# Awel y Môr Offshore Wind Farm

# Category 8: Other Documents

## Disposal Site Characterisation

Date: April 2022

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# Glossary of terms

| TERM | DEFINITION |
|---|---|
| Array area | The area where the Wind Turbine Generators (WTGs), Offshore Substation Platforms (OSPs), associated foundations, inter-array cables, inter-platform cables, export cables (including the GyM interlink cable), a meteorological mast (met mast) (or suitable alternative such as floating LiDAR) and Permanent Vessel Moorings (PVMs) may be located. |
| Bedforms | Features on the seabed (e.g. sandwaves, ripples) resulting from the movement of sediment over it. |
| Benthic | A description for flora and fauna associated with the seabed. Flora and fauna that lie in, on or near the seabed are termed 'benthos'. |

| TERM | DEFINITION |
|---|---|
| Biotope | The combination of physical environment (habitat) and its distinctive assemblages of conspicuous species. |
| Development Consent Order (DCO) | An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS) for Business, Energy and Industrial Strategy (BEIS). |
| Design envelope/ Maximum Design Scenario (MDS) | The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to the impacts assessed. |
| The 'GyM interlink' zone | An area that extends from the AyM array into the GyM array to facilitate connection from one of the AyM OSPs or a WTG to the western GyM OSP. |
| Habitat | The place in which an animal or plant lives. In the marine environment, this is defined according to geographical location, physiographic features and the physical and chemical environment, including salinity, wave exposure, tidal currents, geology, substrate, biological zone, features and modifiers. |
| 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. |
| Hydrodynamic | Of or relating to the motion of fluids and the forces acting on solid bodies immersed in fluids and in motion relative to them. |
| Infauna | Animals living in the seabed sediment. |

| TERM | DEFINITION |
|---|---|
| Inter-array cables | Offshore cables that link individual WTGs within the AyM site. |
| Inter-platform cables | Offshore cables that link offshore substation platforms within the AyM site. |
| Intertidal | Area of seashore that is covered at high tide and uncovered at low tide. |
| Marine Licence | A licence under the Marine and Coastal Access Act 2009 for marine works in Welsh waters which is administered by the Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers. |
| Offshore export cables | The cables which transmit power from the offshore substation platform to the onshore cable circuits at landfall between Rhyl and Prestatyn. |
| Offshore Export Cable Corridor (ECC) | The area where the offshore export cables will be installed, bringing power generated to the onshore cable circuits at landfall between Rhyl and Prestatyn. |
| Order Limits | The limits within which AyM (the authorised project) may be carried out. |
| Other Wind Farm Infrastructure' Zone (OWFIZ) | An area to the west of the array area, which will preclude WTGs and OSPs but will allow for a met mast, inter-array cables and PVMs. |
| Scour | Local erosion of sediments caused by local flow acceleration around an obstacle and associated turbulence enhancement. |
| Suspended Sediment Concentration | Mass of sediment in suspension per unit volume of water. |

| TERM | DEFINITION |
|---|---|
| Traffic Separation Scheme (TSS) | A traffic-management route-system established by the International Maritime Organization (IMO) comprising traffic-lanes indicating the general direction of the vessels in that zone; vessels navigating within a TSS lane all transit in the same direction or cross the lane in an angle as close to 90 degrees (°) as possible. |

# Abbreviations and acronyms

| TERM | DEFINITION |
|---|---|
| BEIS | Department for Business, Energy and Industrial Strategy |
| BSL | Below Sea level |
| CFE | Controlled Flow Excavation |
| DCO | Development Consent Order |
| ECC | Export Cable Corridor |
| EIA | Environmental Impact Assessment |
| ES | Environmental Statement |
| GBS | Gravity Base System |
| HDD | Horizontal Directional Drilling |
| IMO | International Maritime Organization |
| MDS | Maximum Design Scenario |
| MFE | Mass Flow Excavation |
| NRA | Navigational Risk Assessment |
| NRW | Natural Resources Wales |

| TERM | DEFINITION |
|---|---|
| NSIP | Nationally Significant Infrastructure Project |
| OSP | Offshore Substation Platforms |
| OWF | Offshore Wind Farm |
| PCBs | Polychlorinated biphenyls |
| PAHs | Polycyclic Aromatic Hydrocarbon |
| PVM | Permanent Vessel Moorings |
| ROV | Remotely Operated Vehicle |
| SAC | Special Area of Conservation |
| SPA | Special Protection Area |
| SPM | Suspended Particulate Matter |
| SSC | Suspended Sediment Concentrations |
| TEL | Threshold Effect Level |
| TSHD | Trailing Suction Hopper Dredger |
| TSS | Traffic Separation Scheme |
| WTGs | Wind Turbine Generators |

# Units

| UNIT | DEFINITION |
|---|---|
| km | Kilometre |
| $km^2$ | Square kilometre |
| NM | Nautical mile |
| m | Metre |

| UNIT | DEFINITION |
|---|---|
| $m^2$ | Square metre |
| $m^3$ | Cubic metre |
| mm | Millimetre |
| m/s | Metres / second |
| Mg/l | Milligram / litre |
| MW | Megawatt |

# 1 Introduction

## 1.1 Purpose of document

1 This document has been drafted by GoBe Consultants to provide the licensing authorities with the necessary information to permit disposal of material associated with the construction of Awel y Môr offshore wind farm (hereafter referred to as AyM).

2 This document represents the site characterisation for the proposed disposal site associated with the construction of AyM.

3 Site characterisation is the process whereby a proposed marine disposal site for spoil material and drill arisings generated by construction activities is described in terms of the existing environment, using all available data sources. In order to provide the necessary information to permit disposal, in the event Natural Resources Wales (NRW) consider a formally licenced disposal site necessary, the Applicant has opted to provide a site characterisation report to NRW, to inform the decision-making process and to allow the licensing of the proposed disposal site as well as facilitating the consideration of the need for any relevant conditions in relation to the disposal activity within the Marine Licence and/or Development Consent Order (DCO) for AyM.

4 This document outlines the site characterisation for a proposed disposal site in the array area. The disposal will involve material originating from dredging, drilling and sand wave clearance activities associated with the construction of AyM.

5 The following information is provided:

- The dredged and/ or drilled material characteristics;
- The disposal site characteristics;
- The assessment of potential effects; and
- The reasons for the site selection.

6 This site characterisation report has been provided to enable NRW to consider including relevant conditions covering the disposal activity within the Marine Licence for AyM. Therefore, the Marine Licences granted by NRW would cover the deposit of all substances and articles (including spoil) and the carrying out of works, involved in the construction of the generating station and associated development.

7 Noting that all the information required for site characterisation to support a disposal application is contained within the AyM Environmental Statement (ES), this report avoids duplication, by providing a summary of the key points relevant to site characterisation and refers the reader back to the more detailed information and data presented within various sections of the ES. This document provides a standalone characterisation but should be read in conjunction with the ES.

## 1.2 Project overview

8 The Applicant is proposing to develop AyM, a 'sister project' to the existing and operational Gwynt y Môr Offshore Wind Farm (GyM). The proposed development will be located 11 km north of Llandudno and 10 km off the Welsh coast in the Irish Sea with a total proposed array area of 78 km$^2$. AyM will consist of both onshore and offshore infrastructure including 34-50 WTGs, export cables to landfall, interlink cables with the already existing GyM and connection to the electricity transmission network. The location for AyM is outlined in Figure 1. Details of the project design can be found in Volume 2: Chapter 1: Offshore Project Description (application ref: 6.2.1).

9 The array area includes where the Wind Turbine Generators (WTGs), Offshore Substation Platforms (OSPs), associated foundations, inter-array cables, inter-platform cables, export cables (including the GyM interlink cable), a meteorological mast (met mast) and Permanent Vessel Moorings (PVMs) may be located. Additionally, the 'Other Wind Farm Infrastructure' Zone (OWFIZ) is an area to the west of the array area, which will preclude WTGs and OSPs but will allow for a met mast, inter-array cables and PVMs.

10 The offshore ECC includes the area where the offshore export cables will be installed, bringing power generated to the onshore cable circuits at landfall between Rhyl and Prestatyn.

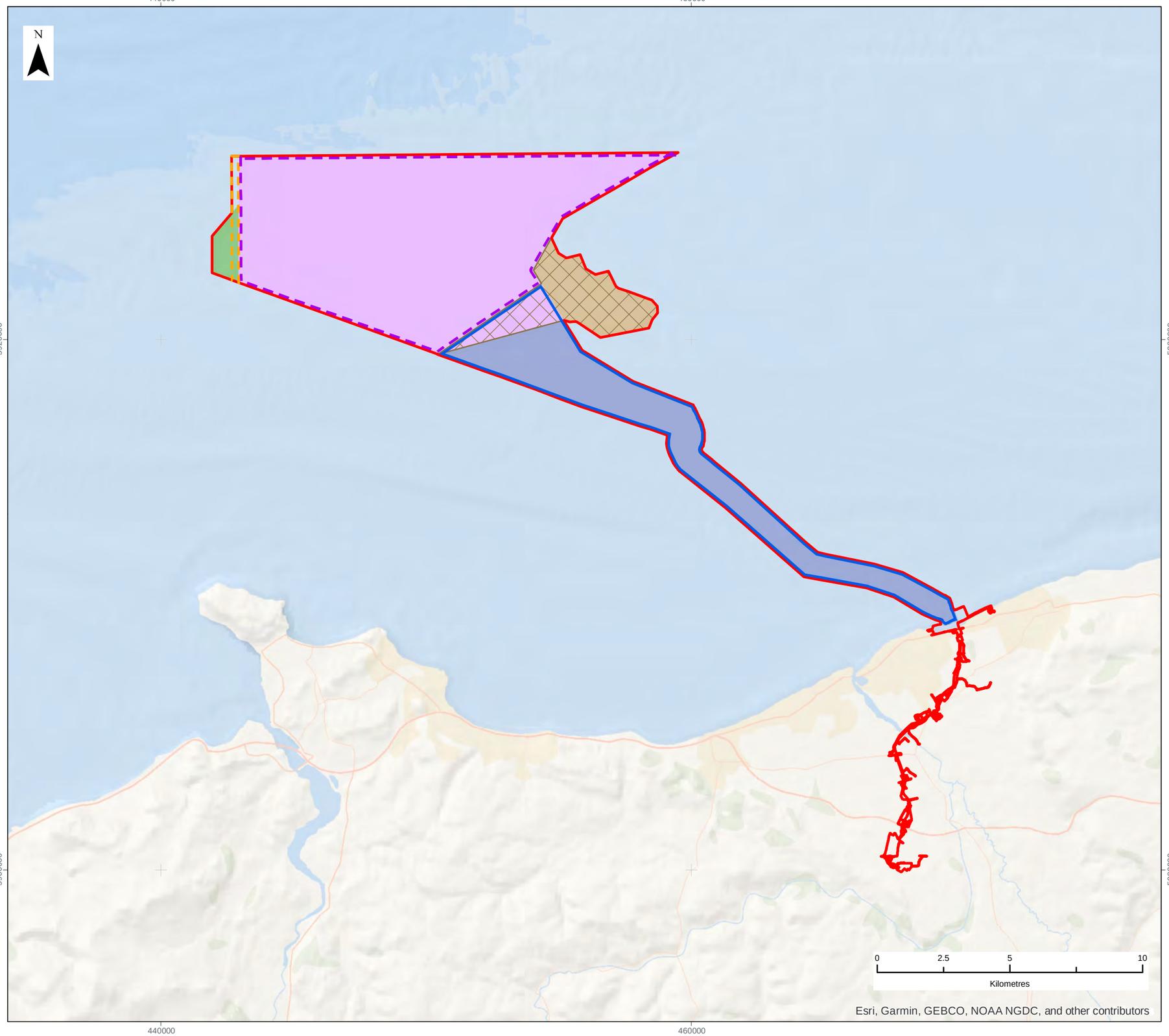
11 The 'GyM interlink' zone is the area that extends from the AyM array into the GyM array to facilitate connection from one of the AyM OSPs or a WTG to the western GyM OSP.

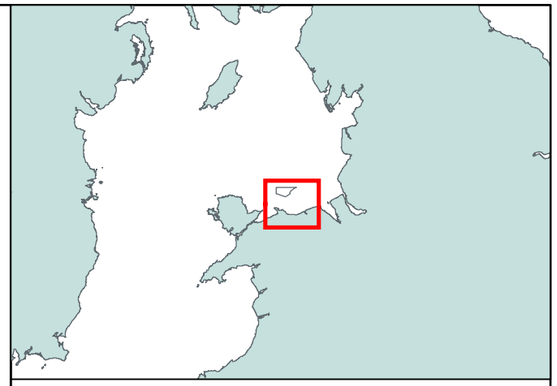
12 The location of the proposed sites is presented in Figure 1.

13 Six foundation options are being considered for use on the project. The options themselves and their intended use is detailed below in Table 1. An alternate monopile configuration is considered for OSPs, and the two scenarios are detailed in full within Volume 2, Chapter 1.

Table 1: Foundation options for use on AyM

| FOUNDATION OPTIONS | AYM INFRASTRUCTURE | | |
|---|---|---|---|
| | WTG | OSP | MET MAST |
| Monopile | ✓ | ✓ | ✓ |
| Alternative monopile configuration | × | ✓ | × |
| Multi-leg pin-piled jacket | ✓ | ✓ | × |
| Mono suction caisson | ✓ | × | × |
| Multi-leg suction caisson jacket | ✓ | ✓ | × |
| Mono GBS | ✓ | ✓ | × |
| Multi-leg GBS jacket | ✓ | ✓ | × |



LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Subsea Infrastructure and Temporary Works Area
- GyM Interlink Zone
- Array Disposal Area
- ECC Disposal Area
- GyM Disposal Area

Data Source:

PROJECT TITLE:

*AWEL Y MÔR OFFSHORE WINDFARM*

FIGURE TITLE:

## AyM Order Limits

| VER | DATE | REMARKS | Drawn | Checked |
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| 1 | 28/02/2022 | For Issue | BPHB | RM |
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## Figure 1

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

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AWEL Y MÔR
Offshore Wind Farm

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# 2 Predicted source and spoil amounts

## 2.1 Sources of spoil

14 Spoil will be generated from the installation of the foundation types listed in Table 1.

15 The source of material proposed to be disposed of within the array will be dredged material as part of foundation seabed preparation works and cable installation preparation. Spoil created by dredging will be disposed of adjacent to the dredging location within the array area or within a nominated disposal area in close proximity and will be discharged at the sea surface settling rapidly to the seabed.

### Seabed preparation

16 For those foundation types that may require seabed preparation (i.e. all foundation types excluding monopiles), any soft mobile or unlevel sediment in the area of installation may need to be removed to create a firm, stable and level seabed prior to foundation installation.

17 Methods for seabed preparation include Mass or Controlled Flow Excavation (MFE/ CFE) or dredging (such as Trailing Suction Hopper Dredging (TSHD), backhoe dredging or water injection dredging). The design envelope for seabed preparation for the different foundation types is discussed in detail within the foundation-specific sections in Volume 2, Chapter 1. Typically, surface sediments (sands and gravels) will be removed by a dredger which will subsequently release the dredged sediment at the water surface or via discharge pipes, within the array area, usually adjacent to the foundation locations.

18 Some foundations, in particular larger Gravity Base System (GBS) foundations, need to be placed on prepared areas of seabed due to their size. Seabed preparation involves levelling and/ or dredging of soft mobile sediments as required, as well as boulder and obstacle removal. It is likely that dredging would be required in the case of GBS foundations. GBS foundations installed in the array may require seabed preparation, with dredging to an average depth of ~2 m. If required, this would be carried out by dredging vessels and the spoil would be deposited on the seabed within a licensed disposal area within the array. In some cases, it may be required to place a layer of gravel on the seabed prior to the installation of GBS foundations to provide a clear, level surface.

19 Depending on ground conditions within the AyM array area, drilling may be required to install piles to their target depth for those WTG and OSP foundation types involving piling (i.e. monopiles or piled jackets). Spoil created by drilling will normally be disposed of adjacent to the foundation location (i.e. the drilling location) and will be discharged at the sea surface settling rapidly to the seabed.

## Cable installation preparation – sandwave clearance and pre-trenching

20 Cables carrying the electrical current generated by WTGs will link WTGs, PVMs and the met mast together and on to an OSP.

21 Possible installation methods for array cables include:

- Simultaneous lay and burial via ploughing, cutting or jetting;
- Post-lay burial via cutting, jetting, MFE or dredging (TSHD, backhoe dredging or water injection dredging); and
- Installation following pre-installation ploughing or trenching.

22 Prior to the installation of cables (array, export, inter-platform cables and interlink cables), seabed preparation in the form of sandwave clearance and pre-trenching may be required to facilitate the use of cable installation equipment within its operational tolerances and to reduce stress on the cable by maximising the bending radius. These activities also reduce the chance of unsuccessful cable installation and increases the likelihood of installation to the maximum target burial depth.

23 As with seabed preparation described above, sandwave clearance may be undertaken by techniques such as a suction hopper dredger or backhoe dredger, which will subsequently release material at the sea surface or via discharge pipes and will be composed of surficial sediments. Alternatively, the seabed may be levelled by the use of MFE/ CFE.

24 Cables are required to carry the electrical current generated by the WTGs to the OSPs to the onshore cable circuits at landfall between Rhyl and Prestatyn.

25 The maximum total of offshore ECC is 80 km (including offshore inter-platform cable length and the offshore interlink cable length). A section of the export cable is installed within the array area and this proportion of the spoil will be disposed of in the array disposal site.

26 Possible installation methods for offshore export cables include:

- Simultaneous lay and burial via ploughing, cutting or jetting;
- Post-lay burial via cutting, jetting, ploughing, MFE or dredging (TSHD, backhoe dredging or water injection dredging); and
- Installation following pre-installation ploughing, cutting or trenching.

27 A single interlink cable may be installed to connect one of the AyM WTGs or an AyM OSP to the western GyM OSP, to be installed within the AyM array and the GyM interlink zone.

28 Where the interlink cable approaches the GyM OSP, existing rock protection will need to be manipulated to enable the cable to be safely installed. This will involve manipulating a maximum of 100 $m^3$ of existing rock protection around the GyM OSP using divers, Remotely Operated Vehicle (ROV) or a remote arm from a surface vessel. The installation method for the interlink cable is identical to the export cable.

## 2.2 Volume of spoil for disposal

### 2.2.1 AyM array disposal site

29 The material is to be disposed of anywhere within the array area or within a nominated disposal area in close proximity. The MDS volumes of material to be disposed in the array area from seabed preparation for foundation works, pile drilling and cable installation preparation are summarised in Table 2.

30 It is important to note that it is possible that piled jacket foundations may require seabed preparation as well as drilling. In this case, the total volume for disposal for this foundation type will not exceed the total volume for the MDS of seabed preparation for non-piled foundations.

Table 2: Summary of MDS spoil volumes associated with seabed preparation, pile drilling and cable installation in the array area disposal site.

| SOURCE | VOLUME ($M^3$) | |
|---|---|---|
| | DRILLING FOR PILED FOUNDATIONS | SEABED PREPARATION FOR NON-PILED FOUNDATIONS |
| Foundations | | |
| WTG Foundations | 276, 862 (assuming 60% of locations require drilling to full pile depth) (Monopile) | 500,000 |
| OSP | 24,127 (monopile) | 86,400 (GB Jacket Foundation) |
| Met Mast | 589 | N/A |
| Cables (Sandwave Clearance) | | |
| Array cables | 7,600,000 | |

| SOURCE | VOLUME ($M^3$) | |
|---|---|---|
| | DRILLING FOR PILED FOUNDATIONS | SEABED PREPARATION FOR NON-PILED FOUNDATIONS |
| Export cable | 1,532,615 | |
| GyM Interlink cable | 860,625 | |
| Cables (Trenching) | | |
| Array cables | 2,089,854 | |
| Export cable | 160,273 | |
| GyM Interlink cable | 90,000 | |
| Total | 12,634,945 (in the case of drilling) | 12,920,356 (in the case of non-piled foundations) |

31 As a worst-case, the total volume of natural material that may require disposal would be up to 12,920,356 $m^3$.

# 3 Alternative options for disposal

32 Once drilled or dredged material has been produced, it is classified as a waste material. Once a material has entered the waste stream it is strictly controlled.

33 Disposal of dredged and drilled material is controlled under the London Convention 1972, the Oslo-Paris Commission (OSPAR) Convention 1992, and the European Union (EU) Waste Framework Directive 2008/98/EC. As well as the Welsh National Marine Plan 2019 that sets the safeguarding policy and policy principles for dredging and disposal activity (Policy SAF_01).

34 At the core of the Waste Framework Directive is the Waste Hierarchy (Department for Environment, Food & Rural Affairs (Defra) 2011) which comprises:

- Prevention;
- Re-use;
- Recycle;
- Other recovery; and
- Disposal

35 Where prevention or minimisation is not possible, management options for dealing with waste material must consider the alternative options in the order of priority indicated above (i.e. re-use, recycle, other recovery and then disposal).

36 The consideration of alternative solutions to the disposal of drilled and/or dredged material within the array is therefore an important part of the site characterisation process and is required in order to inform the decision-making process required of the relevant authority (NRW). The following sections of this document present information on potential alternative to the disposal of drilled and dredged material from AyM.

## 3.1 Prevention

37 The Waste Hierarchy places a strong emphasis on waste prevention or the minimisation of waste. However, consent is being sought for AyM for the use of a range of foundation options and cable installation methodologies.

38 For piled foundations, if percussive piling alone does not achieve full pile penetration due to the presence of hard ground conditions, the material inside the monopile/pin piles may need to be drilled out before the pile can be driven to the required depth. If drilling is required, the generation of spoil arising from the drilling will be unavoidable. For piled foundations, the MDS is that up to 100% of the foundations may require drilling to assist with installation.

39 If non-piled foundations are chosen, seabed preparation works including dredging and disposal will be unavoidable in order to achieve the flat and stable seabed that is required to seat these particular foundation types, although the volumes of spoil generated will depend on the size of foundations needed and the seabed conditions at each installation location.

40 Sandwave clearance is expected to be required in areas where sandwave gradients are in excess of the working limits for standard cable installation equipment, to avoid unnecessary strain on the cables through bending, and to maximise ploughing efficiency and reduce the chances of burial failure. Additionally, the cable must be buried to a depth where it may be expected to stay buried for the duration of the project lifetime. Sandwaves are generally mobile in nature therefore the cable must be buried beneath the level where natural sandwave movement would uncover it. Sometimes this can only be done by removing the mobile sediments before installation takes place. Therefore, to install the cables for AyM, sandwave clearance and the associated dredging and disposal works will in some cases be unavoidable.

41 As a result, the safe and effective installation of the AyM infrastructure may involve installation techniques that give rise to spoil. Whilst volumes of spoil will be minimised to that necessary for safe and effective installation, it is not possible to prevent spoil generation.

## 3.2 Re-use

42 Where prevention is not possible, the re-use of dredged and drilled material is the preferred option. The Welsh National Marine Plan 2019 encourages the beneficial use of dredged material and specifies that the waste hierarchy should be followed (Policy aim 313). Potential options for the re-use of dredged and drilled material can include:

- Beach nourishment/replenishment schemes;
- Land reclamation schemes; and
- Habitat enhancement schemes.

43 The material for disposal could potentially have alternative uses.

44 Collection of drill arisings would be costly and may not even be technically possible due to the need for suction dredging vessels in addition to drilling vessels and the limited material produced at each foundation site means collection would not be viable.

45 Dredger movements would lead to additional environmental impacts due to increased vessel emissions that could be avoided if dredged material were disposed of *in situ* (i.e. close to the source of production). Barges for transporting material away from AyM may also require four-point anchoring systems at each loading point, which would also result in an additional environmental impact which the disposal of material *in situ* would preclude.

46 At the time of writing, no projects have been identified that could accept the type and volume of spoil material that might be generated during the construction of AyM. Therefore, even if it were technically and economically feasible to re-use the spoil material, at present there are no known projects to facilitate its re-use.

47 In conclusion, the assessments undertaken have not identified any significant adverse (in EIA terms) impacts on receptors as a result of the proposed disposal activity. It is concluded that whilst potential alternative options for use of this material may exist in theory and at some point in the future, disposal *in situ* remains the most viable option. *In situ* disposal also has the advantage of retaining sediment within the local sedimentary system.

## 3.3 Recycle

48 Recycling of drilled and dredged material would involve transforming the material into a different form, for example to produce bricks or aggregate material. Whilst the WNMP notes that beneficial use of dredged material is encouraged, in the context of recycling and the waste hierarchy the MMO guidance is referred to in this case, which states that recycling is generally a land-based solution, with material produced being used in onshore construction projects (MMO 2011). As such, the same issues with respect to vessel movements to transport the dredged material to land, as discussed above, would apply. The disposal of drilled and dredged spoil material *in situ* would preclude the additional environmental impacts that would arise.

## 3.4 Other recovery

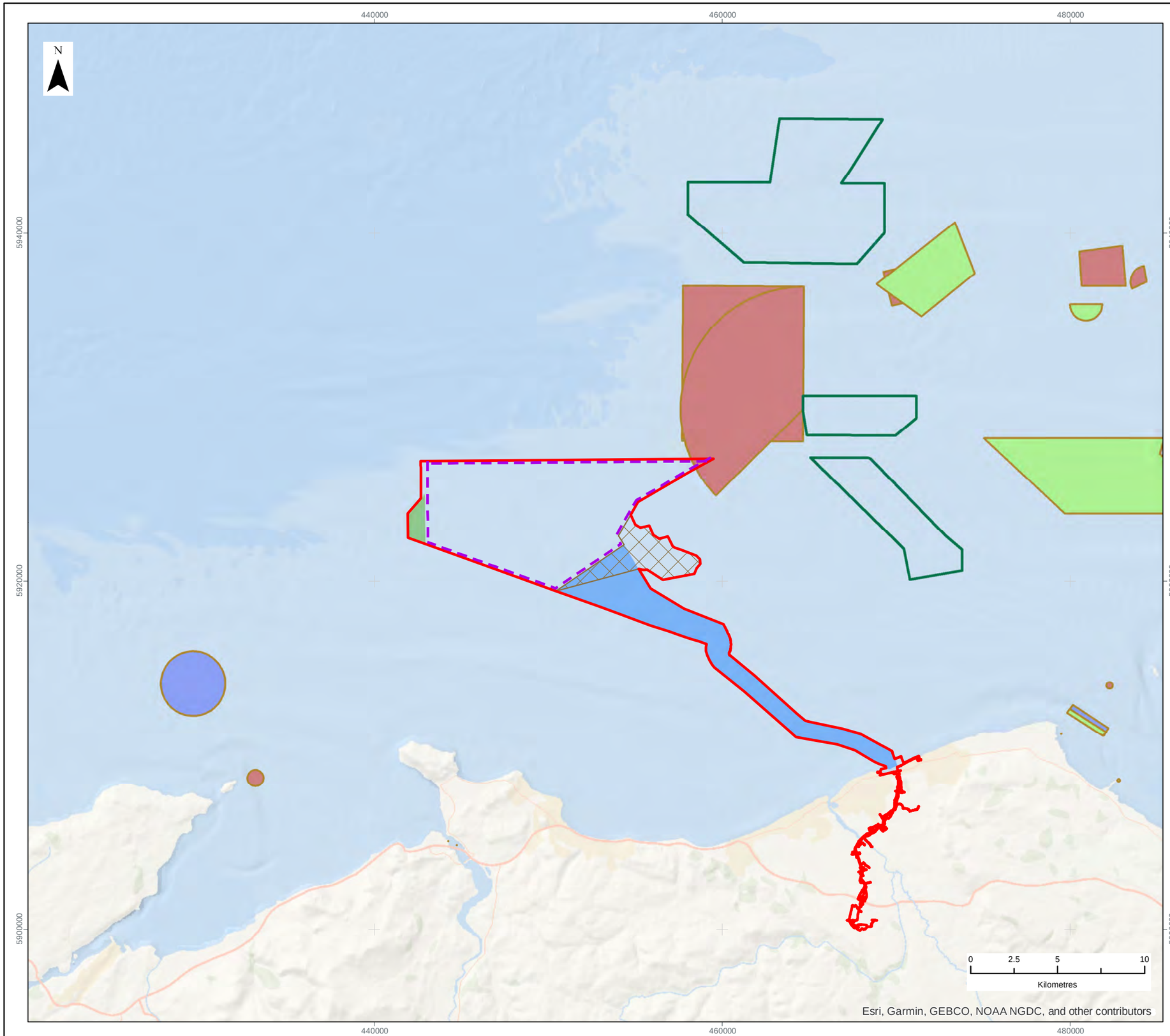
49 There are currently very few examples of recovery from dredged and drilled material (MMO 2011), and no such options have been identified for the spoil material from AyM.

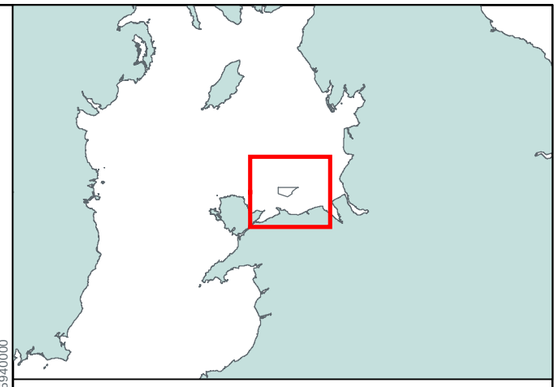
## 3.5 Disposal

50 Disposal sites are generally licensed to enable the disposal of material from specific locations and activities. It is not considered desirable to use an existing disposal site since they are not generally designated for additional volumes beyond those necessary for the specific purpose for which they were licensed.

51 Historically, significant quantities of material have been disposed of in Liverpool Bay. Material from the Mersey Docks has been deposited in the Mersey Estuary since 1825 and in Liverpool Bay since 1874. Dredged material is at present the major material disposed of in the Irish Sea. The quantities of disposal each year vary significantly depending on the requirements associated with harbour and marine dredging from the Liverpool and Birkenhead docks and the approach channel to the river Mersey.

52 With regards to the potential to dispose of the produced spoil at an existing marine disposal site, the closest open marine disposal sites are Site Y (IS150), 13.7 km to the north east of the array and Site Z (IS140) 15.5 km to the north east of the array and are presented in Figure 2. The very eastern draft order limits of the array overlaps with the Liverpool Bay (sludge) B site, which received sewage sludge and industrial waste up until 1998 and is now closed. The licenced disposal sites for Burbo Bank extension and GyM are also now closed, and do not overlap with the array or ECC.



LEGEND

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

Disposal Site (Status)

- Open Disposal Site
- Closed Disposal Site
- Disused Disposal Site

Data Source:
Disposal Sites data from CEFAS,
Aggregates data from The Crown Estate

PROJECT TITLE:

*AWEL Y MÔR OFFSHORE WINDFARM*

FIGURE TITLE:

## Aggregate Areas and Disposal Sites

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FIGURE NUMBER:

## Figure 2

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

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AWEL Y MÔR
Offshore Wind Farm

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# 4 Characteristics of the disposal sites

## 4.1 Physical characteristics

53 This section provides a summary of the physical characteristics of the AyM array area.

54 Further details on the physical environment are set out in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2).

### Tidal and wave regime

55 AyM is located in a macro-tidal setting, with a spring tidal range of around 6.5 m. This range increases from west to east. Currents speeds are approximately 0.75 to 1.0 m/s. The array area is open to north-westerly offshore waves that are generated within the Irish Sea. Locally generated waves related to the prevailing winds come from westerly, north-westerly and northern sectors.

### Seabed geology

56 The Quaternary geology of the array area has been shaped and influenced by a series of glacial events during the retreat of the British Isles ice sheet and Irish Sea Ice Stream. Overlying the bedrock is an extensive sequence of Quaternary glaciogenic and seabed sediments. These comprise a range of coarse and fine grained sediments.

57 The seabed within the AyM array and wider Liverpool Bay largely consists of either sandy gravel or gravely sand. The seabed is relatively free of fines (defined as particles of less than 0.063 mm), with waves generally preventing the deposition of mud or silt, whilst tidal currents prevent the deposition of mud further offshore within Liverpool Bay. All of the 62 sample stations are characterised by the EUNIS biotope 'Sublittoral coarse sediment': "coarse sediments including coarse sand, gravel, pebbles, shingle and cobbles which are often unstable due to tidal currents and/or wave action." These habitats are generally found on the open coast or in tide-swept channels of marine inlets. They typically have a low silt content and a lack of a significant seaweed component. They are characterised by a robust fauna including venerid bivalves (EEA, 2019).

58 Both sand waves and megaripples are present in the array and are over 4 m high in places.

59 The offshore sand banks of Constable Bank and Rhyl Flats are located immediately to the south of the array. They are understood to have an important influence on the geomorphology of the adjacent coastline, through the possible exchange of sediments and potential impacts on hydrodynamics.

## Suspended sediments

60 The AyM array is located, approximately, 45 km to the east of the Anglesey turbidity maximum, maintained in position by high tidal flows, and defined as a maximum due to its suspended sediment concentration levels (5 mg/l in summer and 10 to 15 mg/l in winter) relative to the surrounding waterbody (3 to 4 mg/l; Ellis et al, 2008).

61 Values taken from the period 1998 to 2015 do not exceed 5 mg/l (research has shown that it is the tidal forcing that results in predictable patterns and temporal variability in the Irish Sea turbidity levels (Bowers et al., 1998; Bowers et al., 2002)). Within the array, maximum Suspended Particulate Matter (SPM) values are shown to be in the range of 1.25 to 5 mg/l, August and January, respectively.

62 Near-bed suspended sediment data is available from the GyM array area and for two locations within the array. This information, given its distance offshore and relative to AyM, provides an overview of the likely natural variation in near-bed Suspended Sediment Concentrations (SSC) levels throughout the tidal cycle and in response to storm events. The available data, suggests:

- In the absence of storm events, typical concentrations throughout the tidal cycle are less than 25 mg/l;
- Storm events elevate the SSC levels. The data shows that a storm event with a significant wave height of, approximately, 4.5 m has results in levels in excess of 300 mg/l;
- There is typically a short temporal lag between the maximum wave height and corresponding maximum SSC levels.

## 4.2 Biological characteristics

63 This section provides a summary of the biological characteristics of the disposal sites. Full details are provided in Volume 2, Chapter 5,Volume 2, Chapter 6: Fish and Shellfish Ecology (application ref: 6.2.6), Volume 2, Chapter 7: Marine Mammals (application ref: 6.2.7) and Volume 2, Chapter 4: Offshore Ornithology (application ref: 6.2.4) and their associated Technical Report annexes.

### 4.2.1 Benthic Ecology

64 There was a clear spatial distribution in the habitat types present within the array area and this reflected the sediment character.

65 Two biotope complexes and two sub-biotopes have been identified within the array these are:

- The dominant biotope complex observed in 45 of the 66 array stations were classified as 'Circalittoral coarse sediment' further defined as the A5.143 *Protodorvillea 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 benthic ecology study area site surveys as shown in Volume 2, Chapter 5. The A5.143 biotope is known to be variable both spatially and temporally in terms community structure and also sediment type.

- 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 *Pisione remota*, *Polygordius* and *Halomonas elongata*, and the echinoderm *Echinocyamus pusillus* and as such, these stations were further classified to biotope level as '*Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel' (A5.145).
- 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 '*Nephtys cirrosa* and *Bathyporeia spp.* in infralittoral sand' (A5.233);
- 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.

### 4.2.2 Fish and Shellfish

66 In the array area, the fish communities comprised of demersal species including, plaice (*Pleuronectes platessa*), whiting (*Merlangius merlangus*), dab (*Limanda limanda*), solenette (*Buglossidium luteum*), haddock (*Melanogrammus aeglefinus),* pogge *(Agonus cataphractus), scaldfish (Arnoglossus laterna),* Sole *(Solea solea) and* sand goby (*Pomatoschistus minutus*).

67 Pelagic species that dominated or were abundant included, herring (*Clupea harengus*), sprat (*Sprattus sprattus*), common dragonet (*Callionymus lyra*), and poor cod (*Trisopterus minutus*).

68 Thornback ray (*Raja clavate)* and small-spotted catshark (*Scyliorhinus canicular*) were the most dominant elasmobranchs recorded in the area, followed by the cuckoo ray (*Raja naevus*), nursehound (*Scyliorhinus stellaris*), blonde ray (*Raja brachyuran*) and smoothhound (*Mustelus asterias*). No rare or endangered elasmobranch species were recorded.

69 A number of migratory species may pass through the eastern Irish Sea and Liverpool Bay, including, Atlantic salmon (*Salmo salar*), Sea Trout (*Salmo trutta*) and European eel (*Anguilla Anguilla*).

70 There are two distinct shellfish resources within the Irish Sea; a large scallop ground is located across the whole eastern Irish Sea, and a *Nephrops* resource is located to the north of Liverpool Bay, between the Isle of Man and the Cumbria coast outside of the ZoI for AyM. Generally low densities of queen scallop (*Aequipecten opercularis*), king scallop (*Pecten maximus*) are expected for the area. Shellfish abundances inshore appear to be dominated by cockles, crabs, lobsters, mussels, shrimp and whelk.

71 Further details on fish and shellfish are set out in Volume 4, Annex 6.1: Fish and Shellfish Ecology Technical Baseline Report (application ref: 6.4.6.1).

### 4.2.3 Marine Mammals

72 The marine mammal species which are most likely to occur in the AyM area include harbour porpoise (*Phocoena phocoena*), harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*). Harbour porpoises were most abundant with a density of 0.13 porpoises/ km$^2$ and an average abundance of 45 per year. The harbour porpoise population does fluctuate over the year with higher values in late winter.

73 Grey seals haul-out around the coast of Anglesey (including the Skerries), around Llandudno (Angel Bay) and the Dee Estuary (Hilbre North and West Hoyle Sandbank). There are also confirmed pupping sites also around Anglesey and the Lleyn Peninsula, although the majority of pup production in Welsh waters is located in Pembrokeshire, where there is an estimated 4% of the UK breeding population. A total of 20 seals were sighted during Year 1 of the site-specific APEM aerial surveys with a maximum monthly density estimate for seals within the area of 0.14 seals/km$^2$.

74 Dolphin and whale species were not recorded during the baseline survey of AyM site specific surveys.

75 In the GyM area, nine confirmed harbour porpoise groups were recorded between 2010-2019 and a total of 69 grey seal sightings were confirmed between 2003-2019 in the GyM windfarm area.

76 For information regarding survey methods and results see ES, Volume 2, Chapter 7: Marine Mammals (application ref: 6.2.7).

### 4.2.4 Offshore Ornithology

77 Aerial visual and boat-based surveys between 1979 and 1996 recorded a total of 19 bird species in the wider AyM offshore ornithology study area, as shown in Volume 2, Chapter 4. With the key species recorded in the greatest abundance/density being gannet (*Morus bassanus*), fulmar (*Fulmarus glacialis*) and kittiwake (*Rissa tridactyla*).

78 Twenty-four offshore aerial digital surveys have been conducted across the AyM array area between March 2019 and February 2021.

79 A total of 21 bird species were recorded, with the key species recorded in the greatest abundance/density within the array area (and 4 km buffer) being common scoter (*Melanitta nigra*), kittiwake (*Rissa tridactyla*), common gull (*Larus canus*), great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), comic tern (*Sterna hirundo*), guillemot (*Uria aalge*), razorbill (A*lca torda*), red-throated diver (*Gavia stellata*), fulmar (*Fulmarus glacialis*), manx shearwater (*Puffinus puffinus*) and gannet (*Morus bassanus*).

80 For further information regarding survey methods and results see ES, Volume 2, Chapter 4: Offshore Ornithology and Volume 4, Annex 4.1 (application ref: 6.2.4 and 6.4.4.1).

#### Designated Sites

81 AyM may have an influence on designated sites, which include offshore ornithological receptors as notified features. The sites are described in depth in Volume 2, Chapter 4, although all sites were assessed to have a negligible magnitude of impact and were therefore classified as not significant for all receptors.

## 4.3 Human environment characteristics

82 This section summarises the human environment of the AyM array area. Further detail can be found in the following ES Chapters and their associated annexes; Commercial Fisheries (application ref: 6.2.8), Shipping and Navigation (application ref: 6.2.9), Offshore Archaeology and Cultural Heritage (application ref: 6.2.11) and Other Users (application ref: 6.2.12).

### Commercial fisheries

83 Data indicate that few large vessels over 15 m in length are active in the commercial fisheries study area as seen in Volume 2, Chapter 8. While some scallop dredging may take place within the northernmost portion of the AyM array area, dredging activity is more significant to the north and west of the commercial fisheries study area further offshore. This was corroborated through consultation with the fishing industry.

84 The key fleet metiers operating across the AyM commercial fisheries study area include, UK (Welsh, Scottish and English-registered) vessels targeting shellfish species, particularly whelk, king and queen scallop, lobster, common prawn and crab; and UK (Welsh and English-registered) vessels targeting mixed demersal species, particularly bass, flounder and thornback ray.

85 Larger vessels, including dredgers and potters, target particular species year-round, but a portion of vessels in these metiers will form part of a local UK multi-purpose fleet comprised typically of vessels under 10 m in length which switch between gears (e.g. pots, nets and gears using hooks) to adapt to seasonal variations in fisheries.

86 Landings from the commercial fisheries study area by these fleets from the based on landed volume and value are dominated by shellfish species; over 93% of landings by UK vessels between 2016 and 2020 were of shellfish with the remainder accounted for by demersal species. Over the same time period, Welsh-registered vessels were responsible for 45% of landings from the commercial fisheries study area by value, English-registered vessels for 45% and Scottish-registered vessels for 8%. These vessels operate out of and land to a number of regional and wider UK ports.

87 Industry consultation to date has indicated that several vessels regularly fish in the study area, targeting shellfish species with pots and dredges, and netting for mixed demersal species.

## Shipping and navigation

88 Full details of the navigational features, maritime incidents, and marine traffic baseline assessments are provided in the Navigational Risk Assessment (NRA) Volume 4, Annex 9.1 (application ref: 6.4.9.1).

89 The key navigational feature in the area is considered to be the Liverpool Bay Traffic Separation Scheme (TSS)International Maritime Organization (IMO) adopted routeing measure, given that it dictates the majority of vessel routeing in the area. The TSS is situated within the shipping and navigation study area approximately 0.5 NM from the array, noting that this separation is consistent with that of the neighbouring GyM array area.

90 A total of 17 main routes have been identified from the available data sources. The construction of AyM will have minimal effects in terms of disruption to passing traffic. See Volume 2, Chapter 9: Shipping and Navigation for more detail and figures of shipping lanes.

## Marine archaeology

91 There are no designated or known sites within the array. However, there is potential for archaeological material of a prehistoric date to exist within the marine archaeology study area, as shown in Volume 2, Chapter 11: Offshore Archaeology and Cultural Heritage (application ref: 6.2.11).

92 There are six known wrecks in the array area including the 500 m array buffer and geophysical reporting extent buffer.

93 During the seabed features assessment, a total of 509 anomalies of archaeological potential were identified within the array area (including the infrastructure zones and interlink area.

94 More information on this topic can be found in Volume 2, Chapter 11 and the marine archaeological technical report Volume 4, Annex 11.1 (application ref: 6.4.11).

## Infrastructure and other users

95 There is no spatial overlap of any other OWFs within the AyM array area. Although, the AyM interlink cabling will overlap with the GyM array and may require up to one crossing with a GyM array cable in order to facilitate connection to a GyM OSP via subsea cabling.

96 There are a number of wave and tidal renewable energy projects and demonstration zones along the North Wales coastline. There are five main schemes in North Wales which are at various stages of design and development. However, there is no current overlap with any active sites with AyM.

97 In the area, there are five offshore oil and gas fields. The Liverpool Bay Development and Infrastructure (surface and subsurface) are located to the north east of the infrastructure study area, with the closest asset being a wellhead positioned 1.5 km from AyM within the GyM OWF boundary. The Douglas Complex platforms are located approximately 5.5 km north of AyM. There are no existing or provisional licence blocks or wells that overlap with the AyM array (live or abandoned).

98 There is no overlap with any onshore or offshore infrastructure within the infrastructure study area, aggregate extraction, open sites for dredging and/or disposal or military areas within the AyM array.

# 5 Characteristics of the material being disposed

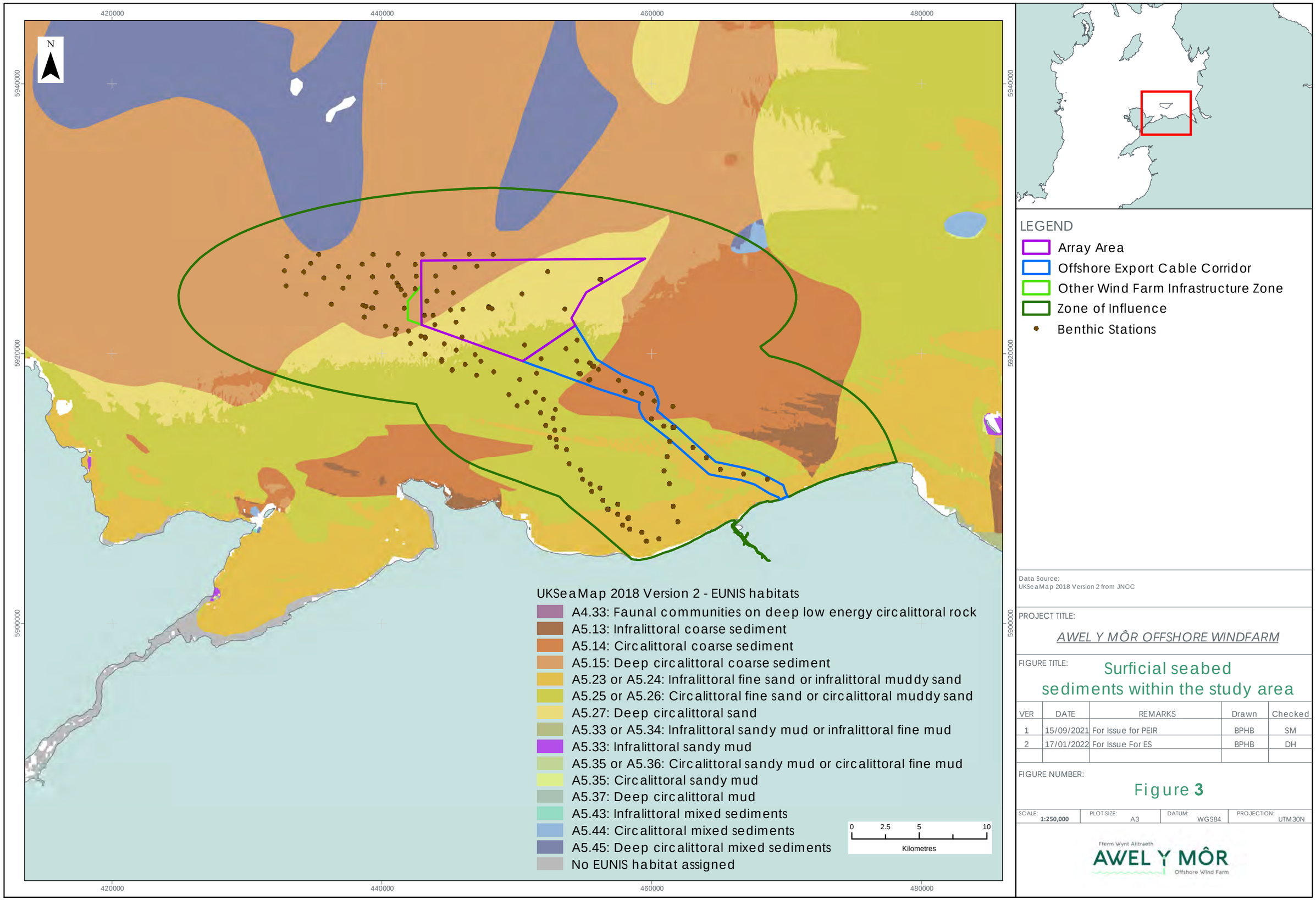
## 5.1 Physical characteristics

99 Dredging can be expected to result in localised lowering of the seabed by up to ~5 m in some places in responses to the presence of mobile sand wave features. More typically, (and given the known characteristics of sandwaves within the array and offshore ECC following the project specific geophysical survey), dredging to depths of between 1- 3 m is more realistic in most areas.

100 The AyM area is located on a seabed characterised by Holocene sands and gravels (Golding et al., 2004; Holmes and Tappin, 2005). The dominant sediment types identified in the main array area that will be dredged include mostly of gravelly sand ranging from very coarse sand to medium sand (Figure 3). The south-east of the array is characterised by coarse sediments and numerous sand waves and megaripples, whilst the west of the array is characterised by gravelly sand.

101 Within the offshore ECC area, the seabed sediments become finer with varying contributions of mud-sized material towards the east of the area, where the influence of the Dee Estuary begins to occur.

102 Full detail of the characteristics of sediments in the AyM array area, offshore ECC and the GyM interlink area can be found in Volume 2, Chapter 3.




LEGEND

- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Zone of Influence
- Benthic Stations

Data Source:
UKSeaMap 2018 Version 2 from JNCC

PROJECT TITLE:

*AWEL Y MÔR OFFSHORE WINDFARM*

FIGURE TITLE:

## Surficial seabed sediments within the study area

| VER | DATE | REMARKS | Drawn | Checked |
|---|---|---|---|---|
| 1 | 15/09/2021 | For Issue for PEIR | BPHB | SM |
| 2 | 17/01/2022 | For Issue For ES | BPHB | DH |
| | | | | |

FIGURE NUMBER:

Figure **3**

| SCALE: | PLOT SIZE: | DATUM: | PROJECTION: |
|---|---|---|---|
| 1:250,000 | A3 | WGS84 | UTM30N |

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

G:\GIS\GIS_Projects\0141 AyM\GIS\Figures\ES\MW&SQ\AYM_MWSQ_Fig4_Seabed_Sediments.mxd

## 5.2 Chemical characteristics

103 This section summarises the chemical characteristics of sediments of the material being disposed. Further detail can be found in Volume 2, Chapter 3.

104 As part of the baseline characterisation at GyM, surface sediments were tested within and around the GyM array including inshore locations along the export cable route corridor. Both organochlorine and PCB residues were below the minimum limit of detection at all of the sampling sites. The concentrations of PAHs within the GyM sediments were also below the limits of detection. The results for the trace metals analysis showed low concentrations within the sediments sampled, with all being below Threshold Effect Levels (TEL), with the exception of arsenic which was recorded at concentrations slightly above the TEL. The GyM ES concluded that arsenic in the area may be attributable to lithogenic inputs from the north Wales region as a result of the geological weathering.

105 The results of the sediment chemistry within the array revealed that nine out of ten stations had PAHs below the TEL threshold.

106 All metals analysed as part of the site-specific survey within the array were below Cefas Guideline Action Level 1 and are not considered to be of concern and the sediment in which they are bound is considered suitable for disposal at sea.

107 The results of the sediment chemistry for the array are also applicable to the offshore ECC and GyM interlink area.

## 5.3 Biological characteristics

108 Biological characteristics were similar across all locations including the array, the offshore ECC and the GyM interlink area. Further detail can be found above in section 4.2 and in the sources described in Table 3 below.

Table 3: Locations of more detailed information for specific data categories.

| DATA | RELEVANT ES DOCUMENT |
|---|---|
| Contaminant analysis | Volume 2, Chapter 3: Marine Water and Sediment Quality (application ref: 6.2.3) |
| Seabed geology | Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2)<br>Volume 4, Annex 2.1: Marine Processes Baseline (application ref: 6.4.2.1) |
| Biotopes and benthic fauna | Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology (application ref: 6.2.5) |
| Fish and shellfish spawning and nursery areas | Volume 2, Chapter 6: Fish and Shellfish Ecology (application ref: 6.2.6)<br>Volume 4, Annex 6.1: Fish and Shellfish Ecology Technical Report (application ref: 6.4.6.1) |

# 6 Assessment of the potential adverse effects of in-situ disposal

## 6.1 Physical environment

109 Gravels and sands will settle relatively rapidly towards the seabed. From the maximum expected height of initial suspension (approximately 35 m above bed within the AyM array area), sediment of these grain sizes is likely to resettle to the seabed (no longer contributing to an increase in SSC) within approximately one to 60 minutes.

110 Although the actual process of disposal may result in a slight change to the existing particle size composition of seabed sediments, the material disposed *in situ* via seabed preparation and cable trenching would be similar to the existing material as the spoil disposal will occur close to the site of production.

111 The closest designated sites (namely the Liverpool Bay SPA, Menai Strait & Conwy SAC and Dee Estuary SAC/ SPA) are all internationally important. However, the seabed in these areas is highly dynamic and is assessed to have some capacity to recover from disturbance. However, any reductions in bed level in response to dredging will be within the range of that occurring naturally in response to migration of the bedform features that may be dredged. Any increases in bed level in response to spoil disposal are expected to be of short-term duration and modest in relation to total water depth at any given location.

112 Marine processes are not themselves receptors in the majority of cases. However, changes to these processes may have an impact on other sensitive receptors.

113 Potential for cumulative temporary increases in SSC and seabed levels as a result of AyM foundation installation and dredged spoil disposal at licensed disposal grounds is extremely limited.

## 6.2 Biological and human environment

114 The ES for AyM provides a detailed impact assessment relating to disposal activities on a number of sensitive biological and human environment receptors, including (amongst others) benthic habitats, fish and shellfish spawning and nursery habitats, marine mammals, birds, and commercial fisheries.

115 For all of these assessments, the effects defined within Volume 2, Chapter 2 have been interpreted with regard to their subsequent impact on various receptors. The sensitivity of various receptors to these effects (increased suspended sediment concentrations, sediment deposition and potential loss of seabed habitats) has been determined based on relevant literature and an assessment of the significance of any impacts undertaken.

116 The relevant chapters/documents of the ES are referenced where further detail of those impact assessments can be found. It is important to note that only impacts related to the disposal of sediment (increased suspended sediment concentrations, sediment deposition and potential loss of seabed habitats) and considered in Table 4.

Table 4: Summary of impacts from disposal of material from seabed preparation, sandwave clearance, pile driving and cable trenching within the AyM Order Limits.

| POTENTIAL IMPACT | RELEVANT SECTION OF ES | MAGNITUDE OF IMPACT | SENSITIVITY OF RECEPTOR | SIGNIFICANCE OF EFFECT |
|---|---|---|---|---|
| Marine Geology, Oceanography and physical processes | | | | |
| Potential changes to suspended sediment concentrations, bed levels and sediment type/ character arising from dredging, drilling and cable installation. | ES Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2) | (Pathway) | (Pathway) | (Pathway) |
| Potential changes to Constable Bank/ Rhyl Flats and designated sites owing to the combined influence of sediment removal activities e.g. dredging and sandwave clearance. | | Low adverse | Medium | Minor (adverse) (not significant) |
| Potential changes to Constable Bank/ Rhyl Flats, designated sites and the adjacent coast, arising from dredging/ disposal induced bed level change and associated modification of waves, tides and sediment transport. | | Negligible adverse | Medium | Minor (adverse) (not significant) |
| Water and Sediment Quality | | | | |
| Deterioration in water quality due to suspension of sediments. | ES Volume 2, Chapter 3: Marine Geology, | Low adverse | Bathing Waters – N/A due to | Minor adverse (not significant) |

| POTENTIAL IMPACT | RELEVANT SECTION OF ES | MAGNITUDE OF IMPACT | SENSITIVITY OF RECEPTOR | SIGNIFICANCE OF EFFECT |
|---|---|---|---|---|
| | Oceanography and Physical Processes (application ref: 6.2.3) | | distance from receptor | |
| | | | WFD waterbodies - due to distance from receptor | N/A |
| | | | Non-designated waters – negligible | Negligible (not significant) |
| Release of sediment-bound contaminants from disturbed sediments | | Low adverse | Bathing Waters – N/A due to distance from receptor | N/A |
| | | | WFD waterbodies - due to distance from receptor | N/A |

| POTENTIAL IMPACT | RELEVANT SECTION OF ES | MAGNITUDE OF IMPACT | SENSITIVITY OF RECEPTOR | SIGNIFICANCE OF EFFECT |
|---|---|---|---|---|
| | | | Non-designated waters – negligible | Negligible (not significant) |
| Offshore Ornithology | | | | |
| Indirect impacts through effects on habitats and prey. | ES Volume 2, Chapter 4: Offshore Ornithology (application ref: 6.2.4) | Negligible adverse | Low | Negligible – Minor adverse (not significant) |
| Benthic and Intertidal Ecology | | | | |
| Temporary increase in SSC and associated sediment deposition (in the offshore ECC and array). | ES Volume 2, Chapter 5: Benthic Ecology (application ref: 6.2.5) | Low adverse | Medium | Minor adverse (not significant) |
| Temporary increase in SSC and associated deposition (in the intertidal). | | Low adverse | Medium | Minor adverse (not significant) |
| Direct and indirect seabed disturbances leading to the release of sediment contaminants. | | Negligible adverse | Low | Negligible adverse (not significant) |

| POTENTIAL IMPACT | RELEVANT SECTION OF ES | MAGNITUDE OF IMPACT | SENSITIVITY OF RECEPTOR | SIGNIFICANCE OF EFFECT |
|---|---|---|---|---|
| Long-term habitat loss/ change from the presence of foundations, scour protection and cable protection. | | Negligible adverse | High | Minor adverse (not significant) |
| Fish and Shellfish | | | | |
| Direct and indirect seabed disturbances leading to the release of sediment contaminants. | ES Volume 2, Chapter 6: Fish and Shellfish (application ref: 6.2.6) | Negligible adverse | Demersal spawners – Low to Medium<br>Pelagic spawners – Medium<br>VERs of Limited Mobility – Medium<br>Mobile VERs – Low | Negligible – Minor adverse (not significant) |
| Marine Mammals | | | | |
| Change in fish abundance/ distribution. | ES Volume 2, Chapter 7: Marine Mammals (application ref: 6.2.7) | Negligible adverse | Low | Negligible adverse (not significant) |
| Commercial Fisheries | | | | |

| POTENTIAL IMPACT | RELEVANT SECTION OF ES | MAGNITUDE OF IMPACT | SENSITIVITY OF RECEPTOR | SIGNIFICANCE OF EFFECT |
|---|---|---|---|---|
| AyM array area and offshore ECC construction activities leading to disturbance of commercially important fish and shellfish resources leading to displacement or disruption of fishing activity. | ES Volume 2, Chapter 8: Commercial Fisheries (application ref: 6.2.8) | Low adverse | Low | Minor adverse (not significant) |

# 7 Monitoring

117 Based on the findings of the impact assessments presented in the ES, and summarised within this document, there are no predicted significant effects across physical processes, benthic or water quality that would necessitate monitoring for disposal and no monitoring is proposed by the specialists for those topics.

# 8 Conclusions

118 This document represents the site characterisation for the disposal site in the array area. It forms the proposal for a licensed disposal site within the for drill arisings, and material from foundation seabed preparation, cable installation preparation, and in relation to the ECC, excavation of HDD exits pits. This is required by NRW to allow it to consider the potential impacts of disposal within these sites.

119 Noting that all the information required for a site characterisation to support a disposal licence application is contained within the wider ES, this document takes the form of a 'framework' document that provides a summary of the key points of relevance to site characterisation and refers to more detailed information and data presented within the relevant sections of the ES at this stage.

120 The source of material proposed to be disposed of within the array will be sediment dredged from the upper layer of the existing seabed via MFE/ CFE or dredging (such as TSHD, backhoe dredging or water injection dredging) as part of foundation seabed preparation works and cable installation preparation, and/ or materials from the deeper soil profile and upper sediments derived from drilling activities for piled foundations.

121 Following the Waste Hierarchy, AyM have analysed all other alternatives and concluded that disposal is the sole choice. Dredging and disposal are unavoidable in order to provide the stable seabed required for foundation types and cable installation. The technologies required for re-use and recycling would have environmental impacts and would be inefficient; consequently, *in situ* disposal remains the most feasible option, with the added benefit of maintaining sediment within the local sedimentary system. However, disposal material volumes will be kept to a minimum in order to ensure safe and successful installation.

122 As a worst-case, the total volume of natural material that may require disposal would be up to 12,920,356 $m^3$.

123 Where drilling is required to facilitate the installation of piles to target depth, the drill arisings will be disposed of at sea, adjacent to the foundation location.

124 The impacts of disposal via the return of dredged material to the water column and/ or the placement of drill arisings adjacent to foundations has been fully assessed. No moderate, large or very large (significant in EIA terms) adverse effects have been identified, with only neutral and slight (not significant in EIA terms) effects predicted on certain receptors.

125 As the assessment has not identified any significant adverse effects on receptors for this proposed disposal activity, it is concluded that, whilst potential alternative options for the use of this material may exist, disposal *in situ* remains the most viable option.

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