9.4.1 Study Area

The Marine Water and Sediment Quality Study Area is based on the Marine Geology, Oceanography and Coastal Processes Study Area (see EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes), and is defined by a combination of the following, in line with that of the Marine Geology, Oceanography and Coastal Processes topic:

- The extent which suspended sediment plumes may be advected (and meaningfully interact with any potentially sensitive receptors); and
- The extent from the Project that tide and wave blockage impacts may potentially be detected, informed by expert judgement and considering prevailing direction across the Project.

The tidal excursion extent across the Project Area is approximately 4.5 km in the Array Area, 7.5 km in the middle of the EICC and 8 to 12 km in the inshore and indicates the maximum dispersion distance that can be expected associated with the any sediment disturbance activities. On the basis of the tidal excision and blockage extent the Marine Water and Sediment Quality Study Area is approximately a buffer of 50 km around the Array Area and 5 km to 12 km along the EICC as illustrated in Figure 9-1. The coastal boundary for the Marine Water and Sediment Quality Study Area is up to the Mean High Water Springs (MHWS) mark, noting that no works are to be completed within the intertidal zone, instead Horizontal Direct Drilling (HDD) will be used to transition between the onshore cable landing pit located on top of the cliff above MHWS, to the subtidal exit point, located approximately 200 metres (m) offshore.

The Marine Water and Sediment Quality temporal scope is defined as the entire lifetime of the Project including construction, operation and maintenance and decommissioning.

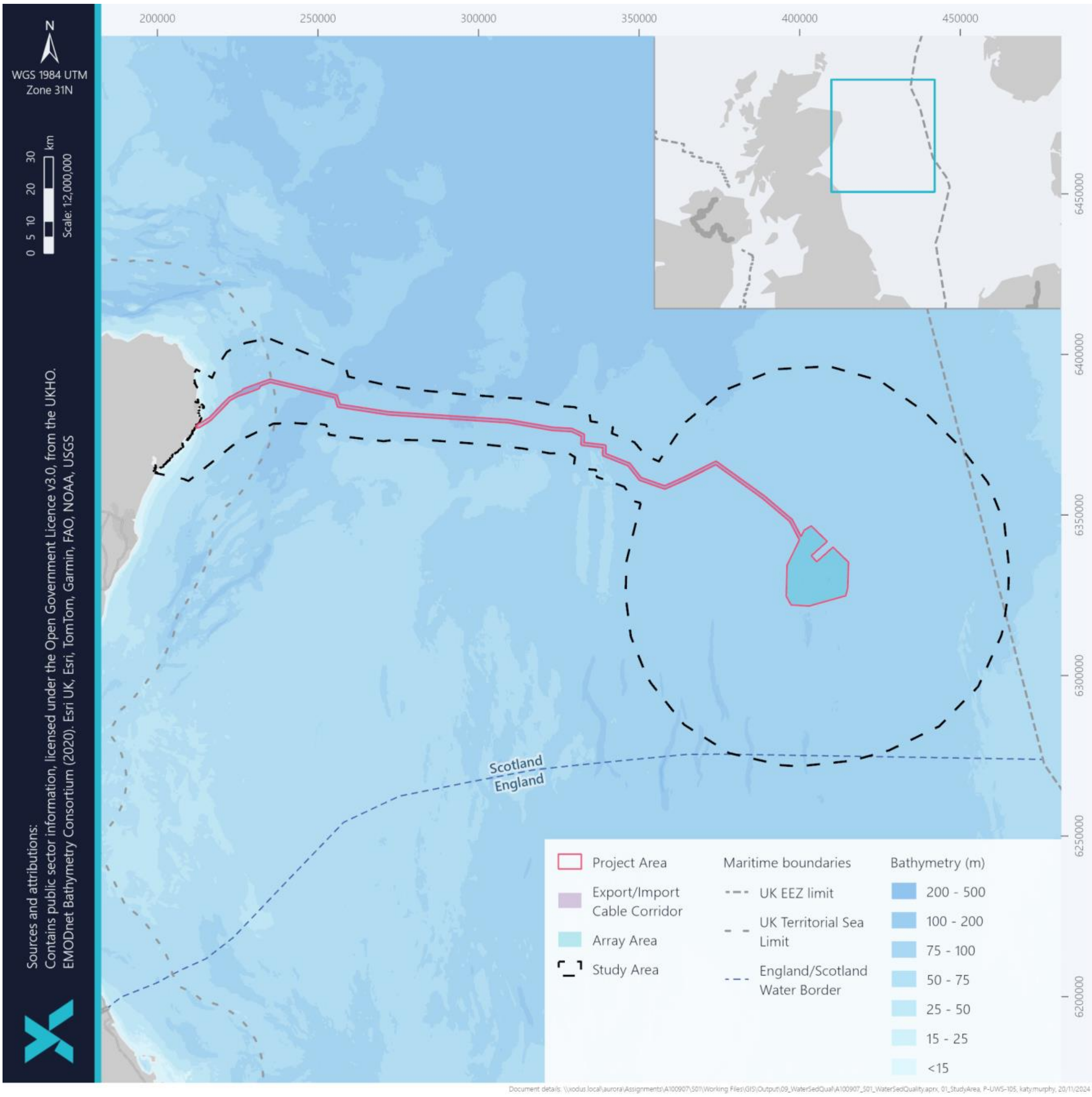

Figure 9-1 Marine Water and Sediment Quality Study Area

9.4.2 Data sources

The existing data sets and literature with relevant coverage to the Project, which have been used to inform the baseline characterisation for Marine Water and Sediment Quality are outlined in Table 9-3. Project specific data obtained and used to inform this topic assessment are presented in Section 9.4.3.

Table 9-3 Summary of key datasets and reports

TITLE	SOURCE	YEAR	AUTHOR
Monthly Average Non-algal Suspended Particulate Matter (SPM) Concentrations on the UK Shelf Waters	https://www.cefas.co.uk/data-and-publications/dois/monthly-average-non-algal-supended-particulate-matter-concentrations/	2016a	Centre for Environment, Fisheries and Aquaculture Science (Cefas)
Suspended Sediment Climatologies Around the UK	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584621/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf	2016b	Cefas
NorthConnect High Voltage Direct Current Cable Infrastructure UK EIAR	https://marine.gov.scot/ml/marine-licence-cable-installation-between-peterhead-scotland-and-simadalen-norway-06771-06870	2018	NorthConnect
Clean Seas Environmental Monitoring Programme (CSEMP) and Monitoring Regions	https://marine.gov.scot/information/clean-seas-environment-monitoring-programme-csemp https://data.marine.gov.scot/sites/default/files//CSEMP%20regions_1.pdf	2019a, 2019b	Marine Scotland
CSEMP – Monitoring Stations	https://www.bodc.ac.uk/resources/portals_and_links/merman/project_overview/	2020	National Oceanography Centre
Urban Waste Water Treatment Directive Sensitive Areas 2019	https://www.gov.scot/binaries/content/documents/govscot/publications/map/2016/01/urban-waste-water-treatment-sensitive-areas-map/documents/urban-waste-water-treatment-sensitive-areas-map-2019/urban-waste-water-treatment-sensitive-areas-map-2019/govscot%3Adocument/UWWTD%2Bdesignations%2B2019.pdf	2020b	SEPA
Dynamic Coast 2	https://www.crew.ac.uk/dynamic-coast	2021	Centre of Expertise for Waters (CREW)
Action Level Tool	https://rconnect.cefas.co.uk/action_levels_tool/	2024	Cefas

TITLE	SOURCE	YEAR	AUTHOR
Scotland's National Marine Plan Interactive (NMPi)	https://marinescotland.atkinsgeospatial.com/nmpi/	2024	Marine Directorate
River Basin Management Plan 3: The river basin management plan for Scotland 2021 – 2027	https://informatics.sepa.org.uk/RBMP3/	2024a	SEPA
Annual Updates on the Condition of the Water Environment	https://www.sepa.org.uk/data-visualisation/water-classification-hub	2024b	SEPA
Scotland's Environment data tool for Bathing Waters	https://www2.sepa.org.uk/bathingwaters/	2024c	SEPA
Bathing water profiles	https://bathingwaters.sepa.scot/profiles/	2024d	SEPA
Nitrates Monitoring	https://www.sepa.org.uk/environment/water/monitoring/nitrates-monitoring/	2024e	SEPA
Nitrate Vulnerable Zones (NVZs)	https://www.gov.scot/policies/agriculture-and-the-environment/nvz/	2024	Scottish Government
Copernicus Marine data service 3D Atlantic – European Northwest shelf model	https://data.marine.copernicus.eu/products	2024	Copernicus Marine

9.4.3 Project site-specific surveys

9.4.3.1 Geophysical survey

9.4.3.1.1 Offshore

Rovco Ltd., supported by Benthic Solutions Ltd., conducted an offshore geophysical survey across the Array Area and EICC between 21st July to 28th September 2023. The geophysical data acquired during the survey consisted of:

- Multibeam Echosounder (MBES);
- Side Scan Sonar (SSS);
- Magnetometer;
- Grab sampling;
- Sub-bottom Profiler (SBP); and
- Two-dimension (2D) Ultra-High Resolution (UHR) multichannel seismic data ('2D UHR').

The findings of the geophysical survey have been detailed in the following reports:

- Rovco Ltd. (2024a). OWF Geophysical Results Report. Cenos OWF Array and EICC Geophysical Survey. Doc: CEN001-ROV-01-CON-GPH-RPT-0013; and
- Rovco Ltd., (2024b). EICC Geophysical Results Report. Cenos OWF Array and EICC Geophysical Survey. Doc: CEN001-ROV-01-CON-GPH-RPT-0015.

9.4.3.1.2 Inshore

The region of the EICC from MHWS to 12 Nautical Miles (NM) has previously been surveyed and assessed within the EIAR submitted by NorthConnect Limited (application reference number 06771 & 06870) (NorthConnect, 2018). The information has been made available to Cenos and is used herein to provide characterisation of the inshore region of the EICC. MMT were commissioned on behalf of NorthConnect to undertake geotechnical and geophysical surveys along the NorthConnect cable route, encompassing the Cenos EICC from MHWS to approximately KP 27.970 (MMT, 2018), with this inshore survey being completed between 8th and 12th December 2016. The scope of this survey included MBES, SSS, SBP and magnetometer, with environmental sampling detailed below in Section 9.4.3.2. Further to the NorthConnect inshore data, an additional inshore geophysical survey was carried out by Benthic Solutions Ltd. Between 13th March to 31st March 2024 (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC) to validate the previous inshore surveys for NorthConnect (MMT, 2018). The 2024 inshore survey (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC) consisted of environmental sampling as well as MBES to acquire bathymetry and backscatter data up to 500 m beyond the 12 NM limit.

9.4.3.2 Environmental Baseline Survey

An Environmental Baseline Survey (EBS) was undertaken by Benthic Solutions Ltd. Between 20th July and 22nd September 2023 covering the Array Area and EICC (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF, EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC).

An EBS consisted of seabed imagery, sediment Particle Size Analysis (PSA), sediment baseline contamination analysis, sediment macrofaunal analysis and water quality analysis were conducted for both the Array Area and EICC survey area (hereafter 'survey area'). Video footage was collected to ground truth the environmental sampling locations. Water sampling at three water depths was completed to characterise the water chemistry and properties. Water column profiling was also carried out via a multi-parameter seawater profiler which was fitted with sensors for CTD, DO, pH and turbidity to characterise water column properties.

The findings of the environmental baseline survey have been detailed in the following reports:

- EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC
- EIAR Vol. 4, Appendix 11: Environmental Baseline Report - OWF; and
- EIAR Vol. 4, Appendix 12: Environmental Baseline Report - EICC.

The relevant information gathered through these surveys pertaining to the Marine Water and Sediment Quality baseline is summarised below.

9.4.3.2.1 Benthic characterisation and seabed sediments

Environmental grab sampling was undertaken to characterise the seabed habitats and sediment properties across the survey area as summarised below. A detailed description of the sampling and analyses processes are detailed in EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC, EIAR Vol. 4 Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC. A total of 30 environmental grab sampling locations were proposed across the Array Area and 20 across the EICC (Figure 9-2). The particle size and chemical contaminant samples were successfully acquired at all locations and therefore are encompassed in the environmental grab sampling locations illustrated in Figure 9-2.

9.4.3.2.1.1 Offshore

Environmental grab samples were successfully acquired at 30 sampling locations within the Array Area and the 20 locations in the EICC. At each benthic environmental baseline station, four successful 0.1 m^2 replicates were required to acquire enough material for three macrofauna replicates for faunal analyses and the remaining sample for physio-chemical sub-sampling which was subsampled for Particle Size Distribution (PSD), heavy and trace metals and hydrocarbons.

For sediment chemistry and contaminants, samples were taken of the following: metals, organics (Total Organic Matter (TOM) and Total Organic Carbon (TOC)), hydrocarbons (Total Hydrocarbon Content (THC) and Polycyclic Aromatic Hydrocarbon (PAH)), Polychlorinated Biphenyls (PCB), organotins (Dibutyltin (DBT) and Tributyltin (TBT)). Samples for organotins, pesticides (Organochlorine Pesticides (OCP)) and flame retardants (Polybrominated Diphenyl Ethers (PBDE)) were acquired at six of the 30 locations in the Array Area and three of the 20 locations in the EICC.

Seabed sediment samples were acquired using a double Van Veen grab (DVV) or mini-Hamon grab (HG) (1 x 1.0 m^2). Seabed photography/videography was used to ground truth each environmental sampling location. All physio-chemical samples were stored in appropriate containers (i.e. glass for hydrocarbons, and plastics for metals and chlorophyl).

9.4.3.2.1.2 Inshore

Given that the scope of the inshore survey was to validate the previous surveys undertaken for NorthConnect (NorthConnect, 2018), no grab samples were acquired and benthic habitats were analysed through seabed photography and video. Therefore, the inshore grab sample data acquired as part of the benthic survey for the NorthConnect EIAR has been utilised (MMT, 2018). The 2016 inshore survey (reported in MMT, 2018) consisted of three sampling locations, with four grab samples acquired at each sampling location, namely three for biotic analysis and one for particle size and chemical analysis. For PSA, up to one litre of sediment was collected. Grab samples were acquired using a 0.1 m^2 Day grab and a 0.25 m^2 United States Navel Electronics Laboratory box corer.

9.4.3.2.2 Water column properties (Water sampling and water column profiling)

Sampling for water column properties, including Total Suspended Solids (TSS), temperature, salinity, pH and contaminants (i.e. water chemistry) was completed at surface, middle and bottom water depths with corresponding water column profiling (CTD and turbidity profiles) at 18 locations across the offshore and inshore survey areas from Benthic Solutions (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC), comprising of 10 in the Array Area, six in the EICC and two in the inshore.

The sampled locations used to inform the environmental baseline characterisation for Marine Water and Sediment Quality are illustrated in Figure 9-2, with further detail provided in the following Sections 9.4.3.2.1.1 and 9.4.3.2.1.2.

Sampling and analyses processes for water column are detailed in the offshore environmental baseline survey reports (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC) and inshore report (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC). No sampling of water column properties was completed for NorthConnect.

9.4.3.2.2.1 Offshore

Sixteen offshore locations were successfully completed for water sampling, comprising 10 in the Array Area (OWF_02, OWF_03, OWF_05, OWF_09, OWF_15, OWF_18, OWF_22, OWF_32, OWF_41, OWF_49) and six along the EICC (EICC_02, EICC_06, EICC_09, EICC_18, EICC_24, and EICC_37) (Figure 9-2). For all sampled locations, water sampling for water column properties and Water chemistry was completed at surface, middle and bottom water depths. Water column profiling (CTD and turbidity profiles) was also obtained at these locations, excluding station OWF_41 and with the addition of sampling at station OWF_10 (Figure 9-2).

Sampling was completed across the offshore locations between August to September 2023. Water sampling was completed using five-litre Niskin bottles triggered using a messenger weight in tandem with a CDT probe. Only the upcast profiles are used in the interpretation of the water column as it was considered to be more accurate.

9.4.3.2.2.2 Inshore

For the 2024 inshore survey, water sampling was successfully completed at two locations on 31st March 2024 (IEICC_W01 and IEICC_W03; see Figure 9-3), with sampling again completed at three water depths (i.e. surface, middle and bottom) and the acquisition of CTD profiles. It is noted that at sample location W03 the surface sample was acquired approximately 350 m from the middle and bottom samples due to the vessel drifting during deployment. The sampled inshore locations are illustrated in Figure 9-3.

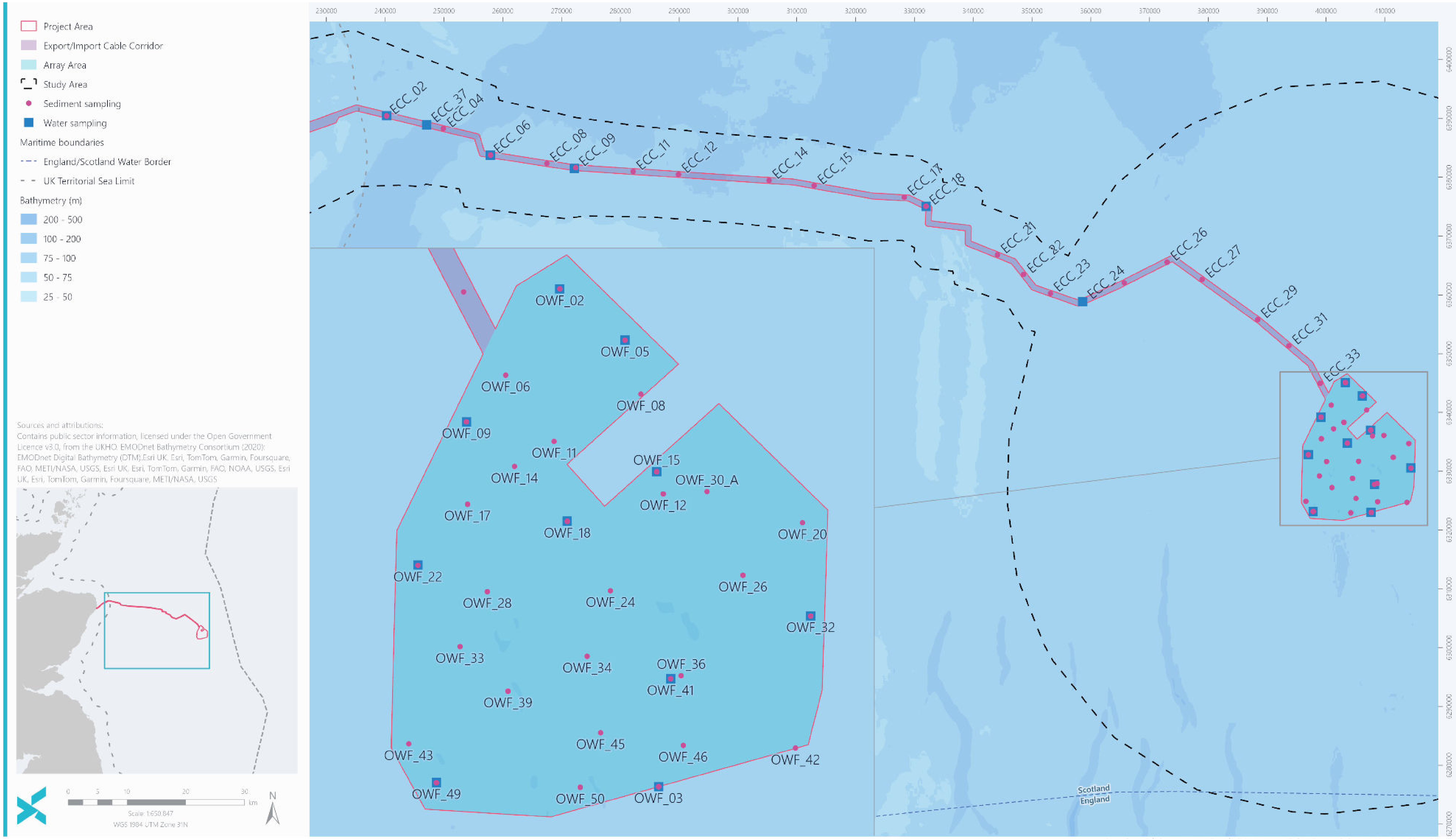

Figure 9-2 Offshore survey environmental sampling locations

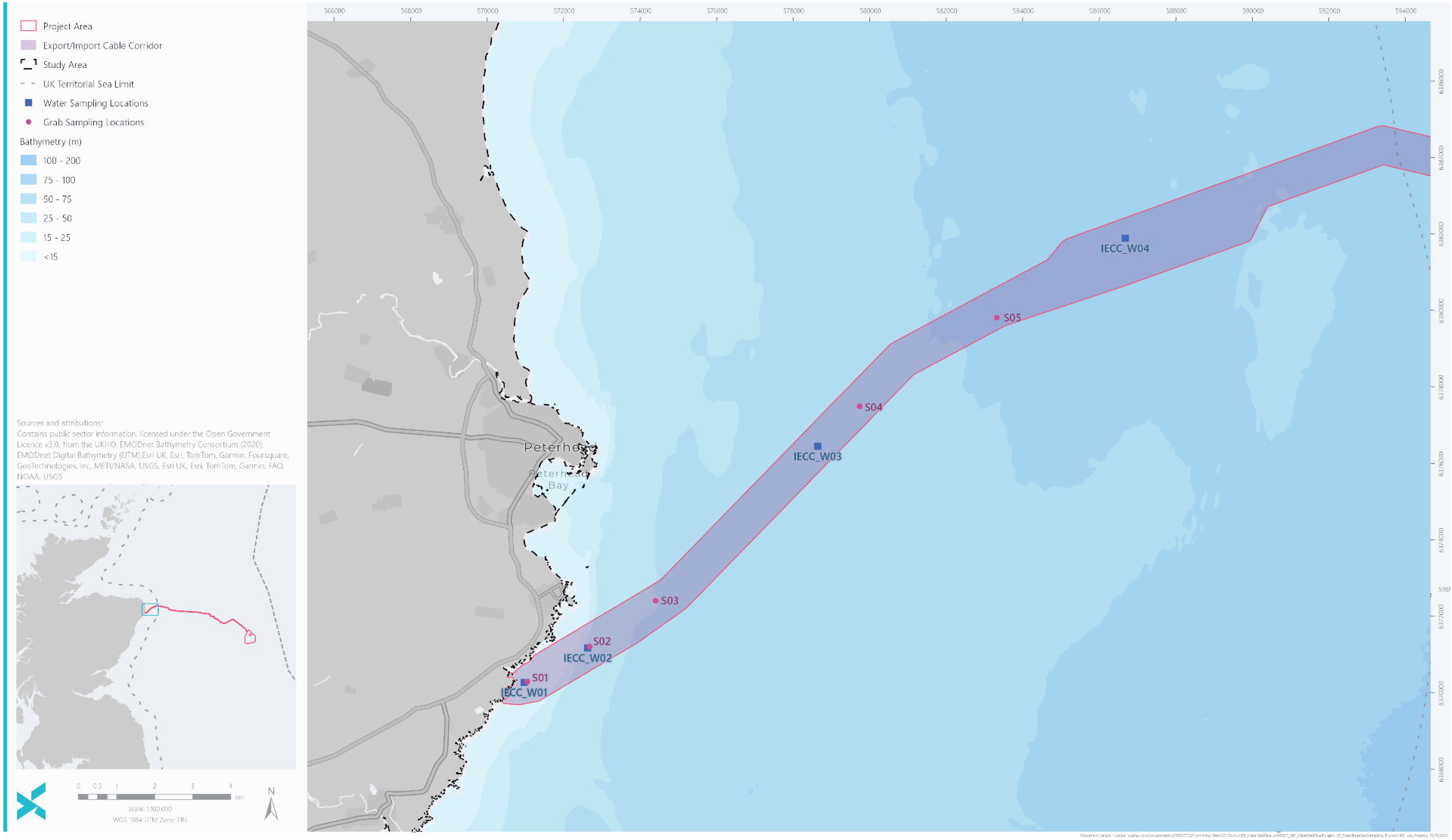

*Figure 9-3 Inshore survey water sampling locations **(EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC)** and inshore sediment sampling locations (MMT, 2018)*

9.4.4 Assessment of sediment quality

Sediment quality standards are typically applied to evaluate the degree to which contaminants are present and to assess the potential impacts on Marine Water and Sediment Quality receptors. Although there are no Environmental Quality Standards (EQS) for *in situ* sediments in Scotland, EQS exist for selected WFD UK priority substances and specific pollutants in relation to water quality in surface waters, within the WAT-SG-53 guidance (SEPA, 2020a). In the absence of any defined EQSs for sediment, data from the Project specific surveys are compared with the Marine Scotland (2017) revised Cefas Action Levels (AL) (developed for the disposal of dredged material). For comparison, data are also often assessed against more stringent quality standards through the Canadian Marine Sediment Quality Guidelines (Canadian Council of Ministers of the Environment (CCME), 1999) and Dutch Quality Standards (International Association of Dredging Companies (IADC)/Central Dredging Association (CEDA), 1997) particularly for hydrocarbons. Although the SEPA WAT-SG-53 guidance relates to surface waters, it is noted that contaminant threshold levels are within the range defined for sediment in the Section below.

9.4.4.1 Marine Scotland revised action levels

Marine Scotland's revised ALs are typically used as part of a 'weight of evidence' approach to demonstrate to decision-makers the suitability of dredged material for disposal at sea but are not themselves statutory standards. The Marine Scotland (2017) revised ALs are presented in Table 9-4. These levels are used in this assessment to inform the potential risk to the environment from contaminants. Contaminants below Action Level 1 (AL1) are generally not considered to be of concern and are approved for disposal at sea. Contaminant levels above Action Level 2 (AL2) are not considered suitable for disposal at sea without further consideration.

Construction activities within the Project Area will result in the disturbance of seabed sediment. Therefore, consideration of the potential for sediment contaminants is applicable, which will be contextualised against the Marine Scotland ALs to provide an indicative risk to the environment.

Table 9-4 Marine Scotland revised actions levels (milligrams per kilogram (mg/kg)) (Marine Scotland, 2017; Management Organisation (MMO), 2014).

CONTAMINANT	MARINE SCOTLAND REVISED AL 1	MARINE SCOTLAND REVISED AL 2[2]
Arsenic	20	70
Mercury	0.25	1.5
Cadmium	0.4	4
Chromium	50	370
Copper	30	300
Nickel	30	150
Lead	50	400

[2] *Marine Scotland AL 2 threshold is not available for PCBs, sum of International Council for the Exploration of the Sea (ICES) 7, DDT, or Dieldrin, as these chemicals are monitored on a presence / absence basis rather than specific levels..*

CONTAMINANT	MARINE SCOTLAND REVISED AL 1	MARINE SCOTLAND REVISED AL 2[2]
Zinc	130	600
Organotins; TBT	0.1	0.5
PCBs, Sum of ICES 73 (∑PCB7)*	0.01	
PCBs, Sum of 25 congeners4 (∑PCB25)	0.02	0.18
Dichlorodiphenyltrichloroethane (DDT)*	0.001	
Dieldrin*	0.005	
PAHs		0.1
THC		100
*Due to the absence in the Marine Scotland (2017) revised guidelines, the values for ∑PCB7, DDT and Dieldrin are drawn from the Cefas guidelines.		

9.4.4.2 Canadian marine sediment quality guidelines

The Canadian marine sediment quality guidelines were developed by the CCME as broadly protective tools to support the functioning of healthy aquatic ecosystems (CCME, 1999). They are based on field research programmes that have demonstrated associations between chemicals and biological effects by establishing cause-and-effect relationships in particular organisms.

Comparison of measured concentrations of various contaminants within the sediments with these guideline values will, therefore, provide a basic indication of the degree of contamination and likely impact on ecology. The Canadian Sediment Quality Guidelines include two values as assessment criteria: the Interim Sediment Quality Guidelines (ISQG) or Threshold Effect Level (TEL) and Probable Effect Level (PEL). The ISQG/TELs and PELs are used to identify the following three ranges of chemical concentrations with regard to biological effects:

- Below the ISQG/TEL: The minimal effect range within which adverse effects rarely occur;
- Between the TEL and PEL: The possible effect range within which adverse effects occasionally occur; and
- Above the PEL: The probable effect range within which adverse effects frequently occur.

Table 9-5 below lists the existing sediment quality guidelines for relevant parameters that have been monitored, including the ISQG/TELs and PELs (dry weights).

---

[3] *PCBs, sum of ICES 7 refers to the sum of the seven ICES PCB congeners: PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, and PCB 180 which are likely to be found in sediment samples.*

[4] *PCBs, sum of 25 congeners refers to the sum of a group of 25 chemical compounds that are monitored.*

Table 9-5 Canadian sediment quality guidelines in mg/kg and micrograms (µg) per kg (CCME, 1999)

SUBSTANCE	UNITS	ISQG/TEL	PEL
Arsenic	mg/kg	7.24	41.6
Cadmium	mg/kg	0.7	4.2
Chromium	mg/kg	52.3	160
Copper	mg/kg	18.7	108
Lead	mg/kg	30.2	112
Mercury	mg/kg	0.13	0.7
Zinc	mg/kg	124	271
PCBs: total PCBs	µg/kg	21.5	189
Acenaphthene	µg/kg	6.71	88.9
Acenaphthylene	µg/kg	5.87	128
Anthracene	µg/kg	46.9	245
Benz(a)anthracene	µg/kg	74.8	693
Benzo(a)pyrene	µg/kg	88.8	763
Chrysene	µg/kg	108	846
Dibenz(a,h)anthracene	µg/kg	6.22	135
Fluoranthene	µg/kg	113	1,494
Fluorene	µg/kg	21.2	144
2-Methylnaphthalene	µg/kg	20.2	201
Naphthalene	µg/kg	34.6	391
Phenanthrene	µg/kg	86.7	544
Pyrene	µg/kg	153	1,398

9.4.4.3

9.4.4.4 Dutch quality standards

There are no UK contamination threshold values regarding total hydrocarbons for marine sediments. In the absence of such guidelines, the Dutch National Institute for Public Health and the Environment's (Rijksinstituut voor Volksgezondheid en Milieu (RIVM)) intervention levels for aquatic sediments can offer a useful comparison. Concentrations above the Dutch RIVM intervention values represent a serious level of contamination, where functional properties of the sediment are seriously impaired or threatened (Hin *et al.*, 2010). Dutch RIVM guidelines only provide single threshold values for metals and total hydrocarbons, which are summarised in Table 9-6.

Table 9-6 Dutch RIVM sediment quality guidelines (Hin et al., 2010)

SUBSTANCE	UNITS	INTERVENTION VALUE SEDIMENT
Metals		
Arsenic	mg/kg	85
Cadmium	mg/kg	14
Chromium	mg/kg	380
Copper	mg/kg	190
Lead	mg/kg	580
Mercury	mg/kg	10
Nickel	mg/kg	210
Zinc	mg/kg	2,000
Polychlorinated biphenyls		
PCBs: total (sum of 7)	µg/kg	1
Total hydrocarbons and polycyclic aromatic hydrocarbons		
Total hydrocarbons	µg/kg	5,000,000
PAHs: total (sum of 10)	µg/kg	40

9.4.4.5 UKOOA 50^{th} and 95^{th} percentiles for background North Sea sediments

In 2001, the United Kingdom Offshore Operators Association (UKOOA) issued a report establishing the 50^{th} and 95^{th} percentile levels for uncontaminated background sediments in the Central North Sea (CNS) (e.g. > 5 km from oil and gas assets), drawing from data across the entire North Sea, specific sectors within the North Sea, or specific sediment types, as deemed most appropriate for accurate interpretation. Given that the Project is located in the CNS in proximity to oil and gas assets (Figure 9-4), there is potential for sediment contaminants to be present attributed with the oil and gas activity. Therefore, the UKOOA 50^{th} and 95^{th} percentile thresholds have been applied to inform the sediment chemistry across the Project with respect to the UKOOA thresholds. Further details on the oil and gas activity within proximity to the Project is provided in EIAR Vol. 3, Chapter 17: Infrastructure and Other Users.

Table 9-7 UKOOA CNS 50th and 95th percentiles for background sediment concentrations (UKOOA, 2001)

ANALYTE	UNITS	UKOOA CNS 50TH PERCENTILE	UKOOA CNS 95TH PERCENTILE
Cadmium	mg/kg	0.02	0.12
Chromium	mg/kg	7.17	31.40
Copper	mg/kg	2	6
Lead	mg/kg	6.65	16.70
Mercury	mg/kg	0.01	0.12
Nickel	mg/kg	4	19
Zinc	mg/kg	10.5	32.6
Barium	mg/kg	117.5	523.3
Iron	mg/kg	3,487	11,160
THC	mg/kg	4.1	40.1

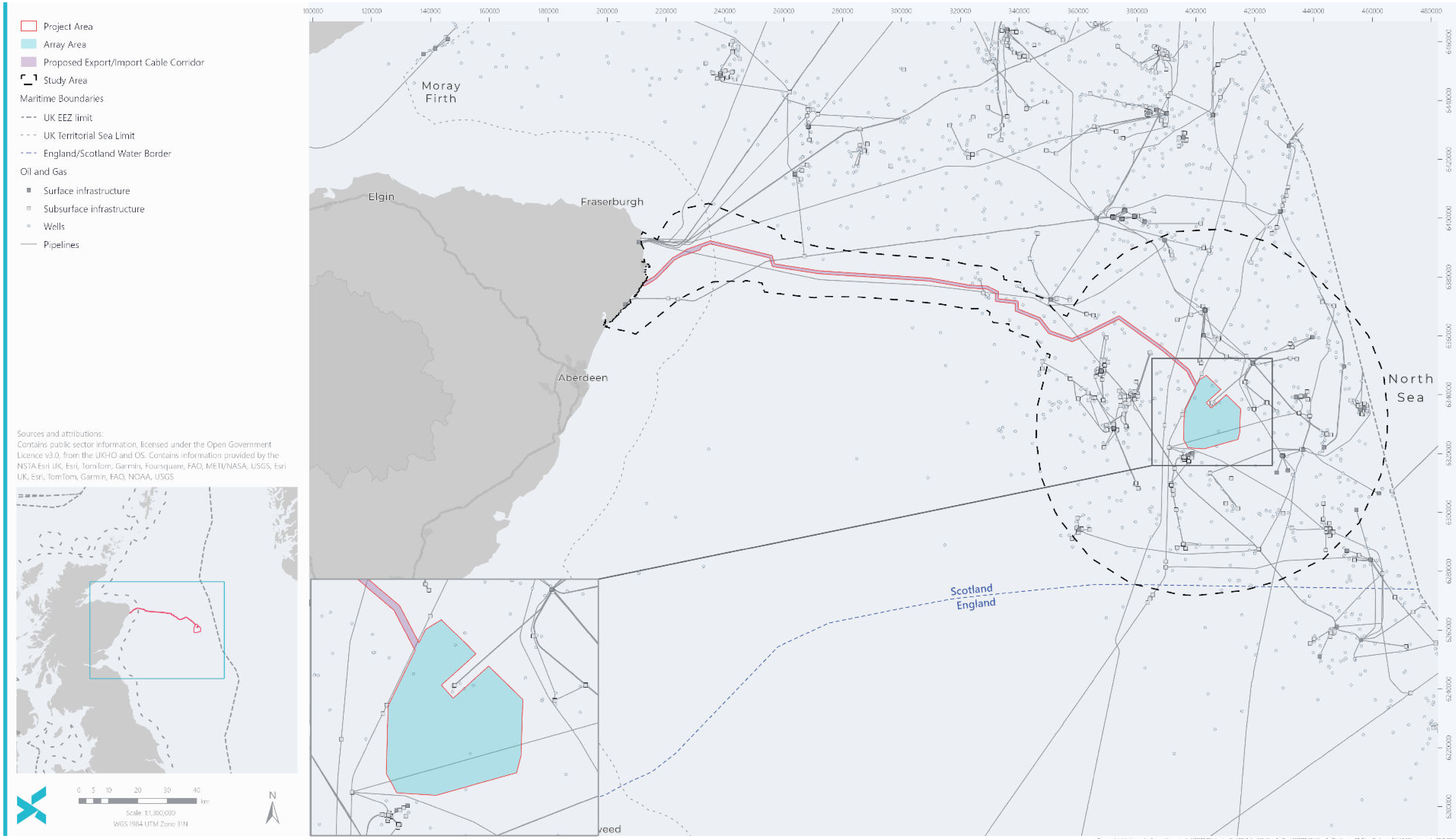

Figure 9-4 Oil and gas assets in proximity to the Project

9.4.4.6 OSPAR Background Concentrations (BC) and Background Assessment Concentrations (BAC)

Normalised total PAH concentrations were calculated to allow comparison to OSPAR (2014) Background Concentrations (BCs) and Background Assessment Concentrations (BACs). BCs are concentrations of contaminants derived from analysis of core samples to reflect pre-industrial background levels for the OSPAR area. BACs have been statistically derived from BCs and represent the level above which concentrations can be considered to be significantly higher than the relevant BC (OSPAR, 2008). BACs have also been considered in association with the UK Marine Environment Monitoring and Assessment National (MERMAN) database as further described in Section 9.4.5.4.1 below. The OSPAR BC and BAC thresholds are summarised in Table 9-8 below.

Table 9-8 OSPAR BC and BAC thresholds (OSPAR, 2014)

ANALYTE	UNITS	BC (OSPAR, 2014)	BAC (OSPAR, 2014)
Naphthalene	µg/kg	5	8
Acenaphthylene	µg/kg	-	-
Acenaphthene	µg/kg	-	-
Fluorene	µg/kg	-	-
Phenanthrene	µg/kg	17	32
Dibenzothiophene	µg/kg	0.6	-
Anthracene	µg/kg	3	5
Fluoranthene	µg/kg	20	39
Pyrene	µg/kg	13	24
Benzo[a]anthracene	µg/kg	9	16
Chrysene	µg/kg	11	20
Benzo[b]fluoranthene	µg/kg	-	-
Benzo[k]fluoranthene	µg/kg	-	-
Benzo[a]pyrene	µg/kg	15	30
Indeno[123,cd]pyrene	µg/kg	50	103
Dibenzo[a,h]anthracene	µg/kg	-	-
Benzo[ghi]perylene	µg/kg	45	80

9.4.4.7 OSPAR Effect Range Low (ERL) and Effect Range Median (ERM) levels

The Effect Range Low (ERL) and Effect Range Median (ERM) definitions applying to the toxicity of heavy and trace metals have been considered as part of the metals analysis, based on Long *et al.*, (1995). As described in (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF), metal concentrations recorded below the ERL value are not expected to elicit adverse effects, while levels above the ERM value are likely to be toxic to some marine life. Buchman (2008) produced screening quick reference tables for the National Oceanic and Atmospheric Administration (NOAA) ERL and ERM values, as summarised in Table 9-9.

Additionally, the OSPAR (2014) ERL and the NOAA ERM (OSPAR, 2008) have been used to assess ERL and ERM levels for PAHs, as summarised in Table 9-10 (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC).

Table 9-9 ERL and ERM levels for the analysis of metals

ANALYTE	UNITS	NOAA ERL (BUCHMAN, 2008)	NOAA ERM (BUCHMAN, 2008)
Arsenic	mg/kg	8.2	70
Cadmium	mg/kg	1.20	9.60
Chromium	mg/kg	81	370
Copper	mg/kg	34	270
Lead	mg/kg	46.70	218
Mercury	mg/kg	0.15	0.71
Nickel	mg/kg	20.9	51.6
Zinc	mg/kg	150	410

Table 9-10 ERL and ERM levels for the analysis of PAH

ANALYTE	UNITS	OSPAR ERL (OSPAR, 2014)	NOAA ERM (OSPAR, 2008)
Naphthalene	µg/kg	160	2,100
Acenaphthylene	µg/kg	44	640
Acenaphthene	µg/kg	16	500
Fluorene	µg/kg	19	540
Phenanthrene	µg/kg	240	1,500
Dibenzothiophene	µg/kg	190	-
Anthracene	µg/kg	85	1,100
Fluoranthene	µg/kg	600	5,100
Pyrene	µg/kg	665	2,600
Benzo[a]anthracene	µg/kg	261	1,600
Chrysene	µg/kg	384	2,800
Benzo[b]fluoranthene	µg/kg	-	-
Benzo[k]fluoranthene	µg/kg	240	-
Benzo[a]pyrene	µg/kg	430	1,600
Indeno[123,cd]pyrene	µg/kg	240	-
Dibenzo[a,h]anthracene	µg/kg	63	260
Benzo[ghi]perylene	µg/kg	85	2,800

9.4.5 Existing baseline

A review of literature and available data sources, augmented by consultation and Project site-specific surveys has been undertaken to describe the current baseline environment for Marine Water and Sediment Quality. The following Sections provide information on the key water and sediment quality properties and receptors across the Marine Water and Sediment Quality Study Area (Figure 9-1).

9.4.5.1 Water column properties

As introduced in Section 9.4.3.2, water column profiling was carried out via a multi-parameter seawater profiler which was fitted with sensors for CTD, DO, pH and turbidity to characterise water column profile properties for ten locations across the Array Area, six along the EICC (Figure 9-2) and two in the inshore (Figure 9-3). Results of the upcast water column profiles for temperature and salinity are discussed in Section 9.4.5.1.1, whilst turbidity and DO are discussed in Section 9.4.5.1.2. Additional information on the annual temperature and salinity properties at varying depths through the water column were extracted from 10 locations across the Project from the Copernicus Marine Service 3D mems_mod_nws_phy_anfc_0.027deg-3D_PT1H-m dataset from the NWSHELF_ANALYSISFORECAST_PHY _004 _013 model (Tonani *et al*., 2022; Aznar *et al*., 2023), with further detail on the model properties described in EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes.

9.4.5.1.1 Temperature and salinity

Based on long-term data collected between 1971 and 2000, the annual mean temperature at the surface in this region of the North Sea is between 9 degrees Celsius (°C) and 10°C, while the near seabed is two degrees less, between 7°C and 8°C. Annual mean salinity near-seabed and at the surface is 35 practical salinity units (psu).

The water column profiles for temperature and salinity across the Project are presented in Figure 9-5 (Array Area) and Figure 9-6 (EICC). A detailed analysis of temperature and salinity is provided in EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes and summarised below.

Based on the Copernicus Marine data collected for 10 locations across the Project, there is an annual variation in temperature and salinity, with the water column being well mixed and lower in temperature in the winter and spring months (approximately between October and May) and seasonal stratification (addressed further in in EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes), with warmer surface water present in the summer to autumn months (approximately June to September). Generally, across the entire Project temperatures universally peaked in late summer/early autumn (i.e. in September). Temperatures are higher further offshore, with temperatures in the Array Area reaching 17°C, compared to temperatures closer to the coast reaching peaks of 15.6°C, all based on modelled temperatures at the sea surface. In terms of salinity, it is generally lower over winter, following the initial drop in temperature in September/October. Also salinity at the coast is slightly lower on average than within the Array Area reaching a minimum of 33.71 psu, compared to a minimum of 34.56 psu.

In terms of the completed water sampling and profiling completed across the Project between August and September 2023, the water column profiles for the Array Area indicated that the upper 25 m of the water column was well mixed with temperatures exceeding 15°C. There was a rapid reduction in temperature at water depths > 35 m which continued until around 47 m where the temperature remains consistent to the seabed (Figure 9-5). For the Array Area, temperature ranged from 16.8°C (OWF_22) to a minimum temperature of 7.8°C (OWF_18, OWF_49) (Figure 9-2) (Figure 9-5). Salinity was consistent within the upper 25 m of the water column and ranged from 34.9 psu

(OWF_49) to 35.2 psu (OWF_32) and then remained around 35 psu from 45 m water depth to the seabed (Figure 9-2) (Figure 9-5).

Along the EICC, the upper 25 m of the water column was well mixed with temperatures of >12°C (Figure 9-6). The reduction in temperature was more variable than that of the Array Area for most locations, aside from EICC_02 which remained well mixed through the water column with little variation in temperature (12.3°C to 13.4°C), with no evidence of a thermocline present (Figure 9-6; Figure 9-2). Temperature ranged from 13.4°C (EICC_02) to a minimum temperature of 9.2°C (EICC_24) (Figure 9-6; Figure 9-2). The reduction in temperature around 20 m to 45 m depth for EICC_06, EICC_18 and EICC_24 indicated the presence of a strong thermocline, notably at sampling location EICC_24 (Figure 9-6). There was minimal variation in the salinity for the EICC with a relatively constant value of ~ 35 psu for most sampling locations, with a maximum of 35.3 psu observed at EICC_18 and EICC_24 (Figure 9-6; Figure 9-2).

As described in Section 9.4.3.2.2.2, the inshore water sampling was completed at two locations (IEICC_W01 and IEICC_W03, see Figure 9-3) to a depth of 22 m (IEICC_W01) and a maximum depth of 62 m (IEICC_W03). The results indicate that temperature was consistent between the two locations at around 7°C, with no thermocline present (Figure 9-7). There was minimal variation in salinity, with IEICC_W01 having slightly lower salinity at 34.2 psu in comparison to 34.4 psu at IEICC_W03 (Figure 9-7). There was no halocline observed (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC).

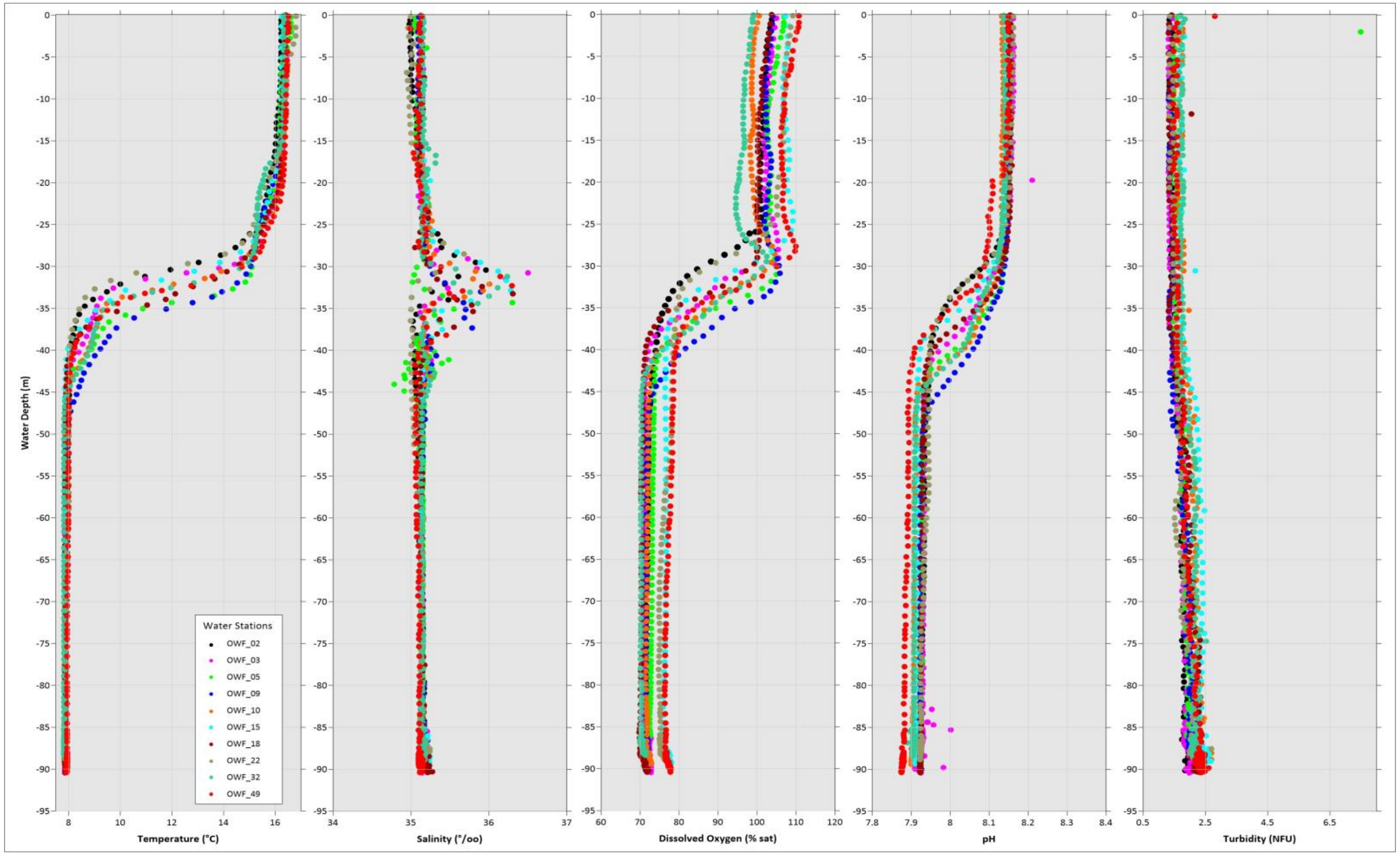

Figure 9-5 CTD profiles across the Array Area ***(EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC)***

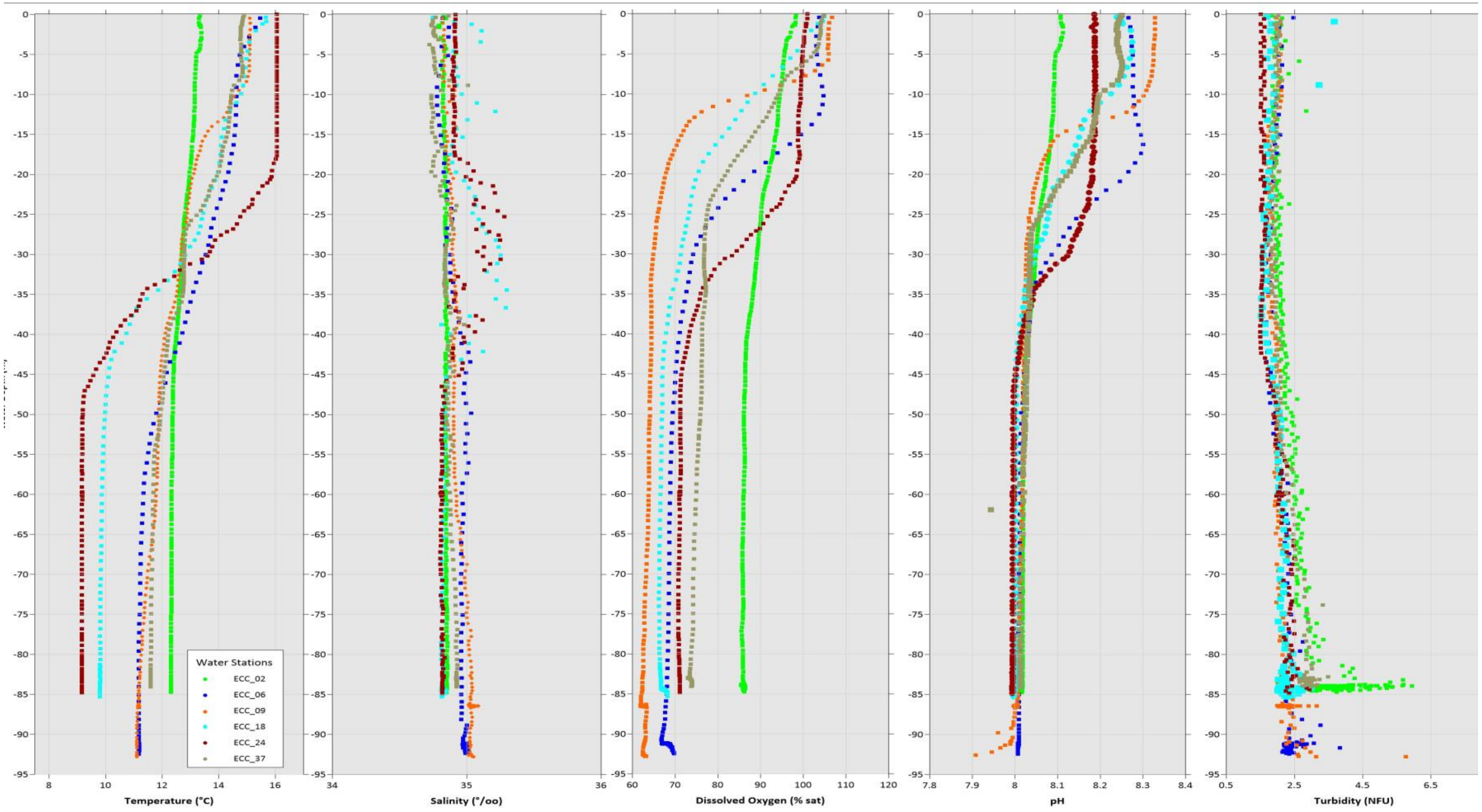

Figure 9-6 CTD profiles across the EICC ***(EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC)***

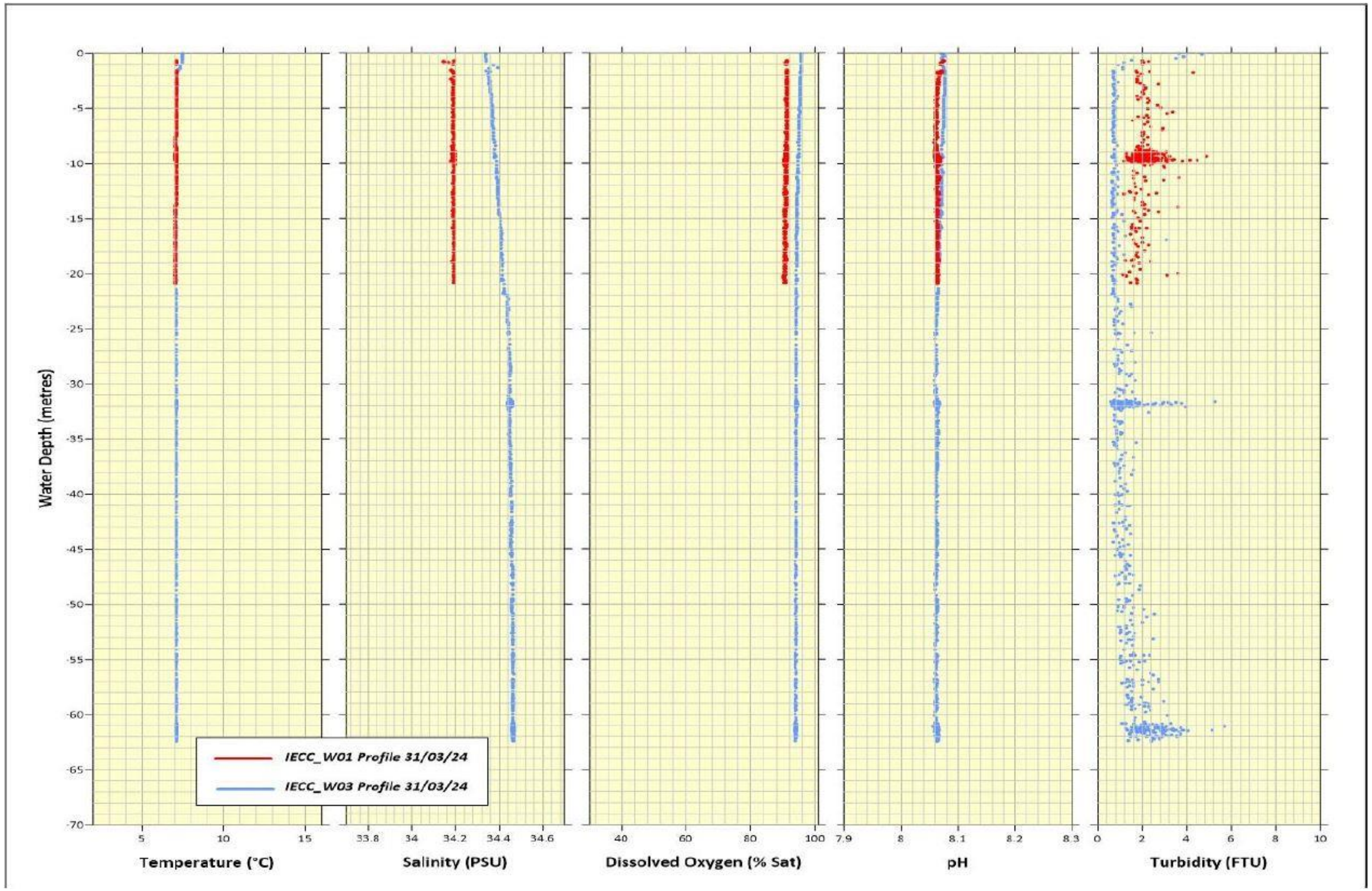

Figure 9-7 CTD profiles in the inshore ***(EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC).***

9.4.5.1.2 Suspended sediment concentration and dissolved oxygen

When finer sediments (i.e. silts and muds) are mobilised they are typically carried in suspension, contributing to higher concentrations of SPM or Suspended Sediment Concentration (SSC) and increasing the turbidity of the water column until the material settles out and is deposited. Rivers, estuaries and coastal erosion can also provide local sources of increased turbidity (see EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes).

The Cefas Suspended Sediment Climatologies report (Cefas, 2016b) and associated dataset provides the spatial distribution of average non-algal SPM for the majority of the United Kingdom Continental Shelf (UKCS). Long-term (1998 to 2015) monthly average concentration of sea surface SPM have been deduced from satellite data. The long-term monthly average SPM for the CNS is relatively stable and of very low concentrations. SPM for the CNS ranges from 0.0006 kg/m^3 in the summer, to 0.001 kg/m^3 in winter, with an annual average of 0.0008 kg/m^3 (Cefas, 2018). The non-algal SPM across the Project is shown in Figure 9-8, with concentrations reducing with increasing distance from the coast. At the EICC landfall, SPM is up to 0.001 kg/m^3. This is consistent along the first half of the EICC. Past approximately the midway point of the EICC, SPM concentrations decrease to a minimum of 0.0006 km/m^3 across the Array Area. This is attributed to the lower levels of seabed sediment mobility further offshore (see EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes), and low levels of coastal erosion and remoteness to any large river or estuary source of fine sediment.

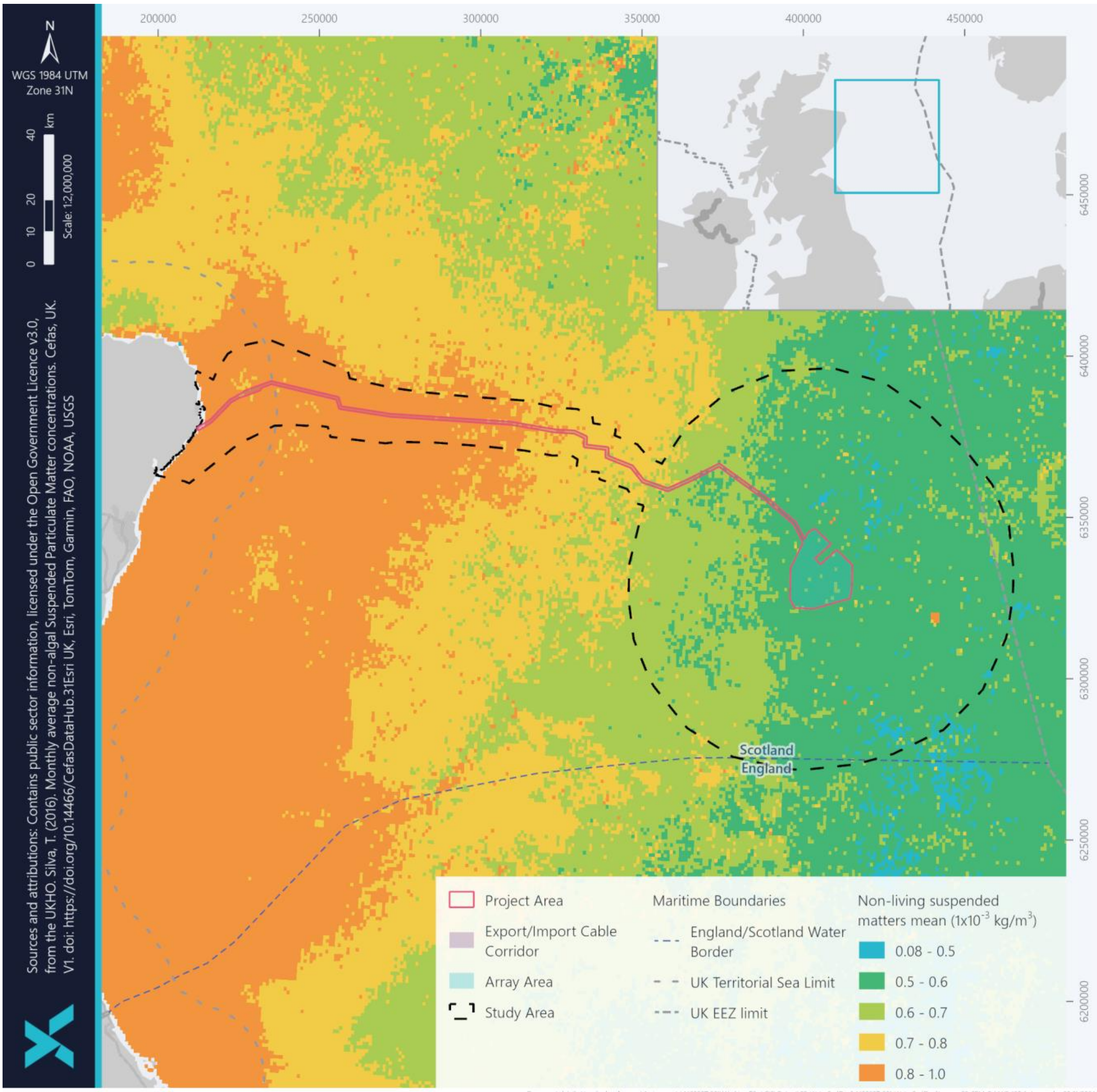

Figure 9-8 Monthly non-algal SPM (Cefas, 2016b)

A detailed characterisation of TSS concentrations throughout the water column from sampled locations across the Project is provided in EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes and has informed the following description of TSS concentrations. The TSS concentrations at the three sampled water depths at the water sample locations for the EICC and Array Area are presented in Table 9-11. The TSS concentrations presented in Table 9-11 are colour coded, ranging from <5 milligrams per litre (mg/l) (darkest green) to 39 mg/l (darkest red) respectively, indicating the lowest to highest measured concentrations at the site, although this is relatively low in the marine environment.

Overall, most samples were recorded below the limit of detection (10 mg/l) (Table 9-11). Across the Array Area, the highest TSS concentrations were observed at the middle and bottom depths within the Array Area at 39 mg/l (OWF_22; OWF_49; Figure 9-2) which overlap with areas of sands and fines (Table 9-11; Figure 9-10). Location OWF_32 was the only other location in the Array Area to have TSS concentrations above the limit of detection at 16 mg/l observed at the bottom depth. Along the EICC, the majority of sampled locations had TSS concentrations above the limit of detection throughout the surface, middle and bottom depths. In the EICC the highest TSS concentration was observed at EICC_09 at 17 mg/l at the surface and 19 mg/l at the bottom depth (Table 9-11). The seabed sediment at EICC_09 is comprised of majority sands (Figure 9-10).

In the inshore, TSS concentrations were primarily less than 5 mg/l, with turbidity was slightly higher at IEICC_W01 than IEICC_W03 (Figure 9-7) (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC).

*Table 9-11 TSS concentrations throughout the water column (surface, middle, bottom) (**EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF** and **EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC**)*

SAMPLE LOCATION	TOTAL SUSPENDED SOLIDS (mg/l)		
	SURFACE	MID	BOTTOM
EICC_02	<10	13	<10
EICC_06	<10	11	10
EICC_09	17	<10	19
EICC_18	15	<10	<10
EICC_24	<10	<10	<10
EICC_37	<10	<10	<10
OWF_02	<10	<10	<10
OWF_03	<10	<10	<10
OWF_05	<10	<10	<10
OWF_09	<10	<10	<10
OWF_15	<10	<10	<10
OWF_18	<10	<5	<5
OWF_22	<5	9	39
OWF_32	<10	<10	16
OWF_41	<10	<10	<10
OWF_49	<10	39	<10

As described above, DO (% saturation) was recorded at ten locations in the Array Area and six locations along the EICC as part of the water column profiling. The results are presented in Table 9-12 below, with DO profiles illustrated in Figure 9-5 (Array Area) and Figure 9-6 (EICC) above. During the summer months a decline in saturation to 70% or less has been observed in stratified areas of the North Sea (Mahaffey *et al.*, 2020; 2023), which is relevant to the timing of when the water column profiles were obtained between 20th July and 22nd September 2023.

For the Array Area, DO saturation in the upper 25 m of the water column remained relatively stable with a decrease at 25 m from ~110% to 75% at ~35 m water depth (Figure 9-5). The stratification observed in the DO reflected the presence of the thermocline and halocline between 25 m to 35 m depth (Section 9.4.5.1.1). The DO saturation continued to reduce to 69.9% at around 40 m depth and then remained stable with depth (Figure 9-5). The range of DO saturation in the Array Area is presented in Table 9-12 below. At the surface, DO ranged from 69.79% (OWF_41) to 85.45% (OWF_02) (see Figure 9-2). At the bottom, DO ranged from 98.35% (OWF_02) to 110.72% (OWF_49).

For the EICC, DO saturation was more variable with the DO in the top 5 m to 20 m of the water column remaining relatively stable followed by a sharp decrease until around 30 m to 40 m depth (Figure 9-6). Below 40 m depth, DO was constant ranging from around 60 to 80 % (Figure 9-6). The stratification in DO for the EICC was more variable, reflecting the variable thermoclines present between 10 m to 45 m depth (Section 9.4.5.1.1). No clear halocline was noted (EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC). The range of DO saturation in the EICC is presented in Table 9-12 below. At the surface, DO ranged from 61.9% (EICC_09) to 85.5% (EICC_02) (see Figure 9-2). At the bottom, DO ranged from 98.4% (EICC_02) to 106.8% (EICC_09). For the inshore, DO saturation was slightly lower at IEICC_W01 than IEICC_W03 (Figure 9-7) (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC).

Table 9-12 DO (% saturation) at sample locations within the EICC and Array Area ***(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)***

SAMPLE LOCATION	RANGE	WATER DEPTH (M)	DISSOLVED OXYGEN (% SATURATION)	TEMPERATURE (°C)
EICC_02	Min	0.2	85.5	12.3
	Max	81.1	98.4	13.4
EICC_06	Min	0.5	66.8	11.2
	Max	92.5	104.8	15.5
EICC_09	Min	0.5	61.9	11.2
	Max	86.6	106.8	15.1
EICC_18	Min	0.4	66.2	9.8
	Max	84.6	105.0	15.7
EICC_24	Min	0.0	70.7	9.2
	Max	82.7	101.0	16.1
EICC_37	Min	0.2	73.0	11.6

SAMPLE LOCATION	RANGE	WATER DEPTH (M)	DISSOLVED OXYGEN (% SATURATION)	TEMPERATURE (°C)
	Max	84.1	104.9	14.9
OWF_02	Min	0.2	85.45	85.45
	Max	84.75	98.35	98.35
OWF_03	Min	0.3	70.32	70.32
	Max	85.95	105.56	105.56
OWF_05	Min	0.3	72.38	72.38
	Max	86.1	106.98	106.98
OWF_09	Min	0.2	71.36	71.36
	Max	87.,65	105.87	105.87
OWF_15	Min	0.15	71.38	71.38
	Max	89.4	104.52	104.52
OWF_18	Min	0.2	75.44	75.44
	Max	89.35	109.16	109.16
OWF_22	Min	0	69.79	69.79
	Max	90.4	103.72	103.72
OWF_32	Min	0.15	74.79	74.79
	Max	88.85	109.22	109.22
OWF_41	Min	0.05	69.97	69.97
	Max	88.4	102.51	102.51
OWF_49	Min	0.15	76.3	76.3
	Max	90.4	110.72	110.72

9.4.5.2 Water quality designated waters

SEPA is responsible for producing and implementing River Basin Management Plans (RBMPs) under the Water Environment and Water Services (Scotland) Act, 2003. River basins comprise all surface waters (including transitional (estuaries) and coastal waters) extending to 5.5 km (3 NM) seaward from the Scottish territorial baseline. Any proposed development within these waters must have regard to the requirements of the WFD to ensure that all surface water bodies achieve 'Good Ecological Status' and that there is no deterioration in status. Five classifications of water quality status are defined: High (near natural), Good, Moderate, Poor and Bad; and each classification is accorded a degree of confidence (high, medium or low) in the overall quality assessment. SEPA's standing advice has been considered as part of the assessment, following SEPA's consultation response (Table 9-2).

Water quality has been determined through an evaluation of the designated waterbodies, designated bathing waters, designated shellfish waters, and nitrate sensitive areas (i.e. urban wastewater treatment sensitive areas and Nitrate Vulnerable Zones (NVZs) within the Marine Water and Sediment Quality Study Area. For the purpose of this chapter of the EIAR, 'designated waters' is the collective term for all designations and the basis for which the impact assessment is completed. Designated waters for which there is a pathway for impacts associated with a hydrodynamic connectivity with the Project based on the Marine Water and Sediment Quality Study Area are illustrated in Figure 9-9.

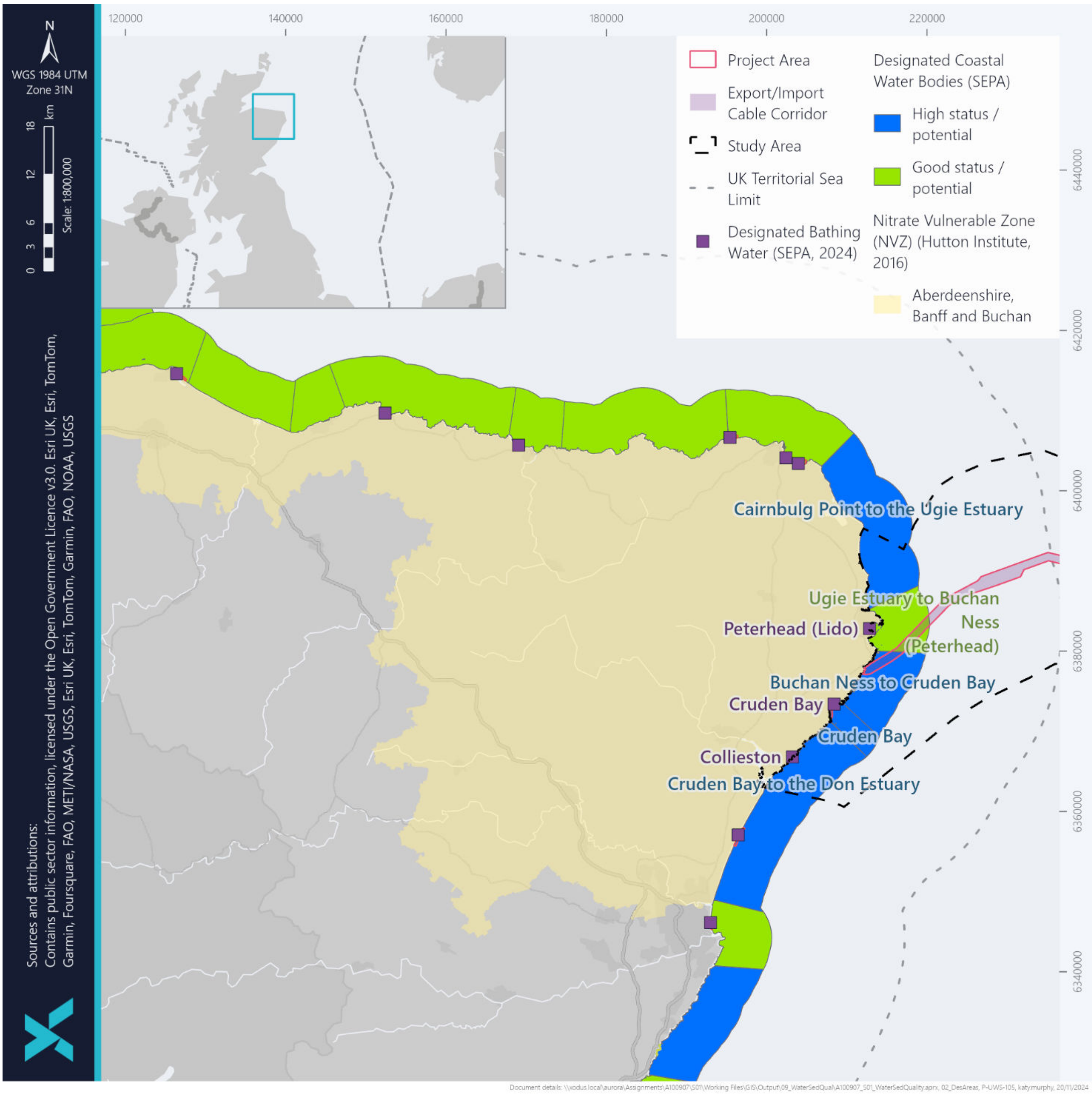

Figure 9-9 Designated waters within the Marine Water and Sediment Quality Study Area

9.4.5.2.1 Designated coastal waterbodies

The Project will directly overlap with two designated coastal waterbodies (Figure 9-9):

- Ugie Estuary to Buchan Ness (Peterhead) (ID: 200131); and
- Buchan Ness to Cruden Bay (ID: 200125).

Additionally, the following designated coastal waterbodies are within the Marine Water and Sediment Quality Study Area (Figure 9-9):

- Cairnbulg Point to the Ugie Estuary (ID: 200142) – located approximately 3.5 km northwest from the EICC;
- Cruden Bay to the Don Estuary (ID: 200117) – located approximately 7.2 km southwest from the EICC; and
- Cruden Bay (ID: 200118) – located approximately 4.3 km southwest from the EICC.

A summary of the condition of each of these designated coastal waterbodies with the most recent five-year data in overall status, ecology and water quality is presented in Table 9-13 and detailed below.

The Ugie Estuary to Buchan Ness (Peterhead) waterbody has an area of 46.3 km^2 (SEPA, 2024a). The Project overlaps with this waterbody for 5.5 km^2, accounting for 11.9% of the overall waterbody area. The Ugie Estuary to Buchan Ness (Peterhead) waterbody is designated as a heavily modified waterbody. The physical condition of the waterbody has faced pressure from modifications to bed, banks and shores as a result of land use and navigation. The overall and physical condition of the Ugie Estuary to Buchan Ness (Peterhead) waterbody is currently listed as in 'Good ecological potential' status, with a similar status for the 2027 and long-term projections. Given the 'Good ecological potential' status, no actions are currently planned to address the pressures. The water quality status is 'Good' with 'High' freedom from invasive species (Table 9-13). Furthermore, the most recent five years of data indicates that the waterbody has maintained 'Good ecological potential' for overall status, 'Good' water quality and 'Moderate' overall ecology (Table 9-13).

The Buchan Ness to Cruden Bay waterbody has an area of 57.7 km^2 (SEPA, 2024a). The Project overlaps with this waterbody for 5.0 km^2, accounting for 8.7% of the overall waterbody area. There are currently no pressures identified for this waterbody. The Buchan Ness to Cruden Bay waterbody is currently listed 'High' for overall status, water quality, physical condition and freedom from invasive species, with a similar status for the 2027 and long-term projections (Table 9-13). The most recent five years of data indicates that the waterbody has maintained 'High' in overall status, overall ecology and water quality (Table 9-13).

The Cairnbulg Point to the Ugie Estuary waterbody has an area of 127.8 km^2 (SEPA, 2024a). There are currently no pressures identified for this waterbody. The Cairnbulg Point to the Ugie Estuary waterbody is currently listed 'High' for overall status, water quality, physical condition and freedom from invasive species, with a similar status for the 2027 and long-term projections (Table 9-13). The most recent five years of data indicates that the waterbody has maintained 'High' in overall status, overall ecology and water quality (Table 9-13)).

The Cruden Bay to Don Estuary waterbody has an area of 149.3 km^2 (SEPA, 2024a). There are currently no pressures identified for this waterbody. The Cruden Bay to Don Estuary waterbody is currently listed 'High' for overall status, water quality, physical condition and freedom from invasive species, with a similar status for the 2027 and long-term projections (Table 9-13). The most recent five years of data indicates that the waterbody has maintained 'High' in overall status, overall ecology and water quality (Table 9-13).

The Cruden Bay waterbody has an area of 19.3 km^2 (SEPA, 2024a). There are currently no pressures identified for this waterbody. The Cruden Bay waterbody is currently listed 'High' for overall status, water quality, physical condition and freedom from invasive species, with a similar status for the 2027 and long-term projections (Table 9-13)). The most recent five years of data indicates that the waterbody has maintained 'High' in overall status, overall ecology and water quality (Table 9-13)).

Table 9-13 Summary of the condition of designated waterbodies (SEPA, 2024a) and most recent five-year data trends in overall status, overall ecology and water quality (SEPA, 2024b)

WATERBODY		CONDITION	2017	2018	2019	2020	2022	CURRENT	2027	LONG-TERM
Ugie Estuary to Buchan Ness (Peterhead)	Overall	Good ecological potential								
	Water quality	Good								
		Physical condition	N/A					Good ecological potential		
		Freedom from invasive species	N/A					High		
		Overall ecology	Moderate					N/A		
Buchan Ness to Cruden Bay	Overall	High								
	Water quality	High								
		Physical condition	N/A					High		
		Freedom from invasive species	N/A					High		
		Overall ecology	High					N/A		
Cairnbulg Point to the Ugie Estuary	Overall	High								
	Water quality	High								
		Physical condition						High		
		Freedom from invasive species						High		
		Overall ecology	High							
Cruden Bay	Overall	High								

WATERBODY		CONDITION	2017	2018	2019	2020	2022	CURRENT	2027	LONG-TERM
	Water quality	High								
		Physical condition	N/A					High		
		Freedom from invasive species	N/A					High		
		Overall ecology	High							
	Overall	High								
Cruden Bay to Don Estuary		Water quality	High							
		Physical condition	N/A					High		
		Freedom from invasive species	N/A					High		
		Overall ecology	High							

9.4.5.2.2 Designated bathing waters

The Peterhead (Lido) (ID: UKS7616042), Cruden Bay (ID: UKS7616012) and Collieston (ID: UKS7616090) designated bathing waters are located within the Marine Water and Sediment Quality Study Area. The Peterhead (Lido) bathing water is the closest in proximity, located 3.8 km northwest of the EICC (Figure 9-9). The Cruden Bay and Collieston bathing waters are located 5.2 km southwest and 13.6 km southwest from the EICC respectively (Figure 9-9). The Project does not directly overlap with these designated bathing waters.

As described in Section 9.4.5.2.1 above, the Project overlaps with the Cruden Bay to the Don Estuary designated coastal waterbody. Although the Balmedie (ID: UKS761605) designated bathing water is located within the Cruden Bay to the Don Estuary waterbody, this bathing water is beyond the tidal excursion extent denoted by the Marine Water and Sediment Quality Study Area. There is therefore considered to be little to no pathway for impacts to these designated bathing waters and are therefore not considered any further (Figure 9-9).

In accordance with the Bathing Water Directive (2006/7/EC), the annual bathing water quality is classified as 'Excellent', 'Good', 'Sufficient', or 'Poor.' The annual bathing water classification is determined using statistics (average value and range of values) calculated from results taken over the previous four years. The water quality indicators SEPA test for are the bacteria *Escherichia coli* (E. coli) and *Intestinal enterococci* (IE). Single sample results above 500 E. Coli and 200 IE are indicative of low water quality when the sample was taken (SEPA, 2024d).

Both Peterhead (Lido) (ID: UKS7616042), and Cruden Bay (ID: UKS7616012) designated bathing waters are listed as having an 'Excellent' condition for the 2023/24 season, with the Collieston (ID: UKS7616090) bathing water listed in 'Good' condition for the 2023/24 season (SEPA, 2024d) (Table 9-14). The Peterhead (Lido) designated bathing water has maintained 'Excellent' condition from the 2018/19 season onwards and was listed in 'Good' condition prior to that. The Cruden Bay designated bathing water has also been in 'Good' condition prior to the current season through the 2019/20 season. All designated bathing waters are noted to be at risk of short-term pollution following heavy rainfall due to the potential for sewer overflows. Additionally, there is the potential for agricultural run-off at the Cruden Bay bathing water (SEPA, 2024d). The Cruden Bay catchment area is primarily associated with agricultural land use which results in agricultural diffuse pollution during wet periods. There is a pumping station to Peterhead Bay which is permitted to discharge under wet weather and emergency conditions. Furthermore, the presence of fishing vessels in the harbour may result in discharge of hold water to the harbour area. There is no risk from overproduction or excessive growth of cyanobacteria (blue-green algae) or algae (SEPA, 2024d).

Table 9-14 The condition of the designated bathing waters within the Marine Water and Sediment Quality Study Area over recent years (SEPA, 2024d)

<table>
<tr><th>WATERS</th><th>2017/18</th><th>2018/19</th><th>2019/20</th><th>2020/21</th><th>2021/22</th><th>2022/23</th><th>2023/24</th></tr>
<tr><td>Peterhead (Lido)</td><td>Good</td><td colspan="2">Excellent</td><td>No Data*</td><td colspan="3">Excellent</td></tr>
<tr><td>Cruden Bay</td><td colspan="3">Good</td><td></td><td colspan="2">Good</td><td>Excellent</td></tr>
<tr><td>Collieston</td><td colspan="3">Good</td><td></td><td colspan="3">Good</td></tr>
</table>

*There were no classifications calculated for 2020/21 due to the shortened season and reduced sampling during the Coronavirus Disease (COVID-19) pandemic.

9.4.5.2.3 Designated shellfish water protected areas

The Project does not overlap with any shellfish water protected areas. Furthermore, there are no shellfish water protected areas in the Marine Water and Sediment Quality Study Area as the closest sites are > 100 km away located in the inner Moray Firth at Cromarty Bay (SWPA11), which is harvested for pacific oyster, and Dornoch Firth (SWPA13), which is harvested for common mussels. Due to the intervening distance between the Project and these designated shellfish waters, there is no pathway for water quality impacts from the Project to the designated shellfish waters, therefore, no further assessment is required. The status of fisheries of commercial importance are discussed in EIAR Vol. 3, Chapter 14: Commercial Fisheries.

9.4.5.2.4 Nutrient sensitive areas

Nutrient sensitive areas comprise of NVZs and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Waste Water Treatment Directive (91/271/EEC). Each of these designations and any sites that intersect the Marine Water and Sediment Quality Study Area are considered in the Sections below.

9.4.5.2.4.1 Urban wastewater treatment sensitive areas

The Urban Waste Water Treatment Directive Sensitive Areas Map 2019 for Scotland (SEPA, 2020b) details the areas in Scotland that have been designated as sensitive to the effects of sewage discharges in accordance with the Urban Waste Water Treatment (Scotland) Regulations 2003. These sensitive areas include lochs, rivers, estuaries, designated bathing waters, and designated shellfish water protected areas. The urban wastewater treatment sensitive areas within the Marine Water and Sediment Quality Study Area include the designated bathing waters as described above, as well as the River Ugie North/South confluence to tidal limit river (ID: 23215) in the River Ugie catchment.

The River Ugie North/South confluence to tidal limit river flows into the Ugie Estuary to Buchan Ness (Peterhead) designated coastal waterbody for which the Project overlaps (see Section 9.4.5.2.1). The current overall condition is ‘Poor’ with ‘Moderate’ water quality, ‘Good’ physical condition and ‘High’ freedom from invasive species (SEPA, 2024a). The 2027 and long-term projects are ‘Good’ overall condition, water quality and physical condition and ‘High’ freedom from invasive species. The most-recent five-year data indicates that river has been in ‘Poor’ overall status and overall ecology and ‘Moderate’ water quality (SEPA, 2024b). This is a result of the impact on the water quality of this river due to diffuse source associated with agriculture.

9.4.5.2.4.2 Nitrate vulnerable zones

The primary source of nitrate is from agricultural diffuse pollution (SEPA, 2024d). Areas where nitrate concentrations in groundwater exceed, or are likely to exceed, the standard level (50 mg/l) set out in Nitrates Directive (91/676/EEC) are designated as NVZs (SEPA, 2024e; Scottish Government, 2024). There are currently five NVZs in Scotland, with the Scottish Government reviewing designations every four years, and SEPA monitoring the nitrate concentrations in the surface and ground waters. NVZs are mainly terrestrial and associated with agricultural lands; however, the waterways connect to the coastline, and excess nitrate concentrations can lead to algal blooms and eutrophication in estuaries and transitional waters. The Project overlaps with the Moray, Aberdeenshire/Banff and Buchan NVZ (Scottish Government, 2015b).

9.4.5.3 Seabed sediment properties

Seabed sediments in the CNS are predominantly sand and slightly gravelly sand, although sediments may have higher mud content in basins and deeper waters (Department of Business, Energy and Industrial Strategy (BEIS), 2022). British Geological Survey (BGS) (2024) indicates a dominance of muddy sand across the Array Area and sand and gravelly sand across the EICC, although there are a wide range of typologies present as indicated in Figure 9-11 which illustrates the BGS seabed sediment along with Project site-specific sediment classification across the Project.

The results of the PSA from the Project site-specific surveys confirmed the seabed sediment mainly comprises of sand and fine sediment fractions, with marginally more sand occurring in the EICC (EIAR Vol. 3, Chapter 10: Benthic Ecology, EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC). The grain size throughout the Project ranges from 0.02 millimetres (mm) to 1.84 mm, with a mean of 0.15 mm.

The Array Area is primarily composed of sands and fines, with minimal gravels (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF). The proportions of sands throughout are consistent throughout (mean 55.7% ± 8.44 SD[5]) although slightly lower in the southeastern and southwestern extent of the Array Area (OWF_42, OWF_49; Figure 9-11) (see EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes). The proportion of fines throughout is slightly lower (mean 41.9% ± 6.83 SD), with above average proportion of fines recorded in the south-western region of the Array Area (OWF_49; Figure 9-11). The proportion of gravel in the Array Area is highly variable, with 90% of stations having less than 1% gravel content, aside from the southeastern region where > 60% gravel content was recorded (OWF_42; Figure 9-11). The mean sediment size within the Array Area is 0.11 mm. Overall, the Array Area samples collected in the survey area are representative of 'Muddy Sand', 'Slightly Gravelly Muddy Sand', 'Muddy Sandy Gravel' and 'Sandy Mud' based on the BGS modified folk classification (Long, 2006).

A similar composition of sediment types is observed along the EICC, comprising of sand and fines with minimal proportions of gravels (EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC). The proportions of sands throughout are consistent throughout (mean 78.31% ± 18.50 SD), although slightly lower at EICC_27 and EICC_29 (Figure 9-12) (see EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes). The proportion of fines in the EICC is less prominent (mean 19.48% ± 16.37 SD) and highly variable ranging from 2.10% (EICC_02) to 82.43% (EICC_29) (Figure 9-12). The proportions of gravel in the EICC is also highly variable, with 80% of stations having less than 1% gravel content, although a much higher gravel content (34.69%) was observed at EICC_27 (Figure 9-12). The mean sediment size within the EICC is 0.19 mm. Overall, the EICC samples collected in the survey area are

[5] *Standard Deviation (SD).*

representative of 'Muddy Sand', 'Sand', 'Slightly Gravelly Muddy Sand', 'Muddy Sandy Gravel' and 'Sandy Mud' based on the BGS modified folk classification (Long, 2006). In the inshore, the MMT (2018) inshore benthic survey reported that the first 100 m of the survey corridor (near land) was bedrock overlaid with gravel and then became primarily sand moving seaward. There was a large proportion of gravel and cobbles / boulders observed at one of the three sampling locations in the inshore; however, moving seaward there was a smaller fraction of gravel present. Overall, the three sampling locations were classified as follows: very silty fine sand, slightly silty sandy gravel with cobbles and finally gravelly medium to coarse sand (NorthConnect, 2018).

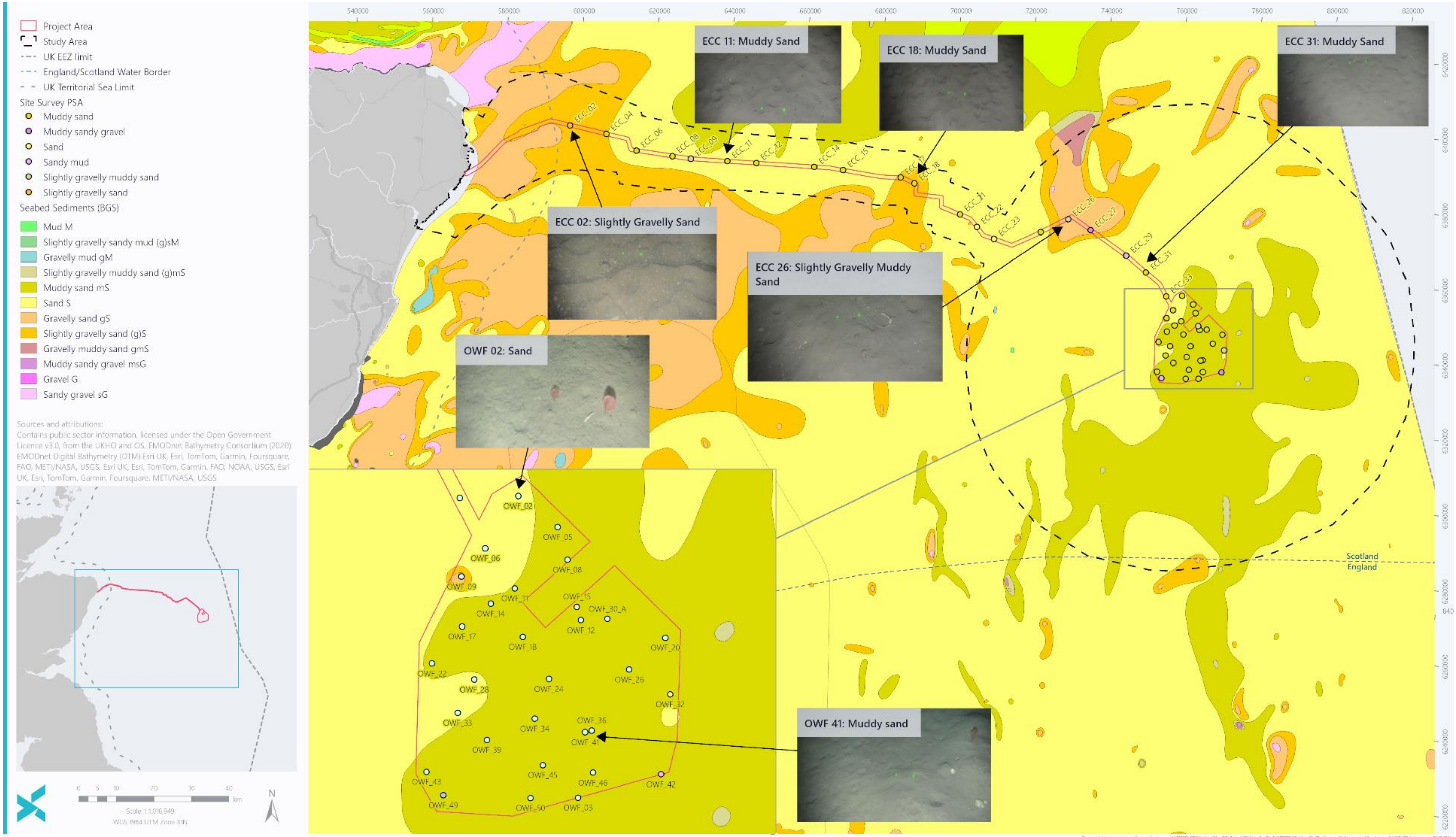

Figure 9-10 Site-specific survey sediments with associated imagery

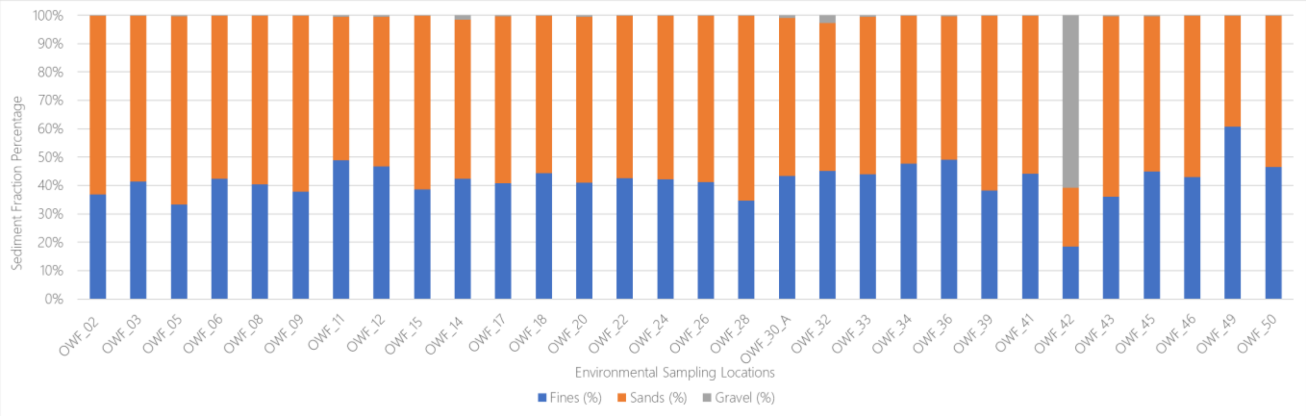

Figure 9-11 Sediment fraction percentage for sampled locations across the Array Area (see ***EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes****)*

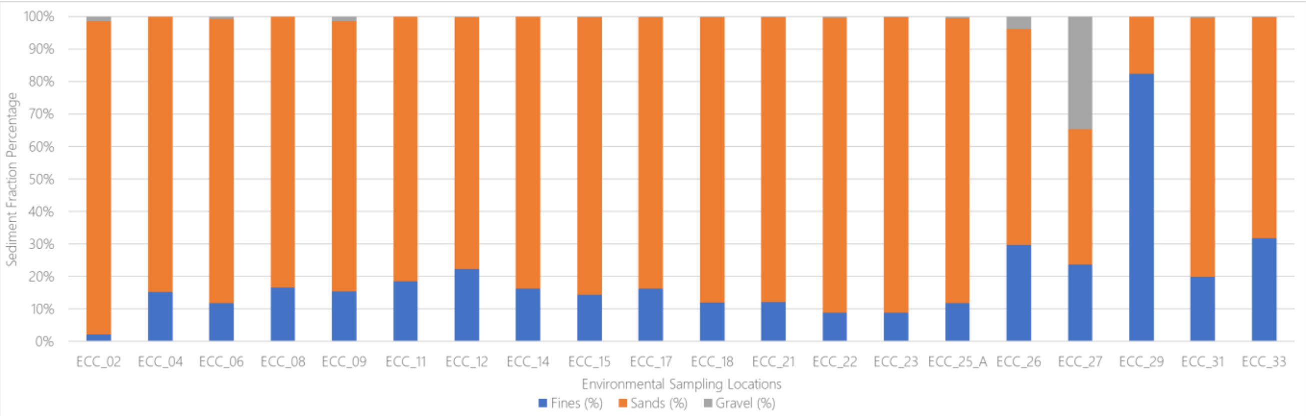

Figure 9-12 Sediment fraction percentage for sampled locations across the EICC (see ***EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes****)*

9.4.5.4 Sediment quality

9.4.5.4.1 Overview

The Marine Scotland 2019 assessment of CSEMP data describes the status and trends of contaminant concentrations in biota and sediment at monitoring stations around the UK between 2013 and 2018. The Project is within the East Scotland Coast and Forties CSEMP monitoring regions (Marine Scotland, 2019b). There are no fixed CSEMP locations or strata recording sediment chemistry and contaminants for the Forties region and only inshore locations within the East Scotland Coast region. These locations are too far to supplement any assumptions related to sediment quality along the EICC beyond 12 NM and the Array Area. The UK MERMAN database indicates records of the following substances within the sediment for the Project (Marine Scotland, 2016; Marine Directorate, 2024):

- Metals: mercury, lead and cadmium – all below BAC levels;
- PAH: pyrene, phenanthrene, naphthalene – all below BAC levels;
- PCBs: CB153 (good status), CB118 (poor status); and
- PBDEs: BD209, BDE99, BDE47 – all in good status.

9.4.5.4.2 Project site-specific sediment chemistry and contamination analysis

As described in Section 9.4.3.2.1, grab samples were successfully acquired at 30 locations in the Array Area and 20 in the EICC analyses of metals, TOM and TOC, hydrocarbons, PAH and PCBs. Samples for organotins, pesticides (OCP) and flame retardants (PBDE) were acquired at only six of the 30 locations in the Array Area and three of the 20 locations in the EICC (Figure 9-13). The results of the analyses are summarised in the Sections below, with further information contained within the environmental baseline survey reports (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC). There were no grab samples obtained in the inshore region (EIAR Vol. 4, Appendix 10: Environmental Baseline and Habitat Assessment Report - Inshore EICC), as described in Section 9.4.3.1.2; however, the MMT (2018) benthic survey acquired grab samples for chemical analysis at three locations which are described below.

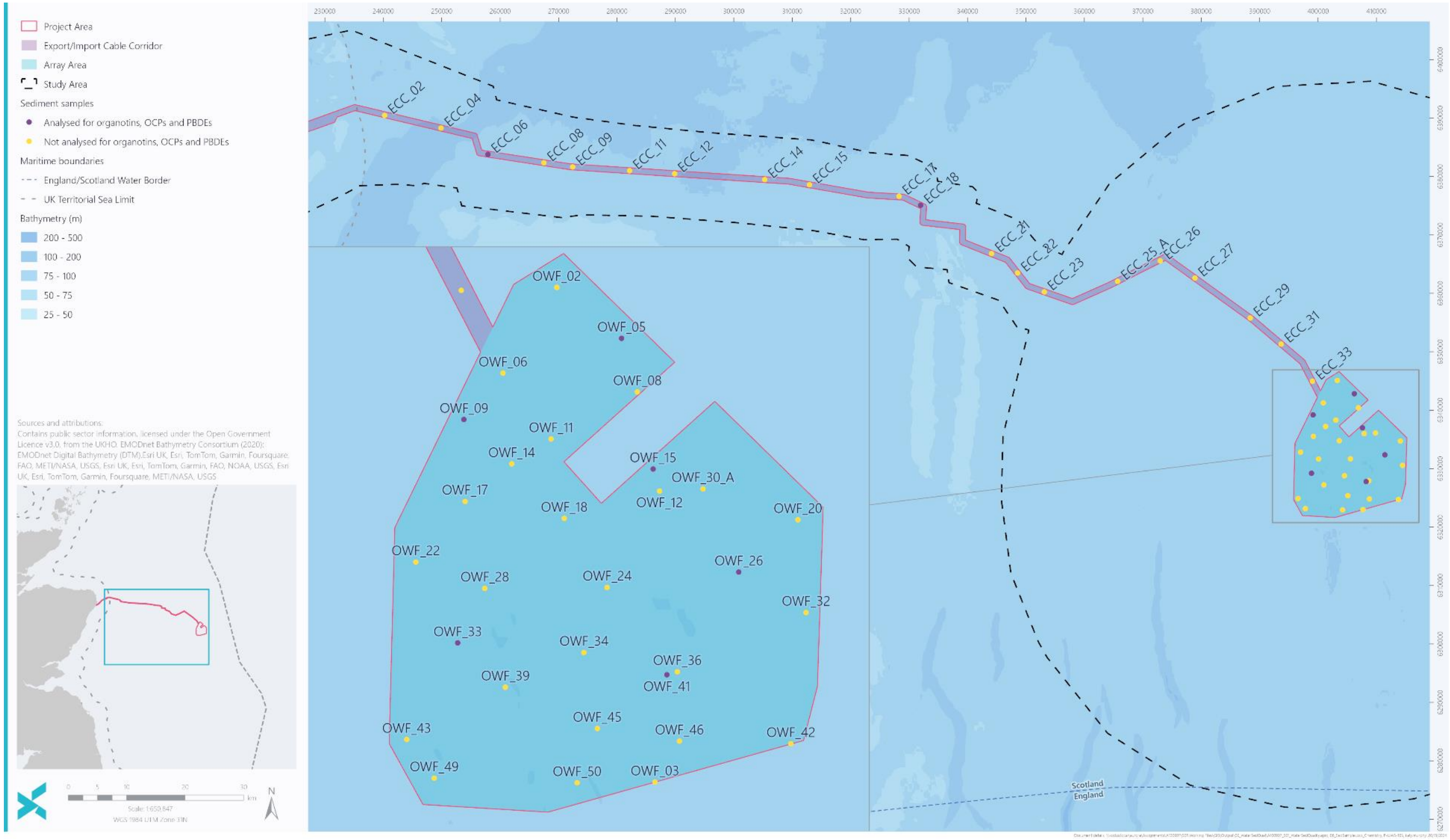

Figure 9-13 Sampling locations for organotins (OCPs and PBDEs) (six in the Array Area, three in the EICC) in comparison to the overall sampling locations for sediment chemistry

9.4.5.4.2.1 Metals

As described in Section 9.4.3.2.1, the grab samples were analysed for arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), zinc (Zn), aluminium (Al), barium (Ba), iron (Fe) and lithium (Li) at 30 locations in the Array Area and 20 locations in the EICC. Metal concentrations were compared against the Marine Scotland (2017) revised ALs, CCME guidelines, Dutch quality standards (RIVM), UKOOA 50th and 95th percentiles and ERL / ERM thresholds described in Section 9.4.4.4. All samples were below the AL1, AL2, CCME PEL, Dutch RIVM and NOAA ERM thresholds.

For Arsenic (As), five sample locations in the Array Area marginally exceeded the CCME ISQG/TEL threshold (7.24 mg/kg) and NOAA ERL (8.2 mg/kg), ranging from 8.8 mg/kg (OWF_33) to 12.4 mg/kg (OWF_30A) (Table 9-15 and Figure 9-14). Additionally, As exceeded the CCME ISQG/TEL and OSPAR ERL thresholds for two sample locations in the EICC (EICC_02, EICC_22) at 10.2 mg/kg (Table 9-15 and Figure 9-14). For mercury (Hg), four sample locations in the Array Area met or marginally exceeded the CCME ISQG/TEL threshold (0.13 mg/kg), ranging from 0.13 mg/kg (OWF_26) to 0.22 mg/kg (OWF_30A) (Table 9-15 and Figure 9-14). Additionally, three of these four sample locations met or exceeded the NOAA ERL (0.15 mg/kg) (OWF_28, OWF_30A, OWF_32) (Table 9-15). The presence of these contaminants especially across the Array Area could relate to anthropogenic activity, although these contaminants can occur naturally, the magnitude and limited occurrence would suggest otherwise.

Nine metals (Cd, Cr, Cu, Pb, Hg, Ni, Zn, Ba and Fe) in the Array Area and seven metals (Cd, Cr, Cu, Hg, Ni, Zn, and Fe) in the EICC were recorded above their respective UKOOA CNS 50th percentile values (Table 9-15). In the Array Area, six of these nine metals (Cd, Cu, Pb, Hg, Zn, Fe) were also recorded above the UKOOA CNS 95th percentile across seven locations (Table 9-15). Three of the seven metals in the EICC (Cu, Pb, and Zn) were also recorded above the UKOOA CNS 95th percentile across two locations (Table 9-15).

For the MMT (2018) inshore data, metal concentrations were assessed against the CCME guidelines (PEL/TEL). The metal concentrations did not exceed the PEL; however, the third sampling location (i.e. furthest seaward) was above the TEL for As (7.24 mg/kg) recorded at 14.9 mg/kg (MMT, 2018). Additionally, the first sampling location (i.e. closest to shore) had an elevated Pb concentration at 17.8 mg/kg; however, this did not exceed the TEL (30.2 mg/kg).

Table 9-15 Metal concentrations (mg/kg dry weight) in samples with threshold values (highlighted cells indicate exceedances) ***(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)****. Where samples exceeded multiple thresholds, the cell has been highlighted the colour of the highest value exceeded*

ANALYTE	AS	CD	CR	CU	PB	HG	NI	ZN	AL	BA	FE	LI
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Detection Limits	0.5	0.04	0.5	0.5	0.5	0.01	0.5	2	10	0.5	36	2
AL1	20	0.4	50	30	50	0.25	30	130	-	-	-	-
AL2	70	4	370	300	400	1.5	150	600	-	-	-	-
CCME TEL	7.24	0.7	52.3	18.7	30.2	0.13	-	124	-	-	-	-
CCME PEL	41.6	4.2	160	108	112	0.7	-	271	-	-	-	-
Dutch RIVM	85	14	380	190	580	10	210	2,000	-	-	-	-
UKOAA 50th %	-	0.02	7.17	2	6.65	0.01	4	10.5	-	117.5	3,487	-
UKOAA 95th %	-	0.12	31.04	6	16.7	0.12	19	32.6	-	523.2	11,160	-
NOAA ERL	8.2	1.20	81	34	46.70	0.15	20.9	150	-	-	-	-
NOAA ERM	70	9.60	370	270	218	0.71	51.6	410	-	-	-	-
Array Area												
OWF_02	2.8	0.07	11.7	3.1	8	0.04	6.4	20.9	3,030	152	5,700	8.5
OWF_03	2.4	0.06	9.5	2.3	6.4	0.02	5.1	15.8	2,930	118	5,570	8.1
OWF_05	2.6	0.05	9.8	2.2	6.2	0.02	5.4	21.8	2,320	115	4,890	6.3
OWF_06	2.5	0.08	12.3	2.9	7.7	0.02	6.5	20.6	2,760	144	5,130	7.6
OWF_08	2.5	0.04	9	2.1	6	0.01	4.9	20.8	2,320	124	4,900	6.1
OWF_09	2.4	0.08	10.7	2.5	6.8	0.01	5.4	18.3	2,300	124	4,680	6.2
OWF_11	2.3	0.06	8	1.9	5.4	0.01	4.6	19.8	2,230	100	4,840	6.4
OWF_12	2.6	0.04	10	2.5	7.1	0.02	5.7	18.2	2,940	171	5,680	8.2
OWF_14	3.2	0.07	12.9	3.1	8	0.03	7	25.9	3,040	133	5,810	8.5
OWF_15	3.3	0.07	11.6	2.6	7.3	0.02	6.1	20.3	2,570	114	5,110	7
OWF_17	2.3	<0.04	10.4	2	6.5	0.01	5.3	18.1	2,320	111	4,830	5.9
OWF_18	2.2	<0.04	11.6	2.3	6.9	0.02	6.1	18.4	2,860	118	5,810	7.5
OWF_20	2	<0.04	10.5	1.7	6	0.01	5.5	17	2,580	100	5,300	6.4
OWF_22	2.5	<0.04	12.8	2.1	6.2	0.01	6.7	19.7	2,710	118	5,400	7.1
OWF_24	2.7	<0.04	11.5	2	7.2	0.01	5.7	17.7	2,680	106	5,370	6.7
OWF_26	9.1	0.18	13.3	8.4	14.8	0.13	10.2	46.6	2,570	17	8,090	7.8
OWF_28	9.3	0.14	17.3	11.4	20.5	0.17	11	54.5	3,640	18	10,400	10.7
OWF_30_A	12.4	0.18	27	17.7	29.8	0.22	17.7	88.4	10,300	47	20,600	32.3
OWF_32	10	0.15	22.7	12.5	20.8	0.15	14.9	71.8	9,450	33	19,100	29.5
OWF_33	8.8	0.17	17.4	12.4	17	0.12	12.6	67.5	6,590	48	15,900	25

ANALYTE	AS	CD	CR	CU	PB	HG	NI	ZN	AL	BA	FE	LI
OWF_34	3	<0.04	10.8	2.8	7.2	0.02	5.7	19.1	2,740	92	5,270	7.3
OWF_36	4.6	0.04	13.1	3.4	9	0.04	7.4	27	3,390	113	6,540	9.5
OWF_39	2.9	<0.04	10.6	2.6	7	0.02	5.7	21.7	2,410	109	4,920	6.7
OWF_41	3.1	<0.04	11.6	2.8	7.4	0.01	6.3	22.5	2,780	107	5,520	7.5
OWF_42	6.6	<0.04	15	4.2	8.7	0.01	12.8	26.8	3,870	95	10,900	13.5
OWF_43	2.9	<0.04	12.2	3.1	7.4	0.02	6.7	26	3,060	140	5,590	8.5
OWF_45	3.8	<0.04	13.1	3	8.2	0.02	7.1	45.7	2,740	116	5,640	7.6
OWF_46	2.9	<0.04	11.7	2.9	8	0.02	6.3	26.1	3,190	121	5,920	9
OWF_49	3.9	<0.04	15.5	3.7	8.8	0.03	8.7	47.1	2,980	136	5,430	8.4
OWF_50	3.8	<0.04	14	3.3	8.6	0.02	7.6	31.2	2,690	92	5,140	7.3
Min	2	0.04	8	1.7	5.4	0.01	4.6	15.8	2,230	17	4,680	5.9
Max	12.4	0.18	27	17.7	29.8	0.22	17.7	88.4	10,300	171	20,600	32
Median	2.9	0.07	11.7	2.85	7.4	0.02	6.35	21.75	2,770	113.5	5,545	7.6
EICC												
EICC_02	10.2	0.05	11.1	1.5	6.9	0.01	3.6	15.2	1,240	10	7,180	4.2
EICC_04	3.4	0.06	8.8	1.6	3.7	0.01	3.8	18.8	1,780	10	5,100	5.4
EICC_06	4.2	0.06	10	1.4	4.6	0.01	3.7	16.3	1,440	7	5,290	4.4
EICC_08	3.7	0.06	9.2	2.3	4.5	0.01	4.1	15.6	1,760	14	5,510	5
EICC_09	3.8	0.04	10.5	2.8	4.3	0.01	4.5	14.1	1,770	14	5,880	4.6
EICC_11	2.7	0.06	8.3	2.7	3.7	0.01	4.5	13.6	2,080	20	4,860	5.2
EICC_12	3.3	0.07	9.7	3.1	4.5	0.03	5.8	15.8	2,350	22	5,210	6.2
EICC_14	6.3	0.05	14.3	18.2	20.5	0.02	5.3	56.6	1,940	14	7,210	5
EICC_15	4.7	0.05	13	3.2	5.2	0.02	6.3	39.8	1,890	15	6,040	4.5
EICC_17	4.7	0.05	13.4	2.9	5.1	0.06	5.2	22	2,020	20	6,090	4.9
EICC_18	4.2	0.05	11.5	2.4	4.2	<0.01	4.2	24	1,420	13	5,320	3.5
EICC_21	3.6	0.05	11.2	1.8	4.1	<0.01	3.2	13.8	1,100	8	3,930	2.6
EICC_22	10.2	0.06	16.7	2.5	7.1	<0.01	4.2	16.9	1,180	13	7,170	2.5
EICC_23	5.8	<0.04	14.6	2.9	5.3	0.04	4.4	17.4	1,210	13	5,110	2.6
EICC_25_A	4	<0.04	9.7	2.6	4.4	0.02	3.8	13.8	1,150	19	4,200	2.6
EICC_26	3.8	0.05	9.4	2.6	4.1	0.01	4.4	16.1	1,630	74	5,260	4.1
EICC_27	3.8	0.05	10.2	2.6	4.1	0.02	4.7	18.7	1,660	52	4,880	4.2
EICC_29	3.8	<0.04	13.9	2.8	5.8	0.01	4.8	16.5	1,770	45	4,970	4.1
EICC_31	3	0.05	8	1.7	4.2	0.01	3.3	14.2	1,510	42	4,210	3.7
EICC_33	2.3	0.05	8.6	2.3	5.1	0.01	4.4	14.9	2,130	99	4,950	5.3
Min	2.3	0.04	8	1.4	3.7	0.01	3.2	13.6	1,100	7	3,930	2.5

ANALYTE	AS	CD	CR	CU	PB	HG	NI	ZN	AL	BA	FE	LI
Max	10.2	0.07	16.7	18.2	20.5	0.06	6.3	56.6	2,350	99	7,210	6.2
Median	3.8	0.05	10.35	2.6	4.5	0.01	4.4	16.2	1,710	14.5	5,235	4.3
Inshore												
S01	4.5	<0.1	20.4	5.4	17.8	0.01	8.4	30.1	-	-	-	-
S02	5	<0.1	11.9	3.8	6.7	0.01	5.9	17.2	-	-	-	-
S03	14.9	<0.1	9.1	4.1	10.4	0.01	8	23.5	-	-	-	-
Min	4.5	<0.1	9.1	3.8	6.7	0.01	5.9	17.2	-	-	-	-
Max	14.9	<0.1	20.4	5.4	17.8	0.01	8.4	30.1	-	-	-	-
Median	5	<0.1	11.9	4.1	10.4	0.01	8	23.5	-	-	-	-

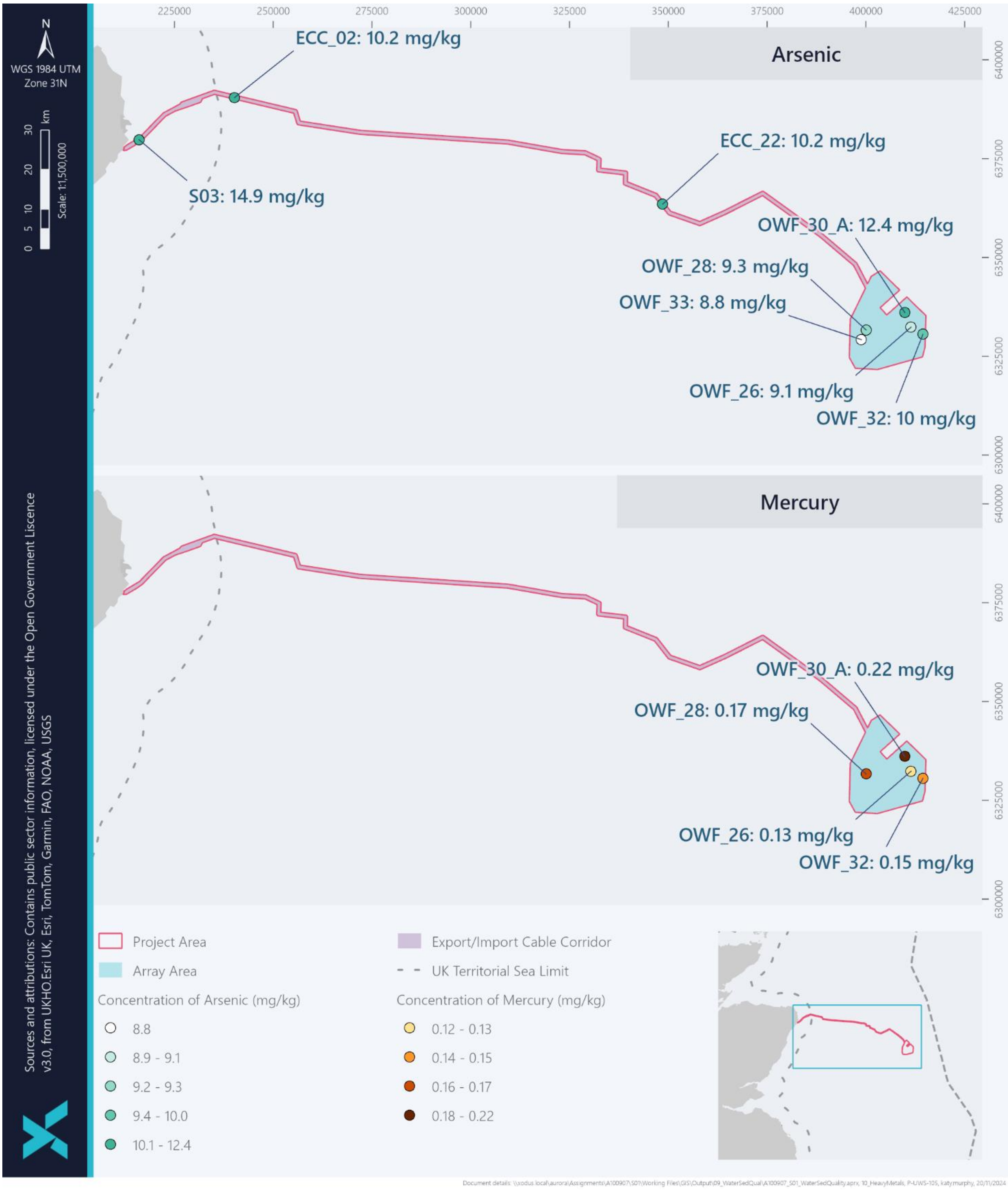

Figure 9-14 As and Hg occurrences above the CCME ISQG/TEL threshold, illustrating the location and magnitude above the threshold

9.4.5.4.2.2 Organics

As described in Section 9.4.3.2.1, the grab samples were analysed for TOM and TOC at 30 locations in the Array Area and 20 locations in the EICC. The TOM values were compared against the UKOOA 50th and 95th percentiles described in Section 9.4.4.5. All samples were below the UKOOA 95th percentile.

Throughout the survey area, the minimum values observed for TOC and TOM were in the EICC (0.13% (EICC_02) and 0.9% (EICC_06, EICC_21, EICC_22, EICC_23) respectively) while the maximum values were observed in the Array Area (0.51% and 2.9% (OWF_49)) (Table 9-16 and Figure 9-15). Overall, TOC ranged from 0.22% to 0.51% in the Array Area and 0.13% to 0.27% in the EICC (Table 9-16 and Figure 9-15). TOM ranged from 1.6% to 2.9% in the Array Area and 0.9% to 1.9% in the EICC (Table 9-16 and Figure 9-15). TOM was above the UKOOA 50th percentile for all sampled locations in the Array Area and the majority of sampled locations in the EICC. Based on the sampling results, TOC and TOM are not considered to be a concern across the Project Area.

For the MMT (2018) inshore data, all three sampling locations were considered to have low concentrations of organic matter with the TOC ranging from 0.23% (furthest seaward) to 0.35% (closest to shore).

Table 9-16 Total Organic Matter (TOM) and Total Organic Carbon (TOC) (%) in samples with threshold values (highlighted cells indicate exceedances) ***(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)***

ANALYTE	TOC (%)	TOM (%)
Detection Limits	0.02 %	0.2 %
UKOOA 50th %	-	1.13
UKOOA 95th %	-	4.48
Array Area		
OWF_02	0.43	2.4
OWF_03	0.41	2.2
OWF_05	0.34	1.7
OWF_06	0.38	2.1
OWF_08	0.32	1.9
OWF_09	0.36	1.8
OWF_11	0.34	1.9
OWF_12	0.40	2.2
OWF_14	0.45	2.3
OWF_15	0.33	2.0
OWF_17	0.22	1.8
OWF_18	0.43	2.2
OWF_20	0.37	1.9
OWF_22	0.40	2.1

ANALYTE	TOC (%)	TOM (%)
OWF_24	0.35	2.0
OWF_26	0.43	2.2
OWF_28	0.35	1.8
OWF_30_A	0.35	1.7
OWF_32	0.27	2.0
OWF_33	0.44	2.4
OWF_34	0.33	2.0
OWF_36	0.41	2.7
OWF_39	0.42	2.0
OWF_41	0.32	2.2
OWF_42	0.44	2.3
OWF_43	0.41	2.5
OWF_45	0.32	2.2
OWF_46	0.49	1.6
OWF_49	0.51	2.9
OWF_50	0.47	2.6
Min	**0.22**	**1.6**
Max	**0.51**	**2.9**
Median	**0.39**	**2.1**
EICC		
EICC_02	0.13	1.9
EICC_04	0.24	1.4
EICC_06	0.16	0.9
EICC_08	0.21	1.3
EICC_09	0.16	1.0
EICC_11	0.22	1.3
EICC_12	0.27	1.7
EICC_14	0.23	1.1
EICC_15	0.21	1.1
EICC_17	0.25	1.5
EICC_18	0.17	1.1
EICC_21	0.22	0.9
EICC_22	0.21	0.9
EICC_23	0.17	0.9
EICC_25_A	0.18	1.0

ANALYTE	TOC (%)	TOM (%)
EICC_26	0.24	1.3
EICC_27	0.26	1.5
EICC_29	0.22	1.2
EICC_31	0.25	1.3
EICC_33	0.23	1.6
Min	0.13	0.9
Max	0.27	1.9
Median	0.22	1.25
Inshore		
S01	0.35	N/A
S02	0.31	N/A
S03	0.23	N/A
Min	0.23	N/A
Max	0.35	N/A
Median	0.31	N/A

Figure 9-15 TOC and TOM occurrence and magnitude across the Project, with the symbols indicating the magnitude above the limit of detection

9.4.5.4.2.3 Organotins (DBT & TBT)

DBT and TBT were analysed across six locations in the Array Area (OWF_05, OWF_09, OWF_15, OWF_26, OWF_33 and OWF_41) and three locations in the EICC (EICC_06, EICC_18 and EICC_29) (Figure 9-13). For all sampled locations throughout the survey area, concentrations of organotins were recorded below the detection limit (1 µg/kg) and therefore did not exceed any thresholds (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC). Therefore, organotins have not been considered further.

9.4.5.4.2.4 Hydrocarbons

Grab samples were analysed for hydrocarbons (PAH and THC) at 30 sites in the Array Area and 20 sites in the EICC. Hydrocarbon concentrations were compared against the Marine Scotland (2017) revised AL1, CCME ISQG/PEL, UKOOA 50th and 95th percentiles, OSPAR ERL and NOAA ERM and OSPAR BC/BAC thresholds described in Section 9.4.4.5. THC was above the UKOOA CNS 50th percentile (4.1 mg/kg) for all locations in the Array Area, ranging from 8.18 mg/kg (OWF_06) to 19.9 mg/kg (OWF_42) (Table 9-17 and Table 9-16). In the EICC THC values were recorded below the detection limit (0.1 mg/kg) for the majority of sampled locations, aside from one location which exceeded the UKOOA CNS 50th percentile at 9.6 mg/kg (EICC_27) (Table 9-17). The occurrence and magnitude of PAH contaminants above the Marine Scotland (2017) revised AL1 across the Project are illustrated in Figure 9-16. PAH concentrations exceeded the OSPAR BC and OSPAR BAC thresholds throughout all sampled locations in the Array Area for one or more of the PAHs analysed (Table 9-17), which is considered to be due to the proximity of nearby oil and gas assets as illustrated in Figure 9-4. As illustrated in Figure 9-16, six PAH contaminants exceeded the Marine Scotland (2017) revised AL1 threshold (100 µg/kg). This included fluoranthene (OWF_08), benzo[b]fluoranthene (26 sampled locations), benzo[k]fluoranthene (10 sampled locations), indeno[1,2,3,c,d]pyrene and benzo[g,h,i]perylene (all locations) and the threshold (10 µg/kg) was exceeded for dibenzo(a,h)anthracene (all locations) (Figure 9-16). Additionally, the OSPAR ERL thresholds for indeno[1,2,3,c,d]pyrene (240 µg/kg) was exceeded at 13 sampled locations and benzo[g,h,i]perylene (85 µg/kg) at all sampled locations (Table 9-17 and Figure 9-16).

In the EICC, PAH concentrations were below the detection limit (1 µg/kg) throughout the majority of sampled locations; however, the OSPAR BC was exceeded for naphthalene, phenanthrene and benzo[a]anthracene (EICC_27), fluoranthene, pyrene, chrysene, benzo[a]pyrene (EICC_12, EICC_27) and indeno[1,2,3,c,d]pyrene and benzo[g,h,i]perylene (EICC_27, EICC_29, EICC_31 and EICC_33) (Table 9-17). Additionally, the OSPAR BAC was exceeded for naphthalene (EICC_27) (Table 9-17).

For the MMT (2018) inshore data, all three sampling locations did not exceed any thresholds for hydrocarbons (PAH and THC).

Table 9-17 PAH (µg/kg) and THC (mg/kg) concentrations in samples with threshold values (highlighted cells). Where measured concentrations of the contaminant in the sample was below the detection limits, the value was not calculated and is represented by 'NC' (Not Calculated) ***(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)****. Where samples exceeded multiple thresholds, the cell has been highlighted the colour of the highest value exceeded*

ANALYTE	NAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	DIBENZOTHIOPHENE	ANTHRACENE	FLUORANTHENE	PYRENE	BENZO[A]ANTHRACENE	CHRYSENE	BENZO[B]FLUORANTHENE	BENZO[K]FLUORANTHENE	BENZO[A]PYRENE	INDENO[123,CD]PYRENE	DIBENZO[A,H]ANTHRACENE	BENZO[GHI]PERYLENE	THC
UNITS	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	mg/kg
Detection Limits	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.1
Marine Scotland AL1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10	100	-
CCME ISQG	34.6	5.87	6.71	21.2	86.7	-	46.9	113	153	74.8	108	-	-	88.8	-	6.22	-	-
CCME PEL	391	128	88.9	144	544	-	245	1494	1398	693	846	-	-	763	-	135	-	-
UKOOA 50th %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.1
UKOAA 95th %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40.1
OSPAR ERL	160	44	16	19	240	190	85	600	665	261	384	-	240	430	240	63	85	-
NOAA ERM	2,100	640	500	540	1,500	-	1,100	5,100	2,600	1,600	2,800	-	-	1,600	-	260	2,800	-
OSPAR BC	5	-	-	-	17	0.6	3	20	13	9	11	-	-	15	50	-	45	-
OSPAR BAC	8	-	-	-	32	-	5	39	24	16	20	-	-	30	103	-	80	-
Array Area																		
OWF_02	8.72	NC	NC	NC	25.16	NC	NC	36.30	28.07	19.58	28.94	95.3	78.8	34.10	163.5	17.77	141.9	10.21
OWF_03	10.46	NC	NC	NC	28.81	NC	NC	39.13	29.31	22.83	32.12	121.3	95.0	41.67	220.9	22.38	184.5	10.17
OWF_05	10.43	NC	NC	NC	27.41	NC	NC	38.03	29.17	22.57	32.92	118.7	97.0	40.71	221.9	24.92	177.1	12.51
OWF_06	NC	NC	NC	NC	14.64	NC	NC	20.72	16.14	12.02	17.33	73.2	54.2	23.58	136.9	16.66	112.7	8.18
OWF_08	12.00	NC	NC	NC	35.07	NC	NC	106.33	78.10	53.38	62.70	156.0	122.3	76.64	272.0	31.55	217.1	10.4
OWF_09	10.32	NC	NC	NC	24.16	NC	NC	30.80	22.65	18.55	26.87	105.8	73.7	33.91	196.6	23.71	159.2	12.92
OWF_11	10.81	NC	NC	NC	25.91	NC	NC	33.79	25.80	20.27	28.12	112.3	89.9	37.79	211.0	27.58	172.6	10.71
OWF_12	11.24	NC	NC	NC	30.30	NC	NC	46.74	35.68	28.60	37.73	149.3	106.1	51.12	283.6	34.65	220.7	12.63
OWF_14	9.91	NC	NC	NC	22.71	NC	NC	30.61	23.10	18.25	24.73	99.0	69.4	33.17	186.0	22.17	147.6	11.83
OWF_15	10.70	NC	NC	NC	26.60	NC	NC	37.76	28.55	23.06	31.37	135.6	95.9	43.88	253.9	31.80	202.8	9.89
OWF_17	18.03	NC	NC	NC	35.43	NC	NC	48.25	36.10	29.13	38.79	149.7	106.6	49.52	281.9	33.04	223.7	10.02
OWF_18	9.88	NC	NC	NC	26.10	NC	NC	37.87	29.69	22.89	29.26	116.3	82.4	39.06	220.0	26.59	173.1	11.21
OWF_20	7.91	NC	NC	NC	17.07	NC	NC	25.25	19.06	15.39	21.67	90.0	64.6	29.12	171.4	21.79	136.0	8.21
OWF_22	11.00	NC	NC	NC	28.95	NC	NC	32.71	24.96	19.26	28.17	106.4	78.0	35.18	204.4	25.13	161.9	12.62
OWF_24	15.66	NC	NC	NC	43.69	NC	NC	50.51	38.12	30.65	41.63	156.5	115.9	53.29	306.2	36.21	235.4	14.57
OWF_26	9.93	NC	NC	NC	24.81	NC	NC	33.71	25.37	21.18	27.76	116.7	80.5	38.36	219.7	28.06	170.7	11.24
OWF_28	11.33	NC	NC	NC	28.85	NC	NC	38.69	29.91	23.43	32.65	135.9	94.4	44.53	258.1	32.36	205.2	11.96
OWF_30_A	9.53	NC	NC	NC	20.91	NC	NC	34.27	24.76	20.98	28.11	111.0	78.2	37.20	211.5	27.04	164.1	8.77

ANALYTE	NAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	DIBENZOTHIOPHENE	ANTHRACENE	FLUORANTHENE	PYRENE	BENZO[A]ANTHRACENE	CHRYSENE	BENZO[B]FLUORANTHENE	BENZO[K]FLUORANTHENE	BENZO[A]PYRENE	INDENO[123,CD]PYRENE	DIBENZO[A,H]ANTHRACENE	BENZO[GHI]PERYLENE	THC
OWF_32	14.78	NC	NC	NC	34.61	NC	NC	53.73	46.15	40.88	52.58	172.2	134.5	69.64	315.5	40.10	252.7	11.39
OWF_33	9.33	NC	NC	NC	25.15	NC	NC	39.12	29.80	22.88	32.63	125.4	90.5	42.58	237.2	28.67	188.0	13.08
OWF_34	11.24	NC	NC	NC	26.53	NC	NC	37.94	29.93	24.04	32.90	127.1	90.5	42.56	232.5	27.72	184.7	11.55
OWF_36	13.46	NC	NC	NC	33.15	NC	NC	49.23	35.94	28.93	38.53	155.9	109.8	51.28	288.6	36.62	229.7	14.92
OWF_39	7.42	NC	NC	NC	19.31	NC	NC	32.50	24.83	19.69	26.37	104.6	76.0	36.00	201.0	25.56	162.5	12.0
OWF_41	9.70	NC	NC	NC	33.42	NC	NC	51.19	40.39	28.60	37.18	148.5	107.2	51.50	275.1	35.01	220.5	10.3
OWF_42	12.16	NC	NC	NC	30.23	NC	NC	43.70	31.68	26.31	36.29	147.5	103.4	47.36	283.0	35.28	216.6	19.9
OWF_43	8.22	NC	NC	NC	20.55	NC	NC	29.08	21.57	16.84	24.88	100.6	66.6	31.81	191.2	24.12	152.1	15.27
OWF_45	15.41	NC	NC	NC	29.72	NC	NC	52.55	36.05	31.11	41.54	154.3	109.8	53.38	289.9	37.56	229.0	13.1
OWF_46	8.42	NC	NC	NC	21.66	NC	NC	36.60	26.74	21.71	29.58	127.6	89.1	41.43	247.7	29.31	193.0	13.68
OWF_49	7.89	NC	NC	NC	21.72	NC	NC	31.09	23.56	18.80	25.51	105.1	75.0	33.95	207.1	25.38	163.6	14.9
OWF_50	12.29	NC	NC	NC	30.25	NC	NC	50.62	37.44	31.00	38.61	154.4	111.4	54.34	279.3	35.95	235.3	18.05
EICC																		
EICC_04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	25.6	18.2	NC	35.2	NC	29.5	NC
EICC_06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	21.4	NC	NC	NC
EICC_08	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	23.1	21.7	NC	30.2	NC	30.0	NC
EICC_09	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	22.4	21.6	NC	33.8	NC	35.8	NC
EICC_11	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	26.3	24.5	NC	35.3	NC	32.7	NC
EICC_12	NC	NC	NC	NC	NC	NC	NC	21.2	16.9	NC	13.9	32.4	28.7	15.0	45.1	NC	40.6	NC
EICC_14	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	20.9	18.1	NC	34.3	NC	30.6	NC
EICC_15	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	26.9	19.3	NC	41.9	NC	37.2	NC
EICC_17	NC	NC	NC	NC	16.2	NC	NC	NC	NC	NC	NC	26.2	16.7	NC	43.2	NC	39.6	NC
EICC_18	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	23.6	NC	NC	37.0	NC	35.1	NC
EICC_21	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	17.4	16.6	NC	31.1	NC	30.1	NC
EICC_22	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	20.5	NC	18.4	NC
EICC_23	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	19.1	NC	NC	33.8	NC	33.0	NC
EICC_25_A	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	19.9	NC	NC	33.8	NC	31.1	NC
EICC_26	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	22.2	18.8	NC	38.6	NC	35.1	NC
EICC_27	9.6	NC	NC	NC	19.1	NC	NC	21.1	16.3	10.3	18.1	54.8	37.8	19.1	83.9	NC	75.8	9.6
EICC_29	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	37.0	28.6	NC	65.9	NC	65.6	NC
EICC_31	NC	NC	NC	NC	NC	NC	NC	16.6	NC	NC	12.6	39.8	36.3	NC	78.3	NC	72.5	NC
EICC_33	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	37.2	32.3	NC	71.9	NC	64.6	NC
Inshore																		
S01	1.5	NC	NC	NC	4.6	NC	1.7	10.7	10.4	6.7	8	8.2	4.4	8.2	6.9	1	7.3	-
S02	1.2	NC	NC	NC	4.9	NC	1.4	5.7	5.4	3.2	3.9	4.3	2.6	3.7	4	NC	4.2	-
S03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	-

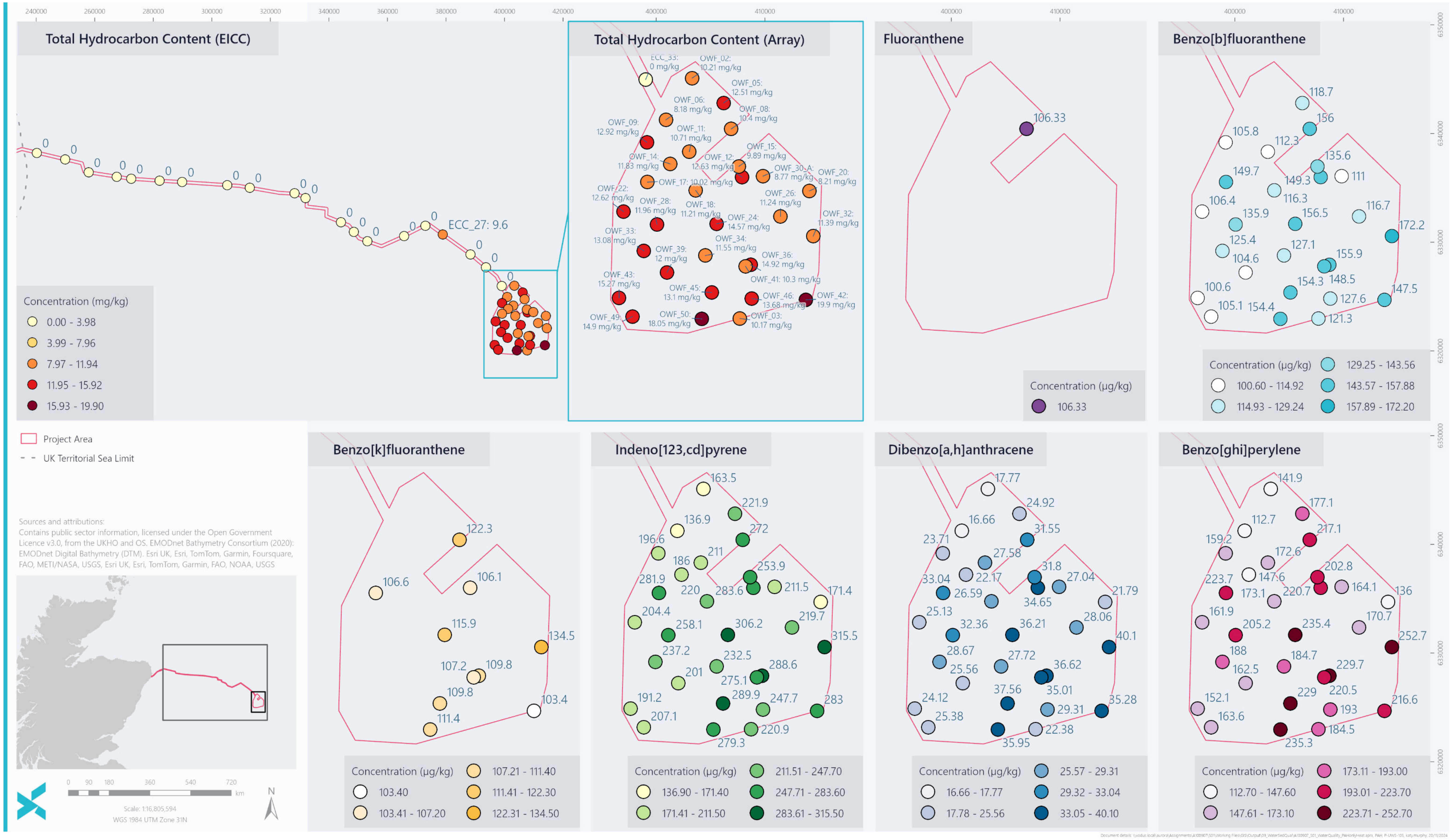

Figure 9-16 PAH occurrence and magnitude across the Project. For THC the symbols represent the magnitude above the limit of detection. For all other PAH contaminants, the symbols represent the presence and occurrence above the Marine Scotland (2017) AL 1 threshold

9.4.5.4.2.5 PCBs

PCB concentrations were analysed at 30 sampled locations in the Array Area and 20 locations in the EICC. PCB concentrations were compared against the AL1 and Dutch RIVM thresholds described in Section 32. Additionally, the sum of 25 congeners (ΣPCB25) was compared against the AL2 and CCME PEL/ISQG thresholds.

Throughout the majority of the survey area the PCB concentrations were below the detection limit (0.08 µg/kg) (Table 9-18); however, there were three locations in the Array Area (OWF_02, OWF_03 and OWF_41) and three locations in the EICC (EICC_06, EICC_11 and EICC_14) where concentrations were above the detection limit (Table 9-18 and Figure 9-17). For sampled locations that were above the detection limit, concentrations ranged from 0.08 µg/kg to 0.41 µg/kg in the Array Area and 0.08 µg/kg to 0.32 µg/kg in the EICC (Table 9-18).

The sum of ICES 7 (ΣPCB7) concentrations did not exceed the Marine Scotland (2017) revised AL1 threshold (10 µg/kg) but did very marginally exceed the Dutch RIVM threshold (1 µg/kg) at three locations in the Array Area: 1.17 (OWF_02), 1.30 (OWF_03) and 1.27 (OWF_41) (Table 9-18 and Figure 9-17). The slight exceedance here would not suggest that there was a serious level of PCB contamination within the survey area, as this is likely associated with the proximity to oil and gas assets. The sum of 25 congeners (ΣPCB25) ranged from 1.98 µg/kg to 4.88 µg/kg in the Array Area and 0.21 µg/kg to 1.31 µg/kg in the EICC (Table 9-18 and Figure 9-17. . Therefore, the sum of 25 congeners (ΣPCB25) did not exceed the revised AL2 threshold (200 µg/kg), CCME ISQG threshold (21.5 µg/kg), or CCME PEL threshold (189 µg/kg), indicating that PCBs are not a concern across the Project Area. Thus, PCBs have not been considered further.

Table 9-18 PCB concentrations (µg/kg) including the sum of ICES 7 (ΣPCB7) (µg/kg) and sum of 25 congeners (ΣPCB25) (µg/kg) ***(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)****. Where measured concentrations were below the detection limit (0.08 µg/kg), the value is represented by 'NC' and has only been included for locations where there were measurements above the detection limit*

ANALYTE	PCB28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 18	PCB 105	PCB 110	PCB 128	PCB 141	PCB 149	PCB 151	PCB 156	PCB 158	PCB 170	PCB 180	PCB 183	PCB 187	PCB 194	PCB 31	PCB 44	PCB 47	PCB 49	PCB 66	∑PCB7*	∑PCB25
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Detection limit	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-	-
Marine Scotland AL1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
Dutch RIVM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Array Area																											
OWF_02	0.08	0.11	0.21	0.2	0.35	0.22	NC	NC	0.23	0.11	0.08	0.18	NC	NC	0.21	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.17	1.98
OWF_03	0.14	0.26	0.21	0.12	0.16	0.19	NC	0.21	0.23	0.18	0.21	0.26	0.41	0.23	0.18	0.2	0.22	0.21	0.23	0.15	0.15	0.18	0.19	0.22	0.14	1.30	4.88
OWF_41	0.15	0.23	0.22	0.15	0.18	0.18	0.09	0.16	0.21	0.2	0.12	0.24	0.2	0.13	0.15	0.13	0.16	0.17	0.15	0.13	0.18	0.28	0.2	0.23	0.28	1.27	4.52
EICC																											
EICC_06	NC	0.09	0.18	0.17	0.26	0.14	NC	NC	0.23	NC	NC	0.12	NC	NC	NC	NC	0.12	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.31
EICC_11	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.21	NC	NC	NC	0.21
EICC_14	NC	NC	NC	NC	0.08	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.16	0.28	NC	NC	0.09	NC	NC	0.32	NC	NC	NC	0.93

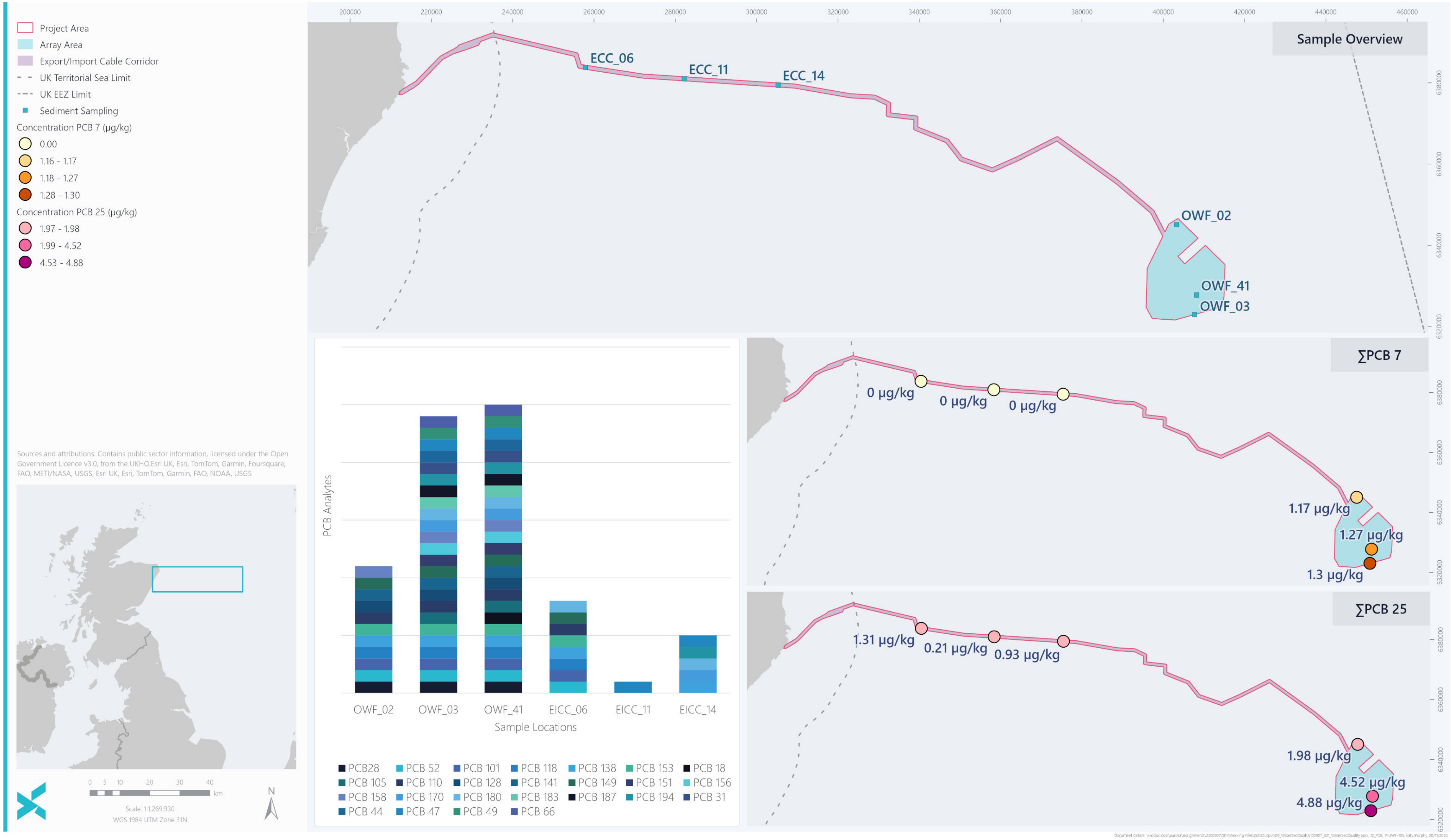

Figure 9-17 PCB occurrence and magnitude across the Project, where the symbols for ΣPCB7 and ΣPCB25 represent the magnitude above the limit of detection. For all other PCB contaminants, the symbology presents the occurrence, with the graph demonstrating the specific PCB analyte

9.4.5.4.2.6 Pesticides (OCP) and flame retardants (PBDE)

Grab samples were analysed for pesticides (OCPs) and flame retardants (PBDE) at six locations in the Array Area and three locations in the EICC (Figure 9-13).

OCP concentrations were below the detection limit (0.1 µg/kg) throughout the majority of the sampled locations in the Array Area, with only one location having samples recorded above the detection limit (OWF_41) (Figure 9-13). The following OCPs were above the detection limit: alpha-Hexachlorocyclohexane (AHCH) (0.1 µg/kg), beta-Hexachlorocyclohexane (BHCH) (0.33 µg/kg), gamma-Hexachlorocyclohexane (GHCH) (0.3 µg/kg), dieldrin (0.43 µg/kg), dichlorodiphenyldichloroethylene (DDE) (0.23 µg/kg), dichlorodiphenyltrichloroethane (DDT) (1.06 µg/kg) and dichlorodiphenyldichloroethane (DDD) (Table 9-19). OCP concentrations were below the detection limit (0.1 µg/kg) for all three sample locations in the EICC (Table 9-19).

PBDE concentrations were below the detection limit (0.05 µg/kg) for the majority of sampled locations throughout the survey area, aside from PBDE 99 which was above the detection limit for two locations in the Array Area: OWF_26 (0.13 µg/kg) and OWF_41 (0.19 µg/kg) (Table 9-20; Figure 9-13) and for PBDE 209 which was above the detection limit for all sampled sites in the Array Area and EICC, ranging from 0.41 µg/kg in the EICC (EICC_29) to 1.79 µg/kg in the Array Area (OWF_05) (Table 9-20; Figure 9-13).

Based on the sampling results, OCPs and PBDEs are not considered to be a concern across the Project Area.

*Table 9-19 OCP concentrations (µg/kg dry weight) in samples **(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)**. Only results above detection levels are represented, six locations sampled in the Array Area and three along the EICC. All samples were below detection levels in the EICC*

ANALYTE	AHCH	BHCH	GHCH	DIELDRIN	HCB	DDE	DDT	DDD
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Detection Limit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Array Area								
OWF_41	0.1	0.33	0.3	0.43	<0.1	0.23	1.06	0.29

*Table 9-20 PBDE concentrations (µg/kg dry weight) in samples **(EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC)***

ANALYTE	PBDE 17	PBDE 28	PBDE 47	PBDE 66	PBDE 100	PBDE 99	PBDE 85	PBDE 154	PBDE 153	PBDE 138	PBDE 183	PBDE 209
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Detection Limit	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Array Area												
OWF_05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.79
OWF_09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.69
OWF_15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.46
OWF_26	<0.05	<0.05	<0.05	<0.05	<0.05	0.13	<0.05	<0.05	<0.05	<0.05	<0.05	1.04
OWF_33	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.66
OWF_41	<0.05	<0.05	<0.05	<0.05	<0.05	0.19	<0.05	<0.05	<0.05	<0.05	<0.05	1.16
EICC												
EICC_06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.52
EICC_18	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.54
EICC_29	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.41

9.4.5.5 Marine Invasive Non-Native Species

There are no records of INNS reported within the offshore survey, inshore survey or 2018 inshore survey reports.

9.4.6 Future baseline

Determining the future baseline draws upon information about the likely future use and management of the Project in the absence of development, climate change and any other proposed developments that may act cumulatively with the Project. Sea temperatures are predicted to increase due to climate change, with warming being observed in the North Sea where the Project is located since the mid-1980s and the trend being predicted to continue (Cornes *et. al.*, 2023). Despite the predicted increase is sea temperature associated with climate change, it is not anticipated to have a marked effect on the presence of contaminants in seabed sediments. Instead, the increase in temperature would mostly influence or be linked with other meso-scale water column properties, including:

- Dissolved oxygen, which is predicted to decline around UK waters and this occurring more strongly in the North Sea, although deeper water where more exchange occurs with oceanic water would be less affected (Mahaffey, *et. al.*, 2020; 2023); and
- For pH, where there is a predicted ongoing decline in pH resulting in increasing ocean acidification, with this being more evident in surface waters (Findlay, *et. al.*, 2022).

With respect to salinity there is a considerable uncertainty for future changes, although future projects of UK shelf seas do suggest marine water would be less saline driven by changes in ocean circulation (in response to climate change) (Dyer, *et. al.*, 2020). Increased storminess may also increase baseline SPM concentrations but using the existing baseline regarding sediment mobilisation will thus represent a 'worst-case' assessment. Based on available evidence, including findings from EIAR Vol. 3, Chapter 9: Marine Water and Sediment Quality and EIAR Vol. 3, Chapter 20: Carbon and Greenhouse Gases, in the absence of the Project, any future baseline for Marine Water and Sediment Quality over the lifetime of the Project is unlikely to be markedly different from the current baseline in terms of compliance with water quality standards (note that there are no formal standards for SPM in UK marine waters). Therefore, it is considered appropriate to use the current baseline for the purpose of this assessment.

Targets have been predicted for the future status of waterbodies, with the recognition of pressures that contribute to a waterbody's failure to meet good ecological status and the implementation of ongoing monitoring and management to minimise impacts on the waterbody status. EQS for the designated coastal waterbodies within the Marine Water and Sediment Quality Study Area (i.e. Buchan Ness to Cruden Bay, Cairnbulg Point to Ugie Estuary, Cruden Bay and Cruden Bay to Don Estuary) are noted as having 'High' overall status currently with the same status predicted for 2027 and long-term. The Ugie Estuary to Buchan Ness (Peterhead) waterbody is listed in 'Good ecological potential' status as historically the physical condition of the waterbody has been heavily modified. Nevertheless, the outlook for the waterbody is that it will maintain 'good ecological potential'. Furthermore, the ongoing implementation of SEPA guidance on pollution prevention and acceptable EQS for surface waters and discharges to sea mean that the good ecological status of the intersected coastal waterbodies is also likely to continue and potentially improve into the future.

The Peterhead (Lido) and Cruden Bay designated bathing waters are both listed in 'Excellent' overall condition, with the Collieston bathing water listed in 'Good' condition. Peterhead (Lido) has maintained 'Excellent' condition since the 2018/19 bathing water season. Cruden Bay received a status of 'Poor' in the 2019/20 bathing water season due to agricultural diffuse pollution. Collieston has maintained 'Good' condition since the 2018/19 bathing water season. The marine water and sediment water Study Area is within the Moray, Aberdeenshire/Banff and Buchan NVZ; however, it is anticipated that monitoring and management will be ongoing as SEPA continues to monitor the nitrate concentrations in surface and ground waters.

The future baseline for sediment quality in the region will mostly be influenced by offshore oil and gas activity including future decommissioning for the nearby oil and gas assets. Current monitoring around decommissioned oil and gas platforms indicates that there are chemical signatures present within proximity (i.e. a few kilometres) around decommissioned assets for years after decommissioning (INSITE, 2023). For example, the Miller platform in the Northern North Sea, decommissioned in 2018, was found to have high levels of hydrocarbons close to the platform years later, with metals remaining high close to the platform irrespective of decommissioning time indicating heavy pollution (INSITE, 2023). Research is currently ongoing on this topic.

9.4.7 Summary and key issues

Table 9-21 Summary and key issues for Marine Water and Sediment Quality

SUMMARY AND KEY ISSUES	PROJECT AREA
	• The Project overlaps with two designated coastal waterbodies: the Ugie Estuary to Buchan Ness (Peterhead) waterbody which currently has 'Good ecological potential' for the overall condition and Buchan Ness to Cruden Bay waterbody which is in 'High' overall condition; • There are an additional three designated coastal waterbodies in the Marine Water and Sediment Quality Study Area which are all in 'High overall condition and three designated bathing waters which are in 'Excellent' and 'Good' condition for the 2023/24 bathing water season and have maintained 'Excellent' and 'Good' conditions for previous seasons; • There are no shellfish water protected areas within the Marine Water and Sediment Quality Study Area; • With regards to nutrient sensitive areas, the Marine Water and Sediment Quality Study Area overlaps with the Moray, Aberdeenshire/Banff and Buchan NVZ. The urban wastewater treatment sensitive areas include the designated bathing waters and the River Ugie catchment; • With regards to sediment quality, metals exceeded one or more thresholds for all locations, with arsenic exceeding the CCME ISQG/TEL and NOAA ERL thresholds at seven locations and mercury exceeding the CCME ISQG/TEL at four locations; and • THC concentrations did not exceed the Dutch RIVM threshold for any location; however, PAH concentrations exceeded one or more thresholds for all locations in the Array Area and five locations in the EICC.

9.4.8 Data gaps and uncertainties

The baseline environment detailed in Section 9.4 above has been established through an extensive review of the available primary (i.e. Project site-specific surveys) and secondary data sources and literature (Table 9-3) and information gained through consultation, which are considered to be sufficient to inform the environmental impact assessment. Therefore, there is a robust baseline available to inform the impact assessment and there are no significant data gaps regarding Marine Water and Sediment Quality.

9.5 Impact assessment methodology

9.5.1 Impacts requiring assessment

The impacts identified as requiring consideration for Marine Water and Sediment Quality are listed in Table 9-22. Information on the nature of impact (i.e. direct or indirect) is also described.

Table 9-22 Impacts requiring assessment for Marine Water and Sediment Quality

POTENTIAL IMPACT	NATURE OF IMPACT
Construction and decommissioning	
Potential changes to suspended sediment concentrations (Array Area)	Direct
Potential changes to suspended sediment concentrations (EICC)	Direct
Mobilisation of sediment contaminants (Array Area)	Direct
Mobilisation of sediment contaminants (EICC)	Direct
Loss of drilling fluids and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone	Direct
Operation and maintenance	
Potential changes to suspended sediment concentrations (Array Area)	Direct
Potential changes to suspended sediment concentrations (EICC)	Direct
Mobilisation of sediment contaminants (Array Area)	Direct
Mobilisation of sediment contaminants (EICC)	Direct
Decommissioning*	
* In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning are considered analogous with, or likely less than, those of the construction phase.	

9.5.2 Impacts scoped out of the assessment

The impacts scoped out of the assessment during EIA scoping, and the justification for this, are listed in Table 9-23. These were agreed within the Scoping Opinion, the responses of which have been displayed in Table 9-2for further reference. Additionally, the embedded mitigation that was utilised to further justify scoping these receptors out for further assessment within this chapter is provided in Table 9-26.

Table 9-23 Impacts scoped out for Marine Water and Sediment Quality

IMPACT SCOPED OUT	JUSTIFICATION
Construction	
Accidental releases to the marine environment	Accidental releases to the marine environment will be limited to the chemical or hydrocarbon inventory on construction vessels. All vessels involved in the Project will be required to comply with best practice management. This includes the application of strict environmental controls through the implementation of the EMP, which will include a Marine Pollution Contingency Plan (MPCP), to be secured through Section 36 and Marine Licence conditions. These plans will detail procedures in the event of an accidental release, characterise all sources for potential contaminant releases and provide key emergency contact details for use in the event of a release. Measures detailed in the EMP and MPCP will be in accordance with OSPAR Convention and Marine Pollution (MARPOL) Convention guidelines for preventing pollution at sea. Individual vessels will also have a SOPEP in place. For these reasons, the potential for accidental release of contaminants from vessels is extremely unlikely and any incidents would be responded to quickly, with strict controls to effectively minimise the scale and impact of any accidental release on the marine environment. As this embedded mitigation minimises the likelihood of a significant effect to negligible, accidental releases to the marine environment has been scoped out of the EIA as a potential impact pathway.
Operation and maintenance	
Accidental releases to the marine environment	As per construction above, given the implementation of control measures and small quantities of hydrocarbons and chemicals on board vessels, it is concluded that there will be no potential significant effects on marine water quality.
Loss of drilling muds and cuttings into the sea from the subtidal exit of HDD undertaken beneath the littoral zone	HDD requires drilling of the pilot hole and subsequent reaming to full size for most of the bore before the pilot hole is finally extended the short distance to the marine exit, thus minimising loss of drilling fluid and cuttings on breakthrough. Although losses will be minimised, effects cannot be excluded until data are available on the muds and additives to be used. This has been scoped in for construction only on a precautionary basis, depending on confirmation of details of drilling muds (and additives) to be used it may not be required for construction.

IMPACT SCOPED OUT	JUSTIFICATION
	This has been scoped out for operation and maintenance because HDD does not apply to this phase of the Project.
Decommissioning	
Loss of drilling muds and cuttings into the sea from the subtidal exit of HDD undertaken beneath the littoral zone	As per operation and maintenance above, this impact has been scoped out for decommissioning as HDD does not apply to this phase of the Project.

9.5.3 Assessment methodology

An assessment of potential effects is provided separately for the construction, operation and maintenance and decommissioning phases.

The assessment for Marine Water and Sediment Quality is undertaken following the principles set out in EIAR Vol. 2, Chapter 7: EIA Methodology. The sensitivity of the receptor is combined with the magnitude of the effect to determine the impact significance. Topic-specific sensitivity and magnitude criteria are assigned based on professional judgement, as described in Table 9-24 and Table 9-25.

.

Table 9-24 Sensitivity criteria

SENSITIVITY OF RECEPTOR	DEFINITION
High	• Receptor is of very high importance and is protected under national and international legislation (e.g. WFD); • The receptor is recognised to be very sensitive to effects and has no capacity to avoid or adapt to an effect, tolerate or absorb an effect, or recover to baseline conditions; and • An effect would result in a change to the status of the receptor.
Medium	• Receptor is of high importance and is protected under national and international legislation (e.g. WFD); • The receptor is recognised to be sensitive to effects, with a very little capacity to avoid or adapt to an effect, tolerate or absorb an effect, or recover to baseline conditions; and • An effect could lead to a potential change in the status of the receptor.
Low	• The receptor has high capacity to avoid or adapt to an effect, tolerate or absorb an effect, or recover to baseline conditions; and • An effect is unlikely to result in a change to the status of the receptor.
Negligible	• Receptor of very low importance, with no associated designations; • Receptor has full capacity to avoid or adapt to an effect, tolerate or absorb an effect, or recover to baseline conditions; and • No change is expected to the status of the receptor.

Table 9-25 Magnitude of effect criteria

MAGNITUDE CRITERIA	DEFINITION
High	• The effect occurs over a large spatial extent resulting in widespread, long-term, or permanent changes in baseline conditions; and • The effect is very likely to occur and/or will occur at a high frequency or intensity.
Medium	• The effect occurs over a local to medium extent with a short- to medium-term change to baseline conditions; and • The effect is likely to occur and/or will occur at a moderate frequency or intensity.
Low	• The effect is localised and temporary or short-term, leading to a detectable change in baseline conditions; and • The effect is unlikely to occur or may occur but at low frequency or intensity.
Negligible	• The effect is highly localised and short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions; and • The effect is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.
No change	• No change from baseline conditions.

The consequence and significance of effect is then determined using the matrix provided in EIAR Vol. 2, Chapter 7: EIA Methodology.

9.5.4 Embedded mitigation

As described in EIAR Vol. 2, Chapter 7: EIA Methodology, certain measures (primary and tertiary mitigation) have been adopted as part of the Project development process in order to reduce the potential for impacts to the environment, as presented in Table 9-26. These have been accounted for in the assessment presented below. The requirement for additional mitigation measures (secondary mitigation) will be dependent on the significance of the effects on Marine Water and Sediment Quality receptors.

Table 9-26 Embedded mitigation measures relevant to Marine Water and Sediment Quality

CODE	MITIGATION MEASURE	TYPE	DESCRIPTION	SECURED BY
MM-006	EMP	Tertiary	The EMP will set out procedures to ensure all activities with the potential to affect the environment are appropriately managed and will include a description of planned activities and procedures, roles and responsibilities, pollution control and spillage response plans, incident reporting, chemical usage requirements, waste management plans, plant service procedures, communication and reporting structures, and programme of work. It will detail the final design selected and take into account Marine Licence conditions and commitments. The EMP will additionally include an INNS Management Plan (INNSMP) and a MPCP and will be developed in consultation with stakeholders.	The EMP, including the INNSMP and MPCP, will be required under Section 36 Consent and/or Marine Licence conditions. An outline EMP is provided as part of the Application EIAR Vol. 4 Appendix 32: Outline EMP.
MM-009	Decommissioning Programme	Tertiary	The development of, and adherence to, a Decommissioning Programme, approved by Scottish Ministers prior to construction and updated throughout the Project's operational life. This will be written in accordance with applicable guidance and will detail the required activities, programme and environmental management for decommissioning.	The Decommissioning Programme will be required under Section 105 of the Energy Act 2004 (as amended) and a condition of the Section 36 Consent.
MM-010	MPCP	Tertiary	Accidental releases to the marine environment will apply strict environmental controls through the implementation of the EMP, which will include a MPCP. These plans will detail procedures in the event of an accidental release, characterise all sources for potential contaminant releases and provide key emergency contact details for use in the event of a release. Measures detailed in the EMP and MPCP will be in accordance with OSPAR and MARPOL Convention guidelines for preventing pollution at sea. Individual vessels will also	The MPCP will be required under Section 36 Consent and/or Marine Licence conditions as part of the EMP.

CODE	MITIGATION MEASURE	TYPE	DESCRIPTION	SECURED BY
			have a SOPEP in place. For these reasons, the potential for accidental release of contaminants is extremely unlikely and any incidents would be responded to quickly, with strict controls to effectively minimise the scale and impact of any accidental release on the marine environment.	An outline EMP is provided as part of the Application EIAR Vol. 4, Appendix 32: Outline EMP.
MM-011	Use of Anti-fouling Systems	Tertiary	International Maritime Organization (IMO) International Convention on the Control of Harmful Anti-Fouling Systems on Ships 2001 will be adhered to, in order to minimise the potential for toxic effects to the wider environment.	Details of anti-fouling measures will be provided within the EMP, required under Section 36 Consent and/or Marine Licence conditions. An outline EMP is provided as part of the application EIAR Vol. 4 Appendix 32: Outline EMP.

9.5.5 Worst-case scenario

As detailed in EIAR Vol. 2, Chapter 7: EIA Methodology, this assessment considers the worst-case scenario for the Project parameters which are predicted to result in the greatest environmental impact, known as the 'realistic worst-case scenario'. The worst-case scenario represents, for any given receptor and potential impact on that receptor that would result in the greatest potential for change.

The Project is to entail the construction of up to 95 Floating Turbine Units (FTUs) and associated cabling infrastructure, with each FTU comprising a Wind Turbine Generator (WTG) supported by a floating substructure and mooring system, detailed in EIAR Vol.2, Chapter 5: Project Description. The principal pathway for impacts to Marine Water and Sediment Quality receptors are associated with disturbance effects resulting in increased SSC or mobilisation of sediment bound contaminants as a result of the Project activities or infrastructure interacting with the seabed. No sandwave clearance is to be completed anywhere across the Project, with boulder clearance being completed by ploughing or by grab, furthermore, there is no drilling of pin piles or excavation of exit point(s) at the HDD exit point, therefore the mechanisms for seabed disturbance across the Project are greatly reduced.

Given that the worst-case scenario is based on the design option (or combination of options) that represents the greatest potential for change, confidence can be held that development of any alternative options within the design parameters will give rise to no worse effects than assessed in this impact assessment. Table 9-27 presents the worst-case scenario for potential impacts on Marine Water and Sediment Quality during construction, operation and maintenance and decommissioning. The construction phase is anticipated to last a total of up to six-years.

Table 9-27 Worst-case scenario specific to Marine Water and Sediment Quality impact assessment

POTENTIAL IMPACT	WORST-CASE SCENARIO	JUSTIFICATION
Construction		
Potential changes to suspended sediment concentrations (Array Area)	• For up to 95 FTUs, construction of: – Moorings for semi-submersible only as this would interact with the seabed: ▪ Up to six per FTU, with a maximum semi-taut mooring length of 4,541 m per FTU; ▪ Mooring line pre-lay (worst-case area): 3,960 m of mooring line per FTU of 1 m disturbance width totalling 376,200 m^2; and ▪ Mooring installation to take one-week per FTU. – Suction or driven pile anchors for semi-submersible and Tension Leg Platform (TLP): ▪ For semi-submersible, a total of six anchors per FTU, with a maximum seabed footprint of 198 m^2 per FTU and 15,840 m^2 for Array Area; and ▪ For TLP, a total of three clusters of piles, up to nine piles, with a maximum seabed footprint of 297 m^2 per FTU and 28,215 m^2 for Array Area. • For OSCPs, construction of: – Up to two OSCPs, with a seabed footprint per jacket foundation of 1,209 m^2, total seabed footprint of 2,418 m^2. • For IACs: – Maximum width of seabed disturbance for IACs installation tool of 20 m corridor: any disturbance from boulder clearance (grab and plough) and Pre-Lay Grapnel Run (PLGR) within this corridor. Total seabed disturbance area of 5.6 km^2 (20 m width x 280 km length) although little to no disturbance volume is anticipated associated with this width and only through the trenching process; and	The parameters that represent the largest spatial area of impact associated with construction activities in the Array Area which in turn have the greatest potential to result in increases in SSC.

POTENTIAL IMPACT	WORST-CASE SCENARIO	JUSTIFICATION
	– Up to 120 IACs with a total length of 280 km (on the seabed). Maximum trench width of 2 m and maximum trench depth of 1.8 m. Installation via jet trenching, mechanical trenching and/or ploughing.	

Potential changes to suspended sediment concentrations (EICC)	• For Export/Import Cable, construction of:
	– A bundle of two High Voltage Directional Current (HVDC) cables and one fibre-optic cable in a single trench with a total route length of 230 km;
	– Maximum trench width of up to 2 m and trench depth of 1.8 m, based on a minimum Depth of Burial (DoB) of 0.4 m and a maximum Depth of Lowering (DoL) of 1.5 m. Exception is within 12 NM where maximum trench width of up to 3 m for pre-lay trenching via a plough. Installation via ploughing, trenching or jetting and assumes:
	  – 100% cable buried within the East of Gannet and Montrose Fields Nature Conservation MPA (NCMPA) (except for cable/pipeline crossings); and
	  – 95% cable buried between 12 NM and NCMPA (except for cable/pipeline crossings).
	• Associated with the Export/Import Cable installation is a maximum 20 m corridor width of seabed disturbance from the installation tool, with any disturbance from PLGR and boulder clearance (grab and plough) within this corridor. Total seabed disturbance area of 4.6 km^2, although little to no disturbance volume is anticipated associated with this width and only through the trenching process.
		The parameters that represent the largest spatial area of impact associated with construction activities in the EICC which in turn have the greatest potential to result in increases in SSC, with onward impacts to the water quality status of designated waters.

Mobilisation of sediment contaminants (Array Area)	• As described for the Potential changes to SSC (Array Area) impact.	
Mobilisation of sediment	• As described for the Potential changes to suspended sediment concentrations (EICC) impact.	

POTENTIAL IMPACT	WORST-CASE SCENARIO	JUSTIFICATION
contaminants (EICC)		
Loss of drilling muds and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone	• For landfall: – Maximum of one exit point with three boreholes, with a total maximum of 3,000 m^3 in fluid losses which will contain 18 m^3 in solid losses (most likely bentonite) to the sea at the HDD pop-out. The three boreholes will be drilled individually, not concurrently, and therefore there will be a maximum of 1,000 m^3 of fluid loss (containing 6 m^3 of drilling solids) discharged at any one time	The parameters that represent the largest extent of release of drilling fluids (i.e. bentonite) into the sea associated with landfall installation via HDD.
Operation and maintenance		
Potential changes to suspended sediment concentrations (EICC)	• Operation and maintenance activities along the EICC including Export/Import Cable repair which has the potential to result in changes to suspended sediment concentrations. It should be noted that the extent would be less than that assessed during construction; and • Up to four Export/Import Cable repairs (e.g. deburial and reburial) during operational lifetime.	The parameters that represent the greatest potential for increased suspended sediment associated with operation and maintenance activity. During operation and maintenance, suspended sediment concentrations will result from cable repair and/or replacement activities.
Mobilisation of sediment	• Operation and maintenance activities across the Array Area including IACs repair and/or replacement which has the potential to result in changes to suspended sediment concentrations. It should be noted that the extent would be less than that assessed during construction;	

POTENTIAL IMPACT	WORST-CASE SCENARIO	JUSTIFICATION
contaminants (Array Area)	• Up to 10% of IACs requiring repair (e.g. deburial and reburial) and up to 10% of IACs requiring replacement; and • Re-tensioning of each mooring line twice over the operational lifetime with up to 10% of mooring lines requiring replacement .	
Decommissioning		
In the absence of detailed information regarding decommissioning works, the implications for Marine Water and Sediment Quality are considered analogous to or likely less than those of the construction phase. Therefore, the worst-case parameters defined for the construction phase also apply to decommissioning. The decommissioning approach is set out in EIAR Vol. 2, Chapter 5: Project Description.		

9.6 Assessment of potential effects

9.6.1 Potential effects during construction

9.6.1.1 Potential changes to suspended sediment concentrations

This impact relates to the potential for increased SSC as a result of the disturbance of sediment into the water column during construction activities. The baseline SSC in the Project Area was established through the water column sampling and profiling undertaken as part of the site-specific environmental baseline survey, as summarised in Section 9.4.3.2. The results of the upcast water column profiles for turbidity and DO are discussed in Section 9.4.5.1.2. The background concentrations in the Array Area generally showed a TSS of <10 mg/l across all depths analysed (Table 9-11). The highest TSS concentrations were observed in the Array Area ranging from <5 mg/l to 39 mg/l. The site-specific PSA indicates that there are a higher proportion of fines present in the Array Area than the EICC (see Section 9.4.5.3). In the EICC, TSS ranged from <10 mg/l to 19 mg/l. Regionally, Cefas (2016b) indicate that the Marine Water and Sediment Quality Study Area typically has low concentrations (Figure 9-8). From the site-specific surveys (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF and EIAR Vol. 4, Appendix 12: Environmental Baseline Report – EICC), DO (% saturation) ranged from 61.9% to 110.72% in the Project Area, with evidence of stratification in the Array Area and more variable stratification in the EICC (Figure 9-5; Figure 9-6).

The boulder clearance to be undertaken will use a boulder grab or plough to relocate boulders which will result in little sediment disturbance.

Furthermore, there is no sandwave clearance or drilling of pin piles for the FTUs or the OSCPs, with the installation of the piles considered to result in little seabed disturbance, and any resulting increases in SSC being very local and temporary. With respect to the moorings and the swept area footprint of 1.44 km^2 that could interact with the seabed would only really occur during the operation and maintenance phase. Instead, the only disturbance during construction would be associated with the temporary pre-lay of the moorings prior to connection with the FTU. The resulting disturbance associated with this activity would again be limited, being very localised and again temporary with any movement of the moorings. Therefore, the worst-case disturbance from construction activities within the Project Area in terms of footprint and volume is considered to relate to cable installation activities, as detailed in Table 9-27.

Based on the 20 m width of seabed disturbance from the installation tool, there is a total disturbance area of 5.6 km^2 (IACs) or 1.2 km^2 (EICC). The disturbance volumes associated with the installation tool within the area of disturbance will be minimal, whereby the increases in SSC would be localised and transient as the installation progresses. Furthermore, along the EICC, which is primarily comprised of sand with a small proportion of fines, the disturbance and any increases in SSC will be of an even shorter duration.

The worst-case sediment disturbance with the potential for increasing SSC is associated with the direct cable trenching via jetting, mechanical trenching and/or ploughing, with the trenching being a simultaneous cable lay & burial. Based on the maximum trench width of 2 m (except within 12 NM where the maximum trench width of up to 3 m is applied) and trench depth of 1.8 m (Table 9-27), a total disturbance volume of up to 1,008,000 m^3 and 878,400 m^3 will occur for the 280 km and 230 km total length for the IACs and Export/Import Cable, respectively. Disturbance will occur at an assumed rate of 397.5 kilograms per second (kg/s) based on the trenching rate of 250 metres per hour (m/hr).

However, in terms of the actual disturbed volume per unit area based on a metre length as the trenching progress, only a volume of 3.6 m^3 will be actively disturbed, with the disturbance remaining near the seabed. Therefore, in terms of the potential for effects to Marine Water and Sediment Quality receptors, including the potential increases in SSC, it is the 3.6 m^3 per unit area of disturbance that directly informs this assessment, noting that the trenching process moved along the cable, so all effects would be transient as the trenching progresses.

Based on the identified worst-case scenario for increases in SSC, work presented in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, analyses the potential generated plume in terms of the increased SSC magnitude, extent and duration, based on the disturbed volume (i.e. up to 3.6 m^3 disturbance per unit area), with the results used to inform this assessment. The completed analysis results conservatively assumes 100% of the sediment volume will be disturbed and ejected as the trenching progresses, with a large proportion of the coarse sediment quickly falling to the seabed in proximity to the disturbance activity, while only the finer sediment (comprising fine sands and silts) would develop into a plume to extend further afield from the disturbance site. Based on the sand and silt sediment that occurs across the Project, increases in SSC associated with the initial and instantaneous sediment disturbance would be several orders of magnitude greater than background levels of < 10 mg/l, at magnitudes on the order of millions of mg/l, with this concentration only being within 6 m of the disturbance for the fastest flow speeds and the lowest disturbance height (assumed to be up to 1 m). The high SSC would also only be short-lived and temporary and reduce very quickly with increasing distance from the disturbance site, as the sediment quickly settles to the seabed on the order of seconds to minutes. With the cable burial tool estimated to move up to 250 m/hr, any influence of the plume experienced immediately downstream will be similarly limited in duration to the order of approximately 14 seconds, after which time, the plume will have been advected downstream. A slower moving tool would cause a longer duration of increased SSC, however, with a proportionally reduced level of SSC due to the lower rate of disturbance.

It is only a much smaller proportion of disturbed sediment volume that would develop into a plume over a greater extent. Finer material (fine sands, clays and muds, present as surficial sediment layers in high proportions in some locations) will be advected away from the release location by the prevailing tidal current. High initial concentrations are to be expected but will be subject to rapid dispersion, both laterally and vertically, to near-background levels (tens of mg/l) within hundreds to a few thousands of metres of the point of release. In practice, only a small proportion of the material disturbed is expected to be fines, with a corresponding reduction in the expected levels of SSC.

Within the Array Area and along the EICC, analysis of the increases in SSC from cable trenching activities as presented in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report identified zones of impact based on distance from the disturbance as follows:

- 0 to 50 m – zone of highest SSC increase, with plume dimensions and SSC, being primarily controlled by the volume of sediment released and the manner in which the deposit settles. At the time of active disturbance - very high SSC increase (tens to hundreds of thousands of mg/l) lasting for the duration of active disturbance plus up to 30 minutes following end of disturbance; where dominant (e.g. areas of outcropping glacial material), coarse sands and gravels, or larger clasts of still consolidated cohesive silts, may deposit in local thicknesses of tens of centimetres to several metres; unconsolidated finer sediment (i.e. muddy fine sands) is unlikely to deposit in measurable thickness. Beyond one hour after the end of active disturbance there is no remaining change to SSC;

- 50 to 500 m – zone of measurable SSC increase, mainly comprising sands that are released or resuspended higher in the water column and resettling to the seabed whilst being advected by ambient tidal currents. Plume dimensions and SSC again controlled by the volume of sediment released, the height of resuspension or release above the seabed, and the ambient current speed and direction at the time. At the time of active disturbance - high SSC increase (hundreds to low thousands of mg/l) lasting for the duration of active disturbance plus up to 30 minutes following end of disturbance. Beyond one hour after the end of active disturbance there is no remaining change to SSC;
- 500 m to the tidal excursion buffer distance – zone of lesser but measurable SSC increase, comprising mainly fines that are maintained in suspension for more than one tidal cycle and are advected by ambient tidal currents. Plume dimensions and SSC are primarily controlled by the volume of sediment released, the patterns of current speed and direction at the place and time of release and where the plume moves to over the following 24 hours. At the time of active disturbance – low to intermediate SSC increase (tens to low hundreds of mg/l) as a result of any remaining fines in suspension, only within a narrow plume (tens to a few hundreds of metres wide, SSC decreasing rapidly by dispersion to ambient values within one day after the end of active disturbance. One to six hours after end of active disturbance – decreasing to low SSC increase (tens of mg/l), while six to 24 hours after end of active disturbance SSC decreases gradually through dispersion to background SSC (no measurable local increase). No measurable change from baseline SSC after 24 to 48 hours following cessation of activities; and
- Beyond the tidal excursion buffer distance or anywhere not tidally aligned to the active sediment disturbance activity, there is no expected measurable effect or change to SSC nor any measurable sediment deposition.

Based on the low disturbance volume per unit area, the relative short duration of the active deposition phase and the small proportion of the sediment bulk that would develop into a plume, the period of higher SSC will not ultimately affect the water column DO properties, as the increased SSC is only on the order of minutes to less than a tidal cycle.

9.6.1.1.1 Potential changes to SSC (Array Area)

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity given there is no overlap with any designated waters (Section 9.4.5.2) and the region is not sensitive to changes in SSC, as this occurs naturally. During construction, potential changes to SSC within the Array Area will result from the installation of the FTU anchors, OSCPs piles and mooring lines and the IACs trenching. However, it is the cable trenching associated with the IACs that presents the greatest potential for increased SSC, as the resulting SSC from the other activities will be minimal. As described above and detailed within EIAR Vol.4, Appendix 7 - Marine & Physical Processes Modelling Report, based on the disturbed volume of up to 3.6 m^3 per unit area as the cable trenching progresses, the maximum extent of the plume within the Array Area could be up to the tidal excursion extent of around 4.5 km. The maximum SSC for the cable trenching activities is very locally hundreds of thousands of mg/l, which then reduces to hundreds to low thousands of mg/l between 50 m and 500 m from the disturbance. Should the plume reach the tidal excursion extent of around 4.5 km, between one to six hours after disturbance, SSC would be at tens of mg/l. A return to background levels characteristic of the Array Area also occurs rapidly with the cessation of activity with concentrations of around <10 mg/l occurring over longer durations (at approximately six to 24 hours). Given the temporary duration of the increased SSC and the localised spatial extent and magnitude of the plume, the magnitude of effect is low.

Evaluation of significance

Taking the low sensitivity of the seabed sediment and water column within the Array Area and the low magnitude of the effect, the overall effect of potential changes to SSC (Array Area) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Low	Minor
Impact significance - NOT SIGNIFICANT			

9.6.1.1.2 Potential changes to SSC (EICC)

The potential changes to SSC within the EICC includes the wider environment outside of designated water and the marine area covered by designated waters. For the latter, there is potential for effects to the water quality status of designated waters within the vicinity of the Project Area as a result of changes to SSC during trenching. Designated waters are protected through various legislative regimes which implement the WFD (2000/60/EC) and the Bathing Waters Directive (2006/7/EC). As such any proposed development within these waters must have regard to the requirements of the directives to ensure that all surface water bodies achieve 'Good' ecological status and that there is no deterioration in status. As detailed in Section 9.4.5.2, the designated waters of relevance include the designated coastal waterbodies and bathing waters that either directly interact with the Project or indirectly through hydrodynamic connectivity, as they are located within the Marine Water and Sediment Quality Study Area. There are no shellfish designated waters within the Marine Water and Sediment Quality Study Area. Furthermore, the nutrient sensitive areas (e.g. urban wastewater treatment areas and NVZ) are encompassed within the assessment of the designated waters. This assessment considers the wider environment along the EICC outside of designated waters, in addition to the potential for effects to the following designated waters:

- Designated coastal waterbodies:
  - Ugie Estuary to Buchan Ness (Peterhead) (ID: 200131), which directly overlaps with the EICC;
  - Buchan Ness to Cruden Bay (ID: 200125), which directly overlaps with the EICC at landfall;
  - Cairnbulg Point to the Ugie Estuary (ID: 200142), which is located approximately 3.5 km northwest from the EICC;
  - Cruden Bay to the Don Estuary (ID: 200117), which is located approximately 7.2 km southwest from the EICC; and
  - Cruden Bay (ID: 200118), which is located approximately 4.3 km southwest from the EICC.
- Designated bathing waters:
  - Peterhead (Lido) (ID: UKS7616042), which is located approximately 3.8 km northwest from the EICC;
  - Cruden Bay (ID: UKS7616012), which is located approximately 5.2 km southwest from the EICC; and
  - Collieston (ID: UKS7616090), which is located approximately 13.6 km southwest from the EICC.

9.6.1.1.2.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the EICC outside of designated waters is considered to be of low sensitivity given there is no overlap with any designated waters (Section 9.4.5.2) and the region is not sensitive to changes in SSC, as this occurs naturally. During construction, potential changes to SSC will result from cable trenching activities based on the volume of material that would be disturbed and the trenching progresses. As described above and detailed within EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum extent of the plume associated with cable trenching activities and the 3.6 m^3 disturbance per unit area along the EICC will be the tidal excursion distance of up to 12 km. Very locally, the maximum SSC for the cable trenching activities is hundreds of thousands of mg/l, which then reduces to hundreds to low thousands of mg/l between 50 m and 500 m from the disturbance. Should the plume reach the tidal excursion extent, which ranges between 5 km and 12 km along the EICC, between one to six hours after disturbance, SSC would be at tens of mg/l. A return to background levels would also occur rapidly as the trenching moves on, with concentrations of <10 mg/l occurring over longer durations (at approximately six to 24 hours). Given the temporary duration of the increased SSC and the localised spatial extent and magnitude of the plume, the magnitude of effect is low.

Evaluation of significance

Taking the low sensitivity of the seabed sediment and water column within the EICC and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Low	Minor

Impact significance - NOT SIGNIFICANT

9.6.1.1.2.2 Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody

The Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody overlaps with the EICC for 5.5 km^2, representing 11.9% of the overall waterbody area. The waterbody is designated as a heavily modified waterbody due to pressures on the physical condition of the waterbody associated land use and navigation. Furthermore, this waterbody is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural runoff. Nevertheless, no measures are currently proposed to address the pressures as this waterbody is in 'Good' status, with a similar projection for the long-term. The Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC which could affect the water quality status of the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody. For the Export/Import Cable, a volume of up to 3.6 m^3 per unit area would be disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the increased SSC associated with this seabed disturbance will be temporary in duration occurring generally for less than a tidal cycle, with the maximum extent of a sediment plume localised to the tidal excursion extent of 12 km in the inshore. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated coastal waterbody and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Ugie Estuary to Buchan Ness (Peterhead) (ID: 200131)	Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

9.6.1.1.2.3 Buchan Ness to Cruden Bay Coastal Waterbody

The cable landfall is within the Buchan Ness to Cruden Bay coastal waterbody, with the EICC overlapping this waterbody by 5.0 km^2, accounting for 8.7% of the overall waterbody area. The waterbody is currently in 'High' overall condition, with a similar status projected long-term. There are no pressures currently identified on this waterbody; however, this waterbody is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural runoff. The Buchan Ness to Cruden Bay coastal waterbody is of medium sensitivity due to its classification under the WFD.

The trenching associated with the construction of the Export/Import Cable have the potential to result in changes to SSC which could affect the water quality status of the Buchan Ness to Cruden Bay coastal waterbody, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the increased SSC associated with this seabed disturbance will be temporary in duration occurring for generally for less than a tidal cycle, with the maximum extent of a sediment plume localised to the tidal excursion extent of 12 km in the inshore. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated coastal waterbody and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Buchan Ness to Cruden Bay (ID: 200125)	Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

9.6.1.1.2.4 Cairnbulg Point to the Ugie Estuary Coastal Waterbody

The Cairnbulg Point to the Ugie Estuary coastal waterbody is located 3.5 km northwest from the EICC and overlaps the Marine Water and Sediment Quality Study Area. The waterbody is currently in 'High' overall condition, with a similar status projected for the long-term. There are no pressures currently identified on this waterbody; however, this waterbody is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural runoff. The Cairnbulg Point to the Ugie Estuary coastal waterbody is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC as a result of a plume, which could extend into the waterbody and affect the water quality status of the waterbody, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum plume extent resulting from cable trenching will be approximately the tidal excursion extent of 12 km in the inshore, thereby potentially extending into this waterbody, which is 3.5 km away from the EICC. However, the SSC quickly reduces with increasing distance from the disturbance site, with the plume duration generally being less than a tidal cycle at its widest extent. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated coastal waterbody and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Cairnbulg Point to the Ugie Estuary (ID: 200142)	Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

9.6.1.1.2.5 Cruden Bay to the Don Estuary Coastal Waterbody

The Cruden Bay to the Don Estuary coastal waterbody is located 7.2 km southwest from the EICC and overlaps the Marine Water and Sediment Quality Study Area. The waterbody is currently in 'High' overall condition, with a similar status projected for the long-term. There are no pressures currently identified on this waterbody; however, this waterbody is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural runoff. The Cruden Bay to the Don Estuary coastal waterbody is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC as a result of a plume, which could extend into the waterbody and affect the water quality status of the waterbody, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum plume extent resulting from cable trenching will be approximately the tidal excursion extent of 12 km in the inshore, thereby potentially extending into this waterbody, which is 7.2 km away from the EICC. However, the SSC quickly reduces with increasing distance from the disturbance site , with the plume duration generally being less than a tidal cycle at its widest extent. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated coastal waterbody and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Cruden Bay to the Don Estuary (ID: 200117)	Medium	Low	Minor

Impact significance – NOT SIGNIFICANT

9.6.1.1.2.6 Cruden Bay Coastal Waterbody

The Cruden Bay coastal waterbody is located 4.3 km northwest from the EICC and overlaps the Marine Water and Sediment Quality Study Area. The waterbody is currently in 'High' overall condition, with a similar status projected for the long-term. There are no pressures currently identified on this waterbody; however, this waterbody is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural runoff. The Cruden Bay coastal waterbody is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC as a result of a plume, which could extend into the waterbody and affect the water quality status of the waterbody, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum plume extent resulting from cable trenching will be approximately the tidal excursion extent of 12 km in the inshore, thereby potentially extending into this waterbody, which is 4.3 km away from the EICC. However, the SSC quickly reduces with increasing distance from the disturbance site, with the plume duration generally being less than a tidal cycle at its widest extent. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated coastal waterbody and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Cruden Bay (ID: 200118)	Medium	Low	Minor
Impact significance – NOT SIGNIFICANT			

9.6.1.1.2.7 Peterhead (Lido) Bathing Water

The Peterhead (Lido) bathing water is located 3.8 km northwest from the EICC but is within the Marine Water and Sediment Quality Study Area. The bathing water is currently in ''Excellent' condition for the 2023/4 season and has maintained 'Excellent' or 'Good' condition over recent years. However, the bathing water is noted to be at risk of short-term pollution following heavy rainfall due to the potential for sewer overflows. Furthermore, the bathing water is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural run-off. The Peterhead (Lido) bathing water is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC as a result of a plume developing and affect the water quality status of the bathing water, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum plume extent resulting from cable trenching will be approximately the tidal excursion extent of 12 km in the inshore, thereby potentially extending into this waterbody, which is 3.8 km away from the EICC. The SSC quickly reduces with increasing distance from the disturbance site, with the plume duration generally being less than a tidal cycle at its widest extent. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated bathing water and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Peterhead (Lido) (ID: UKS7616042)	Medium	Low	Minor
Impact significance - NOT SIGNIFICANT			

9.6.1.1.2.8 Cruden Bay Bathing Water

The Cruden Bay bathing water is located 5.2 km southwest from the EICC but is within the Marine Water and Sediment Quality Study Area. The bathing water is currently in 'Excellent' condition for the 2023/4 season and has maintained 'Good' condition over recent years. The bathing water is noted to be at risk of short-term pollution following heavy rainfall due to the potential for sewer overflows, as well as potential for agricultural run-off. This is associated with the density of agricultural lands in the Cruden Bay catchment and the associated Aberdeenshire, Banff and Buchan NVZ described above. The Cruden Bay bathing water is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC as a result of a plume developing and affect the water quality status of the bathing water, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum plume extent resulting from cable trenching will be approximately the tidal excursion extent of 12 km in the inshore, thereby potentially extending into this waterbody, which is 5.2 km away from the EICC. The SSC would quickly reduce with increasing distance from the disturbance site, with the plume duration generally being less than a tidal cycle at its widest extent. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the medium sensitivity of the designated bathing water and the low magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Cruden Bay (ID: UKS7616012)	Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

9.6.1.1.2.9 Collieston Bathing Water

The Collieston bathing water is located 13.6 km southwest from the EICC but is within the Marine Water and Sediment Quality Study Area. The bathing water is currently in 'Good' condition for the 2023/4 season and has maintained 'Good' condition over recent years. However, the bathing water is noted to be at risk of short-term pollution following heavy rainfall due to the potential for sewer overflows. Furthermore, the bathing water is located within the Aberdeenshire, Banff and Buchan NVZ and therefore may be affected by nitrate pollution associated with agricultural run-off. The Collieston bathing water is of medium sensitivity due to its classification under the WFD.

The trenching of the Export/Import Cable have the potential to result in changes to SSC as a result of a plume developing and affect the water quality status of the bathing water, with a volume of up to 3.6 m^3 per unit area disturbed as cable trenching progresses. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the maximum plume extent resulting from cable trenching will be approximately the tidal excursion extent of 12 km in the inshore, thereby potentially extending into this waterbody, which is just over the excursion extent at 13.6 km away from the EICC. The SSC quickly reduces with increasing distance from the disturbance site, with the plume duration generally being less than a tidal cycle at its widest extent. Given the localised, temporary nature of the trenching, the magnitude is low.

Evaluation of significance

Taking the Taking sensitivity of the designated bathing water and the Taking magnitude of the effect, the overall effect of potential changes to SSC (EICC) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Collieston (ID: UKS7616090)	Medium	Low	Minor

Impact significance – NOT SIGNIFICANT

9.6.1.2 Mobilisation of sediment contaminants

This impact relates to the potential for disturbance and release of sediment bound chemical contaminants into the water column during trenching and dispersed over a wider area.

The potential for chemical contaminants to be present within Project Area was investigated through Project site-specific surveys, as introduced in Section 9.4.3, with results presented in Section 9.4.5. The completed site-specific sediment sampling and contaminant analyses identified limited contamination within samples obtained across the Project Area, as discussed in Section 9.4.5, and the locations of these samples are shown in Figure 9-2. Overall, it was found that only low occurrences of the contaminants analysed were present, with the majority of contaminants being below the revised AL1, ISQG/TEL and Dutch RIVM guidelines.

In the case of metals, all samples were below the revised AL1, AL2, CCME PEL, Dutch RIVM and NOAA ERM thresholds. However, a number of samples were at or marginally exceeded the lower thresholds associated with the CCME ISQG/TEL, NOAA ERL and OSPAR ERL as follows (Section 9.4.4.6):

- Array Area:
  - Five samples exceeded the thresholds for As (Figure 9-14);
  - Four samples exceeded the thresholds for Hg (Figure 9-14); and
  - Up to nine metals Cd, Cr, Cu, Pb, Hg, Ni, Zn, Ba and Fe) were recorded above their respective UKOOA CNS 50th percentile values typically all occurring with the same samples (Table 9-15).
- EICC:
  - Two samples exceeded the thresholds for As from the 2023 survey (EIAR Vol. 4, Appendix 11: Environmental Baseline Report – OWF) and one location in the earlier MMT (2018) survey (Figure 9-14); and
  - Seven metals Cd, Cr, Cu, Hg, Ni, Zn, and Fe) were recorded above their respective UKOOA CNS 50th percentile values, again typically all occurring with the same samples (Table 9-15).

In the case of hydrocarbons, there were more occurrences in the Array Area, with only a few samples from the EICC being above the detection limit (Figure 9-16). In particular THC was above the UKOOA CNS 50th percentile (4.1 mg/kg) for all locations in the Array Area (Table 9-17). In the EICC, THC values were recorded below the detection limit 0.1 mg/kg) for the majority of sampled locations, aside from one location which exceeded the UKOOA CNS 50th percentile at 9.6 mg/kg (Table 9-17). PAH concentrations exceeded the OSPAR BC and OSPAR BAC thresholds throughout all sampled locations in the Array Area for one or more of the PAHs analysed (Table 9-17). Furthermore, the revised AL1 threshold (100 µg/kg) was exceeded for fluoranthene (OWF_08), benzo[b]fluoranthene (26 sampled locations), benzo[k]fluoranthene (10 sampled locations), indeno[1,2,3,c,d]pyrene and benzo[g,h,i]perylene (all locations) (Figure 9-16). Additionally, the OSPAR ERL thresholds for indeno[1,2,3,c,d]pyrene (240 µg/kg) was exceeded at 13 sampled locations and benzo[g,h,i]perylene (85 µg/kg) at all sampled locations (Table 9-17). The PAH concentrations were below the detection limit (1 µg/kg) throughout the majority of sampled location in the EICC; however, the OSPAR BC was exceeded for naphthalene, phenanthrene and benzo[a]anthracene, fluoranthene, pyrene, chrysene, benzo[a]pyrene and indeno[1,2,3,c,d]pyrene and benzo[g,h,i]perylene. Additionally, the OSPAR BAC was exceeded for naphthalene (Table 9-17). For the MMT (2018) inshore data, all three sampling locations did not exceed any thresholds for hydrocarbons (PAH and THC). The presence of hydrocarbons in the Array Area (Figure 9-16), is consistent with the presence of oil and gas assets in this region of the CNS (Figure 9-4), however, it is not considered to represent a wide spread occurrence of contaminants as detected levels, although above thresholds for the UKOOA CNS 50th percentile, are well below the UKOOA CNS 95th percentile (Table 9-17).

In terms of PCBs, analysis showed that they are not a concern across the Project Area (Section 9.4.5.4.2.5). In terms of pesticides (OCP), OCP concentrations were below the detection limit (0.1 µg/kg) throughout the majority of the sampled locations in the Array Area and EICC. The revised AL1 threshold was exceeded for DDT (1 µg/kg) in one location in the Array Area (Table 9-19). Based on the sampling results, OCPs and flame retardants (PBDEs) are not considered to be a concern across the Project Area.

The worst-case disturbance and associated volume relevant to inform this impact assessment, is as introduced for the potential changes to SSC impact in Section 9.6.1.1, with up to 3.6 m^3 per unit area being disturbed as cable trenching progresses. For any potential occurrence of contaminants within the trench footprint, the contaminants concerned (e.g. heavy metals) would largely be attached to sediment particles as the contaminants will adhere to sediment particles rather than be individual particles. In the event of disturbance, only very small concentrations of contaminants enter to the dissolved phase, with the vast majority remaining adhered to the sediment particles when temporarily entering suspension in the water column. Should contaminants enter the dissolved phase, partition coefficients would indicate that concentrations would typically reduce by several orders of magnitude than the concentrations associated with suspended sediments. Therefore, should any contaminants be disturbed during cable trenching, these would largely settle out quickly. Should any proportion be dissolved into the water column, these would be of very low concentrations and would be rapidly dispersed by tidal processes in relation to the sediment plume. Furthermore, as presented in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, the modelling results demonstrate that the majority of the sediment bulk disturbed during trenching would quickly fall to the seabed in proximity to the disturbance activity, with minimal deposition occurring with increasing distance from the disturbance. Therefore, should contaminants be present in disturbed sediment, the majority would be deposited quickly in proximity to the disturbance, with very little being dispersed more widely associated with the plume.

Based on the disturbed volume per units area and as described in Section 9.6.1.1 above, within the Array Area, analysis of the increases in SSC from cable trenching activities shows that the maximum plume extent is approximately 4.5 km in the direction of the prevailing tidal flow, with the plume potentially extending in the direction of both the flood and ebb based on the duration. Along the EICC, the maximum plume extent is approximately 12 km in the direction of the prevailing tidal flow, with the plume potentially extending in the direction of both the flood and ebb respectively based on the duration.

9.6.1.2.1 Mobilisation of sediment contaminants (Array Area)

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity due to no overlap with any designated waterbodies. Within the Array Area the magnitude of effect is considered to be low. There is a low occurrence of contaminants above revised AF1, ISQG/TEL and Dutch RIVM guidelines guidance thresholds within the Array Area. Where contaminants are present and above the UKOOA CNS 50th percentile, detected levels are well below the UKOOA CNS 95th percentile, with little occurrences at or above the Marine Scotland (2017) revised AL1 or CCME ISQG/TEL thresholds. Furthermore, the low disturbance volume, the temporary nature of the sediment dispersion impacts associated with the trenching, the maximum plume extents and short duration of increased SSC associated with the worst-case modelling of cable trenching, all reduce the potential for the wider dispersion of any disturbed contaminants. This coupled with the highly dispersive nature of the environment ensures that impacts are low in the Array Area.

Evaluation of significance

Taking the low sensitivity of the Array Area seabed sediment and water column and the low magnitude of the effect, the overall effect of mobilisation of sediment contaminants (Array Area) during construction is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Low	Minor
	Impact significance - NOT SIGNIFICANT		

9.6.1.2.2 Mobilisation of sediment contaminants (EICC)

The mobilisation of sediment contaminants within the EICC includes the wider environment outside of designated water and the marine area covered by designated waters, with the potential for onward impacts to the water quality status of designated waters. The potential for impacts are assessed for each below.

9.6.1.2.2.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the EICC outside of designated waters is considered to be of low sensitivity given there is no overlap with any designated waters. The magnitude of effect for the EICC is considered to be negligible, as there is little to no occurrence of contaminants within the EICC as demonstrated above in Sections 9.6.1.1 and 9.6.1.2 and Figure 9-14, Figure 9-16 and Figure 9-17. In the isolated occurrence where a contaminant is detected, it occurs in isolation with no other detections identified in surrounding samples. Furthermore, the low disturbance volume, the short duration of sediment disturbance and resulting temporary nature of the sediment dispersion and maximum plume extent of 12 km in the inshore, combined with rapid sedimentation of the majority of the sediment bulk in close proximity to the disturbance activity and dilution of any dissolved contaminants all mean no impacts are anticipated.

Evaluation of significance

Taking the low sensitivity of the EICC seabed sediment and water column and the negligible magnitude of the effect, the overall effect of mobilisation of sediment contaminants (EICC) during construction is considered to be negligible and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Negligible	Negligible
Impact significance - NOT SIGNIFICANT			

9.6.1.2.2.2 All designated waters

Properties of the designated waters are as introduced for the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (Section 9.6.1.1.2.2), Buchan Ness to Cruden Bay coastal waterbody (Section 9.6.1.1.2.3), Cairnbulg Point to the Ugie Estuary coastal waterbody (Section 9.6.1.1.2.4), Cruden Bay to the Don Estuary coastal waterbody (Section 9.6.1.1.2.5), Cruden Bay coastal waterbody (Section 9.6.1.1.2.6), Peterhead (Lido) bathing water (Section 9.6.1.1.2.7), Cruden Bay bathing water (Section 9.6.1.1.2.8) and Collieston bathing water (Section 9.6.1.1.2.9). A medium sensitivity is applied for all due to their classification under the WFD and Bathing Waters Directive.

There is little to no occurrence of contaminants along the EICC or in the inshore (Sections 9.6.1.1 and 9.6.1.2 and Figure 9-14, Figure 9-16 and Figure 9-17). In the isolated occurrence where a contaminant is detected, it occurs in isolation with no other detections identified in surrounding samples. The limited potential occurrence combined with the low disturbance volumes, the short-duration and temporary nature of cable trenching activities and HDD operations, the rapid sedimentation of disturbed sediment in close proximity to the disturbance, a maximum 12 km tidal excursion extent of any generated sediment plume and additional dilution of any dissolved contaminants that may be present, means that the magnitude of effect on this receiving waterbody is considered to be negligible.

Evaluation of significance

Taking the medium sensitivity of the designated waters (including coastal waterbodies and bathing waters) and the negligible magnitude of the effect, the overall effect of mobilisation of sediment contaminants (EICC) during construction is considered to be negligible and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
All designated waters: Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (ID: 200131); Buchan Ness to Cruden Bay coastal waterbody (ID: 200125); Cairnbulg Point to the Ugie Estuary (ID: 200142) coastal waterbody; Cruden Bay to the Don Estuary (ID: 200117) coastal waterbody; Cruden Bay (ID: 200118) coastal waterbody; Peterhead (Lido) bathing water (ID: UKS7616042); Cruden Bay bathing water (ID: UKS7616012); and Collieston bathing water (ID: UKS7616090)	Medium	Negligible	Negligible
Impact significance - NOT SIGNIFICANT			

9.6.1.3 Loss of drilling fluids and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone

HDD will be used to transition between the onshore cable landing pit (on top of the cliff above MHWS) and the exit point approximately 200 m offshore, therefore, the Project will not be trenching through the intertidal zone, with all potential impacts being in the subtidal environment. Installation of the landfall via HDD has the potential to result in loss of drilling fluids such as bentonite, which is a Pose Little or No Risk to the Environment (PLONOR) material (OSPAR Commission, 2021) and a small volume of drill cuttings, into the sea, which in turn can affect the water quality status of designated waters. As described for Section 9.6.1.1.2 above, all designated waters are assessed as having medium sensitivity due to their classification under the WFD.

During construction, there will be a maximum of 3,000 m^3 drilling fluid lost to the sea during the drilling of the one exit point with three boreholes. This fluid will contain 18 m^3 of drilling solids (most likely bentonite). There will be a maximum of 1,000 m^3 of fluid loss (containing 6 m^3 of drilling solids) discharged at any one time as each of the three boreholes (within the one exit point) will be drilled individually not concurrently. The HDD exit is expected to be at least 200 m offshore, with the release of drilling fluids as described above being highly localised, occurring largely within the immediate vicinity of the HDD exit point. As described in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, should a plume develop associated with the release, it will be advected in the direction of the ambient tidal currents, which are aligned to (not towards) the adjacent coastline. The direction and speed of transport (north or south along the coast) will depend on the state of the tide (flood or ebb) at the time of the release. It is expected that the plume would be dispersed to relatively low concentrations within hours of release and to background concentrations within a few tidal cycles (i.e. one day), with an associated maximum dispersion extent of 12 km, associated with the tidal excursion extent. The bentonite in the drilling fluid normally has an overall density and viscosity similar to seawater and so is expected to behave (advect, mix and disperse) in a similar manner. and duration of less than a tidal cycle. In the immediate vicinity of the HDD exit and release, i.e. <10 m, SSC could be tens of thousands of mg/l. However, with increased dispersion distance there is also increased dilution, so within 50 m SSC reduces to thousands of mg/l and by a distance of 500 m away from the HDD exit, SSC is between background levels and tens of mg/l, with no discernible increases in SSC at the tidal excursion extent. Therefore, it is anticipated that any effect on water or sediment quality from the HDD activity will be short-term in nature, given the rapid dispersion of the losses. Overall, the impact is highly localised and short-term in nature, with full rapid recovery expected to result in very slight changes to baseline conditions and therefore the magnitude of effect is negligible.

Evaluation of significance

Taking the medium sensitivity of the designated waters (including coastal waterbodies and bathing waters) and the negligible magnitude of the effect, the overall effect of loss of drilling fluids and cuttings into the sea from the subtidal exit of HDD undertaken beneath the littoral zone during construction is considered to be negligible and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
All designated waters	Medium	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

9.6.2 Potential effects during operation and maintenance

9.6.2.1 Potential changes to suspended sediment concentrations

During operation and maintenance, potential changes to SSC may result from cable repair and/or cable replacement activities within the Array Area (IACs) and the EICC (Export/Import Cable). The increase in SSCs associated with the operation and maintenance activities will be less than that assessed for the construction phase in Section 9.6.1.1 above. This is on the basis that the operation and maintenance activities will mostly be highly localised and occurring intermittently over the life of the Project for a very short duration of time, with the exception of the mooring line movement across the 1.44 km^2 swept area footprint, which will occur concurrently with the marine processes over the life of the Project, albeit at minimal levels considered to be less than that associated with operation and maintenance repair activities.

9.6.2.1.1 Potential changes to SSC (Array Area)

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity given there is no overlap with any designated waters. During operation and maintenance, potential changes to SSC within the Array Area will result from the cable repair and/or cable replacement activities associated with the IACs. It is assumed that up to 10% of the cables may require repair throughout the lifetime of the Project, resulting in 19 cables requiring repair. The same parameter is assumed for cable replacement. The operational life of the Project is 35 years. The duration of cable repair and/or cable replacement activities is assumed to be up to one week. The repair and/or replacement activities will be highly localised to the area of the cable requiring attention. The maximum extent of the plume within the Array Area could be up to the tidal excursion extent of around 4.5 km. The maximum SSC for the cable trenching activities is very locally hundreds of thousands of mg/l, which then reduces to hundreds to low thousands of mg/l between 50 m and 500 m from the disturbance. Should the plume reach the tidal excursion extent of around 4.5 km, between one to six hours after disturbance, SSC would be at tens of mg/l. A return to background levels characteristic of the Array Area also occurs rapidly with the cessation of activity with concentrations of around <10 mg/l occurring over longer durations (at approximately six to 24 hours). Given the low frequency of occurrence, with the highly localised and short-term nature of the potential changes to SSC, the magnitude of effect is negligible.

Evaluation of significance

Given the low sensitivity of the seabed sediment and water column within the Array Area and the negligible magnitude of the effect, the overall effect of potential changes to SSC (Array Area) during operation and maintenance is considered to be negligible and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

9.6.2.1.2 Potential changes to SSC (EICC)

9.6.2.1.2.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the EICC outside of designated waters is considered to be of low sensitivity given there is no overlap with any designated waters. During operation and maintenance, potential changes to SSC within the EICC will result from the cable repair activities associated with the Export/Import Cable. There is potential for up to four Export/Import Cable repairs during the operational lifetime of the Project of up to 35 years. It is assumed that repair activities would occur over 10 days. The increased SSC associated with the cable repair activities could have maximum plume extent of 12 km in the inshore based on the tidal excursion extent, with a duration generally of less than a tidal cycle at its widest extent. Given the low frequency of occurrence, with the highly localised and short-term nature of the potential changes to SSC during the operation phase, the magnitude of effect is negligible.

Evaluation of significance

Taking the low sensitivity of the seabed sediment and water column within the EICC and the negligible magnitude of the effect, the overall effect of potential changes to SSC (EICC) outside designated waters during operation and maintenance is considered to be negligible and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Negligible	Negligible
Impact significance - NOT SIGNIFICANT			

9.6.2.1.2.2 All designated waters

Properties of the designated waters are as introduced for the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (Section 9.6.1.1.2.2), Buchan Ness to Cruden Bay coastal waterbody (Section 9.6.1.1.2.3), Cairnbulg Point to the Ugie Estuary coastal waterbody (Section 9.6.1.1.2.4), Cruden Bay to the Don Estuary coastal waterbody (Section 9.6.1.1.2.5), Cruden Bay coastal waterbody (Section 9.6.1.1.2.6), Peterhead (Lido) bathing water (Section 9.6.1.1.2.7), Cruden Bay bathing water (Section 9.6.1.1.2.8) and Collieston bathing water (Section 9.6.1.1.2.9). A medium sensitivity is applied for all due to their classification under the WFD and Bathing Waters Directive.

During operation and maintenance, potential changes to SSC within the EICC will result from the cable repair activities associated with the Export/Import Cable. There is potential for up to four Export/Import Cable repairs during the operational lifetime of the Project of up to 35 years. It is assumed that repair activities would occur over 10 days. The increased SSC associated with the cable repair activities could have maximum plume extent of 12 km in the inshore based on the tidal excursion extent, with a duration generally of less than a tidal cycle at its widest extent. Given the low frequency of occurrence, with the highly localised and short-term nature of the potential changes to SSC during the operation phase, the magnitude of effect is negligible.

Evaluation of significance

Taking the medium sensitivity of the designated coastal waterbody and the negligible magnitude of the effect, the overall effect potential changes to SSC during operation and maintenance is considered to be negligible and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
All designated waters	Medium	Negligible	Negligible
Impact significance - NOT SIGNIFICANT			

9.6.2.2 Mobilisation of sediment contaminants

During operation and maintenance, mobilisation of sediment contaminants may result from cable repair and/or cable replacement activities within the Array Area (IACs) and the EICC (Export/Import Cable). The mobilisation of sediment contaminants associated with the operation and maintenance activities will be less than that assessed for the construction phase in Section 9.6.1.2 above. This is on the basis that the operation and maintenance activities will mostly be highly localised and occurring intermittently over the life of the Project for a very short duration of time, with the exception of the mooring line movement across the 1.44 km^2 swept area footprint, which will occur concurrently with the marine processes over the life of the Project, albeit at minimal levels considered to be less than that associated with operation and maintenance repair activities.

9.6.2.2.1 Mobilisation of sediment contaminants (Array Area)

The receiving environment (i.e., the sediment and water column) within the Array Area is considered to be of low sensitivity due to no overlap with any designated waterbodies. There is a low occurrence of contaminants above the revised AF1, ISQG/TEL and Dutch RIVM guidelines guidance thresholds within the Array Area. Where contaminants are present and above the UKOOA CNS 50^{th} percentile, detected levels are well below the UKOOA CNS 95^{th} percentile. It is assumed that up to 10% of the IACs may require repair throughout the lifetime of the Project, resulting in 19 cables requiring repair. The same parameter is assumed for cable replacement. The operational life of the Project is 35 years. The duration of cable repair and/or cable replacement activities is assumed to be up to one week. The repair and/or replacement activities will be highly localised to the area of the cable requiring attention. The maximum extent of the plume within the Array Area could be up to the tidal excursion extent of around 4.5 km, with a duration of approximately six to 24 hours. Overall, given the maximum plume extent, the short duration and temporary nature of the works, the magnitude is low.

Evaluation of significance

Taking the low sensitivity of the Array Area seabed sediment and water column and the low magnitude of the effect, the overall effect of mobilisation of sediment contaminants (Array Area) during operation and maintenance is considered to be minor and not significant in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Low	Minor

Impact significance - NOT SIGNIFICANT

9.6.2.2.2 Mobilisation of sediment contaminants (EICC)

The mobilisation of sediment contaminants within the EICC includes the wider environment outside of designated water and the marine area covered by designated waters, with the potential for onward impacts to the water quality status of designated waters. The potential for impacts is assessed for each below.

9.6.2.2.2.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the EICC outside of designated waters is considered to be of low sensitivity given there is no overlap with any designated waters. The magnitude of effect for the EICC is considered to be negligible, as there is little to no occurrence of contaminants within the EICC and demonstrated above. In the isolated occurrence where a contaminant is detected, it occurs in isolation with no other detections identified in surrounding samples. During operation and maintenance, mobilisation of sediment contaminants within the EICC may result from the cable repair activities associated with the Export/Import Cable. There is potential for up to four Export/Import Cable repairs during the operational lifetime of the Project of up to 35 years. It is assumed that repair activities would occur over 10 days. The repair and/or replacement activities will be highly localised to the area of the cable requiring attention. The maximum extent of the plume within the EICC could have maximum plume extent of 12 km in the inshore based on the tidal excursion extent, with a duration generally of less than a tidal cycle at its widest extent. Overall, the effect is considered to be highly localised, short-term in duration and of a very low frequency given that there is no little to no occurrence of contaminants within the EICC so mobilisation of sediment contaminants is unlikely to occur.

Evaluation of significance

Taking the low sensitivity of the EICC seabed sediment and water column and the negligible magnitude of the effect, the overall effect of mobilisation of sediment contaminants (EICC) during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
Water column and seabed sediment	Low	Negligible	Negligible
Impact significance - NOT SIGNIFICANT			

9.6.2.2.2.2 All designated waters

Properties of the designated waters are as introduced for the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (Section 9.6.1.1.2.2), Buchan Ness to Cruden Bay coastal waterbody (Section 9.6.1.1.2.3), Cairnbulg Point to the Ugie Estuary coastal waterbody (Section 9.6.1.1.2.4), Cruden Bay to the Don Estuary coastal waterbody (Section 9.6.1.1.2.5), Cruden Bay coastal waterbody (Section 9.6.1.1.2.6), Peterhead (Lido) bathing water (Section 9.6.1.1.2.7), Cruden Bay bathing water (Section 9.6.1.1.2.8) and Collieston bathing water (Section 9.6.1.1.2.9). A **medium** sensitivity is applied for all due to their classification under the WFD and Bathing Waters Directive.

As described for Section 9.6.2.2.2.1 above, there is little to no occurrence of contaminants within the EICC. Mobilisation of sediment contaminants may result from the cable repair activities associated with the Export/Import Cable. However, as described above the maximum extent of the plume within the EICC could have maximum plume extent of 12 km in the inshore based on the tidal excursion extent, with a duration generally of less than a tidal cycle at its widest extent, with the activities being highly localised to the area of the cable requiring attention. Therefore, the effect is considered to be highly localised, short-term in duration and would occur at a very low frequency. Given these reasons, the magnitude is **negligible**.

Evaluation of significance

Taking the medium sensitivity of the of the designated waters (including coastal waterbodies and bathing waters) and the negligible magnitude of the effect, the overall effect of mobilisation of sediment contaminants (EICC) during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

Receptor	Sensitivity	Magnitude of effect	Consequence
All designated waters	Medium	Negligible	Negligible
Impact significance - NOT SIGNIFICANT			

9.6.3 Potential effects during decommissioning

Effects on Marine Water and Sediment Quality receptors associated with decommissioning are anticipated to result from the full removal of the Project components. Decommissioning activities will be subject to consultations and further assessments closer to the time of decommissioning to understand technical feasibility, safety and risk, and environmental considerations in detail. These details will be included in a Decommissioning Programme which will be developed post-consent and updated over the life of the Project.

The decommissioning of the Project intends to complete the full removal of offshore infrastructure to below the mudline (where safe/practicable to do so), in line with the OSPAR Convention and forthcoming guidance from OSPAR's North-East Atlantic Environmental Strategy 2030. The majority of decommissioning works are likely to be undertaken in reverse to the sequence of construction works and involve similar or lesser levels of effects to construction.

A Decommissioning Programme will be prepared prior to construction, in line with the requirements of Section 105 of the Energy Act 2004 (as amended) and any applicable guidance available at the time. Currently it is assumed that:

- FTU substructure and WTG components will be removed and towed to port;
- Mooring lines will be removed, and where possible piles will be removed or cut to a suitable distance below the mudline such that the upper portion is removed;
- Cables no longer required will be removed where safe to do so; where they cross live third-party assets, they may be cut and left in situ to prevent damage to third-party operations; and
- The OSCP(s) will be decommissioned and the jacket and topside(s) will be towed to shore. The piles will be cut a suitable distance below the mudline.

The sensitivities and effect magnitudes for decommissioning are considered to be comparable to those identified for the construction phase. Therefore, in the absence of detailed information regarding decommissioning works, the effects during the decommissioning of the Project are considered analogous with, or likely less than, those of the construction phase.

9.6.4 Summary of potential effects

A summary of the outcomes of the assessment of potential effects from the construction, operation and maintenance and decommissioning of the Project is provided in Table 9-28. No significant effects on Marine Water and Sediment Quality receptors were identified. Therefore, mitigation measures in addition to the embedded mitigation measures listed in Section 9.5.4 are not considered necessary.

Table 9-28 Summary of potential effects

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning						
Potential changes to suspended sediment concentrations (Array Area)	Seabed sediment and water column in the wider environment	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Potential changes to suspended sediment concentrations (EICC)	Seabed sediment and water column in the wider environment	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	All designated waters: Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (ID: 200131); Buchan Ness to Cruden Bay coastal waterbody (ID: 200125); Cairnbulg Point to the Ugie	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
	Estuary (ID: 200142) coastal waterbody; Cruden Bay to the Don Estuary (ID: 200117) coastal waterbody; Cruden Bay (ID: 200118) coastal waterbody; Peterhead (Lido) bathing water (ID: UKS7616042); Cruden Bay bathing water (ID: UKS7616012); and Collieston bathing water (ID: UKS7616090)					
Mobilisation of sediment contaminants (Array Area)	Seabed sediment and water column in the wider environment	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Mobilisation of sediment contaminants (EICC)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	All designated waters	Medium	Negligible	Negligible (not significant)	None required above	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
					embedded mitigation measures.	
Loss of drilling muds and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						
Potential changes to suspended sediment concentrations (Array Area)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Potential changes to suspended sediment concentrations (EICC)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
					mitigation measures.	
	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Mobilisation of sediment contaminants (Array Area)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Mobilisation of sediment contaminants (EICC)	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Decommissioning						
The sensitivity of receptors and the magnitude of effect to Marine Water and Sediment Quality receptors concluded as part of the assessment of potential effects during the construction phase (Section 9.6.1) are also applicable to the decommissioning phase.						

9.7 Assessment of cumulative effects

9.7.1 Introduction

Works associated with the construction, operation and maintenance and decommissioning phases of the Project have the potential to interact with those from other plans, activities and projects (developments) within the marine environment, therefore resulting in cumulative effects on Marine Water and Sediment Quality receptors.

The general approach to cumulative effects assessment adopted for the Project is outlined within EIAR Vol. 2, Chapter 7: EIA Methodology and in EIAR Vol. 4, Appendix 31: Cumulative Effects Assessment Methodology. As part of the cumulative process, a long list of plans, activities and projects (developments) is first defined. Upon review of this long list, the construction period of some of the identified developments did not overlap with the construction phase of the Project, so these plans, activities and projects (developments) will not be considered further in this cumulative assessment.

Further detail on the particular approach to cumulative effects assessment in relation to Marine Water and Sediment Quality receptors is detailed below.

The list of relevant developments that have been included within the cumulative effects assessment are outlined in Table 9-29 and illustrated in Figure 9-18. The identification of projects (developments) has been informed by a screening exercise which was undertaken to identify relevant developments within a defined Zone of Influence (ZoI).

ZoIs with respect to effects offshore have been defined by a varying buffer extent around the Project but is approximately twice the tidal excursion extent (see Section 9.4.1) to account for the potential coalescence of disturbance of cumulative developments. Therefore, the ZoI for water and sediment quality is approximately 9 km around the Array Area, increasing to around 16 km in the middle of the EICC and 24 km in the inshore.

Table 9-29 List of developments considered for the Marine Water and Sediment Quality cumulative effects assessment

LOCATION	PROJECT TYPE	PROJECT NAME[6]	DISTANCE TO PROJECT (KM)	STATUS	CONFIDENCE[7]
United Kingdom	Disposal	North Buchan Ness	1.56	Operational	Low
United Kingdom	Disposal	Peterhead	1.57	Operational	Low
United Kingdom	Disposal	Peterhead Harbour	4.06	Operational	Low
United Kingdom	Disposal	Fraserburgh	21.04	Operational	Low
United Kingdom	Cable	Eastern Green Link 3	0	Pre-Application (Scoping)	Low
United Kingdom	Offshore Wind	Muir Mhòr Offshore Wind Farm	0	Application	Low
United Kingdom	Offshore Wind	MarramWind Offshore Wind Farm	0	Pre-Application (Scoping)	Low

[6] *All identified cumulative developments are within the ZoI for the EICC, with none occurring within the ZoI for the Array Area.*
[7] *Confidence ratings have been applied to each cumulative development where: 'Low' = pre-application or application, 'Medium' = consented and 'High' = under construction or operational. Disposal sites are an exception to this; despite being operational, they are marked as 'Low' owing to uncertainty over frequency of use.*

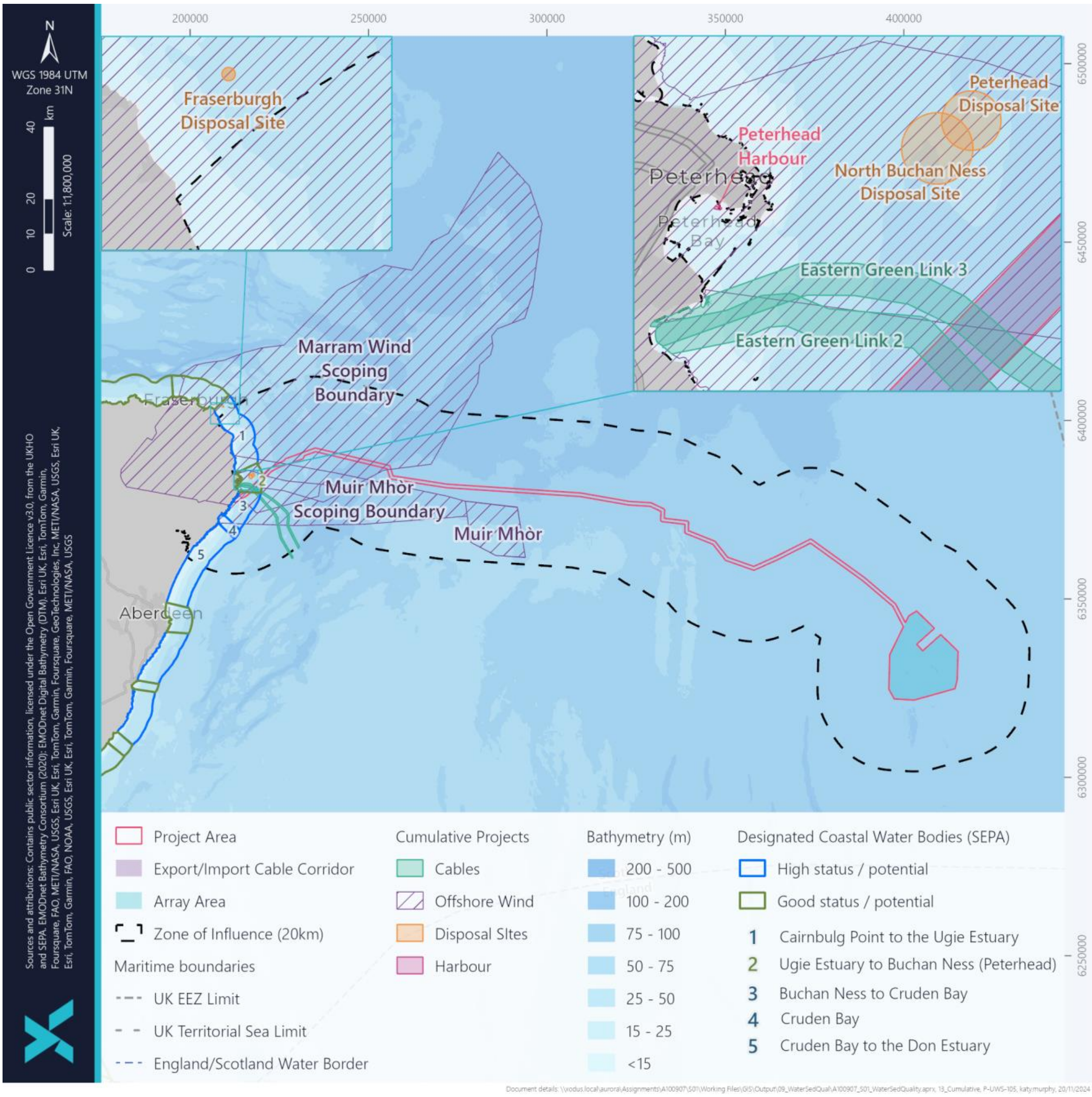

Figure 9-18 Cumulative developments relevant to the Marine Water and Sediment Quality cumulative effects assessment

The following effects have been taken forward for cumulative assessment:

- Construction and decommissioning:
  - Potential changes to suspended sediment concentrations (Array Area);
  - Potential changes to suspended sediment concentrations (EICC);
  - Mobilisation of sediment contaminants (Array Area);
  - Mobilisation of sediment contaminants (EICC); and
  - Loss of drilling fluids and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone.
- Operation and maintenance:
  - Potential changes to suspended sediment concentrations (Array Area);
  - Potential changes to suspended sediment concentrations (EICC);
  - Mobilisation of sediment contaminants (Array Area); and
  - Mobilisation of sediment contaminants (EICC).

9.7.2 Cumulative construction effects

9.7.2.1 Potential changes to suspended sediment concentrations (Array Area)

As described for the construction effects assessment above in Section 9.6.1.1.1, the receiving environment (i.e. the sediment and water column) within the Array Area is considered to be low sensitivity, given there is no overlap with any designated waters. There are also no developments within the ZoI of 9 km for the Array Area, therefore the cumulative effects is considered to be of negligible magnitude. Given the low sensitivity and negligible effect, the cumulative effects of potential changes to SSC within the Array Area during construction is considered to be negligible and not significant in EIA terms.

9.7.2.2 Potential changes to suspended sediment concentrations (EICC)

9.7.2.2.1 The EICC outside of designated waters

As described for the construction effects assessment above in Section 9.6.1.1.2.1, the receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity, given there is no overlap with any designated waters. The developments that overlap with the ZoI are as summarised in Table 9-29, and include operational disposal sites, cables and offshore wind developments. The pathway for cumulative effects are associated with the potential for increased SSC from all projects (developments).

For the operational disposal sites, three of the four identified sites are within 5 km of the EICC boundary (Table 9-29), so there is the potential for coalescence of sediment plumes during the Project construction. Without detailed information for individual disposal activities, a qualitative assessment is completed in relation to the modelling analyses completed for the Project and presented in EIAR Vol. 4, Appendix 7 - Marine & Physical Processes Modelling Report, and described for the Project alone construction assessment above (Section 9.6.1.1.2). For the disposal activities the instantaneous SSC up to hundreds of thousands of mg/l, which then reduces to hundreds to low thousands of mg/l between 50 m and 500 m from the disturbance as identified from the Project is considered to be relevant. Should the sediment plume reach the tidal excursion extent, which ranges between 5 km and 12 km along the EICC, between one to six hours after disposal, SSC would be at tens of mg/l, returning to background levels of <10 mg/l at approximately six to 24 hours. Should the plumes from the disposal sites and the Export/Import Cable coalesce, it is not anticipated that there would be an increase in SSC, instead flocculation would occur, with increased sedimentation, meaning the extents, SSC magnitude and duration would still be similar to that modelled for the Project. The above effect also applies to the remaining cumulative development, including a cable development and three OWF developments at the pre-application stage, which are either in close proximity or directly overlap with the EICC. The potential pathway for increases in SSC would result in the same increases in SSC, with the plume extents remaining the same as these are driven by tidal processes. Depending on the nature of the cumulative development construction activity, particularly in the case of the offshore windfarms, should that activity entail drilling, the duration of any plume could be longer. However, the primary driving mechanism for the plume duration is not due to the Project but is as a result of the cumulative development activity.

Overall, given the maximum plume extent of up to 12 km based on tidal excursion extent with a duration generally of less than a tidal cycle at its widest extent, with the temporary duration of the increased SSC and the localised spatial extent and magnitude of the plume, a low magnitude of effect is applied. Given the low sensitivity of the seabed sediment and water column within the EICC and the low magnitude of the effect, the cumulative effects of potential changes to SSC outside designated waters (EICC) during construction is considered to be minor and not significant in EIA terms.

9.7.2.2.2 All designated waters

Properties of the designated waters are as introduced for the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (Section 9.6.1.1.2.2), Buchan Ness to Cruden Bay coastal waterbody (Section 9.6.1.1.2.3), Cairnbulg Point to the Ugie Estuary coastal waterbody (Section 9.6.1.1.2.4), Cruden Bay to the Don Estuary coastal waterbody (Section 9.6.1.1.2.5), Cruden Bay coastal waterbody (Section 9.6.1.1.2.6), Peterhead (Lido) bathing water (Section 9.6.1.1.2.7), Cruden Bay bathing water (Section 9.6.1.1.2.8) and Collieston bathing water (Section 9.6.1.1.2.9). A medium sensitivity is applied for all due to their classification under the WFD.

The potential for cumulative effects on designated waters are exactly as that described for areas along the EICC outside of designated waters in Section 9.7.2.2.1 above. Therefore, a low magnitude of effect is again applied. Given the medium sensitivity of the seabed sediment and water column within designated waters along EICC and the low magnitude of the effect, the cumulative effects of potential changes to SSC within designated waters (EICC) during construction is considered to be minor and not significant in EIA terms.

9.7.2.3 Mobilisation of sediment contaminants (Array Area)

As described for the construction effects assessment above in Section 9.6.1.2.1, the receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity, given there is no overlap with any designated waters. There are also no developments within the ZoI of 9 km for the Array Area, therefore a negligible magnitude of effect is applied . Given the low sensitivity and negligible effect, the cumulative effects for mobilisation of sediment contaminants within the Array Area is considered to be negligible and not significant in EIA terms.

9.7.2.4 Mobilisation of sediment contaminants (EICC)

9.7.2.4.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity, given there is no overlap with any designated waters (Section 9.6.1.1.2.1). The developments that overlap with the ZoI are as summarised in Table 9-29, while the pathway for cumulative effects is associated with the potential mobilisation of contaminants contained within sediment, from all projects (developments).

As described in relation to the Project alone assessment (Section 9.6.1.2), there is considered to be little to no occurrence of contaminants along the EICC (Sections 9.4.5 and 9.6.1.2 and Figure 9 14, Figure 9 16 and Figure 9 17), with this also applying to the ZoI. The pathway for this cumulative effect is through direct disturbance only, so any sediment disturbed associated with the cumulative developments is more likely to deposited in close proximity to that disturbance activity. Should fine sediment plumes coalesce between the cumulative developments and the Project, there would be the deposition of sediment rather than the mobilisation of any new sediment or contaminant. A negligible magnitude of effect is assessed. This is on the basis of the limited occurrence or presence of contaminants, the short duration of sediment disturbance and resulting temporary nature of the sediment dispersion and maximum plume extent of 12 km in the inshore, combined with rapid sedimentation of the majority of the sediment bulk in close proximity to the disturbance activity and dilution of any dissolved contaminants.

Given the low sensitivity and negligible effect, the cumulative effects of mobilisation of sediment contaminants within the EICC outside of designated waters during construction of is considered to be negligible and not significant in EIA terms.

9.7.2.4.2 All designated waters

Properties of the designated waters are as introduced for the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (Section 9.6.1.1.2.2), Buchan Ness to Cruden Bay coastal waterbody (Section 9.6.1.1.2.3), Cairnbulg Point to the Ugie Estuary coastal waterbody (Section 9.6.1.1.2.4), Cruden Bay to the Don Estuary coastal waterbody (Section 9.6.1.1.2.5), Cruden Bay coastal waterbody (Section 9.6.1.1.2.6), Peterhead (Lido) bathing water (Section 9.6.1.1.2.7), Cruden Bay bathing water (Section 9.6.1.1.2.8) and Collieston bathing water (Section 9.6.1.1.2.9). A medium sensitivity is applied for all due to their classification under the WFD.

The potential for cumulative effects on designated waters are exactly as that described for areas along the EICC outside of designated waters in Section 9.7.2.4.1 above. Therefore, a negligible magnitude of effect is again applied. Given the medium sensitivity of the seabed sediment and water column within designated waters along EICC and the low magnitude of the effect, the cumulative effects of mobilisation of sediment contaminants within designated waters (EICC) during construction is considered to be negligible and not significant in EIA terms.

9.7.2.5 Loss of drilling fluids and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone

As described for Section 9.7.2.2.2 above, all designated waters are assessed as having medium sensitivity due to their classification under the WFD. As assessed for the Project alone assessment in Section 9.6.1.3, release of drilling fluids could result in a maximum dispersion extent of 12 km and duration of less than a tidal cycle. Although in the immediate vicinity of the HDD exit, the SSC could be tens of thousands of mg/l and by a distance of 500 m away, the SSC would be between background levels and tens of mg/l. Effects from the Project alone will be short-lived and localised. In the context of the cumulative developments, the impact from the Project would still be minimal, with any increases in SSC being from the cumulative development as described and assessed in Sections 9.7.2.2.1 and 9.7.2.2.2, with little to no contribution from the Project HDD activities. Therefore, a negligible magnitude of effect is assessed in terms of the potential for cumulative effects with the Project HDD activities.

Given the medium sensitivity of the seabed sediment and water column within designated waters and the negligible magnitude of the effect, the cumulative effects during construction is considered to be negligible and not significant in EIA terms.

9.7.3 Cumulative operation and maintenance effects

9.7.3.1 Potential changes to suspended sediment concentrations (Array Area)

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity, given there is no overlap with any designated waters (Section 9.6.2.1.1). There are also no developments within the ZoI of 9 km for the Array Area, therefore the cumulative effects is considered to be of negligible magnitude. Given the low sensitivity and negligible effect, the cumulative effects for potential changes to SSC within the Array Area during operation and maintenance is considered to be negligible and not significant in EIA terms.

9.7.3.2 Potential changes to suspended sediment concentrations (EICC)

9.7.3.2.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity, given there is no overlap with any designated waters (Section 9.6.2.1.2.1). The developments that overlap with the ZoI are as summarised in Table 9-29, and include operational disposal sites, cables and offshore wind developments. The increased SSC associated with the Project operational phase activities could have a maximum plume extent of 12 km in the inshore based on the tidal excursion extent, with a duration generally of less than a tidal cycle at its widest extent. The impact extent and duration associated with the cumulative developments are assessed to be the same, on the basis of the construction phase cumulative assessment (Section 9.7.2.2.1). However, given the low frequency of occurrence disturbance events and SSC increases during the operational phase, with the highly localised and short-term nature of the potential changes to SSC during the operation phase, the effect is considered to be of negligible magnitude. Given the low sensitivity and negligible magnitude of effect, the cumulative effects of potential changes to SSC (EICC) during operation and maintenance , is considered to be negligible and not significant in EIA terms.

9.7.3.2.2 All designated waters

As described for Section 9.7.2.2.2 above, all designated waters are assessed as having medium sensitivity due to their classification under the WFD. The potential for cumulative effects on designated waters during the operational phase are exactly as that described for areas along the EICC outside of designated waters in Section 9.7.3.2.1 above. Therefore, a negligible magnitude of effect is applied. Given the medium sensitivity of the seabed sediment and water column within designated waters along EICC and the low magnitude of the effect, the cumulative effects of potential changes to SSC (EICC) during operation and maintenance is considered to be negligible and not significant in EIA terms.

9.7.3.3 Mobilisation of sediment contaminants (Array Area)

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low sensitivity, given there is no overlap with any designated waters (Section 9.6.2.1.1). There are also no developments within the ZoI of 9 km for the Array Area, therefore the cumulative effects is considered to be of negligible magnitude. Given the low sensitivity and negligible magnitude of the effect, the cumulative effects of mobilisation of sediment contaminants within the Array Area during operation and maintenance of is considered to be negligible and not significant in EIA terms.

9.7.3.4 Mobilisation of sediment contaminants (EICC)

9.7.3.4.1 The EICC outside of designated waters

The receiving environment (i.e. the sediment and water column) within the Array Area is considered to be of low magnitude, given there is no overlap with any designated waters (Section 9.6.2.1.2.1). The developments that overlap with the ZoI are as summarised in Table 9-29. The cumulative assessment for the potential mobilisation of contaminants during the construction phase in Section 9.7.2.4.1 above identified a low magnitude due to the limited occurrence or presence of contaminants. With little potential for mobilisation during the construction phase, there is an even further reduced potential during the operational phase. Therefore, a negligible effect magnitude is considered applicable with respect to operational cumulative effects. Given the low sensitivity and negligible effect, the cumulative effects of mobilisation of contaminants within the EICC during operation and maintenance is considered to be negligible and not significant in EIA terms.

9.7.3.4.2 All designated waters

As described for Section 9.7.2.2.2 above, all designated waters are assessed as having medium sensitivity due to their classification under the WFD. The potential for cumulative effects on designated waters are exactly as that described for areas along the EICC outside of designated waters in Section 9.7.3.4.1 above. Therefore, a negligible magnitude of effect is applied. Given the medium sensitivity of the seabed sediment and water column within designated waters along EICC and the negligible magnitude of the effect, the cumulative effect of mobilisation of contaminants within the EICC during operation and maintenance is considered to be negligible and not significant in EIA terms.

9.7.4 Cumulative decommissioning effects

The decommissioning of the Project intends to complete the full removal of offshore infrastructure to below the mudline (where safe/practicable to do so). The majority of decommissioning works are likely to be undertaken in reverse to the sequence of construction works. However, there is limited information on the details around decommissioning of the Project and around the lifecycle of other developments. Considering this, it is assumed that decommissioning involves similar or lesser levels of effects to construction.

A Decommissioning Programme will be prepared prior to construction, in line with the requirements of Section 105 of the Energy Act 2004 (as amended) and any applicable guidance available at the time.

9.7.5 Summary of cumulative effects

A summary of the outcomes of the assessment of cumulative effects for the construction, operation and maintenance and decommissioning phases of the Project is provided in Table 9-30.

Table 9-30 Summary of assessment of cumulative effects

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning						
Potential changes to suspended sediment concentrations (Array Area)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Potential changes to suspended sediment concentrations (EICC)	Seabed sediment and water column in the wider environment	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	All designated waters: Ugie Estuary to Buchan Ness (Peterhead) coastal waterbody (ID: 200131); Buchan Ness to Cruden Bay coastal waterbody (ID: 200125); Cairnbulg Point to the Ugie Estuary (ID:	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
	200142) coastal waterbody; Cruden Bay to the Don Estuary (ID: 200117) coastal waterbody; Cruden Bay (ID: 200118) coastal waterbody; Peterhead (Lido) bathing water (ID: UKS7616042); Cruden Bay bathing water (ID: UKS7616012); and Collieston bathing water (ID: UKS7616090)					
Mobilisation of sediment contaminants (Array Area)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Mobilisation of sediment contaminants (EICC)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
					mitigation measures.	
Loss of drilling muds and cutting into the sea from the subtidal exit of HDD undertaken beneath the littoral zone	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						
Potential changes to suspended sediment concentrations (Array Area)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Potential changes to suspended sediment concentrations (EICC)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF EFFECT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Mobilisation of sediment contaminants (Array Area)	Seabed sediment and water column in the wider environment	Low	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Mobilisation of sediment contaminants (EICC)	All designated waters	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

9.8 Inter-related effects

Inter-related effects are the potential effects of multiple effects, affecting one receptor or a group of receptors. Inter-related effects include interactions between the effects of the different phases of the Project (i.e. interaction of effects across construction, operation and maintenance and decommissioning), as well as the interaction between effects on a receptor within a Project phase. The potential inter-related effects for Marine Water and Sediment Quality receptors are described below.

9.8.1 Inter-related effects between Project phases

For potential changes to SSC and mobilisation of sediment contaminants, the expected duration of the resulting disturbance to the sediment from trenching will subside within a matter of six to 24 hours and therefore there is considered to be no interaction between the construction and operation and maintenance phases. Furthermore, the effect of loss of drilling fluids and cuttings into the sea from the subtidal exit of HDD undertaken beneath the littoral zone only applies to construction and has been scoped out of the operation and maintenance phase. Given the operational life of 35 years, there is no potential for inter-related effects between the construction and decommissioning phases due to the short lived nature of any realised effects during construction as detailed in Section 9.6.

9.8.2 Inter-related effects within a Project phase

Given the nature of the impacts assessed in Section 9.6, there is potential for the water quality status of designated waters to be affected by multiple impacts (e.g. potential changes to SSC, mobilisation of sediment contaminants and loss of drilling fluids and cuttings into the sea) within the construction phase. An assessment on the water quality status of designated waters has been undertaken for each impact pathway, and the assessments concluded there would be no significant effect. As such, it is considered that no inter-related effects are predicted that would result in an effect of greater significance than already assessed for each individual impact section.

9.8.3 Inter-relationships

Inter-relationships are defined as the interaction between the impacts assessed within different topic assessment chapters on a receptor. The other chapters and effects related to the assessment of potential effects on Marine Water and Sediment Quality are provided in Table 9-31.

Table 9-31 Marine Water and Sediment Quality inter-relationships

CHAPTER	POTENTIAL EFFECT	DESCRIPTION
EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes	Disturbance and release of contaminated sediments and increases in suspended sediments	Changes in marine geology, oceanography and coastal processes, including disturbance of sediment, can result in increases in suspended sediment concentrations and therefore have consequences on marine water and sediment quality. The development and spread of a sediment plume in addition to potential increases in suspended sediments and associated deposition during construction are assessed in EIAR Vol. 3, Chapter 8: Marine Geology, Oceanography and Coastal Processes and used to inform this chapter. The effects of the operation and maintenance of the Project on marine geology, oceanography and coastal processes may also have consequences on water column structure and changes in landfall morphology which may affect marine water and sediment quality.
EIAR Vol. 3, Chapter 10: Benthic Ecology	Indirect impacts on benthic fauna and habitats associated with changes in water quality from suspended sediments, or due to disturbance of contaminants in the sediment.	Changes in water and sediment quality can result in indirect impacts on benthic fauna and habitats which are sensitive to water quality, disturbance of sediment, and contamination. This is assessed in EIAR Vol. 3, Chapter 10: Benthic Ecology.
EIAR Vol. 3, Chapter 11: Marine Mammal Ecology.	Indirect impacts on marine mammals associated with changes in water quality from suspended sediments, or due to disturbance of contaminants in the sediment.	Changes in water and sediment quality can result in indirect impacts on marine mammals which are sensitive as it can impair their ability to locate prey and/or influence prey species distribution. Potential changes to suspended sediment concentrations has been scoped out of the marine mammals impact assessment. This is because the increased turbidity associated with Project activities is expected to be localised and short lived hence there will be no noticeable effect on marine mammals' ability to locate prey. Furthermore, disturbance will be limited to the base of the 110 m water column where material may be resuspended, and this is unlikely to propagate to the upper levels of the water column.

CHAPTER	POTENTIAL EFFECT	DESCRIPTION
EIAR Vol. 3, Chapter 12: Ornithology	Indirect impacts on ornithology associated with changes in water quality from suspended sediments, or due to disturbance of contaminants in the sediment	Changes in water and sediment quality can result in indirect impacts on ornithological receptors which are sensitive as it can affect the distribution and abundance of prey species. The potential impact of prey availability on ornithological receptors is assessed in EIAR Vol. 3, Chapter 12: Ornithology.
EIAR Vol. 3, Chapter 13: Fish and Shellfish Ecology.	Indirect impacts on fish and shellfish associated with changes in water quality from suspended sediments, or due to disturbance of contaminants in the sediment.	Changes in water and sediment quality can result in indirect impacts on fish and shellfish (including spawning habitats) which are sensitive to water quality, disturbance of sediment, and contamination. This is assessed in EIAR Vol. 3, Chapter 13: Fish and Shellfish Ecology.
EIAR Vol. 3, Chapter 14: Commercial Fisheries	Indirect impacts on exploited fish and shellfish resources associated with changes in water quality from suspended sediment, or due to the distance of contaminants in the sediment.	Changes in water and sediment quality can result in indirect impacts on the ecology of fish and shellfish species of commercial importance which are sensitive to water quality, disturbance of sediment, and contamination and therefore lead to impacts on the commercial fisheries that exploit them. A qualitative assessment based on the findings of EIAR Vol. 3, Chapter 10: Benthic Ecology and EIAR Vol. 3, Chapter 13: Fish and Shellfish Ecology has been undertaken in EIAR Vol. 3, Chapter 14: Commercial Fisheries.
EIAR Vol. 3, Chapter 17: Infrastructure and Other Users	Indirect impacts on other sea users (e.g. other developments, recreation and tourism) associated with changes in water quality from suspended sediments, or due to disturbance of contaminants in the sediment.	Changes in water and sediment quality can result in indirect impacts to other sea users such as nearby developments (e.g. aquaculture sites) and marine recreation and tourism activity along the Peterhead coast which are sensitive to water quality and contamination. Potential effects on aquaculture receptors have been scoped out as there are no active aquaculture sites within the vicinity of the Project, with the closest site being > 40 km away. Impacts on marine recreation and tourism have not been considered.

9.9 Whole Project assessment

Please refer to EIAR Vol. 2, Chapter 7: EIA methodology for the full description of the Whole Project assessment..

The onshore aspects of the Project (i.e. those landwards of Mean Low Water Springs (MLWS)), including the onshore HDD entry point and the and the Export/Import Cable pull through, have been consented through the NorthConnect HVDC Cable Planning Consent. Details of the onshore project infrastructure which has been acquired through NorthConnect is presented within EIAR Vol. 2, Chapter 5: Project Description. These onshore aspects of the Project have been considered in relation to the impacts assessed in Section 9.6. The findings are presented below.

As described in the NorthConnect EIAR Vol. 2, Chapter 10: Water Quality Onshore, the onshore project is within the vicinity of five designated waterbodies consisting of a small manmade pool used for fishing, lagoons used for water treatment from the operational quarry, agricultural ponds with agricultural drains and finally waterbodies formed through the natural infilling of disused quarries (NorthConnect, 2018). There are nine watercourses in proximity, with the watercourses being identified as agricultural drains with low levels of water (NorthConnect, 2018). It is noted that while there are no signs of pollution or industrial discharge, there is potential for agricultural runoff (e.g. agricultural pesticides and herbicides) into the watercourses. As described in Section 9.4.5.2.4.2, the Project overlaps with the Aberdeenshire, Banff and Buchan NVZ. Additionally, there are Drinking Water Protected Areas (Groundwater and Surface Water) as designated under The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013 within vicinity to the onshore project (Scottish Government, 2014). The groundwater is identified as Peterhead (ID: (ID: 150630) which is currently in 'Good' overall condition as of 2020 (SEPA, 2024a).

The assessment of geology and hydrology has also considered the historic land use and contamination. There is potential for contaminated spoil and waste to be present associated with the disused quarries. There is a former railway, although no surface signs of contamination associated with the railway line or made ground was found in the investigation, and finally as described above there is agricultural use of the land which has the potential to result in contamination (NorthConnect, 2018). Soil sample testing completed as part of NorthConnect found that inorganics and pesticides were below the limit of detection and metals were equivalent to background concentrations and therefore concluded there is not a contamination source present across the onshore project (NorthConnect, 2018). Impacts from the onshore project (e.g. release of hazardous substances and surface water runoff) could reduce the water quality of the groundwater and surface waterbodies and watercourses. However, such impacts will be mitigated using standard embedded mitigation measures (e.g. standard best practice mitigation to avoid sedimentation and pollution and a Pollution Prevention Plan), in line with any conditions issued under the Planning Permission in Principle and/or licences issued under the Controlled Activities (Scotland) Regulations 2005 (CAR).

The potential impacts associated with the construction, operation and maintenance and decommissioning of the Project on Marine Water and Sediment Quality receptors has been assessed in full in Section 9.6 and there are considered to be no significant effects. It is not anticipated that there will be any additional impacts from the onshore aspects of the Project on Marine Water and Sediment Quality receptors. Therefore, the potential for effects between the onshore and offshore elements of the Project on Marine Water and Sediment Quality receptors is expected to be minimal. there is no potential for the onshore aspects of the Project to significantly exacerbate any of the effects assessed within this chapter.

9.10 Transboundary effects

Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state's territory affects the environment of another EEA state(s).

There is no potential for transboundary impacts upon Marine Water and Sediment Quality receptors due to construction, operation and maintenance and decommissioning of the Project. The potential effects associated with the Array Area are localised (i.e. up to 4.5 km) and are not expected to affect other EEA states. Therefore, transboundary effects for Marine Water and Sediment Quality receptors do not need to be considered further.

9.11 Summary of mitigation and monitoring

No secondary mitigation, over and above the embedded mitigation measures proposed in Section 9.5.4, is either required or proposed in relation to the potential effects of the Project on Marine Water and Sediment Quality receptors as no adverse significant impacts are predicted.

No monitoring is currently proposed for Marine Water and Sediment Quality receptors.

9.12 References

Aznar, R., Amo-Baladrón, A., Castrillo, L., Reffray, G., Escudier, R., Sotillo, M. and Cailleau, S., (2023). Product User Manual. Atlantic - European North West Shelf - Ocean Physics Analysis and Forecast Product. NWSHELF_ANALYSISFORECAST_PHY_004_013. Issue 2.0.

Buchman, M.F. (2008). Screening Quick Reference Tables (SQuiRTs). NOAA OR & R Report; 08-1. Available online at: https://repository.library.noaa.gov/view/noaa/9327 [Accessed on 16/07/2024].

Department of Business, Energy and Industrial Strategy (BEIS) (2022). UK Offshore Energy Strategic Environmental Assessment 4 (OESEA 4) Appendix 1b: Geology, Substrates & Coastal Processes. Available online at: https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-4-oesea4 [Accessed on 12/07/2024].

British Geological Survey (BGS) (2024). Seabed Sediments 250k. Offshore GeoIndex Web Map. Available online at: https://www.bgs.ac.uk/datasets/marine-sediments-250k/ [Accessed on 08/07/2024].

Canadian Council of Ministers of the Environment (CCME) (1999). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Available online at: https://www.pla.co.uk/Environment/Canadian-Sediment-Quality-Guidelines-for-the-Protection-of-Aquatic-Life [Accessed on 08/07/2024].

Centre for Environment, Fisheries and Aquaculture Science (Cefas) (2016a). Monthly Average Non-algal Suspended Particulate Matter (SPM) Concentrations on the UK Shelf Waters. Available online at: https://www.cefas.co.uk/data-and-publications/dois/monthly-average-non-algal-supended-particulate-matter-concentrations/ [Accessed on 08/07/2024].

Cefas (2016b). Suspended Sediment Climatologies Around the UK. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584621/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf [Accessed on 08/07/2024].

Cefas (2018). UK Marine Monitoring and Assessment Strategy: Sea surface suspended sediments and turbidity. Available online at: https://moat.cefas.co.uk/ocean-processes-and-climate/turbidity/ [Accessed on 20/08/2024].

Cefas (2024). Action Level Tool. Available online at: https://rconnect.cefas.co.uk/action_levels_tool/ [Accessed on 08/07/2024].

Centre of Expertise for Waters (CREW) (2021). Dynamic Coast 2. Available online at: https://www.crew.ac.uk/dynamic-coast [Accessed on 08/07/2024].

Copernicus Marine (2024). Copernicus Marine Data Service 3D Atlantic European Northwest Shelf Model. Available online at: https://data.marine.copernicus.eu/products [Accessed on 30/10/2024].

Cornes, R. C., Tinker, J., Hermanson, L., Oltmanns, M., Hunter, W. R., LloydHartley, H., Kent, E. C., Rabe, B. and Renshaw, R. Climate Change Impacts on Temperature Around the UK and Ireland. MCCIP Science Review 2023, 18pp. doi: 10.14465/2023.reu08.tem.

Dye, S., Berx, B., Opher, J., Tinker, J. P. and Renshaw, R., (2020). Climate Change and Salinity of the Coastal and Marine Environment Around the UK. MCCIP Science Review 2020, 27pp. doi: 10.14465/2020.arc04.sal.

Findlay, H. S., Artoli, Y., Birchenough, S. N. R., Hartman, S., León, P. and Stiasny, M., (2022). Climate Change Impacts on Ocean Acidification Relevant to the UK and Ireland. MCCIP Science Review 2022, 24pp. doi: 10.14465/2022.reu03.oac.

Hin, J. A., Osté, L. A. and Schmidt, C. A., (2010). Guidance document for Sediment Assessment. Ministry of Infrastructure and the Environment.

INSITE (2023). INSITE Webinar Series Episode 06 Marine Monitoring. Presentation by Dr Natalie Hicks (University of Essex). 30 November 2023. Available online at: https://insitenorthsea.org/impact [Accessed on 20/08/2024].

International Association of Dredging Companies (IADC) and Central Dredging Association (CEDA) (IADC/CEDA) (1997). Environmental aspects of dredging – conventions, codes, and condition: marine disposal, Netherlands, 1-71.

Long, E. R., MacDonald, D. D., Smith, S. L. and Calder, F. D. (1995). Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuary sediments. Environmental Management 19: 81-97.

Long, D. (2006). BGS detailed explanation of seabed sediment modified folk classification.

Mahaffey, C., Hull, T., Hunter, W., Greenwood, N., Palmer, M., Sharples, J., Wakelin, S. and Williams, C. (2023). Climate Change Impacts on Dissolved Oxygen Concentration in Marine and Coastal Waters Around the UK and Ireland. MCCIP Science Review 2023, 31pp. doi: 10.14465/2023.reu07.oxy.

Mahaffey, C., Palmer, M., Greenwood, N. and Sharples, J. (2020). Impacts of climate change on dissolved oxygen concentration relevant to the coastal and marine environment around the UK. MCCIP Science Review 2020, 31–53. doi: 10.14465/2020.arc02.oxy.

Marine Scotland (2016). Hazardous Substances. Available online at: https://marine.gov.scot/node/12618 [Accessed on 10/07/2024].

Marine Scotland (2017). Pre-disposal Sampling Guidance. Version 2 – November 2017. Available online at: 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 [Accessed on 11/10/2024].

Marine Scotland (2019a). Clean Seas Environment Monitoring Programme (CSEMP). Available online at: https://marine.gov.scot/information/clean-seas-environment-monitoring-programme-csemp [Accessed on 10/07/2024].

Marine Scotland (2019b). Marine Scotland Data: UK's Clean Seas Environmental Monitoring Programme (CSEMP) monitoring stations 2018. Available online at: https://data.marine.gov.scot/sites/default/files//CSEMP%20regions_1.pdf [Accessed on 10/07/2024].

Marine Directorate (2024). Scotland's National Marine Plan Interactive (NMPi). Available online at: https://marinescotland.atkinsgeospatial.com/nmpi/ [Accessed on 10/07/2024].

Marine Management Organisation (MMO) (2014). Guidance: Marine Licensing: sediment analysis and sample plans. Available online at: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans#full-publication-update-history [Accessed on 16/07/2024].

MMT Sweden AB (MMT) (2018). NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey.

NetRegs (2024). Guidance for Pollution Prevention (GPP) documents. Available online at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/ [Accessed on 19/08/2024].

National Oceanography Centre (2020). Clean Seas Environment Monitoring Programme (CSEMP). Available online at: https://www.bodc.ac.uk/resources/portals_and_links/merman/project_overview/ [Accessed on 10/07/2024].

NorthConnect (2018). North Connect High Voltage Direct Current Cable Infrastructure UK Environmental Impact Assessment Report. Volume 2 Main Document. July 2018. Available online at: https://marine.gov.scot/ml/marine-licence-cable-installation-between-peterhead-scotland-and-simadalen-norway-06771-06870 [Accessed on 12/07/2024].

OSPAR (2008). OSPAR Publication 2008-379 CEMP Assessment Manual: Co-ordinated Environmental Monitoring Programme Assessment Manual for contaminants in sediment and biota.

OSPAR (2014). Levels and Trends in Marine Contaminants and their Biological Effects. CEMP Assessment Report 2013. Publication number: 631/2014, OSPAR Commission 2014.

OSPAR Commission (2021). OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR) – Update 2021. (OSPAR Agreement 2013-06). Available online at: https://www.cefas.co.uk/media/p3sbu3bn/ospar-list-of-substances-used-and-discharged-offshore-which-are-considered-to-pose-little-or-no-risk-to-the-environment-plonor-update-2021.pdf [Accessed 14/10/2024].

Rovco Ltd. (2024a). Offshore Windfarm Geophysical Results Report. MV Glomar Supporter. Geoenvironmental Survey, Cenos Offshore Windfarm Project. Revision C1. 12th April 2024. Document No. 23014-EN-SU-RP-003.

Rovco Ltd. (2024b). EICC Geophysical Results Report. MV Glomar Supporter. Cenos EICC Environmental Survey. Revision C2. 30th April 2024. Document No. 23014-EN-SU-RP-004.

Scottish Environmental Protection Agency (SEPA) (2020a). Supporting Guidance (WAT-SG-53) Environmental Quality Standards and Standards for Discharges to Surface Waters. Available online at:

https://www.sepa.org.uk/media/152957/wat-sg-53-environmental-quality-standards-for-discharges-to-surface-waters.pdf [Accessed on 08/07/2024].

SEPA (2020b). Urban Waste Water Treatment Directive Sensitive Areas 2019. Available online at: https://www.gov.scot/binaries/content/documents/govscot/publications/map/2016/01/urban-waste-water-treatment-sensitive-areas-map/documents/urban-waste-water-treatment-sensitive-areas-map-2019/urban-waste-water-treatment-sensitive-areas-map-2019/govscot%3Adocument/UWWTD%2Bdesignations%2B2019.pdf [Accessed on 08/07/2024].

SEPA (2023a). Position Statement on alteration of structures and Invasive Non-Native Species. August 2023. Available online at: https://www.sepa.org.uk/regulations/water/guidance/#PS [Accessed on 19/08/2024].

SEPA (2023b). Land Use Planning System SEPA Guidance Note 13, Version 9. LUPS-GU-13. December 2023. Available online at: https://www.sepa.org.uk/media/u0bbeakd/lups-gu13-standing-advice-on-marine-consultations.pdf [Accessed on 19/08/2024].

SEPA (2024a). River Basin Management Plan 3: The river basin management plan for Scotland 2021 – 2027. 2021 Updates to the Water Environment Hub. Available online at: https://informatics.sepa.org.uk/RBMP3/ [Accessed on 08/07/2024].

SEPA (2024b). Water Classification Hub. Available online at: https://www.sepa.org.uk/data-visualisation/water-classification-hub [Accessed on 08/07/2024].

SEPA (2024c). Scotland's Environment data tool for Bathing Waters. Available online at: https://informatics.sepa.org.uk/BathingWaters/ [Accessed on 09/07/2024].

SEPA (2024d). Scotland's Bathing Waters – Bathing water profiles. Available online at: https://bathingwaters.sepa.scot/profiles/ [Accessed on 09/07/2024].

SEPA (2024e). Nitrates monitoring. Available online at: https://www.sepa.org.uk/environment/water/monitoring/nitrates-monitoring/ [Accessed on 08/07/2024].

Scottish Government (2014). Drinking water protected areas – Scotland river basin district: maps. Map 9. Available online at: https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/ [Accessed on 16/10/2024].

Scottish Government (2015a). Scotland's National Marine Plan. Available online at: https://www.gov.scot/publications/scotlands-national-marine-plan/ [Accessed on 08/07/2024].

Scottish Government (2015b). Nitrate Vulnerable Zones Scotland Map 4: Aberdeenshire, Banff, Buchan and Moray. Available online at: https://www.gov.scot/binaries/content/documents/govscot/publications/map/2018/08/nitrate-vulnerable-zones-maps/documents/moray-aberdeenshire-banff-and-buchan-nvz/moray-aberdeenshire-banff-and-buchan-nvz/govscot%3Adocument/Moray%252C%2BAberdeenshire%252C%2BBanff%2Band%2BBuchan%2BNVZ.pdf [Accessed on 09/07/2024

Scottish Government (2024). Agriculture and the environment – Nitrate Vulnerable Zones. Available online at: https://www.gov.scot/policies/agriculture-and-the-environment/nvz/ [Accessed on 08/07/2024].

Tonani, M., Ascione, I. and Saulter, A., (2022). Product User Manual. Ocean Physical-Wave Analysis and Forecast Product. NORTHWESTSHELF_ANALYSIS_FORECAST_PHY_004_013 and NORTHWESTSHELF_ANALYSIS_FORECAST_WAV_004_014. Issue 1.3.

UK Offshore Operators Association (UKOOA) (2001). An analysis of U.K Offshore Oil & gas Environmental Surveys 1975-95, pp. 141.