Partners in UK offshore wind

MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Morgan array area site characterisation report

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Image of an offshore wind farm

www.morganandmona.com/morgan

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RPS

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Morgan Offshore Wind Ltd.

Contents

Tables

Figures

Glossary

Term	Meaning
Applicant	Morgan Offshore Wind Limited
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	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 one or more Nationally Significant Infrastructure Project (NSIP).
Demersal	Fish living on or near the seabed.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment (EIA) process for the Morgan Generation Assets.
Epifauna	Animals living on the seabed surface.
Habitat	The environment that a plant or animal lives in.
Infauna	Animals living in the seabed sediment.
Information to Support an Appropriate Assessment	A report setting out a study to consider whether the Morgan Generation Assets could have adverse effects, either alone or in combination with other plans or projects, on the integrity of designated European sites for which the potential for likely significant effects (LSE) has been previously established.
Marine Conservation Zone (MCZ) Assessment	An assessment of the potential for the Morgan Generation Assets to affect the protected features of MCZs, and any ecological or geomorphological processes on which the protected feature is dependent on.
Marine licence	The Marine and Coastal Access Act 2009 requires a marine licence to be obtained for licensable marine activities. Section 149A of the Planning Act 2008 allows an applicant for a Development Consent Order (DCO) to apply for a 'deemed marine licence' as part of the Development Consent Order (DCO) process.
Maximum Design Scenario (MDS)	The Maximum Design Scenario (MDS) represents the parameters that make up the realistic worst case scenario. This is selected from a range of parameters and may be different for different receptors and activities.
Morgan Offshore Wind Project Generation Assets	This is the name given to the Morgan Generation Assets project as a whole (includes all infrastructure and activities associated with the project construction, operations and maintenance, and decommissioning).
Morgan Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, scour protection, cable protection and offshore substation platforms (OSPs) forming part of the Morgan Offshore Wind Project Generation Assets will be located.
Offshore Substation Platform (OSP)	The offshore substation platforms located within the Morgan Array Area will transform the electricity generated by the wind turbines to a higher voltage allowing the power to be efficiently transmitted to shore.
Suspended Sediment Concentration (SSC)	Mass of sediment in suspension per unit volume of water.
Wind turbines	The wind turbine generators, including the tower, nacelle and rotor.

Acronyms

Acronym	Description
AL	Action Level
Cefas	Centre for Environment, Fisheries and Aquaculture Science
Defra	Department for Environment Food and Rural Affairs
EIA	Environmental Impact Assessment
EU	European Union
IEF	Important Ecological Feature
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
NSTA	North Sea Transition Authority
OSP	Offshore Substation Platform
OSPAR	Oslo-Paris (The Convention for the Protection of the Marine Environment of the North-East Atlantic)
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PEIR	Preliminary Environmental Information Report
PEL	Probable Effect Level
PSA	Particle Size Analysis
SAC	Special Area of Conservation
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TEL	Threshold Effect Level
UKHO	United Kingdom Hydrographic Office

Units

Unit	Description
%	Percentage
cm	Centimetres
m	Metre
km	Kilometre
nm	Nautical miles
km^2	Square kilometre
m^3	Cubic metre

Unit	Description
$m^3/s/m$	Cubic metres per second per metre (total load)
mg/kg	Milligrams per kilogram
mg/l	Milligrams per litre

1 Morgan Array Area - site characterisation report

1.1 Introduction

1.1.1.1 Morgan Offshore Wind Limited (the Applicant), a joint venture of bp Alternative Energy Investments Ltd. (hereafter referred to as bp) and Energie Baden-Württemberg AG (hereafter referred to as EnBW) is developing the Morgan Offshore Wind Project Generation Assets (hereafter Morgan Generation Assets). The Morgan Generation Assets is a proposed wind farm located in the east Irish Sea.

1.1.1.2 This document has been drafted to provide the licensing authorities with the necessary information to permit disposal of material associated with the construction of the Morgan Generation Assets. This document represents the site characterisation for the proposed disposal site associated with the construction of the Morgan Generation Assets. It specifically outlines the disposal of material originating from dredging, drilling and sand wave clearance activities associated with the Morgan Generation Assets within the Morgan Array Area.

1.1.1.3 Site characterisation provides a description of the existing environment at the proposed marine disposal site for spoil material and drill arisings generated by construction activities, using all available data sources. This report has been prepared in the event a formally licenced disposal site is deemed necessary.

1.1.1.4 Noting that all the information required for a site characterisation to support a disposal licence application is contained within the Morgan Generation Assets Environmental Statement, 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 Environmental Statement.

1.1.1.5 This Disposal site characterisation report covers the Morgan Generation Assets and associated infrastructure (identified in section 1.1.2) and will accompany the application for deemed marine licence(s) as part of the Development Consent Order (DCO) application.

1.1.2 Project background and overview

1.1.2.1 The Morgan Array Area (i.e. the area within which the offshore wind turbines will be located) is 280 km^2 in area and is located 22.22 km (12 nm) from the Isle of Man coastline, 37.13 km (20.1 nm) from the northwest coast of England and 58.5 km (31.6 nm) from the Welsh coastline (Anglesey) (when measured from Mean High Water Springs (MHWS) (Figure 1.1). The Morgan Array Area is located wholly within English offshore waters (beyond 12 nm from the English coast).

1.1.2.2 The Morgan Generation Assets will include up to 96 wind turbines. The maximum proposed number of turbines has been reduced from 107 proposed in the Preliminary Environmental Information Report (PEIR). The proposed capacity of the Morgan Generation Assets exceeds 100 MW and therefore the Planning Act 2008 thresholds. The Morgan Generation Assets is thus considered as a Nationally Significant Infrastructure Project. The final capacity of the Morgan Generation Assets will be determined based on available technology and constrained by the design envelope of the wind turbines presented in Volume 1, Chapter 3: Project description of the Environmental Statement (Document Reference F1.3). The offshore infrastructure will also include up to 60 km of interconnector cable and 390 km of inter-array cable.

1.1.2.3 The key components of the Morgan Generation Assets include:

- Offshore wind turbines
- Foundations (for wind turbines and Offshore Substation Platforms (OSPs))
- OSPs
- Scour protection
- Cable protection
- Inter-array cables linking the individual wind turbines to the OSPs
- High Voltage Alternating Current transmission system including:
  - OSPs
  - Offshore interconnector cable(s).

1.1.2.4 The wind turbines and OSPs will be attached to the seabed by foundation structures. The Applicant requires flexibility in foundation choice to ensure that anticipated changes in available technology can be accommodated within the Morgan Generation Assets final design. The foundation types that are being considered for the Morgan Generation Assets are shown in Table 1.1.

Table 1.1: Foundation options for wind turbines and OSPs

	Wind turbines	OSPs
Maximum number of structures	96	4
Pin piled three-legged jacket	Yes	Yes
Pin piled four-legged jacket	Yes	Yes
Pin piled six-legged jacket	No	Yes
Suction bucket three-legged jacket	Yes	Yes
Suction bucket four-legged jacket	Yes	Yes
Suction bucket six-legged jacket	No	Yes
Gravity base	Yes	Yes

1.1.3 Scope and purpose of document

1.1.3.1 This document is the Disposal site characterisation report for the Morgan Generation Assets which is required to apply for a permit for the disposal of seabed and sub-bottom geological material within the Morgan Array Area (as shown in Figure 1.1) that may arise during the construction of the Morgan Generation Assets.

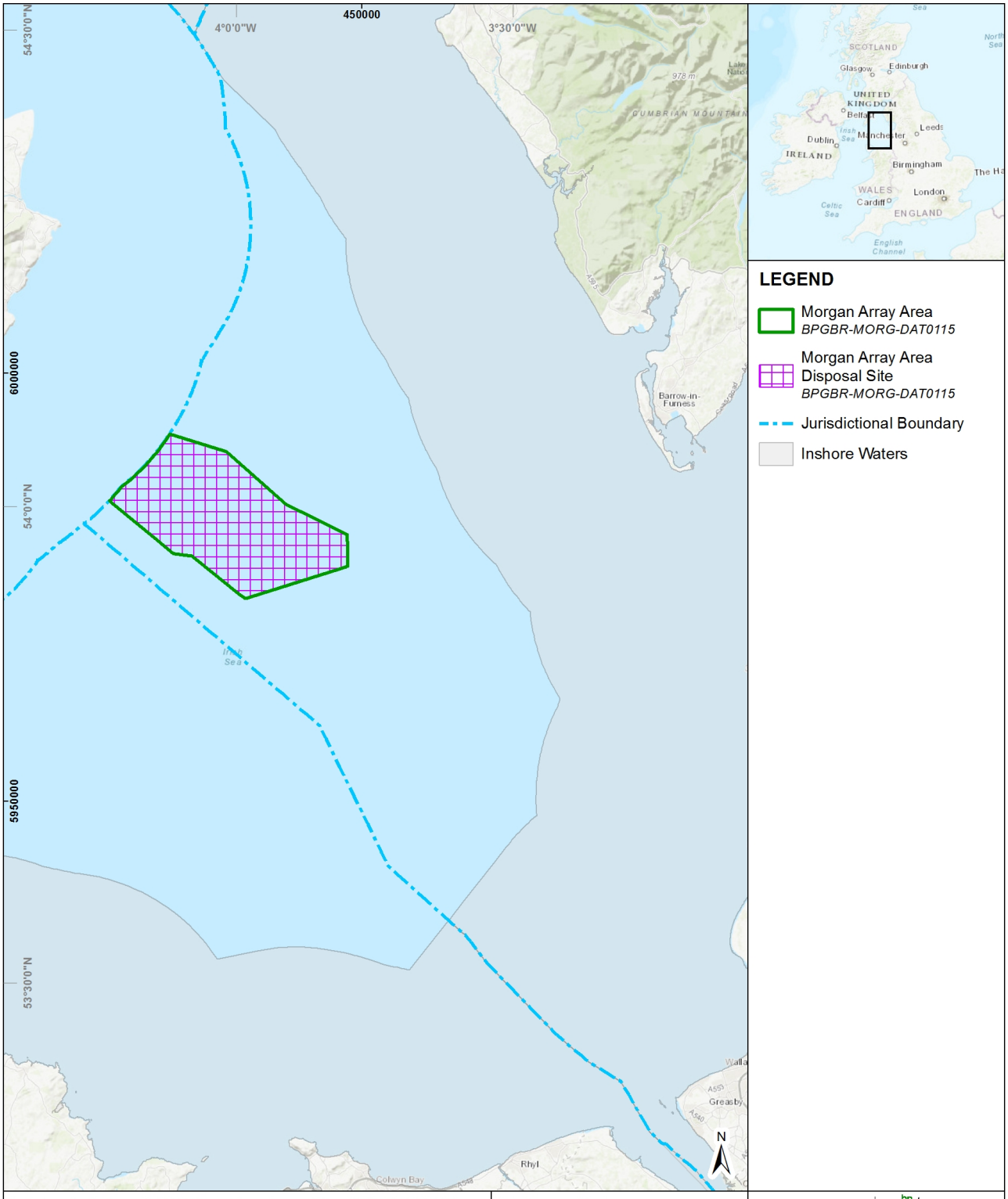
1.1.3.2 This report draws on the findings of the technical reports and assessments produced for the Morgan Generation Assets Environmental Statement, to support the application for licensing of the Morgan Generation Assets disposal site.

1.1.3.3 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. It is a requirement that a Disposal site characterisation report be submitted to the Marine Management Organisation (MMO), and their scientific advisor, Centre for Environment, Fisheries

and Aquaculture Science (Cefas), to inform the decision-making process and to allow the licensing of the disposal site as well as facilitating the consideration of the need for any relevant conditions in relation to the disposal activity within the deemed marine licence(s) for the Morgan Generation Assets.

1.1.3.4 This Disposal site characterisation report is structured as follows:

- Section 1.1: Introduction
- Section 1.2: Predicted spoil sources and volumes
- Section 1.3: Consideration of alternative disposal options
- Section 1.4: Characteristics of the disposal site – physical, biological, human environment
- Section 1.5: Characteristics of material to be disposed – physical, chemical and toxicological, biological
- Section 1.6: Assessment of potential adverse effects on physical, biological, and human environment
- Section 1.7: Conclusions
- Section 1.8: References.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 2.5 5 10 nm
0 5 10 20 km

Drawing Number:
RPSE-MG-ES-MISC-004-01

Drawing Title:
LOCATION OF THE PROPOSED MORGAN ARRAY AREA DISPOSAL SITE

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:750,000

VER	DATE	DETAILS	BY	CHECK
00	02/10/23	First Issue	MJ	EG
01	01/12/23	Revision	NG	AH

Figure 1.1: Location of the proposed Morgan Array Area disposal site

1.1.4 Consultation

1.1.4.1 A summary of the key issues raised during consultation activities undertaken to date specific to dredging and disposal site characterisation is presented in Table 1.2.

Table 1.2: Summary of key consultation topics raised during consultation activities undertaken for the Morgan Generation Assets relevant to disposal site characterisation.

Date	Consultee	Type of consultation	Summary of consultation	Response
July 2022	Natural England	Scoping Opinion	Natural England did not agree that there was sufficient evidence to scope out the release of sediment-bound contaminants.	The release of sediment bound contaminants is assessed in section 2.8.5 (of Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement) and levels of contamination are described in section 1.5.2 of this Disposal site characterisation report.
	The Planning Inspectorate		The Environmental Statement should have identified the likely site for disposal of drilling arisings and include an assessment of effects from these activities.	The disposal of drilling has been assumed to occur within the Morgan Array Area and the effects of drilling on suspended sediment concentrations (SSC) have been assessed in section 2.8.4 (of Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement). Consideration of the proposed site for disposal is presented within section 1.4 and 1.5 of this Disposal site characterisation report.
June 2023	MMO	S42 consultation	The MMO notes that Thomson Environmental Consultants are not validated by the MMO to undertake particle size analysis (PSA) in support of marine licences, and therefore these results cannot be considered for purposes of dredge and disposal operations.	The PSA analysis was conducted by Kenneth Pye Associates Ltd. and Ocean Ecology (both MMO validated laboratories[1]).
			The MMO noted some inconsistencies regarding the presentation of the sediment chemistry analysis.	Inconsistencies regarding the sediment chemistry analysis have been addressed. The full analysis is presented in section 1.7.2 of Volume 4, Annex 2.1 Benthic subtidal ecology technical report of the Environmental Statement. The full sediment contamination data is presented in Appendix F of Volume 4, Annex 2.1 Benthic

[1] https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans

Date	Consultee	Type of consultation	Summary of consultation	Response
				subtidal ecology technical report of the Environmental Statement.
			The MMO notes that no disposal site is specified for the removal of material required for seabed preparation, with the PEIR stating that material is to be redistributed within the area. However, given the volume of material to be moved, and the potential use of a suction dredger, the MMO considers it necessary under the requirements of the London Dumping Convention/London Protocol and Oslo-Paris (The Convention for the Protection of the Marine Environment of the North-East Atlantic) (OSPAR) for a disposal site to be designated for these works.	Noted, and as detailed in this Disposal site characterisation report, a disposal site within the Morgan Array Area is proposed.

1.2 Predicted spoil sources and volumes

1.2.1 Sources of spoil

1.2.1.1 In the context of this Disposal site characterisation report for the Morgan Generation Assets, the term 'spoil' covers all material (i.e. sediment) which is extracted from (e.g. by dredging or drilling), and subsequently deposited on, the seabed during the construction of the Morgan Generation Assets.

1.2.1.2 Spoil will be generated from sandwave clearance activities within the Morgan Array Area prior to inter-array and interconnector cables and foundations being installed. Many of the cable installation tools require a stable, flat seabed surface in order to install cables as it may not be possible to install the cable up or down a slope over a certain angle. In addition, the cables must be buried to a depth where they can be expected to stay buried for the duration of the lifetime of the Morgan Generation Assets. Sandwaves are generally mobile in nature therefore cables must be buried beneath the level where natural sandwave movement could uncover them. Wind turbine and OSP foundations need to be placed in level, pre-prepared areas of seabed. This can only be achieved by removing the mobile sediments before installation takes place. Unexploded Ordnance and boulder clearance will also be required. Additional seabed preparation may be required prior to gravity base foundation installation, including dredging of sediments.

1.2.1.3 Site-specific geophysical data from the Morgan Array Area and bathymetry data were used to identify sandwaves and it was determined that up to 40% of the total length of the inter-array cables and 60% of the interconnector cables would require sandwave clearance. Site-specific geophysical data from the Morgan Array Area and bathymetry data also identified that up to 60% of foundation locations may require sandwave clearance. If dredging is required, it would be carried out by dredging vessels using suction hoppers or similar.

1.2.1.4 Pin piles for the foundations are driven and/or drilled into the seabed. If drilling is required, spoil arising from the drilling will be disposed of within the vicinity of the source.

1.2.2 Volume of spoil for disposal

1.2.2.1 The total spoil volume for the Morgan Generation Assets disposal site is calculated using the Maximum Design Scenario (MDS) for sandwave clearance associated with the relevant infrastructure within the Morgan Array Area.

1.2.2.2 The maximum amount of spoil that is anticipated to arise within the Morgan Array Area, which would require disposal within the Morgan Generation Assets Disposal Site is 18,236,920 m^3 (Table 1.3). The source of this total volume of spoil could arise from the activities outlined in section 1.2.1, such as sandwave clearance for installation of cables and foundations, dredging works for seabed preparation associated with installation of cables and foundations and/or drill arisings from jacket foundation installation. However, the MDS considers sandwave clearance only, as spoil arising from drilling and trenching would be much lower than the volumes presented in Table 1.3 for sandwave clearance.

Table 1.3: Summary of MDS spoil volumes associated with seabed preparation in the Morgan Generation Assets disposal site.

Source	Sandwave clearance (m^3)
Wind Turbine Generator foundations	9,414,040
OSPs	735,415
Inter-array cables	5,026,651
Interconnector cables	3,060,814
Total	18,236,920

1.3 Consideration of alternative disposal options

1.3.1.1 Once drilled or dredged material has been produced, it is classified as a waste material, and is therefore considered to be part of a waste stream and strictly controlled.

1.3.1.2 The disposal of dredged and drilled material is under the London Convention 1972, the OSPAR Convention 1992, and the European Union (EU) Waste Framework Directive 2008/98/EC.

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

- Prevention
- Re-use
- Recycle
- Other recovery

- Disposal.

1.3.1.4 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).

1.3.1.5 The consideration of alternative solutions to the disposal of drilled and/or dredged material within the array area 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. The following section 1.3.1 presents information on the consideration of potential alternatives to the disposal of drilled and dredged material from the Morgan Array Area and justification for why disposal *in situ* is the most appropriate option.

1.3.1 Waste hierarchy

Prevention

1.3.1.1 The Waste Hierarchy places a strong emphasis on waste prevention or the minimisation of waste. Consent is being sought for Morgan Generation Assets for the use of a range of foundation options and cable installation methodologies. Further information is required before the design of the Morgan Generation Assets can be finalised and it is possible, for example, that more than one foundation type may be used across the project.

1.3.1.2 For piled foundations, if piling alone does not achieve full pile depth due to the presence of hard ground conditions, the material inside the 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.

1.3.1.3 If non-piled foundations are chosen (e.g. suction bucket three-legged jackets, suction bucket four-legged jackets, suction bucket six-legged jackets and gravity bases), 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. The volumes of spoil generated will, however, depend on the size of foundations needed and the seabed conditions at each installation location.

1.3.1.4 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. The target burial depth, depending on the outcome of the Cable Burial Risk Assessment, is 2 m. 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 the Morgan Generation Assets, sandwave clearance and the associated dredging and disposal works will in some cases be unavoidable.

1.3.1.5 As a result, the safe and effective installation of the Morgan Generation Assets 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 completely. Therefore consideration must next be given to whether re-use of the spoil generated is possible.

Re-use

1.3.1.6 As prevention of spoil is not possible, the potential for the dredged and drilled material to be re-used must next be considered. Potential examples of options for the re-use of dredged and drilled material can include:

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

1.3.1.7 The dredging and site preparation associated with conical gravity base foundations may involve the use of up to 7,000 m^3 of this material, per foundation, as ballast within the structure. This activity would count as 're-use' and would minimise the volume of material disposed of *in situ*. The remaining material will be sidecast in close proximity to be available within the sediment cell for transport and sandwave regeneration.

1.3.1.8 With regards to consideration of other options for the re-use of material arising from the Morgan Generation Assets, this would require the movement of up to 18,236,920 m^3 away from the Morgan Array Area (see Table 1.3 for the detailed breakdown) which would be associated with additional vessel movements. For example, alternative uses for the spoil would most likely to be based on land, which would require up to approximately 1,658 dredging cycles for the Morgan Array Area (assuming a hopper capacity of 11,000 m^3) each with a vessel round trip from the closest port (for example, in Liverpool Bay).

1.3.1.9 Collection of drill arisings has been considered but this would be costly due to the need for suction dredging vessels in addition to drilling vessels. Furthermore, the limited material produced at each foundation site (i.e. the maximum spoil volume per pile is 2,107 m^3 for the three-legged jacket foundations) means collection would not be viable.

1.3.1.10 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 the Morgan Array Area may also require four-point anchoring systems at each loading point, which would also result in an additional environmental impact to the seabed which the disposal of material *in situ* would preclude. The re-use of material onshore has therefore not been deemed viable.

Recycle

1.3.1.11 As prevention and re-use of spoil are not feasible, the potential for the dredged and drilled material to be re-recycled must next be considered. Recycling of drilled and dredged material would involve transforming the material into a different form, for example to produce bricks or aggregate material. As outlined in the MMO guidance (MMO, 2011), these are generally land-based solutions with any material produced used in onshore construction projects. As such, the same issues with respect to vessel movements to transport the dredged material to land, as discussed above in paragraphs 1.3.1.8 to 1.3.1.10, would apply. The disposal of drilled and dredged spoil material *in situ* would preclude the additional environmental impacts that would arise. The re-recycling of material has therefore not been deemed viable.

Other recovery

1.3.1.12 As prevention, re-use and re-cycling of spoil are not feasible, the potential for other means of recovery must next be considered. 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 the Morgan Generation Assets. Other means of recovering the material arising from the Morgan Generation Assets has therefore not been deemed viable.

Disposal

1.3.1.13 The final option for consideration is, therefore, disposal and initial consideration has been given to the potential to dispose of material at an existing disposal site (i.e. rather than licensing a new disposal site). The closest open marine disposal site is the Barrow D disposal site, located to the east of Morgan Generation Assets.

1.3.1.14 Disposal sites, such as the Barrow D disposal site are, however, generally only licensed to enable the disposal of material from specific projects/locations and activities. It is not, therefore, considered feasible 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.

1.3.1.15 In addition, the use of an existing open disposal site would require the transport of the Morgan Generation Assets spoil material away from Morgan Array Area to another disposal site, resulting in additional vessel movements with associated environmental implications as discussed above in paragraphs 1.3.1.8 to 1.3.1.10. The receiving seabed environment at an alternative location may also be characterised by a somewhat different sediment composition. Disposal of the spoil material *in situ* within the Morgan Generation Assets boundary, and close to the point of production, ensures that the spoil will be returned into a broadly similar sedimentary environment (and in the case of drill arisings, ensures that the spread of material away from the point of production is minimised). Disposal of material at another disposal site may also require hydrodynamic and sediment transport modelling studies to determine the capacity of the site to accommodate the additional spoil type and volumes.

1.3.1.16 Therefore, disposal at existing marine disposal sites does not represent the most efficient or environmentally robust approach to disposal of material from Morgan Generation Assets.

1.3.1.17 In conclusion, the assessments undertaken have not identified any significant adverse (in Environmental Impact Assessment (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, disposal *in situ* remains the most viable option. *In situ* disposal also has the advantage of retaining sediment within the local sedimentary system which is consistent with the National Policy Statement (NPS) for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero, 2023). This is also important for facilitating the recovery of benthic communities and seabed features (e.g. sandwaves).

1.4 Characteristics of the disposal site

1.4.1 Physical characteristics

1.4.1.1 This section provides a summary of the physical characteristics of the Morgan Generation Assets. Further details on the physical environment are set out in Volume

4, Annex 1.1: Physical processes technical report of the Environmental statement and Volume 2, Chapter 1: Physical processes of the Environmental statement.

Bathymetry

1.4.1.2 Seabed levels across the Morgan Array Area range from depths of 32 m to 54 m Mean Sea Level (MSL) with a deeper corridor travelling across the Morgan Array Area from the southwest to the northeast. Shallower depths are observed in the north and the south of the Morgan Array Area.

Tidal and wave regime

1.4.1.3 The Morgan Array Area has an average tidal range of 3.65 m as published by Admiralty (United Kingdom Hydrographic Office (UKHO)) at Holyhead and a mean tidal range of 4.55 m at the standard port of Douglas.

1.4.1.4 The semi-diurnal tides are the dominant physical process in the Irish Sea moving into the Irish Sea from the Atlantic Ocean through both the North Channel and St. George's Channel. The tidal range in the Irish Sea is highly variable with the range in Liverpool Bay exceeding 10 m on the largest spring tides, the second largest in Britain.

1.4.1.5 The wave climate in the Morgan Array Area is described as having dominant short period, southwest direction waves. During the metocean buoy deployment the largest wave height recorded was 8.92 m (Hmax) during Storm Franklin in 2022 (Fugro, 2022).

1.4.1.6 The highest mean annual significant wave height of 1.39 m was recorded between the Isle of Man and Anglesey with the significant wave height reducing closer to the coast with a low of 0.73 m recorded to the west of the Dee Estuary (ABPmer, 2008).

1.4.1.7 Within the Morgan Generation Assets mean annual wave height ranges from 1.1 m to 1.3 m. Over 40% of waves arise from the southwest and all significant wave heights greater than 4 m originate from the southwest or west (ABPmer, 2018).

Seabed geology

1.1.1.1. Across the Morgan Array Area, the underlying geology consists of Triassic and Carboniferous sandstone and mudstone bedrock lithologies (Mellett *et al*., 2015). The bedrock of sandstone and mudstone is covered by sediments from the Quaternary age with small areas exposed (Mellett *et al.,* 2015). Potential weathering during the last glacial period may have weakened the uppermost surface of underlying bedrock (Mellett *et al.,* 2015). Quaternary sediment thickness in the central Irish Sea is <20 m although in short distances this can increase to >100 m due to the presence of glacial valleys. However, in the east and west of the Irish Sea sediment thickness is circa 50 m (Mellett *et al.,* 2015).

1.4.1.8 In the Irish Sea, there is a high variability in the bedforms ranging from very small ripples (5 cm high) to very large sediment waves (>10 m high). The seafloor morphology of the Morgan Array Area also includes several distinct features such as sandwaves, megaripples, sediment waveforms and outcrops (XOCEAN, 2022 and Gardline, 2022). Seabed substrate within the Morgan Array Area ranged from sand, sandy gravel, and gravelly sand.

Bedforms and sediment transport

1.4.1.9 Within the Morgan Array Area, the residual current speeds are several orders of magnitude smaller than those along the coastline. Residual currents are the net flow

over a full tidal cycle and drive the sediment transport. Residual currents flow into the east Irish Sea from the north of the Isle of Man and also west around Anglesey. This correlates with this region being a sediment sink. In the Morgan Array Area, sediment transport rates are highest during springs on the flood tide, with total sediment loads of up to 0.0001 $m^3/s/m$ and 0.00005 $m^3/s/m$ on the peak of the flood and ebb tides respectively. Net sediment transport rates are circa 0.4 -1.5 $m^3/d/m$ within the Morgan Array Area.

Suspended sediment

1.1.1.2. Suspended sediment concentrations (SSCs) are regulated by tidal currents and intensify during wind-driven storm events. SSC levels have a seasonal pattern due to the seasonality of storm events. Offshore monitoring within the Morgan Array Area recorded typical SSC levels of 3 mg/l, however as expected during a storm event this increased to circa 20 mg/l corresponding with increased wave heights (Fugro, 2022).

1.4.1.10 Cefas records SSC as non-algal suspended particulate matter. Within the Morgan Array Area, this was estimated to be on average 0.9 mg/l to 3 mg/l between 1998 and 2015 (Cefas, 2016). These values display a seasonal pattern with heightened levels during winter months and are regulated by tidal currents.

1.4.2 Biological characteristics

1.4.2.1 This section provides a summary of the biological characteristics of the Morgan Array Area. Details for further information on each receptor are outlined in Table 1.4 below.

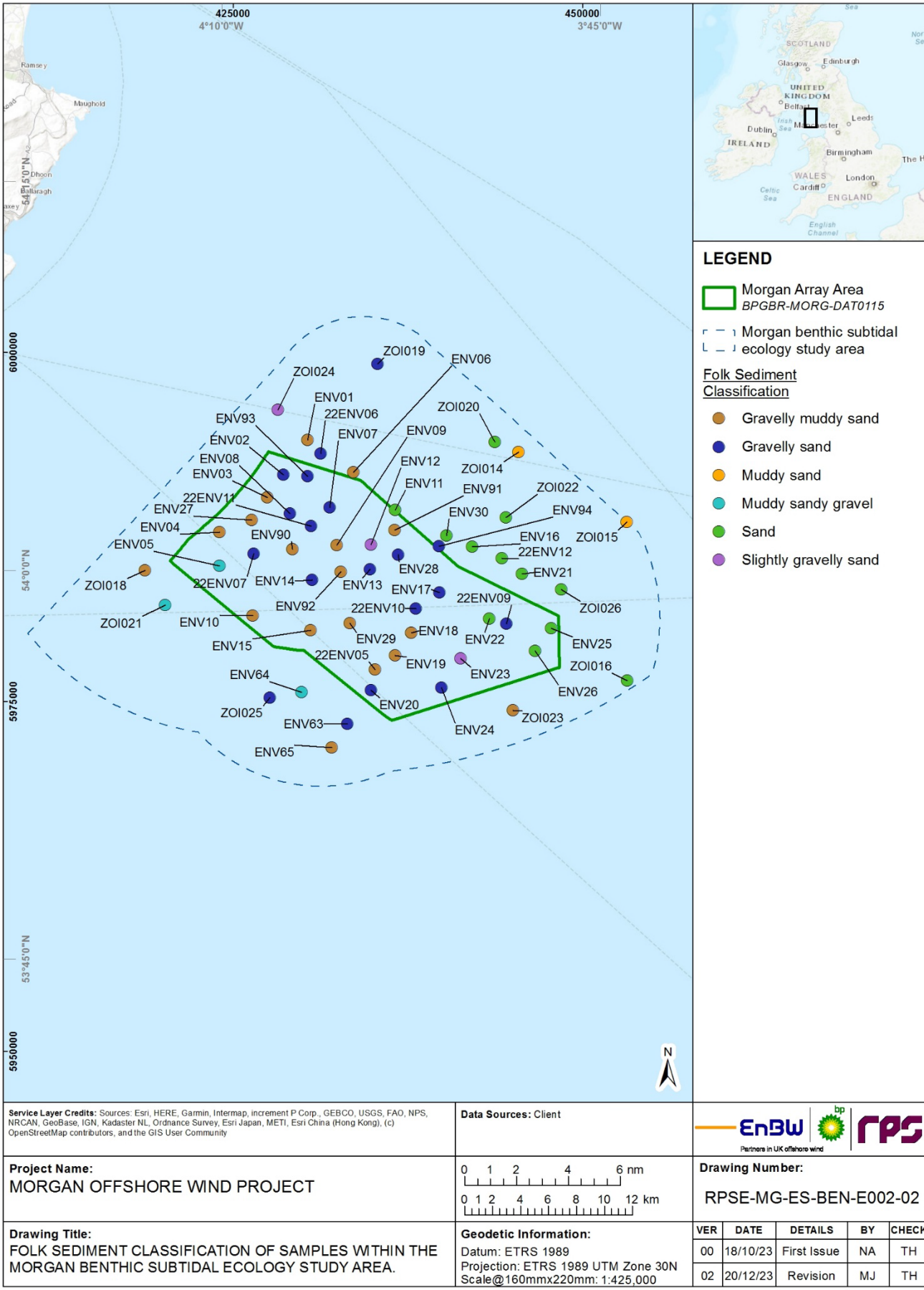
Table 1.4: Chapter information for further information on biological characteristics.

Receptor	Chapter reference
Benthic subtidal ecology	Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement Volume 4, Annex 2.1: Benthic subtidal ecology technical report of the Environmental Statement.
Fish and shellfish ecology	Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement Volume 4, Annex 3.1: Fish and shellfish ecology technical report of the Environmental Statement.
Marine mammals	Volume 2, Chapter 4: Marine mammals of the Environmental Statement Volume 4, Annex 4.1: Marine mammals technical report of the Environmental Statement.
Offshore ornithology	Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement Volume 4, Annex 5.1: Offshore ornithology baseline characterisation technical report of the Environmental Statement.

Benthic subtidal ecology

1.4.2.2 Subtidal sediments recorded from infaunal grab samples collected across the Morgan Array Area during the site-specific benthic subtidal surveys are presented in Volume

4, Annex 2.1: Benthic subtidal ecology technical report of the Environmental Statement and



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 1 2 4 6 8 10 12 km

Drawing Number:
RPSE-MG-ES-BEN-E002-02

Drawing Title:
FOLK SEDIMENT CLASSIFICATION OF SAMPLES WITHIN THE MORGAN BENTHIC SUBTIDAL ECOLOGY STUDY AREA.

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:425,000

VER	DATE	DETAILS	BY	CHECK
00	18/10/23	First Issue	NA	TH
02	20/12/23	Revision	MJ	TH

1.4.2.3 Figure 1.2. Sediments ranged from gravelly sand to muddy sandy gravel with most samples classified as gravelly muddy sand or gravelly sand. According to the simplified Folk Classification (Long, 2006), most stations were classified as mixed or coarse sediments.

1.4.2.4 Across the Morgan Array Area, the infaunal communities were generally dominated by annelids and crustaceans. The most abundant individuals generally belonged to Annelida with the polychaete *Scalibregma inflatum* being overall the most abundant species with a total of 936 individuals recorded. Epifaunal species recorded were dominated by annelids and echinoderms with low numbers of molluscs and arthropods. Stations in areas of coarse and mixed sediments were associated with the presence of dead man's fingers *Alcyonium digitatum*, common starfish *Asterias rubens*, brittle stars *Ophiura* sp. and the common hermit crab *Pagurus bernhardus*.

1.4.2.5 The benthic communities in the Morgan Array Area were characterised by three main biotopes. In the west of the Morgan Array Area the polychaete-rich deep Venus community in offshore mixed sediments (SS.SMx.OMx.PoVen) biotope was dominant. The SS.SMx.OMx.PoVen biotope was the most extensive biotope recorded within the Morgan Array Area, characterising the communities in the north and along the west boundary and extending into the south and east of the Morgan Array Area as well as further south into the Mona Offshore Wind Project. This biotope is characterised by a diverse community particularly rich in polychaetes potentially with a significant venerid bivalve component. Species present in this biotope included polychaetes such as *Glycera lapidum*, *Aonides paucibranchiata*, and *Mediomastus fragilis* as well as the echinoderm *Echinocyamus pusillus*.

1.4.2.6 A similar biotope, offshore circalittoral mixed sediment (SS.SMx.OMx) was recorded in a small area in the centre of the Morgan Array Area. The sediments and communities in areas of the SS.SMx.OMx biotope were characterised by polychaetes, bivalves and Nemertea. Species recorded in this biotope included *Kurtiella bidentata, E. pusillus, Pholoe baltica, Glycera lapidum, Syllis armillaris* and *Urothoe marina.*

1.4.2.7 The circalittoral coarse sediment biotope (SS.SCS.CCS) was recorded across the central sections of the Morgan Array Area, with smaller areas in the north and east of the Morgan Array Area. The SS.SCS.CCS biotope was characterised by a robust community of infaunal polychaetes, mobile crustacea and bivalves which included species such as *Scoloplos armiger*, *Owenia* sp., Nemertea and *Abra* sp.

1.4.2.8 In the east of the Morgan Array Area, the *Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud (SS.SMu.CSaMu.LkorPpel) biotope was dominant extending along the northeast and east boundaries. The communities associated with this biotope were also characterised by polychaetes and bivalves with most species adapted to sandy habitats such as *L. koreni, Spiophanes bombyx* and *P. baltica*.

Figure 1.2: Folk sediment classification of samples within the Morgan benthic subtidal ecology study area.

Fish and shellfish ecology

1.4.2.9 Species identified as likely to be found within the fish and shellfish ecology study area (covers the east Irish Sea, extending from MHWS west from the Mull of Galloway in Scotland to the west tip of Anglesey, following the territorial waters 12 nm limit of the Isle of Man, based on consultation with the EWG and all relevant stakeholders) include:

- Demersal species – sandeel, whiting *Merlangius merlangus*, lemon sole *Microstomus kitt*, ling *Molva molva*, plaice *Pleuronectes platessa*, cod, and European hake *Merluccius merluccius*
- Pelagic species – herring, mackerel *Scomber scombrus*, sprat *Sprattus sprattus*, and European sea bass *Dicentrarchus labrax*
- Elasmobranch species – basking shark *Cetorhinus maximus*, lesser spotted dogfish *Scyliorhinus canicular*, tope shark *Galeorhinus galeus*, spurdog *Squalus acanthias*, common skate *Dipturus batis*, spotted ray *Raja montagui*, and thornback ray *Raja clavata*
- Diadromous species – Atlantic salmon *Salmo salar*, European eel *Anguilla anguilla*, sea trout *Salmo trutta*, river lamprey *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus*, Allis shad *Alosa alosa*, twaite shad *Alosa fallax*, sparling/European smelt *Osmerus eperlanus*; and freshwater pearl mussel *Margaritifera margaritifera* (included here due to reliance on Atlantic salmon and sea trout at specific life stages)
- Shellfish species – king scallop, queen scallop, European lobster *Homarus gammarus*, edible crab *Cancer pagurus*, velvet swimming crab *Necora puber*, squid *Loligo* spp., common whelk *Buccinum undatum*, and *Nephrops*.

1.4.2.10 The spawning and nursery habitats present in the fish and shellfish ecology study area are based on Ellis *et al*. (2012) and Coull *et al*. (1998) with the seasonality of each species covered in Volume 4, Annex 3.1: Fish and shellfish ecology technical report of the Environmental statement. The Coull *et al*. (1998) and Northern Ireland Herring Larvae Survey datasets showed significant herring spawning areas to the west and northwest of the fish and shellfish ecology study area, and to the north, east and northeast of the IoM. The most suitable spawning grounds were located entirely outside of, but within 10 km of the north and northwest of the Morgan Array Area which is further supported by results from detailed site-specific survey PSA data (see Volume 4, Annex 8.1: Fish and shellfish ecology technical report of the Environmental Statement for full results). This site-specific survey data found that the majority of the Morgan Array Area comprised unsuitable sediment for herring spawning, with only small patches of suitable habitat mainly in the north section of the Morgan Array Area.

1.4.2.11 Sandeel high and low intensity spawning grounds have been identified by Ellis *et al*. (2012) as being present throughout the fish and shellfish ecology study area. The site-specific benthic surveys and EMODnet seabed substrate data shows overall good alignment within the Morgan Array Area, showing that the majority of stations sampled represented unsuitable sandeel spawning habitat. However in the west and south of the Morgan Array Area a number of suitable and sub-prime habitats were identified, with further sparse prime habitats dispersed throughout.

1.4.2.12 Elasmobranch species occurring within the Irish Sea include the spotted and thornback ray. Thornback ray have important spawning grounds in the east Irish Sea around Anglesey (Ellis *et al*., 2012). Other elasmobranch species, including the lesser

spotted dogfish and cuckoo ray, are also found throughout the east Irish sea, with both preferring gravelly or coarse sandy substrates for feeding. Basking shark migrate north to south through the Irish and Celtic Seas in August to October while travelling between north Africa and Scotland to overwinter.

1.4.2.13 High levels of commercial fishing of king scallop have been recorded within the wider fish and shellfish ecology study area (ICES, 2020), and queen scallop in the west of the Morgan Array Area.

Marine mammals

1.4.2.14 Seven marine mammal species are known to occur regularly in the region: harbour porpoise *Phocoena phocoena*, bottlenose dolphin *Tursiops truncatus*, short-beaked common dolphin *Delphinus delphis*, Risso's dolphin *Grampus griseus*, minke whale *Balaenoptera acutorostrata*, grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina*. Other cetacean species are occasional or rare visitors.

1.4.2.15 Harbour porpoise occur throughout the area, whilst short-beaked common dolphin and Risso's dolphin are largely restricted the south of the Irish sea. Sightings of bottlenose dolphin are highest in Cardigan Bay and their distribution is largely coastal. Grey seal extensively use areas of the south Irish Sea, the north of St George's Channel, and Liverpool Bay. Several sites in Wales (such as the Marloes Peninsula and north Pembrokeshire coast and islands off west coast of Pembrokeshire and the Lleyn Peninsula), southwest England (especially Lundy and the Scilly Isles) Northern Ireland (e.g. Strangford Lough) the Republic of Ireland (e.g. the Saltee Islands and Lambay Island) and Liverpool Bay (Solway Firth) support important haul-out sites and genetic studies suggest that individuals here may form a distinct population from those found off west Scotland (SCOS, 2022). Harbour seal are concentrated along the northeast coast of Ireland, east coast of Northern Ireland and the Firth of Clyde. In Northern Ireland most harbour seal haul-outs are located in the southeast of the country, with most harbour seal being counted at Carlingford Lough, Murlough SAC and Rathlin Island (Duck and Morris, 2019), but also counted in aerial surveys in the Maidens SAC, Strangford Lough SAC and Murlough SAC. Further detail on marine mammals is presented in Volume 2, Chapter 4: Marine mammals of the Environmental Statement and Volume 4, Annex 4.1: Marine mammals technical report of the Environmental Statement.

Offshore ornithology

1.4.2.16 Digital aerial surveys for seabirds have been undertaken across the Morgan Offshore Ornithology Array Area study area and commenced in April 2021 and concluded in March 2023, completing a suite of 24 monthly surveys spanning two years. A total of 16 bird species were recorded, with the key species recorded in the greatest abundance/density within the Morgan Array Area (and 4 km buffer) being common guillemot *Uria aalge*, black-legged kittiwake *Rissa tridactyla*, manx shearwater *Puffinus puffinus*, Northern gannet *Morus bassanus,* razorbill *Alca torda*, European herring gull *Larus argentatus*. Further details for ornithology can be found in the Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement and Volume 4, Annex 5.1 Offshore ornithological baseline characterisation technical report of the Environmental Statement.

Designated sites

1.4.2.17 The Morgan Array Area does not overlap with any sites designated for nature conservation or water quality. The nearest Special Area of Conservation (SAC) is the North Anglesey Marine/Gogledd Môn Forol SAC which is located 28.22 km from the Morgan Array Area and the nearest Special Protection Area (SPA) is the Liverpool Bay/Bae Lerpwl SPA, which is located 10.0 km from the Morgan Array Area. The closest Marine Conservation Zone (MCZ) is the West of Copeland MCZ which is located 8.8 km from the Morgan Array Area.

1.4.2.18 Further information and assessment of impacts to designated sites can be found in the Habitats Regulations Assessment Stage 2 Information to Support an Appropriate Assessment (Document Reference E1.1, E1.2 and E1.3) submitted alongside the Environmental Statement which considers effects on sites within the national site network (SACs, SPAs and Ramsar sites) and the Marine Conservation Zone (MCZ) Assessment (Document Reference E4).

1.4.3 Human environment characteristics

1.4.3.1 This section provides a summary of the human environment of the Morgan Array Area. Further detail can be found in the Volume 2, Chapter 6: Commercial fisheries of the Environmental Statement, Volume 2, Chapter 8: Marine archaeology of the Environmental Statement and Volume 2, Chapter 9: Other sea users of the Environmental Statement and their associated annexes.

Commercial fisheries

1.4.3.2 The Morgan Array Area overlaps International Council for the Exploration of the Sea (ICES) rectangles 36E5, 26E6, 37E5 and 37E6. The MMO data indicates that, over the period 2010 to 2020, shellfish was the most important group in terms of landed weight and value for UK vessels, with the highest landings from ICES Rectangle 37E5. Landings of demersal and pelagic species were considerably lower than shellfish.

1.4.3.3 For UK vessels, the largest proportion of vessels was from the >10 m class; these vessels were predominantly from England, the Isle of Man, Northern Ireland, Scotland and Wales. The smaller UK vessels were predominantly from the Isle of Man and England, reflecting the closer proximity of home ports to this fleet, with relatively small recordings of landings for Welsh, Scottish and Northern Irish vessels.

1.4.3.4 Dredges accounted for approximately 59% of total landings by UK vessels from the commercial fisheries study area. This indicates the importance of the queen and king scallop fisheries in the region. Demersal trawl/seine (targeting demersal dwelling species) were also of notable importance in the commercial fisheries study area and consisted mostly of vessels >10 m in length.

Marine archaeology

1.4.3.5 Geophysical data collected for the Morgan Array Area recorded 51 anomalies of potential archaeological interest. Of these, five are considered to be high potential anomalies, five are of medium potential and 41 have been classed as low potential anomalies. The five high potential anomalies that were identified within the Morgan Array Area have also been recorded within the UKHO as named wrecks. The five medium potential anomalies could represent marine archaeology sites from potential

debris to wreck. Full details of the medium potential anomalies can be found in Volume 4, Annex 8.1: Marine archaeology technical report of the Environmental Statement.

Other sea users

1.4.3.6 In terms of recreational sailing and motor cruising, the Royal Yachting Association (RYA) data is limited to inshore waters, but Automated Identification System (AIS) data tracks show that recreational vessels transit through offshore waters within the local other sea users study area (which is based on one tidal excursion of the Morgan Array Area). The Morgan Array Area is characterised by relatively sparse recreational activity, with the exception of the north section of the Morgan Array Area that shows low to moderate recreational activity. Most recreational vessels remain predominantly along the coast, particularly along the entrance to Liverpool, and around Holyhead, Douglas, and Rhyl. Inshore cruising routes are clear of the Morgan Array Area. Offshore cruising routes are present between Liverpool, Douglas, Menai Straits, and Morecambe Bay, running adjacent to, and sometimes crossing, the Morgan Array Area. Relatively few yachts were recorded during the vessel traffic surveys, with less than one per day during the summer survey and none recorded during the winter survey.

1.4.3.7 Sea fishing trips run from Conwy, North Wales and specialise in wreck fishing, deep sea fishing and reef fishing from Anglesey to Liverpool Bay (Sea Fishing Trips in North Wales, 2023). Sea fishing trips also operate from the Isle of Man (Manx Sea Fishing, 2023) and Fleetwood, Lancashire (Blue Mink Boat Charters, 2023) amongst other ports along the coasts of the east Irish Sea.

1.4.3.8 There are a number of proposed and operational offshore wind farms in the east Irish Sea. There is no spatial overlap between any proposed or operational wind farms and the local other sea users study area (and therefore the Morgan Array Area).

1.4.3.9 There is one operational power cable, the United Kingdom/Isle of Man interconnector, between the Isle of Man and Blackpool. A section of the interconnector runs just within and broadly parallel to the north boundary of the local other sea users study area, 830 m to the north of the Morgan Array Area.

1.4.3.10 Licences for the exploration and extraction of oil and gas on the United Kingdom Continental Shelf have been offered since 1964 and are granted by the North Sea Transition Authority (NSTA). These licences are granted for identified geographical UKHO areas (blocks and sub-blocks) in consecutive rounds. There are no licenced blocks overlapping with the local other sea users study area. The NSTA launched the 33rd Oil and Gas Licensing Round in October 2022 and three of the licences which have been offered are for blocks (110/1, 110/2c and 113/26) which overlap with the local other sea users study area.

1.4.3.11 There are no offshore oil and gas installations or pipelines within the local other sea users study area. The nearest offshore oil and gas platform is the Millom West platform, operated by Chrysaor Resources (Irish Sea) Limited (Harbour Energy), located 2.96 km from the Morgan Array Area. Consultation with Harbour Energy has confirmed that the Millom West platform is planned to be decommissioned and vessel access will be required from 2024 to approximately 2030. The Millom East subsea structures are also planned to be decommissioned and vessel access will be required from 2027 to approximately 2032. The South Morecambe cluster is located 12.2 km to the south east of the Morgan Array Area, operated by Spirit Energy. Spirit Energy are planning to decommission all the platforms in the South Morecambe cluster between 2027 and 2031 (Volume 2, Chapter 9: Other sea users of the Environmental

Statement). There are no Carbon Capture and Storage CCS or underground gas storage projects within the local other sea users study area.

1.5 Characteristics of material to be disposed

1.5.1 Physical characteristics

1.5.1.1 Subtidal sediments recorded from infaunal grab samples collected across the Morgan Array Area during the site-specific benthic subtidal surveys ranged from gravelly sand to muddy sandy gravel with most samples classified as gravelly muddy sand or gravelly sand.

1.5.1.2 Full details of the characteristics of sediments within the Morgan Array Area are presented in Volume 2, Chapter 7: Benthic subtidal ecology of the Environmental Statement.

1.5.1.3 Drill arisings may consist of large, granular materials that are too large to be moved by tidal currents and may remain *in situ* for long periods of time. The exact scope for this potential impact will rely on the nature of the materials drilled out during pile drilling.

1.5.2 Chemical characteristics

1.5.2.1 As part of the subtidal survey, sediment samples were taken for the purpose of sediment chemistry analysis. Sediment hydrocarbon, metals, total organic carbon, organotins and Polychlorinated Biphenyl (PCB) analyses were carried out by SOCOTEC, a laboratory validated by the MMO for sediment analysis to inform marine licences applications. Levels of heavy and trace metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), Polycyclic Aromatic Hydrocarbons (PAHs) and PCBs were identified and compared to Cefas Action Levels 1 and 2 (AL1 and AL2) as well as the Canadian Probable Effect Level (PEL) and Threshold Effect Level (TEL). In summary, no contaminants were found to exceed Cefas AL2 or the Canadian PEL.

1.5.2.2 Concentrations of most metals were below the Cefas AL1 and the Canadian TEL and all were below the Cefas AL2 and Canadian PEL. The exception was arsenic which exceeded Cefas AL1 at one sample station in the Morgan Array Area (but was below Cefas AL2) and exceeded the Canadian TEL at 10 stations in the Morgan Array Area but all were below Canadian PEL.

1.5.2.3 No samples in the Morgan Array Area were found to exceed the relevant thresholds for PCBs or PAHs. The levels of the total ICES-7 PCBs were below the relevant Cefas AL1 and levels of total PCBs were also below the Cefas AL1 (0.02 mg/kg) and Cefas AL2 (0.2 mg/kg). Concentrations of all PAHs in samples in the Morgan Array Area were below the relevant Canadian TEL (where one is specified). Concentrations of organotins where below the limit of detection at all stations (see Volume 4, Annex 2.1: Benthic subtidal ecology technical report of the Environmental Statement).

1.5.3 Biological characteristics

1.5.3.1 Information on the biological characteristics of the material to be disposed is outlined above in section 1.4.2.2 to 1.4.2.8. The locations for more detailed information on specific data categories is outlined in Table 1.5.

Table 1.5: Relevant Environmental Statement technical report/chapter for each data type.

Data type	Relevant Environmental Statement document
Contaminant analysis	Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement Volume 4, Annex 2.1: Benthic subtidal ecology technical report of the Environmental Statement
Seabed geology	Volume 2, Chapter 1: Physical processes of the Environmental Statement Volume 4, Annex 1.1: Physical processes technical report of the Environmental Statement Volume 4, Annex 2.1: Benthic subtidal ecology technical report of the Environmental Statement
Biotopes and benthic fauna	Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement Volume 4, Annex 2.1: Benthic subtidal ecology technical report of the Environmental Statement
Fish and shellfish spawning and nursery areas	Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement Volume 4, Annex 3.1: Fish and shellfish ecology technical report of the Environmental Statement

1.6 Assessment of potential adverse effects

1.6.1 Physical environment

1.6.1.1 The following section of this Disposal site characterisation report provides an overview of the key findings for Morgan Generation Assets, as reported in the Environmental Statement, which are relevant to the disposal of dredged and/or drilled material *in situ* within the Morgan Generation Assets disposal site. One impact been assessed in the context of dredging and disposal activities (see Table 1.6).

1.6.1.2 It should be noted that marine processes are not in themselves receptors in the majority of cases when carrying out an impact assessment, but changes to these processes may have an impact on other sensitive receptors (Lambkin *et al.*, 2009). The receptor groups for the potential impact pathways considered within Volume 2, Chapter 1: Physical processes of the Environmental Statement lie principally in other offshore EIA topics, namely:

- Volume 2, Chapter 2: Benthic ecology of the Environmental Statement
- Volume 2, Chapter 3: Fish and shellfish Ecology of the Environmental Statement
- Volume 2, Chapter 4: Marine mammals of the Environmental Statement
- Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement
- Volume 2, Chapter 8: Marine archaeology of the Environmental Statement
- Volume 2, Chapter 9: Other sea users of the Environmental Statement.

1.6.1.3 In such instances, a significance of effect has not been assigned within the assessment, see Volume 2, Chapter 1: Physical processes of the Environmental Statement for further information on the physical pathways and Volume 4, Annex 1.1: Physical processes technical report of the Environmental Statement for more detailed technical information which underpins the impact assessments presented in Volume 2, Chapter 1: Physical processes of the Environmental Statement.

1.6.2 Biological and human environment

1.6.2.1 The Environmental Statement for the Morgan Generation Assets provides detailed impact assessments related to disposal activities on a number of sensitive biological and human environment receptors, including benthic habitats, fish and shellfish habitats, marine mammals, offshore ornithology, commercial fisheries, marine archaeology and other sea users.

1.6.2.2 For all of these assessments, the effects defined within Volume 2, Chapter 1: Physical processes of the Environmental Statement have been interpreted with regard to their subsequent impact on various receptors. The sensitivity of various receptors to these effects (increased SSC, 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.

1.6.2.3 Table 1.6 below provides a summary of the key impacts on physical, biological and human receptors assessed within the Environmental Statement. The relevant section of the Environmental Statement, where further details of these impact assessments are presented, is also provided.

Table 1.6: Summary of impacts relevant to the disposal of spoil within the Morgan Generation Assets disposal site.

Potential impact	Relevant section of the Environmental Statement	Magnitude of impact	Sensitivity of receptor	Significance of effect
Physical processes				
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	Volume 2, Chapter 1: Physical Processes of the Environmental Statement	C: Negligible O: Negligible D: Negligible	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible
Benthic ecology				
Temporary subtidal habitat disturbance	Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement	Subtidal habitat Important Ecological Features (IEFs) C: Low O: Negligible D: Low	Subtidal habitat IEFs C: Low - High O: Low - High D: Low - High	Subtidal habitat IEFs C: Minor adverse O: Minor adverse D: Minor adverse
Increase in suspended sediment concentrations and associated deposition	Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement	Subtidal habitat IEFs C: Low O: Negligible D: Negligible West of Walney MCZ IEFs C: Negligible O: Negligible D: Negligible West of Copeland MCZ IEFs C: Negligible O: Negligible D: Negligible	Subtidal habitat IEFs C: Negligible - Medium O: Negligible - Medium D: Negligible - Medium West of Walney MCZ IEFs C: Negligible O: Negligible D: Negligible West of Copeland MCZ IEFs C: Negligible - Low O: Negligible - Low D: Negligible - Low	Subtidal habitat IEFs C: Negligible – Minor adverse O: Negligible D: Negligible West of Walney MCZ IEFs C: Negligible O: Negligible D: Negligible West of Copeland MCZ IEFs C: Negligible O: Negligible D: Negligible

Potential impact	Relevant section of the Environmental Statement	Magnitude of impact	Sensitivity of receptor	Significance of effect
Disturbance/remobilisation of sediment-bound contaminants	Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement	Subtidal habitat IEFs C: Negligible D: Negligible West of Walney MCZ IEFs C: Negligible D: Negligible West of Copeland MCZ IEFs C: Negligible D: Negligible	Subtidal habitat IEFs C: Low D: Low West of Walney IEFs C: Low D: Low West of Copeland IEFs C: Low D: Low	Subtidal habitat IEFs C: Negligible D: Negligible West of Walney MCZ IEFs C: Negligible D: Negligible West of Copeland MCZ IEFs C: Negligible D: Negligible
Fish and shellfish ecology				
Temporary habitat loss/disturbance	Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement	C: Marine and Diadromous - Low Herring – Negligible O: Marine and Diadromous - Low Herring – Negligible D: Marine and Diadromous - Low Herring - Negligible	C: Marine – Low to High Diadromous- Negligible O: Marine – Low to High Diadromous - Negligible D: Marine – Low to High Diadromous - Negligible	C: Marine - Minor adverse Diadromous - Negligible O: Marine – Minor adverse Diadromous - Negligible D: Marine – Minor adverse Diadromous - Negligible

Potential impact	Relevant section of the Environmental Statement	Magnitude of impact	Sensitivity of receptor	Significance of effect
Increased SSCs and associated sediment deposition	Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement	C: Low O: Negligible D: Low	C: Herring – Medium Queen and king scallop - Medium All other Marine – Low Diadromous – Low O: Marine – Low to Medium Diadromous – Low D: Marine – Low to Medium Diadromous - Low	C: Marine – Minor adverse Diadromous - Negligible O: Queen and king scallop – Minor adverse Marine – Negligible Diadromous – Negligible D: Marine – Minor adverse Diadromous – Negligible
Marine mammals				
Changes in fish and shellfish communities affecting prey availability	Volume 2, Chapter 4: Marine mammals of the Environmental Statement	C: Low O: Low D: Low	C: Minke whale - Medium C: All other marine mammals - Low O: All marine mammals - Low D: All marine mammals - Low	C: Minor adverse O: Minor adverse D: Minor adverse
Ornithology				
Changes in fish and shellfish communities affecting prey availability	Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement	C: Auk species - Negligible D: Auk species - Negligible	C: Auk species – Low D: Auk species - Low	C: Auk species – Negligible D: Auk species - Negligible
Commercial Fisheries				
Potential impacts on commercially important fish and shellfish resources	Volume 2, Chapter 6: Commercial fisheries of the Environmental Statement	Medium	Low to High	Minor adverse – Moderate adverse Reducing to Minor adverse with the further mitigation proposed through development of an Underwater Sound

Potential impact	Relevant section of the Environmental Statement	Magnitude of impact	Sensitivity of receptor	Significance of effect
				Management Strategy post-consent to define appropriate measures to reduce the magnitude of impact to environmentally acceptable levels, and thus reduce the impact
Marine archaeology				
Sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors	Volume 2, Chapter 8: Marine archaeology of the Environmental Statement	C: Low O: Low D: Low	C: High O: High D: High	C: Minor adverse O: Minor adverse D: Minor adverse
Alteration of sediment transport regimes	Volume 2, Chapter 8: Marine archaeology of the Environmental Statement	O: Negligible	O: Medium	O: Negligible
Other sea users				
Displacement of recreational activities	Volume 2, Chapter 9: Other sea users of the Environmental Statement	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Minor adverse O: Minor adverse D: Minor adverse
Reduction or restriction of other offshore energy activities	Volume 2, Chapter 9: Other sea users of the Environmental Statement	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Minor adverse O: Minor adverse D: Minor adverse

1.7 Monitoring

1.7.1.1 Based on the findings of the impact assessments presented in the Environmental Statement, and summarised within this document, long-term impacts from the disposal of spoil and dredged material within the Morgan Array Area are not anticipated. This is due to the limited increase in seabed level, the low levels of contamination in sediments and the temporary nature of any sediment plumes generated.

1.7.1.2 In light of the above, and that impact assessments presented in the Environmental Statement (also see Table 1.6), concluded no significant effects to physical processes, biological or human receptors no monitoring specific to disposal is proposed for the Morgan Array Area disposal site.

1.8 Conclusions

1.8.1.1 This document represents the site characterisation for the Morgan Array Area and is required by the MMO to allow them to consider the potential impacts of disposal within the site. The document forms the proposal for the licensing of a disposal site within the Morgan Array Area for drill arisings, and material arising from foundation seabed preparation, cable installation preparation.

1.8.1.2 Noting that all the information required for a site characterisation to support a disposal licence application is contained within the Morgan Generation Assets Environmental Statement, 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 Environmental Statement.

1.8.1.3 The source of material proposed to be disposed of within the Morgan Array Area will be sediment dredged from the upper layer of the existing seabed via suction hopper dredger as part of seabed preparation works ahead of foundation and cable installation preparation, and/or materials from the deeper soil profile and upper sediments derived from drilling activities for piled foundations.

1.8.1.4 Within the Morgan Array Area disposal site, up to a maximum of 18,236,920 m^3 of material will be disposed of *in situ*. 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. 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 within this document and in relevant chapters of the Environmental Statement, noting that the dredging and site preparation associated with conical gravity base foundations may involve the use of up to 7,000 m^3 of this material, per foundation, as ballast within the structure.

1.8.1.5 The deposition of sediment from disposal activities is predicted to only result in short term, spatially discrete impacts, and the fact that the seabed material to be disposed of *in situ* is not heavily contaminated (as outlined in paragraph 1.5.2.1) has shown that contamination of surrounding sediments will be highly unlikely. The only potential longer-term impact of disposal that may arise will be the deposition of drill arisings on the seabed which may consist of large, granular materials that are too large to be moved by tidal currents and may remain *in situ* for long periods of time. The exact scope for this potential impact will rely on the nature of the materials drilled out during pile drilling.

1.8.1.6 No effects of moderate or major adverse significance (i.e. significant in EIA terms) have been identified in relation to sediment disposal, with only negligible to minor adverse effects predicted on relevant receptors.

1.8.1.7 In conclusion, based on the proposals for disposal within the Morgan Array Area disposal site, the nature of the material to be disposed of, the receiving environment and the predictions of the Environmental Statement on the impact of these activities on physical, biological and human receptors, no significant adverse impacts are predicted and disposal *in situ* is the most viable option.

1.9 References

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