

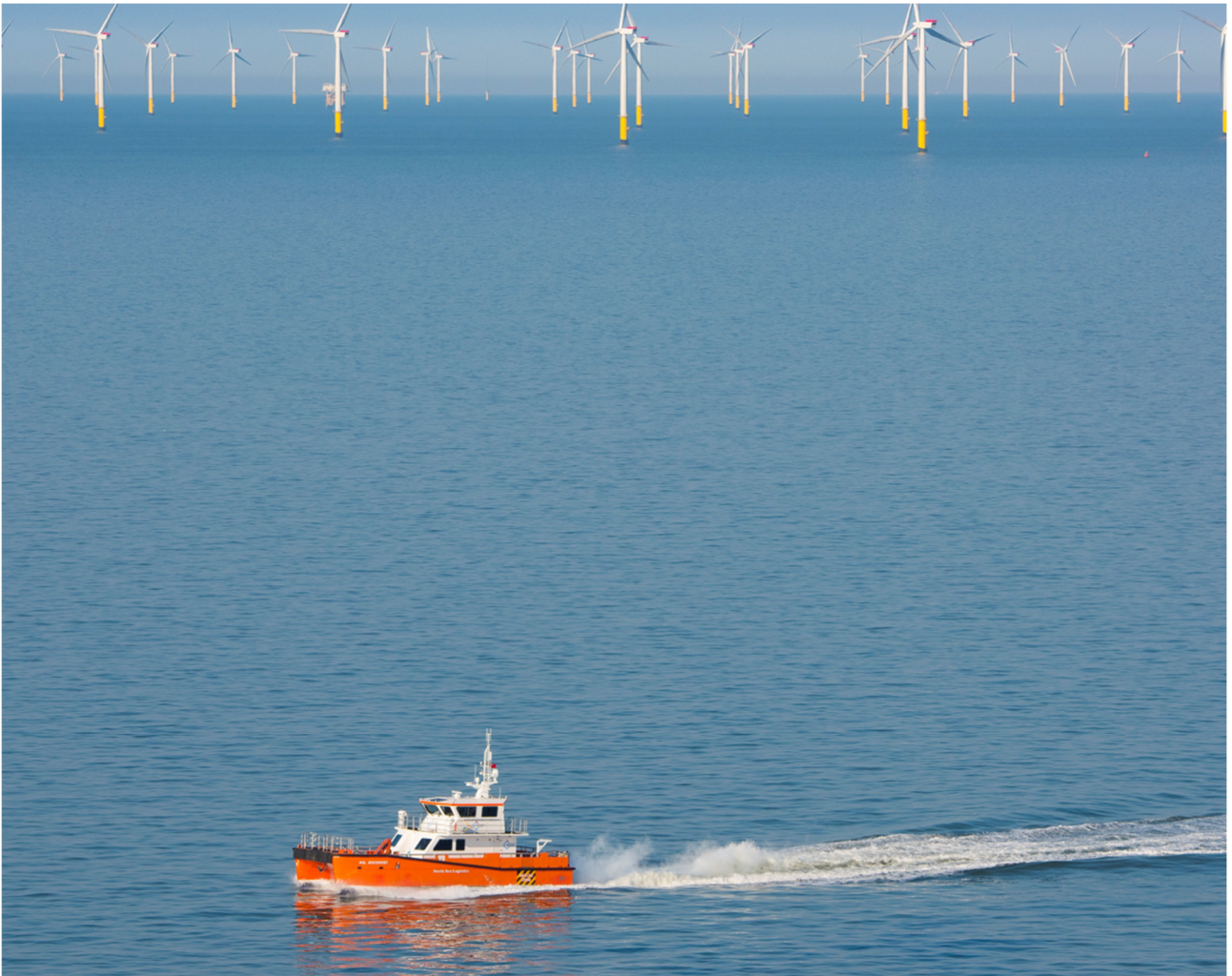
**The Crown Estate**

# Morgan Offshore Wind Farm

An overview of Morgan Ground Conditions

Reference: MRGEO-ARUP-0001 V01

| 15 June 2026



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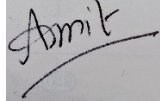

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**Ove Arup & Partners Limited**  
8 Fitzroy Street  
London  
W1T 4BJ  
United Kingdom  
[arup.com](http://arup.com)

# Document Verification

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	Prepared by	Checked by	Approved by
<b>Name</b>	Sam Taylor	Amit Sultaniya	Paul Morrison
<b>Signature</b>			

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	Prepared by	Checked by	Approved by
<b>Name</b>			
<b>Signature</b>			

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# 1. Introduction

The Crown Estate (TCE) has commissioned Ove Arup & Partners Ltd (Arup) to prepare an overview of ground conditions at the Morgan Offshore Wind Farm, based on currently available geotechnical and geophysical information. The purpose of this report is to provide a high-level ground conditions summary, using the site investigations undertaken to date. Raw data from the source documents has not been independently reviewed or reinterpreted for this study. This report therefore presents the findings and interpretations reported in the previous studies.

The summary has been developed with the specific intent of consolidating existing knowledge into useful insights on the geological profile and variability of subsurface conditions across the site, highlighting key stratigraphic units, material characteristics, and potential geotechnical constraints. These insights can be used as part of preliminary assessments for foundation feasibility, constructability considerations, and associated risks.

This report has been prepared for TCE, no reliance is provided to third parties. The report is a summary document of a complex geological site; the reader should consult the original data when developing tender or other stages of design.

## 2. Site description

### 2.1 Location

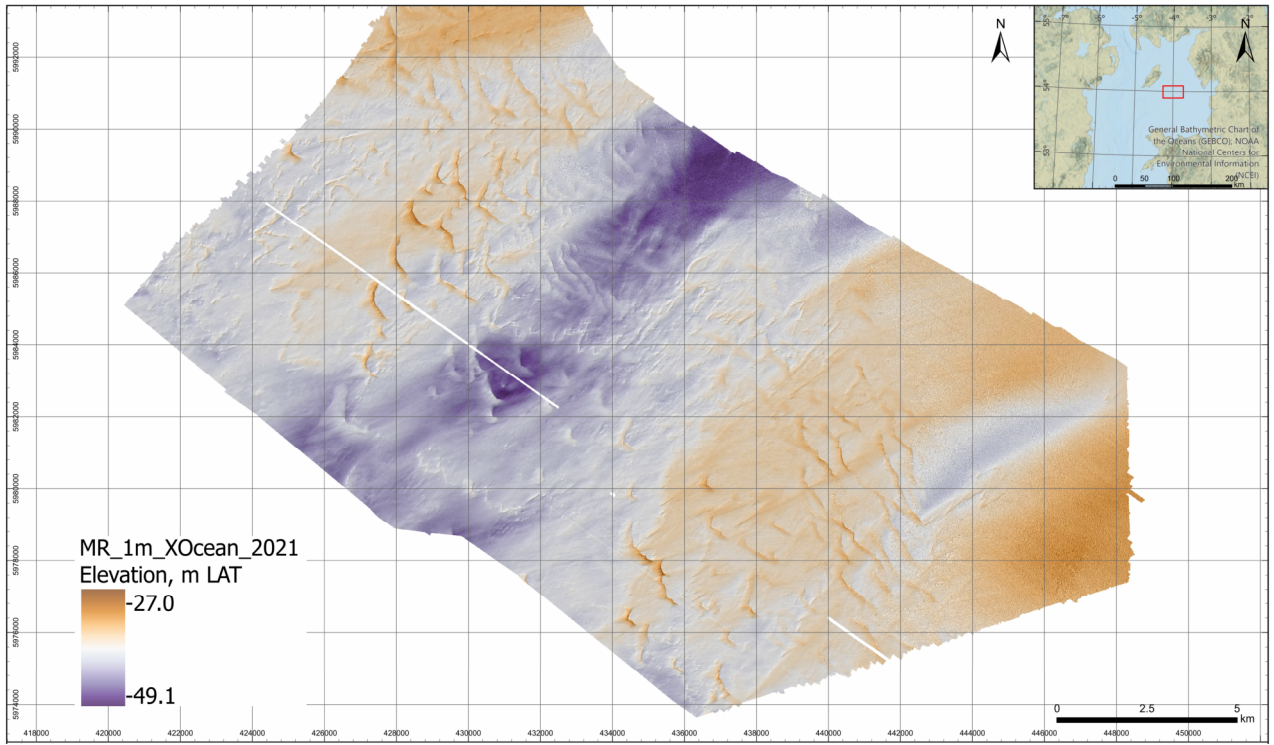
The Morgan site is located approximately 40km off the northwest coast of England within the Irish Sea. The Morgan development area is roughly 300km<sup>2</sup>.



Figure 2-1 - Morgan Offshore Wind Farm regional setting (10kmx10km grid)

### 2.2 Bathymetry and seabed conditions

The bathymetry at the Morgan site is gently undulating with a locally deeper channel in the middle. The north-west and south-east halves typically lie at around -27 to -35m below LAT. The localised channel crosses the centre of the site on a south-west to north-east alignment, reaching depths of up to approximately -49.1m below LAT.



**Figure 2-2 - Bathymetry contours from XOcean 2021 in mLAT (from MRGEO-G4803-NGI-10001 Fig. 1.2.3, ETRS 1989 UTM Zone 30N)**

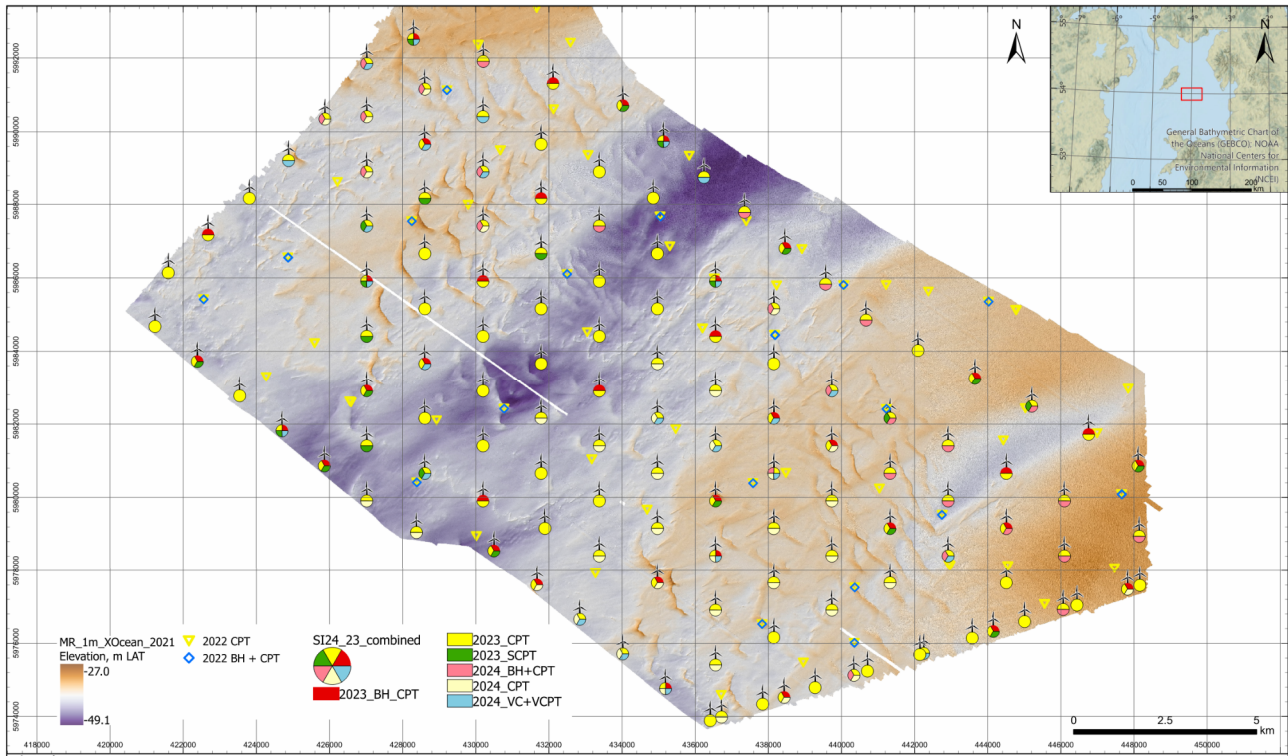
### 3. Sources of information

The following table summarises the surveys and site investigation completed to date.

**Table 3-1 - Summary of investigations to date**

Contractor	Period of execution	Details of works
Gardline & XOcean	2021	2D Ultra High Resolution (UHR) Spraker Seismic; Backscatter; Bathymetric Digital Terrain Model (DTM); Magnetometer; Multi-beam Echo Sounder (MBES); Sub Bottom Profiler (SBP) Pinger; 17nr Seabed Cone Penetration Tests (CPT) at Morgan; Side Scan Sonar (SSS)
Gardline Limited	April-July 2022 August-September 2022	50nr Seabed CPTs, 46nr Vibro-cores (VC)
Fugro	2022	6nr Downhole sampling & CPT; 128nr Seabed CPTs; 20nr Borehole geophysical logging (BGL)
PGS	May-September 2023	UHR 3D Seismic
GEO	May-July 2023	313nr Seabed CPTs inc. cyclic, 8nr seismic CPTs & 87nr Pore Pressure Dissipation Tests (PPDT)
Fugro	July-August 2023 June-November 2023	58nr boreholes and 148nr seabed CPTs Seabed CPTs inc. cyclic, seismic CPTs & PPDT, Downhole sampling & CPT inc. cyclic (remoulded) CPTs & BGL
GEO	June-July 2024	114nr Seabed CPTs, 34nr PPDT, 52nr vibrocores & 52nr Temperature Probe (TRT)
Fugro	June-August 2024; September-October 2024	28nr Downhole sampling & CPT inc. seismic CPTs.
Gardline Limited	March-June 2025	32nr Downhole sampling & CPT, 32nr CPT & SBES.
Fugro	June-September 2025	18nr Downhole sampling & CPT, 6nr boreholes

Figure 3-1 - Morgan exploratory locations from 2022, 2023 and 2024 (MRGEO-G4803-NGI-10001 Fig. 1.2.3, ETRS 1989 UTM Zone 30N) Figure 3-1 shows the spread of exploratory locations and type of data from the 2022 to 2024 campaigns.



**Figure 3-1 - Morgan exploratory locations from 2022, 2023 and 2024 (MRGEO-G4803-NGI-10001 Fig. 1.2.3, ETRS 1989 UTM Zone 30N)**

The following documentation was used in the writing of this report:

- [1] Gardline Limited Morgan & Mona Integrated Offshore Wind Farm Survey, 2021
  - a. 11602 - Volume II – Measured and Derived Geotechnical Parameter and Final Results
- [2] Gardline Limited, Morgan & Mona Integrated Offshore Wind Farm Survey 2022
  - a. 11781 – Volume II - Measured and Derived Geotechnical Parameter and Final Results
- [3] Fugro, Morgan & Mona Geotechnical Site Investigation, 2022
  - a. 210983-02b 02 - Measured and Derived Geotechnical Parameters Report - Morgan
  - b. 210983-03b 03 - Geotechnical Parameters and Engineering Report - Morgan
- [4] Fugro, Morgan & Mona Geotechnical Site investigation, 2023
  - a. 220138-02b 02 - Measured and Derived Geotechnical Parameters Report – Morgan
- [5] Norwegian Geotechnical Institute reports, 2023
  - a. MRGEO-G4803-NGI-10001 B04 Morgan - Volume 3 Data Interpretation and Evaluation of Representative Geotechnical Parameters
  - b. MRGEO-G1301-NGI-10001 B07 Morgan Geotechnical Design Basis
- [6] GEO, Morgan & Mona Geotechnical investigation, 2023
  - a. Morgan, Factual Report - Final Rev 01
- [7] Fugro, Morgan & Mona Geotechnical Site investigation, 2024
  - a. 226226-02b 02 – Measured and Derived Geotechnical Parameters Report – Morgan
- [8] GEO, Morgan & Mona Geotechnical investigation, 2024
  - a. Morgan, Factual Report - Final Results, Rev.02

- [9] Fugro, Morgan & Mona Geotechnical Site investigation, 2025
  - a. 262386-02b 02 Measured and Derived Geotechnical Parameters Report (Morgan)
- [10] Gardline Limited, Morgan & Mona Phase 3 Geotechnical Survey
  - a. MRGEO-G4803-GRL-10002\_B01\_Field Operations and Final Measured and Derived Results Report.pdf

## 4. Ground conditions

### 4.1 Section contents

This section of the report summarises the regional geological setting of the Morgan site, the stratigraphic sequence, the ranges of geotechnical parameters and the associated ground-related risks.

### 4.2 Regional geology

The geology at the Morgan site generally comprises the Mercia Mudstone Group, which in turn overlies the Sherwood Sandstone Group with Permian / Carboniferous strata below; in the west of the site the Mercia Mudstone and Sherwood Sandstone Groups along with the Permian strata have been eroded away leaving Carboniferous strata at the top of the solid geology. In the east of the site the Penarth Group exists locally at the top of the solid geology, the presence of any Lias Group strata may be included within the Penarth Group. The geological map (Solid Geology) is shown in Figure 4-1 from 1994 (in 1999 the Lias was renamed the Lias Group).

Repeated Quaternary glaciations have shaped the area. These have resulted in over-consolidation, erosion, buried channels and glacial landforms. The structural geology is complex, reflecting multiple extensional and compressional phases. The principal structural feature is the Keys Fault. It trends NNW–SSE and separates the Mercia Mudstone and Penarth Groups from the Sherwood Sandstone.

The following figures (Figure 4-1 and Figure 4-2) show the regional geological context.



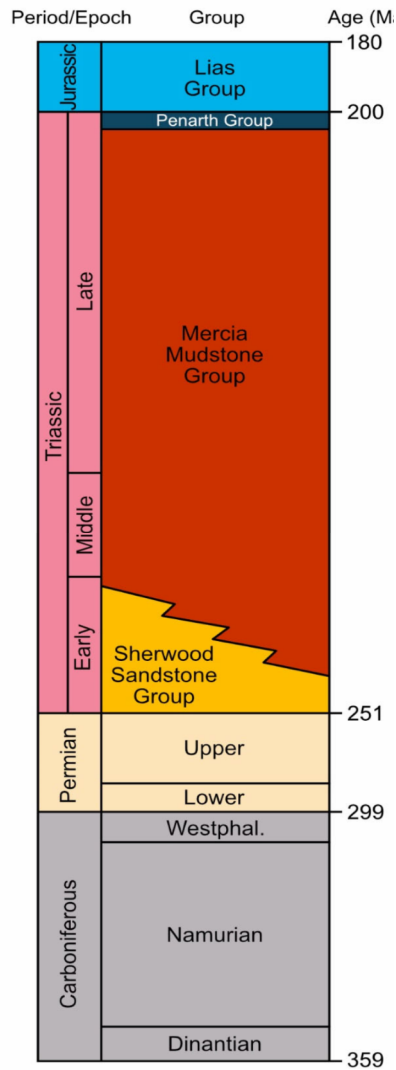


Figure 4-2 - Chronostratigraphy of bedrock units at Morgan (MRGEO-G4803-NGI-10001 B04 Fig 2.1.3a)

### 4.3 Stratigraphy

The stratigraphy at the Morgan Offshore Wind Farm is highly variable. Previous studies identified and developed soil units and bedrock units from the previous site investigations. The following sub-sections present the stratigraphy profile and are based on a review of the information from the previous investigations at the site; previous investigations are presented in Table 3-1.

Figure 4-3 shows the identified soil and bed rock unit classification and particle content pie charts per unit. It should be noted that the figure presents 25 soil units and 8 bedrock units; however, MRGEO-G4803-NGI-10001 reported that soil units IVa, IVe, and IVf, and bedrock unit wMMG (weathered Mercia Mudstone with gypsum) are absent across the Morgan site.

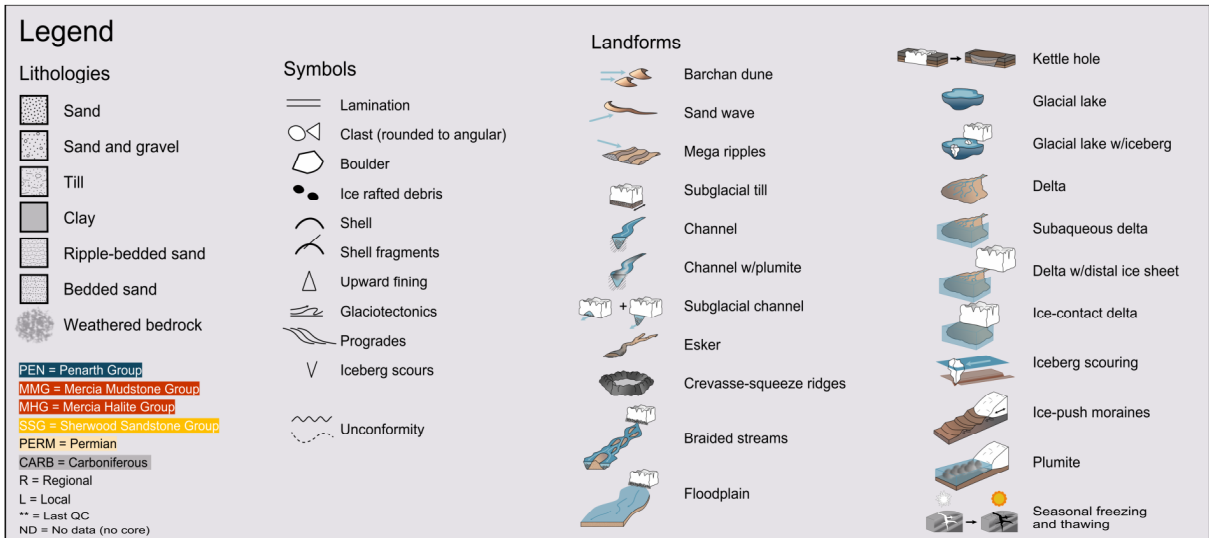
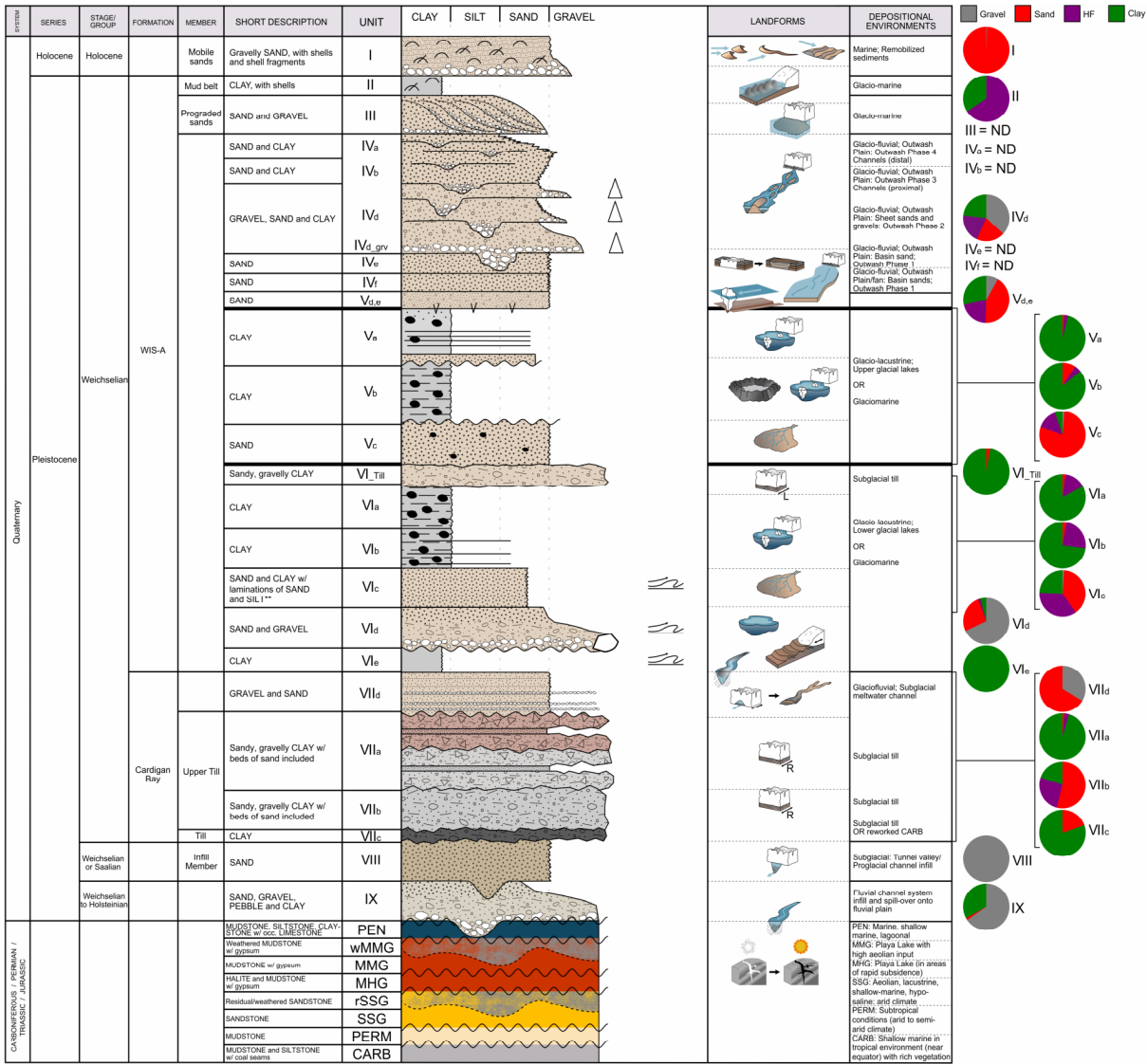


Figure 4-3 – Conceptual stratigraphy soil units and particle content (MRGEO-G4803-NGI-10001 B04 Fig 2.1.3a)

### 4.3.1 Quaternary soil units

Previous studies utilised the Quaternary soil deposits, which are highly variable across the site. Total of 22 soil units were identified in the NGI Phase 3.1 ground model, reported in MRGEO-G4803-NGI-10001 at

Morgan. Soil units were classified by dominant material type: Clay (C), High Fines (HF), Sand (S), and Gravel (GRV). A summary of these units is listed below (youngest first).

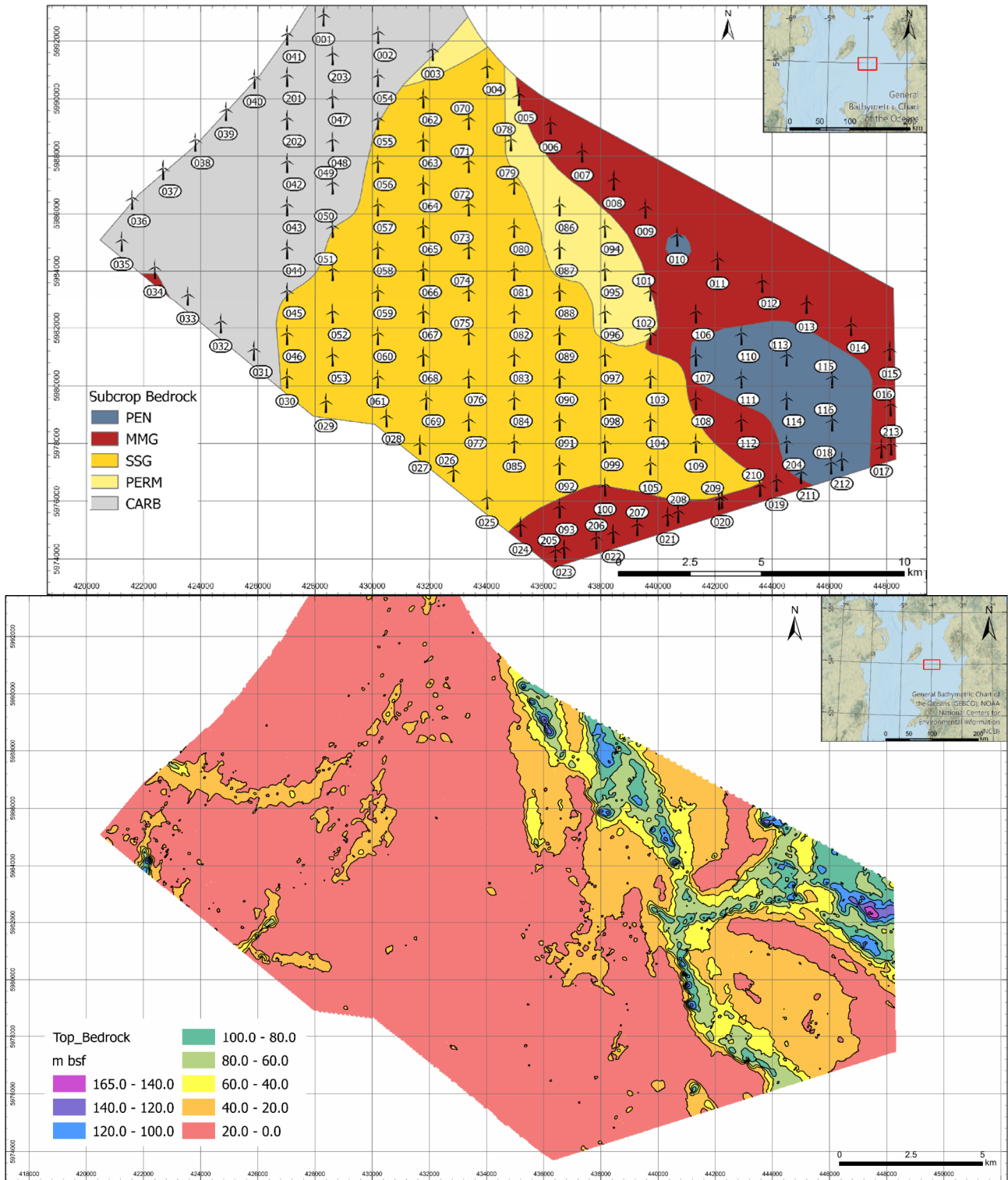
- Unit I: Mobile sands, typically a loose to very dense fine to coarse gravelly SAND with beds of soft clay. Typical depth of occurrence between seabed level and up to 8m below seafloor.
- Units II–III: Glaciomarine clay, sand and gravel. Typically, a soft to firm sandy CLAY (II) becoming a gravelly fine to coarse SAND (III). MRGEO-G4803-NGI-10001 reports that Unit III is not present across Morgan but is included in the unitisation exercise for completeness. Typical depth of occurrence between seabed level and 8m depth.
- Units IV-V: Glacio-lacustrine and glaciomarine. Interbedded sands, clays and high-fines soils. Typically, very dense gravelly SAND, becoming firm to very stiff sandy gravelly CLAY, becoming medium to very dense silty fine to coarse SAND. Typical depth of occurrence between 0 to 30m below sea floor.
- Units VI–VII: Thick glacial sequences of subglacial till, glacio-lacustrine clays and glaciofluvial sediments. Typically, very stiff sandy CLAY with beds of sand, becoming dense to very dense silty fine SAND, becoming very stiff slightly sandy slightly gravelly CLAY. Typical depth of occurrence between 2m and 70+m below sea floor.
- Unit VIII: Found mostly on the eastern area of the site. Typically, dense to very dense SAND. Typical depth of occurrence between 22m and 50m below seafloor.
- Unit IX: Found mostly on the western area of the site. Typically, a mixed SAND, GRAVEL, PEBBLE and CLAY. Typical depth of occurrence between 20m and 50m.

#### 4.3.2 Bedrock units

Five bedrock units have been identified at the site. They include (youngest first):

- Penarth Group (PEN): Dark grey calcareous MUDSTONE, SILTSTONE with marine fossils, claystones and occasional limestone. The Penarth Group is the youngest bedrock unit and found mainly in eastern areas.
- Mercia Mudstone Group (MMG): Typically, a completely weathered to residual CLAY, becoming very weak to weak moderately weathered to completely weathered MUDSTONE. Dominant bedrock unit comprising reddish-brown to greenish-grey mudstones with gypsum and halite; highly variable due to folding, faulting, weathering and halite dissolution.
- Sherwood Sandstone Group (SSG): Typically, a very weak to moderately strong moderately weathered to highly weathered SANDSTONE. reddish-brown fine- to medium-grained sandstones of fluvial and aeolian origin, locally weathered to residual gravelly sand.
- Permian (PERM): Typically, a very weak to moderately strong Fresh to slightly weathered mudstone Siltstone, and sandstone with dolomites and evaporites, deposited in arid to semi-arid conditions.
- Carboniferous (CARB): Typically, a very weak to weak fresh to highly weathered mudstone/siltstone with coal seams, sub-cropping mainly in the north-west of the site.

Figure 4-4 shows the presence of bedrock formation across the Morgan site and anticipated depth range of the bedrock from seabed.



**Figure 4-4 - Map of sub cropping bedrock top (MRGEO-G4803-NGI-10001 Fig. 2.1.1 and top of bedrock bottom (MRGEO-G4803-NGI-10001 Fig. A1.25)**

Bedrock is anticipated to be encountered within approximately 20 m across significant portion of the Morgan site. Greater depths to bedrock are expected towards the north-east of the site, although the depth of occurrence varies spatially.

Based on borehole data, the dominant bedrock units comprise the Penarth Group (PEN), Mercia Mudstone Group (MMG), Sherwood Sandstone Group (SSG), and Carboniferous rocks (CARB). Less prevalent units include the Mercia Mudstone Halite Group (MHG), reddish Sherwood Sandstone Group (rSSG), and Permian (PERM) deposits, which are also locally present across the site. It should be noted that many boreholes were terminated prior to encountering bedrock, introducing some uncertainty in the interpreted depth to rockhead and the distribution of underlying units.

Figure 4-5 provides a summary of identified soil units across boreholes at the Morgon site in various geotechnical campaigns. The figure provides valuable overview of the presence of various soil units across the site.

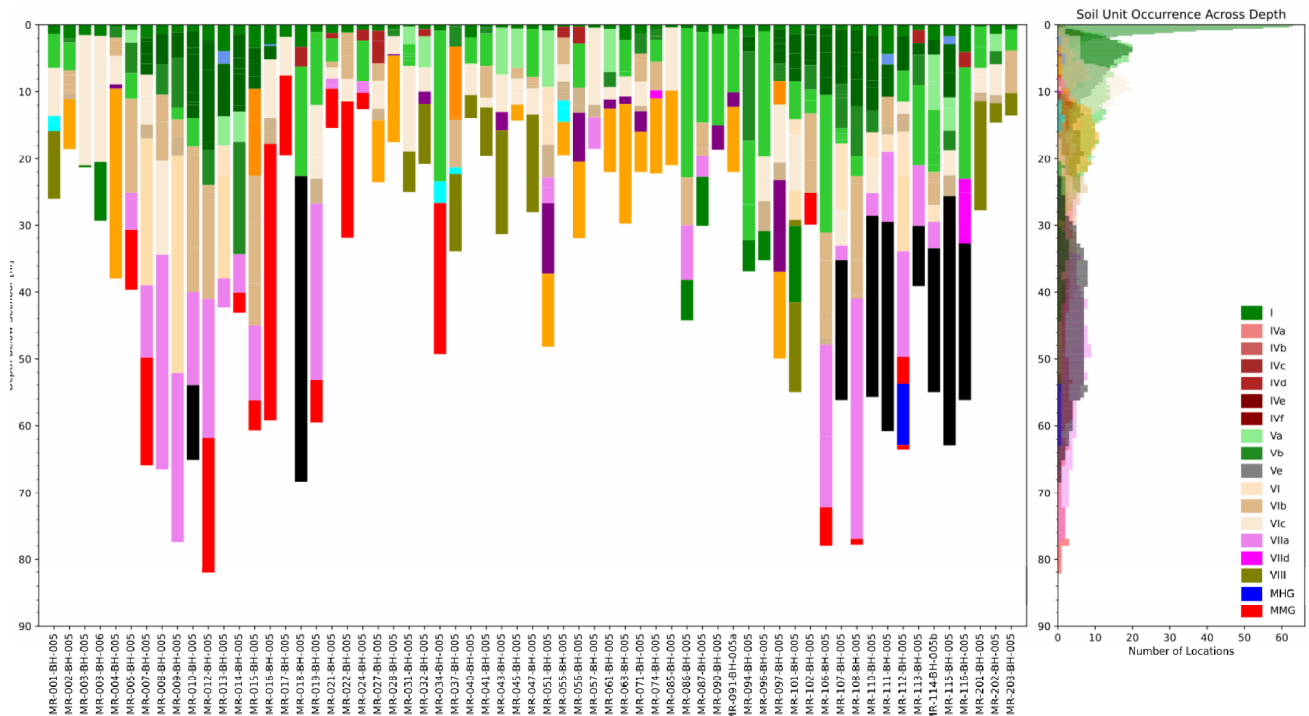


Figure 4-5 - Soil stratigraphy identified at borehole locations from 2023 and 2024 SI campaigns (MRGEO-G4803-NGI-10001 B04 Fig. 2.2.2)

#### 4.4 Geotechnical parameters

MRGEO-G1301-NGI-10001 B07 presents a statistical assessment of both measured and derived geotechnical parameters across the Morgon site. For each parameter, five characteristic design lines (lines A to E) were developed for each soil parameter within each grouped geological unit. In addition, for each design line, key statistical percentiles (P1, P10, P35, P50, P65, P90, and P99) were also presented.

For clarity and practical application, Table 4-1 presents the overall range of design profiles at both the top and base of each soil (or sub-soil) unit, together with a representative median value (P50 characteristic condition C) for each unit as shown by bracketed numbers in the table.

**Table 4-1 - Summary of geotechnical parameter ranges at Morgan (MRGEO-G1301-NGI-10001 B07 Appendix B)**

Soil Unit	Top and bottom Depth [m]	Unit weight [kN/m <sup>3</sup> ]	q <sub>i</sub> [MPa]	f <sub>s</sub> [MPa]	Q <sub>t</sub> [-]	F <sub>r</sub> [-]	S <sub>u</sub> [kPa]	φ' [°]	UCS [MPa]	d <sub>r</sub> [%]	G <sub>max</sub> [MPa]	K <sub>0</sub> [-]	OCR [-]	μ <sub>res, 100kPa, 100kPa</sub>
Group I S	0.01	19.1	0.01	0.01	145.2 to 17603.1	0.04 to 7.22	N/A	29.0 to 47.0	N/A	30.0 to 100.0	N/A	0.5	1	N/A
	10.0	19.1	0.25 to 33.02 (2.86)	0.01 to 0.42 (0.01)	10.0 to 14760.6 (10.0)	0.04 to 7.22 (0.56)	N/A	29.0 to 47.0 (38.0)	N/A	30.0 to 100.0 (37.0)	5.0 to 153.0 (27.0)	0.5 (0.5)	1 (1)	N/A
Group II C	0.01	21	0.15 to 1.4	0.01 to 0.06	16.3 to 35.1	0.19 to 2.41	11.0 to 146.0	N/A	N/A	N/A	N/A	2.5	25	N/A
	20.0	21	0.15 to 1.4 (0.4)	0.01 to 0.06 (0.01)	10.0 to 22.7 (10.0)	0.19 to 2.41 (1.33)	11.0 to 146.0 (38.0)	N/A	N/A	N/A	41.0 to 105.0 (60.0)	0.55 to 1.3 (0.68)	1.0 to 6.0 (2.0)	N/A
Group II HF	0.01	19.5	0.01	0.01	59.0 to 229.3	0.23 to 1.12	N/A	29.0 to 47.0	N/A	30.0 to 68.0	N/A	1.19 to 1.88	6 to 11	N/A
	20.0	19.5	0.62 to 16.15 (1.91)	0.01 to 0.16 (0.01)	10.0 to 10.0 (10.0)	0.23 to 1.12 (0.8)	N/A	29.0 to 47.0 (37.0)	N/A	30.0 to 68.0 (30.0)	18.0 to 104.0 (33.0)	0.5 (0.5)	1 (1)	N/A
Group IV C	0.01	21.2	0.63 to 27.86	0.01 to 1.18	381.5 to 1474.6	1.02 to 6.83	32.0 to 1564.0	N/A	N/A	N/A	N/A	1.85 to 2.5	13.0 to 25.0	N/A
	20.0	21.2	0.63 to 27.86 (3.81)	0.01 to 1.18 (0.15)	10.0 to 817.4 (22.0)	1.02 to 6.83 (4.24)	32.0 to 1564.0 (182.0)	N/A	N/A	N/A	55.0 to 1025.0 (181.0)	0.5 to 1.75 (1.07)	1.0 to 8.0 (1.0)	N/A
	0.01	20.2	0.01	0.01	791.8 to 7072.1	0.08 to 6.53	N/A	30.0 to 47.0	N/A	30.0 to 100.0	N/A	1.71 to 2.5	14.0 to 25.0	N/A

Soil Unit	Top and bottom Depth [m]	Unit weight [kN/m <sup>3</sup> ]	q <sub>t</sub> [MPa]	f <sub>s</sub> [MPa]	Q <sub>t</sub> [-]	F <sub>r</sub> [-]	S <sub>v</sub> [kPa]	φ' [°]	UCS [MPa]	d <sub>r</sub> [%]	G <sub>max</sub> [MPa]	K <sub>0</sub> [-]	OCR [-]	μ <sub>res, 100kPa, 100kPa</sub>
Group IV HF	20.0	20.2	1.8 to 195.76 (29.1)	0.01 to 2.42 (0.45)	10.0 to 4753.5 (75.4)	0.08 to 6.53 (1.37)	N/A	30.0 to 47.0 (41.0)	N/A	30.0 to 100.0 (94.0)	22.0 to 528.0 (131.0)	0.5 to 1.33 (0.55)	1.0 to 11.0 (1.0)	N/A
	0.01	20.4	0.01	0.01	879.3 to 8317.8	0.12 to 5.16	N/A	30.0 to 47.0	N/A	30.0 to 100.0	N/A	1.85 to 2.5	16.0 to 25.0	N/A
Group IV S	20.0	20.4	2.3 to 146.7 (40.41)	0.01 to 2.01 (0.29)	10.0 to 4741.9 (10.0)	0.12 to 5.16 (0.76)	N/A	30.0 to 47.0 (47.0)	N/A	30.0 to 100.0 (100.0)	21.0 to 471.0 (139.0)	0.5 to 0.69 (0.5)	1.0 to 6.0 (1.0)	N/A
	0.01	22	0.01 to 24.31	0.01 to 1.11	283.6 to 873.2	0.86 to 7.51	9.0 to 1051.0	N/A	N/A	N/A	N/A	1.32 to 2.5	10.0 to 25.0	N/A
Group V C	40.0	22	4.52 to 33.61 (9.24)	0.13 to 1.52 (0.35)	10.0 to 445.6 (22.0)	0.86 to 7.51 (3.88)	98.0 to 1436.0 (317.0)	N/A	N/A	N/A	56.0 to 1118.0 (180.0)	0.5 to 2.25 (1.44)	1.0 to 19.0 (6.0)	N/A
	0.01	20.4	0.01	0.01	1060.9 to 3421.6	0.01 to 15.89	N/A	29.0 to 47.0	N/A	30.0 to 100.0	N/A	1.9 to 2.5	17.0 to 25.0	N/A
Group V HF	40.0	20.4	1.55 to 86.5 (19.58)	0.01 to 1.85 (0.24)	10.0 to 1566.3 (106.2)	2.17 to 18.47 (3.42)	N/A	29.0 to 47.0 (40.0)	N/A	30.0 to 100.0 (72.0)	26.0 to 462.0 (127.0)	0.5 to 1.33 (0.66)	1.0 to 12.0 (2.0)	N/A
	0.01	20.6	0.01	0.01	1194.7 to 5860.1	0.19 to 4.72	N/A	31.0 to 47.0	N/A	33.0 to 100.0	N/A	2.06 to 2.5	20.0 to 25.0	N/A
Group V S	40.0	20.6	3.41 to 114.14 (32.27)	0.02 to 1.68 (0.22)	10.0 to 3343.6 (141.8)	0.19 to 4.72 (0.75)	N/A	31.0 to 47.0 (45.0)	N/A	33.0 to 100.0 (92.0)	32.0 to 542.0 (148.0)	0.5 to 1.36 (0.75)	1.0 to 14.0 (2.0)	N/A

Soil Unit	Top and bottom Depth [m]	Unit weight [kN/m <sup>3</sup> ]	q <sub>t</sub> [MPa]	f <sub>s</sub> [MPa]	Q <sub>t</sub> [-]	F <sub>r</sub> [-]	S <sub>u</sub> [kPa]	φ' [°]	UCS [MPa]	d <sub>r</sub> [%]	G <sub>max</sub> [MPa]	K <sub>0</sub> [-]	OCR [-]	μ <sub>res,100kPa,100kPa</sub>
Group VIC	0.01	21.8	0.01 to 40.29	0.01 to 1.62	278.1 to 761.4	1.42 to 7.67	25.0 to 1343.0	N/A	N/A	N/A	N/A	1.29 to 2.5	10.0 to 25.0	N/A
	60.0	21.8	8.24 to 56.22 (15.62)	0.06 to 1.83 (0.33)	10.0 to 369.6 (32.2)	1.42 to 7.67 (4.04)	159.0 to 2011.0 (509.0)	N/A	N/A	N/A	68.0 to 1251.0 (240.0)	0.5 to 1.57 (1.03)	1.0 to 18.0 (6.0)	N/A
Group VI HF	0.01	20.4	0.01	0.01	1071.0 to 3298.9	0.36 to 7.0	N/A	30.0 to 47.0	N/A	30.0 to 100.0	N/A	1.79 to 2.5	17.0 to 25.0	N/A
	60.0	20.4	3.18 to 112.14 (32.05)	0.02 to 2.5 (0.59)	10.0 to 1511.0 (140.0)	0.36 to 7.0 (1.95)	N/A	30.0 to 47.0 (40.0)	N/A	30.0 to 100.0 (86.0)	36.0 to 626.0 (173.0)	0.5 to 1.35 (0.66)	1.0 to 12.0 (2.0)	N/A
Group VIS	0.01	20.4	0.01	0.01	3649.6 to 7336.1	0.01 to 4.64	N/A	32.0 to 47.0	N/A	39.0 to 100.0	N/A	2.15 to 2.5	22.0 to 25.0	N/A
	60.0	20.4	7.79 to 156.99 (44.74)	0.03 to 2.34 (0.33)	10.0 to 2406.3 (231.3)	8.04 to 18.6 (12.96)	N/A	32.0 to 47.0 (46.0)	N/A	39.0 to 100.0 (98.0)	56.0 to 598.0 (199.0)	0.5 to 1.2 (0.6)	1.0 to 12.0 (2.0)	N/A
Group VII C	0.01	21.9	1.1 to 51.54	0.07 to 1.79	331.8 to 688.3	2.73 to 7.62	66.0 to 1618.0	N/A	N/A	N/A	N/A	2.28 to 2.5	23.0 to 25.0	N/A
	60.0	21.9	3.09 to 56.04 (9.37)	0.07 to 1.79 (0.36)	10.0 to 256.5 (16.5)	2.73 to 7.62 (5.23)	104.0 to 1732.0 (357.0)	N/A	N/A	N/A	86.0 to 1329.0 (278.0)	0.5 to 1.9 (1.04)	1.0 to 17.0 (4.0)	N/A
	0.01	21.4	0.01	0.01	1899.2 to 2689.3	0.53 to 8.09	N/A	30.0 to 47.0	N/A	30.0 to 100.0	N/A	2.11 to 2.5	21.0 to 25.0	N/A

Soil Unit	Top and bottom Depth [m]	Unit weight [kN/m <sup>3</sup> ]	q <sub>t</sub> [MPa]	f <sub>s</sub> [MPa]	Q <sub>t</sub> [-]	F <sub>r</sub> [-]	S <sub>v</sub> [kPa]	φ' [°]	UCS [MPa]	d <sub>r</sub> [%]	G <sub>max</sub> [MPa]	K <sub>0</sub> [-]	OCR [-]	μ <sub>res,100kPa,100kPa</sub>
Group VII HF	60.0	21.4	3.83 to 140.63 (23.11)	0.06 to 4.46 (0.96)	10.0 to 570.4 (133.7)	0.53 to 8.09 (4.06)	N/A	30.0 to 47.0 (40.0)	N/A	30.0 to 100.0 (77.0)	51.0 to 700.0 (149.0)	0.5 to 1.11 (0.63)	1.0 to 7.0 (2.0)	N/A
			0.01	20.2	0.01	2528.2 to 4538.7	0.11 to 7.58	N/A	33.0 to 47.0	N/A	48.0 to 100.0	N/A	2.33 to 2.5	23.0 to 25.0
Group VII S	60.0	20.2	8.0 to 205.94 (62.15)	0.04 to 2.67 (0.49)	10.0 to 1313.7 (247.0)	0.11 to 7.58 (0.84)	N/A	33.0 to 47.0 (46.0)	N/A	48.0 to 100.0 (100.0)	63.0 to 755.0 (242.0)	0.5 to 1.3 (0.8)	1.0 to 9.0 (3.0)	N/A
			0.01	22.6	0.01 to 46.22	0.27 to 1.13	126.4 to 345.1	1.76 to 6.97	41.0 to 1003.0	N/A	N/A	N/A	N/A	2.5
Group VIII C	80.0	22.6	77.29 to 46.22 (136.22)	0.27 to 5.38 (6.06)	10.0 to 146.4 (10.0)	1.76 to 6.97 (6.26)	1034.0 to 5969.0 (2520.0)	N/A	N/A	N/A	109.0 to 1506.0 (387.0)	2.5	25.0 (25.0)	N/A
			0.01	20.2	0.01	705.8 to 934.2	0.16 to 0.42	N/A	40.0 to 47.0	N/A	N/A	N/A	N/A	2.5
Group VIII S	80.0	20.2	69.64 to 189.73 (173.13)	0.07 to 1.17 (0.28)	10.0 to 10.0 (10.0)	0.16 to 0.42 (0.16)	N/A	40.0 to 47.0 (47.0)	N/A	98.0 to 100.0 (100.0)	151.0 to 1046.0 (536.0)	0.99 to 1.16 (1.07)	4.0 to 6.0 (5.0)	N/A
			0.01	22.1	9.03 to 67.95	0.44 to 1.73	529.0 to 773.6	1.24 to 6.6	168.0 to 2391.0	N/A	N/A	N/A	2.31 to 2.5	21.0 to 25.0
Group IX C	40.0	22.1	9.03 to 67.95 (28.64)	0.69 to 1.73 (1.2)	10.0 to 175.4 (60.2)	4.22 to 9.58 (5.76)	168.0 to 2391.0 (686.0)	N/A	N/A	N/A	108.0 to 1445.0 (373.0)	1.58 to 2.39 (2.18)	6.0 to 21.0 (18.0)	N/A

Soil Unit	Top and bottom Depth [m]	Unit weight [kN/m <sup>3</sup> ]	q <sub>t</sub> [MPa]	f <sub>s</sub> [MPa]	Q <sub>t</sub> [-]	F <sub>r</sub> [-]	S <sub>u</sub> [kPa]	φ' [°]	UCS [MPa]	d <sub>r</sub> [%]	G <sub>max</sub> [MPa]	K <sub>0</sub> [-]	OCR [-]	μ <sub>res,100kPa,100kPa</sub>
Group PEN	0.01	22.7	N/A	N/A	N/A	N/A	N/A	N/A	0.58 to 24.35	N/A	N/A	N/A	N/A	N/A
	80.0	22.7	N/A	N/A	N/A	N/A	N/A	N/A	0.58 to 24.35 (4.77)	N/A	N/A	N/A	N/A	N/A
Group MMG	0.01	21.3	3.19 to 321.8	0.06 to 14.26	260.1 to 776.9	0.16 to 7.03	N/A	N/A	0.06 to 9.73	N/A	N/A	1.5	13.0 to 25.0	0.3 to 0.65
	80.0	21.3	3.19 to 321.8 (33.74)	0.06 to 14.26 (1.32)	10.0 to 394.6 (31.9)	0.93 to 7.79 (4.63)	N/A	N/A	1.07 to 14.2 (1.92)	N/A	27.0 to 5530.0 (1204.0)	1.5 (1.5)	1.0 to 17.0 (9.0)	0.22 to 0.56 (0.33)
Group MHG	0.01	20.5	N/A	N/A	N/A	N/A	N/A	N/A	1.91 to 34.9	N/A	N/A	N/A	N/A	N/A
	80.0	20.5	N/A	N/A	N/A	N/A	N/A	N/A	1.91 to 34.9 (10.84)	N/A	N/A	N/A	N/A	N/A
Group rSSG HF	0.01	20.8	0.01	0.01	69.0 to 215.0	1.7 to 2.74	N/A	33.0 to 47.0	N/A	78.0 to 100.0	N/A	2.5	25	N/A
	80.0	20.8	17.94 to 91.56 (48.28)	0.44 to 2.54 (1.19)	1069.6 to 1215.5 (1173.2)	3.26 to 4.3 (4.07)	N/A	33.0 to 47.0 (41.0)	N/A	78.0 to 100.0 (96.0)	106.0 to 467.0 (225.0)	0.98 to 1.08 (1.03)	4.0 to 5.0 (4.0)	N/A
	0.01	20.4	0.01	0.01	3152.2 to 3811.5	0.01 to 5.0	N/A	34.0 to 47.0	N/A	57.0 to 100.0	N/A	2.5	25	N/A

Soil Unit	Top and bottom Depth [m]	Unit weight [kN/m <sup>3</sup> ]	q <sub>t</sub> [MPa]	f <sub>s</sub> [MPa]	Q <sub>t</sub> [-]	F <sub>r</sub> [-]	S <sub>u</sub> [kPa]	φ' [°]	UCS [MPa]	d <sub>i</sub> [%]	G <sub>max</sub> [MPa]	K <sub>0</sub> [-]	OCR [-]	μ <sub>res,100kPa,100kPa</sub>
Group rSSG S	80.0	20.4	14.1 to 166.72 (70.96)	0.04 to 2.66 (0.82)	10.0 to 535.7 (303.3)	0.3 to 5.49 (1.67)	N/A	34.0 to 47.0 (47.0)	N/A	57.0 to 100.0 (100.0)	88.0 to 951.0 (271.0)	0.5 to 1.27 (0.96)	1.0 to 7.0 (4.0)	N/A
Group SSG	0.01	21.8	N/A	N/A	N/A	N/A	N/A	N/A	0.66 to 45.87	N/A	N/A	N/A	N/A	N/A
	80.0	21.8	N/A	N/A	N/A	N/A	N/A	N/A	0.66 to 45.87 (16.75)	N/A	N/A	N/A	N/A	N/A
Group PERM	0.01	23.9	N/A	N/A	N/A	N/A	N/A	N/A	0.5 to 184.22	N/A	N/A	N/A	N/A	N/A
	80.0	23.9	N/A	N/A	N/A	N/A	N/A	N/A	0.5 to 184.22 (10.27)	N/A	N/A	N/A	N/A	N/A
Group CARB	0.01	25.4	N/A	N/A	N/A	N/A	N/A	N/A	1.6 to 170.82	N/A	N/A	N/A	N/A	N/A
	80.0	25.4	N/A	N/A	N/A	N/A	N/A	N/A	1.6 to 170.82 (26.87)	N/A	N/A	N/A	N/A	N/A

Notes:

q<sub>t</sub> = Corrected cone resistance, f<sub>s</sub> = Sleeve friction, Q<sub>t</sub> = Normalised cone resistance, F<sub>r</sub> = Friction ratio,

S<sub>u</sub> = Undrained shear strength, φ' = Effective friction angle, UCS = Unconfined compressive strength, D<sub>r</sub> = Relative density,

G<sub>max</sub> = Maximum shear modulus, K<sub>0</sub> = Coefficient of earth pressure at rest, OCR = Over consolidation ratio, μ<sub>res,100kPa</sub> = normalised residual interface strength at a normal stress of 100kPa.

N/A – not available

The accuracy of the numbers presented is a mathematical presentation of the results and not an indication of the confidence in the exact value.

## 4.5 Ground related risks

### 4.5.1 Scour

Unit I, comprising Holocene-age mobile sands, presents a geohazard due to its susceptibility to seabed mobility processes. These sediments are prone to reworking under hydrodynamic forcing (waves, tides, and storm events), which may lead to localised and regional seabed level changes.

### 4.5.2 Unexploded Ordnance (UXO)

There is well-documented regional evidence of unexploded ordnance (UXO) across the Irish Sea, representing a safety and programme risk during offshore construction. UXO clearance activities undertaken by ALARP at the Morgan site in 2023, focused on the previously planned wind turbine generator (WTG) locations, identified potential UXO targets at 10 investigated locations. Although clearance has been undertaken, residual risk remains due to the possibility of uncharted or deeply buried ordnance.

### 4.5.3 Shallow bedrock

Ground conditions characterised by variable and shallow bedrock across parts of the site present challenges for offshore wind foundation design and installation. Variability in bedrock depth and profile may constrain feasible foundation types and may lead to complex installation conditions. In addition, the transition from superficial deposits to rock can introduce high variability in geotechnical parameters.

## 5. Conclusion

This report presents a high-level overview of the ground conditions at the site using available information from site investigations and previously completed studies. The summary has been developed with the specific intent of consolidating existing knowledge into a summary document of the geological profile and variability of subsurface conditions across the site, highlighting key stratigraphic units, material characteristics, and potential geotechnical constraints. These insights are valuable for informing preliminary assessments of foundation feasibility, constructability considerations, and associated risks.

It is important to emphasise that the content reflects the findings, interpretations, and conclusions reported in the original source documents, and no independent verification, reinterpretation, or validation of the raw data has been undertaken as part of this work.