RWE

Awel y Môr Offshore Wind Farm

Category 6: Environmental Statement

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Glossary of terms

TERM	DEFINITION
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biotope	A region of habitat associated with a particular ecological community.
Drop-Down Video (DDV)	A survey method in which imagery of habitat is collected, used predominantly to survey marine environments.
EUNIS habitat classification	A pan-European system which facilitates the harmonised description and classification of all types of habitat, through the use of criteria for habitat identification.
Holocene	The Holocene is the current geological epoch. It began approximately 11,650 calibrated years before present, after the last glacial period, which concluded with the Holocene glacial retreat. The Holocene and the preceding Pleistocene together form the Quaternary period.
Intertidal	The area of the shoreline between Mean High Water Springs and Mean Low Water Springs.
Megafauna	Large animals of a particular region, habitat or geological period.
Megaripples	An extensive undulation of the surface of a sandy beach or seabed, typically tens of meters from crest to crest and tens of centimeters in height.
Mini-hamon grab	Comprises of a stainless-steel box shaped sampling scoop mounted in a triangular frame, ideal for

TERM	DEFINITION
	sampling seabed sediments, as well as sampling for benthic macrofauna.
Mollusca	Phylum of invertebrates which have a soft unsegmented body, commonly protected by a calcareous shell.
SACFOR	An abundance scale used for both littoral and sublittoral taxa from 1990 onwards.
Side Scan Sonar (SSS)	Side-imaging sonar used to create an image of the seafloor.
Single-beam and multi-beam echo sounders (SBES and MBES)	A type of sonar which transmits soundwaves, using the time taken between emission and return to establish a depth. This can be done using singular or multiple beams.
Subtidal	The region of shallow waters which are below the Mean Low Water Springs.

Abbreviations and acronyms

TERM	DEFINITION
AyM	Awel y Môr Offshore Wind Farm
BAC	Background Assessment Concentrations
BAP	Biodiversity Action Pan
BC	Background Concentrations
BSL	Below Sea-Level
B-fields	A type of magnetic field
CBRA	Cable Burial Risk Assessment

TERM	DEFINITION
CEA	Cumulative Effects Assessment
CoEMP	Coordinated Environmental Monitoring Programme
CIEEM	Chartered Institute of Ecology and Environmental Management
CSIP	Cable Specification and Installation Plan
DCO	Development Consent Order
DDV	Drop-Down Video
EA	Environment Agency
ECC	Export Cable Corridor
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPA	Environmental Protection Agency
ERL	Effect Range Low
ES	Environmental Statement
EUNIS	European Nature Information System
E-fields	Electric Fields
FOCI	Feature of Conservation Importance
GBS	Gravity Base Structure
GC	Gas Chromatography
GES	Good Environmental Status
GyM	Gwynt y Môr
HDD	Horizontal Directional Drilling

TERM	DEFINITION
HRA	Habitats Regulation Assessment
INNS	Invasive Non-Native Species
ISQG	Interim Sediment Quality Guideline
IUCN	International Union for Conservation of Nature
iE-fields	Induced Electric Fields
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LOD	Limit of Detection
MarLIN	Marine Life Information Network
MarESA	Marine Evidence based Sensitivity Assessment
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-beam Echo Sounder
MCA	Maritime and Coastguard Agency
MCCIP	Marine Climate Change Impacts Partnership
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MFE	Mass Flow Excavation
MHWS	Mean High Water Spring
MINNS	Marine Invasive Non-Native Species
MLWS	Mean Low Water Spring
MMO	Marine Management Organisation
MNCR	Marine Nature Conservation Review

TERM	DEFINITION
MPCP	Marine Pollution Contingency Plan
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
NNR	National Nature Reserve
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
NPD	Sum of naphthalene, phenanthrene, dibenzothiophene
NPS	National Policy Statement
OESEA3	UK Offshore Energy Strategic Environmental Assessment 3
OFTO	Offshore Transmission Operator
OSP	Offshore Substation Platform
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OSS	Offshore Substation
OWF	Offshore Wind Farm
PAH	Polycyclic Aromatic Hydrocarbons
PEMP	Project Environmental Management Plan
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PSA	Particle Size Analysis
RIAA	Report to Inform Appropriate Assessment
rMCZ	recommended Marine Conservation Zone
SAC	Special Area of Conservation

TERM	DEFINITION
SBES	Single-beam Echo Sounders
SBP	Sub-Bottom Profiler
SCI	Site of Community Importance
SEA6	Strategic Environmental Assessment 6
SoNaRR	State of Natural Resources Report
SoS	Secretary of State
SPMP	Scour Protection Management Plan
spp.	Species
SPP	Scour Protection Plan
SSC	Suspended Sediment Concentrations
SSS	Side Scan Sonar
SSSI	Site of Special Scientific Interest
TSHD	Trailing Suction Hopper Dredger
THC	Total Hydrocarbon
TOC	Total Organic Carbon
TWT	The Wildlife Trust
VER	Valued Ecological Receptor
WNMP	Welsh National Marine Plan
WTG	Wind Turbine Generator
ZoI	Zone of Influence

Units

UNIT	DEFINITION
cm	Centimetre
g	Gram
m	Metre
m^2	Square metre
m^3	Cubed metre
mg	Milligram
mg/l	Milligram per litre
mm	Millimetre
km	Kilometre
km^2	Square kilometre
µg/g	Mircogram per gram
µT	Microtesla
%	Percent

5 Benthic Subtidal and Intertidal Ecology

5.1 Introduction

1 This chapter of the Environmental Statement (ES) presents the results of the Environmental Impact Assessment (EIA) to date of the potential impacts of Awel y Môr Offshore Wind Farm (AyM) on benthic subtidal and intertidal ecology. Specifically, this chapter considers the potential impact of AyM seaward of Mean High Water Springs (MHWS) during its construction, operation and maintenance (O&M), and decommissioning phases.

2 This chapter has been informed by the following ES chapters:

- Volume 2, Chapter 1: Offshore Project Description (application ref: 6.2.1);
- Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2); and
- Volume 2, Chapter 3: Marine Water and Sediment Quality (application ref: 6.2.3).

5.2 Statutory and policy context

3 This section identifies legislation and national and local policy of particular relevance to benthic subtidal and intertidal ecology.

4 This document has been prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations 2017), of relevance to Nationally Significant Infrastructure Projects (NSIPs), and the Marine Works (Environmental Impact Assessment) Regulations 2007, of specific relevance to marine licensing under the Marine and Coastal Access Act (MCAA) 2009 in Welsh waters. The EIA Regulations 2017 require developers to provide a *"… description of the likely significant effects on the factors specified in regulation 5(2)… which… should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the developments"*. The EIA regulations are considered along with the legislation relevant to benthic subtidal and intertidal ecology.

5 In undertaking the assessment, the following legislation has been considered:

- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017;
- The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended);
- The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention; 1979);
- EU Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the 'Habitats Directive')[i];
- The Conservation of Habitats and Species Regulations 2017 (as amended).
- Marine and Coastal Access Act 2009;
- The Environment (Wales) Act 2016; and
- The Wildlife and Countryside Act 1981 (as amended).

6 Guidance on the issues to be assessed for offshore renewable energy developments has been obtained through reference to the Overarching National Policy Statement (NPS) for Energy (NPS EN-1; Department for Energy and Climate Change (DECC), 2011a), the National Policy Statement for Renewable Energy Infrastructure (NPS EN-3, DECC, 2011b), the NPS for Electricity Networks Infrastructure (NPS EN-5; DECC, 2011c), the UK Marine Policy Statement (MPS; HM Government, 2011), and the relevant Marine Plans.

7 In addition to the current NPS, the draft NPSs (which were consulted on from the 6 September to 30 November 2021) have been reviewed to determine the emerging expectations and changes from previous iterations of the NPSs. This includes the Draft Overarching NPS EN-1 (DECC, 2021a), EN-3 (DECC, 2021b) and EN-5 (DECC 2021c), however, there are no specific polices in the Draft NPS EN-5 which relate to benthic and intertidal ecology and offshore connections.

[i] The Habitats Directive (Council Directive 92/43/EEC) and certain elements of the Wild Birds Directive (Directive 2009/147/EC) (known as the Nature Directives) were transposed into domestic law by the 2017 Regulations. Following the Exit from the EU the Regulations were updated and referred to as the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. Any references to Natura 2000 in the 2017 Regulations and in guidance now refers to the new national site network.

8 Specifically, the guidance within NPS EN-3 was considered, which identifies that the applicants should have regard to both subtidal and intertidal seabed habitats (paragraph 2.6.59 and paragraph 2.24.1 in the Draft NPS EN-3). NPS EN-3 (paragraph 2.6.63 and paragraph 2.24.4 in the Draft NPS EN-3) specifically notes the following potential issues:

- Effects of Offshore Wind Farms (OWFs) can include temporary disturbance during the construction phase (including underwater noise) and ongoing disturbance during the O&M phase and direct loss of habitat; and
- The presence of the Wind Turbine Generators (WTGs) can also have positive benefits to ecology and biodiversity.

9 NPS EN-3 (paragraphs 2.6.64 to 2.6.67, 2.6.81 to 2.6.83, 2.6.113 to 2.6.114 and 2.6.119) includes guidance on what matters are to be included in an applicant's assessment and these are summarised in Table 1.

10 The national policy considerations relevant to benthic subtidal and intertidal ecology in the Draft Renewable Energy Infrastructure NPS EN-3 (paragraphs 2.24.5 to 2.24.8, 2.25.3, 2.27.3 and 2.30.2 to 2.30.3) are summarised in Table 1.

Table 1: Summary of NPS EN-3 and Draft NPS EN-3 policy relevant to benthic subtidal and intertidal ecology and AyM.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
NPS EN-3	Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed OWF (paragraph 2.6.64).	The potential effects associated with the construction, operation and decommissioning of AyM have been assessed (Sections 5.11, 5.12, and 5.13).
Draft NPS EN-3	Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed OWF (paragraph 2.24.5).	The potential effects associated with the construction, operation and decommissioning of AyM have been assessed (Sections 5.11, 5.12, and 5.13).
NPS EN-3	Consultation on the assessment methodologies should be undertaken at an early stage with the statutory consultees as appropriate (paragraph 2.6.65).	Consultation has been undertaken through the scoping process and is ongoing through the EIA Evidence Plan process (Table 4).
Draft NPS EN-3	Consultation on the assessment methodologies should be undertaken at an early stage with the statutory consultees as appropriate (paragraph 2.24.6).	Consultation has been undertaken through the scoping process and is ongoing through the EIA Evidence Plan process (Table 4).

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
NPS EN-3	Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational OWFs should be referred to where appropriate (paragraph 2.6.66)	Relevant data collected as part of post-construction monitoring from other OWFs has informed the assessment of (Sections 5.11, 5.12, and 5.13). The Marine Management Organisation (MMO) has produced a review[ii] (MMO, 2014) on post-construction monitoring that has been undertaken for OWFs within which it is noted that there have been limited effects arising on benthic communities from certain impacts. Where appropriate this chapter cross refers to those studies either individually or through reference to the MMO review.
Draft NPS EN-3	Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational OWFs should be referred to where appropriate (paragraph 2.24.7)	Relevant data collected as part of post-construction monitoring from other OWFs has informed the assessment of (Sections 5.11, 5.12, and 5.13). The Marine Management

[ii] Whilst this review focussed primarily on English projects monitoring data from Gwynt y Môr was also considered, and the underlying ecological significance is applicable across the UK.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
		Organisation (MMO) has produced a review[iii] (MMO, 2014) on post-construction monitoring that has been undertaken for OWFs within which it is noted that there have been limited effects arising on benthic communities from certain impacts. Where appropriate this chapter cross refers to those studies either individually or through reference to the MMO review.
NPS EN-3	Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity (paragraph 2.6.67).	Both the positive and negative effects of AyM have been assessed (Sections 5.11, 5.12, and 5.13).
Draft NPS EN-3	Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity (paragraph 2.24.8).	Both the positive and negative effects of AyM have been assessed (Sections 5.11, 5.12, and 5.13).

[iii] Whilst this review focussed primarily on English projects monitoring data from Gwynt y Môr was also considered, and the underlying ecological significance is applicable across the UK.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
NPS EN-3	Applicants should assess the effects on the subtidal environment from habitat loss due to foundations and seabed preparation, predicted scour, scour protection and altered sedimentary processes (paragraph 2.6.113 and paragraphs 2.25.2 and 2.30.2 of the Draft NPS EN-3) and effects on the intertidal zone (paragraph 2.6.81).	The assessment has considered effects from all development phases on benthic and intertidal habitats and species in the vicinity of AyM. These assessments included all likely effects from temporary and long-term habitat loss and the effects of changes in physical processes (Sections 5.11, 5.12, and 5.13).
Draft NPS EN-3	Applicants should assess the effects on the subtidal environment from habitat loss due to foundations and seabed preparation, predicted scour, scour protection and altered sedimentary processes (paragraph 2.6.113 and paragraphs 2.25.2 and 2.30.2 of the Draft NPS EN-3) and effects on the intertidal zone (paragraph 2.27.3).	The assessment has considered effects from all development phases on benthic and intertidal habitats and species in the vicinity of AyM. These assessments included all likely effects from temporary and long-term habitat loss and the effects of changes in physical processes (Sections 5.11, 5.12, and 5.13).
NPS EN-3	Applicants should assess the effects on the benthic environment from extendible legs and anchors of construction vessels (paragraph 2.6.113) and habitat disturbance in the intertidal zone during cable installation and removal (decommissioning) (paragraph 2.6.81).	The AyM ES has considered the effects of benthic and intertidal disturbances throughout the whole of the development (Sections 5.11, 5.12, and 5.13), with specific reference to construction vessels and anchors in paragraph 122 *et seq*. and habitat

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
		disturbance within the intertidal zone in paragraph 137 *et seq*.
Draft NPS EN-3	Applicants should assess the effects on the benthic environment from extendible legs and anchors of construction vessels (paragraph 2.30.2) and habitat disturbance in the intertidal zone during cable installation and removal (decommissioning) (paragraph 2.27.3).	The AyM ES has considered the effects of benthic and intertidal disturbances throughout the whole of the development (Sections 5.11, 5.12, and 5.13), with specific reference to construction vessels and anchors in paragraph 122 *et seq*. and habitat disturbance within the intertidal zone in paragraph 137 *et seq*.
NPS EN-3	Applicants should assess the effects of increased suspended sediment leads during construction on subtidal habitats (paragraph 2.6.113) and intertidal habitats (paragraph 2.6.81).	Specific effects of increased suspended sediment load and the associated sediment deposition on benthic and intertidal ecology have been assessed with regards to the construction phase (paragraph 171 *et seq*.).
Draft NPS EN-3	Applicants should assess the effects of increased suspended sediment leads during construction on subtidal habitats (paragraph 2.30.2) and intertidal habitats (paragraph 2.27.3).	Specific effects of increased suspended sediment load and the associated sediment deposition on benthic and intertidal ecology

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
		have been assessed with regards to the construction phase (paragraph 171 *et seq*.).
NPS EN-3	Applicants should assess the predicted rates for subtidal habitat recovery (paragraph 2.6.113) and intertidal habitats (paragraph 2.6.81).	The likely rates of recovery of benthic and intertidal habitats/ species have been presented for each impact assessed, and are based on the Marine Evidence Based Sensitivity Assessment[iv] (MarESA) which has been used to inform the assessment of the significance of the effect (Sections 5.11, 5.12, and 5.13).
Draft NPS EN-3	Applicants should assess the predicted rates for subtidal habitat recovery (paragraph 2.30.2) and intertidal habitats (paragraph 2.27.3).	The likely rates of recovery of benthic and intertidal habitats/ species have been presented for each impact assessed, and are based on the Marine Evidence Based Sensitivity Assessment[v] (MarESA) which has been used to inform the assessment of the significance of the effect (Sections 5.11, 5.12, and 5.13).

[iv] https://www.marlin.ac.uk/sensitivity/sensitivity_rationale
[v] https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
NPS EN-3	The Applicant should not have to assess the effects of the cables on intertidal and subtidal habitat during the operational phase of the OWF (paragraph 2.6.114).	Indirect disturbance of benthic species from Electromagnetic Fields (EMF) generated by inter-array and export cables has been scoped out, except for those species which are listed under Section 7 of the Environment (Wales) Act 2016. The significance of the effect on these species has been assessed in Section 5.12.
Draft NPS EN-3	Applicants should assess the effects on the subtidal environment from potential impacts from EMF on benthic fauna (paragraph 2.30.2 of the Draft NPS EN-3).	
	Applicants should assess the impacts on protected sites (paragraph 2.30.2 of the Draft NPS EN-3)	Protected sites including those in the former Natura 2000 network (now the UK National Site Network), have been considered during the AyM assessment with potential effects on the relevant habitats associated with the construction, operation and decommissioning of AyM described in Sections 5.11, 5.12, and 5.13. Reference to Natura 2000 sites and their features are also made in the Report to Inform

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
		Appropriate Assessment (RIAA) (Report 5.2 (application ref: 5.2))
NPS EN-3	Construction and decommissioning methods should be designed appropriately to minimise effects on subtidal habitats, taking into account other constraints. Mitigation measures may include: - surveying and micrositing of the export cable route to avoid adverse effects on sensitive habitat and biogenic reefs; - burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and - the use of anti-fouling paint might be minimised on subtidal surfaces, to encourage species colonisation on the structures. (paragraph 2.6.119 of the NPS EN-3)	Where considered appropriate, and where effects associated with the project may be considered significant in the absence of mitigation, mitigation has been considered during the AyM assessment (Table 12).
Draft NPS EN-3	Construction, maintenance and decommissioning methods should be designed appropriately to	

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	minimise effects on subtidal habitats, taking into account other constraints. Review of up-to-date research should be undertaken and all potential mitigation options presented. Mitigation measures which the Secretary of State should expect the applicants to have considered may include: - surveying and micrositing or re-routing of the export and inter-array cables to avoid adverse effects on sensitive habitats, biogenic reefs or protected species - burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state - the use of anti-fouling paint might be minimised on subtidal surfaces, to encourage species colonisation on the structures (paragraph 2.30.3 of the Draft NPS EN-3)	

11 In addition to the above, NPS EN-3 includes guidance relating to potential secondary or indirect impacts arising from changes to the physical environment which should also be considered.

12 Further guidance on what matters should be included within an applicant's assessment regarding biodiversity and designated sites is provided within NPS EN-1 (paragraphs 5.3.1 to 5.3.30 and paragraph 5.4.1 to 5.4.17 of the Draft Overarching NPS EN-1), which is summarised in Table 2.

13 The planning process for Nationally Significant Infrastructure Projects (NSIPs) is administered by the Planning Inspectorate (PINS), while the Secretary of State (SoS) makes the final decision on the Development Consent Order (DCO). A number of points relating to the determination of an application and in relation to mitigation are detailed in NPS EN-3 (paragraphs 2.6.68 to 2.6.71 and 2.6.75 to 2.6.77), which are summarised in Table 2.

14 In addition to the current NPS, the draft NPS EN-3 policy considerations relevant to benthic subtidal and intertidal ecology (paragraphs 2.24.10, 2.24.11, 2.24.18, 2.24.19, 2.26.6, 2.27.6, 2.27.7, 2.30.5, 2.30.6 and 2.35.12) are summarised in Table 2.

Table 2: Summary of NPS EN-3 and the Draft NPS EN-3 policy on decision making with regard to benthic subtidal and intertidal ecology and consideration in the AyM assessment.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
NPS EN-3	The SoS should consider the effects of a proposal on marine ecology and biodiversity taking into account all relevant information made available to it (paragraph 2.6.68).	Where relevant to benthic ecology this has been described and considered within the assessment for AyM in Sections 5.11, 5.12, and 5.13.
	The designation of an area as Natura 2000 site does not necessarily restrict the construction or operation of OWFs in or near that area (paragraph 2.6.69).	Natura 2000 sites have been considered during the AyM assessment with potential effects on the relevant habitats described in Sections 5.11, 5.12, and 5.13.
	Mitigation may be possible in the form of a careful design of the development itself and the construction techniques employed (paragraph 2.6.70).	Where considered appropriate, and where effects associated with the project may be considered significant in the absence of mitigation, mitigation has been considered during the AyM assessment (Table 12).
	Ecological monitoring is likely to be appropriate during the construction and operational phases to identify the actual impact so that, where appropriate, adverse effects can then be	Where appropriate, monitoring has been considered during assessment of potential

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	mitigated and to ensure further useful information to be published relevant to future projects (paragraph 2.6.71).	effects associated with the AyM assessment (Table 12).
	The conservation status of intertidal habitat (paragraph 2.6.84) and benthic habitat (paragraph 2.6.115) is of relevance to the SoS.	The conservation status of intertidal and benthic receptors has been considered throughout this assessment (Section 5.1 – Valued Ecological Receptors (VERs)).
	The SoS should be satisfied that activities have been designed taking into account sensitive benthic environmental aspects (paragraph 2.6.116) and intertidal habitats (paragraph 2.6.85).	The assessment has identified potential impacts on sensitive benthic and intertidal habitats (Sections 5.11, 5.12, and 5.13).
	Where adverse effects are predicted, in coming to a judgement, the SoS should consider the extent to which the effects are temporary or reversible, this includes the installation and decommissioning of cables (paragraph 2.6.86).	The duration and reversibility of effects has been included in the assessment of effects (Sections 5.11, 5.12 and 5.13).
	Where is it proposed that the offshore export cables are armoured and buried at a sufficient depth to minimise heat effects, the effects of heat	The nature, potential burial depth, and installation of export cables has been considered in the assessment (Sections 5.11,

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	on sensitive species from cable infrastructure during operation are unlikely to be a reason for the SoS to refuse to grant consent for a development (paragraph 2.6.118).	5.12 and 5.13) and in accordance with the cable design as presented in Volume 2, Chapter 1.
Draft NPS EN-3	The SoS should consider the effects of a proposal on marine ecology and biodiversity taking into account all relevant information made available to it (paragraph 2.24.18 of the Draft NPS EN-3).	Where relevant to benthic ecology this has been described and considered within the assessment for AyM in Sections 5.11, 5.12, and 5.13.
	The designation of an area as Natura 2000 site does not necessarily restrict the construction or operation of OWFs in or near that area (paragraph 2.24.19 of the Draft NPS EN-3).	Natura 2000 sites have been considered during the AyM assessment with potential effects on the relevant habitats described in Sections 5.11, 5.12, and 5.13.
	The conservation status of intertidal habitat (paragraph 2.27.6 of the Draft NPS EN-3) and benthic habitat (paragraph 2.30.5 of the Draft NPS EN-3) is of relevance to the SoS.	The conservation status of intertidal and benthic receptors has been considered throughout this assessment (Section 5.1 – Valued Ecological Receptors (VERs)).

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	The SoS should be satisfied that activities have been designed taking into account sensitive benthic environmental aspects (paragraph 2.30.6 of the Draft NPS EN-3) and intertidal habitats (paragraph 2.27.7 of the Draft NPS EN-3).	The assessment has identified potential impacts on sensitive benthic and intertidal habitats (Sections 5.11, 5.12, and 5.13).
	Where adverse effects are predicted, in coming to a judgement, the SoS should consider the extent to which the effects are temporary or reversible (paragraph 2.35.12 of the Draft NPS EN-3), this includes the installation and decommissioning of cables.	The duration and reversibility of effects has been included in the assessment of effects (Sections 5.11, 5.12 and 5.13).
	Mitigation will be possible in the form of careful design of the development itself and the construction techniques employed (paragraph 2.24.10 of the Draft NPS EN-3).	Where considered appropriate, and where effects associated with the project may be considered significant in the absence of mitigation, mitigation has been considered during the AyM assessment (Table 12).
	Ecological monitoring will be appropriate during the pre-construction, construction and operational phases to identify the actual impacts	Where appropriate, and where sufficient uncertainty exists in the prediction of significance, monitoring has been considered

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	caused by the project and compare them to what was predicted in the EIA/ HRA. Should impacts be greater than those predicted, an adaptive management process may need to be implemented and additional mitigation required, to ensure that so far as possible the effects are brought back within the range of those predicted. Monitoring should be of sufficient standard to inform future decision-making. Increasing the understanding of the efficacy of alternatives and mitigation will deliver greater certainty on developer requirements (paragraph 2.24.11 of the Draft NPS EN-3).	during assessment of potential effects associated with the AyM assessment, which includes a pre-construction survey in order to microsite around Section 7 habitats (Table 12). It is important to note that by virtue of the proposed project being an extension to, or sister project of, the adjacent Gwynt y Môr (GyM) project, reference is made to the existing data gathered during monitoring undertaken for GyM. The monitoring at GyM provides greater certainty in the assessment findings for the proposed AyM.
	The SoS should also consider any negative impacts from rock armouring on benthic habitats and a balance between protection of various receptors must be made, with all mitigation and alternatives to rock armouring reviewed (paragraph 2.26.6 of the Draft NPS EN-3).	Offshore cables are proposed to be buried for the project. However, the potential need for cable protection (either for crossings and/ or where burial is not achievable) has been considered within the assessments in relation to the potential effects on the receiving benthic environment. Therefore, the nature, potential burial depth, and installation of

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
		export cables has been considered in the assessment (Sections 5.11, 5.12 and 5.13) and in accordance with the cable design and specification as presented in Volume 2, Chapter 1, as confirmed with NRW through the submission of the cable specification information plan (application ref: 5.4).

15 Guidance has been provided within the Marine Strategy Framework Directive (2008/56/EC) (MSFD), adopted in July 2008, which has been considered in this assessment. The MSFD is transposed for the whole of the UK by the Marine Strategy Regulations 2010, providing a UK-wide framework for meeting the requirements of the Directive. The relevance of the MSFD to AyM has been described in Volume 1, Chapter 2: Policy and Legislation (application ref: 6.1.2).

16 The overarching aim of the MSFD is to achieve 'Good Environmental Status' (GES) by 2020, across Europe's marine environment. Annex I of the MSFD identifies 11 high level qualitative descriptors for determining GES, with those relevant to the benthic and intertidal ecology assessment for AyM outlined in Table 3, with a brief description of how and where these have been addressed in this assessment.

Table 3: Summary of the MSFD high level descriptor of GES relevant to benthic subtidal and intertidal ecology and consideration in the AyM assessment[vi].

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
MSFD	Descriptor 1 – Biological diversity: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	The effects on biological diversity have been described and considered within the assessment for AyM alone and the cumulative effects assessment (CEA) (Sections 5.11, 5.12 and 5.13).
	Descriptor 2 – Non-indigenous species: Non-indigenous species introduced by human activity are at levels that do not adversely alter the ecosystems.	The potential for effects associated with non-indigenous species on benthic species and habitats that may be attributable to the AyM project are assessed in Section 5.11.
	Descriptor 4 – Elements of marine food web: All elements of marine food webs, to the extent they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.	The effects on benthic and intertidal ecology, inclusive of the interlinkages with interdependent ecological receptors described in other chapters is integral within this chapter and the wider ES with inter relationships described where appropriate.

[vi] Descriptor 3 and 6 are considered in other relevant chapters, including Volume 2, Chapter 6: Fish and Shellfish Ecology (application ref: 6.2.6).

LEGISLATION / POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	Descriptor 6 – Sea floor integrity: Seafloor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.	The effects on benthic and intertidal ecology, inclusive of any risk to ecological integrity, has been described and considered within the assessment for AyM alone and the CEA (Sections 5.11, 5.12, 5.13 and 5.14).
	Descriptor 7 – Alteration of hydrographical conditions: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	The potential for permanent alterations to hydrographical conditions that may be attributable to AyM to adversely affect marine ecosystems is assessed within sections Section 5.11.
	Descriptor 8 – Contaminants: Concentrations of contaminants are at levels not giving rise to pollution effects.	The effects of contaminants on benthic and intertidal habitats and species have been assessed in Section 5.11.
	Descriptor 10 – Marine litter: Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	A Project Environmental Management Plan (PEMP) will be produced post-consent and followed to cover the O&M phase of AyM. The PEMP will include planning for accidental spills, address all potential contaminant releases and include key emergency contact details (e.g.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
		Environment Agency (EA), Natural Resources Wales (NRW), and Maritime and Coastguard Agency (MCA)). A Decommissioning Programme will be developed post consent to cover the decommissioning phase (Table 12).

5.2.1 Overview of Welsh Planning Policy

Planning Policy Wales

17 Planning Policy Wales (Welsh Government, 2021a) sets out the land use planning policies of the Welsh Government, forming a strategic framework to guide development. Planning Policy Wales provides specific guidance on topics such as the natural, built and historic environment; economic development, transport, housing, tourism, recreation and managing environmental risks.

Welsh National Marine Plan

18 The Welsh National Marine Plan (WNMP) was published on 12 November 2019 and contains policy across a range of considerations (including nature conservation, sustainable use, seascape, and coastal communities and economic growth) (Welsh Government, 2019). The WNMP includes sector objectives for renewable energy to support decarbonisation of the Welsh economy and the use of marine renewable energy generation (including OWF).

19 The policies within the WNMP that have been considered for this assessment and the aims of each are summarised as follows:

- ENV_01: Resilient marine ecosystems - Aims to ensure that biological and geological components of ecosystems are maintained, restored where needed and enhanced where possible, to increase the resilience of marine ecosystems and the benefits they provide. Under this policy, the sensitivities of marine ecosystems and ecosystem impacts should be taken into account when developing proposals and, where possible, proposals should also demonstrate how they will contribute to ecosystem protection, restoration and/ or enhancement. This policy has been addressed within the assessment in Sections 5.11, 5.12 and 5.13.
- ENV_03: Invasive non-native species - Proposals should assess the likely risk of introducing or spreading INNS and put in place reasonable biosecurity measures where necessary to reduce or stop their introduction or spread. This policy has been addressed within the assessment in Sections 5.11 and 5.12. The project is also committing to a biosecurity plan via embedded mitigation measures as outlined in Table 12.

- ENV_04: Marine Litter - Proposals should ensure that they are compliant with the relevant national and international legislation including the Environmental Protection Act and the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations. This policy aims to contribute towards achieving the targets for reducing marine litter. It also aims to contribute towards the wider achievement of ecosystem resilience and to safeguard the coastal and marine environment from harm resulting from the release of marine litter. The project is committing pollution prevention via embedded mitigation measures as outlined in Table 12.

Future Wales – The National Plan

20 Future Wales – the National Plan 2040 is Wales' national development framework, setting the direction for development in Wales to 2040 (Welsh Government, 2021b). It is a development plan with a strategy for addressing key national priorities through the planning system, including sustaining and developing a vibrant economy, achieving decarbonisation and climate-resilience, developing strong ecosystems and improving the health and well-being of our Welsh communities.

21 NRW produced a State of Natural Resources Report (SoNaRR) in 2020 which describes the current condition of marine ecosystems in Wales. It also contains a resilience assessment for subtidal and intertidal habitats and establishes future trends, particularly of relevance to benthic ecology in terms of marine Invasive Non-Native Species (INNS). This aspect of policy has been addressed in Sections 5.11 and 5.12 (specifically in relation to marine INNS), as well as within Section 5.7.8 which considers evolution of the baseline.

5.3 Consultation and scoping

22 The benthic ecology of the area within which the proposed development is located has been the subject of detailed discussion between regulators and AyM.

23 Consultation is a key part of the DCO pre-application process. Consultation regarding benthic subtidal and intertidal ecology has been undertaken with various statutory and non-statutory authorities through the agreed Evidence Plan process (being used for the EIA process as well as for the Habitats Regulation Assessment (HRA)). A formal Scoping Opinion was sought from the SoS following submission of the Scoping Report (Innogy Renewables UK, 2020). The Scoping Opinion (PINS, 2020) was issued in July 2020 by PINS.

24 AyM's statutory consultation period under Section 42 of the Planning Act 2008 ran from 31 August to 11 October 2021, a period of six weeks. The PEIR was published as part of formal consultation which provided preliminary information on benthic subtidal and intertidal ecology within Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology.

25 A summary of the responses relevant to the benthic and intertidal ecology chapter in the Scoping Opinion are summarised in Table 4 below. This table also provides a summary of the key themes of the feedback received in relation to benthic subtidal and intertidal ecology and outlines how the feedback has been considered in this ES chapter. A full list of all comments received during the formal consultation period and the response to those comments is provided in the Consultation Report (application ref: 5.1).

Table 4: Summary of consultation relating to benthic subtidal and intertidal ecology.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
August 2020 – Scoping Opinion	Accidental pollution resulting from construction can be scoped out.	Accidental pollution impacts have been scoped out and are not assessed in this chapter.
	Noise pollution on benthic ecology during foundation installation during construction.	Noise impacts have been scoped out and are not assessed in this chapter.
	Cumulative impacts identified in the Scoping Report (paragraphs 424).	Cumulative effects have been assessed in Section 5.14.
	The ES should include an assessment of the impacts on Annex I reef and sandbank habitat (e.g. Constable Bank) during all phases of the Proposed Development. The ES should describe how route selection and micro-siting has been used to address these impacts. Any significant effects to these habitats should be assessed in the ES.	The site selection process is now complete and direct impacts to the Constable Bank sandbank (noted as Annex I for the purposes of Regulation 17 reporting) have been avoided by adopting an alternative route. Impacts on Annex I sandbank habitat have therefore been scoped out from further consideration.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	The ES should assess impacts from jack-up vessels and anchoring where significant effects are likely to occur.	Temporary habitat disturbance from jack-up vessels and anchoring during construction, operation and decommissioning activities has been undertaken in Sections 5.11, 5.12 and 5.13 respectively.
August 2020 benthic survey consultation (NRW)	NRW reviewed the proposed benthic sampling strategy requested additional sample locations within the survey strategy.	Additional sampling locations for grabs and Drop-down video (DDV) were put forward and the scope of the benthic survey was agreed with NRW. This will be reported in the Evidence Plan Report that will accompany the final application.
September 2020 ETG Meeting (as detailed in the Evidence Plan Report)	Indirect disturbance of benthic species from EMF generated by inter-array and export cables during operation.	EMF impacts have been scoped out for all benthic receptors except those listed under Section 7 of the Environment (Wales) Act 2016 (as agreed in the Environmental Impact Assessment Evidence Plan Report (application ref: 8.2)). However, as no Section 7 species were identified within the

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
		study area (Section 5.7), this impact has not been considered further in this assessment.
October 2021 Section 42 Consultation Responses	NRW requested that all qualifying features of the SACs are included in the assessment.	All qualifying features have been assessed and a list of these are provided in Table 9.
	NRW advised that the United Kingdom Biodiversity Action Plan is no longer applicable to Wales following the 'UK Post-2010 Biodiversity Framework'. NRW noted this should be amended to Section 7 of the Environment (Wales) Act 2016.	Reference to the UKBAP has been removed and amended to Section 7 Environment (Wales) Act 2016 through the Benthic Subtidal and Intertidal Ecology Chapter.
	NRW requested an assessment of the temporary increase in suspended sediment concentrations (SSC) on "Large shallow inlets and bays" and "Submerged or partially submerged sea caves" features for Menai Strait and Conwy Bay SAC and "Estuaries" features for Dee Estuary/ Aber Dyfrdwy SAC,	This has been considered in this chapter (see Section 5.11) and a figure presenting the designated feature and modelled SSC plume has been provided (Figure 8 – Menai Strait and Conwy Bay SAC and Figure 9 – Dee Estuary/ Aber Dyfrdwy SAC). Reference, in the context of the feature of

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	and a figure to illustrate these designated features against the modelled SSC plume.	the SAC, should also be made to the RIAA (Report 5.2 (application ref: 5.2))
	Although NRW agreed that the effects of both long-term habitat loss due to the presence of infrastructure and the increased risk of introduction of marine Invasive and Non-Native Species (INNS) would not be significant, in terms of EIA terms, they advised that magnitude and sensitivity classifications should be applied consistently.	This has been reviewed throughout this chapter and updated accordingly in Sections 5.11, 5.12 and 5.13.
	The Wildlife Trust (TWT) requested accurate figures for the amount of habitat lost to properly assess the impact significance. A breakdown of the exact amount of habitat lost for each of the different array/ cable route options should be provided with an impact significance assigned.	A breakdown of the worst-case scenario for habitat loss is provided in Table 11. This details the design with the maximum potential impact benthic features within the array area and the offshore ECC.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	TWT have also requested that cable and scour protection should not be left to remain *in situ* post-decommissioning, as a matter of course; at the end of the wind farm's life, surveys should be conducted to assess the quality of the communities established and a decision on their removal made in conjunction with the statutory authorities.	The approach to decommissioning will be detailed in the Decommissioning Programme and Plan, which will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. The Decommissioning Plan will follow best practice guidance available at the time. The assessment considered the temporary and permanent loss due to removal of foundations, cable and rock protection in Section 5.13.
	TWT note in Figure 2 that there has been less sampling of the western part of the array area than for the rest of the site for which there is pre-existing data from other windfarm projects. We do not have full certainty that this is sufficient to characterise the benthos of the whole site.	Using information gathered from existing literature and data sources, and site-specific surveys, there is good data coverage across large parts of the AyM benthic ecology study area (Figure 2), particularly following the reduction of the Order Limits.

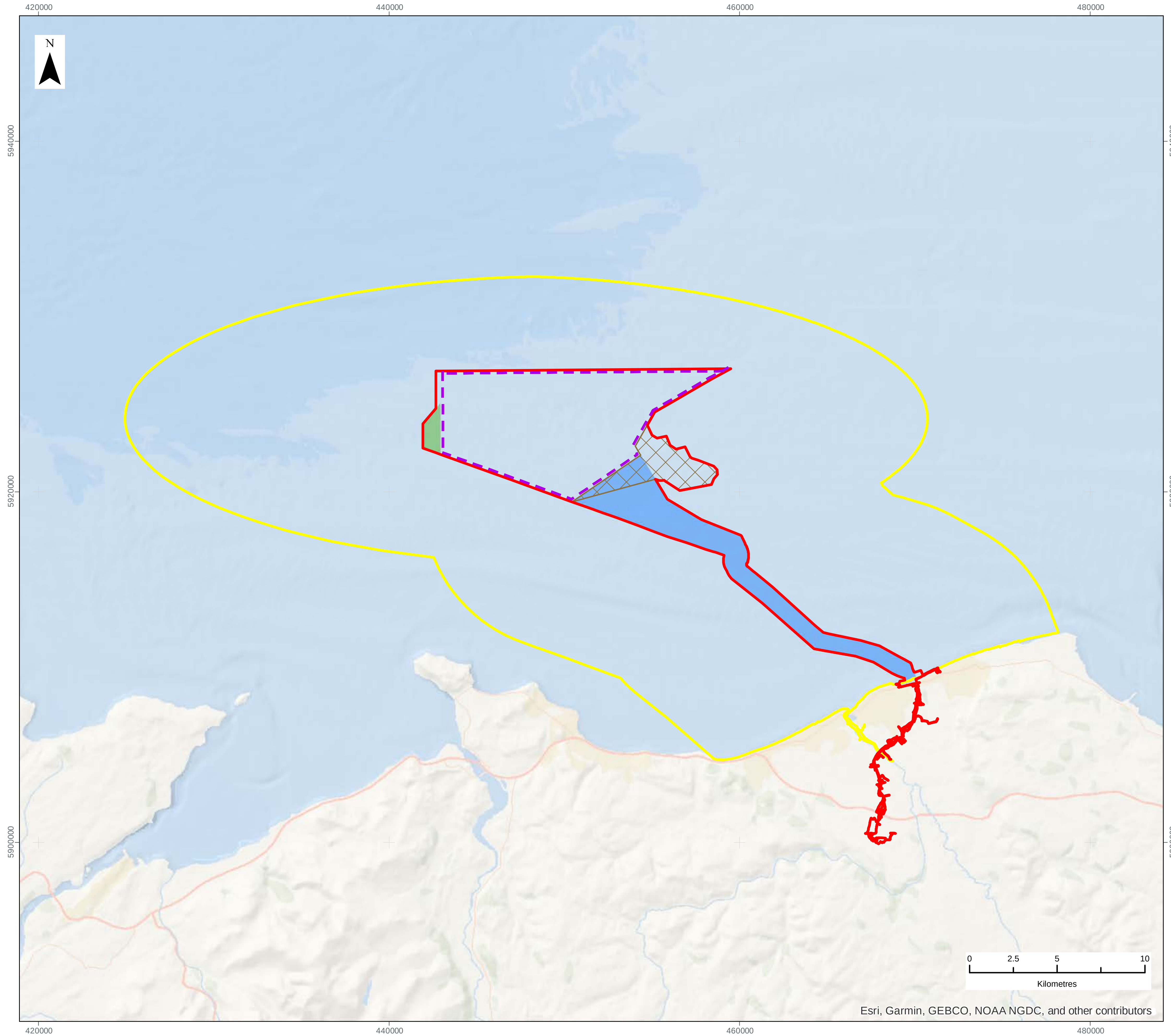
DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	TWT were concerned that within the ZoI, fine particles in suspension could settle between sandwave rows on neap tides.	Information on deposition of fine particles/ sediment is presented in the project specific hydrodynamic modelling (Volume 4, Annex 2.3). Volume 2, Chapter 2 also highlights that fine sediments that do settle are likely to be subject to further erosion and dispersion during subsequent tides.
	TWT provided further descriptors to characterise the baseline benthic environment in the proposed array and the offshore ECC.	These descriptors have been included within this chapter in Existing environment (Section 5.7).

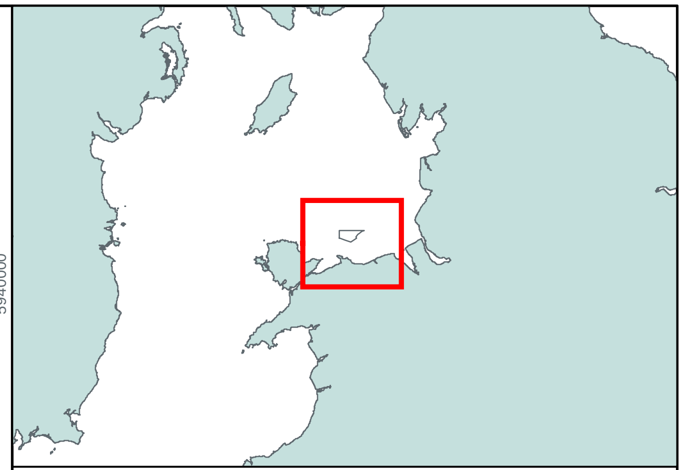
5.4 Scope and methodology

5.4.1 Study area

26 For the purpose of identifying benthic ecological receptors with the potential to be significantly affected by AyM, a Zone of Influence (ZoI) has been defined based on the project specific hydrodynamic modelling undertaken (Volume 4, Annex 2.3: Physical Processes Modelling Results Report (application ref: 6.4.2.3)), as this defines the maximum distance suspended sediments disturbed by the maximum design scenario (MDS) construction activities might impact benthic habitats.

27 The ZoI is presented in Figure 1 and has been defined as a maximum elliptical ZoI which extends to a maximum of 18 km to the west of the array area (and less to the east), and a maximum of 8.5 km around the offshore Export Cable Corridor (ECC); these ZoIs encapsulate the maximum extent of measurable plumes predicted by the modelling from construction activities (see Appendix A of Volume 4, Annex 2.3), although the majority of suspended sediment is expected to be deposited much closer to the disturbance activity. The AyM benthic ecology study area includes the intertidal zone at landfall up to MHWS. An ellipse around the array area has been used to define the ZoI for the activities within the array, owing to the plumes generally moving in parallel relative to the coast in less disperse plumes. This ellipse encapsulates the maximum extent of measurable plumes (i.e. 1 mg/l) predicted by the modelling.





LEGEND

- Benthic Ecology ZoI
- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: AyM benthic subtidal and intertidal study area and ZoI

VER	DATE	REMARKS	Drawn	Checked
1	09/09/2021	For Issue For PEIR	BPHB	RM
2	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 1

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:225,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

G:\GIS\GIS_Projects\0141 AyM\GIS\Figures\ES\Benthic\AyM_BE_Fig1_Study_Area_ZoI.mxd

28 The benthic characterisation presented here provides a regional overview before focusing on the study area within the offshore components of the development boundary (Figure 1). The immediate Red Line Boundary (Order Limits), and ZoI effectively characterise the predicted zone of potential primary (direct) and secondary (indirect) impacts of the development on benthic receptors respectively. The study area has been broken down into three sections, and these sections have been assessed individually in terms of their potential impacts on benthic subtidal and intertidal ecology. The sections considered within this chapter comprise the following:

- Array area (including WTGs, offshore substation (OSS) and inter-array cables);
- Offshore ECC; and
- Landfall (including the intertidal zone).

29 Site-specific surveys for AyM were undertaken to characterise the benthic ecology throughout the array and a number of export cable corridor options all of which are described in Volume 4, Annex 5.1: Benthic Ecology Subtidal Characterisation (Array) (application ref 6.4.5.1) and Volume 4, Annex 5.2 Benthic Ecology Subtidal Characterisation (Offshore ECC) (application ref 6.4.5.2). The offshore ECC has since been confirmed (previously referred to as option 'East B') and therefore it is the East B option, which is described and assessed here, including the intertidal areas at landfall. The scope of both the intertidal and subtidal benthic surveys having been agreed with NRW (see Table 4). The data from the AyM site specific surveys have been used in the characterisation of the AyM study area.

30 Within the subtidal area a full geophysical survey was undertaken, supplemented with Drop-Down Video (DDV) data and grab samples to enable characterisation of the benthic communities present within the study area, and to determine the presence of sensitive habitats (including *Sabellaria spinulosa* reef). The survey additionally included sediment Particle Size Analysis (PSA) and contaminant analysis using grab samples.

31 A site-specific Phase 1 intertidal survey (Volume 4, Annex 5.3: Benthic Ecology Intertidal Characterisation (application ref 6.4.5.3)) was carried out at the potential landfall locations within the offshore ECC. The scope was agreed with NRW and provides adequate coverage for the purposes of EIA. Standard Phase 1 survey methods were followed (Davies *et al*., 2001, Wyn and Brazier, 2001 and Wyn *et al*., 2000).

32 In the UK there are two commonly used classification schemes; the Marine Habitat Classification for Britain and Ireland (Joint Nature Conservation Committee (JNCC), 2015) and the Europe-wide scheme European Nature Information System (EUNIS) (EEA, 2019) which is strongly reflective of the UK system. Under both the subtidal and intertidal benthic ecology surveys habitats and communities have been classified according to both the Marine Nature Conservation Review (MNCR) (JNCC, 2015) and EUNIS (EEA, 2019) biotope classification schemes. Biotopes provide a simplified description of the variation in biological community across a region to make it easier to visualise patterns and see which areas are similar in character. This chapter and the associated annexes rely primarily on the biotope classification system.

5.5 Assessment criteria and assignment of significance

33 The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts.

34 The magnitude of potential impacts is defined by a series of factors, including the spatial extent of any interaction, the likelihood, frequency and duration of a potential impact. The definitions of magnitude used in the assessment are defined in Table 5.

Table 5: Impact magnitude definitions.

MAGNITUDE	DEFINITION[vii]
High	The proposed development would result in a complete change to baseline conditions and status of conservation features/ ecological functionality; or the proposed development would result in a change from baseline conditions that would affect the conservation status of the site or feature.
Medium	The site feature's conservation status would not be affected, but the impact is likely to be material in terms of ecological objectives or populations. If, in light of full information, it cannot be clearly demonstrated that the impact will not adversely affect the conservation objectives, then the impact should be assessed as high.
Low	Minor shift away from baseline but the impact is of limited temporal or physical extent.
Negligible	Discernible or barely discernible change from baseline conditions that results in a slight alteration to the key characteristics or features of a receptor.

[vii] In line with best practice, the MarESA assessment methodology has been applied, which factors in duration of impact within sensitivity (please refer to footnote viii).

35 In line with the Chartered Institute of Ecology and Environmental Management (CIEEM) guidance (CIEEM 2018), the sensitivities of different biotopes have been classified by the Marine Life Information Network (MarLIN) on the MarESA four-point scale (high – medium – low – not sensitive) (MarLIN 2019). The scale takes account of the resistance and recoverability (resilience) of a species or biotope in response to a stressor. Specific benchmarks (duration and intensity) are defined for the different impacts for which sensitivity has been assessed (e.g. smothering, abrasion, habitat alteration etc.). Detailed information on the benchmarks used and for further information on the definition of resistance and resilience can be found on the MarLIN website[viii].

36 The CIEEM guidance also considers the importance of ecological features. Ecological features can be important for a variety of reasons and may relate, for example, to the quality, rarity or extent of habitats/ species, and/ or the extent to which they are threatened throughout their range, or to their rate of decline.

37 For the purposes of this assessment, four sensitivity categories have been defined, each drawing on the four MarLIN MarESA categories [viii] and the importance of the receptor (Table 6).

Table 6: Sensitivity/ importance of the environment.

RECEPTOR SENSITIVITY/ IMPORTANCE	DESCRIPTION/ REASON
High	Equivalent to MarLIN MarESA sensitivity category 'High'. The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover only over very extended timescales i.e. > 25 years or not at all (resilience is 'Very Low'); or The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human

viii https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

RECEPTOR SENSITIVITY/ IMPORTANCE	DESCRIPTION/ REASON
	activities, and is expected to recover only over very extended timescales i.e. > 10 or up to 25 years (resilience is ‘Low’). The extent/ distribution of the habitat/ species is restricted to the locality of development area.
Medium	Equivalent to MarLIN MarESA sensitivity category ‘Medium’. The habitat or species is noted as exhibiting ‘None’ or ‘Low’ resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium timescales, i.e. > 2 or up to ten years (resilience is ‘Medium’); or The habitat or species is noted as exhibiting ‘None’ resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over < 2 years (resilience is ‘High’); or The habitat or species is noted as exhibiting ‘Medium’ resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium to very long timescales, i.e. > 2 years or up to 25 years or not at all (resilience is ‘Medium’, ‘Low’ or ‘Very Low’). The extent/ distribution of the habitat/ species is nationally or regionally restricted.
Low	Equivalent to MarLIN MarESA sensitivity category ‘Low’. The habitat or species is noted as exhibiting ‘Low’ or ‘Medium’ resistance (tolerance) to an external factor, whether that arises from natural events or human

RECEPTOR SENSITIVITY/ IMPORTANCE	DESCRIPTION/ REASON
	activities, and is expected to recover over < 2 years (resilience is 'High'); or The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium to very long timescales, i.e. > 2 years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low'). The extent/ distribution of the habitat/ species is widespread around the UK.
Negligible	Equivalent to MarLIN MarESA sensitivity category 'Not Sensitive'. The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over short timescales, i.e. < 2 years (resilience is 'High'). The habitat/ species is distributed throughout the North-East Atlantic.

38 The matrix used for the assessment of significance is shown in Table 7. The combination of the magnitude of the impact with the sensitivity of the receptor determines the assessment of significance of effect.

39 For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms, whether this be adverse or beneficial. Any effect that has a significance of minor or negligible is not significant.

Table 7: Matrix to determine effect significance.

		SENSITIVITY			
		HIGH	MEDIUM	LOW	NEGLIGIBLE
ADVERSE MAGNITUDE	HIGH	Major	Major	Moderate	Minor
	MEDIUM	Major	Moderate	Minor	Negligible
	LOW	Moderate	Minor	Minor	Negligible
	NEGLIGIBLE	Minor	Minor	Negligible	Negligible
BENEFICIAL MAGNITUDE	NEGLIGIBLE	Minor	Minor	Negligible	Negligible
	LOW	Moderate	Minor	Minor	Negligible
	MEDIUM	Major	Moderate	Minor	Negligible
	HIGH	Major	Major	Moderate	Minor

Note: Effects of 'moderate' significance or greater are defined as significant with regard to the EIA Regulations.

5.6 Uncertainty and technical difficulties encountered

40 Grab sampling and video surveys, while providing detailed information on the infauna and epifauna present, cannot cover wide swaths of the seabed and consequently represent point samples that must be interpreted in combination with the geophysical datasets to produce benthic maps that provide comprehensive cover.

41 Classification of survey data into benthic habitats and the production of benthic habitat maps from the survey data, while highly useful for assessment purposes, has two main limitations:

- Difficulties in defining the precise extents of each biotope, even when using site specific geophysical survey data to characterise the seabed; and
- There is generally a transition from one biotope to another, rather than fixed limits and therefore, the boundaries of where one biotope ends and another starts often cannot be precisely defined.

42 Consequently, the biotope maps presented in this chapter should not be considered as definitive, nor should the habitat boundaries be considered to be fixed, they do however represent a robust characterisation of the receiving environment.

43 There are additional limitations inherent within the MarESA sensitivity assessments. These include the assessments not being site specific and consequently there may be differences in sensitivity within a species in different habitats. These limitations are included within the confidence score assigned to the MarESA assessment, for which the full details and rationale are provided on the MarLIN website, and in the assessment summaries.

44 The overall confidence in the evidence used for the MarESA sensitivity assessments is assessed for three categories: the quality of the evidence/ information used; the degree to which the evidence is applicable to the assessment; and the degree of concordance (agreement) between the available evidence. A 'low' confidence score can be applied for the different categories if:

- For quality of the evidence – the assessment is based on expert judgement (i.e. insufficient scientific evidence or grey literature[ix]);
- For applicability of the evidence – the assessment is based on proxies for the pressure (e.g. based on natural disturbance events rather than anthropogenic); and
- For the degree of concordance of the evidence – the available evidence does not agree on direction or magnitude of the impact or recoverability.

45 The confidence of the sensitivity assessment is based on the confidence of the assessments for the resilience and resistance of each habitat. If the confidence for the resilience or resistance assessment is 'low' or 'not relevant' then the corresponding confidence for the sensitivity assessment will also be low. This is of particular relevance to the quality of the evidence that is available.

46 However, despite the above uncertainties, it should be noted that there is robust data available on the benthic communities present in the study area. The seabed in the area is well studied and surveyed, therefore, the sensitivities of the habitats present are understood, and the post-construction surveys undertaken for AyM can be used to validate the assessments of the likely impacts within this chapter. As such, the available evidence base is sufficiently robust to underpin the assessment presented here.

5.7 Existing environment

5.7.1 Methodology to inform the baseline

47 A detailed baseline description of benthic subtidal and intertidal ecology resources across the AyM benthic subtidal and intertidal ecology study area, and wider Liverpool Bay, is presented within Volume 4, Annexes 5.1 to 5.3. A summary of the existing baseline is presented within this section.

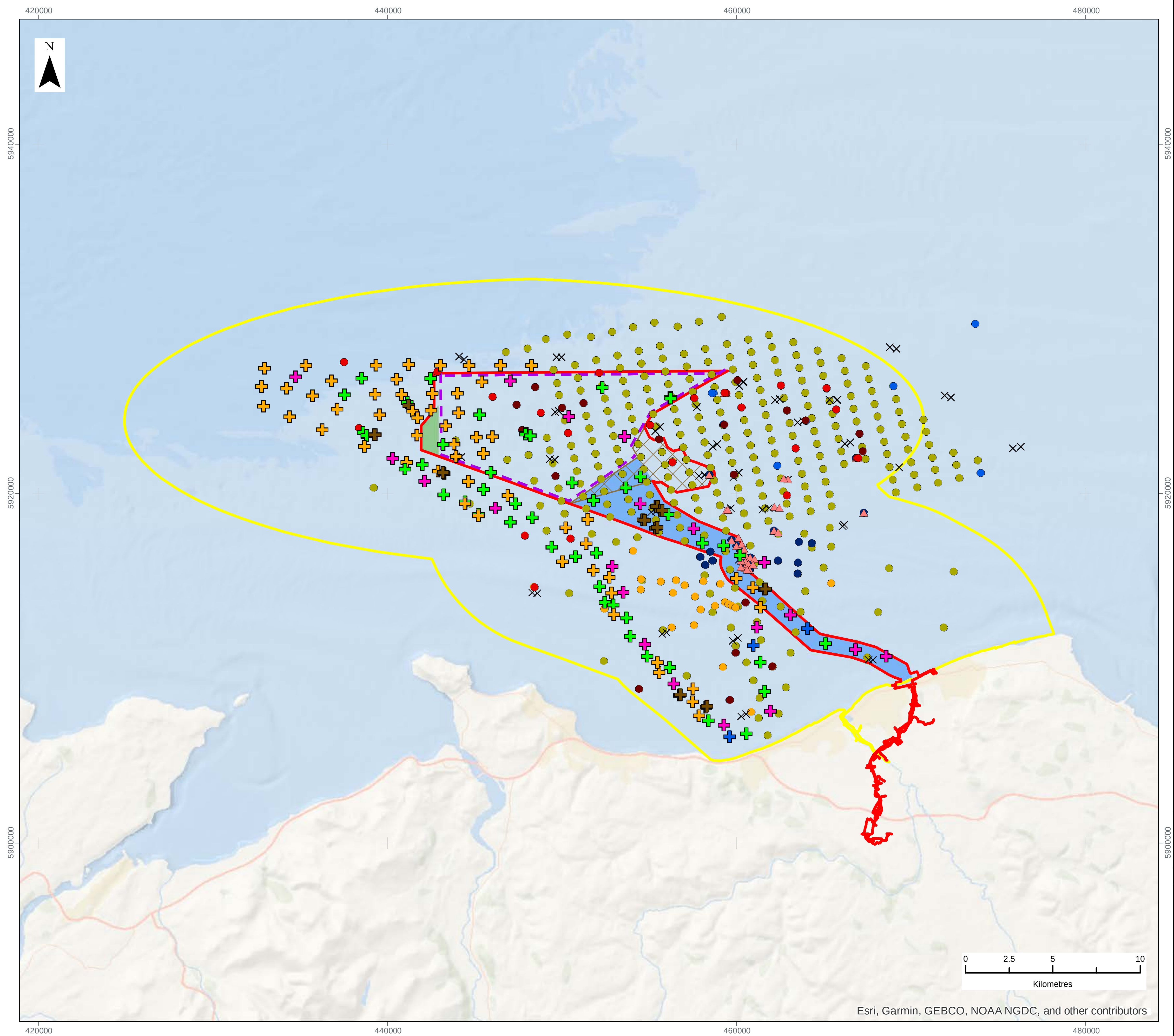
[ix] Grey literature is information produced on all levels of government, academia, business and industry in electronic and print formats not controlled by commercial publishing" i.e.. where publishing is not the primary activity of the producing body.

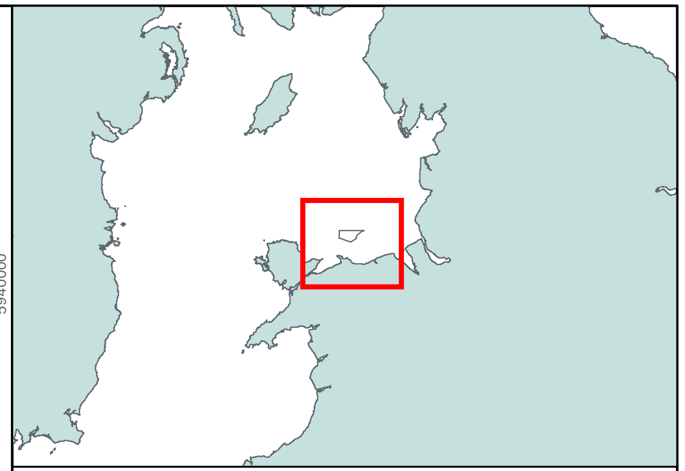
48 Information on the benthic and intertidal communities within the AyM ecology study area was collected through a detailed desktop review of existing literature and data sources, and site-specific surveys. These have provided coverage across large parts of the AyM benthic ecology study area, and wider region (See Table 8 and Figure 2).

Table 8: Data sources consulted for the AyM.

SOURCE	SUMMARY	COVERAGE OF AYM ARRAY AREA AND OFFSHORE ECC ORDER LIMITS
GyM baseline characterisation (CMACS, 2005a)	DDV and grab sampling gear were deployed across the GyM site and surrounding area as part of the baseline characterisation.	Good data coverage across the AyM benthic ecology study area (Figure 2).
GyM OWF pre-construction study (CMACS, 2011)	DDV and grab sampling gear were deployed across the GyM site and surrounding area as part of pre-construction monitoring.	Good data coverage across the AyM benthic ecology study area (Figure 2).
GyM OWF post-construction surveys (NIRAS, 2017 and 2018/ 2019 survey)	DDV and grab sampling gear were deployed across the GyM site and surrounding area as part of post-construction monitoring.	Good data coverage across the AyM benthic ecology study area (Figure 2).
UKSeaMap (2018)	EUNIS Level 4 model, detailing biological zone and substrate.	Complete coverage up to MHWS.

SOURCE	SUMMARY	COVERAGE OF AYM ARRAY AREA AND OFFSHORE ECC ORDER LIMITS
North Hoyle OWF baseline characterisation (CMACS, 2002)	Benthic grab and trawl sampling were undertaken across the North Hoyle OWF site and surrounding area as part of the characterisation study.	No overlap with the AyM array area or offshore ECC search area. However, dataset provides a regional context for site-specific information.
NRW (2016)	Phase I habitat survey of intertidal at landfall.	Intertidal East of Rhyl.
Burbo Bank OWF baseline characterisation (SeaScape Energy, 2002)	Benthic grab and trawl sampling were undertaken across the Burbo Bank OWF site and surrounding area as part of the characterisation study.	No overlap with the AyM array area or offshore ECC search area. However, dataset provides a regional context for site-specific information.
Rhyl Flats pre-construction study (CMACS, 2005b)	Benthic grab and trawl sampling were undertaken across the Rhyl Flats OWF site and surrounding area as part of pre-construction monitoring.	Rhyl Flats monitoring data overlaps with the AyM offshore export cable route search area (Figure 2).





LEGEND

- Benthic Ecology ZoI
- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Fauna & PSA (GyM EIA, 2005)
- Fauna & PSA (Rhyl Flats, 2006)
- Fauna & PSA (GyM pre-con, 2011)
- DDV (GyM pre-con, 2011)
- Trawl (GyM pre-con, 2011)
- Fauna & PSA (GyM post-con Yr1, 2016)
- PSA only (GyM post-con Yr1, 2016)
- DDV (GyM post-con Yr1, 2016)

AyM pre-con (2020)

- Macrofauna and PSD
- Macrofauna, PSD, video and stills
- Macrofauna, PSD and contaminant sampling
- Macrofauna, PSD, contaminant sampling, video and stills
- Video and stills

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: New and existing subtidal benthic grab, DDV and trawl data

VER	DATE	REMARKS	Drawn	Checked
1	09/09/2021	For Issue For PEIR	BPHB	RM
2	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 2

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:225,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

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49 Site specific surveys for AyM have been undertaken to provide an up-to-date characterisation of the habitats and species occurring within the study area. Both the subtidal and intertidal benthic surveys were conducted by Fugro Ltd. All survey methodologies were in line with the relevant guidance documentation (Cefas, 2002; Cefas *et al*., 2004; Davis *et al*., 2001; Ware and Kenny, 2011), and agreed with NRW during the benthic survey consultation in August 2020.

50 Within the array area a total of 62 grab sampling stations were selected to ground truth the different sediment types observed from the geophysical data, and to also provide spatial coverage across the survey area. At each station, one macrofaunal sample was required, with one particle size distribution (PSA) subsampled from the same sample. A subset of 10 grab stations were selected for additional sampling for chemistry analysis, with second grab samples taken at these stations and subsampled for the required analysis. At 22 of the stations DDV data were acquired along 50 m transects. At four stations, the orientation and distance of the transect were defined to investigate boundaries between two sediment types.

51 A total of 18 grab sampling stations were selected across the array area. At each proposed station, one macrofaunal sample and one PSA subsample were collected. Seven of the stations were selected for additional sampling for sediment chemistry, and at 16 of the stations, and along three transects, video and stills data were collected. Additional parallel transects, positioned 50 m north and 50 m south of the original location, were undertaken at three stations and along three transects to further investigate potentially sensitive habitats.

52 The following sections provide the broad regional characterisation of the wider study area before focussing on the site-specific data.

5.7.2 The wider study area

53 Much of the subtidal benthos in the eastern Irish Sea is composed of sedimentary communities. These communities tend to be dominated by burrowing animals known as infauna although epifauna (species living on the surface of sediments) are also important, especially in areas of coarser substratum (NIRAS, 2017; CMACS, 2005; SeaScape Energy, 2002; COWL, 2001). Mackie (1990) described most of the eastern Irish Sea as being dominated by Venus communities, the deep Venus community occurring on coarser sands and gravels and the shallow Venus community on finer sands, usually in shallower waters. However, it is considered that it is the shallow Venus community which dominates areas around the Irish Sea coastline, including much of Liverpool Bay. Surveys across the adjacent GyM site during the post-construction monitoring programme identified that the infaunal communities across the site were relatively rich, although the total number of taxa at each station ranged from 16 to 144 with generally high numbers of taxa recorded at stations located within the wind farm. There were also generally high numbers of individuals from samples taken within the wind farm.

54 The most abundant faunal group in the grab survey were annelid worms. The most abundant taxa included the horseshoe worm *Phoronis* species (spp.), the amphipod *Urothoe marina,* the keel worm *Spirobranchus triqueter* and the ribbon worm *Nemertea* spp.

55 Sessile epifauna recorded were typical of sand-scoured mixed sediments, mostly cnidarians such as *Hydrallmania falcata*, *Sertularia* spp. (both hydrozoans), the octocoral *Alcyonium digitatum* and the anemones *Metridium senile, Urticina felina*, *Sagartia* spp. and *Sagartiogeton undatus*. The erect bryozoan *Flustra foliacea* was also recorded across much of the site. Mobile epifauna included echinoderms such as the starfish *Asterias rubens*, sea urchin *Psammechinus miliaris* and brittlestars *Ophiura* spp. as well as the goby *Pomatoschistus* spp.

56 The results of the surveys across the GyM site, which included grab, DDV and trawl data from pre- and post-construction surveys, were used to describe a number of biotopes (JNCC Marine Habitat Classification) within the AyM benthic ecology study area (Figure 3), these are listed and described in the following paragraphs.

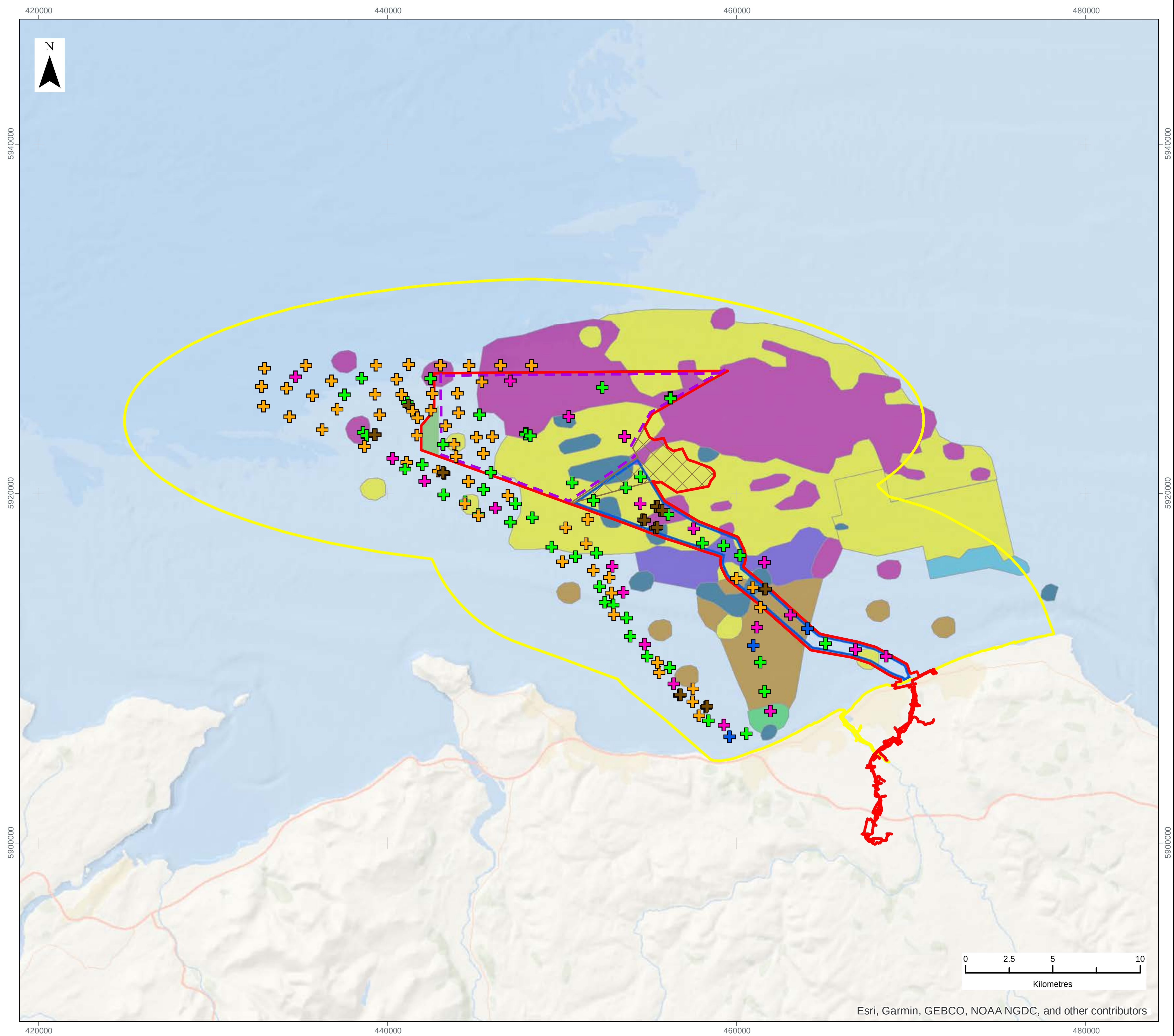
57 SS.SCS.ICS.MoeVen (*Moerella* spp. with venerid bivalves in infralittoral gravelly sand): Infralittoral medium to coarse sand and gravelly sand which is subject to moderately strong water movement from tidal streams may be characterised by *Moerella* spp. with the polychaete *Glycera lapidum* (agg.) and venerid bivalves. Typical species include *Moerella pygmaea* or *M. donacina* with other robust bivalves such as *Dosinia lupinus*, *Timoclea ovata*, *Goodallia triangularis* and *Chamelea gallina*.

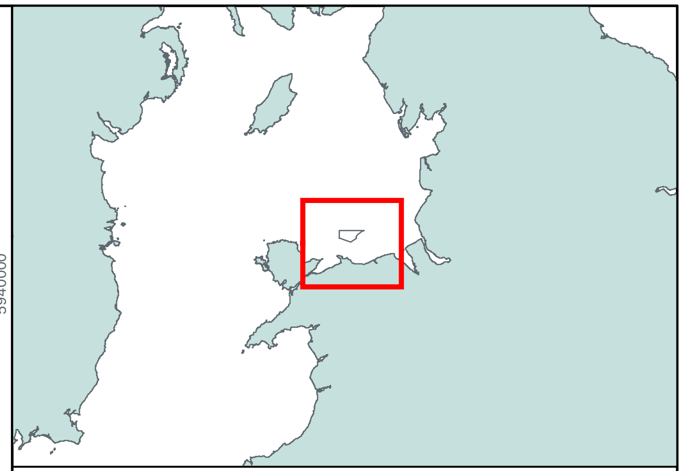
58 SS.SSA.IfiSa.NcirBat (*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand): Well-sorted medium and fine sands characterised by *N. cirrosa* and *Bathyporeia* spp. (and sometimes *Pontocrates* spp.) which occur in the shallow sublittoral to at least 30 m depth. This biotope occurs in sediments subject to physical disturbance, as a result of wave action (and occasionally strong tidal streams).

59 SS.SCS.CCS.MedLumVen (*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel): Circalittoral gravels, coarse to medium sands, and shell gravels, sometimes with a small amount of silt and generally in relatively deep water (generally over 15-20 m), may be characterised by polychaetes such as *M. fragilis*, *Lumbrineris* spp., *G. lapidum* with the sea urchin *Echinocyamus pusillus*. Other taxa may include Nemertea spp., *Protodorvillea kefersteini*, *Owenia fusiformis*, *Spiophanes bombyx* and *Amphipholis squamata* along with amphipods such as *Ampelisca spinipes*.

60 SS.SSA.IMuSa.FfabMag (*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves): In stable, fine, compacted sands and slightly muddy sands in the infralittoral and littoral fringe, communities occur that are dominated by venerid bivalves such as *C. gallina*. This biotope may be characterised by a prevalence of *F. fabula* and *M. mirabilis* or other species of *Magelona* (e.g. *M. filiformis*). Other taxa, including the amphipod *Bathyporeia* spp. and polychaetes such as *Chaetozone setosa*, *S. bombyx* and *Nephtys* spp. are also commonly recorded.

61 SS.SCS.ICS.SLan (dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand): Dense beds of *L. conchilega* occur in coarse to medium fine gravelly sand in the shallow sublittoral, where there are strong tidal streams or wave action. Several other species of polychaete also occur as infauna e.g. *S. bombyx*, *Scoloplos armiger*, *C. setosa* and *M. mirabilis*.





LEGEND

- Benthic Ecology ZoI
- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone

Biotopes GyM EIA (2005)

- SS.SSA.IMuSa.EcorEns
- SS.SSA.ImuSa.FfabMag
- SS.SCS.CCS.MedLumVen
- SS.SCS.ICS.MoeVen
- SS.SSA.IfiSa.NcirBat
- SS.SCS.ICS.SLan
- Unclassified stoney ground

AyM pre-con (2020)

- Macrofauna and PSD
- Macrofauna, PSD, video and stills
- Macrofauna, PSD and contaminant sampling
- Macrofauna, PSD, contaminant sampling, video and stills
- Video and stills

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Biotope descriptions from new and existing sources

VER	DATE	REMARKS	Drawn	Checked
1	09/09/2021	For Issue For PEIR	BPHB	RM
2	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 3

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:225,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

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62 The biotope communities identified above are typical of the faunal assemblages previously described for the eastern Irish Sea. This is supported by benthic surveys undertaken at the Burbo Bank OWF site located at the mouth of the Mersey Estuary, which described the benthic communities from across much of the surveyed area to be dominated largely by the biotope SS.SSA.IMuSa.FfabMag in deeper areas and by SS.SSA.IfiSa.NcirBat in shallower areas, including most of the subtidal part of the offshore ECC (SeaScape Energy, 2002).

63 Results from the site-specific surveys undertaken at the Rhyl Flats OWF identified that the benthic community was also similar to that described above, with the main biotopes also being SS.SSA.IfiSa.NcirBat and SS.SSA.IMuSa.FfabMag (COWL, 2002).

64 The North Hoyle baseline survey of 2001 revealed that the benthic community at North Hoyle fitted reasonably well to that of Mackie's shallow Venus community, with the biotope SS.SCS.ICS.MoeVen dominating most of the site (RWE, 2003).

5.7.3 The Array

Bathymetry and seabed features

65 The water depths across the array area range from 15.2 m LAT to 41.9 m LAT, generally increasing towards the north-west. The seafloor in the south-east is characterised by numerous sandwaves and mega-ripples, while the west of the site was relatively flat and featureless. Sandwaves have been reported to be actively mobile and migrating.

Sediment characterisation

66 Sediment descriptions using the Folk description (1954) categorised the seabed of the main array area as predominantly gravelly sand (47 stations) or sand (10 stations), with the remaining stations described as gravelly muddy sand (three stations), muddy sandy gravel (one station) or sandy gravel (one station). When the graphical mean particle size of the samples was considered, this was classified as Wentworth (1922) sediment descriptions which ranged from 'very coarse sand' to 'medium sand'.

67 There was a clear spatial pattern in sediment type across the survey area; within the western part of the survey area sediments contained a moderate proportion of gravel and a small fines fraction. In the eastern array area, sandwaves and mega ripples were evidently formed by clean sands (no fines) with a low gravel content. The spatial patterns evident in sediment composition represents a clear linkage to the geophysical characteristics of the seafloor and suggest that particle size is likely to be influenced by the degree of sediment mobility. Mobility is greatest where there is exposure to tidal streams and wave action, which in turn, is influenced by water depths across the area.

68 TWT noted in their Section 42 response that '*cycles of settlement and resuspension fines, including organic detritus will often be advected to and concentrate in certain locations. In Liverpool Bay the advection by near bed residual currents and selective deposition is shorewards*'. TWT also state '*Most of the superficial sediment… is a gravelly sand with enough mud in the interstices for it to be partly cohesive on the northern edge. There are large amounts of shell contributing to the gravel component*'.

69 The area has also been subject to high disturbance from scallop dredging and beam trawling, the impacts of which in the Irish Sea have been documented in Kaiser *et al*. (1996).

Sediment Chemistry

70 Sediment contaminant analysis was carried out on samples collected at ten locations across the array area, with the sampling locations providing a broad coverage.

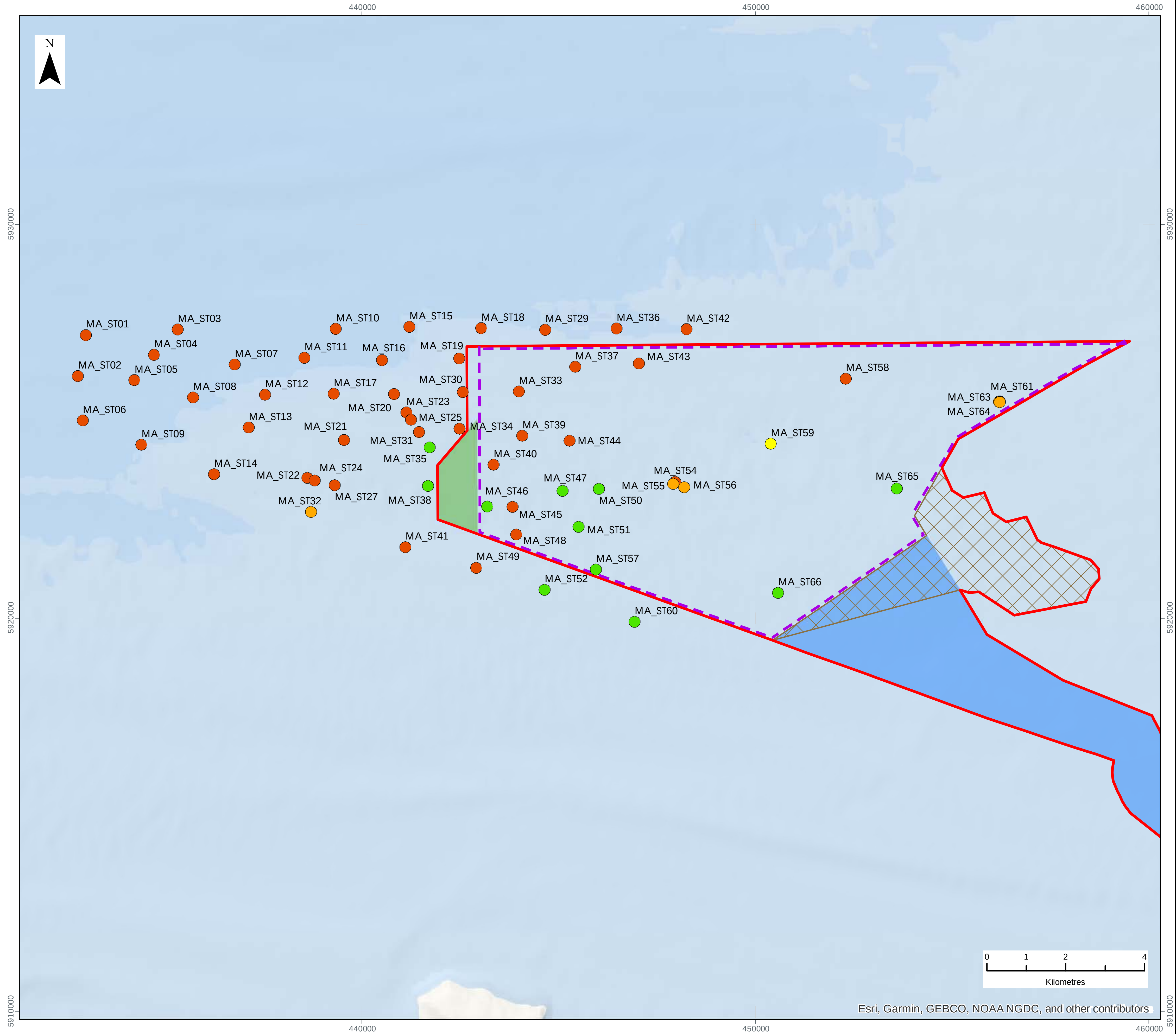
71 The US EPA has identified 16 priority Polycyclic Aromatic Hydrocarbons (PAHs) to be monitored (Keith, 2015) and the Coordinated Environmental Monitoring Programme (CoEMP) specifies nine PAHs of specific concern (OSPAR, 2014), which primarily reflect inputs from anthropogenic combustion sources. Total PAH concentrations (two to six ring) were higher than the median concentration recorded from the Strategic Environmental Assessment 6 (SEA6) (Cefas, 2005) Irish Sea surveys (0.0237 micrograms per gram (µg/g)) at six stations; however, the median value from the AyM site specific survey was broadly comparable to the SEA6 median value. The proportion of petrogenically derived NPD (sum of naphthalene, phenanthrene, dibenzothiophene) to total aromatic material present in these sediments indicated a predominantly pyrolytic source for the aromatic compounds in the sediments.

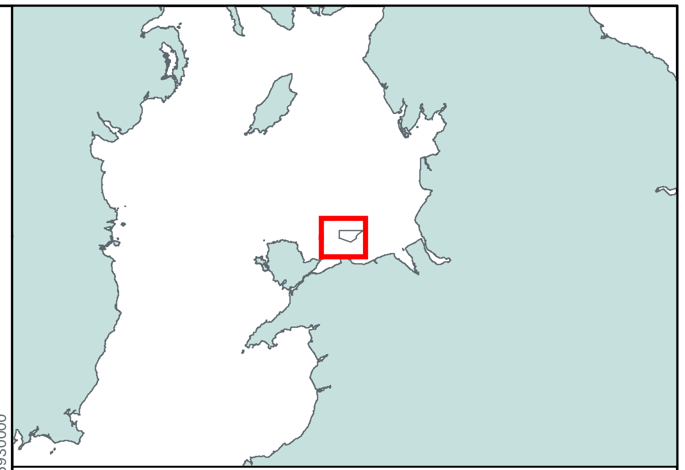
72 The elemental content of the sediments was determined following aqua regia digest. The aqua regia digest releases for analysis the 'non-residual' heavy metals, which are not incorporated in the mineral matrix and are therefore potentially available for biological uptake. The bioavailable metals concentrations in sediments were all below their respective Cefas Action Levels and the CoEMP Effect Range Low (ERL) indicating that these metals are unlikely to have an adverse effect on the macrofaunal communities present.

Seabed habitats and communities

73 There was a clear spatial distribution in the habitat types present within the array area and this reflects the sediment character (and therefore also variations in side scan sonar (SSS) reflectivity and seabed morphology evident from multi-beam echo sounder (MBES) data). By combining and considering collectively the seabed photographic data, particle size data and macrofaunal data, one habitat, two biotope complexes and two sub-biotopes within the array area were identified (Figure 4[x]).

[x] Figure 4 illustrates the project specific data collected in the west of the site based on the Order Limits defined at Scoping. The eastern region of the site is supplemented by exiting datasets which are detailed in addition to the site-specific data, in Figure 2.





LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone

EUNIS Classification

- Circalittoral coarse sediment (A5.14)
- Branchiostoma lanceolatum in circalittoral coarse sand with shell gravel (A5.145)
- Sublittoral sand (A5.2)
- Nephtys cirrosa and Bathyporeia spp. in infralittoral sand (A5.233)

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Habitat types identified within the AyM array area during baseline surveys

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 4

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:100,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

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74 45 of the 66 array survey stations were classified as ‘Circalittoral coarse sediment’ (A5.14) within the technical report. Further consideration and analysis of these communities at these stations has determined that the biotope complex can be further defined as the A5.143/ SS.SCS.CCS.PKef *P. kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand. This biotope is a disturbed or transitional variant of the SS.SCS.ICS.MoeVen biotope (*Moerella* spp. with venerid bivalves in infralittoral gravelly sand) that was reported in the AyM study area during the GyM OWF site surveys (see paragraph 56 *et seq*.). The A5.143/ SS.SCS.CCS.PKef biotope is known to be variable both spatially and temporally in terms community structure and also sediment type (Conner *et al*., 2005). However, the sediment structure and secondary characterising species identified within the AyM baseline surveys sufficiently correspond with those described for the biotope to enable confident classification to biotope (Level 4) and therefore comparison with MArESA assessments.

75 Five stations had a higher sand content with different dominant taxa than those stations originally assigned to the ‘Circalittoral coarse sediment’ (A5.14) biotope complex. These dominant taxa included the polychaetes *P. remota*, *Polygordius* and *H. elongata*, and the echinoderm *E. pusillus* and as such, these stations were further classified to biotope level as ‘*Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel’ (A5.145).

76 Eleven stations were classified as the biotope complex ‘Infralittoral fine sand’ (A5.23) across the array area, due to the high sand and low gravel/ mud content and faunal assemblages being typical of clean sands with moderate exposure to wave or tidal action. Infaunal analysis showed similarities to the sub biotope ‘*N. cirrosa* and *Bathyporeia spp.* in infralittoral sand’ (A5.233), whereby the dominant taxa at these stations included the annelid *N. cirrosa* and amphipods *B. gracilis* and *B. elegans*.

77 A single station was classified as the habitat ‘Sublittoral sand’ (A5.2) due to the sediment comprising of high sand content, minimal gravel and lacking fines content. The impoverished macrofaunal assemblage present at this station did not allow classification to biotope complex/ biotope level.

78 The sediments observed throughout the survey area were identified as comprising of 'subtidal sands and gravels' which is listed under Section 7 of the Environment (Wales) Act 2016. However, this habitat is the most widely distributed subtidal habitat in the UK (JNCC, 2019).

79 No other Annex I habitats or Annex II species, OSPAR threatened and/ or declining species and habitats, or habitats and species listed under Section 7 of the Environment (Wales) Act 2016, were observed within the survey area.

80 As part of their Section 42 response, TWT states that the '*distribution of sand binding hydroids such as Nemertesia antennina is important in this region, alongside any other biogenic features that influence bed load transport such as Flustra, Chaetopterus tubes and Alcyonium*'.

81 It should also be noted that there were historically patches of *Modiolus modiolus* (horse mussel) reef, however these reef features have since been decimated by scallop dredging (Kaiser *et al.,* 1996).

5.7.4 The offshore export cable corridor

Bathymetry and sediment characterisation

82 Sediment descriptions using the Folk description (1954) categorised the seabed along the length of the export cable route surveyed as predominantly sand or sandy gravel (16 stations), with one station described as gravelly muddy sand and one as gravelly sand. This was supported by the geophysical interpretation of the sediments.

83 A spatial pattern in the sediment type was apparent along the cable route whereby predominantly sand sediments were identified within the nearshore portion of the route and farthest offshore portion, adjacent to the main array. Sediments with higher gravel content were identified from three stations towards the middle of the route in water depths of 13 m below sea-level (BSL) to 20 m BSL, and from one station in water depths of 8 m BSL to 9 m BSL. One station located towards the centre of the route in water depths of 13 m BSL to 15 m BSL comprised predominantly sand, but with moderate proportions of both mud and gravel.

84 Historic charts show Liverpool Bay was subject to river channel developments, which have changed significantly over time with the movement of sandbanks (Wessex Archaeology, 2006). Following a rise in sea levels these historic channels can contain a variety of sediments including terrestrial. This is further evidenced in a study by the British Geological Survey (2012) with cores taken from intertidal sediments in the Mersey estuary recording peat up to 1.5 m thick, containing wood fragments. Moreover, cores and boreholes have sampled terrestrial deposits within the Irish Sea, with the Menai Strait recording peat with wood at various depths down to approximately 25 m (Roberts *et al.*, 2011). Hazell (2008) recorded along the coast of Liverpool Bay several boreholes reaching peat up to 17 m.

Sediment chemistry

85 Total PAH concentrations (two to six ring) were higher than the median concentration recorded from the SEA6 (Cefas, 2005) Irish Sea surveys (0.0237 µg/g) at two stations, of which one was closest to land.

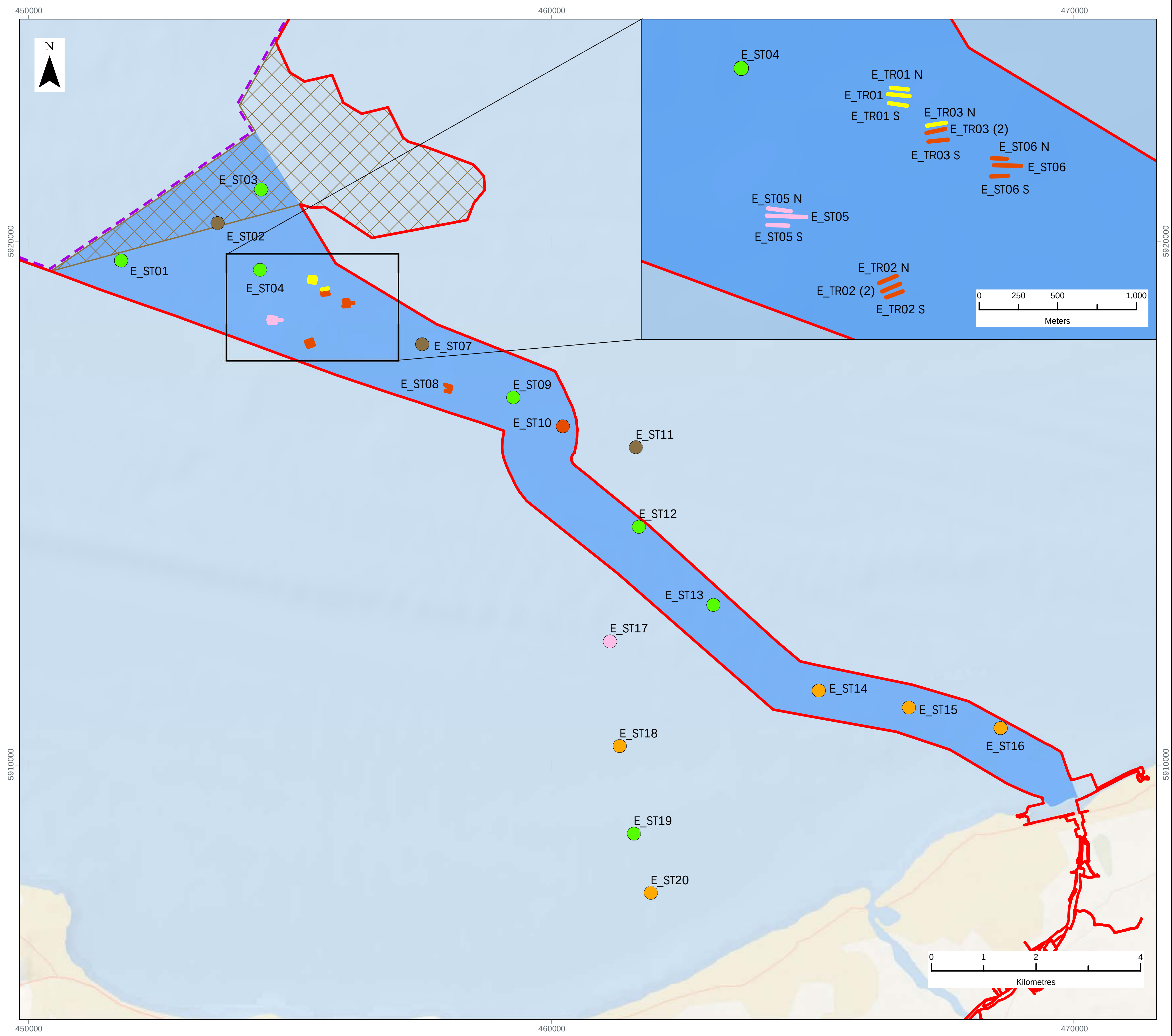
86 The individual US EPA 16 PAH concentrations were all below the CoEMP ERL values, and therefore are unlikely to have any adverse effects on the macrofaunal community. The proportion of petrogenically derived NPD to total aromatic material present in these sediments (mean 27) indicated a predominantly pyrolytic source for the aromatic compounds in the sediments.

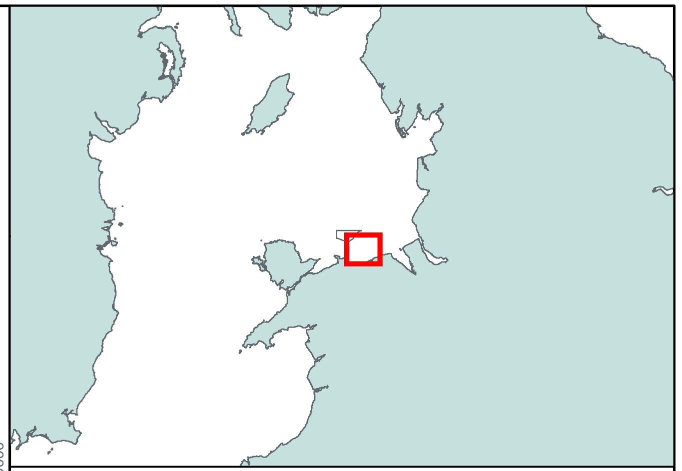
87 Analysis of sediments following aqua regia digest determined that the bioavailable metals concentrations in sediments within the offshore ECC were all below their respective Cefas action levels and the CoEMP ERL indicating that these metals are unlikely to have an adverse effect on the macrofaunal communities present.

Seabed habitats and communities

88 When seabed photographic data, particle size data and macrofaunal data were considered collectively, one habitat, three biotope complexes and two biotope were identified within the subtidal portion of the offshore ECC (Figure 5[xi]).

[xi] Figure 5 illustrates the project specific data collected based on the Order Limits defined at Scoping. Note the proposed final location of the offshore ECC is referenced, however data collected since Scoping is provided for completeness.





LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- GyM Interlink Zone

EUNIS Classification

- Infralittoral coarse sediment (A5.13)
- Sublittoral sand (A5.2)
- Nephtys cirrosa and Bathyporeia spp. in infralittoral sand (A5.233)
- Fabulina fabula and Magelona mirabilis with venerid bivalves and amphipods in infralittoral compacted fine muddy sands (A5.242)
- Infralittoral muddy sand (A5.24)
- Infralittoral mixed sediments (A5.43)

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Habitat types identified within the AyM offshore ECC during baseline surveys

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 5

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:75,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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89 The majority of stations and transects surveyed identified predominantly sand sediments, with these being defined within the habitat ‘Sublittoral sand’ (A5.2) and the biotope complex ‘Infralittoral muddy sand’ (A5.24). Where quantitative sample data were available, and communities appeared to match those identified from published data (EEA, 2019; JNCC, 2015), classifications were further refined, with the biotope ‘*N. cirrosa* and *Bathyporeia* spp. in infralittoral sand’ (A5.233) defined at seven stations and the biotope ‘*F. fabula* and *M. mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sands’ (A5.242) at three nearshore stations. The differentiation between these two faunal communities was attributed to the differences in sediment character resulting from variability in tidal and/ or wave exposure.

90 Isolated patches of coarser sediments (gravel, pebbles, cobble and boulders) were identified within predominantly sand habitats, but more extensive areas of gravelly sand or predominantly gravel habitat were identified from two stations. These were defined as the ‘Infralittoral coarse sediment’ (A5.13) biotope complex and were colonised epifaunal anemones (Actiniaria), along with infaunal taxa such as *Phoronis* spp. and *Poecilochaetus serpens* which have an affinity for coarser sediments. These areas are considered to be transitional between the habitats dominated by sand and those represented by larger proportions of coarse substrate (infralittoral mixed sediment).

91 Within the survey area eight stations and five transects were classified as the biotope complex ‘Infralittoral mixed sediment’ (A5.43) from seabed video data, as no grab samples were acquired. Sediments primarily comprised sand with shell fragments and a varying proportion of cobbles and boulders and supported epifaunal assemblages typical of mixed sediments. The technical report was not able to classify the habitats at these stations further as the communities present do not accurately represent a single biotope, however, further consideration of the communities present has determined that the mixed sediment habitats present resemble a transition between A5.433/ SS.SMx.IMx.VsenAsquAps ‘*Venerupis senegalensis*, *A. squamata* and *Apseudes latreilli*’ and A5.441/ SS.SMx.CMx.ClloMx ‘*Cerianthus lloydii* and other burrowing anemones in circalittoral muddy mixed sediment’.

92 With the exception of the biotope '*F. fabula* and *M. mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sands' (A5.242), the habitat types defined did not demonstrate a clear spatial distribution; these were instead patchily distributed throughout the central and offshore areas of the route probably the result of sediment mobility.

93 Several sensitive habitats/ species were reported to have the potential to occur within the survey area. Eleven stations and nine transects were classified as 'Low resemblance to stony reef'.

94 It should be noted that when determining whether an area of the seabed should be considered as Annex I stony reef, if a 'low' is scored in any of the four characteristics (composition, elevation, extent or biota), then a strong justification would be required for this area to be considered as 'reef', for the purposes of Annex I of the Habitats Directive or Section 7 of the Environment (Wales) Act 2016.

95 These discrete patches of stony habitat were scored as 'low' resemblance to stony reef, as per the qualifying criteria set out in regulatory guidance (Irving 2009, and Golding *et al*., 2020). Additional to setting out the reef qualifying criteria thresholds, this guidance also suggests that "when determining whether an area of the seabed should be considered as Annex I stony reef, if a 'low' is scored in any of the four characteristics (composition, elevation, extent or biota), then a strong justification would be required for this area to be considered as contributing to the Marine Natura site network of qualifying reefs in terms of the EU Habitats Directive". This suggests that the patches identified during this survey would not be considered as contributing to the national Marine Natura site network unless there is strong justification. Based on these results and evidence from geophysical studies across the site (Volume 4, Annex 5.2), the areas of 'infralittoral mixed sediments' are expected to comprise a patchy mosaic of stony substrate surrounded by mixed sediment habitat that is typical of the wider region, rather than extensive areas of unbroken stony reef.

96 The sediments observed throughout the survey area were identified as comprising of 'subtidal sands and gravels' (as listed under Section 7 of the Environment (Wales) Act 2016).

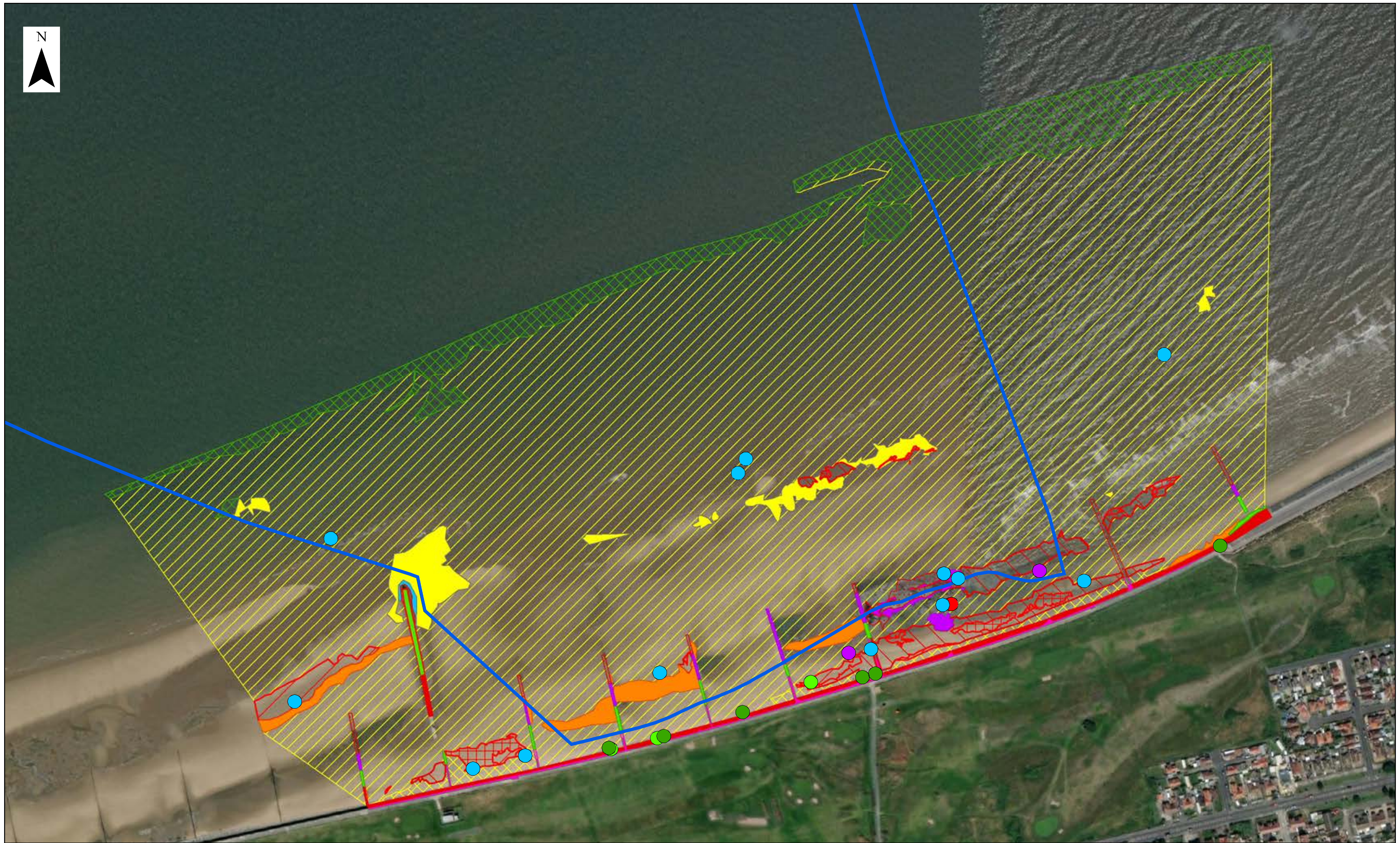
97 No other Annex I habitats or Annex II species, OSPAR threatened and/ or declining species and habitats, or habitats and species listed under Section 7 of the Environment (Wales) Act 2016, were observed within the subtidal offshore ECC survey area.

5.7.5 The intertidal export cable corridor

98 The foreshore within the offshore ECC predominantly comprises sand, with areas of muddy sand interspersed across the mid shore (Figure 6). Areas of consolidated mud (peat) are present in the mid and upper shore (with some clay also exposed in the upper shore). A concrete/ corrugated metal protected outflow pipe is found within the survey area to the west, extending from the upper shore to the lower mid shore. In the upper shore, areas of coarser sediments that are subject to wave action are present. An area of more stable anthropogenic debris (e.g. concrete piles), boulders and bedrock are present in the upper east section of the survey area. Relatively evenly distributed wooden groynes are also constructed along the upper shore. The foreshore is backed by a high cement seawall, beneath which are a series of sloping steps.

99 As part of the Section 42 responses TWT noted the intertidal section of the offshore ECC '*is likely to encounter a small band of muddy sand that can at times have a super abundant benthos with Lagis koreni, Abra alba and Amphiura brachiata. This biotope undergoes considerable temporal variation. At times there may be populations of Lutraria spp. that may wash out and strand in spectacular quantities. At other times and overlapping with the lower shore flats there may be very dense populations of Lanice conchilega. Slightly further out dense patches of Donax vittatus may be encountered*'. TWT also reference the Liverpool Bay Sludge Studies (1973-1986[xii]), during which there was '*evidence that sometimes the veneer of sediment was thin enough for the sampling grab to hit the glacial till. Vibro-coring was undertaken as part of the sludge investigations, where it was found that inshore there are areas where there are anoxic sub-surface conditions especially after residues of plankton blooms advect into limited areas*'.

[xii] https://eprints.hrwallingford.com/136/1/SR108.pdf



LEGEND

Offshore Export Cable Corridor

Biotope Target

- Access
- Anthropogenic
- Semibalanus balanoides and Littorina spp. on exposed to moderately exposed eulittoral boulders and cobbles (A1.1133)
- Fucus spiralis on full salinity exposed to moderately exposed upper eulittoral rock (A1.212)
- Communities of littoral rockpools (A1.41)

EUNIS Classification

- A1.1 - High energy littoral rock
- A1.1 variant - High energy littoral rock
- A1.11 - Mussel and/or barnacle communities
- A1.111 - Mytilus edulis and barnacles on very exposed eulittoral rock
- A1.1133 - Semibalanus balanoides and Littorina spp. on exposed to moderately exposed eulittoral boulders and cobbles
- A1.1133 variant - Semibalanus balanoides and Littorina spp. on exposed to moderately exposed eulittoral boulders and cobbles
- A1.212 - Fucus spiralis on full salinity exposed to moderately exposed upper eulittoral rock
- A1.45 - Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrata
- A2.1 - Littoral coarse sediment
- A2.2 - Littoral sand and muddy sand
- A2.211 - Talitrids on the upper shore and strandline
- A2.24 - Polychaete/bivalve-dominated muddy sand shores
- A2.245 - Lanice conchilega in littoral sand
- A2.821 - Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata
- B3.11 - Lichens or small green algae on supralittoral and littoral fringe rock
- B3.111 - Yellow and grey lichens on supralittoral rock

0 0.1 0.2 0.4
Kilometres

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Data Source:

PROJECT TITLE: AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Habitat types identified within the AyM intertidal offshore ECC during the baseline surveys

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER: Figure 6

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:5,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

G:\GIS\GIS_Projects\0141 AyM\GIS\Figures\ES\Benthic\AyM_BE_Fig6_Habitat_Types_Survey.mxd

101 The littoral sediment habitat complex 'Littoral sand and muddy sand' (A2.2; equivalent in part to 'Littoral sand' (LS.LSa)) mosaicked with relatively small areas of the biotope complex 'Polychaete/ bivalve-dominated muddy sand shores' (A2.24/ LS.LSa.MuSa) was reported to account for the majority of the intertidal area within the offshore ECC (Volume 4, Annex 5.2). Further consideration of the sediment character (muddy sands) and main characterising species identified during the surveys (i.e. *Limecola balthica* and *Arenicola marina*) has determined that both the areas mapped as A2.2/ LS.LSa and A2.24/ LS.LSa.MuSa within Volume 4, Annex 5.3 can be confidently further defined as LS.LSa.MuSa.LimAre (A2.241) '*L. balthica* and *A. marina* in muddy sand shores'.

102 Several smaller areas of other littoral sediment habitats also occur, these are: Littoral coarse sediment (A2.1/ LS.LCS), Talitrids on the upper shore and strandline (A2.211/ LS.LSa.St.Tal), polychaete/ bivalve-dominated muddy sand shores (A2.24/ LS.LSa.MuSa) and *L. conchilega* in littoral sand (A2.245/ LS.LSa.Lan).

103 Far less extensive areas of littoral rock habitats and communities were also observed on the more stable substrates exposed by wave action (including the emergent peat and clay exposures), and on the man-made structures, these were classified as: high energy littoral rock (A1.1/ LR.HLR), mussel and/ or barnacle communities (A1.11/ LR.HLR.MusB), *Semibalanus balanoides* and *Littorina spp*. on exposed to moderately exposed eulittoral boulders and cobbles (A1.1133/ LR.HLR.MusB.Sem.LitX), ephemeral green and red seaweeds on variable salinity and/ or disturbed eulittoral mixed substrata (A2.821/ LR.FLR.Eph.EphX), lichens or small green algae on supralittoral and littoral fringe rock (B3.11/ LR.FLR.Lic), yellow and grey lichens on supralittoral rock (B3.111/ LR.FLR.Lic.YG), *Mytilus edulis* and barnacles on very exposed eulittoral rock (A1.111), *S. balanoides* and *Littorina spp*. on exposed to moderately exposed eulittoral boulders and cobbles (A1.1133/ LR.HLR.MusB.Sem.LitX), *Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock (A1.212; equivalent to '*F. spiralis* on exposed to moderately exposed upper eulittoral rock' (LR.MLR.BF.FspiB)), communities of littoral rockpools (A1.41; equivalent to 'Rockpools' (LR.FLR.Rkp)) and ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrata (A1.45; equivalent to part of 'Ephemeral green or red seaweed communities (freshwater or sand-influenced)' (LR.FLR.Eph.EphX).

104 The majority of habitats that were reported in the study area by NRW during a phase I habitat survey in 2016 (which was unrelated to the AyM development) were also observed in 2020 (Volume 4, Annex 5.3) However, NRW (2016a) reported that the majority of the foreshore comprised of the biotope complex 'Polychaetes in littoral fine sand' (A2.23/ LS.LSa.FiSa.Po) mosaicked with the sub-biotope '*Eurydice pulchra* in littoral mobile sand' (A2.2232/ LS.LSa.MoSa.AmSco.Eur), two habitats within the 'Littoral sand and muddy sand' habitat complex reported in the current survey. The temporal variability in the spatial extent of these habitats is typical of a highly dynamic coastal environment but may also be attributable to the construction of boulder breakwaters west of the intertidal survey area, which reduce longshore drift, trapping finer (mud) sediments (Bull *et al*., 1998). The honeycomb reef worm *Sabellaria alveolata* was observed encrusting an upper shore boulder in the offshore ECC survey area as well as between the boulders at the base of the outflow pipe. The general distribution of the species was not sufficiently extensive to map its presence as a separate habitat type, and the species presence was not considered to be Annex I biogenic reef, or reef for the purposes of study area of the Environment (Wales) Act 2016. However, aggregations of *S. alveolata* up to approximately 30 cm in height were present at the outflow pipe, which for the purposes of assessment is considered to be representative of the study area/ Section 7 of the Environment (Wales) Act 2016 priority habitat '*S. alveolata* Reefs'.

105 On the mid to upper shore of the offshore ECC survey area, exposed peat was reported. Due to the observation of faunal burrows and emergent piddock shells, these areas also have the potential to represent the Section 7 habitat 'peat and clay exposures with piddocks'.

106 No other sensitive habitats or species were observed within the intertidal offshore ECC.

5.7.6 Designated sites

107 AyM does not overlap spatially with any international Natura 2000 designated sites within the national site network (i.e. Special Area of Conservation (SAC), Site of Community Importance (SCI) and Ramsar sites) nationally designated sites (i.e. Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR) and recommended/ designated Marine Conservation Zone (rMCZ/ MCZ) with benthic ecology features. The sites that lie in the area of potential secondary impact of AyM are identified Table 9. This table also summarises the qualifying features that relate to seabed habitats and benthic ecology and the distance from the closest part of AyM.

108 As no designated sites with benthic ecology features directly overlap with the AyM Order Limits, there will be no direct impact assessment on any designated sites. An assessment of indirect impacts (e.g. changes in suspended sediment concentrations (SSC) and/ or sediment deposition) as informed through the physical processes modelling presented in Volume 4, Annex 2.3 has been undertaken on relevant benthic ecology features within sites that have the potential to be indirectly affected by AyM. Those benthic ecology and seabed habitat features of designated sites within the array and offshore ECC study areas (and associated buffers) have been screened into the assessment.

Table 9: Marine nature conservation designations with relevance to benthic subtidal and intertidal ecology and AyM OWF.

SITE AND STATUS	DISTANCE FROM AYM	QUALIFYING FEATURES
International		
Menai Strait and Conwy Bay/ Y Fenai a Bae Conwy SAC	Array and offshore ECC = 6.1 km	Annex I habitats that are a primary reason for the selection of this site, which include: *Primary Features* - Sandbanks which are slightly covered by sea water all the time; - Mudflats and sandflats not covered by seawater at low tide; and

SITE AND STATUS	DISTANCE FROM AYM	QUALIFYING FEATURES
		- Reefs - *Qualifying features* - Large Shallow inlets and bays; and - Submerged or partially submerged sea caves
Dee Estuary/ Aber Dyfrdwy SAC	Array = 20.9 km Offshore ECC = 3.4 km	Annex I habitats that are a primary reason for the selection of this site, which include: *Primary Features* - Mudflats and sandflats not covered by seawater at low tide; - *Salicornia* and other annuals colonizing mud and sand; and - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) - *Qualifying Features* - Estuaries

5.7.7 Valued Ecological Receptors (VERs)

109 The value of ecological features is dependent upon their biodiversity, social, and economic value within a geographic framework of appropriate reference (CIEEM 2018). The most straightforward context for assessing ecological value is to identify those species and habitats that have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, OSPAR, priority habitats and species under Section 7 of the Environment (Wales) Act 2016). However, only a very small proportion of marine habitats and species are afforded protection under the existing legislative or policy framework; therefore, evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not have a specific conservation value in themselves but may be functionally linked to a feature of high conservation value.

110 Table 10 presents the VERs, their conservation status and importance within the AyM benthic subtidal and intertidal ecology study areas and the justification and regional importance of each receptor.

111 The current baseline description above provides an accurate reflection of the current state of the existing environment. The earliest possible date for the start of construction is 2026, with an expected operational life of up to 25 years, and therefore there exists the potential for the baseline to evolve between the time of assessment and point of impact. Outside of short-term or seasonal fluctuations, changes to the baseline in relation to benthic ecology usually occur over an extended period of time (considered in Section 5.7.8 below). Based on current information regarding reasonably foreseeable events over the next six years, the baseline is not anticipated to fundamentally change from its current state at the point in time when impacts occur. The baseline environment for operational/ decommissioning impacts is expected to evolve as described in the next section, with the additional consideration that any changes during the construction phase will have altered the baseline environment to a degree as set out in this chapter.

Table 10: VERs within the AyM benthic subtidal and intertidal ecology study area.

VER	REPRESENTATIVE BIOTOPE	PROTECTION STATUS	CONSERVATION INTEREST	DISTRIBUTION WITHIN THE STUDY AREA	IMPORTANCE WITHIN THE STUDY AREA AND JUSTIFICATION
Subtidal sands and gravels	A5.143 – *P. kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand A5.145 – *B. lanceolatum* in circalittoral coarse sand with shell gravel. A5.2 – Sublittoral sand A5.23 - Infralittoral fine sand A5.233 – *N. cirrosa* and *Bathyporeia spp*. in infralittoral sand. A5.2 - Sublittoral sand A5.24 - Infralittoral muddy sand	None	Section 7 Environment (Wales) Act priority habitat	Distributed widely throughout the subtidal study area (array and offshore ECC).	National – however, it should be noted that this habitat is widespread nationally as well as regionally.

VER	REPRESENTATIVE BIOTOPE	PROTECTION STATUS	CONSERVATION INTEREST	DISTRIBUTION WITHIN THE STUDY AREA	IMPORTANCE WITHIN THE STUDY AREA AND JUSTIFICATION
	A5.242 – *F. fabula* and *M. mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sands A5.13 -Infralittoral coarse sediment Infralittoral mixed sediment A5.43				
Peat and clay exposure with piddocks	Variant of A1.1 – High energy littoral rock	None	Section 7 Environment (Wales) Act habitat	Limited patches of extent at study area boundaries within the mid-upper shore of the intertidal	Nationally important.

VER	REPRESENTATIVE BIOTOPE	PROTECTION STATUS	CONSERVATION INTEREST	DISTRIBUTION WITHIN THE STUDY AREA	IMPORTANCE WITHIN THE STUDY AREA AND JUSTIFICATION
				portion of the offshore ECC.	
S. alveolata Reefs	N/A	None	Section 7 Environment (Wales) Act habitat, OSPAR and Annex I outside SAC (Article 2, Habitats Directive)	Extremely limited in extent within the intertidal portion of the offshore ECC in association with an outfall pipe.	Nationally important but only present due to stabilization provided by existing pipeline infrastructure which will remain intact.

5.7.8 Evolution of the baseline

112 The EIA Regulations 2017 require that "*A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the ES (EIA Regulations, Schedule 4, Paragraph 3). From the point of assessment, over the course of the development and operational lifetime of AyM (operational lifetime anticipated to be up to 25 years from first power), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that AyM is not constructed, using available information and scientific knowledge of benthic ecology.

113 An assessment of the future baseline conditions has been carried out (in the event of no development) and is described within this section. The baseline environment is not static and will exhibit some degree of natural change over time, with or without AyM in place, due to naturally occurring cycles and processes. Therefore, when undertaking impact assessments, it will be necessary to place any potential impacts in the context of the envelope of change that might occur naturally over the project lifetime.

114 Further to potential change associated with existing cycles and processes, it is necessary to take account of the potential effects of climate change on the marine environment. Variability and long-term changes on physical influences may bring direct and indirect changes to benthic and intertidal habitats and communities in the mid to long term future (UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3) 2016). A strong base of evidence indicates that long-term changes in the benthic ecology may be related to long-term changes in the climate or in nutrients (OESEA3 2016), with climatic process driving shifts in abundances and species composition of benthic communities (Marine Climate Change Impacts Partnership (MCCIP) 2015). Studies of the benthic ecology over the last three decades have shown that biomass has increased by at least 250 to 400%; opportunistic and short-lived species have increased; and the abundance of long-living sessile animals has decreased (Krönke 1995; Krönke 2011). Modelling sea surface temperature in relation to climate change in the UK has shown that the rate of temperature increase over the previous 50 years has been greater in waters off the east coast of the UK compared to the west and this is predicted to continue for the next 50 years (MCCIP 2013).

115 Furthermore, most literature to date focuses specifically on temperature, with regard to the effects of climate change on marine habitats. Climatic warming also causes deoxygenation within the water column. Over the past 50 years, oxygen content has decreased from 0.06-0.43% (Stramma *et al*., 2010) with a further 7% decrease predicted for the year 2100 (IPCC 2013). It was concluded from 26 years of monitoring a benthic community within the Firth of Clyde, UK that the benthic communities had been affected by the decreasing levels of oxygen. This finding agreed with other short-term studies (Breitburg *et al.*, 2018, Levin *et al*., 2009). Specific changes included changes in morphology, burrow depth, bioturbation and feeding mode (Caswell *et al*., 2018).

116 As such, the baseline in the AyM study area described above is a 'snapshot' of the present benthic ecosystem within a gradually yet continuously changing environment. Any changes that may occur during the construction, operation and decommissioning of AyM should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment, and the changes that would be expected to occur naturally in the absence of AyM.

5.8 Key parameters for assessment

117 This section describes the MDS parameters on which the benthic and intertidal ecology assessment has been based. These are the parameters which are judged to give rise to the maximum levels of effect for the assessment undertaken, as set out in Volume 2, Chapter 1. Should AyM be constructed to different parameters within the design envelope, then impacts would not be any greater than those set out in this ES using the MDS presented in Table 11.

Table 11: Maximum design scenario.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
CONSTRUCTION		
Temporary habitat disturbance	Temporary habitat disturbance from jack-up vessels and anchor footprints: - 312 jack-up operations, with a maximum disturbance of 1,100 m^2 per operation would result = **0.343.2 km^2** in total. - Indicative impacted footprint for deployment of all anchors used during WTG, Offshore Substation Platform (OSP), met mast, topside and export cable installation = **0.464.4 km^2.** - Temporary habitat disturbance from seabed preparation for inter-array cable installation: - 100% of the route may require boulder clearance; - Maximum area of seabed affected by sandwave clearance = **5.6 km^2**; and - Material to be disposed of anywhere within the array area or within a nominated disposal area in close proximity. - Temporary habitat disturbance from inter-array cable installation using Mass Flow Excavation (MFE) = **2.09 km^2.**	The temporary disturbance relates to seabed preparation for foundations and cables, jack up and anchoring operations, and cable installation. It should be noted that where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	- Temporary habitat disturbance from export array cable installation using MFE = **1.43 km²**. Temporary habitat disturbance from horizontal directional drilling (HDD) exit pit excavation within the intertidal: - HDD pits will be in either the intertidal or up to 1 km seaward of MHWS; - Stage 1: Up to 3 HDD exit pits (10 m width x 75 m length x 2.5 m depth) excavated via backhoe dredger (or similar) with material sidecast for backfill. Following duct installation the pit may be secured by temporary rock bags or similar for up to 1.5 years; - Stage 2: Following cable installation the HDD exit pits will be refilled using a backhoe dredger (or similar) with the previously side case material; and - Total area = **2,250 m²**.	
Temporary increase in suspended sediment concentrations	Foundation seabed preparation: - 50 WTGs x 2,500 m^2 x small multi-leg gravity base structure (GBS) seabed preparation area x 4 m (depth) = 500,000 m^3	The MDS for foundation installation results from the largest volume suspended from seabed preparation and

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
(SSC) and associated sediment deposition	- 2 x 21,600 m^2 GBS OSP jacket seabed preparation area x 4 m (depth) = 86,400 m^3 - Total volume from seabed prep = 500,000 m^3 + 86,400 m^3 = 586,400 m^3	presents the worst-case for WTG installation.
Direct and indirect seabed disturbances leading to the release of sediment contaminants	Drill arisings from foundation installation: - 50 WTGS x 9,005 m^3 (drill arisings per small monopile) x up to 60% of locations may require drilling = 270,161 m^3 - 2 OSPs x 12,064 m^3 (drill arisings per OSP) = 24,127 m^3 - Total volume from drill arisings = 270,161 m^3 + 24,127 m^3 = 294,288 m^3 Seabed preparation for export cable installation: - Maximum volume of sediment disturbed from sandwave clearance in the offshore ECC: 6,281,000 m^3 Seabed preparation for inter-array cable installation: - Maximum volume of sediment disturbed from sandwave clearance in the array = 7,600,000 m^3; and - Material to be disposed of anywhere within the array area or within a nominated disposal area in close proximity. Inter-array cable installation:	For cable installation, the MDS results from the greatest volume from sandwave clearance and installation. This also assumes the largest number of cables and the greatest burial depth.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	- Total length: 116 km; - Width: 18 m; - Depth: 4 m; and - Volume of disturbed during inter-array cable installation: 116 km x 18 m x 4 m x 0.5 (V-shaped trench) x 50% (material ejected from trench) = 2,089,854 m^{3}. Export cable installation: - Installation method: MFE; - Number of cables: 2; - Total length: 79.4 km in total; - Width: 18 m; - Depth: 4 m; and - Volume: V-shaped trench x 50% material ejected from trench = 1,729,560 m^{3}. Horizontal directional drilling (HDD) exit pit excavation: - HDD pits will be between MHWS and 1,000 m seaward of MHWS; - Stage 1: Up to 3 HDD exit pits (10 m width x 75 m length x 2.5 m depth) excavated via backhoe dredger (or similar)	

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	with material side-cast for backfill. Note that three HDD pits have been included for contingency. Following duct installation, the pit may be secured by temporary rock bags or similar for up to 1.5 years; - Stage 2: Prior to cable installation, MFE will be used to remove loose sediment within the exit pits. Following cable installation, the HDD exit pits will be refilled using a backhoe dredger (or similar) with the previously side case material; - Maximum volume: 3 HDD exit pits x 10 m width x 75 length x 2.5 m depth x 2 (stages) = 11,250 m^3; and - Release of a total of 18,117 m^3 of drill cuttings and drilling mud (bentonite) from three HDD ducts. - Total volume of disturbed sediment for construction activities = **18,610,469 m^3**	
Long-term habitat loss/ change from the presence of foundations, scour	WTGs: - Turbine footprint with scour protection (based on 50 GBS foundations) = 570,209 m^2 OSPs:	The MDS is defined by the maximum area of seabed lost as a result of the placement of structures, scour protection, cable protection and cable crossings. The MDS also

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
protection and cable protection.	- OSP footprint with scour protection (two monopile foundations) = 21,600 m^2 - Met mast: - Met mast footprint with scour protection = 855 m^2 - Export cables: - Maximum rock protection area for non-buried cables = 242,853 m^2 - Cable crossings = 39,500 m^2 Inter-array cables: - Maximum rock protection area for non-buried cables = 192,124 m^2 Total area of long-term habitat loss: **1.067 km^2**.	considers that scour protection is required for all foundations (including the met mast). Habitat loss from drilling and drill arisings is of a smaller magnitude than presence of project infrastructure.
OPERATION		
Colonisation of the WTGs and scour/ cable protection may affect benthic	Total area of introduced hard substrate = **1.067 km^2.**	Maximum scenario for introduced hard substrate is as for the maximum scenario for loss of habitat.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
ecology and biodiversity.		
Increased risk of introduction or spread of marine Invasive Non-Native Species (INNS) due to presence of subsea infrastructure and vessel movements (e.g. ballast water) may affect benthic ecology and biodiversity.	Total area of introduced hard substrate: **1.067 km²**. - Up to 1,208 return vessel trips to site annually from project vessels; - Peak of 22 project vessels; - Up to 124 km of inter array cables; - Up to 79.4 km of offshore export cable; and - Up to 10 km of GyM interlink cable.	Maximum scenario for introduced hard substrate is as for the maximum scenario for loss of habitat. MDS with regards to maximum number of vessel movements during O&M activities.
Temporary habitat disturbance associated with maintenance activities.	The maximum lifetime number of major component replacement events for WTG's and platforms requiring jacking-up activities is 180. The maximum seabed disturbance per year from jacking-up activities is 7,920 m², which equates to **198,000 m²** over the lifetime of the project.	Defined by the maximum number of jack-up vessel operations and maintenance activities that could have an

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	The maximum lifetime number of array cable repairs is 5. The maximum seabed disturbance per cable repair event is 6,000 m^2, which equates to **30,000 m^2** over the lifetime of the project. The maximum lifetime number of export cable repairs is 5. The maximum seabed disturbance per cable repair event is 6,000 m^2, which equates to **30,000 m^2** over the lifetime of the project.	interaction with the seabed anticipated during operation.
Indirect disturbance arising from electromagnetic fields generated by the current flowing through the cables buried to less than 1.5 m below the surface.	Up to 116 km of inter-array cable connecting 50 WTGs producing a maximum field strength of 20 μT (microtesla) at a distance of around 1 m above the cable (seabed). Export cables and GyM interlink cables producing a magnetic field of less than 50 μT (and likely < 30 μT) 1 m above the export cable (seabed).	The maximum adverse scenario is associated with the use of 50 WTGs as this results in the greatest length of inter-array cable and export cables as this results in the longest total length of cable.
Changes to seabed habitats arising from	The greatest changes to the tidal and wave regimes and the sediment transport in the array arise from the use of gravity	Full justification of the worst-case scenarios can be found within Volume 2, Chapter 2.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities.	base foundations and the use of the maximum volume of cable protection.	
DECOMMISSIONING		
Temporary habitat disturbance from decommissioning of foundations, cables and rock protection.	- The decommissioning phase will last up to 3 years. - Buried cables to be left *in situ* (but to be determined in consultation with key stakeholders as part of the decommissioning plan and following best practice at the time);	MDS is assumed to be similar to the construction phase, with all infrastructure removed in reverse-construction order. The removal of cables and rock protection is considered the MDS, however the necessity to remove cables and rock
Increased SSC and sediment deposition from		

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
removal of foundations, cables and rock protection.	- Scour and cable protection to be removed[xiii]; - Landfall infrastructure to be removed[xiii] (but to be determined in consultation with key stakeholders as part of the decommissioning plan and following best practice at the time); and - Structures in the array to be cut off at or below the seabed.	protection will be reviewed at the time of decommissioning. Removal will be subject to agreement with key stakeholders as part of the decommissioning plan.
Loss of introduced habitat from the removal of foundations.	Total area of introduced hard substrate assumed to be equal to that introduced during construction/ operation = **1.067 m^2.**	Defined by the maximum surface area introduced as above. Some materials may be left *in situ*, and this will be reviewed closer to the time of decommissioning. As such, the MDS assumes the removal of all infrastructure.
CUMULATIVE EFFECTS		
Addressed in Cumulative Effects, Section 5.14.		

[xiii] It is noted that this will be subject to best practice at time of decommissioning and surveys conducted to assess the quality of the communities established and a decision on their removal made in conjunction with the statutory authorities.

5.9 Impacts scoped out of the assessment

118 On the basis of the baseline environment and the project description outlined in Volume 2, Chapter 1, a number of impacts have been scoped out (see Table 4), these include:

- Indirect disturbance of benthic species from EMF generated by inter-array and export cables, except for those species which are listed under Section 7 of the Environment (Wales) Act.
- Noise pollution on benthic ecology during foundation installation; and
- Accidental pollution during construction.

5.10 Mitigation measures

119 Mitigation measures that were identified and adopted as part of the evolution of the project design (embedded into the project design) and that are relevant to benthic and intertidal ecology are listed in Table 12. The mitigation includes embedded measures such as design changes and applied mitigation which is subject to further study or approval of details; these include avoidance measures that will be informed by pre-construction surveys, and necessary additional consents where relevant. The composite of embedded and applied mitigation measures apply to all parts of the AyM development works, including pre-construction, construction, O&M and decommissioning.

Table 12: Mitigation relating to benthic subtidal and intertidal ecology.

PARAMETER	MITIGATION MEASURES
GENERAL	
Definition of development boundaries	The development boundary selection was made following a series of constraints analyses, with the array area and offshore ECC route selected to ensure the impacts on sensitive environmental receptors are minimised.
Pre-construction survey	A geophysical survey will be undertaken to facilitate the micrositing around sensitive habitats such as *Sabellaria*.

PARAMETER	MITIGATION MEASURES
CONSTRUCTION	
Pollution prevention	A Project Environment Management Plan (PEMP) is proposed to be produced to ensure that the potential for contaminant release is strictly controlled. The PEMP will include a Marine Pollution Contingency Plan (MPCP) and will also incorporate plans to cover accidental spills, potential contaminant release and include key emergency contact details. Typical measures will include: only using chemicals approved under the Offshore Chemicals Regulations 2002; storage of all chemicals in secure designated areas with impermeable bunding (generally to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials. It will also include key emergency contact details (e.g. NRW, MCA and the project site co-ordinator). The PEMP will be secured by a condition in the Marine Licence.
Invasive Non-native Species (INNS) control	Relevant best practice guidelines will be followed and implemented through the implementation of a Biosecurity Plan to minimise INNS introduction/ spread. Any vessels used for the delivery of materials to site will adhere to industry legislation, codes of conduct and/ or best practice to reduce the risk of introduction or spread of invasive non-native species. The Biosecurity Plan will be conditioned within the Marine Licence.
Cable Installation Plan/ Cable Burial Risk Assessment	Development of, and adherence to, a Cable Specification and Installation Plan (CSIP) post consent. The CSIP will set out appropriate cable burial depth in accordance with industry good practice, minimising the risk of cable exposure. The CSIP will also ensure that cable crossings are appropriately designed to mitigate environmental effects, these crossings will be agreed with relevant parties in advance of CSIP submission. The CSIP will include a detailed Cable Burial Risk Assessment (CBRA) to enable informed judgements regarding burial

PARAMETER	MITIGATION MEASURES
	depth to maximise the chance of cables remaining buried whilst limiting the amount of sediment disturbance to that which is necessary. The CSIP will be conditioned in the Marine Licence.
OPERATION	
Project Design	Development of a Scour Protection Management Plan (SPMP) which will consider the need for scour protection where there is the potential for scour to develop around wind farm infrastructure, including turbine and substation/ platform foundations and cables. The plan will be secured via a condition in the Marine Licence.
EMF	Inter-array and export cables will be buried to a maximum target depth of 0.5 to 4 m, subject to a cable burial risk assessment. Where it is not possible to bury the cables sufficiently, cable protection will be used. While cable protection or burial does not decrease the strength of EMF at source, it does increase the distance between the cables and benthic receptors, thereby reducing the received EMF (from attenuation of the EMF) and potentially reducing the effect on those receptors.
DECOMMISSIONING	
Pollution Prevention	A Decommissioning Programme will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project vessels on-site, partially deconstructed structures) the embedded mitigation measure will be similar to those for the construction phase. In addition, a detailed Decommissioning Plan will be secured as a condition in the Marine Licence.

5.11 Environmental assessment: construction phase

120 The effects of construction of AyM have been assessed on benthic and intertidal ecology in the AyM benthic ecology study area. The environmental impacts arising from construction of AyM are listed in Table 11, along with the design envelope against which each construction phase impact has been assessed.

121 A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is also provided below.

5.11.1 Temporary habitat disturbance

Array area and offshore ECC

122 The total maximum area of temporary loss/ disturbance of subtidal habitat due to construction activities is described in Table 11. This equates to approximately 9.49% of the total seabed area within the AyM Order Limits. It should be noted that the MDS presents a precautionary approach to temporary habitat disturbance because it counts both the total footprint of seabed clearance as well as cable burial across both the array and offshore ECC. This approach effectively counts the footprint of seabed habitat to be impacted by construction in the same area twice. However, this precautionary approach has been taken because there is some potential for recovery of habitats between the activities due to project timescales.

123 The temporary habitat loss within the array area is predicted to be as a result of seabed preparations for foundations, jack-up barge operations and the installation and burial of inter-array and interconnector cables (including associated anchor placements). Within the AyM offshore ECC, temporary habitat loss is predicted as a result of seabed preparation, OSS installation, export cable installation, burial and jointing.

124 Although the benthic habitats that characterise the AyM Order Limits are dominated by subtidal sands and gravels which are considered VERs (see Table 10) these habitats are common and widespread throughout the eastern Irish Sea region as well as around the wider UK (as described in Section 5.7). The temporary habitat disturbance during construction activities would therefore have an impact on a very limited footprint, particularly when compared to the overall extent of such habitats and this loss is not expected to undermine regional ecosystem functions or diminish biodiversity.

125 The impact on benthic habitats is predicted to be of local spatial extent (i.e. restricted to discrete areas within AyM), short-term duration (as it is limited to the duration of construction activities), intermittent and with high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low adverse**.

126 The sensitivity of all biotopes that are known to characterise the AyM Order Limits (Section 5.7) have been assessed according to the detailed MarESA sensitivity assessments (Table 6).

127 The infralittoral mixed sediments biotope complex was also identified in more limited extent within the offshore ECC. The main characterising species of the infralittoral mixed sediments included brittlestars (*Ophiuroidea*, including *O. albida*), starfish (*Asteroidea* including *A. rubens*), crabs (Brachyura, including *N. puber*), hermit crabs (Paguridae), burrowing anemones (Ceriantharia, including *C. lloydii*) and whelk (Buccinidae). The harder substrata were colonised by anemones (*Metridium* spp. and *Sagartia* spp.), soft coral (*A. digitatum*) and faunal turf (Hydrozoa/ Bryozoa). The few limited areas of the infralittoral coarse sediments biotope complex (considered to represent transitional areas) was also colonised epifaunal anemones (Actiniaria), along with infaunal taxa such as *Phoronis* spp. and *P. serpens* which have an affinity for coarser sediments.

128 The sensitivity of many of the species identified within the complexes has not been assessed by MarESA, and as a result, in order to provide a robust assessment, the MarESA assessments for each of the two biotopes which it is postulated that the infralittoral mixed sediment complex represents a transition between (see Section 1.7), have been referred to in Table 13: MarESA assessment for the benthic subtidal habitats for abrasion/ disturbance. Moreover, the information and phrases provided by the in the MarESA assessment have been directly extracted into the sensitivity assessment detailed in Table 13. In addition, the assessment confidence detailed presented is based on the MarESA confidence assessment, which details whether information is available in the data or literature.

Table 13: MarESA assessment for the benthic subtidal habitats for abrasion/ disturbance.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A5.143/ SS.SCS.CCS.Pkef *P. kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	Low (based on medium resistance and high resilience).	Confidence is low as the assessment is based on expert judgement alone.
A5.145/ SS.SCS.CCS.Blan *B. lanceolatum* in circalittoral coarse sand with shell gravel	Low (based on medium resistance and high resilience).	Confidence is low as the assessment is based on expert judgement alone.
A5.233/ SS.SSa.IFiSa.NcirBat *N. cirrosa* and *Bathyporeia* spp. in infralittoral sand	Low (based on low resistance and high resilience).	Confidence is high as the assessment is based on published literature.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A5.242/ SS.SSa.IMuSa.FfabMag *F. fabula* and *M. mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sands	Low (based on medium resistance and high resilience).	Confidence is low as the assessment is based on expert judgement alone.
A5.43/ SS.SMx.IMx Infralittoral mixed sediments assessed as: A5.433/ SS.SMx.IMx.VsenAsquAps V. senegalensis, A. squamata and A. latreilli and A5.441/ SS.SMx.CMx.ClloMx *C. lloydii* and other burrowing anemones in circalittoral muddy mixed sediment	Low (based on medium resistance and high resilience). Medium (based on medium resistance and medium resilience).	Confidence is low as the assessment is based on expert judgement alone. Confidence is medium as it is based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature (habitat, its component species, or species of interest) or similar features.

129 As demonstrated in Table 13, this assessment has determined that all biotopes have a low to medium sensitivity to a disturbance of this nature. The sandy sediment biotopes present all have a low sensitivity to the temporary disturbance predicted. This is not unexpected given that these communities are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. Although MarESA does not provide an assessment for the sensitivity of communities classified at the biotope complex level, the sublittoral sand (A5.2/ SS.SSa), infralittoral fine sand (A5.23/ SS.SSa.IFiSa) and circalittoral coarse sediment (A5.14/ SS.SCS.CCS) are expected to demonstrate low sensitivity to the temporary disturbance predicted for the same reasons as the sandy biotopes.

130 The faunal communities that characterise the sandy biotopes present include infaunal mobile species such as polychaetes and bivalves. Such species can re-enter the substratum following temporary habitat disturbance. The recoverability of such communities is likely to occur as a result of the combination of migration from adjacent surrounding unaffected areas combined with larval dispersal; recovery is therefore likely to occur within one to ten years (based on the MarESA assessments).

131 Evidence to support predicted recovery is provided by a review of post construction monitoring data from other OWF sites including the adjacent GyM (MMO, 2014). The post-monitoring reports reviewed concluded that, to date, OWFs have not had significant impacts on the benthic habitats and associated faunal communities, as the observed differences within the impact areas were also recorded within the reference area and, therefore, could be attributed to natural variability. In particular, the review found that monitoring studies have been successful in identifying lack of ecological impact due to cable laying.

132 Further evidence to support predicted recovery is provided by monitoring data from aggregate extraction sites; it has been reported that the characteristic recovery time for typical sand communities may be two to three years following cessation of dredging activity (Newell *et al*., 2004). Following an initial suppression of species' diversity, abundance and biomass, recovery of species' diversity to within 70 – 80% of that in non-dredged areas was achieved within 100 days (Newell *et al*., 2004). It is important to acknowledge however, that the activities associated with aggregate extraction are different to those associated with OWF construction activities (i.e. they involve the complete removal of sediment). Data collated from more analogous activities such as the burial of telecommunications cables and monitoring of OWFs indicate that recovery is rapid with limited, if any, significant effects being discernible (Foden *et al*., 2011).

133 The infralittoral mixed sediment habitats identified within the AyM benthic subtidal ecology study area are deemed to have a medium sensitivity at most to abrasion and disturbance (Table 13)). However, given the widespread distribution of these habitats and communities around the UK they have been attributed a sensitivity of low.

134 The resilience of majority of the biotope identified has been deemed to be high, with recovery anticipated within two years, although the mixed sediment habitats are likely to recover within 2 to 10 years. That said, many of the species within the mixed sediment habitats are known to have a high recovery potential exhibiting rapid rates of community recovery from disturbance through migration, repair ((Emson and Wilkie, 1980) and larval colonization. For example, although Hydrozoa/ Bryozoa colonies may be removed or destroyed, the resting stages may survive attached to the substratum and provide a mechanism for rapid recovery (Cornelius 1995; Kosevich and Marfenin, 1986).

135 Overall, it is predicted that the sensitivity of the benthic subtidal biotopes is low to medium and the magnitude of the impact is low adverse. The **low** sensitivity of receptors and **low adverse** magnitude of impact would result in an effect of ***minor adverse*** significance (as per the matrix in Table 7) which is not significant in EIA terms.

136 The MarESA assessments identify that the confidence for the sensitivity of the specified habitats to abrasion/ disturbance of the surface is generally high for all habitats. The low confidence is associated with the resistance measure, with high confidence associated with the recovery (resilience) of the habitats. For SS.SSa.IFiSa.NcirBat, the only measure which was assessed as having a low confidence score was the applicability of the sensitivity, which originates from a low confidence score for the applicability of the resilience assessment; however, since the evidence agrees in terms of direction (i.e. whether it is adverse or beneficial) and magnitude of the impact this is a conservative and robust assessment. As such, the assessment of the significance of effects as not significant is considered to be robust.

Intertidal at landfall

137 Direct loss/ disturbance of habitat will occur in the intertidal area from the installation of the export cables at the landfall and the placement of anchors associated with these operations.

138 Where possible methods will be restricted to trenchless techniques, however, depending upon the maximum length that can be achieved by using such techniques, it is possible that the HDD, for example, may exit within the intertidal zone. In this case, cable trenching seaward of the exit point in the intertidal would be necessary, representing the worst-case scenario in terms of intertidal habitat disturbance.

139 If open cut trenching is required, two v-shaped trenched trenches 6m wide will be excavated. In addition, there is the potential need to partially remove two of the intertidal groynes during the works that would be re-instated post-construction. These groynes are man-made structures and support the equivalent of intertidal rock communities. However, at 0.5 m wide and approximately 100 m long the groynes support only a very small area of these communities, and furthermore, only a small section of each of the two groynes will be removed.

140 None of the biotopes likely to be affected are rare or geographically restricted. The area of impact therefore represents a very small footprint compared to their overall extent. The magnitude of the impact has been assessed as **low adverse** on the basis that the impact is of temporary duration, reversible, and localised.

141 The sensitivity of all intertidal biotopes that are known to characterise the AyM Order Limits (Section 5.7) have been assessed according to the detailed MarESA sensitivity assessments in Table 14. A number of the biotope complexes identified within the technical report have been considered further to enable classification to biotope level, therefore facilitating referral to the MarESA sensitivity assessments and more robust assessment (see paragraph 128 for further details on the information provided in Table 14). Both the small patches of *S. alveolata* and piddocks in clay are found on either an existing pipeline or in small patches on the boundary of the cable route and will remain in place and undisturbed; therefore, this impact on these habitats has not been assessed further here for these receptors.

Table 14: MarESA assessment for the benthic intertidal habitats for abrasion/ disturbance.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A1.45/ LR.FLR.Eph assessed as: A1.451/ LR.FLR.Eph.Ent *Enteromorpha* spp. on freshwater-influenced and/ or unstable upper eulittoral rock.	Low (based on medium resistance and high resilience).	Confidence is high as the assessment is based on published literature.
A1.11/ LR.HLR.MusB Mussel and/ or Barnacle Communities assessed as: A1.1133/ LR.HLR.MusB.Sem.LitX *S. balanoides* and *Littorina* spp. on exposed to moderately	Low (based on medium resistance and high resilience).	Confidence is low as the assessment is based on expert judgement.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
exposed eulittoral boulders and cobbles		
A1.111/ LR.HLR.MusB.MytB *M. edulis* and barnacles on very exposed eulittoral rock	Medium (based on low resistance and medium resilience).	Confidence is high as the assessment is based on published literature.
A1.1133/ LR.HLR.MusB.Sem.LitX *S. balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles	Low (based on medium resistance and high resilience).	Confidence is high as the assessment is based on published literature.
A1.212/ R.MLR.BF.FspiB *F. spiralis* on full salinity exposed to moderately exposed upper eulittoral rock	Medium (based on low resistance and medium resilience).	Confidence is high as the assessment is based on published literature.
A2.241/ LS.LSa.MuSa.LimAre *L. balthica* and A. marina in muddy sand shores.	Medium (based on low resistance and medium resilience).	Confidence is medium as it is based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature (habitat, its component species, or species of interest) or similar features.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A2.211/ LS.LSa.St.Tal Talitrids on the upper shore and strandline	Low (based on low resistance and high resilience).	Confidence is high as the assessment is based on published literature.
A2.245/ LS.LSa.Lan *L. conchilega* in littoral sand	Not sensitive (based on high resistance and high resilience).	Confidence is high as the assessment is based on published literature.

142 The habitats directly affected by the temporary habitat loss/ disturbance are considered to generally have low sensitivity to disturbance of this nature. The intertidal zone at landfall consists largely of sandy sediment biotopes. Surveys to determine the impact of cable installation on the intertidal sandy sediments at Burbo Bank landfall showed that sediments appeared to have returned to baseline conditions within 4 weeks (CMACS, 2007). Changes in infaunal communities could not be attributed to the cable burial works as many of the differences were recorded from the control stations as well as those within the cable corridor. The foreshore at landfall was therefore reported as recovered in-line with the prediction made during consent application and no further monitoring was recommended.

143 The communities that characterise the biotopes at the AyM landfall are predominantly infaunal mobile species including the polychaete *A. marina* and bivalve *L. balthica*. The burrowing traits of these two main characterising species may provide some resistance to this pressure, but it is likely that they would be damaged by the physical impacts of the trench excavation, for example. However, both species are relatively mobile and would be able to recolonise disturbed habitat rapidly from adjacent unaffected areas even after severe depletion of the resident populations or community, unless the substratum or other key habitat factors are altered. A case study of *L. balthica*, demonstrated that within one year following sediment removal and disturbance within a given area two generations could be identified, suggesting that recovery resulted from both adult migration and larval recruitment (Bonsdorff, 1984).

144 The intertidal rock communities that are supported by the groyne structures comprise algae dominated communities (together with generally low abundances of less mobile faunal species). Unlike the faunal species discussed above, macroalgae have shorter dispersal distances. The propagules of fucoids in particular are large and sink readily, tending to settle near (within 10 m) of the parent plant (Dudgeon *et al*., 2001; Schiel and Foster, 1986; Norton, 1992; Holt *et al*., 1997). Norton (1992) noted that algal spore dispersal is also determined by currents and turbulent deposition (zygotes or spores being thrown against the substratum). For example, although most *Sargassum muticum* spores settle within 2 m, spores have been reported to travel up to 1 km, whilst *Ulva* spp. spores 35 km. An algal clearance study (Kain (1975)) concluded that recruitment was dependant on time of year due to spore availability. For example, spore production in *Mastocarpus stellatus* is at its maximum between September to December (Dixon and Irvine, 1977), spores of *Osmundea pinnatifida* are present in October and December to June (Maggs and Hommersand, 1993), while the spores of *Lomentaria articulata* are available all year round with a peak in summer (Irvine, 1983).

145 In summary, if fucoid specimens remain on adjacent groynes it is likely that re-growth will occur rapidly due to efficient fertilization rates and recruitment over short distances. The ability of fucoids to re-grow from damaged holdfasts will also aid in recolonization (MarLIN, 2019). Where populations of the characterizing species remain after disturbance, then recovery is likely to be within one to three years (Hartnoll and Hawkins 1985). However, where the disturbance causes a severe decline in the abundance of the characteristic fucoid species then community recovery is likely to be variable and more prolonged over 10-15 years (Southward and Southward (1978)).

146 The remaining intertidal rock habitat types within the intertidal area of the offshore ECC are devoid of fucoids and instead dominated by populations of less mobile fauna including winkles (*Littorina* spp), barnacles (*S. balanoides*), limpets (*Patella* spp.) as well as mussels (*M. edulis*) in low abundance. Recovery of species such as *S. balanoides* and *Patella* spp. is dependent upon recolonization by pelagic larvae. Recovery trajectories following the removal of these communities are unpredictable and interactions between the key species may be positive or negative. Limpets and littorinids may enhance barnacle settlement by grazing and removing algae (Hawkins, 1983) or by depositing pedal mucus trails that attract barnacle larvae (Holmes *et al*., 2005), whilst barnacles may have negative effects on limpet recruitment by occupying space and limiting access to grazing areas (Lewis and Bowman, 1975).

147 Nonetheless, recolonization of *Patella* spp. on rocky shores is expected to be rapid and spat settlement is likely within six months following disturbance/ loss (Hawkins and Southward, 1992; Lewis and Bowman, 1975). A study following the creation of a new rocky shore in the Moray Firth, reported that *Patella vulgata* was present in quadrats after three years (Terry and Sell, 1986). Although recolonization is likely to be rapid, an altered population structure (size and age class) may persist for approximately 15 years because of the complex cycles of dominance involving limpets, barnacles and algae (Hawkins and Southward, 1992; Lewis and Bowman, 1975).

148 Barnacles are also expected to quickly colonize newly created substrate, although a range of factors, including the species interactions outlined above, will influence successful recruitment. Barnacle population recruitment can also be influenced by environmental variables such as wind direction, and success depends on settlement being followed by a period of favourable weather. Release of *S. balanoides* larvae takes place between February and April with peak settlement between April and June (MarLIN, 2019). Bennell (1981) observed that barnacles that were removed from rock surfaces at a site in North Wales returned to pre-original abundance within three years. Following the creation of a new shore in the Moray Firth, *S. balanoides* did not recruit in large numbers until four years after shore creation (Terry and Sell, 1986).

149 The recovery of intertidal habitats will always be mediated by processes acting over different scales including, but not limited to, local habitat conditions and processes such as larval-supply and recruitment between populations. However, the limited extent of the works will facilitate both faunal and floral population re-colonisation and recovery from recovering and/ or un-impacted communities on the adjacent foreshore. It should be noted that recovery does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognisable as the baseline habitat.

150 The magnitude of the impact has been assessed as **low adverse**. Overall, owing to the widespread distribution of the habitats and communities around the UK (and North-East Atlantic), the sensitivity of the intertidal biotopes have been assessed as ranging from being **negligible** to being of **low** sensitivity (Table 14), resulting in a worst-case effect of ***minor adverse*** significance (as per the matrix in Table 7) which is not significant in EIA terms.

151 The MarESA assessments identify that the confidence for the sensitivity of the specified habitats to abrasion/ disturbance of the surface is generally high. The low confidence is associated with the resistance measure, with high confidence associated with the recovery (resilience) of the habitats. As such, the assessment of the significance of effects as not significant is considered to be robust.

5.11.2 Temporary increase in SSC and associated sediment deposition

Array and Offshore ECC

152 Temporary increases in SSC and associated sediment deposition are expected from the foundation and cable installation works and seabed preparation works (including sandwave clearance). Volume 2, Chapter 2 and Volume 4, Annex 2.1: Physical Processes Technical Baseline Report (application ref: 6.4.2.1) provides a full description of the physical assessment, with a summary of the MDSs associated with the impact, as detailed in Table 11 provided in this section.

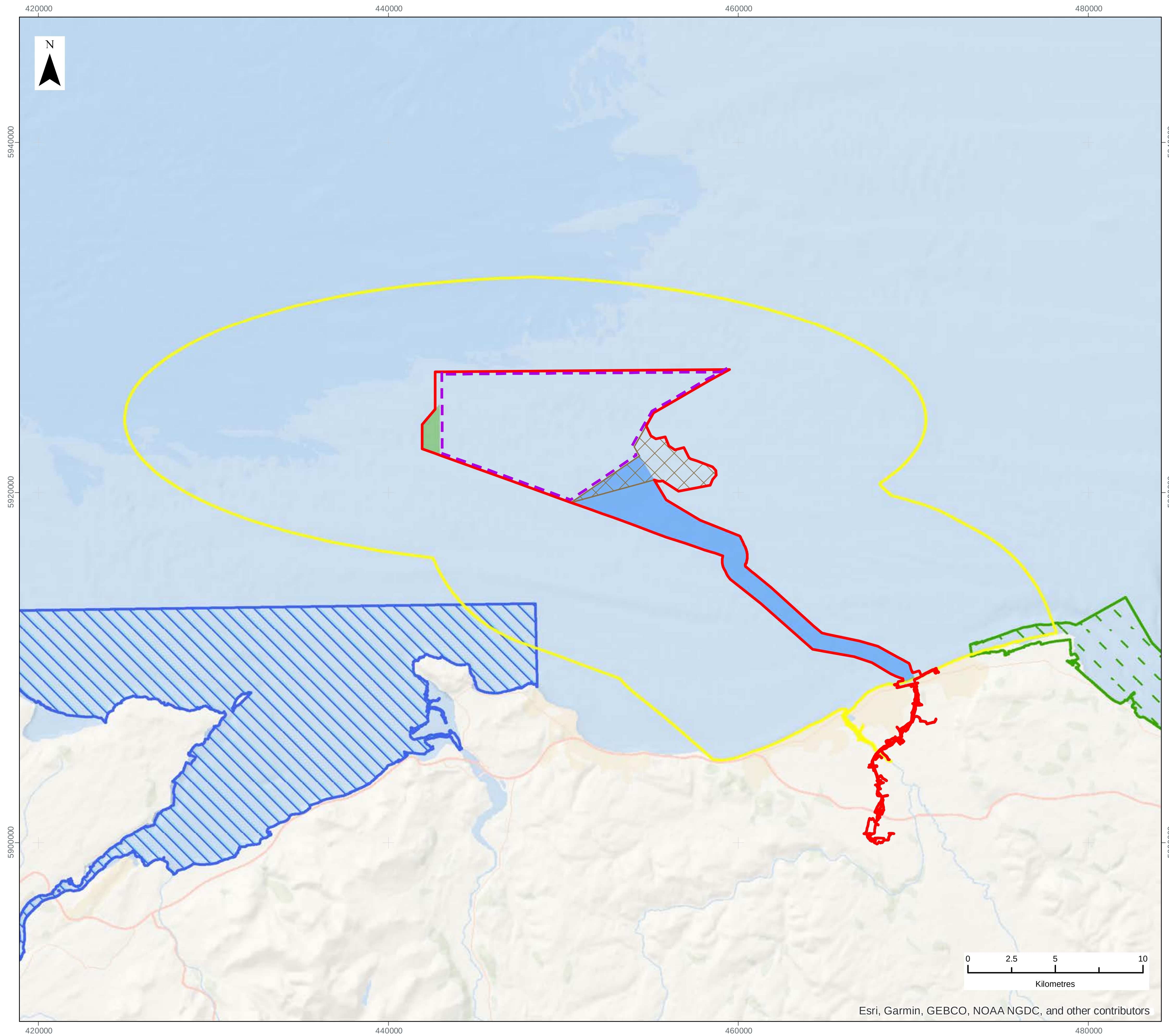
153 SSCs in the Irish Sea vary widely both spatially and temporally, with a general pattern of an inshore to offshore gradient in SSC. SSC's also vary with proximity to the seabed, coastline and are also dependent upon meteorological conditions. Mean "normal" (non-surge/ storm events) SSC background levels in measures at Burbo Bank (c. 20 km north-east of AyM) have been reported in the range of 5 to 20 mg/l within surface waters, increasing to circa 150 mg/l near the seabed (Dong Energy, 2013). These values increase inshore towards the Mersey and Dee estuaries, with SSCs in the Mersey estuary (at Sandon Dock) reaching values in the range of 30 to 450 mg/l near surface waters and 70 to 1,500 mg/l near the seabed. During storm events SSCs are expected to increase to values in the order of hundreds of milligrams.

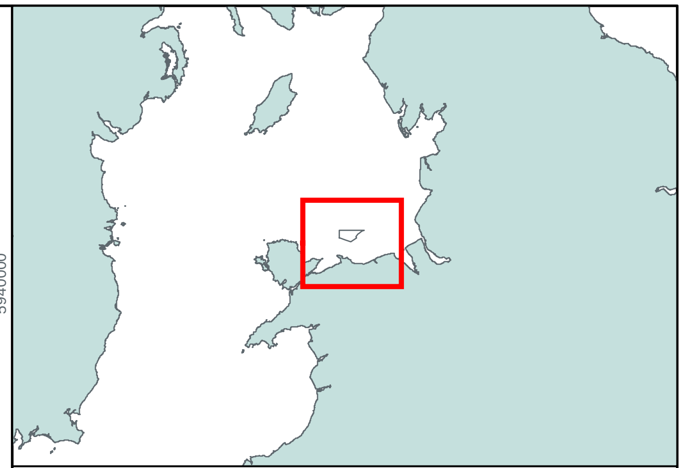
154 The MDS for SSC and deposition during the construction phase of AyM would result in the total release of approximately 18,610,469 m^3 of sediment in the array area and offshore ECC.

155 To summarise the information presented in the project specific hydrodynamic modelling undertaken (Volume 4, Annex 2.3) temporary sediment plumes caused by seabed preparation and installation activities are expected to be restricted to well-within the tidal excursion, with plumes expected to be limited to within the ZoI the offshore ECC (see Figure 1). Sediment plumes are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Sediment deposition will consist primarily of coarser sediments deposited close to the source, with a small proportion of silt deposition (reducing exponentially from source).

156 Taking the above into consideration, the impact of increased SSC and deposition from construction activities is expected to be short-term, intermittent and of localised extent (within one tidal excursion) and reversible.

157 Model predictions show that there is no potential for increased SSC or deposition reaching the eastern boundary of Menai Strait and Conwy Bay SAC. Slightly increased SSC (in concentrations of no greater than 5 mg/l) extend partially into the western boundary of the Dee Estuary/ Aber Dyfrdwy SAC during works such as pre-lay trenching within the offshore ECC (see Figure 7). However, no levels of relevance to the short-term turbidity threshold of 100 mg/l (or the longer term annual mean threshold) which has been assessed below will extend further from the Order Limits than 500 m. Any fine material being dispersed by construction works is likely to be widely distributed and will quickly form part of the background concentrations; deposition of 1 mm will be restricted to < 1 km from the Order Limits and is therefore not predicted to deposit in any measurable thickness within either of the SACs (see Figure 8 and Figure 9). The magnitude of impact on the protected features within the SACs is therefore, considered to be negligible. A full assessment of the potential effects within the SACs has been undertaken within the RIAA (Report 5.2 (application ref: 5.2)).





LEGEND

- Benthic Ecology ZoI
- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Dee Estuary / Aber Dyfrdwy SAC
- Y Fenai a Bae Conwy / Menai Strait and Conwy Bay SAC

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: ZoI in relation to designated sites that have benthic habitats

VER	DATE	REMARKS	Drawn	Checked
1	09/09/2021	For Issue For PEIR	BPHB	RM
2	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:225,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

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158 The communities and habitats identified during the characterisation study area are typical of the wider region. All biotopes identified within the AyM Order Limits and across the wider benthic subtidal ecology study area are acclimated to high levels of SSC that occur naturally within this region and consequently, are subject to and able to tolerate variations in SSC and some degree of sediment deposition. All biotopes and VERs are distributed widely throughout the Irish Sea, and therefore taking the wider environment into context, the magnitude of the impact on all VERs is assessed as being low.

159 The contemporary MarESA assessment use annual mean values to determine the sensitivity of habitats to SSCs. As a result of the short-term nature of the construction phase of the proposed project the benchmarks will not be breached, as elevations in SSC created by the construction works will not reach a sufficient scale or magnitude to significantly alter the annual mean values. Consequently, for the purposes of this assessment, reference has been made to the previous MarLIN sensitivity benchmark for short-term acute increases in SSC (i.e. an arbitrary change of 100 mg/l for 1 month) together with that for short-term acute changes in turbidity (i.e. a change in two categories of the water clarity scale for a period of one month).

160 The sensitivity of the biotopes with reference to both the contemporary MarESA benchmarks for deposition and SSC, and the now superseded short-term MarLIN benchmarks for elevated SSCs and turbidity is summarised in Table 15. For the reasons explained in paragraph 128, the MarESA assessments for two biotopes have been referred to in order to provide a robust prediction of the likely effects upon the infralittoral mixed sediment complex.

161 It can be seen from Table 15 that according to the MarESA assessments, the lower levels of sensitivity are mostly attributed to the biotopes present, but in some cases sensitivity has been assessed as medium.

Table 15: MarESA assessment for the benthic subtidal habitats for temporary increase in SSC and sediment deposition (changes in suspended solids, smothering and siltation rate).

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A5.143/ SS.SCS.CCS.Pkef *P. kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand.	Not sensitive to longer term changes in SSC (short-term changes in SSC and turbidity were not assessed by MarLIN). Medium sensitivity to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm.	Confidence is low for the assessments as these are based on expert judgement.
A5.145/ SS.SCS.CCS.Blan *B. lanceolatum* in circalittoral coarse sand with shell gravel.	Low sensitivity to longer term changes in SSC (short-term changes in SSC and turbidity were not assessed by MarLIN). Low sensitivity to light smothering (< 5 cm). Low sensitivity to heavy smothering (5-30 cm).	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence in the quality of the evidence is high for the smothering assessments as they are based upon published literature.
A5.233/ SS.SSa.IFiSa.NcirBat *N. cirrosa* and *Bathyporeia* spp. in infralittoral sand.	Low sensitivity to longer term and not sensitive to short-term changes in SSC.	Confidence is low for the SSC and turbidity assessments as these are based on expert judgement.

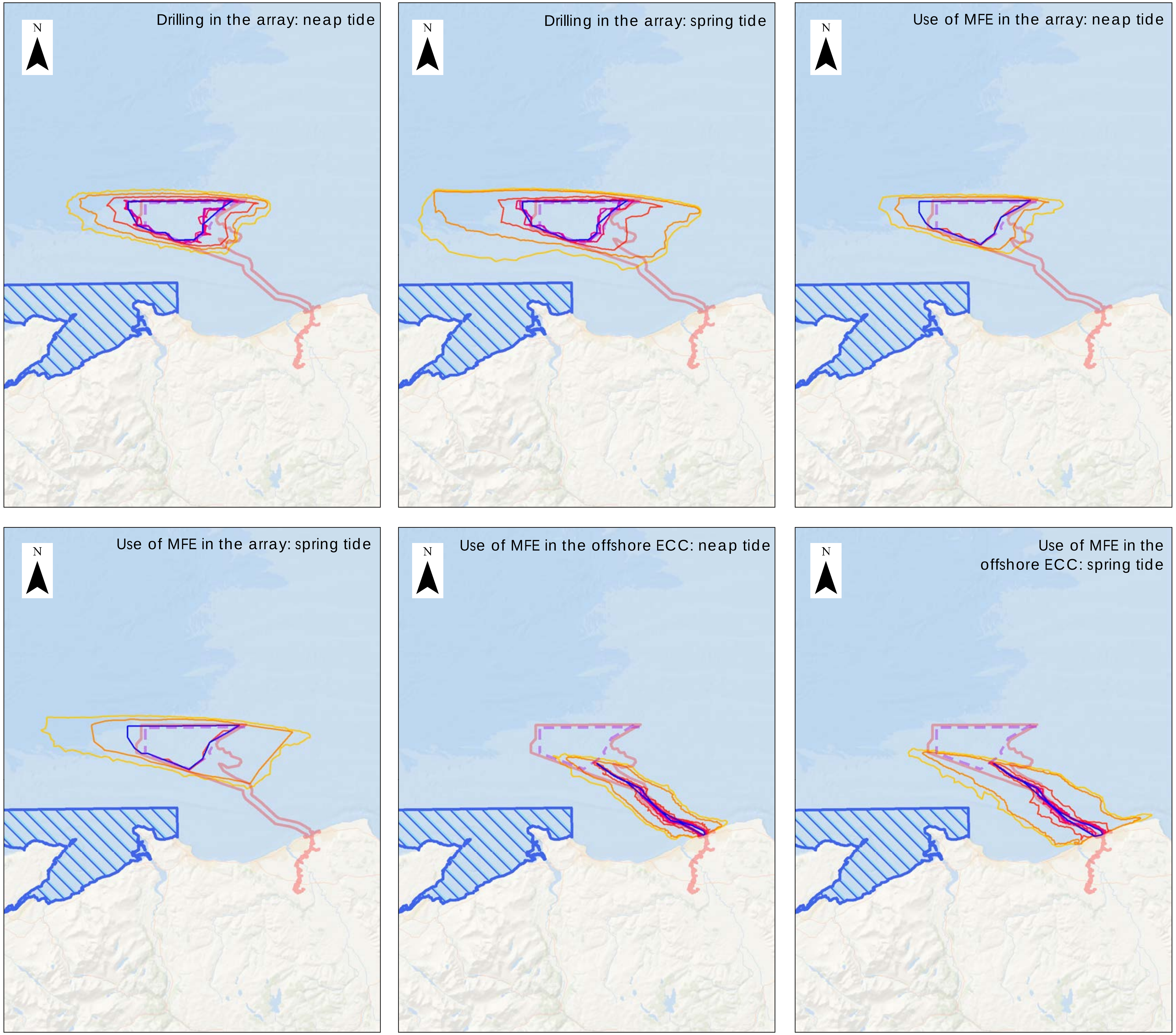
BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
	Low sensitivity to short-term changes in turbidity. Not sensitive to light smothering (< 5 cm). Low sensitivity to heavy smothering (5-30 cm).	Confidence in the quality of the evidence is high for the smothering assessments as they are based upon published literature.
A5.242/ SS.SSa.IMuSa.FfabMag *F. fabula* and *M. mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sands	Low sensitivity to longer term and very low sensitivity to short-term changes in SSC. Low sensitivity to short-term changes in turbidity. Low sensitivity to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	Confidence is low for the SSC and turbidity assessments as these are based on expert judgement. Confidence in the quality of the evidence is high for the smothering assessments as they are based upon published literature.
A5.43/ SS.SMx.IMx Infralittoral mixed sediments assessed as: A5.433/ SS.SMx.IMx.VsenAsquAps V. senegalensis, A. squamata and A. latreilli And:	Low sensitivity to longer term and very low sensitivity to short-term changes in SSC. Very low sensitivity to short-term changes in turbidity. Low sensitivity to light smothering (< 5 cm). Low sensitivity to heavy smothering (5-30 cm).	Confidence is low for all assessments as these are based on expert judgement. Confidence is low for long term SSC and smothering assessments as these are based on expert judgement. Confidence levels for short-terms changes in SSC and turbidity are moderate as the

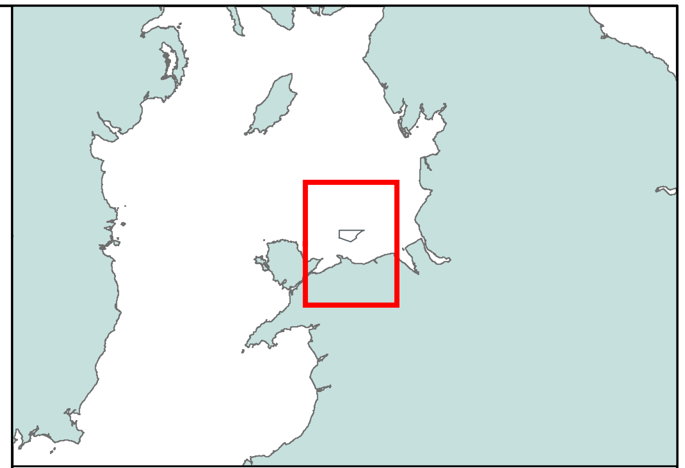
BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A5.441/ SS.SMx.CMx.ClloMx *C. lloydii* and other burrowing anemones in circalittoral muddy mixed sediment.	Not sensitive to short-term and very low sensitivity to longer term changes in SSC. Not sensitive to short-term changes in turbidity. Medium sensitivity to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	assessments have been derived from sources that consider the likely effects of a particular factor on a species or biotope.

162 Model predictions show that there is no potential for increased SSC or deposition reaching the eastern boundary of Menai Strait and Conwy Bay SAC. The sandbank features are the closest features to the eastern boundary (and AyM) but are located c. 6 km to the further west (NRW, 2016b) the plume generated by the AyM construction activities will therefore not reach any of the benthic features for which the SAC has been designated (i.e. sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide, reefs, large shallow inlets and bays, and submerged or partially submerged sea caves). Figure 8 shows the designated features of the Menai Strait and Conwy Bay SAC against the modelled SSC plume and illustrates no interaction between the SSC or deposition and the SAC. It is therefore not considered further in the assessment.

163 The plume modelled (< 5 mg/l) is predicted to extend over the western boundary of the Dee Estuary/ Aber Dyfrdwy SAC and the intertidal mudflats and sandflats (which are designated as mudflats and sandflats not covered by seawater at low tide), but the concentrations are not predicted to exceed 5 mg/l during spring tides (1 mg/l during neaps). Deposition of up to 1 mm depth is restricted to < 1 km from the Order Limits and is therefore not predicted to deposit in any measurable thickness within the SAC boundary on the benthic features designated (i.e. mudflats and sandflats not covered by seawater at low tide, *Salicornia* and other annuals colonizing mud and sand, Atlantic salt meadows and estuaries). Figure 9 shows the designated features of the Dee Estuary/ Aber Dyfrdwy SAC against the modelled SSC plume and illustrates no interaction between the SSC or deposition and the SAC. It is therefore not considered further in the assessment.

164 Additional information on SSC plume and deposition can be found in Section 2.10 of Volume 2, Chapter 2. The full range of worst-case outcomes including maximum plume concentrations and extent are provided in Volume 4, Annex 2.3.





LEGEND

- Order Limits
- Array Area
- Y Fenai a Bae Conwy / Menai Strait and Conwy Bay SAC

Suspended Sediment Concentration

- 1 mg/l
- 5 mg/l
- 50 mg/l
- 100 mg/l
- 150 mg/l
- 250 mg/l
- 500 mg/l

0 10 20 40
Kilometres

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Modelled SSC plume in relation to designated features

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue	BPHB	KJ

FIGURE NUMBER:

Figure 8

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:650,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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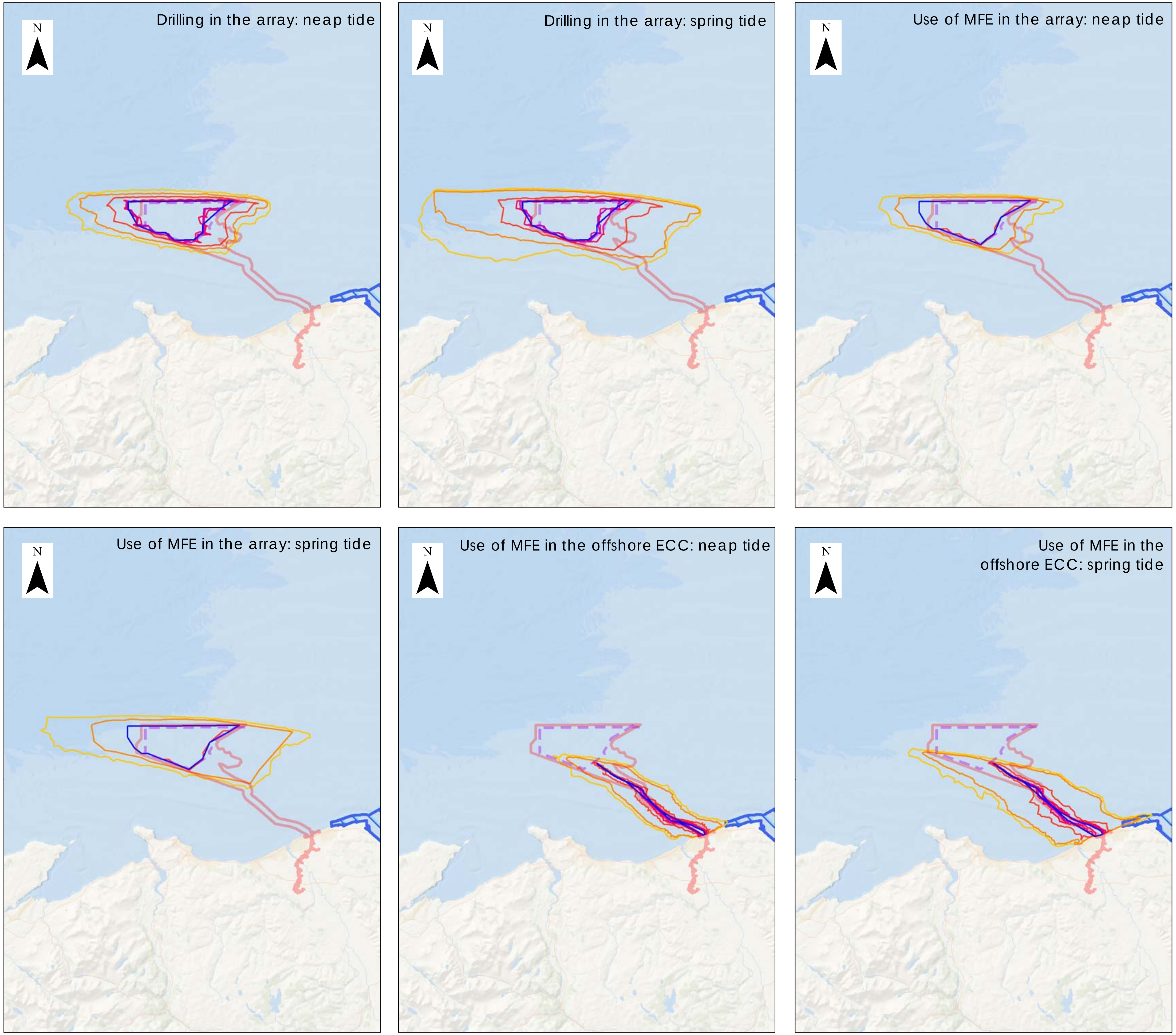

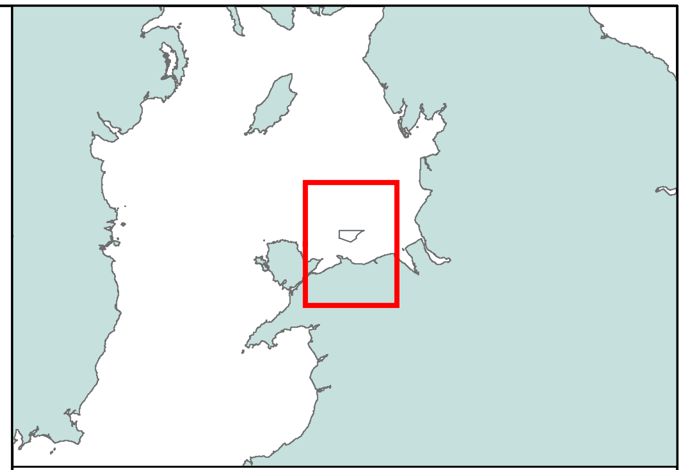

LEGEND

- Order Limits
- Array Area
- Dee Estuary / Aber Dyfrdwy SAC

Suspended Sediment Concentration

- 1 mg/l
- 5 mg/l
- 50 mg/l
- 100 mg/l
- 150 mg/l
- 250 mg/l
- 500 mg/l

0 10 20 40
Kilometres

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Modelled SSC plume in relation to designated features

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue	BPHB	KJ

FIGURE NUMBER:

Figure 9

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:650,000	A3	WGS84	UTM30N

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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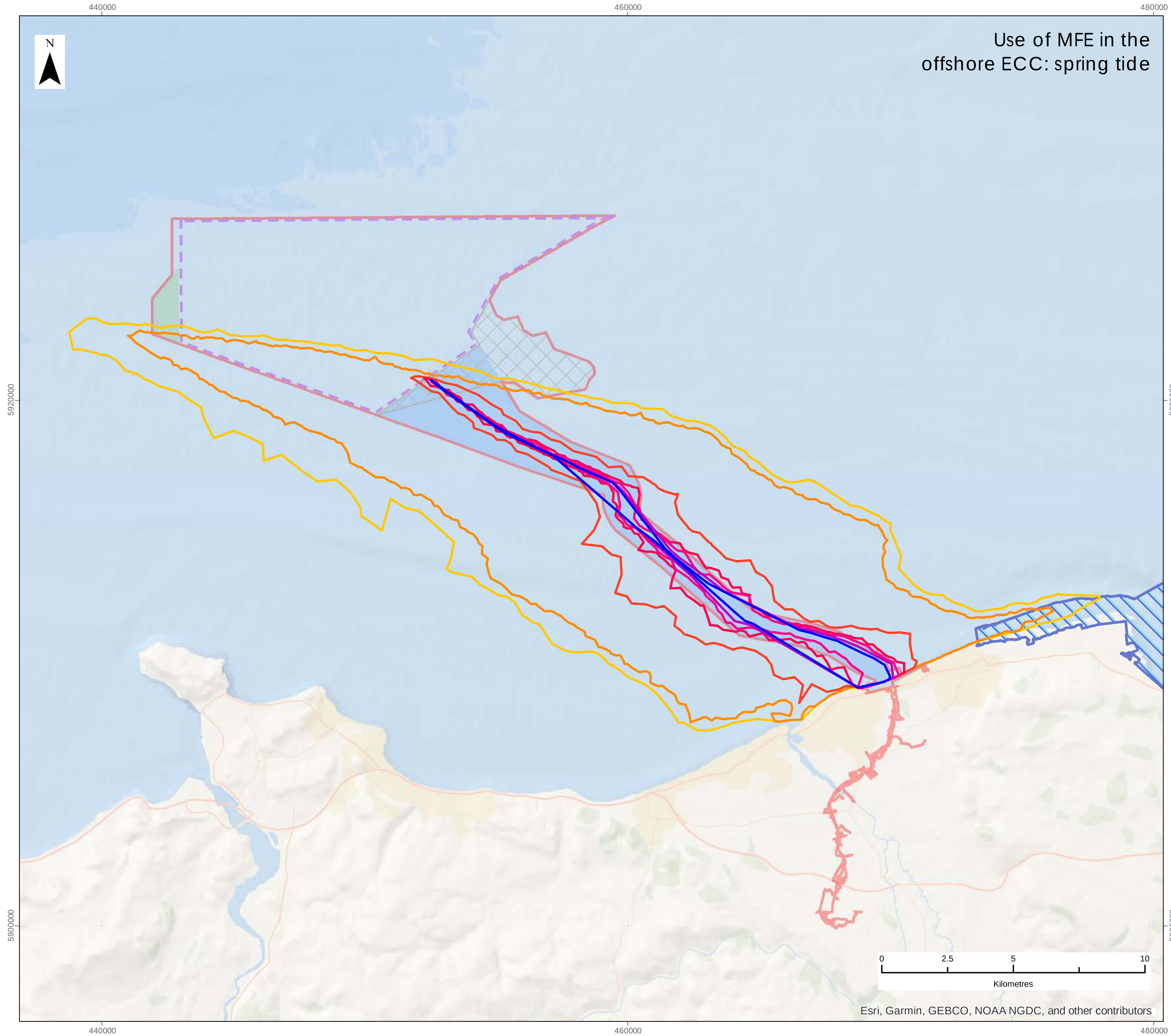

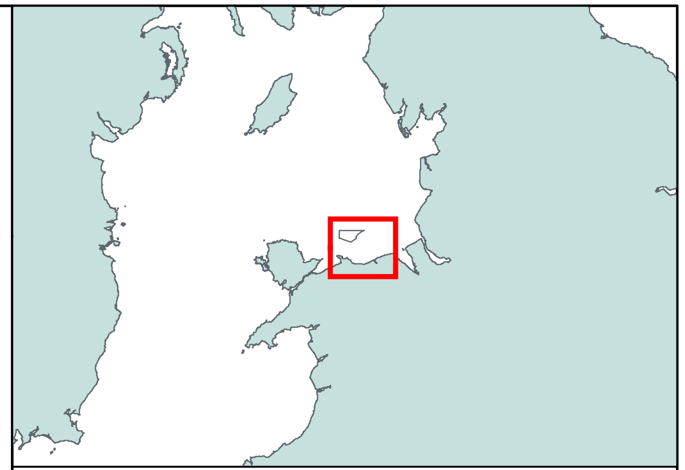

LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Dee Estuary / Aber Dyfrdwy SAC

Suspended Sediment Concentration

- 1 mg/l
- 5 mg/l
- 50 mg/l
- 100 mg/l
- 150 mg/l
- 250 mg/l
- 500 mg/l

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Modelled SSC plume for use of MFE in relation to designated features of the Dee Estuary/ Aber Dyfrdwy SAC

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 10

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:150,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

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165 Low resemblance stony reef is found in the offshore portion of the offshore ECC and therefore will be subject to elevated SSC and deposition. MarESA does not provide an assessment of sensitivity of the A5.43/ SS.SMx.IMx biotope complex, however, the communities described by the baseline technical report most resemble SS.SMx.CMx.ClloMx – *C. lloydii* and other burrowing anemones in circalittoral muddy mixed sediment and SS.SMx.IMx.VsenAsquAps – *V. senegalensis*, *A. squamata* and *A. latreilli* in infralittoral mixed sediment. These biotopes have been assessed by MarESA as not sensitive/ having low sensitivity to changes in suspended solids and turbidity and having low to medium sensitivity to light and heavy siltation. Both have very low sensitivity to short-term increases in suspended solids as assessed by MarLIN, and high to very high recoverability. Furthermore, the moderate to high energy water flow in the area is likely to rapidly redistribute deposited sediments and therefore deposition on more sensitive species (such as bryozoans and hydroids) that are characteristic of the small areas of more stable low resemblance reef.

166 The benthic subtidal habitats that characterise the remaining AyM benthic subtidal ecology study area are deemed to have a low sensitivity at most to increases in SSC (both according to the MarESA and MarLIN benchmarks), low sensitivity to light deposition (0-5 cm) and medium sensitivity to heavy deposition (5-30 cm) (Table 15). The sensitivity of the receptors is therefore considered to be in the range from low to medium according to the EIA assessment values (Table 6), although Table 15 demonstrates that lower levels of sensitivity are recorded for most biotopes. The resilience of these habitats is also high, with recovery anticipated within two years even given high siltation levels.

167 In addition, the limited areas of effect that are predicted and the intermittent nature of the impacts, both spatially and temporally, will facilitate rapid recruitment from adjacent communities. The amphipods and polychaetes which characterise the communities are highly mobile and are capable of colonising new habitats from the surrounding area by adult migration. These habitats are naturally dynamic and, as such, the faunal component is naturally relatively sparse and low in species richness. Therefore, the community might be considered 'mature' (in terms of representative species present) only a few days or weeks after the disturbance, as displaced polychaetes and crustaceans re-enter the substratum (MarLIN, 2019).

168 Increases in SSC and associated sediment deposition will represent a temporary and short-term intermittent impact, affecting a relatively small portion of the benthic subtidal habitats in the AyM benthic subtidal ecology study area.

169 Overall, it is predicted that the sensitivity of the benthic subtidal habitats located across the AyM benthic ecology study area is at worst-case medium according to the detailed MarESA/ MarLIN assessments and published literature. However, given the widespread distribution of these habitats and communities around the UK these habitats have been attributed a sensitivity of low. The **medium** sensitivity and **low adverse** magnitude of the impact on benthic receptors would result in ***minor adverse*** significance of effect which is not significant in EIA terms (as per the matrix in Table 7).

170 The MarESA assessments identify that some aspects of the confidence for the sensitivity of the specified habitats to changes in SSC and for sediment deposition (smothering) is low for all habitats. For all habitats, the low confidence score for the sensitivity assessment is associated with the resistance assessment rather than the resilience assessment. The significance of effect has been assessed based on the lowest resistance score of medium and resilience of medium as part of the sensitivity assessments. Therefore, while the confidence score is low, the assessment is using the most conservative sensitivity. As such, the assessment of the significance of effects as not significant, is considered to be robust.

Intertidal at landfall

171 Temporary increases in SSC and associated sediment deposition in the intertidal area are expected from the cable installation works and the release of drill cuttings and drilling mud from the HDD works. Volume 2, Chapter 2 and Technical Report provides a full description of the physical assessment, with a summary of the MDSs associated with the impact, as detailed in Table 11.

172 Within the intertidal portion of the offshore ECC SSCs are expected to be in the range of 30 to 1,500 mg/l (Dong Energy, 2013). Significantly higher levels may be seen during storm events (Volume 2, Chapter 2).

173 The scenario that results in the greatest impact on intertidal habitats from cable installation is pre-lay trenching using a MFE within the inshore end of the offshore ECC and the release of drill cuttings and drilling mid from HDD works.

174 Open cut trenching in the intertidal area (and the associated formation of berms) will also result in localised elevation of SSCs. While the berms are present on the beach, they will be subject to tidal dispersion, although some of this will result in natural backfill of the trench. It is expected that the berms would be present for only a very short period of time and so the degree of redistribution that may occur is highly limited. After the trench has been backfilled, it is expected that re-working by waves and currents will quickly (in the order of days to weeks) redistribute and smooth any remaining local disturbances.

175 Open cut trenching and the use of the MFE further offshore will not be carried out concurrently and therefore the SSCs will not be cumulative. Elevated SSCs from both sources will be localised and of short-term duration, and rapidly attenuate to natural levels.

176 Given that the habitats are common and widespread throughout the area, and that increases in SSC and associated turbidity and sediment deposition will represent a temporary and short-term intermittent impact, affecting a relatively small region of the intertidal area, the magnitude of the impact is assessed as low.

177 As previously stated for other impacts within the intertidal areal, a number of the biotope complexes identified within the technical report have been considered further to enable classification to biotope level, therefore facilitating referral to the MarESA sensitivity assessments and more robust assessment (see paragraph 128 for further details on the information provided in Table 6).

Table 16: MarESA assessment for the benthic intertidal habitats for temporary increase in SSC and sediment deposition (changes in suspended solids, smothering and siltation rate).

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
A1.45/ LR.FLR.Eph assessed as: A1.451/ LR.FLR.Eph.Ent *Enteromorpha* spp. on freshwater-influenced and/ or unstable upper eulittoral rock	Not sensitive to longer term or to short-term changes in SSC. Not sensitive to increases in turbidity. Low sensitivity to light smothering (< 5 cm). Low sensitivity to heavy smothering (5-30 cm).	Confidence is low and moderate respectively for the SSC and turbidity assessments as these are based on expert judgement or from sources that only cover aspects of the biology of the species (or biotope) or from a general understanding of the species or biotope. Confidence in the quality of the evidence is high for the smothering assessments as they are based upon published literature.
A1.11/ LR.HLR.MusB Mussel and/ or Barnacle Communities assessed as: A1.1133/ LR.HLR.MusB.Sem.LitX *S. balanoides* and Littorina spp. on exposed to moderately exposed	Low sensitivity to longer term increases in SSC and not sensitive to short-term changes in SSC and turbidity. Medium sensitivity to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	Confidence is high for the short-term SSC and turbidity assessments as these been derived from sources that specifically deal with sensitivity and recoverability of a species or biotope to a particular factor. Experimental work has been done investigating the effects of such a factor.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
eulittoral boulders and cobbles		Confidence in the quality of the evidence is also high for the smothering assessments as they are based upon published literature.
A1.111/ LR.HLR.MusB.MytB *M. edulis* and barnacles on very exposed eulittoral rock	Not sensitive to longer term and very low sensitivity to short-term changes in SSC. Very low sensitivity to increases in turbidity. Low sensitivity to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	Confidence is low for the SSC and turbidity assessments as these are based on expert judgement. Confidence in the quality of the evidence is high for the smothering assessments as they are based upon published literature.
A1.1133/ LR.HLR.MusB.Sem.LitX *S. balanoides* and *Littorina* spp. on exposed to moderately exposed	Low sensitivity to longer term increases in SSC and not sensitive to short-term changes in SSC and turbidity. Medium sensitivity to light smothering (< 5 cm).	Confidence is high for the short-term SSC and turbidity assessments as these been derived from sources that specifically deal with sensitivity and recoverability of a species or biotope to a particular factor. Experimental work has been done investigating the effects of such a factor.

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
eulittoral boulders and cobbles	Medium sensitivity to heavy smothering (5-30 cm).	Confidence in the quality of the evidence is also high for the smothering assessments as they are based upon published literature.
A1.212/ R.MLR.BF.FspiB *F. spiralis* on full salinity exposed to moderately exposed upper eulittoral rock	Low sensitivity to longer term increases in SSC, short-term changes in SSC and turbidity were not assessed. Low sensitivity to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	The confidence in the SSC sensitivity assessments is medium as the assessment is based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature (habitat, its component species, or species of interest) or similar features.
A2.241/ LS.LSa.MuSa.LimAre L. balthica and A. marina in muddy sand shores	Short-term increases in SSC and turbidity not assessed, not sensitive to long term changes in SSC. Not sensitive to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	Confidence is low for the SSC assessment as this are based on expert judgement. For the same reason the confidence in the quality of the evidence is low for the light smothering assessment. Confidence is medium for the heavy smothering assessment as it is based on some peer reviewed papers but relies heavily on grey literature or expert

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
		judgement on feature (habitat, its component species, or species of interest) or similar features.
A2.211/ LS.LSa.St.Tal Talitrids on the upper shore and strandline	Short-term increases in SSC and turbidity not relevant, not sensitive to long term changes in SSC. Not sensitive to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm). Not sensitive to light smothering (< 5 cm). Medium sensitivity to heavy smothering (5-30 cm).	Confidence is low for all of the assessments as these are based on expert judgement.
A2.245/ LS.LSa.Lan L. conchilega in littoral sand	Very low sensitivity to short-term increases in SSC and turbidity, not sensitive to long term changes in SSC. Not sensitive to light smothering (< 5 cm).	The confidence in the short-term SSC sensitivity assessments is medium as the assessment is based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
	Low sensitivity to heavy smothering (5-30 cm).	(habitat, its component species, or species of interest) or similar features. Confidence is high for the light the smothering assessment as this been derived from sources that specifically deal with sensitivity and recoverability of a species or biotope to a particular factor. Experimental work has been done investigating the effects of such a factor. Confidence is low for all remaining assessments as they are based on expect judgement.
A4.231/ CR.MCR.SfR.Pid Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Low sensitivity to short-term increases in SSC and turbidity, not sensitive to long term changes in SSC. Moderate sensitivity to light smothering (< 5 cm). Moderate sensitivity to heavy smothering (5-30 cm).	Confidence is low for the SSC assessment as this are based on expert judgement. For the same reason the confidence in the quality of the evidence is low for the light smothering assessment. Confidence is medium for the heavy smothering assessment as it is based on some peer reviewed papers but relies heavily on grey literature or expert

BIOTOPE CODE (EUNIS/ JNCC) AND NAME	SENSITIVITY ASSESSMENT	ASSESSMENT CONFIDENCE
		judgement on feature (habitat, its component species, or species of interest) or similar features.
S. alveolata assessed as: A2.711/ LS.LBR.Sab.Salv *S. alveolata* reefs on sand-abraded eulittoral rock	Very low sensitivity to short-term increases in SSC and turbidity, not sensitive to long term changes in SSC. Not sensitive to light smothering (< 5 cm). Moderate sensitivity to heavy smothering (5-30 cm).	The confidence in the short-term SSC sensitivity assessments is medium as the assessment is based on some peer reviewed papers but relies heavily on grey literature or expert judgement. That for long term SSC is high as this assessment has been derived from sources that specifically deal with sensitivity and recoverability of a species or biotope to a particular factor. Confidence is low for both smothering assessments as they are based on expect judgement.

178 The intertidal habitats that characterise the AyM landfall area have been assessed to have a low sensitivity at most to increases in SSC (both according to the MarESA and MarLIN benchmarks) and turbidity, medium sensitivity to light deposition (0-5 cm) and medium sensitivity to heavy deposition (5-30 cm) (Table 16). The sensitivity of the receptors is therefore considered to be in the range from low to medium according to the EIA assessment values (Table 7), although Table 18 demonstrates that lower levels of sensitivity are recorded for most biotopes. The resilience of these habitats ranges from medium to high, with recovery anticipated in < 2 years for some biotopes but up to 10 for others.

179 Overall, it is predicted that the sensitivity of the benthic subtidal habitats located across the AyM benthic ecology study area are at worst-case medium according to the detailed MarESA/ MarLIN assessments and published literature. However, the MarESA/ MarLIN assessments do not take into account the site-specific environmental conditions, and in considering these it is unlikely that the effects would be detectable above natural background variability. The **medium** sensitivity and **low adverse** magnitude of the impact on benthic receptors would result in ***minor adverse*** significance of effect which is not significant in EIA terms.

180 The MarESA assessment confidence scores were variable across the biotopes within, with this predominately due to low confidence for the resistance assessment and also to the applicability for the resilience assessment. The significance of effect has been assessed based on the lowest resistance score of low and resilience of medium as part of the sensitivity assessments. Therefore, while the confidence score is low, the assessment is using the most conservative sensitivity. Furthermore, as discussed above, the intertidal area at landfall is a naturally energetic site within which there is evidence of naturally high sediment movement, particularly during storm surges and consequently, the communities will be adapted to SSC, turbidity and deposition events which are similar to the impacts of cable installation. As such, the assessment conclusion remains valid and robust.

5.11.3 Direct and indirect seabed disturbances leading to the release of sediment contaminants

181 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an effect on benthic receptors.

182 Contaminant surveys in both the array and offshore ECC reported no pollutants with concentrations above their respective Effects Range Low (ERL) values. All metals concentrations were also less than their respective Cefas guideline Action Levels (AL1 and AL2). Total PAH concentrations (two to six ring) were broadly comparable to the median concentration recorded during the SEA6 Irish Sea surveys (Cefas, 2005).

183 The total area that is likely to be disturbed by construction activities, and therefore the potential volume of material disturbed, resulting in the potential release of sediment bound contaminants is small and localised in extent. In addition, the nature of the subtidal sediments is predominantly coarse, typically with low levels of fines adhering to them, reducing the likelihood of these sediments containing high levels of pollutants.

184 Following disturbance as a result of construction activities, the majority of re-suspended sediments are expected to be deposited in the immediate vicinity of the works. The release of contaminants from the small proportion of fine sediments is likely to be rapidly dispersed with the tide and/or currents and therefore increased bioavailability resulting in adverse eco-toxicological effects are not expected.

185 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible adverse**. Due to the contaminants being below both guideline and action levels where relevant (i.e. levels are below those deemed to have the potential to result in deleterious effects on fauna) and the widespread distribution of the benthic receptors being considered, the sensitivity of benthic receptors has been assessed as **low**. The impact is therefore predicted to be ***negligible adverse*** which is not significant in EIA terms.

5.11.4 Increased risk of introduction or spread of Invasive Non-Native Species (INNS)

186 The main pathways for the transport and introduction of marine INNS in the UK have been identified as recreational boating, aquaculture, fisheries, shipping, and offshore energy (Marine Pathways Project, 2014). The pathways that contribute the most have been found to be dependent on the coastal region being considered (Defra, 2015).

187 Once INNS species become established and disperse within a new habitat they can out-compete local species for space and resources, prey directly on local species, or introduce pathogens (Roy *et al.*, 2012). Consequently, the introduction of INNS during construction could potentially affect the ecological functioning of the communities occupying intertidal and subtidal habitats within the AyM marine ecology study area. There is also potential for the INNS identified during baseline surveys to be transported out of the study area to elsewhere via the construction equipment, although other than the Australasian barnacle *Austrominius modestus* which is ubiquitous through the UK, no other INNS were recorded within the baseline surveys.

188 Pathways of introduction involving vessel movements represent the single highest potential risk route for the introduction of INNS; this could either be from discharge of ballast water at a site or via transportation on vessel hulls (Carlton, 1992; Pearce *et al.*, 2012).

189 During the construction phase, the main vessels in use will be the jack-up barge(s), dredger/ rock barges and attendant tugs.

190 There will be up to 3,436 round trips to port during the construction phase, which will contribute to the risk of introduction or spread of INNS. Numerous inherent mitigation design measures will be incorporated into construction methods via the biosecurity plan to ensure relevant best practice guidelines are followed (Natural England and NRW Biosecurity Planning guidance (Cook *et al.*, 2014)) (see embedded mitigation as outlined in Table 12), which will ensure that the risk of the introduction and/ or spread of INNS will be minimised.

191 Any effects of INNS in relation to intertidal rock communities within the study area would be local and permanent. The magnitude of effect is expected to be **negligible adverse** as the INNS most likely to colonise the small area of additional rock are already present. The sensitivity of the benthic receptors in relation to the impact is therefore considered to be **low**. The effects are therefore expected to be of ***negligible adverse*** significance. The potential for colonisation of new infrastructure by INNS has been assessed in Section 5.12.

192 The potential for colonisation of new infrastructure by INNS has been assessed in paragraph 139. Any effects of INNS during the construction phase in relation to subtidal communities are therefore considered to be of negligible significance.

193 The transport of INNS outside of the study area has been screened out of the assessment because with the implementation of the inherent mitigation outlined above, it is considered that this scenario is highly unlikely. Furthermore, the INNS that were observed within the baseline studies are already ubiquitous throughout UK waters.

5.11.5 Long-term habitat loss/ change from the presence of foundations, scour protection and cable protection

194 The presence of the WTG and OSS foundations and the associated scour protection, along with the cable protection measures used at cable crossings and areas where cable burial is not possible, will lead to a change from a sedimentary habitat to one characterised by hard substrate. While it is recognised that this is predominantly an operational impact, the effect will start to occur at the point of construction and therefore, is considered here. This will be either a long-term habitat loss (for the 25-year design life duration of the project) or a permanent change and is therefore considered an impact of the operational phase of the development and potentially beyond. It is assessed here as habitat loss and a potential adverse effect (due to the potential shift in the baseline condition), although it is noted that this also comprises potential beneficial effects (e.g. providing new habitats for different faunal assemblages to colonise, resulting in a likely increase in biodiversity and biomass).

195 Table 11 identifies the MDS foundation, scour and cable protection footprint and a breakdown of the exact amount of habitat loss per component. The total habitat loss arising from these components would be 1.067 km^2, which equates to approximately 0.83% of the subtidal habitat within the AyM Order Limits. The conclusion of the MDS is each significance would be no greater than its constituent component, and therefore is less than significant.

196 While the impact will be locally significant and comprise a long-term or permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. A change of subtidal sediment biotopes to rock or artificial hard substratum would alter the character of the biotope leading to reclassification and the loss of the sedimentary community. However, while the impact will be locally significant and comprise a long-term or permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. Furthermore, as the habitats and characterising biotopes are common and widespread throughout the wider region the loss of these habitats would be discernible but slight. The magnitude is therefore assessed as negligible.

197 No long-term habitat loss will occur in the intertidal area of AyM offshore ECC as above ground cable protection will be restricted to the subtidal region.

198 The species and habitats identified during the characterisation study are typical of the wider region. All biotopes identified within the AyM Order Limits have been assessed according to the MarESA criteria as having no resistance to long-term or permanent habitat loss/ change, with recovery assessed as very low as the change at the pressure benchmark is at worst-case permanent. The sensitivity of subtidal receptors is therefore considered to be at worst-case high according to the EIA assessment values.

199 In considering the detailed MarESA assessments and UK-wide distribution of the benthic receptors, overall, it is predicted that the sensitivity of the benthic subtidal habitats located across the AyM benthic ecology study area is at worst-case high and the magnitude is negligible. The **high** sensitivity and **negligible adverse** magnitude of the impact on benthic receptors will result in a ***minor adverse*** significance, which is not significant in EIA terms.

5.12 Environmental assessment: operational phase

200 The effects of the operation of AyM have been assessed on benthic and intertidal ecology within the AyM benthic ecology study area. The environmental impacts arising from the operation of AyM are listed in Table 11, along with the Design Envelope against which each operation phase impact has been assessed. A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is provided below.

5.12.1 Colonisation of the WTGs and scour/ cable protection may affect benthic ecology and biodiversity

201 The introduction of hard substrate will change the habitats within the benthic subtidal ecology study area. However, the amount of introduced substrate is relatively small at approximately 1.067 km^2, which accounts for approximately 0.83% of the subtidal benthos within the AyM Order Limits.

202 The AyM benthic ecology study area is dominated by sedimentary habitats, with hard substrates (the majority of which comprise anthropogenic structures) relatively limited to those areas mapped as ‘low resemblance stony reef’ and small areas of the intertidal. The introduction of hard substrate, and associated increases in biodiversity, will alter the biotopes that characterise the subtidal area where infrastructure is introduced and will be long term, lasting for the duration of the development. Any effects on benthic ecology arising from the introduction of hard substrates will be localised to the AyM array area and offshore ECC (where cable protection is laid).

203 The impact is therefore predicted to be of local spatial extent, long-term duration but reversible once the infrastructure is removed. It is noted that removal of all introduced hard substrate will be subject to best practice at time of decommissioning and surveys conducted to assess the quality of the communities established and a decision on their removal made in conjunction with the statutory authorities. It is predicted that the impact will affect the receptor directly. As the habitats and characterising biotopes are common and widespread throughout the wider region the loss of these habitats is assessed as barely discernible and the magnitude is therefore, considered to be negligible.

204 The introduction of new hard substrate will represent a potential shift in the baseline condition of a small proportion of the AyM benthic subtidal ecology study area. Potential beneficial effects that may occur are associated with the likely increase in biodiversity and biomass, as has been observed at the Egmond aan Zee Offshore Windfarm (Lindeboom *et al*., 2011). Individual species with the potential to benefit from the introduction of hard substrate due to the introduction of additional supporting substrate are those which are typical of rocky habitats and intertidal environments.

205 The species potentially introduced may also have indirect and adverse effects through increased predation on, or competition with, neighbouring soft sediment species. However, such effects are difficult to predict and quantify. The increased biodiversity associated with the structures could provide benefits at higher trophic levels, as the benthic organisms colonising the structures provide an additional food source. Studies at the Horns Rev Offshore Windfarm in Denmark provided evidence that OWF structures are used as successful nursery habitats for the edible crab *Cancer pagurus* (BioConsult, 2006). However, any direct benefits are only likely to occur on a very localised basis (i.e. immediately adjacent to the infrastructure).

206 At the nearby Burbo Bank OWF, post construction surveys determined that epifaunal communities have colonised the turbines and scour protection as was predicted within the ES, although only a fraction of the hard substrate afforded by the stony scour protection and rock armour was found to be available to epifauna because of heavy siltation which had filled interstitial spaces. Elsewhere, epifaunal species were common and typical of those colonising hard substrata in the region. No species or communities of nature conservation interest or INNS were noted.

207 Given the presence of existing epifaunal species and colonising fauna within discrete parts of the AyM benthic subtidal ecology study area (i.e. associated with coarser sediment habitats), it is predicted that colonisation of hard substrates by common species such as bryozoans and ascidians will occur.

208 The sediment biotopes likely to be affected are deemed to be of low vulnerability and of local to regional value. Recoverability following removal of the infrastructure is expected to be high although not all introduced hard substrate is likely to be removed, with cable and scour protection potentially remaining in-situ. The sensitivity of these receptors according to the MarESA assessments is therefore considered to be high given a worst-case scenario but limited to areas where infrastructure is not removed. Furthermore, the biotopes are widespread around the UK and found throughout the North-East Atlantic, and as such, the sensitivity has been assessed as medium.

209 The introduction of hard structures such as scour protection can lead to an increase in biomass and biodiversity which may be considered beneficial, but it also represents a change from the baseline environment which may be considered adverse. Any beneficial effects associated with an increase in biodiversity will be highly localised in nature and are not regarded as mitigation for the loss of sedimentary habitat associated with the installation of structures. Overall, it is predicted that the sensitivity of the receptor is **medium** and the magnitude is **negligible adverse**. According to Table 7, the effect is assessed is considered to be of ***minor adverse*** significance, which is not significant in EIA terms.

5.12.2 Increased risk of introduction or spread of marine Invasive Non-Native Species (INNS) due to presence of infrastructure and vessel movements may affect benthic ecology and biodiversity

210 There is a risk that the introduction of hard substrate into a sedimentary habitat may enable the colonisation of the introduced substrate by INNS and serve as 'stepping-stones' thereby facilitating the spread of such species. This along with the movement of vessels in and out of the AyM Order Limits has the potential to impact upon benthic ecology and biodiversity locally and in the broader region.

211 As presented in Table 11, up to 1.067 km^2 of new hard substrate habitat will be introduced into the subtidal area within the AyM Order Limits benthic subtidal ecology study area.

212 In addition to this, there will be up to 3,436 round trips to port during the construction phase and up to 1,208 round trips to port by operational and maintenance vessels, which will contribute to the risk of spread of INNS.

213 Designed-in measures including a marine biosecurity plan (see embedded mitigation as outlined in Table 12) will, however, ensure that the risk of the introduction and/ or spread of INNS will be minimised.

214 The ‘stepping-stone’ effect has the potential to extend the impact beyond a local scale. Based on current scientific knowledge it is not possible to predict whether such a spread will occur, to what extent and which species, if any, this may involve. However, given that post-construction monitoring surveys at the nearby Burbo Bank OWF determined that no species or communities of nature conservation interest or marine INNS were found to colonise the turbines and scour protection at that site (CMACS 2009b), it is anticipated that AyM will also not act as a vector for the introduction of marine INNS. However, AyM may offer or provided habitats for marine INNS, where INNS already exist within the site/ region.

215 The potential impact on biotopes and VER within the AyM benthic subtidal ecology study area is predicted to be of very low spatial extent, long term duration, continuous and irreversible. It is predicted that the impact will affect the receptors indirectly. The magnitude of this impact is considered to be **low**. The sensitivity of the receptors is considered to be **low**, but irrespective of the sensitivity of the receptor, the significance of the impact is ***minor adverse*** which is not significant in EIA terms (Table 7).

5.12.3 Temporary habitat disturbance associated with maintenance activities

216 Temporary subtidal habitat loss will arise from the use of jack-up vessels for operational and maintenance activities as well as from cable maintenance and cable repair (including de-burial and re-burial of export and array cables). A total of up to 0.252 km^2 of temporary habitat disturbance is predicted to arise over the 25-year design life of AyM (equating to approximately 0.197% of the AyM Order Limits).

217 Given that all of the subtidal habitats are common and widespread throughout the AyM Order Limits and wider region, impacts from the individual O&M activities will represent a very small footprint compared to their overall extent.

218 The impacts are predicted to be temporary and of short-term duration and only a single event in each location, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude of this impact is therefore considered to be **negligible adverse**. The sensitivity of the relevant subtidal benthic receptors to temporary habitat disturbance has been assessed as **low**, the impact is therefore of ***negligible adverse*** significance at most which is not significant in EIA terms (Table 7).

5.12.4 Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities

219 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

220 A post construction study at Burbo Bank OWF (CMACS, 2009a) provided evidence to suggest that marked changes in invertebrate abundance and fluctuations in sediment deposition and loss recorded between were as a result of the natural dynamic coastal environment rather than effects of wind farm construction. Despite appreciable fluctuations in individual species, invertebrate communities were reported to remain relatively constant over the period of monitoring from pre-construction to post-construction and of the biotopes identified in baseline surveys were found to persist across the survey area.

221 Similarly, the use of correctly designed scour protection at foundations and insufficiently buried cables will prevent scour occurring at AyM (Volume 2, Chapter 2). The impacts of the use of scour protection have been assessed within this chapter (Section 5.11) and found to have no significant effects on the benthic environment.

222 The Marine Geology, Oceanography and Physical Processes assessment (Volume 2, Chapter 2) has determined that the impacts on hydrodynamic and wave regimes will be **minor adverse** and would not result in significant changes to sediment transport. Therefore, the magnitude is considered **negligible** to **low**, as detailed in Volume 2, Chapter 2. The sensitivity of the receptors to such changes would be **negligible** and consequently the significance of effect would be ***negligible adverse***, which is not significant in EIA terms.

5.12.5 Indirect disturbance arising from electromagnetic fields generated by the current flowing through the cables buried to less than 1.5 m below the surface

223 In agreement with NRW (see Table 4: Summary of consultation relating to benthic subtidal and intertidal ecology.). The following section considers the potential for EMFs to cause indirect disturbance to benthic species qualifying under Section 7 of the Environment (Wales) Act 2016. A consideration of EMF effects on fish and shellfish resources is also provided in Volume 2, Chapter 6: Fish and Shellfish Ecology (application ref 6.2.6).

224 EMF are generated by the current that passes through an electric cable. It is known that EMF can be detected by fish and elasmobranchs and it is thought that any benthic invertebrates can also detect EMF. Three types of fields are generated by underwater electric cables: electric fields (E-fields), magnetic fields (B-fields) and induced electric fields (iE-fields). Standard industry practice is for the cables used to have sufficient shielding to contain the E-fields generated and the cable system descriptions for the inter-array and export cables have followed this (Volume 2, Chapter 1). Shielding and/or burial does not reduce the B-fields and it is these fields that allow the formation of iE-fields. As such, further reference here to EMF is limited to B-fields and associated iE-fields.

225 Impacts from changes in EMFs arising from cables, are not considered to result in a significant effect on benthic subtidal and intertidal receptors. EMFs are likely to be generated by subsea cables and detectable above background levels in close proximity to the cables. Although burial does not mask EMFs it increases the distance between species that may be affected by EMFs and the source. As the cable will be buried or protected, any behavioural responses are likely to be mitigated.

226 It is considered unlikely that EMFs would result in a significant behavioural response that would cause a change in benthic communities within the benthic subtidal ecology study area and that any potential negative effects would be confined to a localised area surrounding the cables. Therefore, the magnitude of the impact considered to be negligible, indicating that any behavioural response of benthic fauna is likely to be discernible or barely discernible over a very small area, that does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

227 The MarESA sensitivity assessments do not consider there to be sufficient evidence to support assessments of impacts of EMF on benthic and intertidal habitats; therefore, a desktop study has been undertaken to describe the typical responses of benthic invertebrates.

228 Typically, the impacts of EMF on marine organisms have focused on electrically sensitive fish and elasmobranchs, with little research focusing on benthic invertebrates, with the few studies using invertebrates focusing on crustaceans (e.g. Woodruff *et al*., 2012). Furthermore, many studies contradict each other or provide inconclusive results (Switzer and Meggitt, 2010), further reducing the available evidence.

229 However, evidence of sensing, responding to, or orienting to natural magnetic field cues has been shown for invertebrates including molluscs and arthropods (Lohman and Willows 1987; Ugolini and Pezzani 1995; Ugolini 2006; Boles and Lohmann 2003). A study by Scott *et al*., (2019) reported that edible crabs (*C. pagurus*) exposed to EMF in the laboratory at the strength predicted around sub-sea cables resulted in a clear attraction of the crabs to EMF and significantly reduced their time spent roaming. This suggests that the natural roaming behaviour, where individuals will actively seek food and/ or mates has been overridden by an attraction to the source of the EMF. The EMF had no effect on stress-related parameters, such as respiration rate or activity level, but the results predict that in benthic areas where there is increased EMFs, there will be an increase in the abundance of *C. pagurus* present.

230 A laboratory study assessing the effects of environmentally realistic, low-frequency B-field exposure on the behaviour and physiology of the common ragworm (*Hediste diversicolor*) did not find any evidence of avoidance or attraction behaviours (Jakubowska *et al*., 2019). The polychaetes did, however, exhibit enhanced burrowing activity when exposed to the B-field, with plausible consequences for their metabolism; however, knowledge about the biological relevance of this response is currently absent (Jakubowska *et al*., 2019).

231 One recent study examined the difference in invertebrate communities along an energised and nearby unenergised surface laid cables and this identified that there were no functional differences between the communities on and around the cables up to three years after installation (Love *et al*., 2016). This study also identified that the EMF levels reduce to background levels generally within one metre of the cable. This supports evidence collected from Nysted Wind Farm at Rødsand, in Denmark which, while the study focused on fish the conclusions which determined that there was no change in the overall distribution that could be attributed to the presence of the cables (Hvidt *et al*., 2004) are likely to be valid for mobile invertebrates.

232 For invertebrate receptor species, it is difficult to translate the patchwork of knowledge about individual-level EMF effects into assessments of biologically or ecologically significant impacts on populations (Boehlert and Gill, 2010). However, given the evidence presented, it is predicted that EMFs have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid.

233 No Section 7 species were identified within the baseline surveys. The sensitivity of benthic receptors is therefore considered to be low, reflecting that the receptor has a high resistance and ability to tolerate the impacts of EMF over the operational lifetime of AyM.

234 Overall, it is predicted that the sensitivity of the benthic subtidal and intertidal receptors is **low** and the magnitude is **negligible adverse**. The significance of effect is therefore ***negligible adverse***, which is not significant in EIA terms.

5.13 Environmental assessment: decommissioning phase

235 The effects of the decommissioning of AyM have been assessed on benthic and intertidal ecology in the AyM benthic ecology study area. The environmental impacts arising from the decommissioning of AyM are listed in Table 11, along with the design envelope against which each decommissioning phase impact has been assessed.

236 TWT advised during their Section 42 comments that developers have a legal requirement in the marine environment to remove cable protection through:

- Requirements to decommission under UNCLOS 1982;
- Requirements to decommission under the Energy Act 2004;
- OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations states that the leaving wholly or partly in place of disused offshore installations within the maritime area is prohibited;
- Subsea cabling sector policy of the Welsh National Marine Plan; and
- Enhanced biodiversity duty and resilience of ecosystems duty under the Environment (Wales) Act 2016.

237 The above advise from TWT will be covered by the Energy Act 2004 legal requirement and a condition on the marine licence that requires a decommissioning plan to be approved by NRW.

238 A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is provided below.

5.13.1 Temporary habitat disturbance from decommissioning of foundations, cables and rock protection

239 Temporary habitat loss/ disturbance of subtidal habitat within the AyM project area will occur as a result of the jack-up vessel operations to remove the foundations and superstructure of the wind farm infrastructure and the removal of the export and array cables.

240 The total maximum area of temporary habitat disturbance due to jack-up vessels and cable removal during decommissioning. This has not been fully quantified but is likely to closely reflect that assessed for the construction phase (see paragraph 122 *et seq*.).

241 Given that the habitats are common and widespread throughout the region, this represents a very small footprint compared to their overall extent. The impacts will be temporary and only a single event in each location; therefore, the magnitude of the impact is assessed as low.

242 The sensitivities of the species to disturbance are described in paragraph 129 *et seq*.

243 The magnitude of the impact has been assessed as **low adverse**, with the maximum sensitivity of the receptors being **low** (Table 13). Therefore, the significance of effects from direct disturbance occurring as a result of decommissioning activities is ***minor adverse***, which is not significant in EIA terms.

5.13.2 Increased SSC and sediment deposition from removal of foundations, cables and rock protection

244 Increases in SSC and sediment deposition from the decommissioning works will be similar to that for construction and are of a similar magnitude. The magnitude of the impact and the sensitivities of the benthic habitats to SSC and sediment deposition are described in detail in paragraph 122 *et seq*. and for the intertidal habitats in paragraph 137 *et seq*.

245 The magnitude of the impact has been assessed as **low adverse**, with the maximum sensitivity of the receptors being **low**. Therefore, the significance of effect from changes in SSC or sediment deposition occurring as a result of decommissioning activities in the subtidal and intertidal area is ***minor adverse***, which is not significant in EIA terms.

5.13.3 Loss of introduced habitat from the removal of foundations and rock protection

246 As detailed in paragraph 194 *et seq*., hard substrate introduced into the AyM Order Limits will become colonised by epifauna. The removal of the foundations during decommissioning would therefore remove the supporting habitats and associated communities.

247 In the event that biogenic reef (e.g. *S. spinulosa* reef) have formed on the foundations, the appropriate approach to the decommissioning of these areas will be agreed with NRW.

248 The removal of the foundations will result in a permanent loss of 1.067 km^2 of hard substrate. The effects will be strictly localised. Therefore, based on the information available at the time of writing, the expected magnitude of impact is low.

249 While the removal of the substrate will result in localised declines in biodiversity, the sediment dominated habitats that remain will be open to recolonization by the original soft benthic species. It is expected that the baseline benthic communities will recover in these areas to their pre-construction state based on the recovery rates for disturbed sediment, which, when also considering the wide distribution of the receptors throughout UK waters, would equate to a maximum sensitivity for the baseline habitats of low.

250 The magnitude of the impact has been assessed as **low adverse**, with the maximum sensitivity of the receptors being **low**. Therefore, the significance of effects from the removal of the hard substrate during decommissioning activities is ***minor adverse***, which is not significant in EIA terms.

5.14 Environmental assessment: cumulative effects assessment (CEA)

251 Cumulative effects can be defined as effects upon a single receptor from AyM when considered alongside other proposed and reasonably foreseeable projects and developments. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind projects.

252 A screening process has identified a number of reasonably foreseeable projects and developments which may act cumulatively with AyM. The full list of such projects that have been identified in relation to the offshore environment are set out in Volume 1, Annex 3.1: Cumulative Effects Assessment (application ref 6.1.3.1).

253 In assessing the potential cumulative impacts for AyM, it is important to bear in mind that some projects, predominantly those ‘proposed’ or identified in development plans, may not actually be taken forward, or fully built out. There is therefore a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, those projects under construction are likely to contribute to cumulative impacts (providing effect or spatial pathways exist), whereas those proposals not yet approved are less likely to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

254 With this in mind, all projects and plans considered alongside AyM have been allocated into 'tiers' reflecting their current stage within the planning and development process. This allows the cumulative impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. This approach also allows appropriate weight to be given to each scenario (tier) when considering the potential cumulative impact. The proposed tier structure that is intended to ensure that there is a clear understanding of the level of confidence in the cumulative assessments provided in the AyM ES. An explanation of each tier is included in Table 17.

Table 17: Description of tiers of other developments considered for CEA (adapted from PINS Advice Note 17).

TIER	PROJECT STAGE
Tier 1	Project under construction.
	Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented.
	Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined.
Tier 2	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted as well as projects that have applied for a Marine Licence from NRW.
Tier 3	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted.
	Identified in the relevant Development Plan (and emerging Development Plans with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.
	Identified in other plans and programmes (as appropriate) which set the framework for future development consents/ approvals, where such development is reasonably likely to come forward.

255 The plans and projects selected as relevant to the CEA of impacts to benthic and intertidal ecology are based on an initial screening exercise undertaken on the long list as set out in Volume 1, Annex 3.1. Consideration of effect-receptor pathways, data confidence and temporal and spatial scales has allowed the selection of the relevant projects for a topic-specific cumulative short-list. For the majority of potential effects for benthic and intertidal ecology, planned projects were screened into the assessment based on a 12 km screening range surrounding both the array and offshore ECC representing the tidal ellipse distance for a single tidal cycle and therefore encompasses the extent of impacts to benthic and intertidal ecology associated with AyM. The specific projects scoped into the CEA for benthic and intertidal ecology, as well as the tiers into which they have been allocated are presented in Table 18 below and are illustrated in Figure 11.

256 The operational projects included within the table are included due to their completion/ commissioning subsequent to the data collection process for AyM and as such not included within the baseline characterisation. Note that this table only includes the projects screened into the assessment for benthic and intertidal ecology based on the criteria outlined above. For the full list of projects considered, including those screened out, please see Volume 1, Annex 3.1.

Table 18: Projects considered within the benthic and intertidal ecology cumulative effect assessment.

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Offshore Wind Farm	GyM OWF	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1
Offshore Wind Farm	Rhyl Flats	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1
Offshore Wind Farm	North Hoyle	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Aggregate Exploration and Option Area	Liverpool Bay (1808)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Aggregate Production Area	Hilbre Swash (392)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Aggregate Production Area	Hilbre Swash (393)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Aggregate Production Area	Liverpool Bay (457)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Offshore Wind Farm Export Cable	GyM OWF Offshore Transmission Operator (OFTO)	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Offshore Wind Farm Export Cable	Rhyl Flats	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Offshore Wind Farm Export Cable	North Hoyle	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Interconnector	Geo-Eirgrid (East West Interconnector)	Active	Medium - Third party project details	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
			published in the public domain but not confirmed as being 'accurate'	
Telecommunication Cable	Western HVDC Link	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Gas)	DD-POA Gas Export (PL1030)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Methanol)	POA-DD Methanol (PL1033)	Active	Medium - Third party project details published in the public domain but not	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
			confirmed as being 'accurate'	
Pipeline Eni (Condensate)	POA-DD Condensate (PL1032)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Tailwind (Oil)	Conwy to Douglas Oil Export (PL2939)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Tailwind (Water)	Douglas to Conwy Water Injection (PL2940)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1

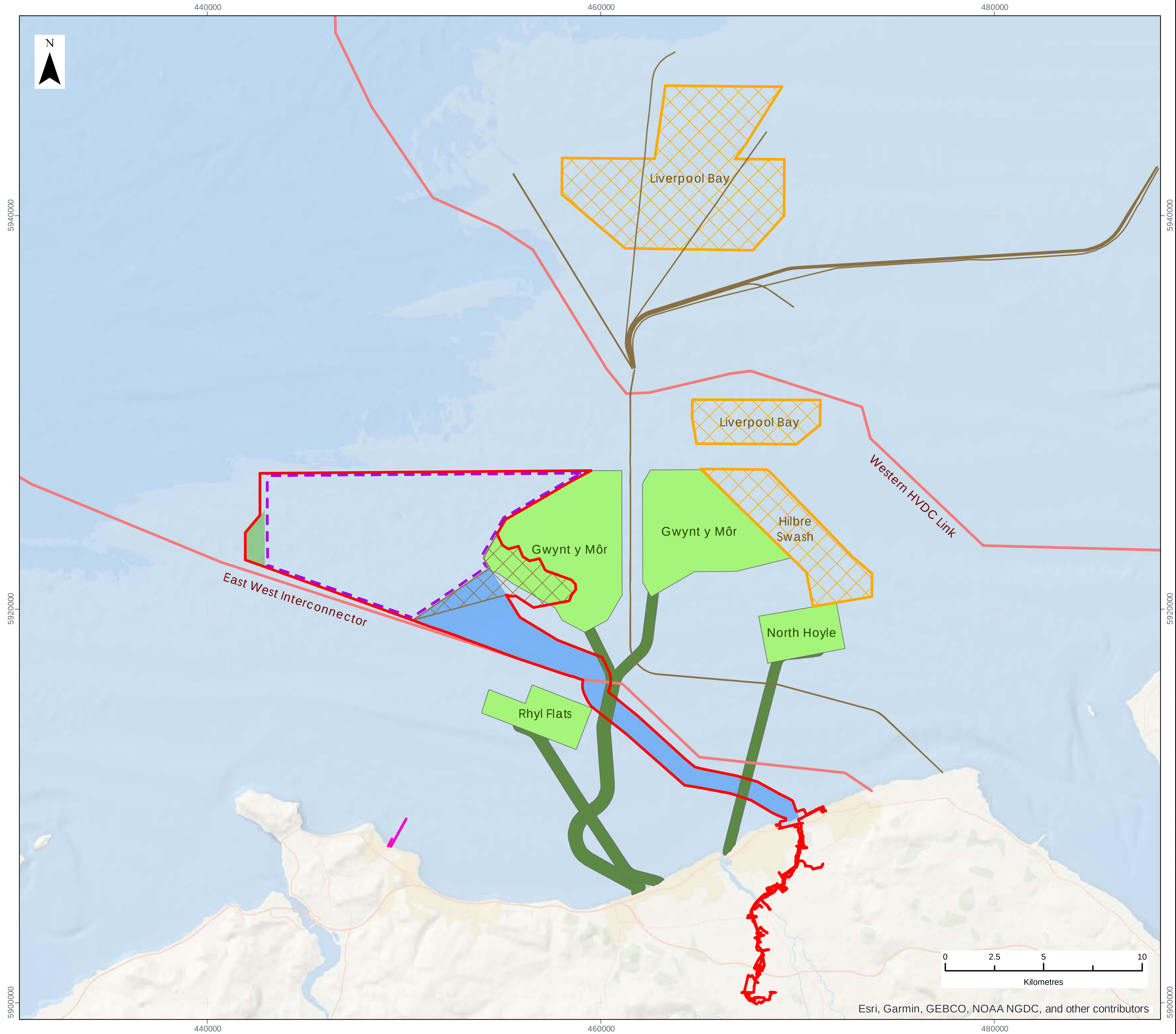
DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Pipeline Tailwind (Condensate)	Douglas to Conwy Condensate Injection (PL2941)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Tailwind (Fibre)	Douglas to Conwy Umbilical (PLU2942)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Oil)	Douglas to CACM (PL1031)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Gas)	Hamilton to Douglas Gas Line (PL1039)	Active	Medium - Third party project details	Tier 1

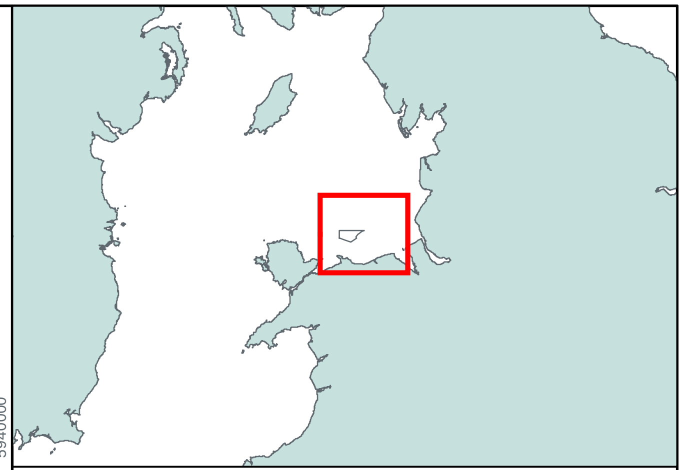
DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
			published in the public domain but not confirmed as being 'accurate'	
Pipeline Eni (Gas)	Hamilton North to Douglas Gas Line (PL1041)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Chemical)	Douglas to Hamilton North (PL1042)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Gas)	Douglas to Lennox Gas Line (PL1036A)	Active	Medium - Third party project details published in the public domain but not	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
			confirmed as being 'accurate'	
Pipeline Eni (Gas)	Lennox to Douglas Gas Line (PL1035)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Chemical)	Douglas to Lennox Chemical Line (PL1037)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Pipeline Eni (Chemical)	Douglas to Hamilton (PL1040)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Pipeline Eni (Chemical)	Douglas to Lennox Chemical Line (PL1038)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Oil and Gas - Eni Accommodation Jackup	Douglas DA	Operational	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Oil and Gas platform – Eni Production Steel	Douglas DP	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Oil and Gas platform – Eni Wellhead Steel	Douglas DW	Active	Medium - Third party project details	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
			published in the public domain but not confirmed as being 'accurate'	
Outfall pipe	MTF_INDUSTRIAL.23044	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Outfall pipe	MTF_INDUSTRIAL.23045	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1





LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Offshore Wind Farm
- Offshore Wind Farm Export Cable
- Subsea Cable
- Aggregate Area
- Oil and Gas Surface Feature
- Pipeline
- Outfall Pipe

Data Source:
OWFs, OWF Export Cables and Aggregate from The Crown Estate.
Oil and Gas Data from the Oil and Gas Authority
Subsea Cables fro KISORCA. Outfall Pipes from OceanWise Marine Themes data

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Projects Screened into the Cumulative Effect Assessment

VER	DATE	REMARKS	Drawn	Checked
1	09/09/2021	For Issue For PEIR	BPHB	RM
2	03/03/2022	For Issue For ES	BPHB	KJ

FIGURE NUMBER:

Figure 11

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:200,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth AWEL Y MÔR Offshore Wind Farm

G:\GIS\GIS_Projects\0141 AyM\GIS\Figures\ES\Benthic\AyM_BE_Fig11_Cumulative_Projects.mxd

257 Certain impacts assessed for the project alone are not considered in the cumulative assessment due to:

- The highly localised nature of the impacts (i.e. they occur entirely within the AyM Order Limits only);
- Management measures in place for AyM will also be in place on other projects reducing the risk of impacts occurring; and/ or
- Where the potential significance of the impact from AyM alone has been assessed as negligible.

258 The impacts excluded from the CEA for the above reasons are:

- Construction phase:
  - Direct and indirect seabed disturbances leading to the release of sediment contaminants: the potential significance of the impact from AyM alone has been assessed as not significant.
- O&M phase:
  - Increased risk of introduction or spread of INNS due to presence of subsea infrastructure and vessel movements (e.g. ballast water) may affect benthic ecology and biodiversity: the potential significance of the impact from AyM alone has been assessed as not significant.

259 The impacts that have been considered in the CEA are as follows:

- Construction phase:
  - Temporary habitat disturbance; and
  - Temporary increase in SSC and sediment deposition.
- O&M phase:
  - Direct disturbance to seabed from jack-up vessels and cable maintenance activities: the impact is highly localised in nature;
  - Long-term habitat loss/ change from the presence of foundations, scour protection and cable protection;
  - Colonisation of the WTGs and scour/ cable protection may affect benthic ecology and biodiversity; and
  - Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities.

260 The cumulative MDS described in Table 19 have been selected as those having the potential to result in the greatest cumulative effect on an identified receptor group. The cumulative impacts presented and assessed in this section have been selected from the details provided in the project description for AyM, as well as the information available on other projects and plans in order to inform a cumulative MDS. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project design envelope to that assessed here, be taken forward in the final design scheme.

Table 19: Cumulative MDS.

POTENTIAL EFFECT	SCENARIO	JUSTIFICATION
Cumulative temporary habitat disturbance	Tier 1: - Aggregate production/ exploration (Liverpool Bay (1808, 457) and Hilbre Swash (392, 393)). - Tier 2: No Tier 2 projects identified. - Tier 3: No Tier 3 projects identified.	If these intermittent activities overlap temporally with either the construction or maintenance of AyM, there is potential for cumulative temporary habitat loss/ disturbance.
Cumulative temporary increase in SSC and sediment deposition	Tier 1: - Aggregate production/ exploration (Liverpool Bay (1808, 457) and Hilbre Swash (392, 393)). - Tier 2: No Tier 2 projects identified. - Tier 3: No Tier 3 projects identified.	If these intermittent activities overlap temporally with either the construction or maintenance of AyM, there is potential for cumulative SSC and sediment deposition to occur within the modelled plume footprints.
Cumulative colonisation of the WTGs and scour/ cable protection by INNS may affect benthic ecology and biodiversity	Tier 1: - O&M of OWFs (GyM, Rhyl Flats and North Hoyle); - Maintenance of operational cables and pipelines (e.g. telecommunications, OWFs, interconnectors, oil and gas); and - Operational oil and gas platform (Douglas). - Tier 2: No Tier 2 projects identified. - Tier 3: No Tier 3 projects identified.	The operational and maintenance of these projects will result in a cumulative increase in the number of vessel movements and the potential for transport of INNS, as well as cumulatively increase the area/ volume of hard substructures and cable/ scour protection available for potential colonization by INNS, which may impact benthic ecology and biodiversity.

261 A description of the significance of cumulative effects upon benthic and intertidal ecology arising from each identified impact is given below.

5.14.1 Cumulative temporary habitat disturbance

262 There is potential for cumulative temporary habitat disturbance as a result of both the construction and maintenance activities associated with AyM and aggregate production/ exploration sites (Table 18). For the purposes of this assessment, this additive impact has been assessed from projects that fall within a 12 km of the AyM array and offshore ECC area. All of the projects identified as having the potential to contribute to cumulative temporary habitats disturbance are Tier 1 projects. There are no Tier 2 of Tier 3 projects.

263 The AyM Order Limits does not overlap with any of the aggregate sites, the nearest is c. 5 km to the east of AyM. The impacts from both the construction and operation of AyM and from aggregate extraction activities are predicted to be local spatial extent, short-term, intermittent and reversible. The magnitude of impacts from the Tier 1 projects identified is therefore considered to be low.

264 However, cumulative effects can also be considered in terms of duration of exposure from multiple projects which do not overlap but happen consecutively. As the effects from the projects will be short-lived, and due to the resilience of the sedimentary biotopes to this type of impact (Section 5.11), concurrent cumulative effects are not expected.

265 Full discussions on the sensitivity of benthic ecology receptors in the AyM benthic ecology study area are presented in Sections 5.15 and 280 which conclude that benthic habitats have a low vulnerability. The maximum sensitivity of receptors in the area is therefore assessed as **low**, with a **low adverse** magnitude of impact; this will result in a ***minor adverse*** significance of effect (in accordance with Table 7: Matrix to determine effect significance.). It is therefore concluded that the significance of effect from temporary habitat disturbance of AyM cumulatively is not significant in EIA terms.

5.14.2 Cumulative increases in SSC and associated sediment deposition

266 There is potential for cumulative increases in SSC and associated sediment deposition as a result of construction activities associated with AyM, and aggregate extraction sites (Table 20). For the purposes of this assessment, this additive impact has been assessed from projects that fall within a 12 km of the AyM array and offshore ECC area. All of the projects identified as having the potential to contribute to cumulative temporary SSCs and deposition are Tier 1 projects. There are no Tier 2 or Tier 3 projects.

267 The SSC plumes generated during the construction (or operation) of AyM are not predicted to reach the nearest aggregate site which is c. 5 km to the east in any levels which are discernible from background levels (< 5 mg/l) (Volume 4, Annex 2.3). Sediment plumes are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Sediment deposition will consist primarily of coarser sediments deposited close to the source, with a small proportion of silt deposition (reducing exponentially from source). The magnitude of impacts from the Tier 1 projects identified are therefore considered to be low.

268 Any activities generating elevated SSCs and deposition during the operational/ active phases of the projects will be short-term, intermittent and localised to the site and therefore any cumulative impacts are expected to be minimal. Therefore, taking this into consideration, there are not predicted to be any significant cumulative effects in respect of SSCs or deposition.

269 Cumulative effects can also be considered in terms of duration of exposure from multiple projects which do not overlap but happen consecutively. As the effects from the projects will be short-lived and extremely intermittent, and due to the resilience of the sedimentary biotopes to this type of impact (Section 5.11), concurrent cumulative effects are not expected.

270 Full discussions on the sensitivity of benthic ecology receptors in the AyM benthic ecology study area to SSC and deposition are presented in paragraphs 5.15 and 280 which conclude that benthic habitats have a maximum of low vulnerability. The maximum sensitivity of receptors in the area is therefore assessed as **low**, with a **low adverse** magnitude of impact; this will result in a ***minor adverse*** significance of effect (in accordance with Table 7: Matrix to determine effect significance.). It is therefore concluded that the significance of effect from cumulative elevated SSC and deposition is not significant in EIA terms.

5.14.3 Cumulative long-term habitat loss

271 Cumulative long-term habitat loss is predicted to occur as a result of the presence of AyM infrastructure, operational offshore wind farms, cables and pipelines and oil and gas platforms within a representative 12 km buffer of the AyM array and offshore ECC. Long term habitat loss may result from the physical presence of foundations, scour protection and cable/ pipeline protection, which are assumed to be in place for the lifetime of the relevant projects and potentially beyond the lifetime of these projects. Although a number of projects overlap with the AyM benthic ecology study area, many of these are cables and interconnectors which are buried below the seabed and therefore do not represent long term habitat loss.

272 While the cumulative impact of long-term habitat loss will be locally significant and comprise a long-term or permanent change in seabed habitat within the footprint of the structures, the footprint of the area affected is highly localised. It is expected that the impacts are reversible following removal of any of the hard substrate, where this might occur however is less certain. As the habitats and characterising biotopes are common and widespread throughout the wider region, the loss of these habitats is predicted to result in a slight alteration of the receptor that does not diminish regional ecosystem functions. The magnitude of loss is therefore assessed as negligible.

273 As previously discussed in impact Section 5.11, the sensitivity of benthic ecology receptors to long-term or permanent habitat loss/ change concludes that all benthic receptors have no resistance to long-term or permanent habitat loss/ change, with recovery assessed as very low as the change at the pressure benchmark is at worst-case permanent. The sensitivity of subtidal receptors is therefore considered to be at worst-case high according to the MarESA assessment values. However, given the widespread distribution of the receptors around the UK (and in the wider North-East Atlantic) the overall sensitivity has been assessed as medium.

274 The maximum sensitivity of receptors in the area has been assessed as **medium**. Given a **negligible adverse** magnitude of impact it is concluded that the significance of effect from long-term habitat loss of AyM cumulatively with Tier 1 projects will result in a ***minor adverse*** significance which is not significant in EIA terms (in accordance with Table 7).

5.14.4 Cumulative colonisation of the WTGs and scour/ cable protection, including by INNS, may affect benthic ecology and biodiversity.

275 There is potential for cumulative impacts from colonisation of the WTG foundations and scour/ cable protection to affect benthic ecology and biodiversity. For the purposes of this assessment, this additive impact has been assessed within a representative 12 km buffer surrounding the array area and offshore ECC. All of the projects identified as having the potential to contribute to this effect are Tier 1 projects. There are no Tier 2 or Tier 3 projects.

276 The cumulative impact of colonisation of the WTGs and scour/ cable protection on benthic ecology is predicted to be of local spatial extent, long-term duration but reversible once the infrastructure is removed. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

277 The sensitivities of the benthic habitats and VERs to the introduction of new hard substrate is described in Section 5.11, which concludes that the soft sediment biotopes likely to be affected by an increase in species diversity are deemed to be of low vulnerability, high recoverability (once the hard substrate is removed) and local to regional value. The sensitivity of these receptors is therefore, considered to be low.

278 Any beneficial effects associated with an increase in biodiversity will be highly localised in nature and is not regarded as mitigation for the loss of sedimentary habitat associated with the installation of these structures. The introduction of hard structures such as scour protection can lead to an increase in biomass and biodiversity which may be considered beneficial, but it also represents a change from the baseline environment which may be considered adverse. Overall, it is predicted that the sensitivity of the receptor is **low** and the magnitude is **low adverse**. The potential effect is therefore of ***minor adverse*** significance, which is not significant in EIA terms.

279 There is little evidence to date from other OWF development having any adverse effects on key species and habitats. It is not possible to predict whether the spread of such specie will occur and to what extent, if any. However, for most offshore projects the implementation of designed-in measures will ensure that the risk of potential introduction and spread of INNS is minimised. Taking into consideration the designed-in measures including a biosecurity plan, the impact of INNS on biotopes and VER within the AyM benthic subtidal ecology study area is predicted to be of very low spatial extent, long term duration, continuous and irreversible. The magnitude of this impact is considered to be **low**. The sensitivity of the subtidal receptors has been assessed as **low**, the significance of the impact is therefore ***minor adverse*** which is not significant as defined in the assessment of significance matrix (Table 7).

5.15 Inter-relationships

280 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, O&M, and decommissioning); to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. subsea noise effects from piling, operational WTGs, vessels and decommissioning); and

- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on benthic ecology such as direct habitat loss or disturbance, sediment plumes, scour, jack-up vessel use etc., may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short-term, temporary or transient effects, or incorporate longer term effects.

281 A description of the likely inter-related effects arising from AyM on benthic ecology is provided in Volume 2, Chapter 14: Inter-Related Effects (application ref 6.2.14), with a summary of assessed inter-relationships provided below.

282 Potential inter-relationships exist between benthic subtidal and intertidal ecology and:

- Fish and shellfish – impacts to benthic ecology may affect the food resource of fish;
- Water quality – impacts on water quality may result in impacts on benthic ecology; and
- Commercial fisheries – impacts on benthic ecology may impact on the catch of commercial fisheries.
- Ornithology – impacts on benthic communities may impact bird populations dependent upon them as a food resource.

5.16 Transboundary effects

283 Transboundary effects are defined as those effects upon the receiving environment of other European Economic Area states, whether occurring from AyM alone, or cumulatively with other projects in the wider area. A screening of potential transboundary effects was undertaken at Scoping which identified that there was no potential for significant transboundary effects to occur in relation to benthic and intertidal ecology.

5.17 Summary of effects

284 This chapter has investigated the potential effects on intertidal and subtidal benthic ecology receptors arising from AyM. The range of potential impacts and associated effects has been informed by scoping responses and consultation responses from stakeholders, alongside reference to existing legislation and guidance.

285 The benthic habitat types present in the area of the AyM Order Limits are widespread in the surrounding area and the impacts of the construction of OWFs and associated infrastructure are well studied. The impacts considered include those brought about directly (e.g. by the presence of infrastructure on the seafloor) and indirectly (e.g. increased SSC from installation methods). Potential impacts considered in this chapter are listed below (Table 20).

286 Cumulative impacts were also considered, and an assessment was carried out examining the potential for interaction of direct and indirect impacts (including the interaction of sediment plumes) as a result of the combined activities of AyM and other activities in the study area. This includes the installation of interconnector cables and aggregate extraction sites.

287 These potential impacts have been investigated using a combination of methods including analytical techniques, the existing evidence base and numerical modelling. In accordance with the requirements of the Rochdale Envelope approach to EIA, the worst-case characteristics of the proposed development have been considered thereby providing a highly conservative assessment.

288 Even based on this conservative assessment approach, it has been found that all impacts arising from the construction, O&M and decommissioning of AyM (including cumulatively) on intertidal and subtidal benthic ecology receptors will result in a maximum level of effect significance of minor adverse (Table 20). The potential effects to intertidal and subtidal benthic ecology receptors are therefore not significant in terms of the EIA Regulations (Volume 1, Chapter 3: Environmental Impact Assessment Methodology (application ref 6.1.3)).

289 Table 20 presents a summary of the significant impacts assessed within this ES, any mitigation and the residual effects.

Table 20: Summary of effects.

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR	MITIGATION MEASURES	RESIDUAL EFFECT
CONSTRUCTION				
Temporary habitat disturbance (in the AyM array area and offshore ECC)	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)
Temporary habitat disturbance (in the intertidal)	Low adverse	Negligible to Low	None proposed beyond existing comments.	Minor adverse (not significant)
Temporary increase in SSC and associated sediment deposition (in the offshore ECC and array)	Low adverse	Medium	None proposed beyond existing comments.	Minor adverse (not significant)
Temporary increase in SSC and associated deposition (in the intertidal)	Low adverse	Medium	None proposed beyond existing comments.	Minor adverse (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR	MITIGATION MEASURES	RESIDUAL EFFECT
Direct and indirect seabed disturbances leading to the release of sediment contaminants	Negligible adverse	Low	None proposed beyond existing comments.	Negligible adverse (not significant)
Increased risk of introduction or spread of Invasive Non-Native Species (INNS)	Negligible adverse	Low	None proposed beyond existing comments.	Negligible adverse (not significant)
Long-term habitat loss/ change from the presence of foundations, scour protection and cable protection	Negligible adverse	High	None proposed beyond existing comments.	Minor adverse (not significant)
OPERATION				
Colonisation of the WTGs and scour/ cable protection may affect	Negligible adverse	Medium	None proposed beyond existing comments.	Minor adverse (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR	MITIGATION MEASURES	RESIDUAL EFFECT
benthic ecology and biodiversity				
Increased risk of introduction or spread of marine Invasive Non-Native Species (INNS) due to presence of infrastructure and vessel movements (e.g. the discharge of ballast water) may affect benthic ecology and biodiversity	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)
Temporary habitat disturbance associated with maintenance	Negligible adverse	Low	None proposed beyond existing comments.	Negligible adverse (not significant)
Changes to seabed habitats arising from effects on physical processes, including	Negligible to Low adverse (as detailed in Volume 2, Chapter 2)	Negligible	None proposed beyond existing comments.	Negligible adverse (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR	MITIGATION MEASURES	RESIDUAL EFFECT
scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities				
Indirect disturbance of benthic species from Electromagnetic Fields (EMF) generated by inter-array and export cables	Negligible adverse	Low	None proposed beyond existing comments.	Negligible adverse (not significant)
DECOMMISSIONING				
Temporary habitat disturbance from decommissioning of foundations, cables and rock protection	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR	MITIGATION MEASURES	RESIDUAL EFFECT
Increased SSC and sediment deposition from removal of foundations, cables and rock protection	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)
Loss of introduced habitat from the removal of foundations and rock protection	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)
CUMULATIVE EFFECTS				
Cumulative temporary habitat loss/ disturbance	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)
Cumulative temporary increase in SSC and sediment deposition	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)
Cumulative long-term habitat loss/ change from presence of	Negligible adverse	Medium	None proposed beyond existing comments.	Minor adverse (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR	MITIGATION MEASURES	RESIDUAL EFFECT
foundations and scour protection and cable protection				
Cumulative colonisation of the WTGs and scour/ cable protection, including by INNS, may affect benthic ecology and biodiversity	Low adverse	Low	None proposed beyond existing comments.	Minor adverse (not significant)

5.18 References

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