The Great Grid Upgrade

Sea Link

Sea Link

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Ground Investigation Report - Kent

August 2024

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1 Introduction

In the next 10 years, the capacity of interconnectors connecting along the South Coast transmission route from Lovedean to Kemsley is forecast to reach circa 7GW, with a further 4GW at Grain and Kingsnorth. A new High Voltage Direct Current (HVDC) link between Richborough in East Kent and a proposed new substation at Friston, in Suffolk, has been identified by National Grid as being the optimal solution to increase transfer capacity between the South Coast and South London and maintain voltage at compliance level.

Mott MacDonald Ltd. (MM) have been commissioned by National Grid to act as FEED consultants on the SEA Link project. This includes supporting NG with the delivery through to the Development Consents Order (DCO) submission, decision, and input to the Works Information for the Main Works Tender to the construction phase of the project. The project involves a 2GW HVDC link between Richborough in Kent and Friston in Suffolk which forms part of the solution to resolve the operational boundary issues in the South Coast, East Coast and London Areas.

It should be noted that this report only covers the on-shore elements of the Kent part of the wider Sea Link project, with off-shore elements assessed by others. The Suffolk part of the onshore scheme is assessed within a separate GIR, summarised below:

- Mott MacDonald Limited, Sea Link FEED, Ground Investigation Report – Suffolk. Document reference: SEAL-MMD-SEAL-ENG-REP-0692

The landfall horizontal directional drill (HDD) element is not within Mott MacDonald Limited's scope. The scope and this report covers the site to its connection with the landfall HDD at the marine to terrestrial transition joint bay.

1.1 Scope and objectives of the report

The objectives of this report are:

- To review and summarise the project-specific ground investigation data, including laboratory test data, for works carried out at the site in 2023;
- Provide a ground model and preliminary geotechnical parameters to inform design development;
- Produce a geotechnical risk register outlining the key ground related hazards and risks associated with the ground conditions, and provide ground engineering advice in support of the proposed design.

The report has been prepared in accordance with the requirements of BS EN 1997-1.

1.2 Description of the project

1.2.1 Description of the site

A site location plan is presented in Figure 1.1 showing the extent of the proposed works including the proposed converter station, outgoing grid connection and cable routes which are described in more detail in Section 1.2.2.

The site encompasses an area of generally low-lying arable farmland, approximately centred around British National Grid Reference TR 331634, located between the villages of Richborough, Minster and Cliffsend. It is crossed from north-south by the A256 dual

carriageway and also includes two golf courses: St. Augustine's Golf Club, and Stonelees Golf Centre. The river Stour and a branch of the Kent Coast Railway Line, between Minster and Sandwich, both pass across the south-western corner of the site.

1.2.2 Proposed works

The Sea Link project forms part of The Great Grid Upgrade and is an essential network reinforcement in East Anglia and the south-east to improve the aging and limited generation capacity of the existing network, which has limited capacity to support the growth in offshore wind, new interconnectors, and nuclear power stations. The project will help reinforce the network:

- By connecting new planned generation, allowing power to be transferred.
- By connecting into the Kent coast, it increases the amount of power that can be transported to and from the south-east, helping to meet domestic demand as well as imports and exports to Europe via interconnectors and,
- By connecting to the proposed Friston substation, Sea Link reinforces the Bramford-Sizewell radial circuits.

The overall project is split into three main elements alongside their associated other works, and this includes the Suffolk onshore scheme, the offshore scheme, and the Kent onshore scheme.

This report covers a preliminary de-risking ground investigation which was undertaken, the aim of which was to obtain sufficient information on the ground conditions for the main contractors to price the construction contract without the necessity to include a significant risk contingency sum for unknown ground conditions

The proposed works summarised below consider the Kent onshore scheme only. Reference should be made to wider project documentation and reports for information for the Suffolk elements of the scheme. A series of general arrangement drawings are included within Appendix A, from the Statutory Consultation in October 2023, showing the proposed works and infrastructure:

- National Grid, Sea Link Order, General Arrangement Plan Series, Location Plan for Consultation, Sheet 1 of 1, Kent. Drawing reference: S42_K/OLP/SS/2001.
- National Grid, Sea Link Order, General Arrangement Plan Series, Master Key Plan for Consultation, Sheet 1 of 1, Kent. Drawing reference: S42_K/MKP/SS/2001.
- National Grid, Sea Link Order, General Arrangement Plan Series, General Arrangement Plans for Consultation, Sheet 1 to 4, Kent. Drawing references: S42_K/IGA/PS/2001 to 2004.

Design drawings showing these main proposed works in further detail are also summarised in Table 1.1 below with the geographic extent shown in Table 1.1.

Further details on ancillary / enabling works such as access / haul road bell mouth arrangement details can be found with the Statutory Consultation drawing pack.

Table 1.1: Statutory Consultation – Design drawings (October 2023)

Drawing title	Drawing Number
The National Grid Electricity Transmission PLC (Sea Link) Order, Design Drawings for Consultation:	
Typical Minster Converter Station – Layout Plan (GIS)	S42_K/TDD/SS/2002
Typical Minster Converter Station – Elevation drawing	S42_K/TDD/PS/2005_SH1 – SH2
Typical Minster 400kV (GIS) Substation – Overall Layout	S42_K/TDD/SS/2001

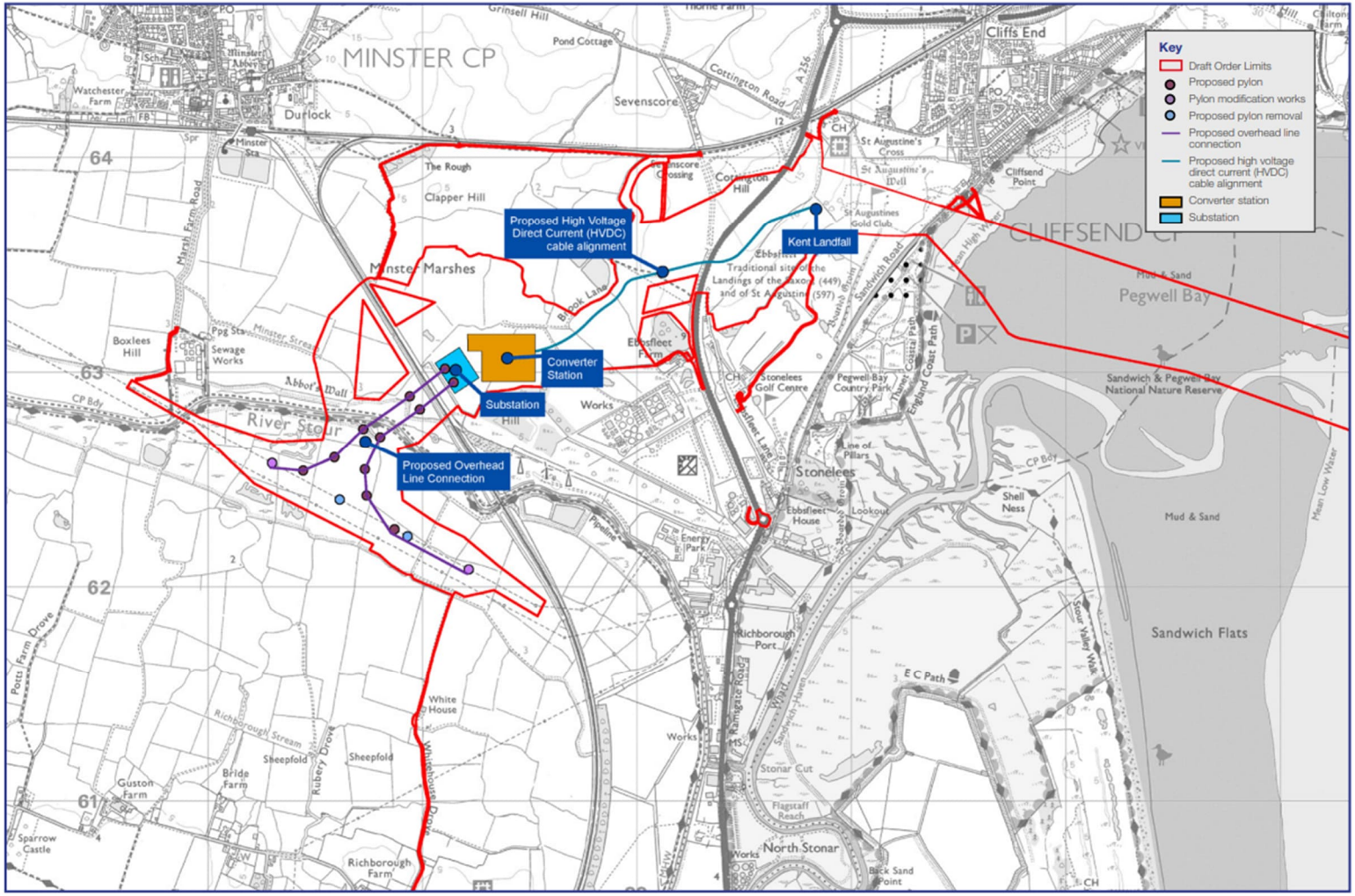
Drawing title	Drawing Number
Typical 400kV (GIS) Substation - Elevation Drawing	S42_K/TDD/PS/2003_SH1 – SH2
Typical HVAC direct buried cross section and construction area	S42_T/TDD/SS/3001
Typical HVAC joint bay arrangements	S42_T/TDD/SS/3003
Indicative horizontal directional drill solution Pegwell bay	S42_M/TDD/SS/1039
Indicative layout of HDD construction compound Pegwell bay	S42_M/TDD/SS/1037
Indicative direct pipe solution Pegwell bay	S42_M/TDD/SS/1040

A high-level summary of the proposed works is presented below:

- A Converter Station (2GW, HVDC, up to 26m tall plus external equipment such as lighting protection etc.) is proposed near Minster.
- A new substation, located directly adjacent to the proposed Converter Station.
- A transition joint bay c. 800m inshore west of St Augustine's Golf Course and Stonelees Golf Centre, to transition from offshore to onshore HDVC, before it continues c. 2km to the proposed converter station.
- A trenchless crossing of the A256 dual-carriageway using Horizontal Directional Drilling (HDD) methods.
- A series of permanent access routes for construction of the scheme including the Converter Station, as well as access routes for construction along the length of the cable route.
- Removal of up to c. 1km of existing HVAC overhead lines, and installation of c. 2.25km new HVAC overhead lines from the Converter Station / Substation near Minster to the existing Richborough and Canterbury overhead line.
- Other ancillary works including pylon modification, highways improvements, and a permanent bellmouth junction off the A256.
- A series of construction compounds located along the length of the scheme in support of construction. It should be noted that the site boundary of the Draft Order is wider in some areas to allow for flexibility of the exact compound locations.
- Drainage infrastructure including permanent attenuation ponds associated with the proposed works.

In addition, only on-shore elements of the work are covered in this report, with off-shore elements assessed by others.

Figure 1.1: SEA Link – project proposal – National Grid (2023)



Source: National Grid, The Great Grid Upgrade, Sea Link, Project overview document, October 2023

1.3 Geotechnical Category of the Project

This project is classed as Geotechnical Category 2 in accordance with BS EN 1997-1 which is defined as conventional types of structure and foundation with no exceptional risk or difficult soil or loading conditions.

Designs for structures in Geotechnical Category 2 should include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied. Routine procedures for field and laboratory testing may be used.

1.4 Other relevant information

No other relevant information was available to evaluate at the time of writing this report.

2 Existing information

This section presents a high-level summary of the key existing information available at the site. The information in this section has been taken from the following sources:

- Mott MacDonald 'Geotechnical and Geo-environmental Preliminary Risk Assessment (Desk Study) Report – Richborough'
- British Geological Survey (BGS), Solid and Drift Map Sheet 274 Ramsgate
- BGS Memoir 'Geology of the country around Ramsgate and Dover'
- BGS GeoIndex Online Viewer and Lexicon of Named Rock Units Online Viewer

Reference should be made to the Mott MacDonald Preliminary Risk Assessment SEAL-MMD-SEAL-ENG-REG-0057 for full details on the site location and background desk study information. The key findings from the PRA are summarised below.

2.1 Topographic information

A detailed summary of the topographic information across the site is presented within the PRA, with a high level summary included below:

- To the west and centre of the site, around the OHL connection and the converter station, the topography across the site is flat and low lying at approximately 0 to +1m AOD.
- In the eastern portion of the site, for the cable corridor, the topography across the site rises from approximately +1m to +2m AOD along the coastline and to the western extent of the alignment, to a high of approximately +11m AOD around the A256 Richborough Way.

2.2 Geological maps and memoirs

The British Geological Survey (BGS) 1:50,000 Series Solid and Drift geological map sheet 274 Ramsgate indicates the site to be predominantly underlain by an impersistent cover of superficial deposits Marine and Estuarine Alluvium (mainly clay). Along the shoreline at the eastern end of the site Marine and Estuarine Alluvium (mainly sand and gravel) is indicated. Modern BGS terminology now refers to these units as, respectively: Tidal Flat Deposits – Clay and Silt; and Beach and Tidal Flat Deposits (Undifferentiated). Localised areas are indicated to have no mapped superficial deposits, including around the A256.

The site is in turn underlain by bedrock geology of the Thanet Beds (now known as the Thanet Formation), and the Margate Chalk Member and Seaford Chalk Formation of the Upper Chalk group.

The approximate northern limit of the Kent Coalfield runs across the site in an east-west direction associated with the Carboniferous Coal Measures which lie at significant depth beneath the Cretaceous strata. There are no faults indicated within the site area, the closest fault being to the east of Cliffs End approximately 1.5km east.

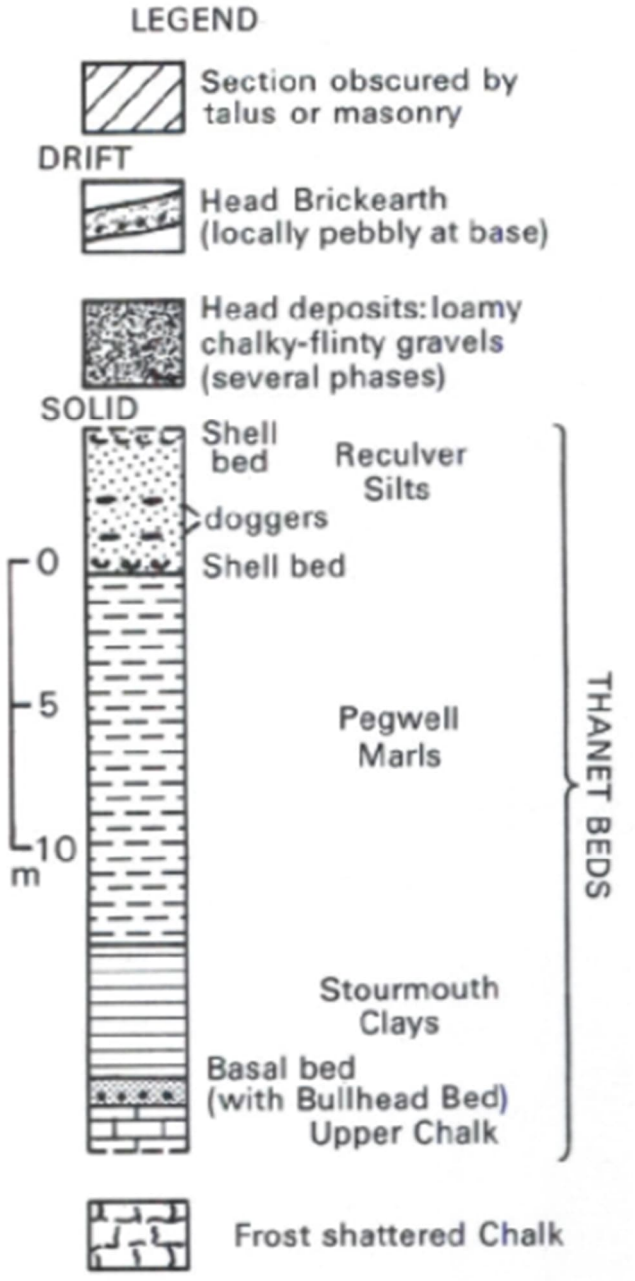
Made Ground/ Worked Ground/ Landscaped Ground/ Disturbed Ground (MG) is not shown on the 1:50,000 scale map. The Groundsure report presents the BGS 1:10,000 scale map showing artificial and Made Ground and indicates that artificial and Made Ground has not been identified within the study area. It is however likely that Made Ground will be present at discrete locations within the construction swathe close to developed areas, in the vicinity of buildings and infrastructure. Topsoil (TPS) is expected across most of the site.

Descriptions of the stratum expected to be present at the site given by the BGS Lexicon of Named Rock Units are presented in Table 2.1 Table 2.1with extract of the BGS superficial and bedrock mapping presented in Figure 2.2 and Figure 2.3 respectively.

The BGS Geology of the country around Ramsgate and Dover Memoir for the 1:50,0000 geological sheets 274 and 290 (England and Wales), 1988 has been reviewed. The site lies within the eastern central area of the Richborough (or Wantsum) Syncline within the Chalk which forms a topographical low in which the River Stour flows eastward across an alluvial plain comprising the infilled Wantsum Channel. As a result up to 50m of Palaeocene and Eocene strata are preserved with the Thanet Formation, comprising of a varied sequence of clays, marls, silts and fine sands, reaching a maximum thickness of 30m in the centre of the syncline. Studies of the Thanet Formation within Pegwell Bay and other nearby sections in Kent suggest the Thanet Formation can be divided into a series of sedimentary units, which are within an upward sequence. The descriptions associated with the below are described from the Pegwell Bay section within c. 1.5km of the site, with an indicative section from the Geological Memoir presented in Figure 2.1.

- Bullhead Flint Conglomerate (Bullhead Bed) - a dark green glauconitic sandy marl with frequent rounded flints
- Stourmouth Clays – c. 4.5m thick, alternation of clay with silty clay in approximately 0.15m intervals. Greenish grey with ochreous staining due to presence of pyrite in outcrop
- Pegwell Marls – c. 13m thick, uniform dark greenish grey marls or silty marls with some mica and glauconite. Faint banding in lower part and more silty at their top.
- Reculver Silts – Up to c. 5m of yellowish grey very fine silty sands with fine glauconite and mica. Calcareous doggers run in bands parallel to the bedding, and a basal shell bed which is locally cemented.

Figure 2.1: Legend excerpt from the Chalk, Tertiary and Quaternary deposits recorded in the Pegwell Bay cliff section



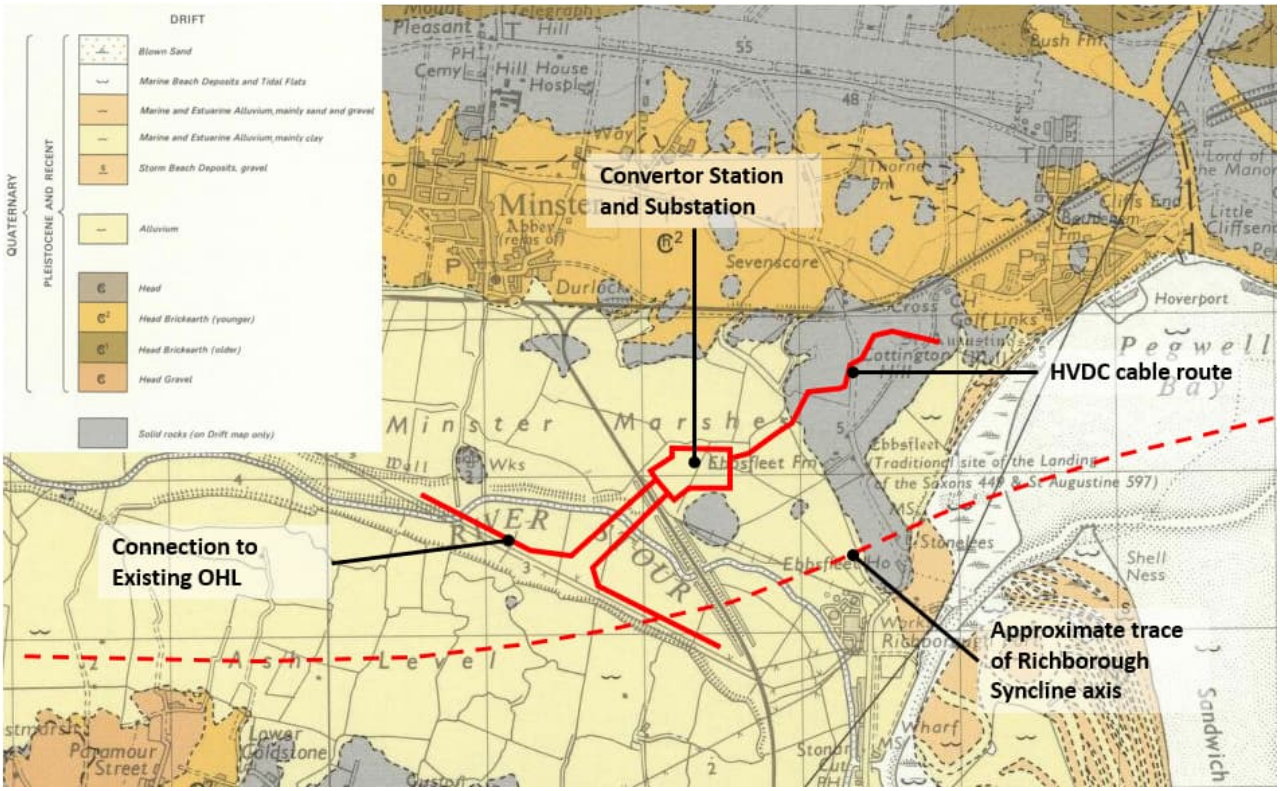
Source: Excerpt from Figure 14 within the Geological Memoir – Geology of the country around Ramsgate and Dover. Memoir for 1:50,000 geological sheets 274 and 290, 1988.

The Thanet Formation has an unconformable contact with the underlying Chalk, being separated by the basal Bullhead Bed. The upward sequence of Palaeocene (Woolwich Formation and Oldhaven Member) and Eocene strata (London Clay Formation) is not present at the site. Marine and Estuarine Alluvium, now referred to as Tidal Flat Deposits – Clay and Silt; and Beach and Tidal Flat Deposits (Undifferentiated), were deposited in salt marsh and intertidal environments during the Flandrian within the former Wantsum Channel.

Table 2.1: BGS Lexicon of Named Rock Units

Stratum	Age Range	Parent Unit	Description
Tidal Flat Deposits (TFD)	Quaternary Period	Intertidal Deposits	Normally a consolidated soft silty clay, with layers of peat, sand and a basal gravel. A stronger, desiccated surface zone is sometimes present.
Beach and Tidal Flat Deposits (Undifferentiated) (BTFU)	Quaternary Period	N/A	Composite deposit of Tidal Flat Deposits as above, and bedded or chaotic shingle, sand, silt and clay;
Thanet Formation (TAB)	Thanetian Age	Montrose Group	The Thanet Formation in this district comprise a varied sequences of clays, marls, silts and fine sands, reaching a maximum thickness of c. 30m in the centre of the Richborough Syncline. The type section is located at Pegwell Bay, with an excerpt of the stratigraphic relationship presented in Figure 2.1, with further detail and engineering description summarised above.
Margate Chalk Member (MACK)	Santonian Age – Campanian Age	Newhaven Chalk Member – White Chalk Subgroup	Marl-free smooth white Chalk with little flint, weakly developed indurated iron-stained sponge beds.
Seaford Chalk Formation (SECK)	Coniacian Age – Santonian Age	White Chalk Subgroup	Firm white Chalk with conspicuous semi-continuous nodular and tabular flint seams. Hardgrounds and thin marls are known from the lowest beds. Some flint nodules are large to very large.

Figure 2.2: BGS Geological Map Extract – Superficial Deposits



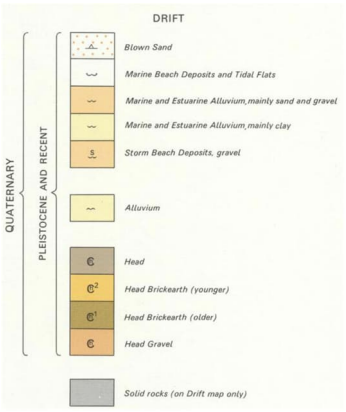
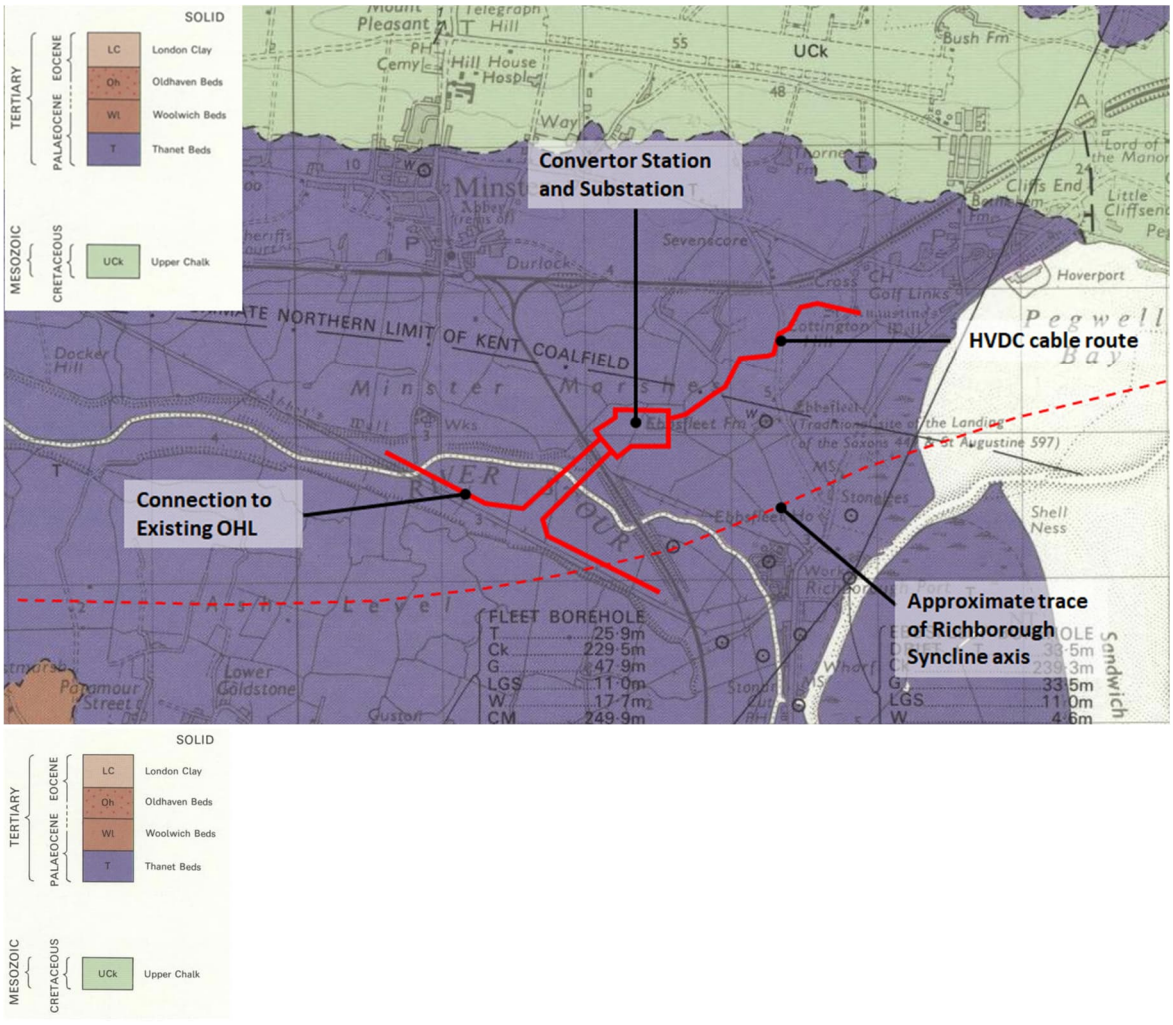


Figure 2.3: BGS Geological Map Extract – Bedrock Deposits



Source: Ordnance Survey, 1992 (WXU001OPRBA01, British Geological Survey @ NERC)

2.3 Previous ground investigations on or adjacent to the site

The following sections summarise the existing boreholes identified on the BGS GeoIndex as well as within the following reports identified to be on or in close vicinity to the site as summarised in Table 2.2:

- Structural Soils Limited 'Factual Report on Ground Investigation' for Richborough Overhead Line Connections
- Central Electricity Generating Board Transmission and Technical Services Division 'Richborough Power Station – additional oil tank, Site investigation, SM347'
- Central Electricity Generating Board Transmission and Technical Services Division 'Richborough Wind Energy Development – Preliminary Site Investigation, SM556'
- Geotechnical Engineering Ltd 'Richborough Connection Factual Report on Ground Investigation'

Table 2.2: Existing ground investigation reports reviewed

Report	Location	Exploratory Holes reviewed
Structural Soils – Richborough OHL Connections, 562316 (2017)	21km length of proposed OHL between Richborough substation and Canterbury substation	BHPC47, BHPC48, BHPC49, BHPC50, BHPC51, BHPC52, BHDX32a, BHDX32b, BHCP53, BHCP54, BHCP55, BHCP56, BHCP57, BHCP59, BHCP60, BHDX49b
Richborough Power Station – additional oil tank, SM347 (1975)	Richborough Power Station approximately 900m south-east of the substation/ convertor station site	BH1, BH2, BH3
Richborough Wind Energy Development, SM556 (1975)	Located adjacent to the River Stour approximately 900m south-east of the substation/ convertor station site	E1, E2, E3, E4, E5 (Static cone penetration tests)
Geotechnical Engineering Ltd, Richborough Connection (2015)	20km of proposed OHL between Richborough substation and Canterbury substation	DCP167, DCP168, DCP184, DCP185, DCP186, DCP187, DCP188, DCP189, RT06, TP40

Full details can be found in the Mott Macdonald PRA and in the individual factual reports. Out of the existing investigations summarised above, only selected relevant boreholes from the Structural Soils investigation for the OHL connection have been reviewed within the following sections. The boreholes at Richborough Power Station lie outside of the study area but have been reviewed for consistency. The exploratory holes from the remaining investigations comprise CPTs and DCPs therefore do not contain detailed ground profile information.

2.4 Encountered geology

2.4.1 Converter station/ substation

The BGS GeoIndex identifies 7 no. exploratory holes located within 0.7km of the site. Details of the ground conditions encountered are presented in Table 2.3.

Table 2.3: BGS Exploratory Hole Details – Convertor Station and Substation Area

Hole	Distance/ direction from site	Date	Hole Depth m bgl	Top of stratum m bgl	Stratum
TR36SW7	480m SW	1959	10.62	0	TPS
				0.23	TFD
				9.45	TAB

Hole	Distance/ direction from site	Date	Hole Depth m bgl	Top of stratum m bgl	Stratum
TR36SW8	450m SW	1959	3.05	0	TPS
				0.15	TFD
TR36SW9	470m SW	1959	3.76	0	TPS
				0.15	TFD
TR36SW98	365m SE	1992	14.5	0	TPS
				0.2	TFD
TR36SW96	250m SE	1992	30	0	TPS
				0.5	TFD
				6.5	TAB
				28.5	WHCK
TR36SW97	300m SE	1992	24	0	TPS
				0.4	TFD
				5	TAB
TR36SW65A/ TR36SW65B/ TR36SW99	700m E	1952	48.77	0	TPS
				0.3	TFD
				8.53	TAB
				28.04	WHCK

Note: TPS – Topsoil, TFD – Tidal Flat Deposits, TAB – Thanet Formation, WHCK – White Chalk Subgroup

Groundwater is expected to be encountered within the top 2 to 3m bgl (within the Tidal Flat Deposits), however; it is noted that the logs considered are not recent and therefore current groundwater levels may vary from this.

2.4.2 HVDC Cable route corridor

There are 5 no. BGS exploratory holes identified in the vicinity of the HVDC cable route on the BGS GeoIndex, only three of which contained information on ground conditions. Details of the ground conditions encountered are presented in Table 2.4.

Table 2.4: BGS Exploratory Hole Details - HVDC Cable Route Corridor

Hole	Distance/ direction from site	Date	Hole Depth m bgl	Top of stratum m bgl	Stratum
TR36SW102	400m N	No ground profile information			
TR36SW103	500m N	No ground profile information			
TR36SW41	785m E	1967	8.84	0	MBD
				1.22	TAB
TR36SW42	700m E	1967	21.3	0	MBD
				1.22	TAB
				19.2	WHCK
TR36SW65A/ TR36SW65B/ TR36SW99	220m S	1952	48.77	0	TPS
				0.3	TFD
				8.53	TAB
				28.04	WHCK

Note: TPS – Topsoil, TFD – Tidal Flat Deposits, TAB – Thanet Formation, WHCK – White Chalk Subgroup

Groundwater levels are expected to be encountered within the top few metres below ground level within the Tidal Flat Deposits. It is likely groundwater levels will be affected by the tide due to the proximity to the coastline.

2.4.3 Convertor station/ substation connection to existing OHL

The BGS GeoIndex identifies 8 no. exploratory holes located in close vicinity of the site. Two of these holes were marked confidential therefore a ground profile was not available. An additional 14 no. boreholes were carried out on or in close vicinity of the site by Structural Soils on behalf of Carillion (BHPC59 to BHPC47, BHDX32a and BHDX32b) for the overhead line between Canterbury and Richborough. Details of the ground conditions encountered in these exploratory holes are presented in Table 2.5.

Table 2.5: BGS and Exploratory Hole Details – Connection between Substation/ Convertor Station and existing OHL

Hole	Distance/ direction from site	Date	Hole Depth m bgl	Top of stratum m bgl	Stratum
TR36SW7	25m E	1959	10.62	0	TPS
				0.23	TFD
				9.45	TAB
TR36SW8	60m E	1959	3.05	0	TPS
				0.15	TFD
TR36SW9	25m E	1959	3.76	0	TPS
				0.15	TFD
TR36SW38	180m E	Unknown	14.9	0	TPS
				0.3	TFD
				5.5	TAB
TR36SW39	395m E	Unknown	15.2	0	TPS
				0.3	TFD
				6.7	TAB
TR36SW40	170m E	Unknown	15.2	0	TPS
				0.3	TFD
				5.2	TAB
TR36SW61	Confidential – no borehole information available				
TR36SW62	Confidential – no borehole information available				
BHPC59	360m E	2017	23	0	TFD
				9	TAB
BHPC57	On site	2017	20	0	TFD
				9	TAB
BHPC56	On site	2017	20	0	TFD
				10.5	TAB
BHPC55	On site	2017	18.45	0	TFD
				12	TAB
BHPC54	On site	2017	17	0	TFD
				7.5	TAB
BHPC53	On site	2017	19	0	TFD
				10	TAB
BHPC52	On site	2017	21.45	0	TPS

Hole	Distance/ direction from site	Date	Hole Depth m bgl	Top of stratum m bgl	Stratum
				0.4	TFD
				12	TAB
BHDX32a	160m S	2017	18	0	TFD
				8	TAB
BHDX32b	180m S	2017	20	0	TPS
				0.2	TFD
				10	TAB
BHPC51	On site	2017	16.95	0	TFD
				8.7	TAB
BHPC50	50m S	2017	16.95	0	TFD
				9.4	TAB
BHPC49	50m S	2017	16.95	0	TFD
				9.3	TAB
BHPC48	160m W	2017	18.45	0	TPS
				0.3	TFD
				9	TAB
BHPC47	385m W	2017	18.6	0	TFD
				4	TAB

Note: TPS – Topsoil, TFD – Tidal Flat Deposits, TAB – Thanet Formation, WHCK – White Chalk Subgroup

Groundwater was struck in all but one of the Structural Soils boreholes at depths ranging between 1.2 and 9m bgl (0.62 to -7.49m AOD) within the Tidal Flat Deposits. A second groundwater strike was encountered in five of the boreholes between 6 and 18m bgl (-4.69 and -16.52m AOD) within the Thanet Sand.

2.4.4 Generalised geological descriptions

Generalised descriptions of the materials encountered in the existing boreholes reviewed is provided in the following sections.

2.4.4.1 Topsoil

Soft to firm brown occasionally slightly sandy CLAY with occasional to frequent rootlets. Sand is fine to coarse.

2.4.4.2 Tidal Flat Deposits (TFD)

Firm grey mottled brown thinly laminated slightly sandy CLAY/ soft grey mottled brown slightly sandy CLAY/ soft to firm brown mottled grey sandy slightly gravelly SILT occasionally with frequent decaying thin roots/ very soft to soft dark greenish/ grey slightly sandy silty CLAY frequently with shell fragments. Gravel is rounded medium to coarse black flint/ Chalk, sand is fine, with rare pockets of peat.

Very loose to loose dark greenish grey locally bluish grey clayey SAND with frequent white marine shell fragments (<8mm diameter). This granular layer is generally encountered below the cohesive material in the boreholes to the west where the thickness of cohesive material generally thins.

2.4.4.3 Thanet Formation (TAB)

Medium dense greenish grey locally brown silty SAND with localised pockets/ lenses of slightly sandy greenish grey CLAY/ medium dense greenish grey clayey SAND/ dense greenish grey slightly silty slightly gravelly SAND with occasional white shell fragments, sand is fine to medium, gravel is subrounded to subangular fine to medium Chalk and shell fragments. Generally, 3 to 10m thick, thinning to the east.

Stiff to very stiff greenish grey slightly sandy to sandy silty CLAY with white shell fragments, sand is fine to medium.

2.4.4.4 Margate Chalk Member (MACK) and Seaford Chalk Formation (SECK)

Chalk was only encountered in three of the BGS boreholes, all other existing boreholes reviewed were terminated within the Thanet Formation before reaching the underlying Chalk. Descriptions of the Chalk on the borehole logs are limited to 'Chalk with flints'.

2.5 Mining, quarrying and geological hazard potential

2.5.1 BritPits

A search of the Brit Pits (British Pits) database containing information of currently active and closed surface and underground mineral workings maintained by the British Geological Survey by Groundsure indicates that no features have been identified in the construction swathe or within 500m of the construction swathe.

2.5.2 Natural Cavities

The Groundsure search of the Stantec UK Ltd national database of natural cavities indicates that there are no records of natural cavities within 500m of the construction swathe.

2.5.3 Surface ground workings

Groundsure have identified historical land uses from the Ordnance Survey mapping that involved ground excavation at the surface, which may or may not have been subsequently backfilled. There are no features identified within the construction swathe, detailed of features identified immediately adjacent to the construction swathe are summarised in Table 2.6.

Table 2.6: Details of Surface Ground Workings identified adjacent to the Cable Swathe

Location	Groundsure ID	Land Use	Date range on mapping
HVDC cable route	B GSIP-2022-12625-10110	Pond	1980 to 1989
Substation/ OHL connection	A GSIP-2022-12625-10100	Ponds	1896
	B GSIP-2022-12625-10100	Unspecified Heap	1938
OHL connection	3 GSIP-2022-12625-10104	Unspecified Heap	1968
	C GSIP-2022-12625-10104	Unspecified Heap	1896 to 1938

2.5.4 Underground workings

The Groundsure report has not identified any historical land uses from Ordnance Survey mapping to indicate the presence of underground workings within 1000m of the construction swathe.

2.5.5 Historical mineral planning areas

No historical mineral planning areas are recorded within 500m of the site from review of Groundsure information.

2.5.6 Mining

The Groundsure report indicates the following:

- The are no historical non-coal mining activities identified within the construction swathe. There are a few localised areas of historical non-coal mining activities, relating to sporadic underground mining of sand and Chalk, within 500m of the construction swathe.
- There are no records of the site being in a Johnson Poole and Bloomer (JPB) mining area and no records on site of coal mining.
- The convertor station/ substation site and OHL connection to the west is located within a coal mining area define by the Coal Authority. A Consultant's Coal Mining Report was obtained which indicated no entries were recorded on site or within the vicinity of the site boundary.
- There are no records on site of gypsum or kaolin and ball clay extraction or tin mining on site.

2.5.7 Radon

The site is in an area where <1% of dwellings exceed the Radon Action Level – no radon protection measures are required as reported in the Groundsure report.

2.5.8 Geological Hazard Potential

The Groundsure report indicates the potential ground stability hazards along with hazard potential at the site sourced from the British Geological Survey - National Geoscience Information Service which is summarised below. Information taken from freely available BGS opensource data (Ground Stability Hazards Hex 5km data set) is presented in parentheses below. A series of drawings are included within Appendix A presenting the level of hazard potential across the scheme based on the Hex 5km data.

- Collapsible deposits – Negligible to Very Low (Significant)
- Compressible ground – Negligible to Moderate (Significant)
- Landslides - Very Low (Low)
- Running Sand – Very Low to Moderate (Significant)
- Shrink / swell – Low (Moderate)
- Soluble rocks – Negligible (Low)

It should be noted that the Hex 5km data summarised above is based on freely available BGS data and is at a relatively coarse resolution which explains the difference with the Groundsure data where there is a more detailed classification, These are discussed in more detail in the subsequent sections of the report as well as the geotechnical risk register within Section 10.

2.6 Hydrology and hydrogeology

The below sections summarise the hydrology and hydrogeological information for the site, reference should be made to the PRA and Groundsure reports for further details.

2.6.1 Hydrology

2.6.1.1 Converter station/ substation

- Minster Stream (Drain) passes immediately to the north of the convertor station/ substation in a roughly west to east direction.
- Numerous streams/ drainage ditches feed into Minster Stream from the north and south located along field boundaries. In a couple of locations these are identified to pass underground for short lengths.
- The water courses are part of the Monkton and Minster Marshes water body catchment.
- There are two reservoirs/ lakes located approximately 400m north-east of the convertor station.
- The River Stour is located approximately 300m to the south-west of the substation.
- A pond/ reservoir is located approximately 80m north of the substation.

2.6.1.2 HVDC Cable route corridor

- There are several surface watercourses within the eastern extent of the HVDC cable route area, the majority of which are located within the St Augustine's Golf Course and Stonelees Golf Centre.
- A lake is present approximately 20m to the south of Sandwich Road, within the Sandwich Bay to Hackling Marshes Site of Special Scientific Interest, with the sea located further east approximately 200m from Sandwich Road.
- Drainage ditches run parallel and adjacent to Brook Lane from the north down to Minster Stream (Drain) and the farm access track that run roughly east-west to the convertor station/ substation site.
- The HVDC cable route is located approximately 50m south of Minster Stream (Drain) and crosses 3 no. streams/ drainage ditches feeding into Minster Stream (Drain) as well as Minster Steam (Drain) on it's south-eastwards turn just before reaching the convertor station.

2.6.1.3 Convertor station/ substation connection to existing OHL

- There is a dense network of surface streams/ drainage ditches across the area both to the north and south of the River Stour. These water courses are part of the Monkton and Minster Marshes. In a couple of locations a few of the watercourses are identified to pass underground for short lengths.
- The OHL alignment from the substation crosses 3 no. streams/ drainage ditches before crossing the River Stour. To the south of the River Stour, the alignment crosses a ponded area and approximately 5 no. further streams/ drainage ditches before connecting to the existing OHL.

2.6.2 Hydrogeology

2.6.2.1 Superficial aquifers

There are no superficial aquifers at the site – the superficial deposits comprise Tidal Flat Deposits which are an unproductive strata.

2.6.2.2 Bedrock aquifers

The Groundsure report indicates the whole of the construction swathe area is underlain by a Secondary A Aquifer (Thanet Formation) described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The underlying White Chalk Subgroup is categorised as a Principal Aquifer, described as layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers were previously designated as major aquifers.

2.6.2.3 Groundwater vulnerability

The Groundsure report presents the groundwater vulnerability across the area local to the site as shown in Table 2.7.

Table 2.7: Groundwater Vulnerability within the Construction Swathe

Location	Groundwater Vulnerability	Stratum
HVDC cable route	Secondary bedrock aquifer, medium to high vulnerability	TAB
Convertor Station/ Substation	Secondary bedrock aquifer, low to high vulnerability	TAB
Convertor Station/ Substation connection to the existing OHL	Secondary bedrock aquifer, low to medium vulnerability	TAB

2.6.2.4 Source Protection Zones (SPZs)

The Groundsure report presents the SPZs across the area local to the site. The construction swathe does not fall within a SPZ. The nearest SPZ (Total Catchment) is located approximately 500m north-east of the HVDC cable route at Cliffs End.

2.7 Flooding

2.7.1 River and coastal flooding

The risk of flooding from rivers or sea categories are as follows:

- Very low - <1 in 1000 chance in any given year,
- Low - <1 in 100 but greater than or equal to 1 in 1000 chance,
- Medium - <1 in 30 but greater than or equal to 1 in 100 chance,
- High – greater than or equal to 1 in 30 chance.

The majority of the HVDC cable route corridor is not identified to be at risk of river and coastal flooding in the Groundsure report. Locally areas along field boundaries where drainage ditches are present are identified as Low risk (Flood Zone 2) and a narrow strip along the north-east to south-west trending boundary of Stonelees Golf Centre/ St Augustine's Golf Course is identified to be High risk (Flood Zone 3).

The Convertor Station and Substation site area is not identified to be in an area at risk of river and coastal flooding by the Groundsure report.

To the south of the River Stour, in the area of the OHL connection, the area immediately adjacent to the River Stour is identified to be at High risk of flooding along with smaller isolated areas further south roughly along the alignment of the existing OHL. Otherwise this area is identified to be at Low risk of river and coastal flooding. Almost all of the area to the south of the River Stour is located within Flood Zone 3 in an area benefiting from flood defences, with a small area to the north of the river and south of the railway line located within Flood Zone 2.

2.7.2 Surface water flooding

The HVDC cable route is generally not identified by the Groundsure report to be in an area at risk of surface water flooding except for at the northern extent within St Augustine's Golf Club/

Stonelees Golf Centre where the highest risk on site and within 50m of the site being 1 in 30 year return period, depth greater than 1.0m (maximum modelled flood depth).

The majority of the Convertor Station/ Substation area is identified to be at risk of surface water flooding with the highest risk on site and within 50m of the site being 1 in 30 year return period, depth 0.3 to 1.0m (maximum modelled flood depth).

There are numerous small localised areas along the OHL connection alignment identified to be at risk of surface water flooding with the highest risk on site and within 50m of the site being 1 in 30 year return period, depth greater than 1.0m (maximum modelled flood depth).

2.7.3 Groundwater flooding

The majority of the Option 3 HVDC cable route has been identified to be at High risk of groundwater flooding in the Groundsure report except for the area of higher ground around the A256 which is identified to be at Moderate to Moderate – High risk.

The Convertor Station/ Substation site area is identified to be at High Risk of groundwater flooding along with the connection to the existing OHL area, except for the localised areas around the River Stour which are identified to be at Moderate- High Risk.

2.8 Historical development and land use

The available mapping/aerial photography indicates that most of the construction swathe comprises undeveloped agricultural land.

On-site land uses include minor developments such as St Augustine's Golf Course, Stonelees Golf Centre and historical sea defences.

Off-site sources have been identified, including residential development, road development, motor racing circuit, reservoirs, rifle range, railway lines and associated embankments, pumping house, historical gasometer, and historical Richborough Power Station, which could represent potential sources of contamination.

Based on the identified land uses and the Department of Environment Industry Profiles, contaminants of concern are likely to include, but are not limited to, metals and metal compounds, hydrocarbons (polycyclic aromatic hydrocarbons, total petroleum hydrocarbons), asbestos, polychlorinated biphenyls, fuels, oils, pesticides, insecticides, herbicides and other agricultural chemicals. These are likely to be localised, if present, and will not represent widespread contamination.

Full details of the on- and off-site historic and current land uses are presented in the Mott MacDonald PRA.

2.9 Site sensitivity

The Mott MacDonald PRA and Groundsure reports hold full details on the following sensitivity issues:

- Waste and landfill sites
- Waste exemptions
- Pollution incidents
- Hazardous substances
- Current industrial land uses
- Discharge consents

- Water abstractions

On-site sensitivities or those immediately adjacent to the site are summarised below. For full details of the sensitivities identified nearby to the construction swathe, refer to the Mott MacDonald PRA.

- Two historical landfill sites are located immediately south-west of the HDD alignment, in the area that is now Pegwell Bay Country Park, identified as a refuse tip in the Groundsure report taking inert household waste.
- Stonelees Golf Course is recorded as a Licensed Waste Site for 'deposits of waste to land as a recovery operation', operated by Overnden Earthmoving company Limited, licence issue date 03.10.2011. No surrender/ expiry date is provided. There are no further details in the Groundsure report in terms of area affected.
- There are no current industrial land uses on site except for the existing OHL towers at the western extent of the site.
- Presence of Thanet OFTO cable within the verge along Sandwich Road.
- A surface water abstraction from the watercourse along the field boundary with Stonelees Golf Centre is located just to the south of the HVDC transition joint bay. Three surface water abstractions are located close to the proposed OHL towers immediately to the south of the River Stour, one of which is historical.
- A groundwater abstraction license is located approximately 300m south of the HVDC cable route close to Ebbsfleet Farmhouse/ Great Oaks Small School.

2.10 Environmental designations

Most of the construction swathe is without environmental designations. Areas where environmental designation apply within or immediately adjacent to the construction swathe are summarised in Table 2.8

Table 2.8: Environmental Designation within or immediately adjacent to the Construction Swathe

Location	Environmental Designation
Converter Station / Substation	Site of Special Scientific Interest (SSSI) (Sandwich Bay to Hacklinge Marshes) – to the immediate south and west
Cable Route Corridor	SSSI (Sandwich Bay to Hacklinge Marshes) – to the east of Sandwich Road and Pegwell Bay Country Park within the HDD alignment Ramsar (Thanet Coast and Sandwich Bay) - to the east of Sandwich Road and Pegwell Bay Country Park within the HDD alignment Special Area of Conservation (Sandwich Bay) - to the east of Sandwich Road and Pegwell Bay Country Park within the HDD alignment Special Protection Area (Thanet Coast and Sandwich Bay) - to the east of Sandwich Road and Pegwell Bay Country Park within the HDD alignment National Nature Reserve (Sandwich and Pegwell Bay) – to the east of Sandwich Road
OHL Connection Area	SSSI (Sandwich Bay to Hacklinge Marshes) – on site between the substation and railway line

- The Thanet Nitrate Vulnerable Zone is located to the north of the construction swathe.
- The whole construction swathe is within a SSSI Impact Risk Zone.
- The whole construction swathe except for the far western extent in vicinity of the OHL connection is within a Conservation Area.
- There is one listed building, St Augustine's Cross (Grade II), located off of Cottington Road on the boundary of the construction swathe.

- Much of the land to the west of the railway line, where the OHL connection is located, lies within a Countryside Stewardship (higher tier) scheme.

2.11 Unexploded ordnance

Detailed UXO Risk Assessments have been undertaken for the site by SafeLane Global, summarised in the following reports:

- Safelane Global, Detailed Unexploded Ordnance Risk Assessment, Richborough – Alternative Option No. 3 for Connection to OHL, Report reference: 9758-5 RA, June 2023.
- Safelane Global, Detailed Unexploded Ordnance Risk Assessment, Richborough – Cable Route and Construction Compounds, Report reference: 9758-4 RA, June 2023.
- Safelane Global, Detailed Unexploded Ordnance Risk Assessment, Richborough – Alternative Area 4 Cable Route, Report reference: 9758-3 RA, June 2023.
- Safelane Global, Detailed Unexploded Ordnance Risk Assessment, Richborough – Option 1, Report reference: 9251-4 RA, June 2023.

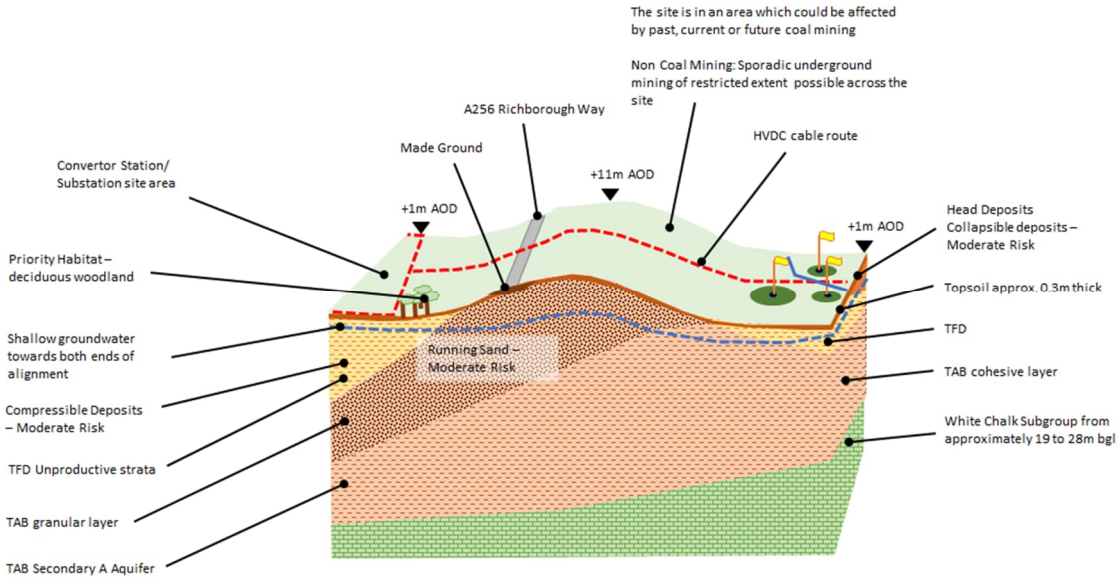
The reports indicate that the UXO risk across the site varies between medium to high. Reference should be made to the reports for their recommended mitigation measures.

2.12 Preliminary Ground Models

A series of conceptual geotechnical ground and groundwater models for the HVDC cable route, convertor station/ substation and OHL connection are presented in the following sections and have been developed by considering the available geological mapping, site topography and existing (historical) ground investigation data. This information has been taken from the Geotechnical and Geo-environmental Preliminary Risk Assessment SEAL-MMD-SEAL-ENG-REG-0057. It is noted that the alignment may have changed slightly since the ground models were produced during the desk study stage, however the general ground profile indicated is still relevant.

2.12.1 HVDC cable route and HDD crossings

Figure 2.4: Preliminary ground model – HVDC cable route and HDD crossings

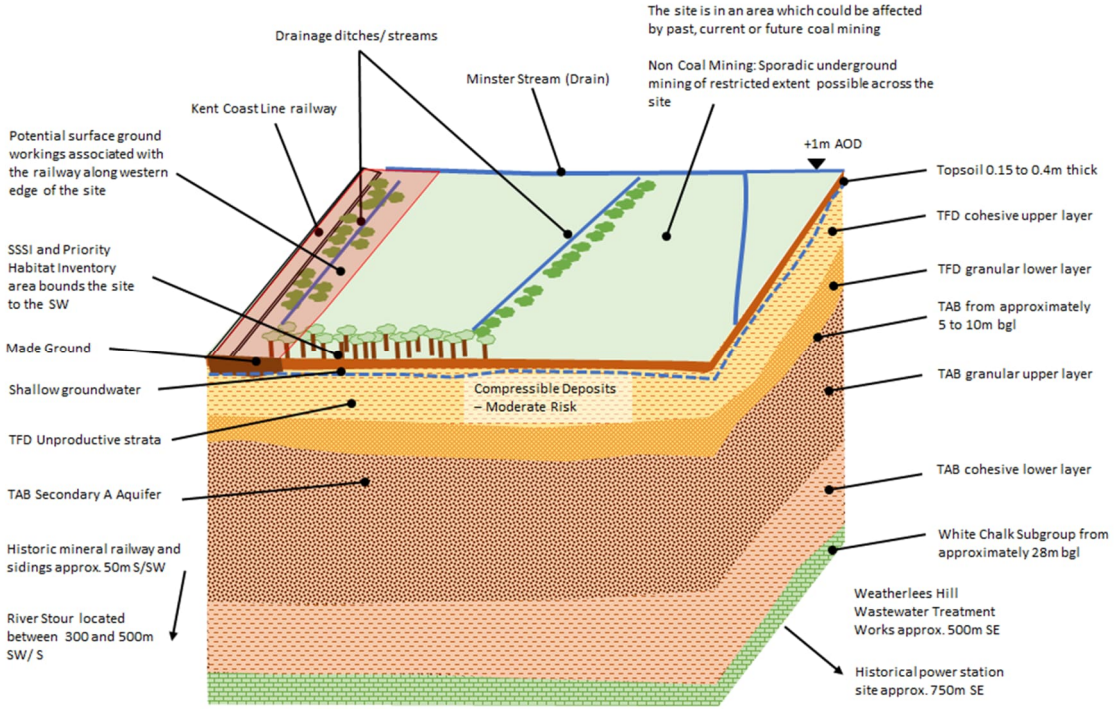


- The site is low-lying to the east and west extents at approximately +1 to +2m AOD rising in the centre to the east of the A256 Richborough Way to around +11m AOD.

- There are no existing boreholes located along the HVDC cable route; therefore, the anticipated ground profile is based on the 3 no. BGS boreholes identified in the vicinity of the HVDC cable route and available geological mapping.
- For the vast majority of the route, except for the low-lying areas at the start of the alignment north of St Augustine's Golf Club and towards the end of the alignment at the convertor station/ substation, superficial cover is not expected and the cable route will likely be constructed within the bedrock Thanet Formation. A thin layer of Topsoil, approximately 0.3m thick, is expected across the site.
- The White Chalk Subgroup is expected to be encountered beneath the Thanet Formation at a depth ranging between 19 and 28m bgl.
- The Tidal Flat Deposits have been identified as a moderate risk is of compressible deposits in the Groundsure report and the Thanet Formation identified as a moderate risk of running sand.
- Made Ground can be expected in the area around the A256 Richborough Way. The site is located within an area where there is potential for sporadic underground mining of restricted extent, therefore; there is potential for unmapped backfilled pits to be encountered.
- Shallow groundwater is anticipated, within the top 1 to 2m bgl, in the low-lying areas at each end of the alignment.
- There is potential for areas of archaeological interest to be present, it is also likely that field drains will be encountered in some excavations.

2.12.2 Converter station/ substation

Figure 2.5: Preliminary ground model – Converter Station/ Substation

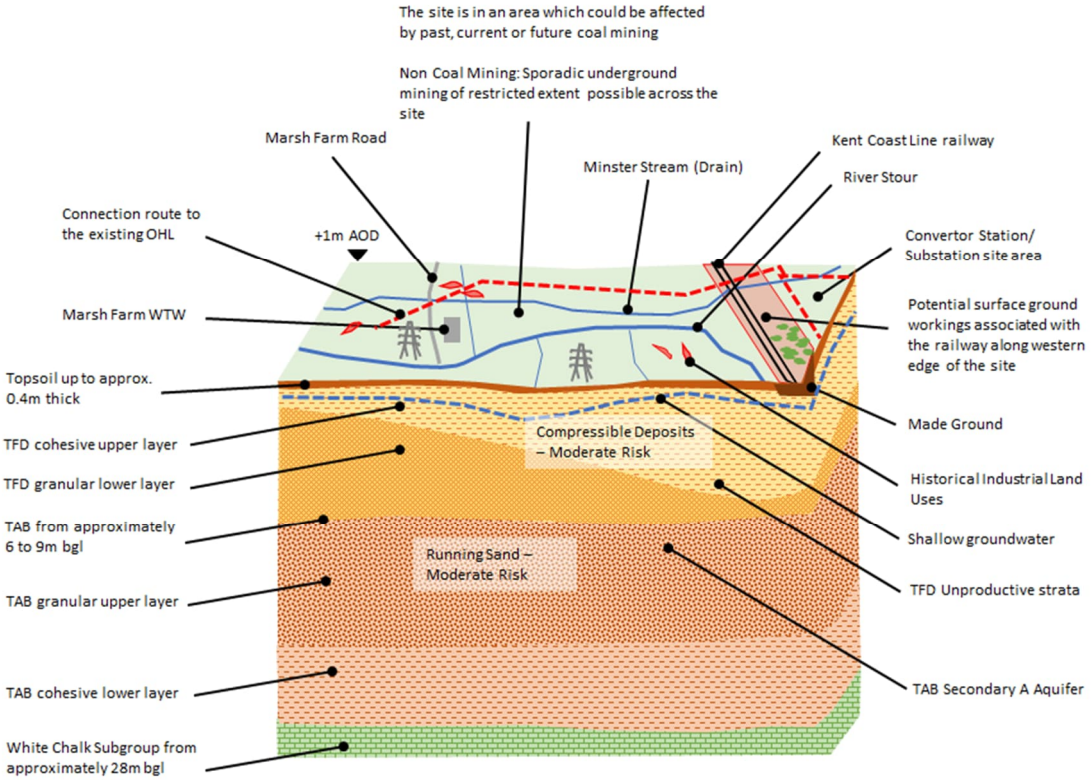


- The site is flat and low-lying at around +1m AOD within an area called Minster Marshes. There are several drainage ditches which bound and transect the site, the largest being Minster Stream (Drain) located across the northern edge of the site.

- There are no existing boreholes located on the proposed site, therefore the anticipated ground profile has been based on BGS borehole records located between 250 and 700m of the site along with geological mapping.
- A thin layer of Topsoil, between 0.15 and 0.4m thick, overlies superficial Tidal Flat Deposits. The top of the Thanet Formation is anticipated to be encountered between approximately 5 and 10m bgl which in turn overlies the White Chalk Subgroup which is anticipated at a depth of around 28m bgl.
- Made Ground is not anticipated to be present on site based on the current and historical land use, however, it is possible that Made Ground associated with surface ground workings relating to the adjacent railway may encroach the site along the western boundary. In addition, a historic mineral railway was located approximately 50m S-SW of the site and the site is located within an area where sporadic underground mining of restricted extent is possible.
- Shallow groundwater is expected, within the top 1 to 2m bgl, based on the proximity of the River Stour and the low-lying nature of the site.
- The Tidal Flat Deposits have been identified as a moderate risk of compressible deposits in the Groundsure report.
- There is potential for areas of archaeological interest to be present, it is also likely that field drains will be encountered in some excavations.

2.12.3 OHL connection

Figure 2.6: Preliminary ground model – OHL connection



- The site is flat and low-lying at around +1m AOD within an area called Minster Marshes to the north of the River Stour and an area called Ash Level to the south. There are numerous drainage ditches and streams which bound and transect the site, the largest being Minster Stream (Drain) located through the centre of the site. The River Stour runs west to east across the southern third of the site.

- There are 6 no. BGS boreholes located within 400m of the site. There are 7 no. boreholes located within the site from the Structural Soils 2017 ground investigation and a further 7 no. located within 400m of the site.
- The existing boreholes indicate the anticipated ground profile to comprise a thin layer of Topsoil (up to 0.4m thick) overlying Tidal Flat Deposits. The Thanet Formation underlies the superficial deposits from a depth of between approximately 6 and 9m bgl. The White Chalk Subgroup is expected to be encountered around 28m bgl, however; none of the existing holes reviewed extended to the Chalk therefore this depth is based on boreholes located further from the site.
- The Tidal Flat Deposits have been identified as a moderate risk is of compressible deposits in the Groundsure report and the Thanet Formation identified as a moderate risk of running sand.
- Shallow groundwater is expected, within the top 1 to 2m bgl, based on the proximity of the River Stour and the low-lying nature of the site.
- Made Ground is not expected to be present on site based on the current and historical land use, except potentially along the railway line. An historic mineral railway was located to the south-west of the site therefore surface ground workings associated with this may encroach onto the site. In addition, the site is located within an area where there is potential for sporadic underground mining of restricted extent therefore there is potential for unmapped backfilled pits to be encountered.
- There is potential for areas of archaeological interest to be present, it is also likely that field drains will be encountered in some excavations.

3 Field and laboratory studies

3.1 Walkover survey

A walkover was attended by representatives of Mott MacDonald Limited prior to the intrusive ground investigation in May 2023, to agree access routes and confirmation of exploratory hole locations and ancillary works. No distinct additional observations were captured during this walkover, with the walkover focussed on the proposed exploratory hole locations, access routes and particular constraints associated with the proposed works.

3.2 Geomorphological and geological mapping

No geomorphological or geological mapping has been undertaken for the site.

3.3 Summary of historical ground investigations

Details of previous ground investigations undertaken are provided in Section 2.3. Only one of the four previous investigations reviewed included exploratory holes located on site with the others being located close to the site. The Structural Soils OHL Connections report (2017) included several boreholes located along the existing OHL route and these have been reviewed to assist with compiling the preliminary ground model for the OHL connection in this area.

3.4 Summary of project specific ground investigation

In 2023 a preliminary de-risking ground investigation was undertaken, the aim of which was to obtain sufficient information on the ground conditions for the main contractors to price the construction contract without the necessity to include a significant risk contingency sum for unknown ground conditions. This was undertaken with the recognition that a further phase of GI will be carried out later in the project by the appoint construction contractor.

The ground investigation was undertaken between 18th of September and 1st December 2023 by Structural Soils Limited, reported in the following report:

- Structural Soils Limited, SEA Link FEED – Kent Onshore Cable Link, Factual Report on Preliminary Ground Investigation, Document reference: 563607-02 (03), April 2024

The ground investigation was scoped and supervised by Mott MacDonald Limited, including wider support and agreement of exploratory hole locations with AECOM, who are the Environmental Consultant supporting the project in relation to environmental constraints such as ecology and archaeology / heritage. During the ground investigation 1st Line Defence Ltd provided unexploded ordnance (UXO) supervision and scanning at all intrusive positions, and Headland Archaeology Ltd maintained an archaeological watching brief for trial pitting works.

Mott MacDonald Limited scheduled the laboratory geotechnical and geo-environmental testing. It should be noted that boreholes were included as part of this scope to inform Red Penguin's offshore design, Red Penguin were consulted to review testing requirements within these boreholes.

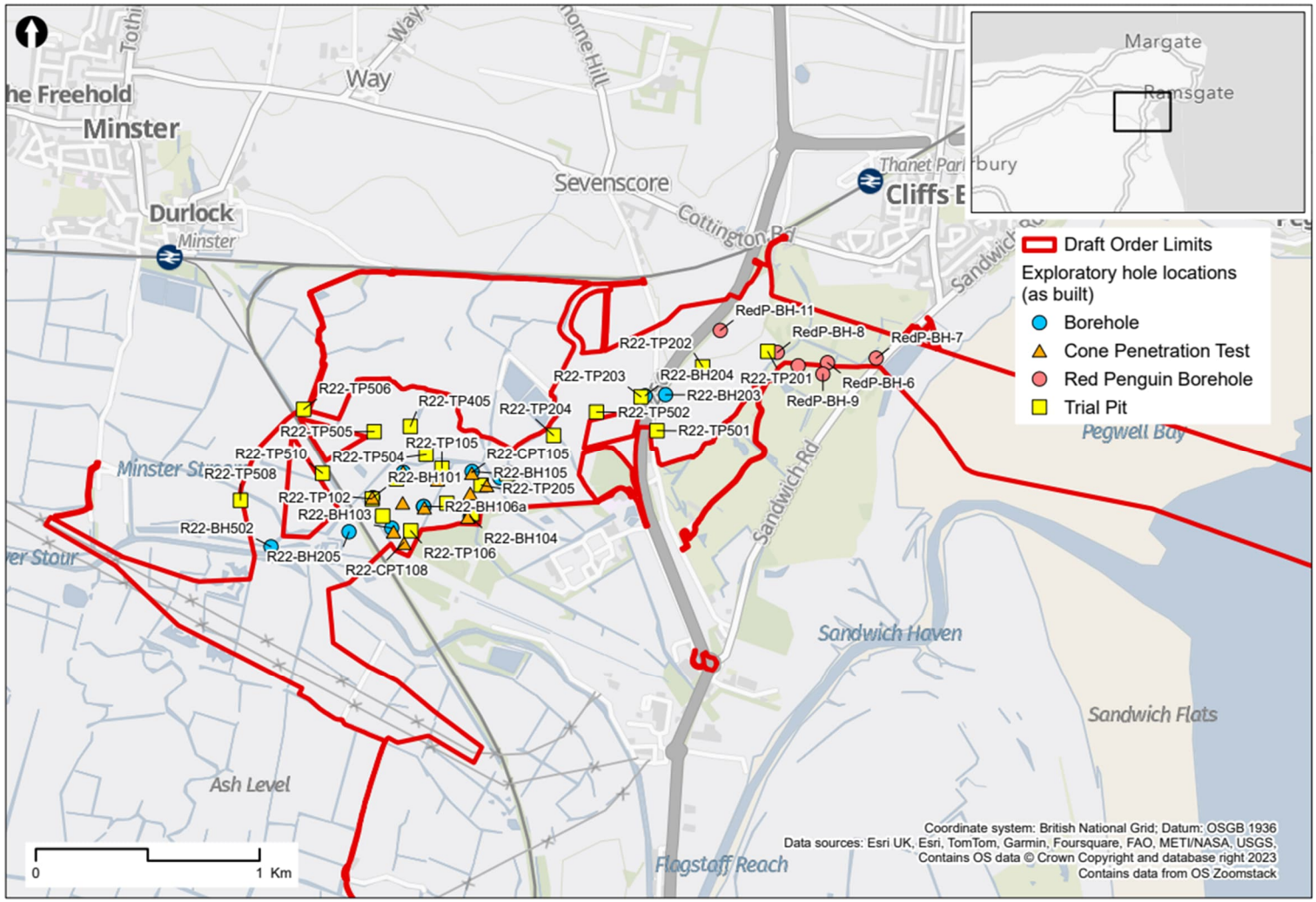
The location of exploratory holes are presented in drawings within Appendix B and Figure 3.1. The de-risking investigation included:

- 12 Cable percussion boreholes to a maximum depth of 32m
- 5 Cable percussion boreholes with rotary cored follow-on, to a maximum depth of 41m

- 11 Cone Penetration Tests (CPTs) to a maximum depth of 10.05m
- Hand dug inspection pits for all of the above, to 1.2m depth
- 22 trial pits to a maximum depth of 4m
- Geotechnical and geo-environmental sampling and laboratory testing;
- In-situ testing including:
  - Standard Penetration Tests (SPTs)
  - Downhole permeability and soakaway testing to assess soil permeability
  - Dynamic Cone Penetrometer testing to inform pavement design
  - Thermal resistivity testing to determine the properties of the soil for cable design
  - Soil resistivity using the Wenner array to determine soil conductivity for earthing design
- Establishing ground location and levels of exploratory holes
- Installation of nine 50mm diameter groundwater monitoring wells and one 50mm diameter gas monitoring well
- Groundwater monitoring for a period of approximately 3 months following the completion of fieldwork, followed by a period of 9 months automatic monitoring utilising data divers in selected exploratory holes. Monitoring of data divers is in progress at the time of writing.
- Factual reporting to BS EN 1997-2:2007 incorporating corrigendum June 2010.
- A description of the works completed along with exploratory hole logs and testing results is presented in the Contractor's factual report .

Six of the boreholes were numbered "RedP-BH-6" to "RedP-BH-11", providing data for the offshore cable landing part of the SEA Link project. While the geological and geotechnical interpretation and analysis of the offshore scheme is being undertaken by others, selected data from these boreholes will be used in this report to further understanding of the ground model and material properties associated with the onshore works.

Figure 3.1: Exploratory Location Plan – 2023 GI



4 Ground Summary

This section of the report discusses the deposits likely to be encountered on site. The assessment is based on the geological unit allocations at the time of ground investigation but may be subject to review and amendment during future stages of design and completion of additional site investigation.

4.1 Ground models from site-specific investigation

A series of ground models have been prepared summarising the ground conditions across the site footprint. These have been separated due to their spatial relationship with the anticipated geology and the proposed works, with a plan showing these in Appendix B.

The site is located across lowland coastal terrain, with a high level summary of the anticipated ground conditions encountered captured below.

The Thanet Formation and areas of Made Ground form the relative areas of high ground, with the remainder of the site sloping towards or being located close to ordnance datum, with these areas defined by areas of Tidal Flat Deposits at ground level.

A brief summary of the ground conditions encountered across the site is presented in the below table. A series of site ground models applicable for certain areas of the site are presented within Appendix C, and inform development of relevant design ground models in later sections of this report. To explain the relationship of some of the deposits listed below, reference should be made to Section 4.2 where a sketch geological section is presented.

Table 4.1: Site material description summary

Strata	Description	Remarks
Topsoil	Grass over friable dark brown to brown slightly sandy silty occasionally organic CLAY to clayey SILT. Localised areas slightly gravelly and rarely with low cobble content, and in one location very silty organic SAND. Sand is fine to coarse. Gravel, where present, is subangular to subrounded, fine to coarse of flint, Chalk and siltstone. Cobbles, where present, are subangular to subrounded flint.	Generally recorded at surface in majority of locations across the site, except where Made Ground may be present.
Made Ground	Firm to very stiff brown slightly gravelly slightly sandy organic clayey SILT / silty CLAY, varying to slightly gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of Chalk, clinker, brick, wood fragments, sandstone and ceramic.	Locally encountered only, likely to be reworked from Topsoil in some areas.
Tidal Flat Deposits	Stiff to very stiff becoming firm to very soft to soft with depth mottled light grey becoming bluish grey to dark blue / mottled orange or yellow slightly sandy or slightly gravelly silty CLAY rarely with medium cobble content, semi-rotten organic material, or rare rootlets. Locally encountered as soft to very soft grey slightly to very sandy clayey SILT / soft dark brown pseudo-fibrous PEAT with a strong organic odour. In some locations with occasional shells or shell fragments, organic odour or rare organic matter.	Present in OHL connection, Converter and Substation and western area of HVDC only. Also recorded in vicinity of HDD alignment (within Red Penguin boreholes, which are not included here)
Thanet Formation	Interbedded beds / bands of:	Reference should be made to Section 2.2 for further details on

Strata	Description	Remarks
	● Firm to very stiff grey to bluish grey (in upper 4 metres, occasionally orangish or yellowish-brown mottled grey) micaceous sandy or clayey SILT or silty CLAY with rare shell fragments. Occasionally slightly gravelly with a low cobble content at its top. Sand is fine or fine to medium. Gravel where present is subangular to rounded fine to coarse siltstone, cobbles are subangular siltstone or subrounded to rounded flint. ● Extremely weak to weak grey SILTSTONE recovered as dense to very dense grey silty angular to subangular fine to coarse GRAVEL with a low cobble content and occasional shell fragments. Cobbles are angular siltstone. ● Sand, which where present at shallow depth is loose yellow or greenish brown silty fine to medium SAND. At greater depths the sand is dense to very dense grey very silty fine or fine to coarse SAND. ● 0.2 - 0.3m basal bed of black subangular to subrounded fine to coarse flint GRAVEL with a low to medium flint cobble content.	likely units encountered in the Thanet Formation. Although logged as a SILTSTONE, it is likely that this sub-unit represents the Pegwell Marls sub-unit of the Thanet Formation. Beds of clay are occasionally recorded towards the base of the unit, potentially correlating with the Stourmouth clays. Silts present at the top of the unit are likely to be associated with the Reculver Silts Bed of Gravel at its base is commonly known as the Bullhead Bed, was locally recorded. Presence of flint cobbles at the top of the unit may suggest the potential presence of Head Deposits derived from the Thanet Formation, these are presented indicatively in Figure 4.4. It should be noted these are noted within the literature in the Geological Memoir (see Section 2.2).
Margate Chalk Member – Newhaven Chalk Formation	Structureless Chalk recovered as dense to very dense white slightly sandy silty angular to subangular fine to coarse GRAVEL. Clasts are extremely weak to very weak low to medium density white with occasional black specks. Matrix is off-white.	Not encountered in vicinity of OHL connection
Seaford Chalk Formation	Structureless Chalk recovered as white slightly gravelly slightly sandy SILT with frequent rinded flint fragments up to 50mm diameter. Gravel is weak low-density white subangular.	Not encountered in vicinity of OHL connection

4.2 Ground model visualisation

A geological section has been prepared through the site along the length of the project, with the section alignment and site-specific GI presented in Figure 4.1 and Figure 4.2.

The geological sections are presented in Figure 4.3 and Figure 4.4.

The data has been extrapolated based on the geological relationships and distributions indicated on the BGS mapping, and is shown to broadly correlate with the expected geology.

Limited topographic information is available along the section alignment, therefore ground levels have been estimated based on freely available open-source LIDAR information available at 1m resolution on the Department for Environment, Food & Rural Affairs (DEFRA) Data Services Platform (2024).

The relationship of different engineering behaviour is complex within the Thanet Formation, and this has been distinguished on the engineering logs presented on the sections where possible. It is known that there are several depositional sub-units as described in Section 2, though limited information is available to correlate these across the sketch sections and therefore the Thanet Formation is presented as one unit for representative purposes.

Historical BGS boreholes have been reviewed within the wider surrounding area to review the relationship between the Thanet Formation and Chalk, including any influence associated with the structural geology and presence of the syncline axis south of the site (see Section 2 for further details). These have been used to help inform the potential top surface of the Chalk where limited information is available in vicinity of the site, including the Converter Station. However, limited deep borehole information is available in vicinity of the Converter Station and to its west, therefore the surface should be treated with caution.

The sketch sections presented in Figure 4.3 and Figure 4.4 display various geological relationships and trends, described below:

- For the purpose of the geological sections, Topsoil has not been presented, this generally forms a veneer across the majority of the site due to its agricultural land use.
- Areas of Made Ground are likely to be present associated with Stonelees Golf Course, as well as areas of infrastructure including railways and roads. Made Ground has been shown indicatively near-surface where limited information is available.
- The extent of the Tidal Flat Deposits correlates with observations from BGS mapping, confined to topographic lows in the western and eastern areas between which the Thanet Formation crops at surface. This unit is likely to have formed of a series of silt, sand and clay filled channels, the complexity of which is difficult to present clearly on the geological sections. It is likely to have resulted in some variability to the top depth of the Thanet Formation.
- The borehole logs and above ground models present the different engineering materials the Thanet Formation has been sub-divided to including silt, sand, clay, marls / cemented beds and gravel (Bullhead Bed). These broadly reflect wider observations of the sedimentary sub-units in the Geological Memoir as described in Section 2.2, however it has not been possible to sub-divide the geological section with certainty and this should be treated with caution given the scale of the alignment (c. 3km).
- In addition, the Geological Memoir suggests the presence of brickearth or head deposits which may be present overlying the Thanet Formation. It is possible these are encountered in the areas of greater elevation where the deposit is exposed along the eastern portion of the HVDC route, and where thought they may be present they have been shown indicatively on the geological section in Figure 4.4 attributed to, for example, presence of flint cobbles in the upper-most beds. It is recommended that this is treated with caution and subject to further assessment at the next design stage to determine their nature / origin.
- The depth to the top of the Chalk is likely to increase gently westwards based on observations in site-specific and wider boreholes. This broadly correlates with structural information associated with the Richborough Syncline, where the Thanet Formation is likely to thicken to c. 30m at the syncline axis which is orientated broadly west to east c. 750m south of the Converter Station.

Figure 4.1: Borehole and section location plan – Sheet 1

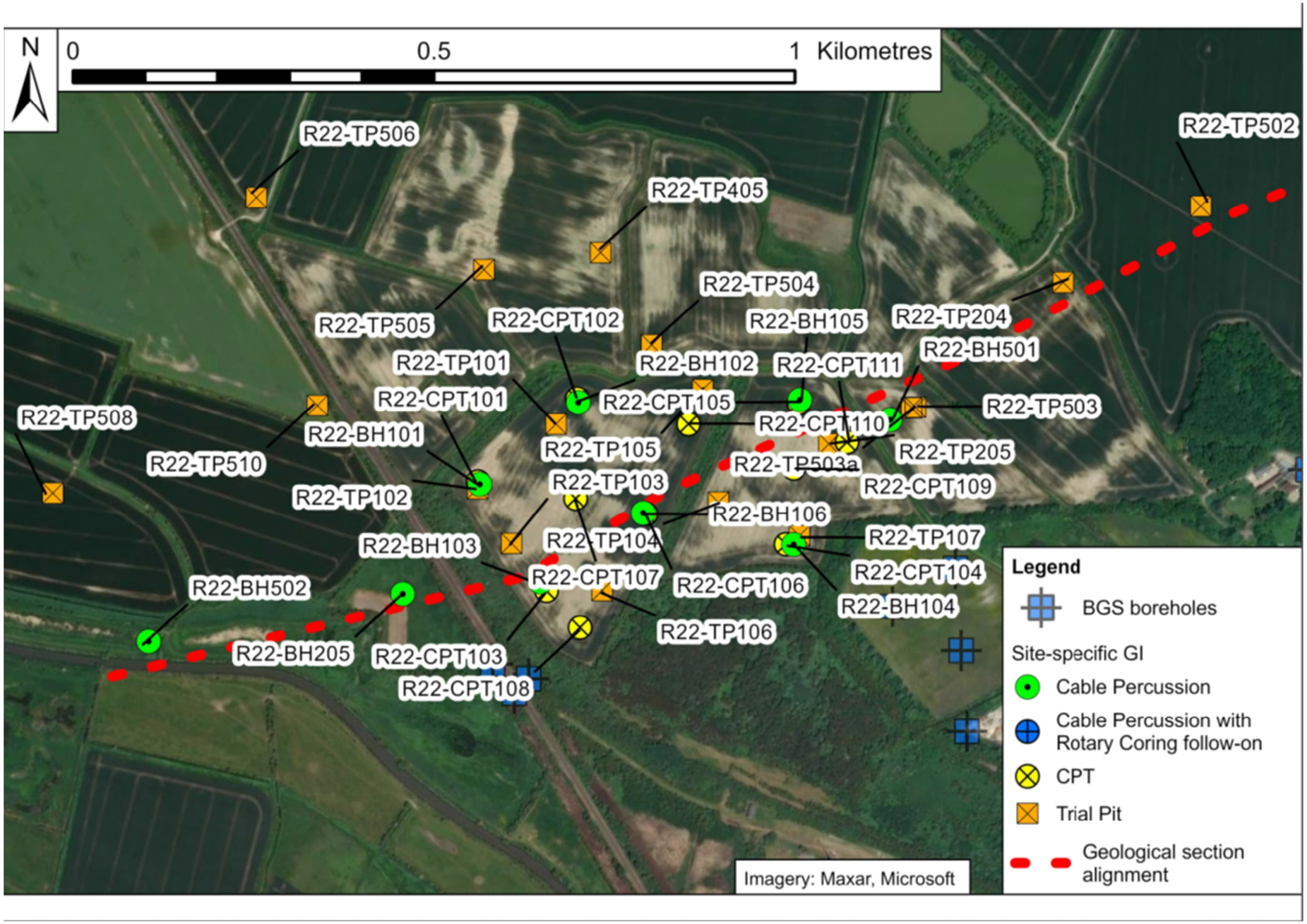


Figure 4.2: Borehole and section location plan – Sheet 2

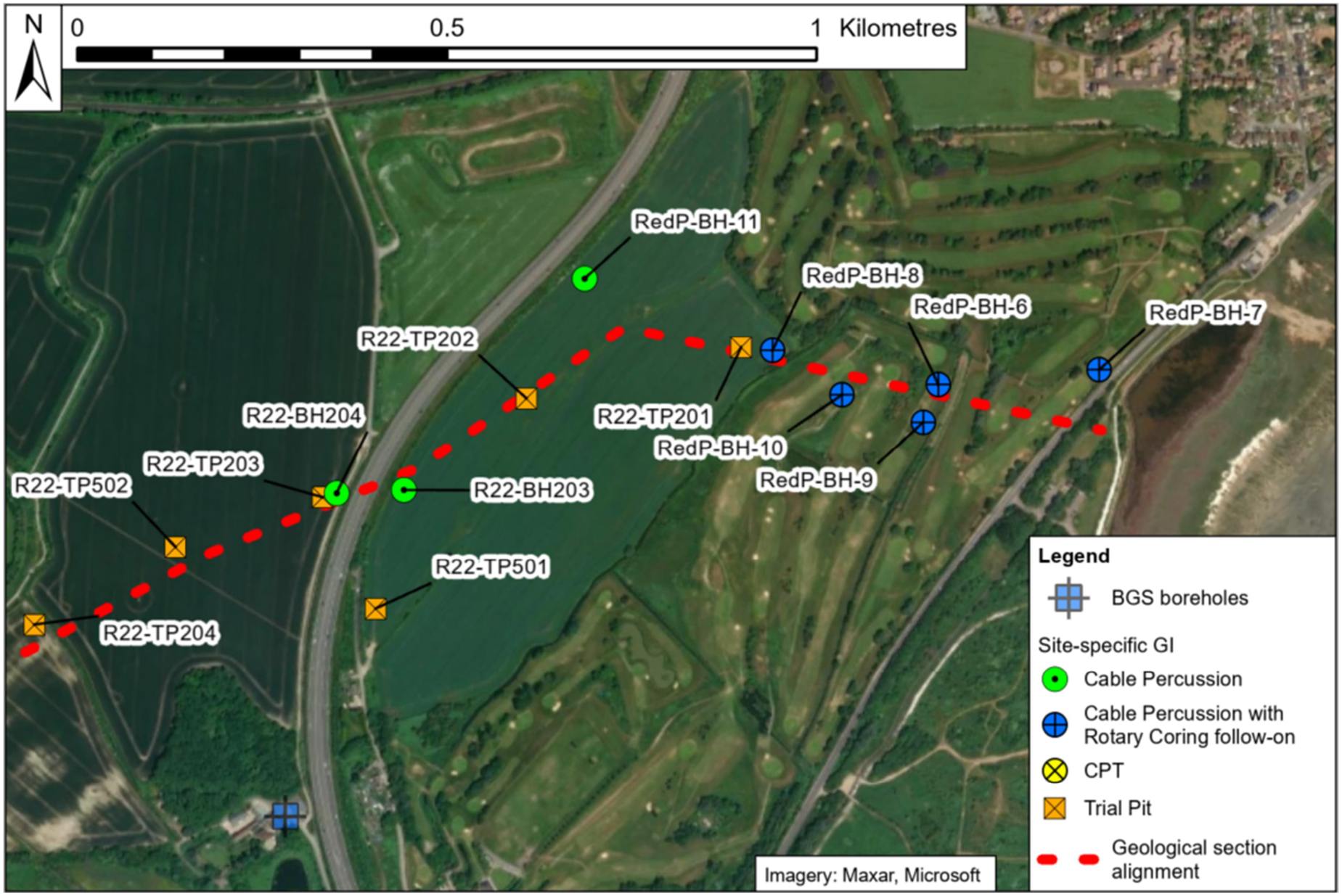


Figure 4.3: Sketch geological Section - Sheet 1

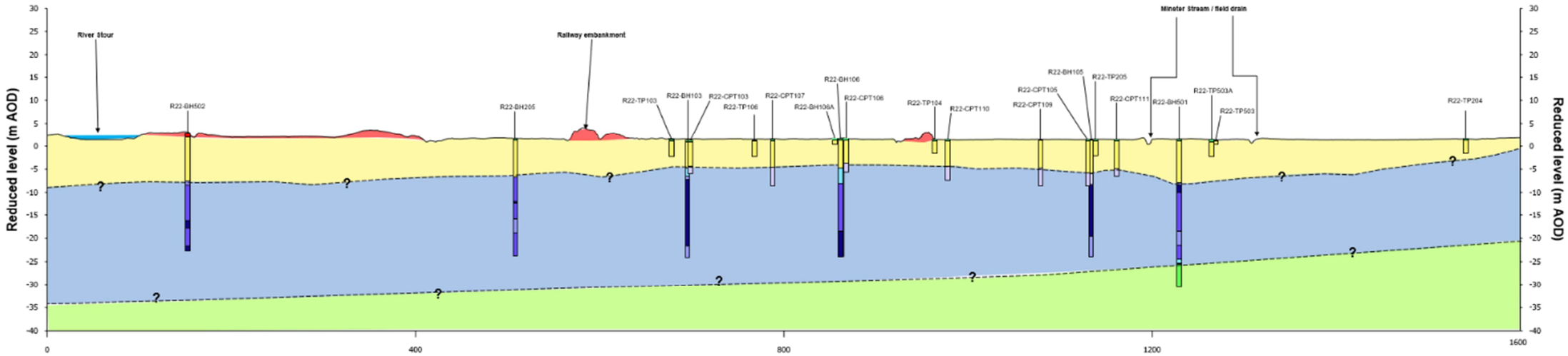
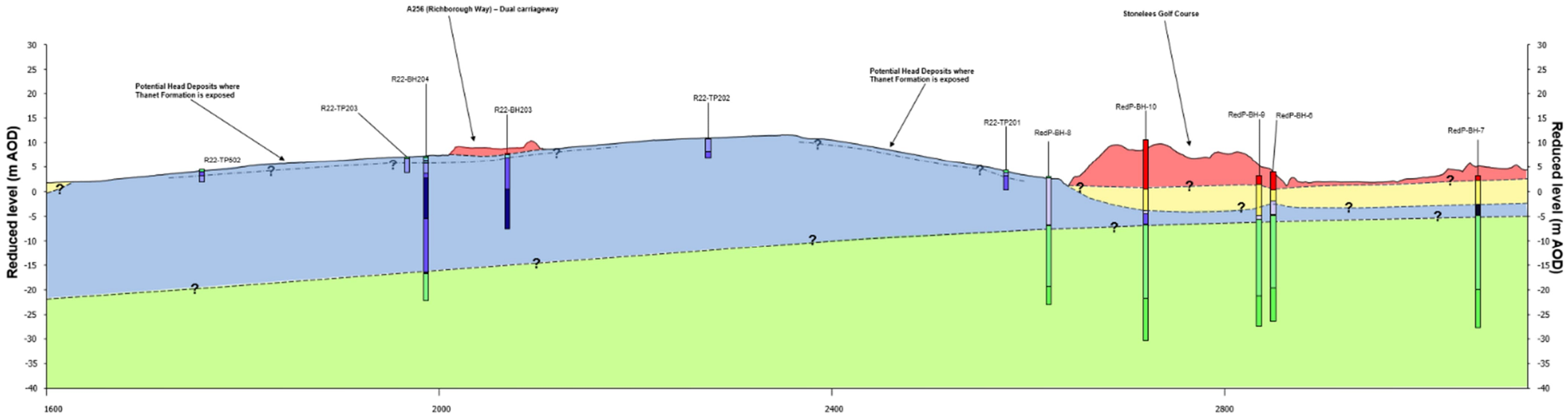
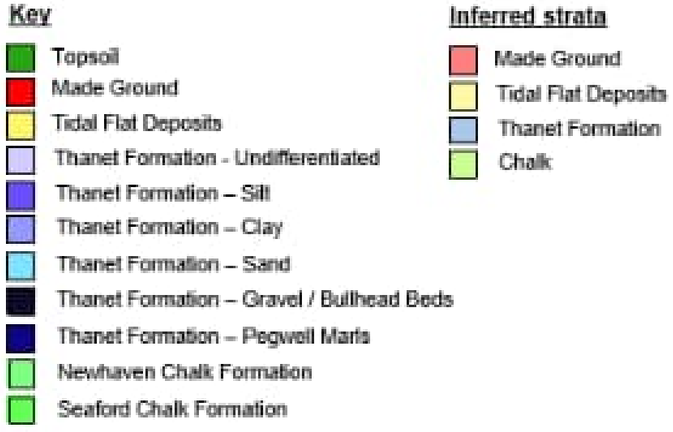
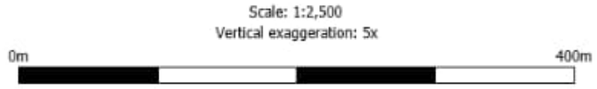


Figure 4.4: Sketch geological Section - Sheet 2







4.3 Groundwater

4.3.1 Groundwater strikes

Details of groundwater strikes during fieldworks are presented in Table 4.2 below. Most groundwater strikes were within the Tidal Flat Deposits, at a level close to Ordnance Datum – this likely represents saturation within the clays from the nearby River Stour and from the sea. Given the cohesive and low permeability nature of the Tidal Flat Deposits, groundwater strikes are likely associated with individual beds or lenses of marginally higher permeability, due to increased silt or sand content.

The groundwater level was observed to slightly rise after some groundwater strikes, indicating higher permeability lenses of soil may be confined by overlying lower permeability clay and silt.

Table 4.2: Groundwater Strike Details

Exploratory Hole	Depth (m bgl)	Reduced level (m OD)	Depth after 20 mins (m bgl)	Stratum
R22-BH101	1.20	0.24	-	Tidal Flat Deposits
R22-BH102	8.30	-6.71	6.40	Thanet Formation
R22-BH103	0.85	0.47	-	Tidal Flat Deposits
R22-BH104	3.00	-1.64	2.78	Tidal Flat Deposits
R22-BH105	1.00	0.43	0.90	Tidal Flat Deposits
R22-BH106	1.05	0.44	-	Tidal Flat Deposits
R22-BH106A	1.00	0.44	-	Tidal Flat Deposits
R22-BH106A	4.80	-3.36	4.60	Tidal Flat Deposits
R22-BH203	8.00	-0.04	7.50	Thanet Formation
R22-BH204	10.45	-3.16	8.13	Thanet Formation
R22-BH205	8.00	-6.42	7.50	Tidal Flat Deposits
R22-BH501	1.00	0.49	-	Tidal Flat Deposits
R22-BH501	7.00	-5.51	6.40	Tidal Flat Deposits
R22-BH502	1.20	1.56	-	Tidal Flat Deposits
R22-CPT101	1.10	0.29	-	Tidal Flat Deposits
R22-CPT105	0.90	0.52	-	Tidal Flat Deposits
R22-CPT106	1.00	0.49	-	Tidal Flat Deposits
R22-CPT107	1.20	0.23	-	Tidal Flat Deposits
R22-CPT108	1.20	0.1	-	Tidal Flat Deposits
R22-CPT111	0.85	0.54	-	Tidal Flat Deposits
R22-TP102	1.50	-0.02	-	Tidal Flat Deposits
R22-TP103	1.20	0.16	-	Tidal Flat Deposits
R22-TP203	3.20	3.94	-	Thanet Formation
R22-TP204	1.20	0.36	-	Tidal Flat Deposits
R22-TP501	3.50	2.41	-	Thanet Formation
R22-TP503A	1.50	-0.15	-	Tidal Flat Deposits
R22-TP506	1.30	0.00	-	Tidal Flat Deposits
RedP-BH-8	1.10	1.91	-	Tidal Flat Deposits
RedP-BH-8	6.50	-3.49	6.20	Tidal Flat Deposits

It is possible that some groundwater strikes/seepage could have occurred without being observed/detected, due to low permeabilities and drilling techniques.

4.3.2 Groundwater monitoring

Nine boreholes were installed with standpipes after drilling, to enable long term monitoring of groundwater levels. These installations are detailed in Table 4.3 below.

Groundwater monitoring was carried out in four rounds post fieldworks, between October 2023 and January 2024. The results of groundwater monitoring are shown in Figure 4.5 and Figure 4.6 below.

Table 4.3: Groundwater Monitoring Installations

Exploratory Hole	Elevation (m OD)	Top (m bgl)	Base (m bgl)	Top of Response Zone (m OD)	Base of Response Zone (m OD)	Stratum
R22-BH102	1.59	0.8	3	0.79	-1.41	TFD
R22-BH103-1*	1.32	0.5	1	0.82	0.32	TFD
R22-BH103-2	1.32	3	6	-1.68	-4.68	TFD
R22-BH104	1.36	3	6	-1.64	-4.64	TFD/TAB
R22-BH105	1.43	0.8	3	0.63	-1.57	TFD
R22-BH204	7.29	27	29	-19.71	-21.71	NCF
R22-BH205	1.58	20	25	-18.42	-23.42	TAB
R22-BH501	1.49	24.5	26.5	-23.01	-25.01	TAB
RedP-BH-8	3.01	11	16	-7.99	-12.99	NCF

* Primarily installed for gas monitoring, however despite the shallow depth of installation, this standpipe also detected groundwater levels during monitoring.

Figure 4.5: Groundwater Monitoring Results – Depth below ground level

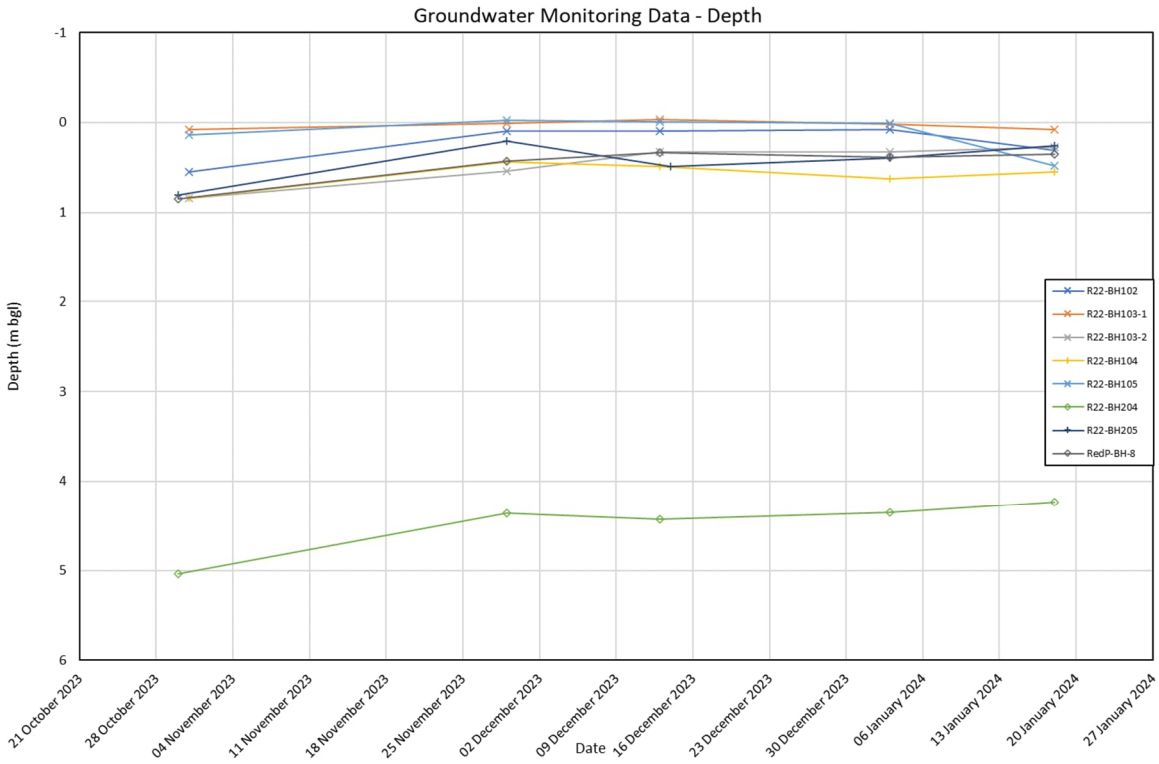
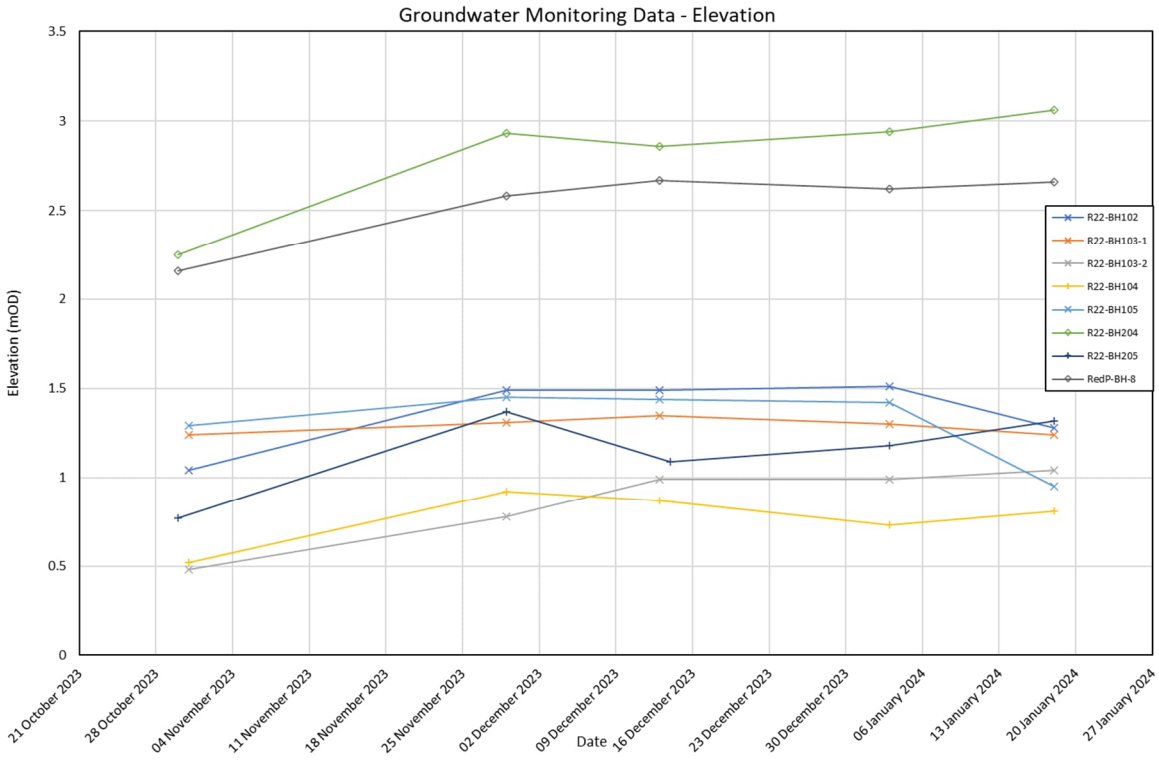


Figure 4.6: Groundwater Monitoring Results – Elevation



R22-BH501 appears to have flooded between the end of fieldworks and the start of the monitoring period, reading 0.1m above ground level for the 4 visits in a row. This standpipe is not presented on the above plot and would suggest a reasonably stable groundwater table, similar to other exploratory holes in the above Figures. Reference should be made to the data logger information installed in this location which recorded groundwater at approximately ground level for the entire duration presented in Figure 4.13.

The remaining data suggests a two-aquifer system present at the site. The upper aquifer spans the tidal flat deposits and upper Thanet formation and is characterised by groundwater levels up to 1.50m above Ordnance Datum, at very shallow depth within the ground (between surface level to approximately 0.5m bgl based on data logger information). This aquifer is interpreted to be in continuity with the nearby River Stour and Minster Stream (Drain), representing the slow drainage of precipitation landing on agricultural fields towards the river and ultimately, the sea.

The data logger information is presented within Figure 4.7 – Figure 4.13, and within the shallow aquifer suggests relatively steady groundwater levels in some instances, but in some boreholes including R22-BH102 and R22-BH105 the groundwater response appears to correlate to precipitation events which may be associated with low pressure systems which results in a small rapid increase in groundwater level which slowly dissipates. Data loggers installed in the Chalk (e.g. R22-BH204) and deeper within the Thanet (e.g. R22-BH205) record steady groundwater levels over these periods, again suggesting a separate aquifer system.

The lower aquifer present on the site spans the lower Thanet formation and the Upper Chalk. Reduced groundwater levels within the two standpipes (RedP-BH-8 and R22-BH204) installed in this aquifer are typically ~1m above those in the upper aquifer, indicating confined and slightly over-pressured conditions.

Figure 4.7: Automatic diver data logger measurements – R22-BH102

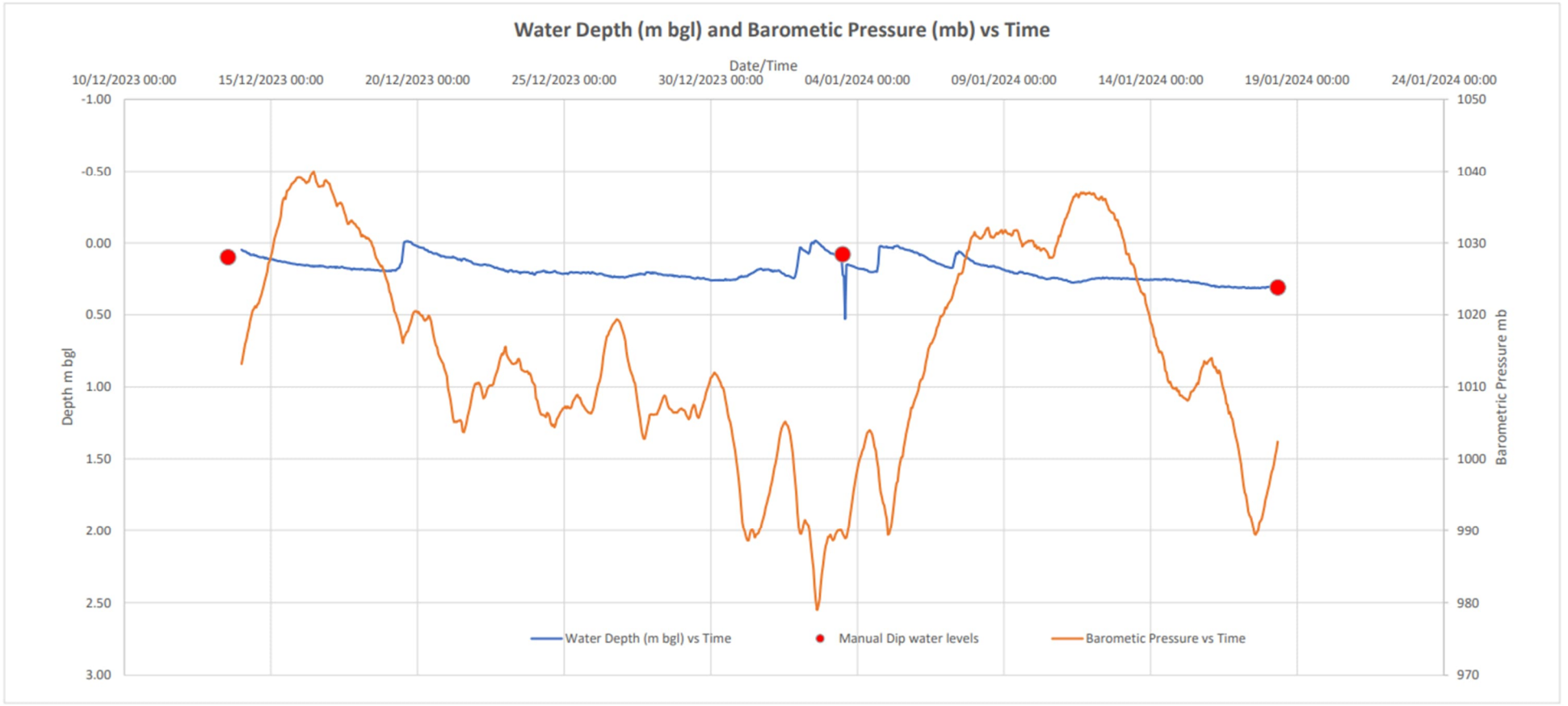


Figure 4.8: Automatic diver data logger measurements – R22-BH102

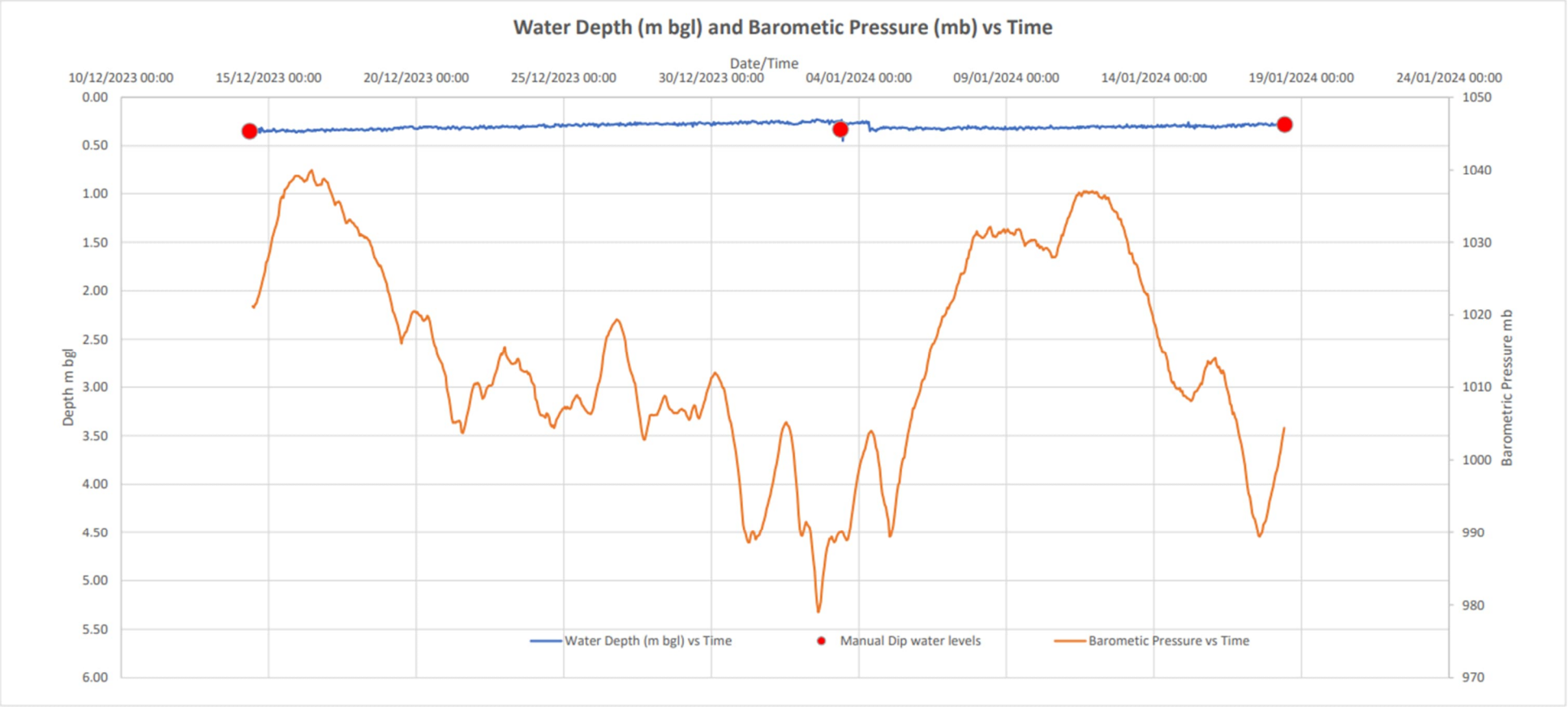


Figure 4.9: Automatic diver data logger measurements – R22-BH104

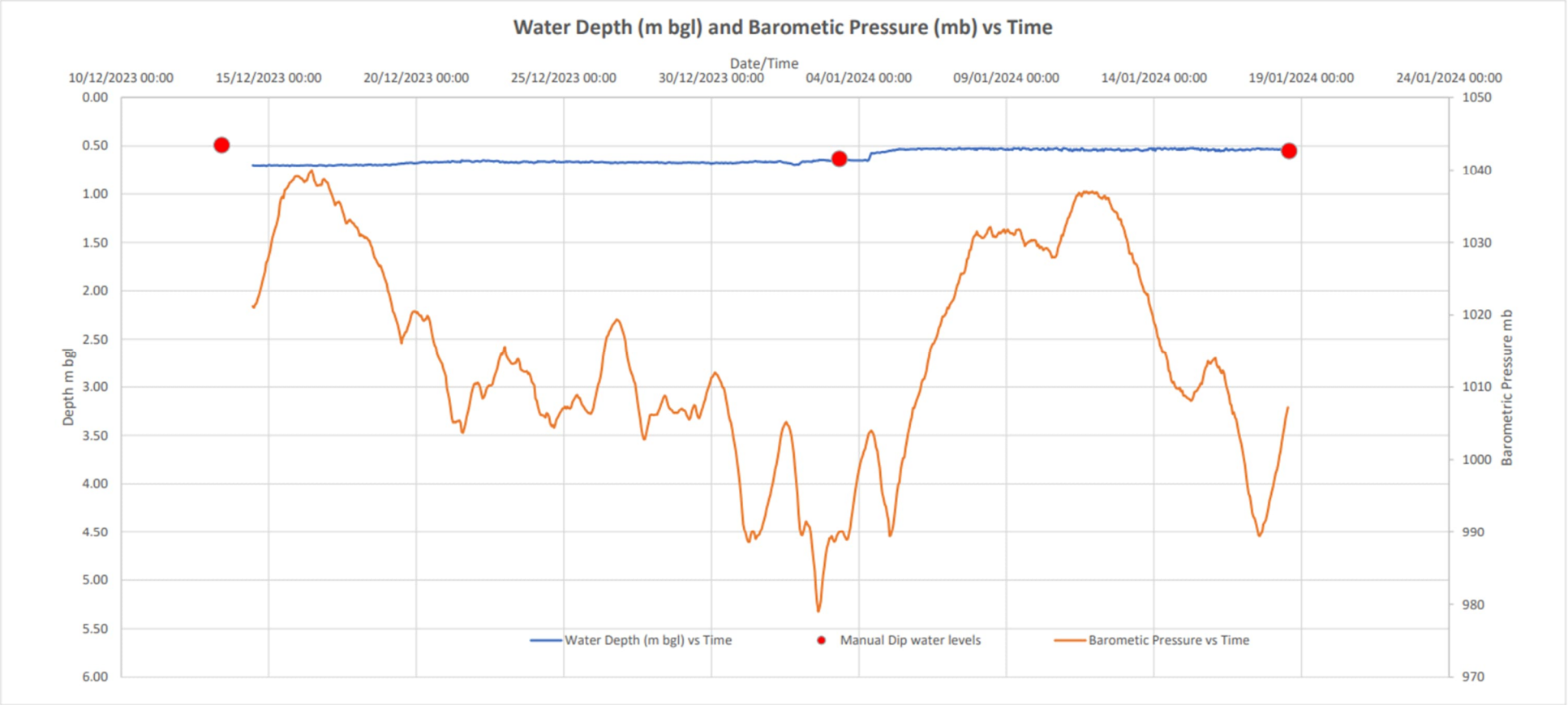


Figure 4.10: Automatic diver data logger measurements – R22-BH105

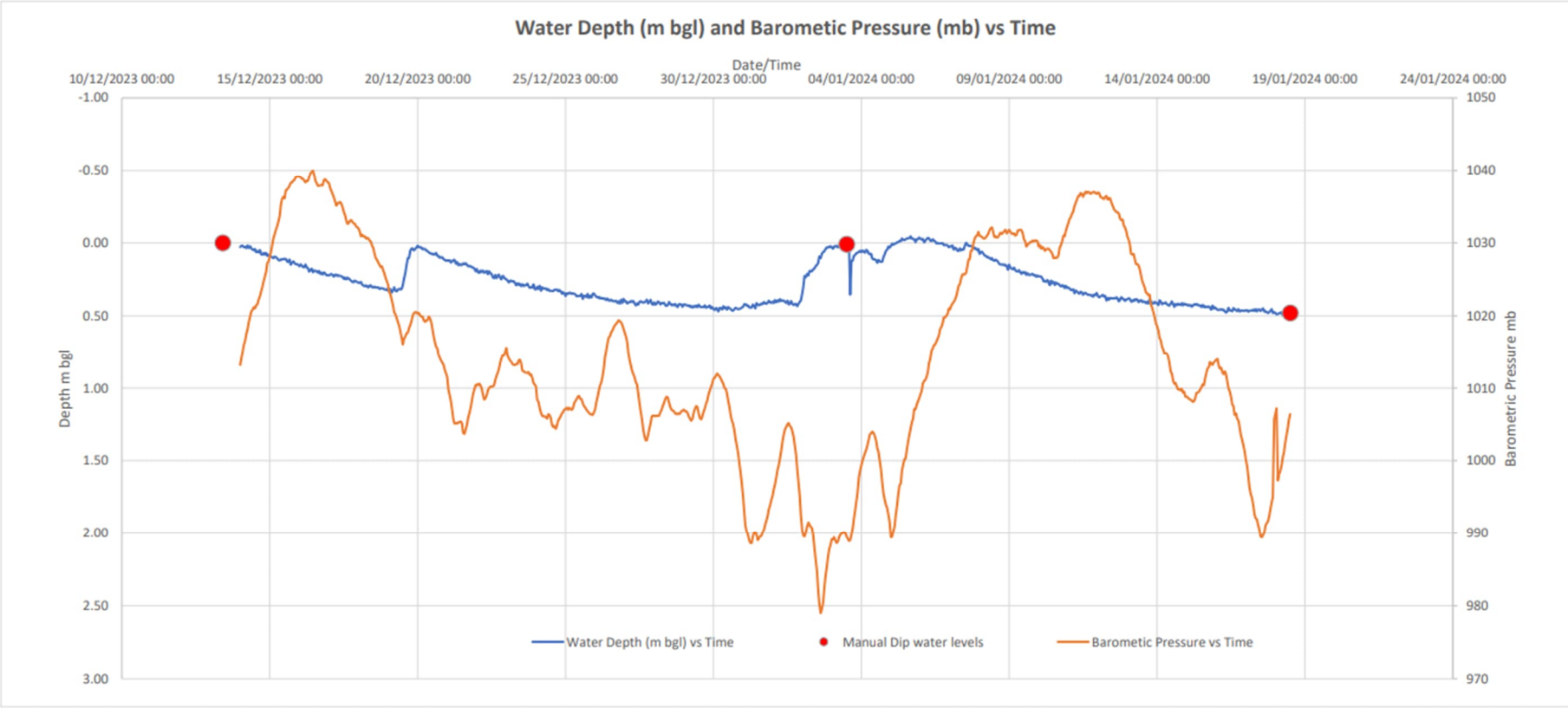


Figure 4.11: Automatic diver data logger measurements – R22-BH204

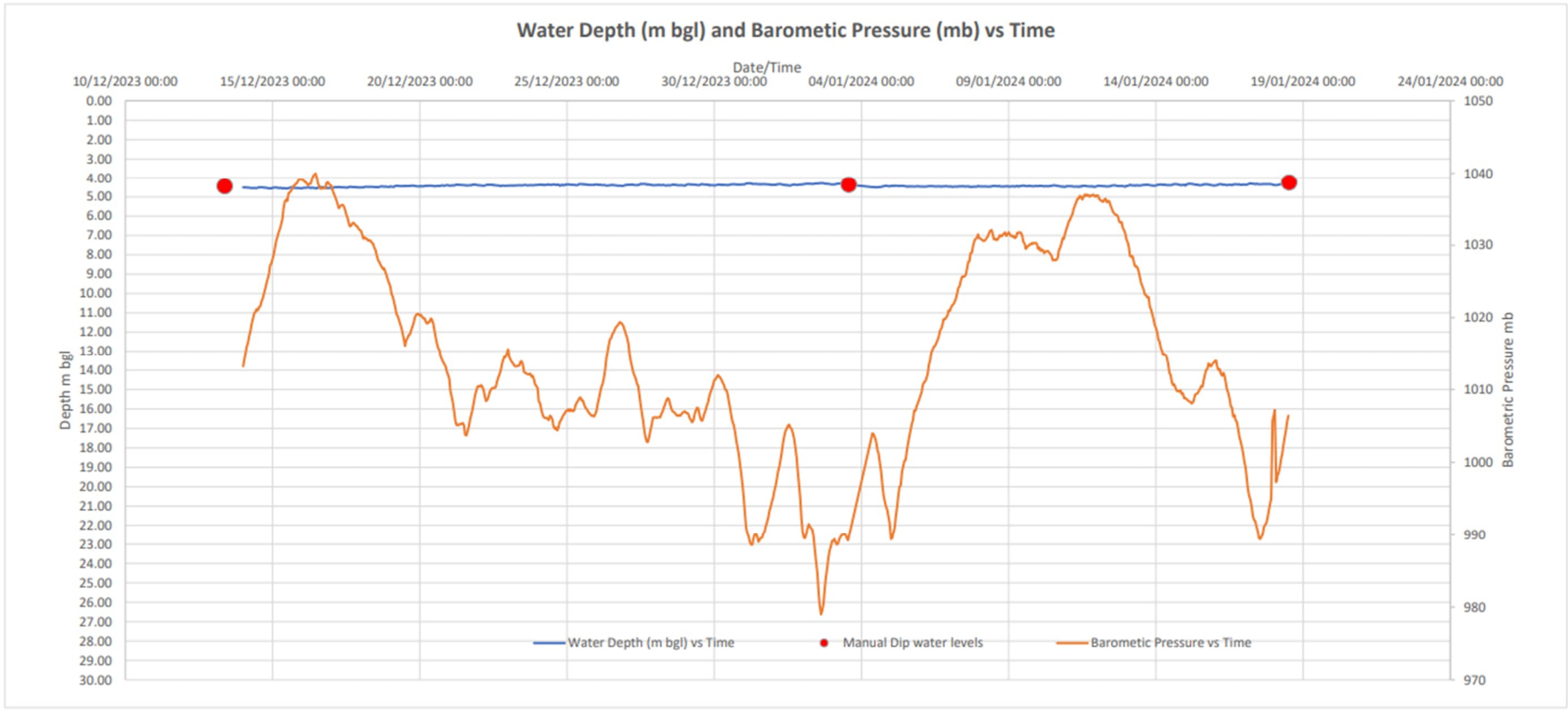


Figure 4.12: Automatic diver data logger measurements – R22-BH205

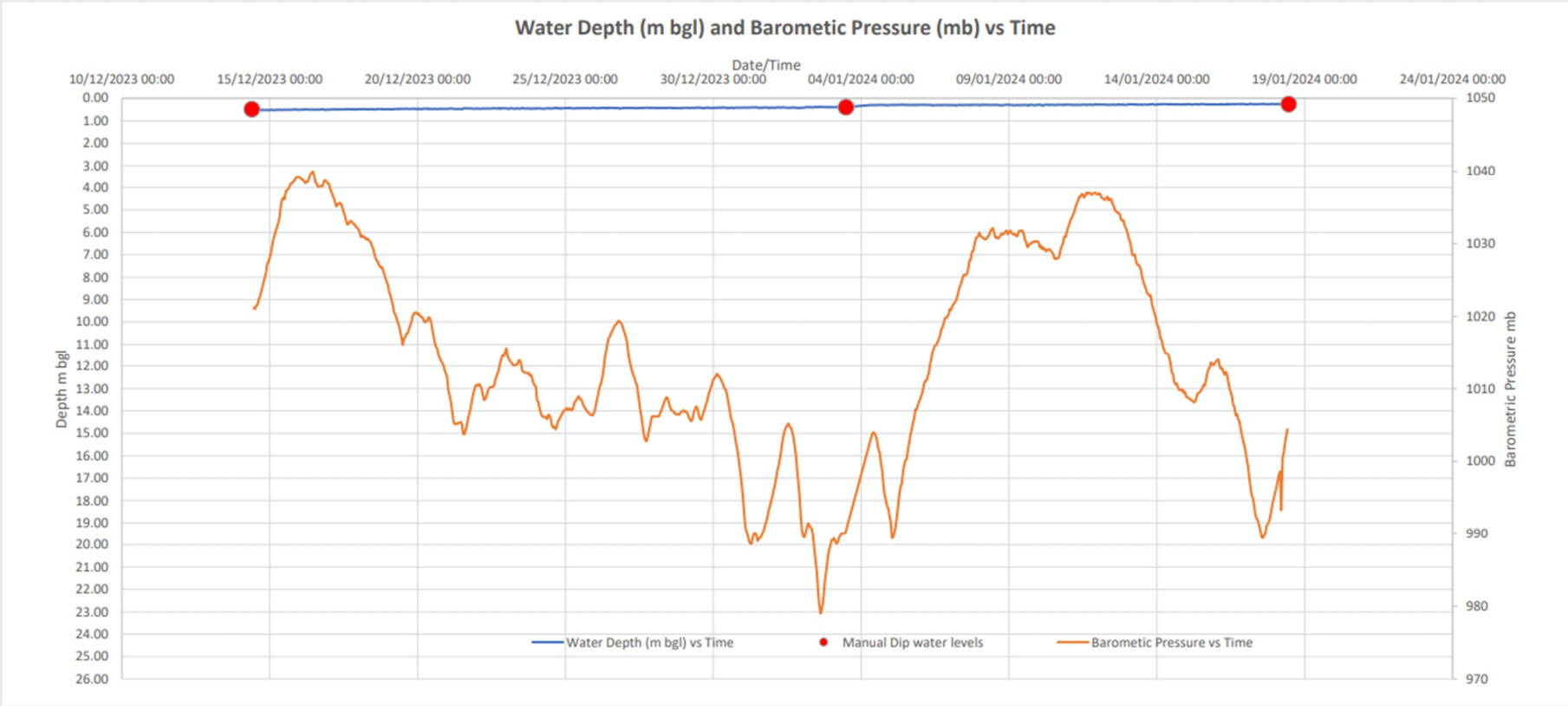


Figure 4.13: Automatic diver data logger measurements – R22-BH501

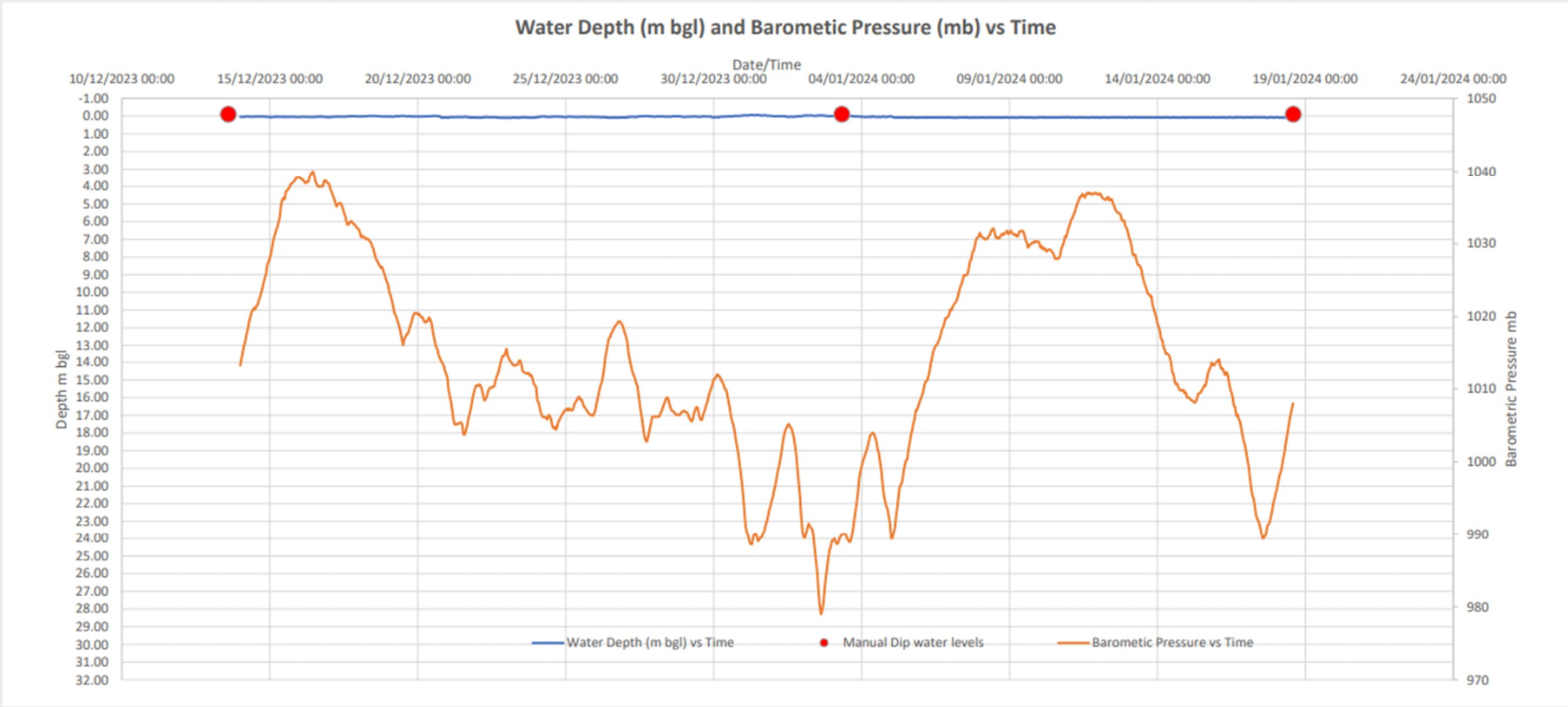
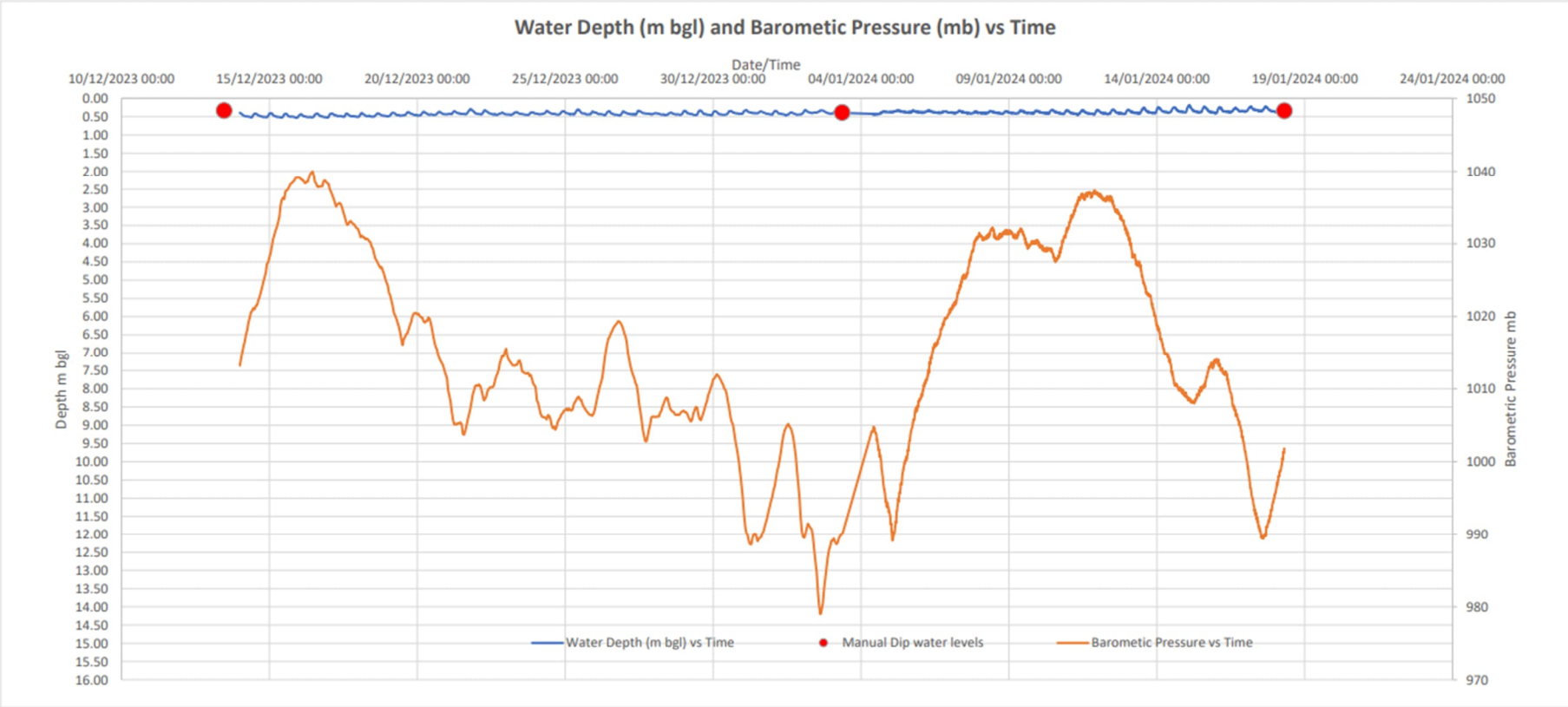


Figure 4.14: Automatic diver data logger measurements – RedP-BH-8



5 Ground conditions and material properties

This section of the report discusses the global geotechnical properties of the materials likely to be encountered on site. The assessment is based on the geological unit allocations identified at the time of the GI, but this may be subject to review and amendment during further stages of design and following the completion of any additional GI that may be undertaken. Information presented is shown with respect to metres below ground level (m bgl) and/or metres above ordnance datum (m AOD) where relevant.

5.1 Made Ground

Significant thicknesses of Made Ground were identified during the GI in the boreholes within the Stonelees and St Augustine's golf clubs, however, these areas are considered by Red Penguin as part of the landfall horizontal direction drill section and are not relevant to the onshore scheme presented in this report, therefore will not be discussed further here.

In R22-BH101, R22-BH203, R22-BH502 and the inspection pit for R22-CPT101, shallow Made Ground (between 0.3-0.9m thick) was identified, present as a silty sand, silty clay or sandy silt, with small amounts of gravel composed of flint, Chalk, and sandstone, as well as anthropogenic material such as brick, clinker, and ceramics. Owing to the agricultural nature of the land, the man-made materials will likely have been reworked into the ground by ploughing and drilling. This material is therefore interpreted to represent a reworked topsoil and will be further considered within Section 5.2.

5.2 Topsoil

The topsoil (including reworked topsoil, as above) encountered in exploratory holes varies in thickness across the site between 0.20 – 0.90m, however, in most locations it is between 0.20-0.50m, with an average thickness of 0.34m.

The material description was generally stiff to very stiff friable brown slightly gravelly slightly sandy to sandy silty CLAY or clayey SILT with rare to frequent rootlets and Chalk gravel.

Topsoil has not been assessed in detail from a geotechnical perspective as it is anticipated to be stripped during construction. Details of the limited in-situ and laboratory testing carried out on Topsoil is provided in the sections below.

5.2.1 Classification testing

Laboratory testing summarised in Table 5.1 indicates ~1-5% organic matter present within the topsoil with a single result reaching 10%, however, this is likely to change seasonally and year to year due to farming practices still ongoing in the agricultural fields. Following BS5930:2015+A1:2020, the topsoil can be classified as a soil with low to medium organic content.

Table 5.1: Topsoil – Summary of organic matter testing

Parameter	No. of tests	Minimum	Maximum	Average	Median
Organic matter content (%)	22	1.7	10.1	3.7	3.0

5.2.2 In-situ Testing – Hand vane

Fifteen in-situ hand vane tests were carried out on Topsoil and reworked topsoil across 4 no. boreholes. Results are summarised in Table 5.2. R22-BH102 and R22-BH205 both recorded relatively consistent peak results in the 152-216kPa range, with residual values around 60-70kPa. In contrast R22-BH104 recorded values of ~70-90kPa with no residual measurement given. This may indicate either operator error in recording only peak data, testing of material disturbed by hand pitting, or that the topsoil at R22-BH104 has been reworked/softened to close to residual strength for the material. It is noted that hand shear vane tests are indicative only and do not provide a direct measurement of undrained shear strength.

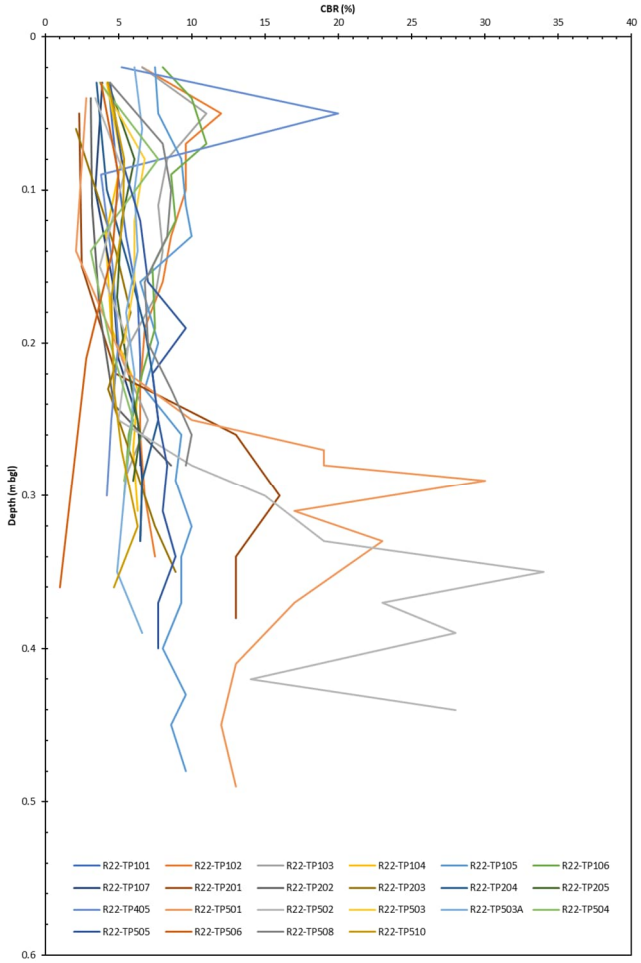
Table 5.2: Topsoil – Summary of in-situ vane testing

Parameter	No. of tests	Minimum	Maximum	Average	Median
Peak Shear Strength (kPa)	15	72	216	139	130
Residual Shear Strength (kPa)	6	56	76	66	64

5.2.3 In-Situ Testing – Dynamic Cone Penetrometer (DCP)

Twenty-two DCP tests were carried out during the GI adjacent to each trial pit. Based on the respective trial pit logs, all 22 tests encountered Topsoil. Figure 5.1 below presents the resulting profile of the California Bearing Ratio (CBR) at each location. CBR values within the Topsoil are generally between 2-10%. R22-TP506 records a decreasing trend reaching a minimum of 1% CBR at 0.36m depth. Three locations (R22-TP201, R22-TP501 and R22-TP502) record CBR values in excess of 10% from approximately 0.25m to 0.49m – in all of these locations the Topsoil overlies the Thanet Formation directly, therefore these are interpreted as representing the boundary between the Topsoil and Thanet Formation.

Figure 5.1: Topsoil – Dynamic Cone Penetrometer CBR Profile



5.3 Tidal Flat Deposits

Tidal Flat Deposits are encountered to the west and east of the A256 and absent beneath the topographic high of the A256 itself. The thickness present varies between 4.10-9.40m below ground level, with its distribution across the site presented in Section 4.2.

The unit is typically stiff to very stiff in the upper 1-2 metres, becoming softer with depth, and is grey mottled orange or yellow, becoming dark grey or bluish grey. It is dominantly a clay, with varying amounts of fine to medium sand, with occasional shells, shell fragments, decomposing organic matter or pockets of peat.

5.3.1 Classification testing

A summary of the soil classification testing undertaken on the Tidal Flat Deposits is presented in Table 5.3 below.

Table 5.3: Tidal Flat Deposits – Summary of classification testing

Parameter	No. of tests	Minimum	Maximum	Mean	Median
Moisture content (%)	162	6.4	160	47	47
Plastic limit (%)	111	19	47	30	30
Liquid limit (%)		37	108	66	67

Parameter	No. of tests	Minimum	Maximum	Mean	Median
Plasticity index I_p	109*	5	81	36	36
Consistency index (I_c)		-0.79	2.10	0.55	0.61
Bulk density (Mg/m^3)	36	1.33	2.13	1.80	1.82
Dry density (Mg/m^3)		0.73	1.83	1.23	1.25
Organic matter content (%)	47	0.2	20	1.9	0.9

* Of 111 liquid and plastic limit tests conducted on TFD samples, two were non-plastic (NP).

Moisture content within the Tidal Flat Deposits generally varies between approximately 20-80% throughout the depth range over which it is encountered, with several samples recording much greater moisture contents up to 160%, and a single sample recording 6.4% moisture (Figure 5.2). The upper metre of the unit shows a slightly increasing trend with depth, likely due to the groundwater level across the site and is possibly indicative of a desiccated crust at the top of the unit. The samples which record much greater moisture contents are noted in the laboratory description as peaty / containing wood / decayed plant matter which is likely to be responsible for the results observed. These may infer a zone of higher organic content, or presence of discontinuous beds of more organic rich material. An organic odour was noted on the material description from a depth of 4m bgl with an organic matter content test carried out at a depth of 4m bgl recorded a value of 2.2%.

Figure 5.4 shows a relatively consistent bulk and dry density across the range of the unit, with two possible outliers (circled red). Lower dry densities correlate to materials of greater moisture and organic content including presence of localised peat, and the result with a greater bulk density crossed a strata boundary between Tidal Flat Deposits and Chalk, and is not considered representative and should therefore be treated with caution.

The A-line plot of plasticity index against liquid limit for the Tidal Flat Deposits (Figure 5.7) shows a relatively wide spread of results, with most samples being identified as a high to very high plasticity clay or silt. A reasonable number of samples sit below the A-line, suggesting silt behaviour. The engineering logs predominantly describe the material as a silty clay which only locally tends to clayey silt, with the results suggesting this could be more prevalent than inferred from the engineering log descriptions. One sample was identified to be extremely high plasticity, and one sample was recorded as a low plasticity silt, with the presence of peat recorded in the laboratory engineering description which may help explain this result.

Consistency index (I_c) values have been derived for the Tidal Flat Deposits (as per guidance in BS EN ISO 14688-2:2018). Ic has been plotted against level in Figure 5.6 and generally ranges between -0.5 and 1.4 although in all ranges between -0.79 to 2.10. This indicates that the unit displays both liquid and all stages (very soft to very stiff) of plastic behaviour and this may suggest sensitive soils are present, where samples organic content is influencing their behaviour (negative consistency index).

Organic matter content tests within the Tidal Flat Deposits show a wide range of soil types, classifying it from an inorganic to high-organic soil. The majority of results place it as an inorganic soil, with localised pockets of organic matter, consistent with log descriptions with identified pockets of peat/decaying wood at various levels. This correlates with results discussed above in relation to moisture content / consistency index data.

Figure 5.2: Tidal Flat Deposits – Moisture content versus level

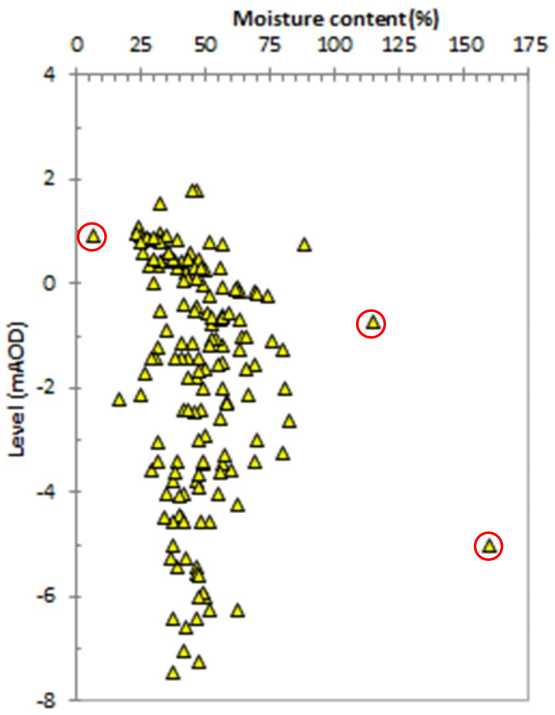


Figure 5.3: Tidal Flat Deposits – Liquid limit, plastic limit, and moisture content versus level

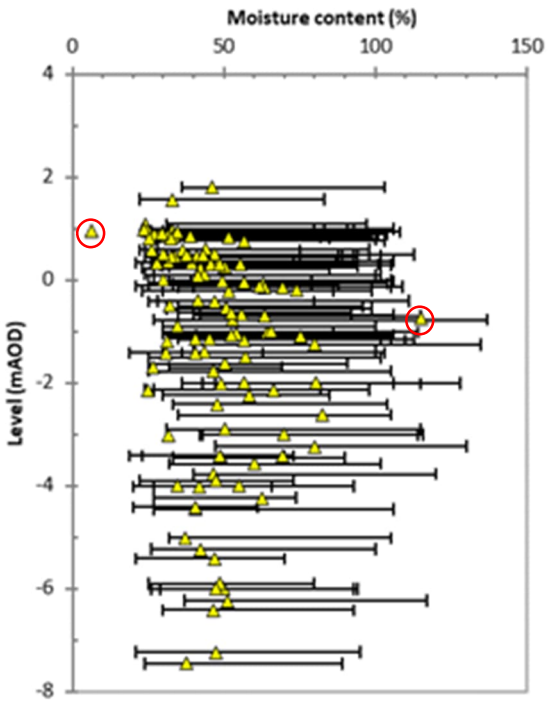


Figure 5.4: Tidal Flat Deposits – Density versus level

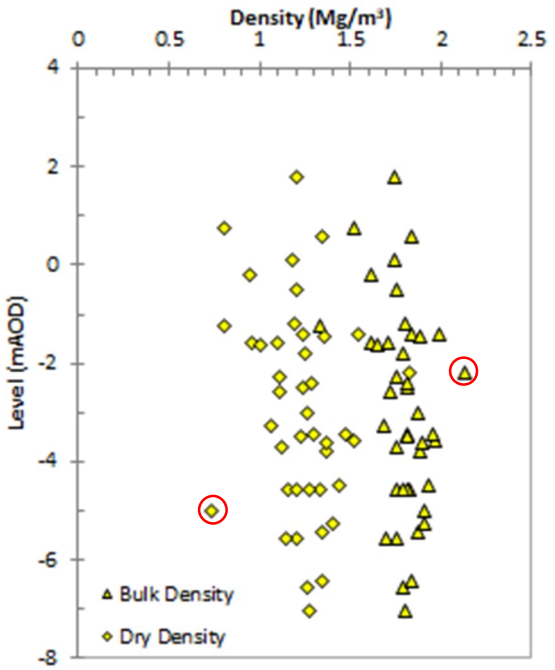


Figure 5.5: Tidal Flat Deposits – Plasticity index versus level

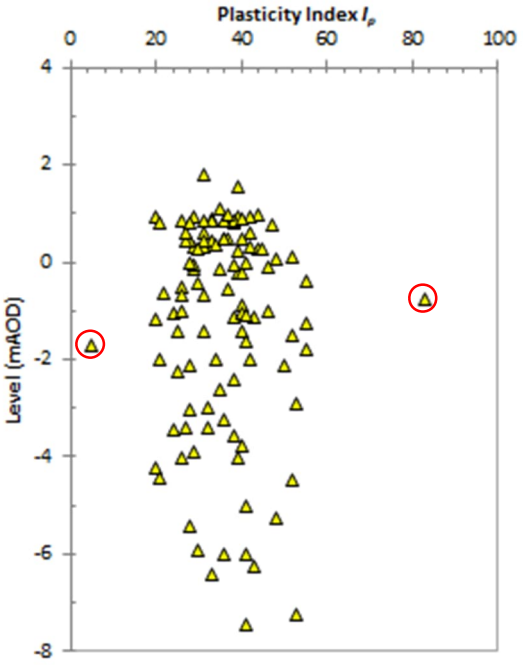


Figure 5.6: Tidal Flat Deposits – Consistency index versus level

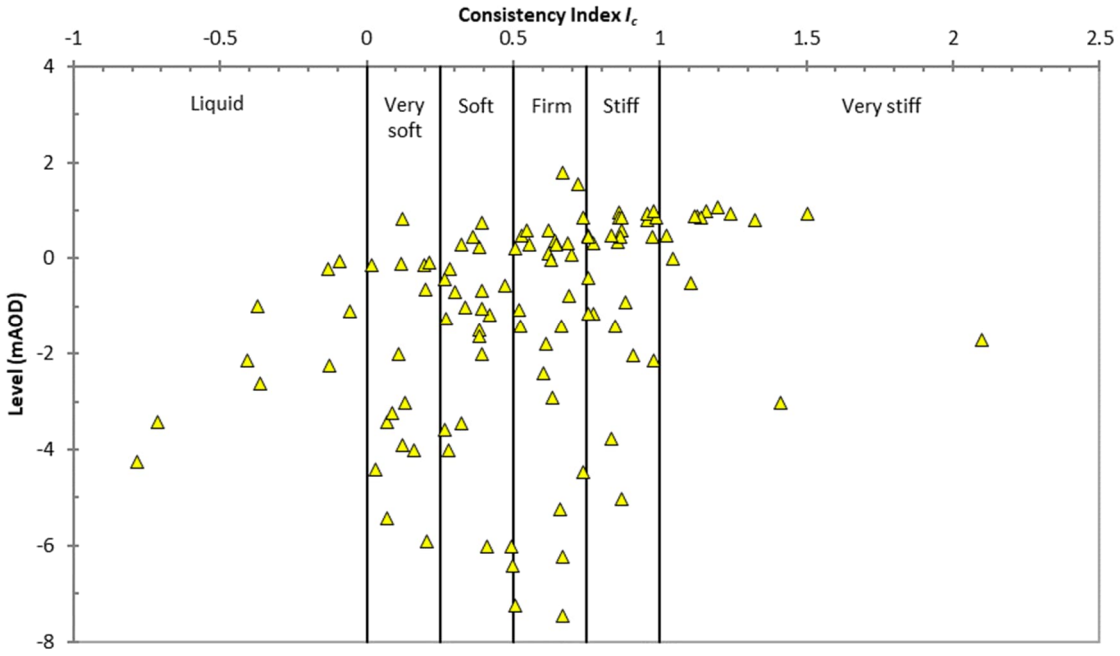
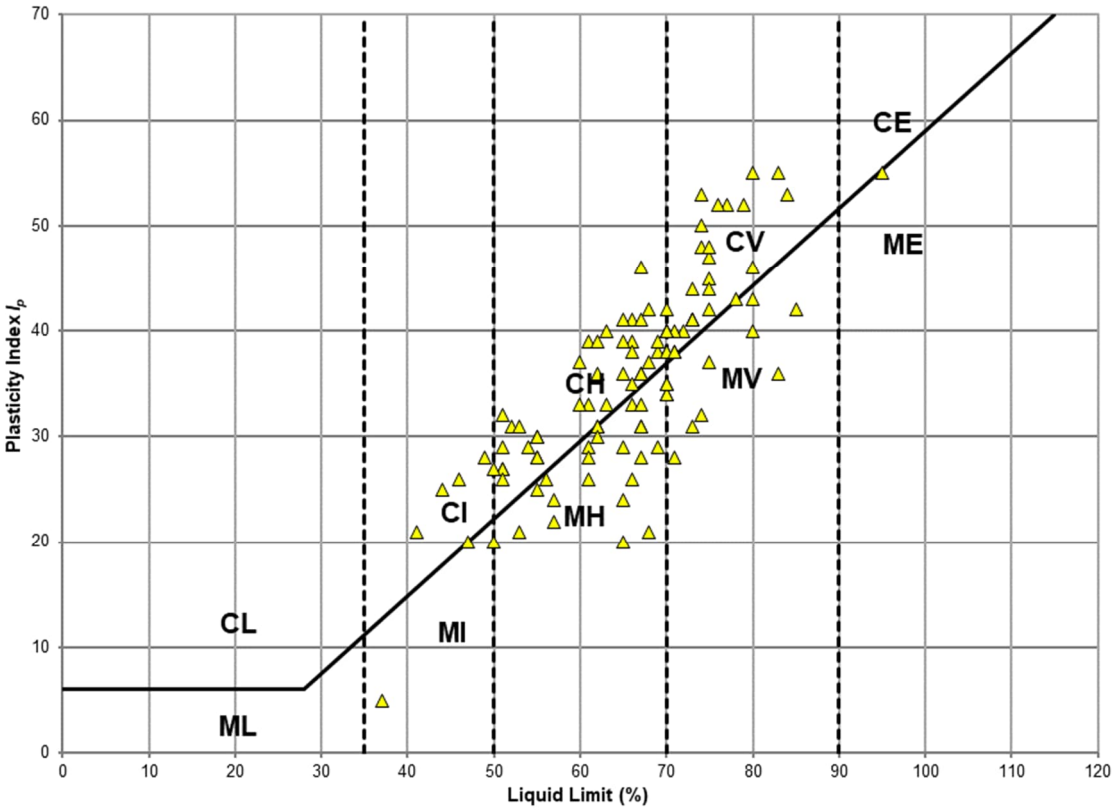


Figure 5.7: Tidal Flat Deposits – A-Line Plot

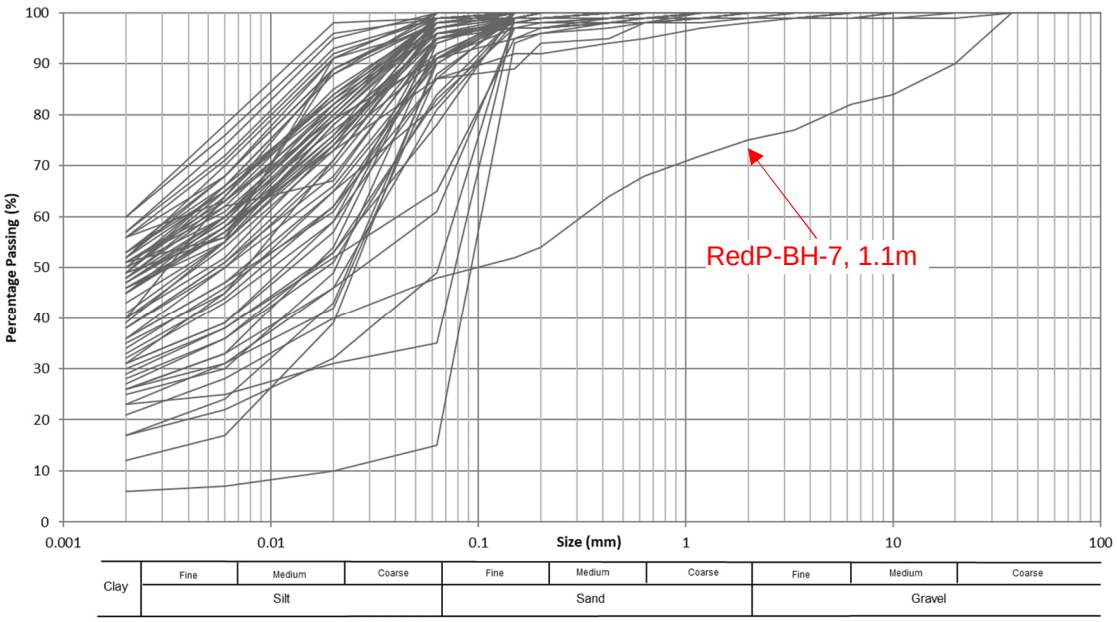


Seventy-two particle size distribution tests were carried out on samples of the Tidal Flat Deposits. These are plotted in Figure 5.8 and show that the vast majority of samples tested were a slightly sandy silty CLAY or clayey SILT with trace fine to coarse gravel content. This broadly correlates with the engineering log descriptions of the material.

Five samples show a higher proportion of material on the boundary of coarse silt/fine sand and would be described as a slightly clayey sandy SILT. These samples are all from within the upper 3.5m depth of locations in the area of the proposed converter station and are probably representative of historic storm or flooding events, depositing a slightly coarser average grain size material during the deposition of the Tidal Flat Deposits.

A single sample, from 1.1m depth in RedP-BH-7, shows a well graded profile with similar proportions of clay, silt, sand and gravel. This location is close to the present-day coastline, and in an area mapped by the BGS as “Beach and Tidal Flat Deposits – Undifferentiated” and therefore likely represents sediment from a beach environment, where the higher energy enables the transport and deposition of a wider range of grain sizes. Since this location is well outside the area of the onshore scheme, it is not deemed to be significant and will not be discussed further.

Figure 5.8: Tidal Flat Deposits – Particle Size Distribution Curves



5.3.2 In-situ testing – SPTs

Table 5.4 and Figure 5.9 summarise the results of the Standard Penetration Tests (SPTs) carried out in the Tidal Flat Deposits.

Nineteen Standard Penetration Tests (SPTs) were undertaken in accordance with BS EN ISO 22476-3: 2005(+A1:2011). SPT Hammer Energy Test Reports have been provided by the Contractor, hence raw 'N' values have been converted to N_{60} values. It is noted that through much of the Tidal Flat Deposits it was not possible to undertake SPTs due to the soft nature of the material resulting in the test rods sinking under their own weight, therefore there is only a limited data set within this unit of tests undertaken within 'stiffer' material and are therefore not representative of the unit as a whole.

Undrained shear strength has been calculated from the SPT N_{60} values, using the Stroud & Butler (1975) correlation presented below. An f1 value of 4.2 was used, based on the correlation with a conservative plasticity index for the Tidal Flat Deposits of 55.

$$C_u = f_1 * N_{60}$$

Six SPTs recorded a value of N=0, due to self-weight penetration of the SPT sampler through the soft clay materials – these tests have been included in plots and calculations as a conservative measure, although it is noted that a resulting shear strength of 0kPa is an underestimate of the actual strength (these results are not presented in Figure 6.10) as the SPT test was not sensitive enough to measure the shear strength of the deposits. As shown in the moisture content results, the shallow SPT profile indicates the presence of a desiccated crust with SPT N values decreasing within the top 1 – 2m bgl.

Table 5.4: Tidal Flat Deposits – Summary of SPT results

Parameter	Number of tests	Minimum	Maximum	Mean	Median
SPT N Value	19	0	20	8	3
SPT N_{60} Value	19	0	24	6	3

Parameter	Number of tests	Minimum	Maximum	Mean	Median
Undrained Shear Strength (kPa) from SPT N_{60} Values	19	0	102	24	14

Figure 5.9: Tidal Flat Deposits – SPT N_{60} versus level

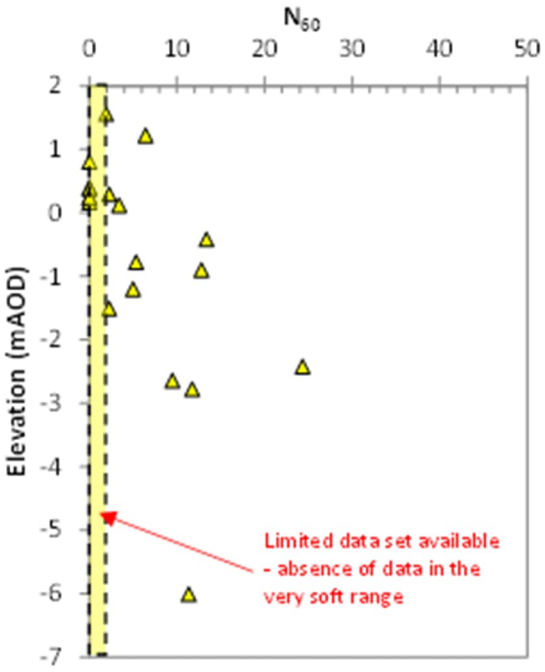
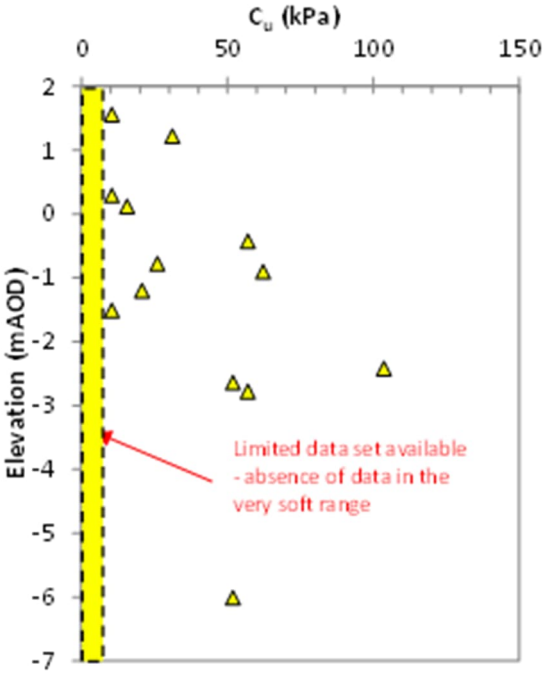


Figure 5.10: Tidal Flat Deposits – SPT derived Cu versus level



5.3.3 In-situ testing – Permeability

Three head permeability tests were conducted within the Tidal Flat Deposits, comprising one rising head and two falling head tests. Test parameters and results are summarised in Table 5.5. Permeability tests were carried out to BS EN ISO 22282-2:2012, and results were all calculated by the Contractor using the Hvorslev method. Two further tests were undertaken where no standing groundwater level was present as borehole soakaway tests in line with the approach given in BRE Digest 365. In both cases there was no drop in water level recorded therefore calculation of infiltration was not possible.

Table 5.5: Tidal Flat Deposits – Summary of Permeability Testing

Location ID	Date of Test	Depth of Response Zone (m)	Permeability (m/s)	Test Type
R22-BH101	05/10/2023	1.20-1.70	-	Borehole soakaway – non-standard
R22-BH103	18/10/2023	3.00-4.00	-	Borehole soakaway – non-standard
R22-BH103	18/10/2023	5.00-6.00	1.2*10-5	Rising head
R22-BH105	28/09/2023	2.00-2.60	3.2*10-6	Falling head
R22-BH105	28/09/2023	3.80-6.10	2.4*10-7	Falling head

5.3.4 In-situ testing – Soil infiltration rate

One soil infiltration test (soakaway test) was conducted within the Tidal Flat Deposits. The test was carried out following the BRE Digest 365 guidance, using the trial pit R22-TP105. Following the excavation and logging of the trial pit a test depth of 1.60m below ground level was chosen and a new pit was dug for the test. Utilising a water bowser and pump the pit was filled with water to approximately 0.5m bgl and monitored over a period of three hours. During the test negligible drawdown was achieved meaning it was not possible to calculate a soil infiltration rate, and the recommended second and third tests were abandoned.

5.3.5 In-situ testing – Dynamic Cone Penetrometer (DCP)

Of the 22 DCP tests carried out during the GI adjacent to each trial pit, 17 have been determined to have encountered the Tidal Flat Deposits, based on a review of the log from the associated trial pits. Figure 5.11 below presents the resulting profile of the California Bearing Ratio (CBR) at each location. CBR values within the Tidal Flat Deposits are quite variable ranging between 1-19% across the depth range of 0.24-2.04m below ground level. A general trend is apparent, with CBR values from ~5-8% at the base of the topsoil trending downwards to a low of ~1-4% around 1m depth, before increasing towards ~7-14% at around 1.5m depth. This indicates the presence of a desiccated crust along with the decreasing trend shown in the moisture content and SPT N values. Only a single test, at R22-TP508, achieved penetration greater than 1.56m.

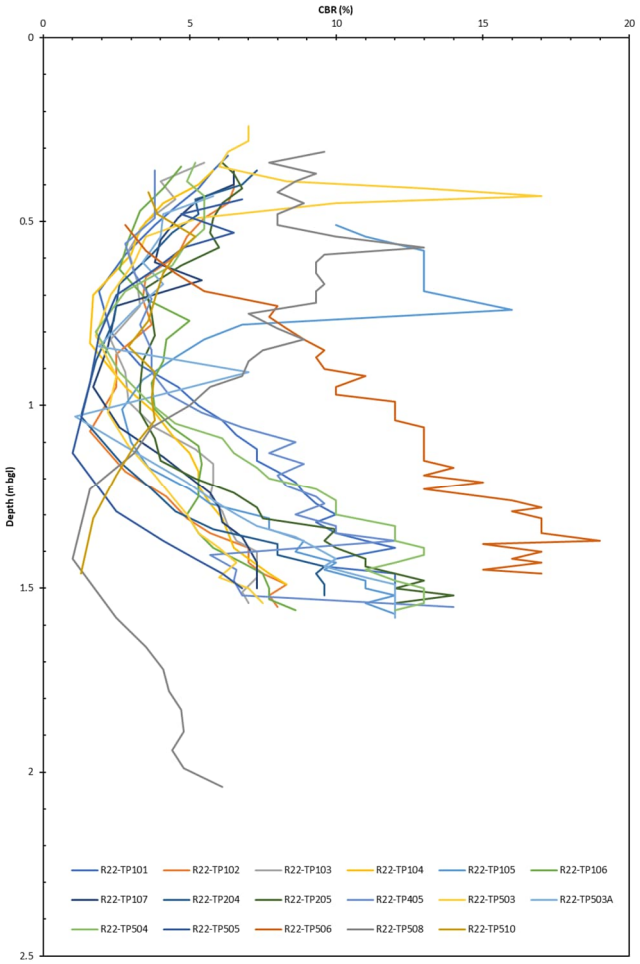
Five tests deviate from the trend described above, and are described below:

- R22-TP105 and R22-TP503 both show a significant spike at 0.74m and 0.43m depth respectively reaching peaks of 16% and 17% CBR. This is likely caused by the presence of a gravel or cobble which was subsequently pushed out of the way of the penetrometer cone. These tests otherwise follow the trend above.
- R22 TP508 begins at ~10% at the base of the topsoil, recording a CBR greater than the trend, decreasing to 1% at 1.42m below ground level. It then shows an increase to 6.1% at its termination depth of 2.04m. Therefore this test shows a stiffer profile to around 1m bgl compared to the other tests followed by a softer profile below 1m bgl to a greater termination depth compared to the other tests.
- R22-TP506 is characterised by deep topsoil of 0.5m thickness, and a steadily rising CBR from 2.8% at 0.5m to 19% at 1.37m.
- R22-TP510 initially follows the general trend, however from 1m it steadily decreases to a minimum of 1.3% CBR at 1.46m where it terminated.

A conservative long-term equilibrium CBR has also been determined based on LR1132, CD225, engineering log descriptions and PSD / Atterberg limit test results. Applying a conservative plasticity value for the Tidal Flat Deposits of 55, LR1132 suggests a long term CBR of 2% may be achievable in poor conditions (assumed due to presence of slow surface water drainage and cohesive, low-permeability strata present at surface level).

In the short-term construction scenario, a CBR of 1% may be achievable in wet conditions.

Figure 5.11: Tidal Flat Deposits – Dynamic Cone Penetrometer CBR Profile



5.3.6 In-situ Cone Penetration Testing (CPT)

Cone Penetration Tests (CPTs) were completed at a number of locations as part of the ground investigation, with the majority of CPT locations being co-located with an adjacent borehole (refer to exploratory hole plan in Section 4).

Results from CPTs can be converted to an undrained shear strength, using the following equation:

$$s_u = \frac{q_c - \sigma_{vo}}{N_k}$$

Where q_c is the corrected cone-tip resistance, σ_{vo} is in-situ effective stress, and N_k is an empirical cone factor related to engineering properties of the soil, and a value of 20 has been utilised for this material.

Figure 5.12 presents the CPT undrained shear strength determined using the above calculation versus level for the tests completed within the Tidal Flat Deposits. Data is only presented below 1.2m bgl, due to hand-dug inspection pits being undertaken prior to probing.

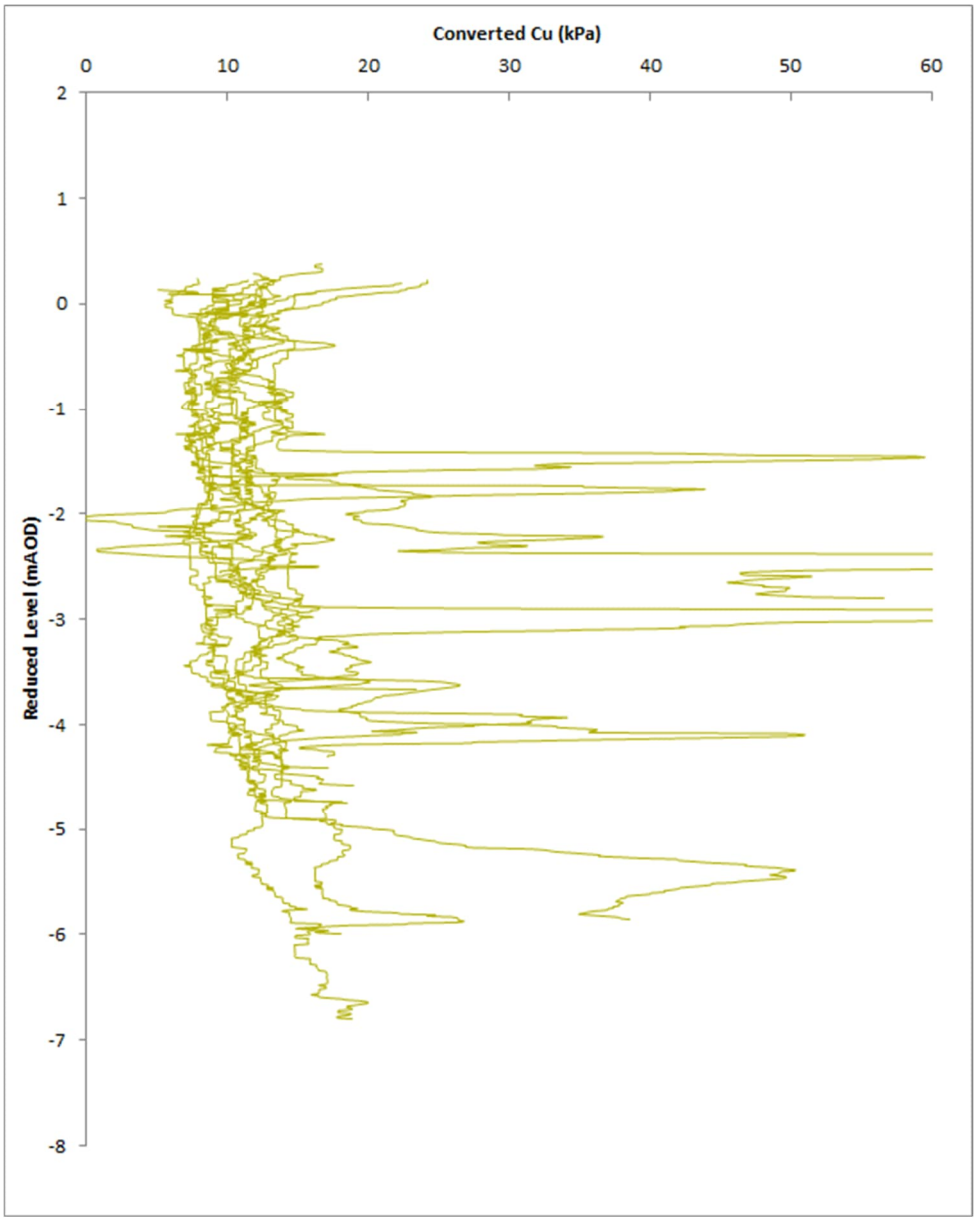
At the top of the unit, reductions in strength are noted which appear to correlate with other in-situ testing and the engineering log descriptions, suggesting the presence of a desiccated crust present to c. 0m AOD. Results below 1.0m AOD suggest a very loose trend of increasing undrained shear strength with depth overall, with most testing suggesting undrained shear

strengths between 6kPa increasing to 15kPa. A localised soft spot was recorded at c. -2m AOD in CPT108, and appears to correlate with a drop in pore pressure suggesting variations in the material, however no co-located borehole was available to review.

Several tests record sharp increases or 'spikes' in data below -1m AOD, where undrained shear strength sharply increases. These appear to correlate with increased granular content, presence of organic materials/shell fragments, and/or increases in consistency noted on the engineering logs, although should be treated with caution due to reflecting localised beds only. In several instances, these are noted towards the base of the deposit at its contact with the underlying Thanet Formation and may be associated with an increase in sand content from review of the engineering logs.

To view all undrained shear strength data together, CPT data has been included alongside other in-situ and laboratory test measurements of undrained shear strength in Figure 5.17 and appears to broadly correlate with observations from the other methods.

Figure 5.12: Tidal Flat Deposits – CPT undrained shear strength versus reduced level



5.3.6.1 Dissipation testing

Dissipation tests were completed in a select number of locations as part of the CPT testing, to derive the horizontal coefficient of consolidation where sufficient information was available to determine the t_x (time taken to achieve a given percentage of degree of dissipation – this varied per test but was generally 50%), as well as having enough information available to enable choice of a suitable T_{50}. The coefficient of consolidation was estimated using the following equation:

$$c = \frac{T_{50}}{t_{50}} r_0^2$$

(Whereby T_{50} is theoretical time factor, t_x is measured time for 'X'% degree of dissipation, and r_0 is penetrometer radius).

A summary of the dissipation test results is presented in Table 5.6. Tests in most instances were undertaken to t_{50}. A large range in the vertical and horizontal coefficient of consolidation is recorded suggesting variable permeability and consolidation characteristics associated with this material. One test in R22-CPT104 dissipated to 50% excess pore pressure within 5 seconds, suggesting material at this test location behaves in a semi-drained manner. Although no distinguishing features are noted on the engineering log around this depth, the CPT data suggests a spike in cone resistance around this depth which is suggestive of encountering a sandier / more permeable bed within the deposit.

Table 5.6: Tidal Flat Deposits – Summary of dissipation testing

Hole ID	Depth (m bgl)	Vertical Coefficient of Consolidation, c_v (m2/yr)	Horizontal Coefficient of Consolidation, c_v (m2/yr)	Remarks
CPT101	2.54	1.93	2.42	30% dissipation reached
CPT102	1.90	13.6	17	50% dissipation reached
CPT102	6.30	41.5	51.9	50% dissipation reached
CPT103	2.85	6.5	8.1	50% dissipation reached
CPT104	3.92		4220	50% dissipation reached. Quick dissipation – t_{50} = 5s
CPT105	2.96	123	153	30% dissipation reached
CPT106	2.48	3	3.7	40% dissipation reached
CPT107	4.39			Insufficient dissipation to report test results
CPT108	2.94	53.4	66.7	50% dissipation reached
CPT109	3.40	58.4	73	50% dissipation reached
CPT110	4.30	-	-	No test result included
CPT111	2.32	7.5	9.4	50% dissipation reached

5.3.7 Undrained shear strength (c_u) testing

Multiple types of shear strength testing have been undertaken within the Tidal Flat Deposits. The results of each are summarised in Table 5.7 below and individually plotted as figures in this section. Figure 5.17 presents a comparison of shear strength data within this unit, with CPT data also included within Section 5.3.6 and Figure 5.12 above.

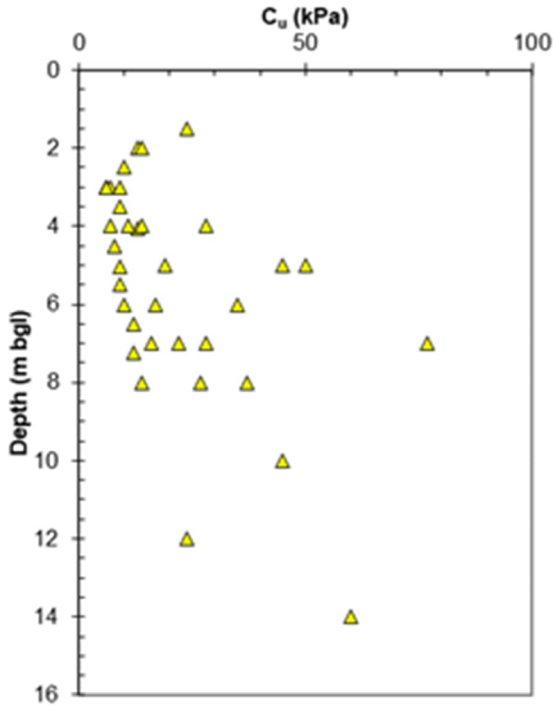
Table 5.7: Tidal Flat Deposits – Summary of Shear Strength Data

Test Type	Number of tests	c_u (kPa)			
		Minimum	Maximum	Mean	Median
UUT	36	6	77	20.9	14
In-situ Hand Vane (peak)*	273	12	244	95	88
In-situ hand vane (residual)*	153	4	84	30	30
Laboratory Vane (peak)	4	9	29	17	16
Laboratory Vane (residual)	4	3	13	7	5

*In-situ hand vane tests provide an indicative value on undrained shear strength only, and are not relied upon compared to other methods of measurement

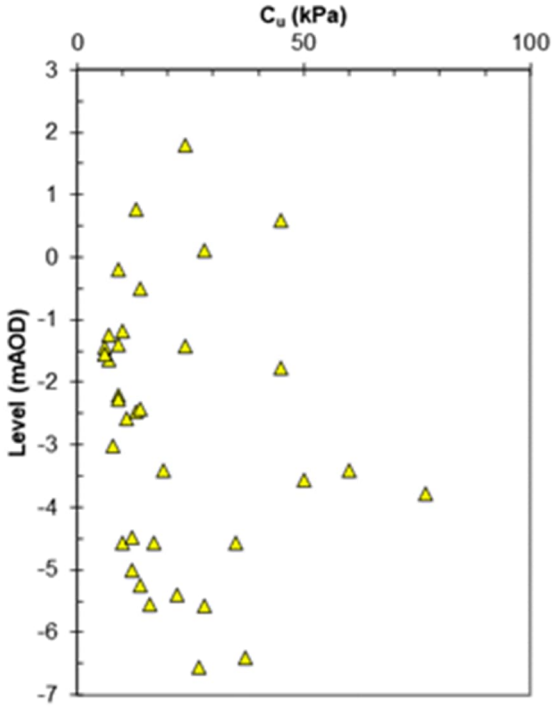
Thirty-six unconsolidated undrained triaxial (UUT) tests were carried out on UT samples of the Tidal Flat Deposits, and a further eight consolidated undrained triaxial tests were carried out. The results are plotted in Figure 5.13 and Figure 5.14 below. The data by depth shows an initial small decrease in shear strength between 1-3m, before a moderate increase in shear strength with depth to 8m below ground level. These trends are primarily a function of the overlying ground cover, in-situ stress changes with depth, and drying/desiccation of shallow materials, as they are more subtle when the data is compared by level (Figure 5.14). It is noted that 21 of the 36 UUT samples failed flatness and/ or perpendicularity checks which may have influenced the test results in these instances.

Figure 5.13: Tidal Flat Deposits – Undrained Shear Strength from UUT testing by Depth



Source: <Insert Notes or Source>

Figure 5.14: Tidal Flat Deposits – Undrained Shear Strength from UUT testing by Level



Source: <Insert Notes or Source>

Two hundred and seventy-three hand vane tests were carried out in-situ, within the trial pits and the borehole and CPT inspection pits in the Tidal Flat Deposits. A further four tests were conducted using a laboratory vane on UT samples recovered from boreholes. The results are plotted in Figure 5.15 and Figure 5.16 below. The results show a generally elevated peak shear strength with a wide range of between 60 and 250kPa at shallow depth, around +1mAOD, rapidly dropping to approximately 10kPa by 0mOD. The residual strength is similarly elevated (albeit with a large range of 10-85kPa) dropping to less than 10kPa beyond 0mAOD. This is indicative of a higher strength desiccated crust near-surface, likely caused by drying out and compaction from agricultural vehicles, as is also indicated by similar trends in results of moisture content, DCP and SPT tests. While only a small quantity of lab vane tests were conducted, the results closely match those from the in-situ hand vane tests.

Figure 5.15: Tidal Flat Deposits – Peak Shear Strength from Lab and Hand Vane testing

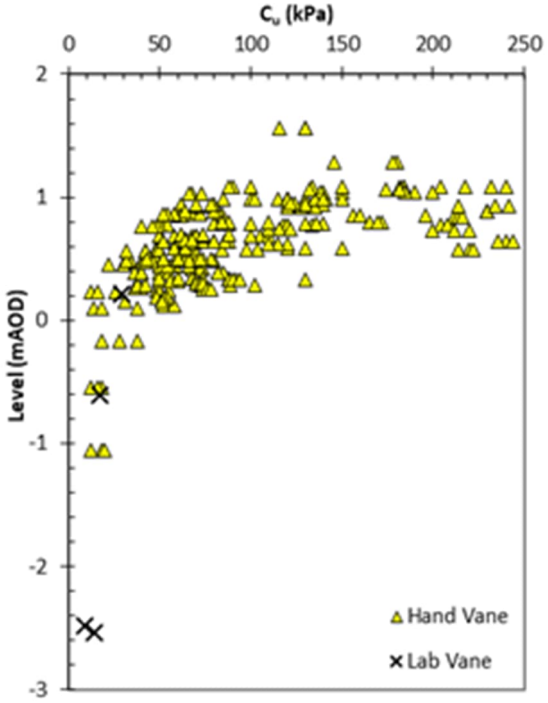


Figure 5.16: Tidal Flat Deposits – Residual Shear Strength from Lab and Hand Vane testing

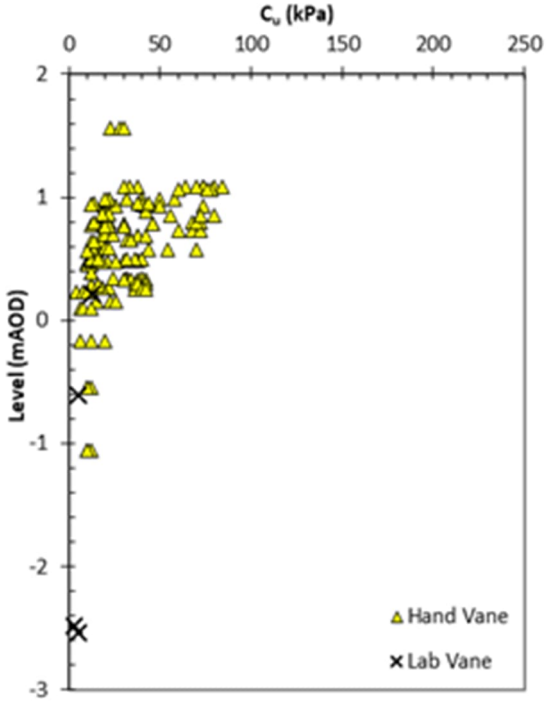
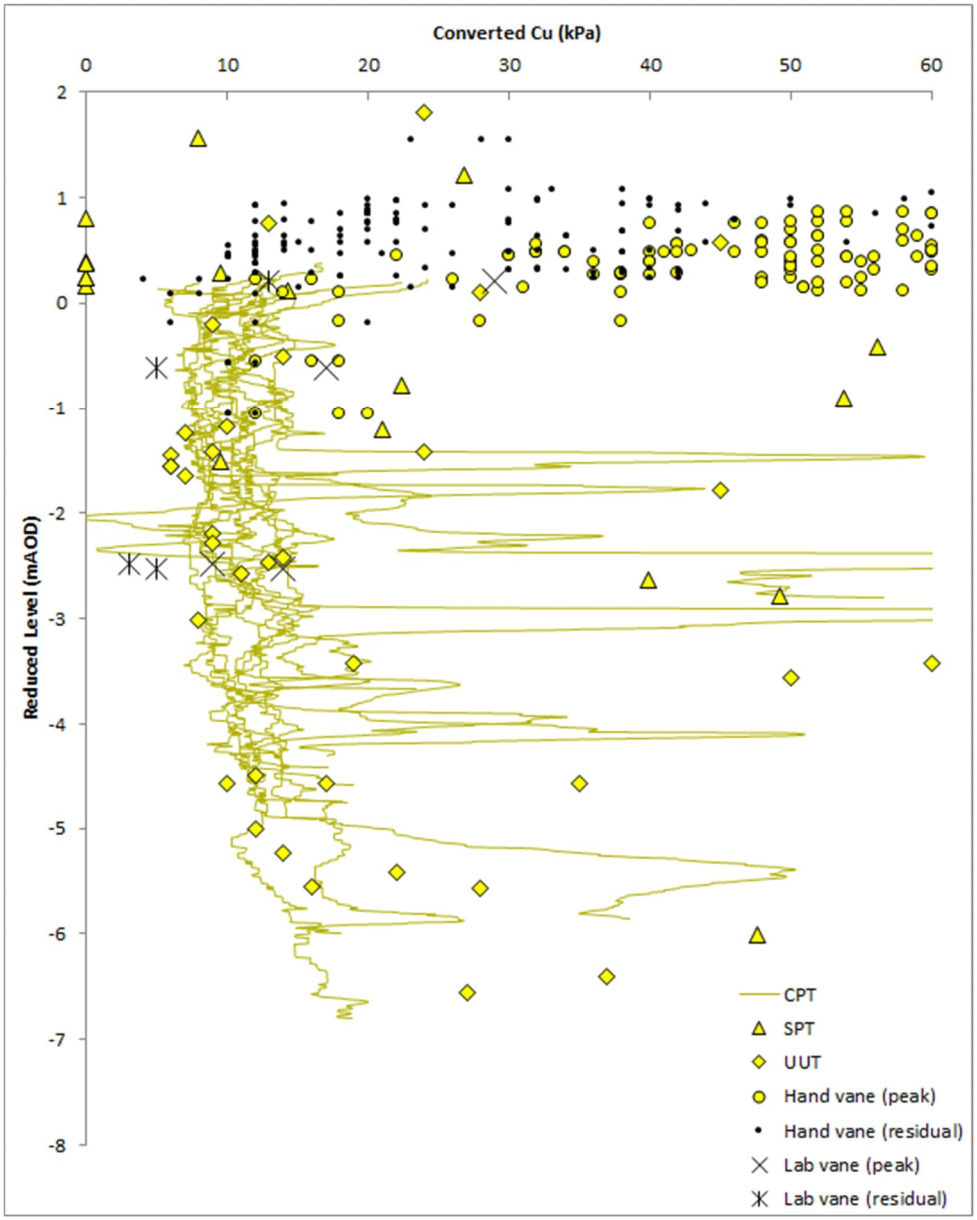


Figure 5.17 below presents a comparison of the undrained shear strength testing carried out across the site in the Tidal Flat Deposits. The data is presented by depth, since as previously mentioned the near-surface hydrogeological conditions and in-situ stress from overlying ground are dependent on the depth, rather than being related to stratigraphy (which would be revealed by plotting by elevation). The overall picture is indicative of a high strength, albeit variable, near-surface layer, overlying a very soft unit with a subsequent minor increase in strength with depth. More localised increases in strength are observed within CPT testing, which may suggest local variability within the unit as discussed in Section 5.3.1 which are likely to relate to granular content and presence of organic materials.

Figure 5.17: Tidal Flat Deposits – Comparison of Undrained Shear Strength (Cu) for all data sources by depth



5.3.8 Effective stress testing

5.3.8.1 Shear box testing

Eight direct shear tests were carried out on bulk samples of the Tidal Flat Deposits in accordance with BS EN ISO 17892-10:2018. All tests were conducted using a small (60mm x 60mm) shear box, on a remoulded specimen from the bulk sample. Remoulding was undertaken to natural moisture content with heavy tamping by hand. The results of these tests are summarised in Table 5.8 below.

Table 5.8: Tidal Flat Deposits – Summary of shear box testing

Hole ID	Depth (m bgl)	Normal stress increments, σ (kPa)	Peak angle of friction, ϕ' (°)	Cohesion intercept, c' (kPa)	Residual angle of friction, ϕ'_r (kPa)	Residual cohesion intercept, c'_r (kPa)
R22-BH103	5.6	56, 112, 224	28	33	29.5	13
R22-BH105	2.6	20, 40, 80	28	4	28	2
R22-BH106A	1.8	15, 30, 60	28	2	23	4
R22-BH106A	5.6	38, 75, 150	37.5	6	35.5	0
R22-BH205	3.5	35, 70, 140	31	6	27.5	9
R22-BH501	3.5	35, 70, 140	24.5	4	20	7
R22-BH502	3.5	35, 70, 140	28.5	4	24.5	6
R22-BH502	9.5	95, 190, 380	29	10	30	7

The overall results show a peak angle of friction between 24.5-37.5°, with a peak cohesion between 2-33kPa, however two results, one with an angle of friction of 37.5° and another with a cohesion of 33kPa are anomalous. These specimens (R22-BH103 5.6m and R22-BH106A 5.6m) were described in the lab as a slightly gravelly silty CLAY, and a slightly gravelly slightly sandy silty CLAY respectively. The elevated values could therefore be a result of gravel contained within the specimen producing higher strength parameters than the bulk clay matrix.

5.3.8.2 Consolidated Undrained Triaxial (CUT) testing

Six single stage consolidated undrained triaxial tests were also conducted on undisturbed samples of the Tidal Flat Deposits.

To allow comparison of the effective stress tests conducted, the t' and s' were calculated for each test, using the following equations:

$$t' \frac{\sigma_1 - \sigma_3}{2}, \text{ and } s' \frac{\sigma_1 + \sigma_3}{2}$$

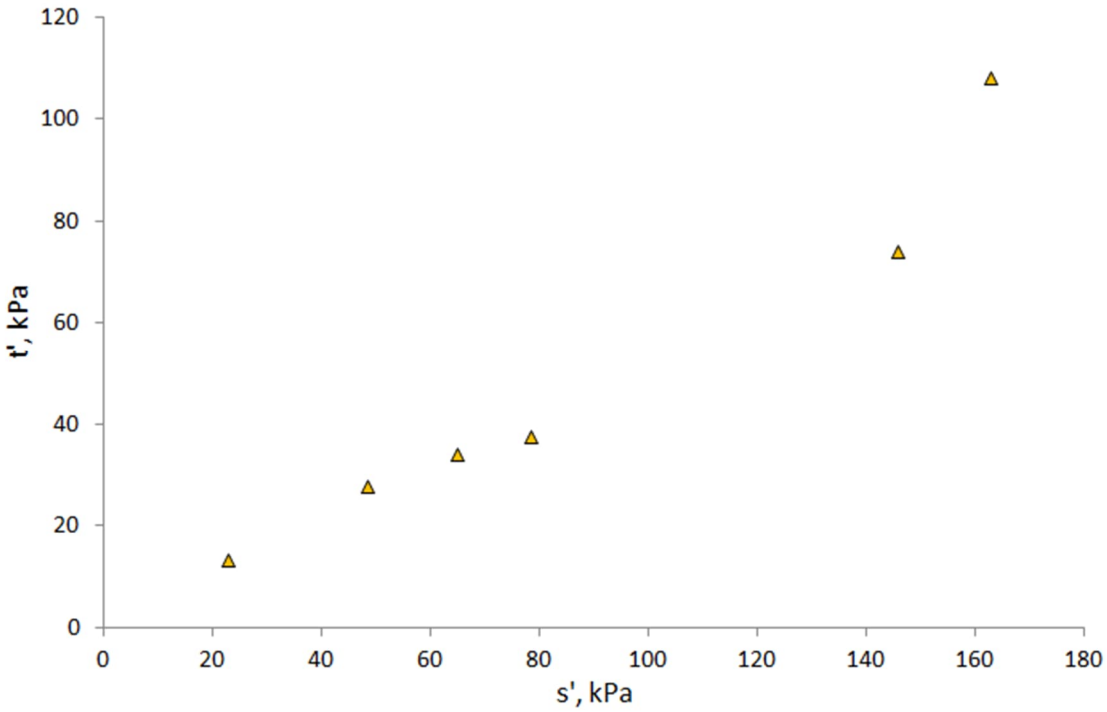
The results in Figure 5.18 show a generally good correlation, with four out of six tests indicating that assuming a cohesion of 0kPa, an effective angle of shearing resistance of approximately 29 degrees is calculated.

BS 8004 allows the calculation of the effective angle of shearing at critical state, using the characteristic plasticity index and the formula below (for plasticity indexes between 5-100%):

$$\varphi_{cv,k} = (42° - \log_{10} I_p)$$

The above equation, utilising a conservative plasticity index value of 55, results in a $\varphi_{cv,k}$ of 20.2°. The results of the CUT testing should present a reasonably higher angle of shearing resistance, which may be slightly greater than typically expected for this material. This may be as a result of secondary and tertiary components in the soil, as all of the engineering descriptions are slightly sandy, and some contain shell fragments or organic matter/peat. However, the relationship presented in BS 8004 is conservative, and the properties of the material are likely to range between the values discussed above. This is discussed further in Section 7.

Figure 5.18: Tidal Flat Deposits – CUT t' versus s' plot



5.3.9 Consolidation testing

Eight one-dimensional consolidation tests were undertaken within the Tidal Flat Deposits to measure the compressibility and consolidation coefficients in the area around the converter station / substation site.

The resultant coefficients of volume compressibility and consolidation are plotted on Figure 5.19 and Figure 5.20 respectively.

The coefficient of volume compressibility data is relatively well constrained. Meanwhile the coefficient of consolidation data shows a wide range of results with some anomalies, such as the sample from R22-BH501, which shows an increase in the consolidation coefficient with test duration.

Figure 5.19: Tidal Flat Deposits – Coefficient of volume compressibility (m_v) versus stress

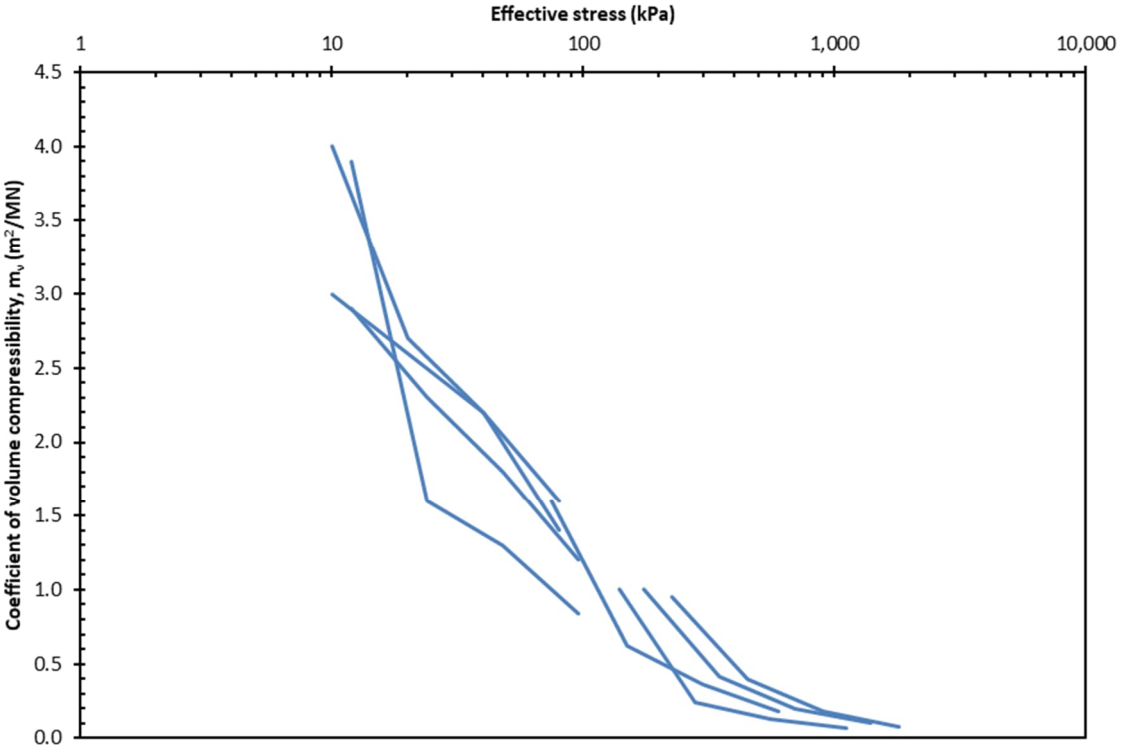
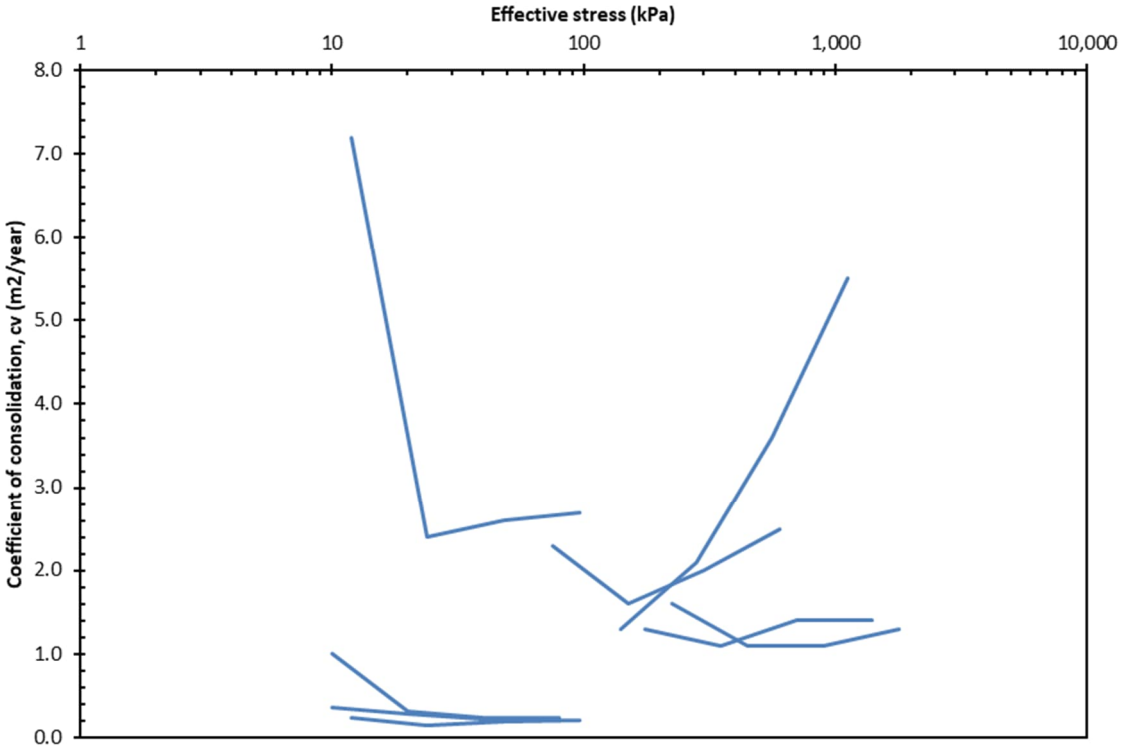


Figure 5.20: Tidal Flat Deposits – Coefficient of consolidation (c_v) versus stress



5.3.10 Earthworks Testing

A series of earthworks relationship tests were undertaken in accordance with BS 1377-2 (2022), including compaction tests utilising a 2.5kg compactive effort, laboratory California Bearing Ratio (CBR) and Moisture Condition Value (MCV) tests. The CBR and MCV tests were undertaken at the same moisture content as the corresponding compaction test to investigate the relationships between these properties. For the compaction tests a particle density of 2.7Mg/m^3 was assumed.

It should be noted that in one test multiple samples were combined, in agreement with Mott MacDonald, to provide sufficient material quantity to carry out the full range of earthworks laboratory testing. It is not thought that this is likely to have a significant impact on the test results presented based on the engineering descriptions of the material and could potentially reflect conditions during construction dependent on the required depth of cut and fill.

A summary of the testing undertaken is presented in Table 5.9 and is described in more detail below. It should be noted that for the purpose of Table 5.9 the full range of results of CBR and MCV tests are reported over the compaction relationship, hence a large variation in the test results observed.

Table 5.9: Tidal Flat Deposits – Earthworks classification testing summary

Compaction

Test type	No. of tests	Maximum Dry Density (Mg/m3)			Optimum Moisture Content (%)		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Light compaction (2.5kg rammer)	16	1.27	1.56	1.42	22	35	29

California Bearing Ratio

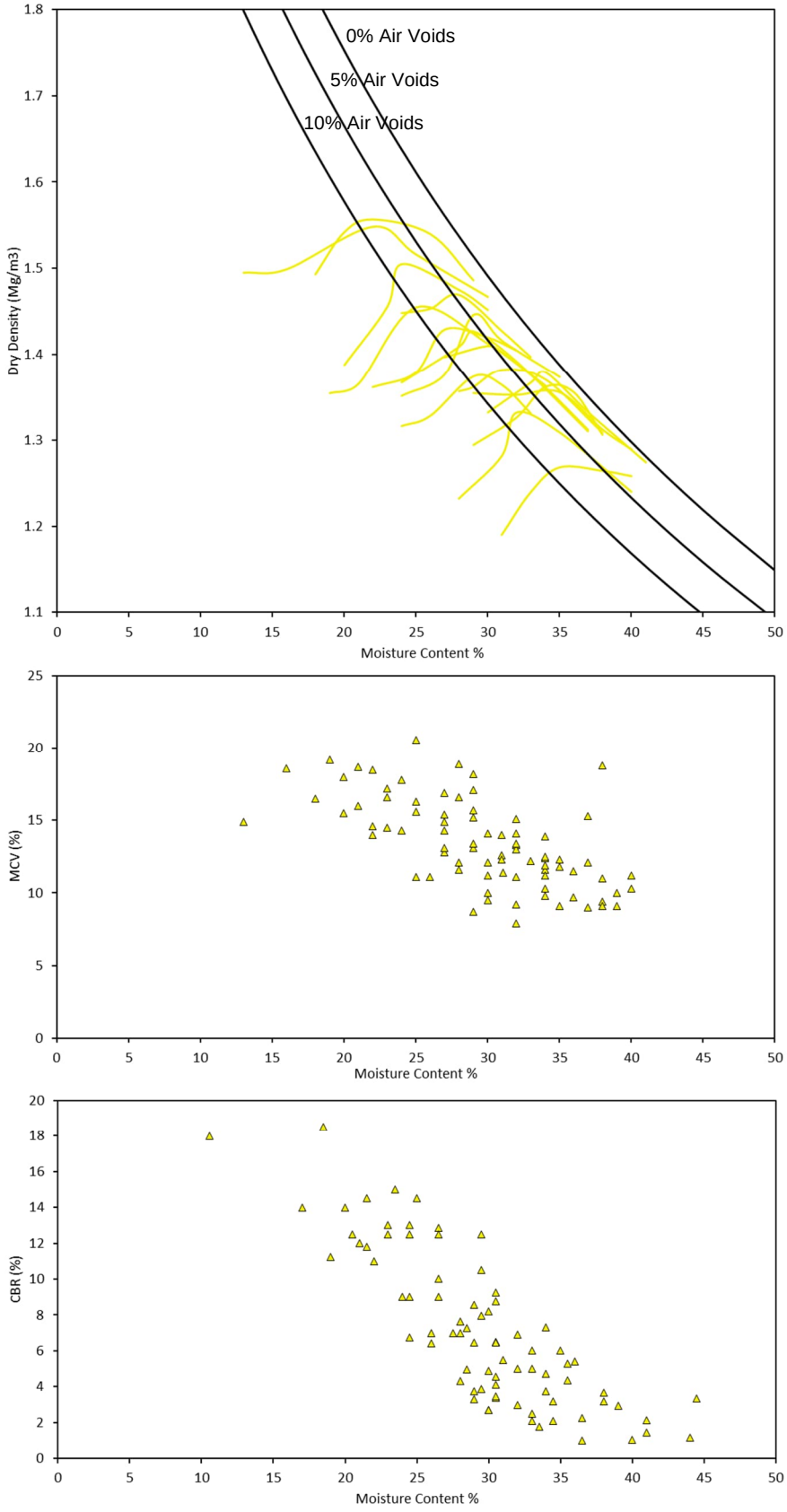
Test type	No. of tests	Minimum	Maximum	Average	Median
Laboratory CBR relationship test	16 (sets of 5 tests)	1.0	18.5	7.1	6.4

Moisture Condition Value (MCV)

Test type	No. of tests	Minimum	Maximum	Average	Median
Laboratory MCV test	16 (sets of 5 tests)	7.9	20.6	13.5	13.1

The relationship testing is presented in Figure 5.21 and can be seen to exhibit a wide, continuous range of optimum moisture contents and maximum dry densities. There is no clear spatial or vertical trend in the results, meaning it may be difficult to control the earthworks properties of this unit in the field effectively. This broadly correlates with the variability noted on the engineering log descriptions.

Figure 5.21: Tidal Flat Deposits – Earthworks relationships



5.3.11 Thermal resistivity

In-situ and laboratory measurements of thermal resistivity were undertaken along the length of the cable route and at the proposed converter station site in a series of trial pits, to inform cable design through obtaining thermal conductivity values. The results are presented in the factual report and are summarised in Table 5.10.

Interpretation of these results are documented separately as part of the cable design and are therefore not reviewed in detail in the scope of this report.

Table 5.10: Tidal Flat Deposits – Summary of in-situ thermal conductivity testing

Material	No. of tests	Thermal conductivity (W/m K)				Test temperature
		Minimum	Maximum	Average	Median	
Converter Station						
Tidal Flat Deposits	63	0.59	0.84	0.71	0.70	15 – 21(°C)
Cable Route						
Tidal Flat Deposits	18	0.52	0.72	0.66	0.67	16 – 17(°C)

5.3.12 Electrical resistivity

Ten electrical resistivity tests were carried out on recompacted bulk samples of Tidal Flat Deposits. The tests were undertaken at an as received moisture content and were remoulded to maximum achievable density. It should be noted that as these were undertaken on bulk samples, their moisture contents should be treated with appropriate caution. The results generally show a decreasing trend with both level and moisture content, as shown in Figure 5.22 and Figure 5.23 respectively. Samples of silt appear to show a consistently higher moisture content and correspondingly a lower resistivity as highlighted by the grey cells in Table 5.11, however, it is not clear whether this is related to level or the geology.

Table 5.11: Tidal Flat Deposits – Summary of electrical resistivity testing

Hole ID	Sample Depth (m)	Moisture content (%)	Electrical Resistivity (Ω m)
R22-BH101	1.8	71	2
R22-BH104	0.5	46	6
R22-BH106A	3.6	60	1
R22-TP101	0.7	31	8
R22-TP102	3.0	67	1
R22-TP103	1.1	65	4
R22-TP104	1.5	76	2
R22-TP105	0.9	37	5
R22-TP106	2.0	68	2
R22-TP107	1.0	38	4

Figure 5.22: Tidal Flat Deposits – Electrical resistivity versus level

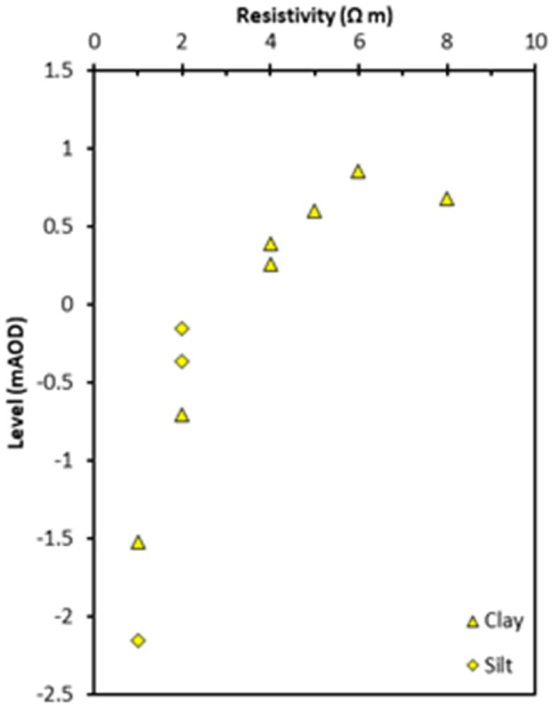
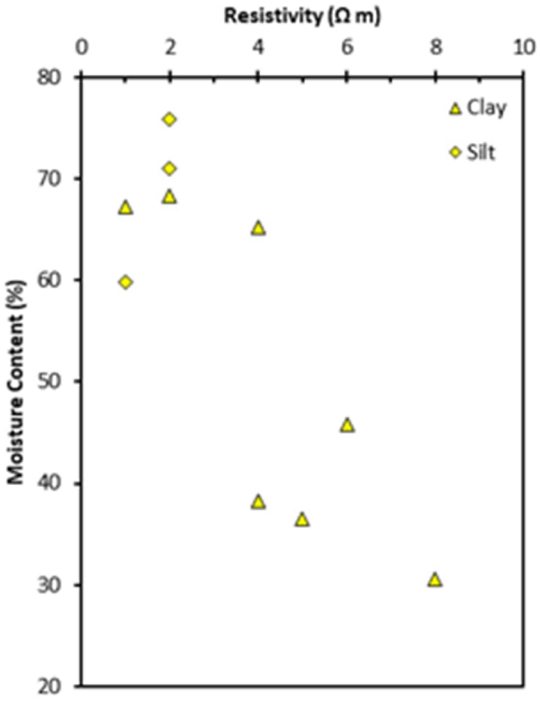


Figure 5.23: Tidal Flat Deposits – Electrical resistivity versus moisture content



Reference should also be made to the RSK Geosciences Soil Electrical Resistivity Test (VES) Report included in the Factual Report which summarises the findings of the in-situ electrical resistivity testing carried out. The results of the soil resistivity testing are to be utilised in the earthing design which is to be documented separately, therefore further discussion is not within the scope of this report.

5.4 Thanet Formation

The Thanet Formation is found across the site. In the east, it is present immediately below the topsoil and forms a topographic high upon which the A256 road is constructed. Moving westwards, past the A256 the upper boundary deepens, and it is in turn overlain by Tidal Flat Deposits. Reference should be made to the geological sections in Section 4.2 which demonstrate its spatial relationship across the site footprint.

The Thanet Formation was variable across the site, with a high-level summary of the key material types encountered provided below. Reference should be made to Section 4 for further information.

The Thanet Formation was generally formed of interbedded bands / beds of:

- Firm to stiff / very stiff grey occasionally brownish or bluish slightly to very sandy micaceous locally clayey SILT with occasional shell fragments, varying to silty CLAY OR locally gravelly with occasional low cobble content. The cobble content was generally recorded at the top of the unit, and could potentially be reflective of a Head deposit derived from the Thanet Formation. The gravel present is also predominantly formed of siltstone, this may be transitional in some areas with the Pegwell Marls detailed below. However, due to the drilling technique it is not possible to determine where the precise strata boundaries occur.

- Generally with depth, encountered as extremely weak to weak grey occasionally greyish green mottled bluish grey slightly sandy rarely calcareous micaceous SILTSTONE with occasional shell fragments. It should be noted that due to the drilling technique utilised, this was recovered as very dense grey silty sandy angular to subangular fine to coarse GRAVEL, occasionally with medium cobble content. This can also be interbedded with very stiff clayey SILT. This unit is interpreted to be the Pegwell Marls and therefore its engineering description should be treated with caution (refer to Section 4 for further detail)
- Generally medium dense to dense (but loose where encountered at shallow depths) grey mottled blue, yellow, green or white silty to very silty fine to medium SAND with occasional shell fragments and bands of silt.
- At its base in some areas, a basal bed of black subangular to subrounded fine to coarse flint GRAVEL with a low to medium flint cobble content, known in literature as the Bullhead Bed, is recorded.

As described in Section 2.2, the above descriptions broadly correlate to the main observed sub-units of the Thanet Formation as indicated from the Geological Memoir.

5.4.1 Classification testing

For the purpose of this section, selected data sets have been segregated in figures by site area, broadly into the following categories:

- Cable alignment
- HDD area (Red Penguin boreholes)
- Converter / Substation
- Other areas – including Minster Stream / River Stour crossings, Overhead lines, and Environment Agency groundwater boreholes

In addition to the above, siltstone was recorded on many of the engineering logs although due to the percussive drilling technique utilised during ground investigation it has generally been recovered as a disturbed cohesive soil and was noted to be very weak. As a result, testing on this material is separated on figures, where relevant.

A summary of classification testing carried out on the Thanet Formation is given in Table 5.12.

Table 5.12: Thanet Formation – Summary of Classification Testing

Parameter	No. of tests	Minimum	Maximum	Mean	Median
Moisture content (%)	78*	9.8	55.7	34.3	34.1
Plastic limit (%)*	58* **	18	42	30	32
Liquid limit (%)*		31	86	63	65
Plasticity index (%)* **		13	60	32	34
Consistency index (Ic)*, **	51* **	0.21	1.63	0.90	0.88
Bulk density (Mg/m^3)*	16	1.77	1.96	1.86	1.84
Dry density (Mg/m^3)*	16	1.24	1.53	1.36	1.30
Organic matter content (%)	8	0.3	2.0	0.7	0.5

*Samples tested over depths where water was added during drilling have been removed, as these are thought to be unrepresentative of materials natural water content. In addition, moisture contents undertaken on samples of siltstone

recovered as a very stiff silt, clay, or gravel have not been included in the above summary, but are presented in the below figures where relevant.

** Four tests identified the material to be non-plastic and are therefore discounted from this analysis.

A total of eight organic matter content tests were undertaken, indicating ranges of organic matter content between 0.30 – 2.0%. The results indicate the material has an organic content lower than the defined limit for a ‘low organic content’ in accordance with BS 5930:2015+A1:2020.

Natural moisture contents within the Thanet Formation generally vary between 20-50% through the whole profile encountered. Within the uppermost metre, some tests record increases in moisture content with depth typically along the cable alignment where the Thanet Formation was recorded closer to the surface. In the majority of locations, the Thanet Formation was encountered at depth below the groundwater table, hence elevated moisture contents being recorded at the top of the unit. There is much scatter in the data, though there is a slightly greater range of moisture contents shown below c. 10m bgl at the Converter Station. A similar trend is observed in data at depth where water was added during drilling, however this should be treated with caution and is not relied upon as discussed above.

Based on an assessment of the drillers logs and engineering logs, where water was added during drilling moisture content test results are not considered to be representative and these values have not been recorded in the above table, but are presented on the below plot as a comparison. These included, amongst a series of tests, two outliers at 13.50m and 15.50m bgl in R22-BH204 (c – 14 – 15m below top of unit, circled in red), where the moisture content reached 102% and 83% respectively (), and are therefore not considered to be a natural moisture content.

In addition, moisture content tests undertaken on samples of recovered siltstone are presented separately on the plot (and subsequent figures), and suggest a reasonable number of samples present predominantly between c. 6 – 15m bgl encounter this material, with their moisture contents broadly correlating with the range observed across the other materials in the Thanet Formation. It is acknowledged that due to the drilling method, the siltstone was disturbed and as it was encountered as a very weak rock, the disturbance has resulted in it generally being recovered as a soil.

Atterberg limit analysis in Figure 5.25 places samples across a variable range of the material’s plasticity, including several tests typically towards the top of the unit which lie close to or below the plastic limit, indicating they will behave in a brittle manner and are moisture deficient. With depth, a greater proportion of samples appear to sit within the centre of the plastic and liquid limits suggesting material may become more saturated. Tests presented in Figure 5.25 include both cohesive and granular materials, suggesting that within granular beds of the Thanet Formation the material may be borderline in its behaviour, associated with a high content of fines (generally described as very silty on the corresponding engineering logs).

Comparison of the plasticity index and liquid limit on the A-line plot (Figure 5.29) shows most samples tested to be a high to very high plasticity clay or silt across the majority of the site. A small population of tests indicate low to intermediate plasticity clay, and these are predominantly located along the cable alignment. One sample was also tested as an extremely high plasticity clay.

The plasticity index of the Thanet Formation is shown in Figure 5.26 to generally range between 20-60. There is a very loose trend in decreasing plasticity with depth from 0 – 8m, and between 8 – 10m data appears to suggest a plasticity index between c. 30 – 40, below which the range of plasticity increases particularly at the Converter Station. It’s possible this could be attributed to particular sub-units within the Thanet Formation.

The consistency index plot in Figure 5.27 shows several trends in the data, dependent on depth below the top of the unit. In the first c. 4 – 5m of the unit, consistency generally increases from soft to stiff or very stiff. Below this depth, there is a general decrease in consistency with depth which appears to correlate with a loose increase in some of the moisture content results, particularly at the Converter Station. The increase in consistency below the top of the unit is likely to represent a weathering profile to the top of the Thanet Formation, though this is less distinct in other classification tests including moisture content / plasticity.

Bulk and dry densities in Figure 5.28 are consistent with depth and no distinct trends are observed across the site.

Figure 5.24: Thanet Formation – Moisture content versus depth

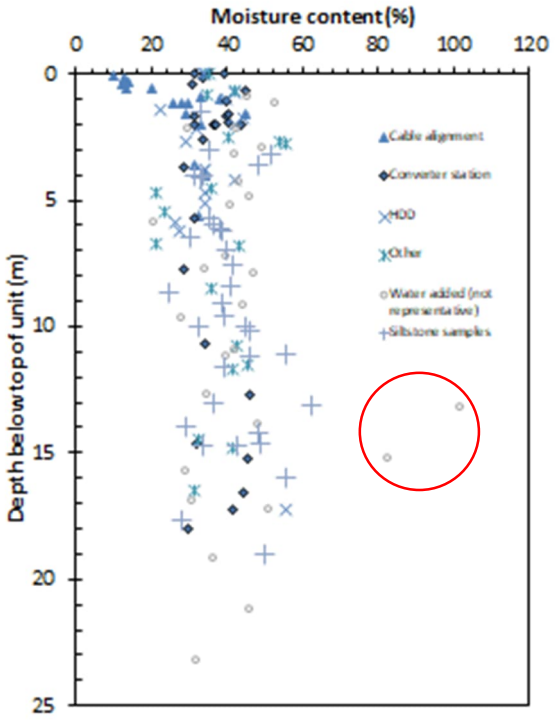
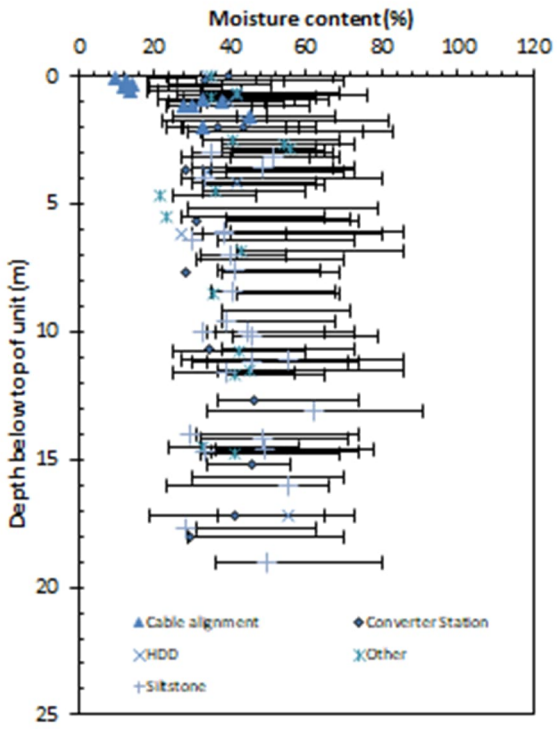


Figure 5.25: Thanet Formation – Moisture content, liquid limit and plastic limit versus depth



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Figure 5.26: Thanet Formation – Plasticity index I_p versus depth

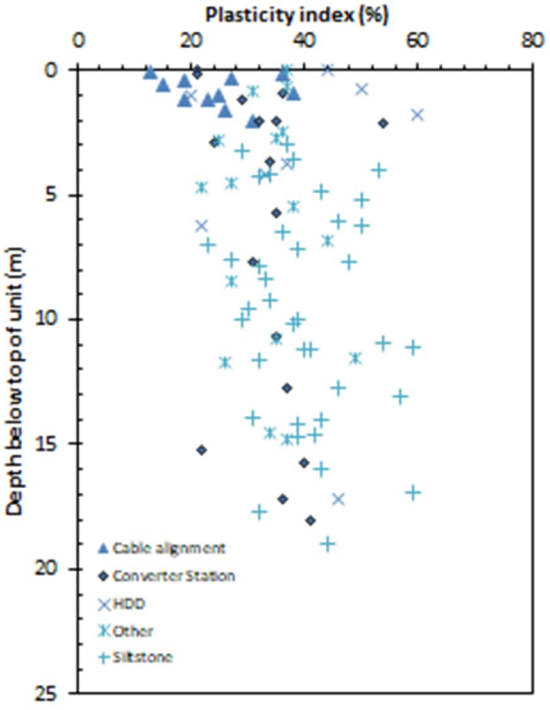


Figure 5.27: Thanet Formation – Consistency index I_c versus depth

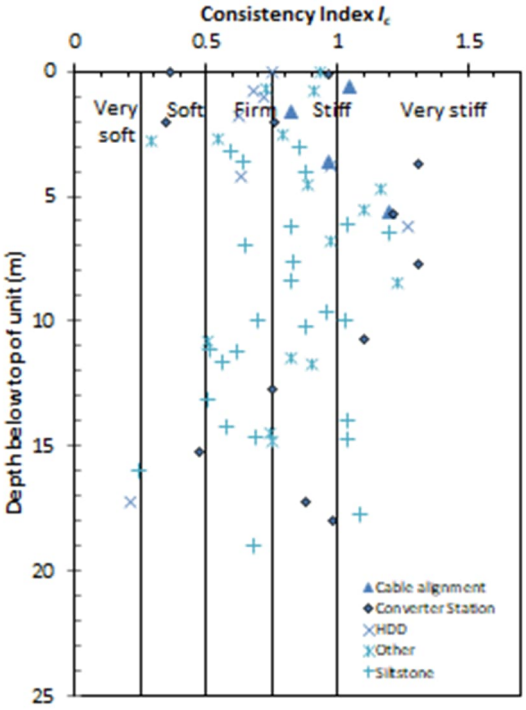


Figure 5.28: Thanet Formation – Bulk and Dry Density versus level

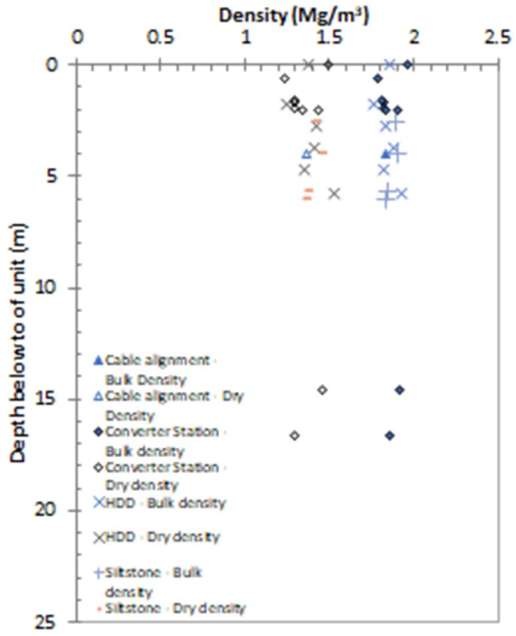
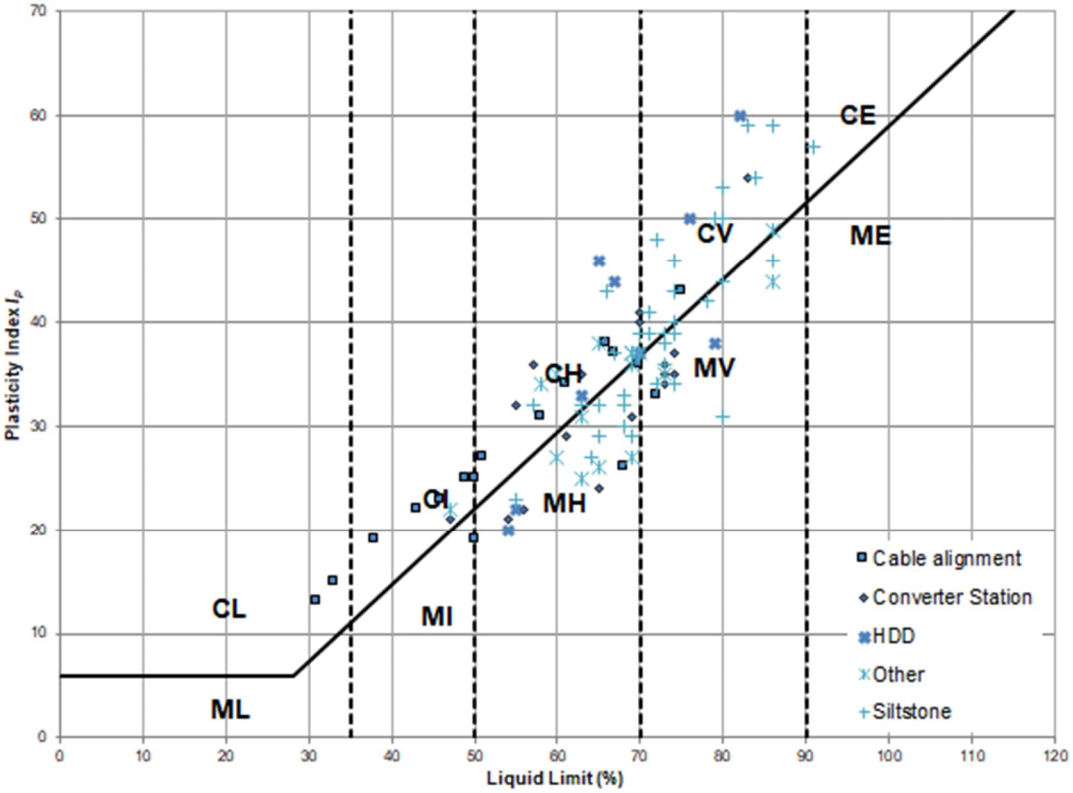


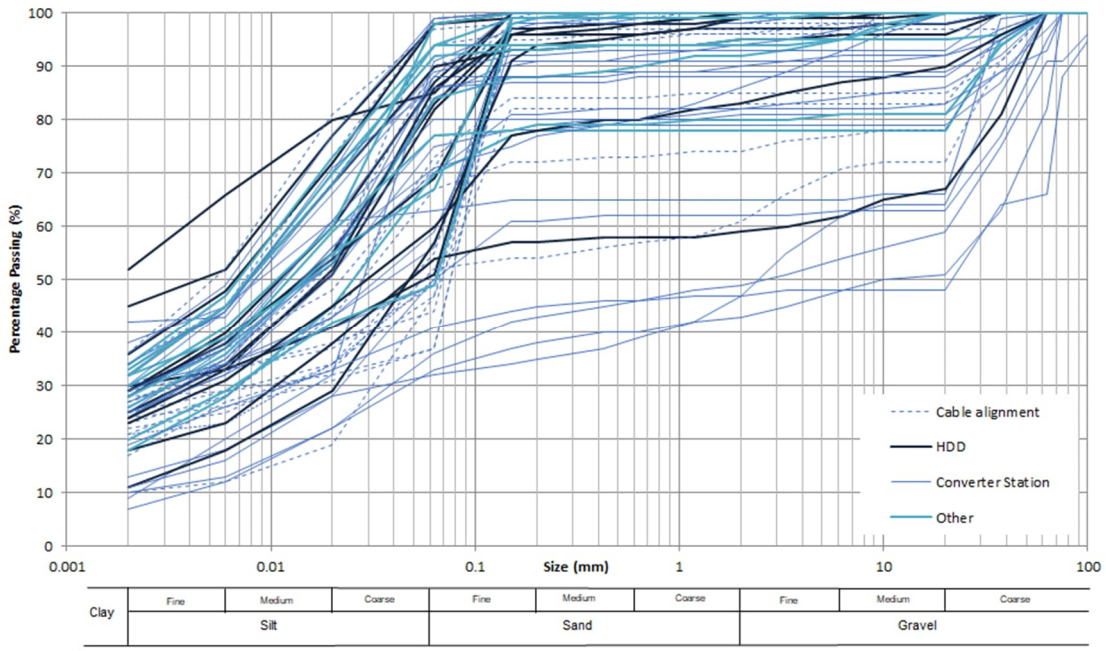
Figure 5.29: Thanet Formation – A-line Plot



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Sixty-three Particle Size Distribution (PSD) tests were conducted on bulk samples of the Thanet Formation. The results of this testing are plotted in Figure 5.30. The plot shows the unit to comprise mostly clay to fine sand size particles, with a gap of very little medium sand to medium gravel size particles. In approximately half of the tests, this is followed by a small to significant amount of coarse gravel. The engineering logs generally describe the unit as a very stiff SILT interbedded with bands logged as a SILTSTONE. It is thought this sub-unit is attributed to the Pegwell Marls, and due to the cable percussive drilling technique this siltstone is generally very broken up and recovered as a coarse gravel, which is reflected in the subsequent PSD testing therefore these tests should be treated with caution. No distinct spatial relationship is observed between different areas of the site.

Figure 5.30: Thanet Formation – Particle Size Distribution Curves



5.4.2 In-Situ Testing – SPTs

A total of 196 SPTs were conducted within the Thanet Formation. Of these, 97 were refusals (N=50 for less than 300mm penetration). These values have been extrapolated in Table 5.13 to provide an interpretation of the equivalent N value were the test continued to 300mm penetration. The average results recorded are reflective of the geological descriptions of an interbedded very stiff SILT or Marl. SPT N_{60} values are presented in Figure 5.31 while the full data set including extrapolated values is presented in Figure 5.32 There is a generally slightly increasing trend with depth for SPT N_{60}, albeit with high spread at the higher values, likely due to the difference between bands of silt / siltstone or Marl associated with the Pegwell Marls.

The refused SPTs (terminated at N=50) are present over the entire depth of the unit, suggesting that the unit is very dense / high strength throughout, though several trends are observed in the data. In the top 5m, a rapid increase in SPT N value is observed suggestive of an upper weathering profile to the top of the unit, and this correlates with classification testing such as consistency data. The data suggests a slight relative decrease in SPT N values below c. 8-10m into the unit, which correlates with observations at depth where consistency index is shown to reduce and where more significant siltstone is recorded on the engineering logs. A significant proportion (c. 45% of SPT tests) in the unit are described as siltstone on the engineering logs, thought to be representative of the sedimentary sub-unit of the Pegwell Marls. To present the

different engineering log descriptions, Figure 5.33 presents the SPT N60 values with respect to the dominant engineering description. This appears to correlate with information in the Geological Memoir, suggesting potential presence of the Stourmouth clays towards the base of the deposit, the Reculver Silts at its top, and the Pegwell Marls forming the dominant central component of the Thanet Formation, reference should be made to Section 2.2 for further information.

Although the SPT N values are only slightly elevated compared to material described as silt, which could suggest a variable degree of cementation of the material surrounding this (as suggested in the BGS memoir), and as a result it is recommended this is treated with caution.

Table 5.13: Thanet Formation – Summary of SPT results

Parameter	Number of tests	Minimum	Maximum	Mean	Median
SPT N Value	196	8	50	42.9	50
Extrapolated SPT N Value	196	8	500	64.4	50
Extrapolated SPT N_{60} Value	196	9.1	608.3	70.3	53.3

Figure 5.31: Thanet Formation – SPT N_{60} versus depth (capped at 50)

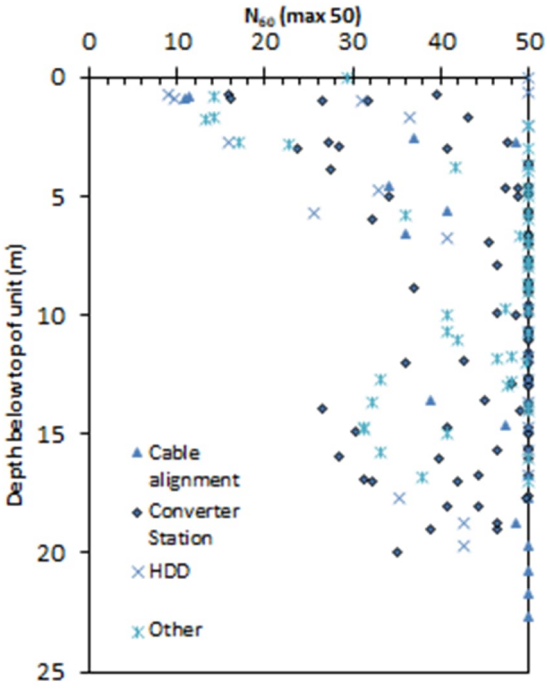


Figure 5.32: Thanet Formation – Extrapolated SPT N_{60} versus depth

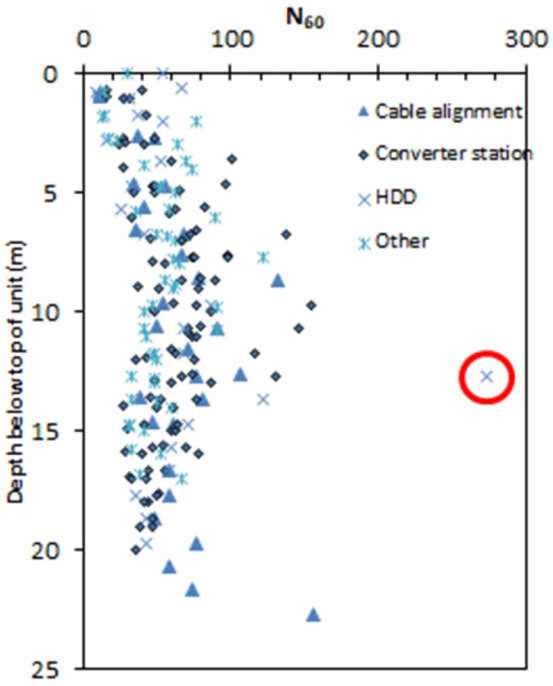
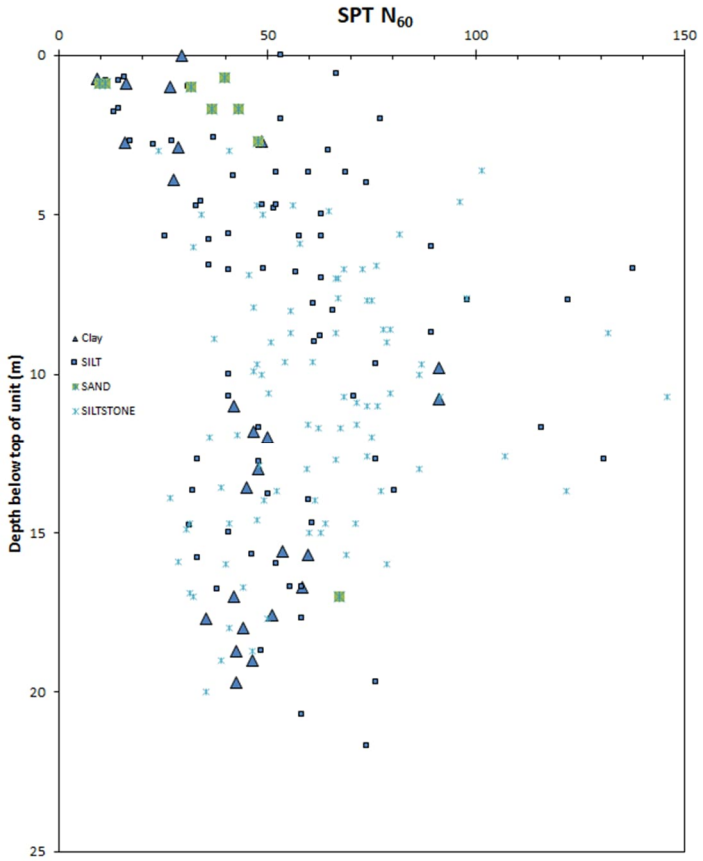


Figure 5.33: Thanet Formation – SPT N_{60} versus depth (Strata type inferred from engineering logs)



5.4.3 In-Situ Testing – Permeability

A falling head permeability tests was conducted in R22-BH101 within the Thanet Formation, with test parameters and results summarised in Table 5.14. Permeability tests were carried out to BS EN ISO 22282-2:2012, and results were all calculated using the Hvorslev method. Three further tests were carried out where no standing groundwater level was present as borehole soakaway tests in line with the approach given in BRE Digest 365. In each case there was no drop in water level recorded therefore calculation of infiltration was not possible.

Table 5.14: Thanet Formation – Summary of Permeability Testing

Location ID	Date of Test	Depth of Response Zone (m)	Permeability (m/s)	Test Type
R22-BH101	06/10/2023	8.40-8.80	$9.99*10^{-8}$	Falling head
R22-BH203	10/10/2023	3.00-4.00	-	Borehole soakaway – non-standard
R22-BH203	10/10/2023	4.50-6.00	-	Borehole soakaway – non-standard
RedP-BH-11	09/10/2023	8.06-8.99	-	Borehole soakaway – non-standard

5.4.4 In-Situ Testing – Soil infiltration rate

One soil infiltration test (soakaway test) was conducted within the Thanet Formation. The test was carried out following the BRE Digest 365 guidance, using the trial pit R22-TP501. Following

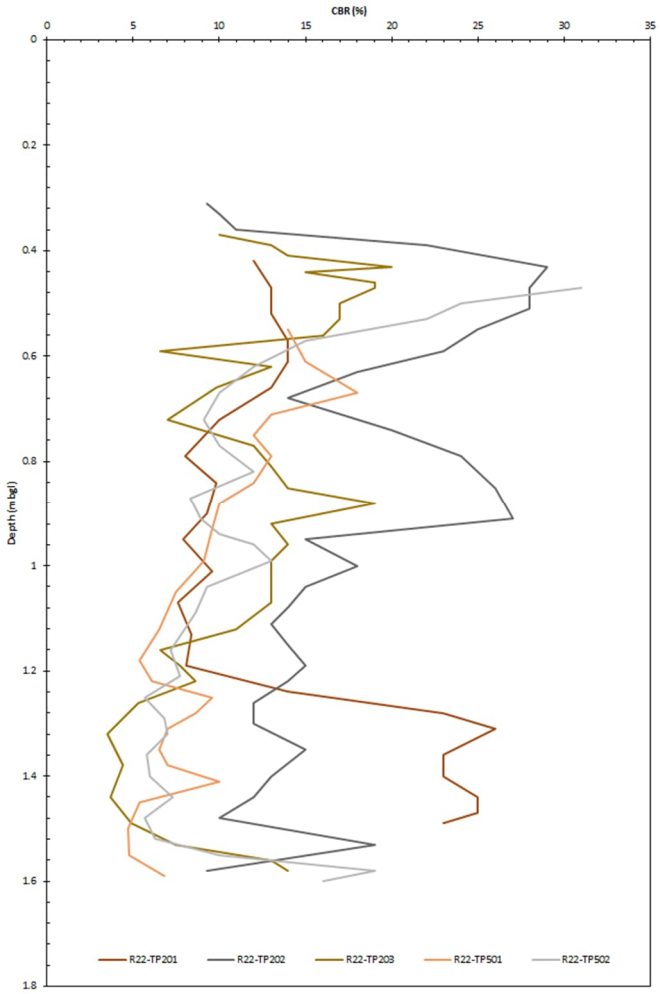
the excavation and logging of the trial pit a test depth of 1.50m below ground level was chosen and a new pit was dug for the test. Utilising a water bowser and pump the pit was filled with water to 0.46m bgl and monitored over a period of three hours. During the test <0.5m drawdown was achieved meaning it was not possible to calculate a soil infiltration rate, and the recommended second and third tests were abandoned.

5.4.5 In-Situ Testing – Dynamic Cone Penetrometer (DCP)

Five DCP tests have been assessed as encountering the Thanet Formation, by comparison against the engineering logs of their associated trial pits. The results of these DCP tests are plotted in Figure 5.34 below. The resultant CBR profile from the testing is highly variable, between 3.5 – 31% overall. The lower bound of the data generally shows a decrease in CBR with depth, from approximately 10% at 0.4m depth to 3.5% at around 1.5m depth. Significant spikes are seen in four out of five test profiles, of up to 25-30% at varying depths.

The conservative long term CBR has also been determined based on CD225 and LR1132, engineering log descriptions and PSD test results / Atterberg limit testing. LR1132 suggests that for a sandy or silty clay a CBR of 2-4% should be achievable.

Figure 5.34: Thanet Formation – CBR from in-situ Dynamic Cone Penetrometer versus depth



Mott MacDonald Restricted

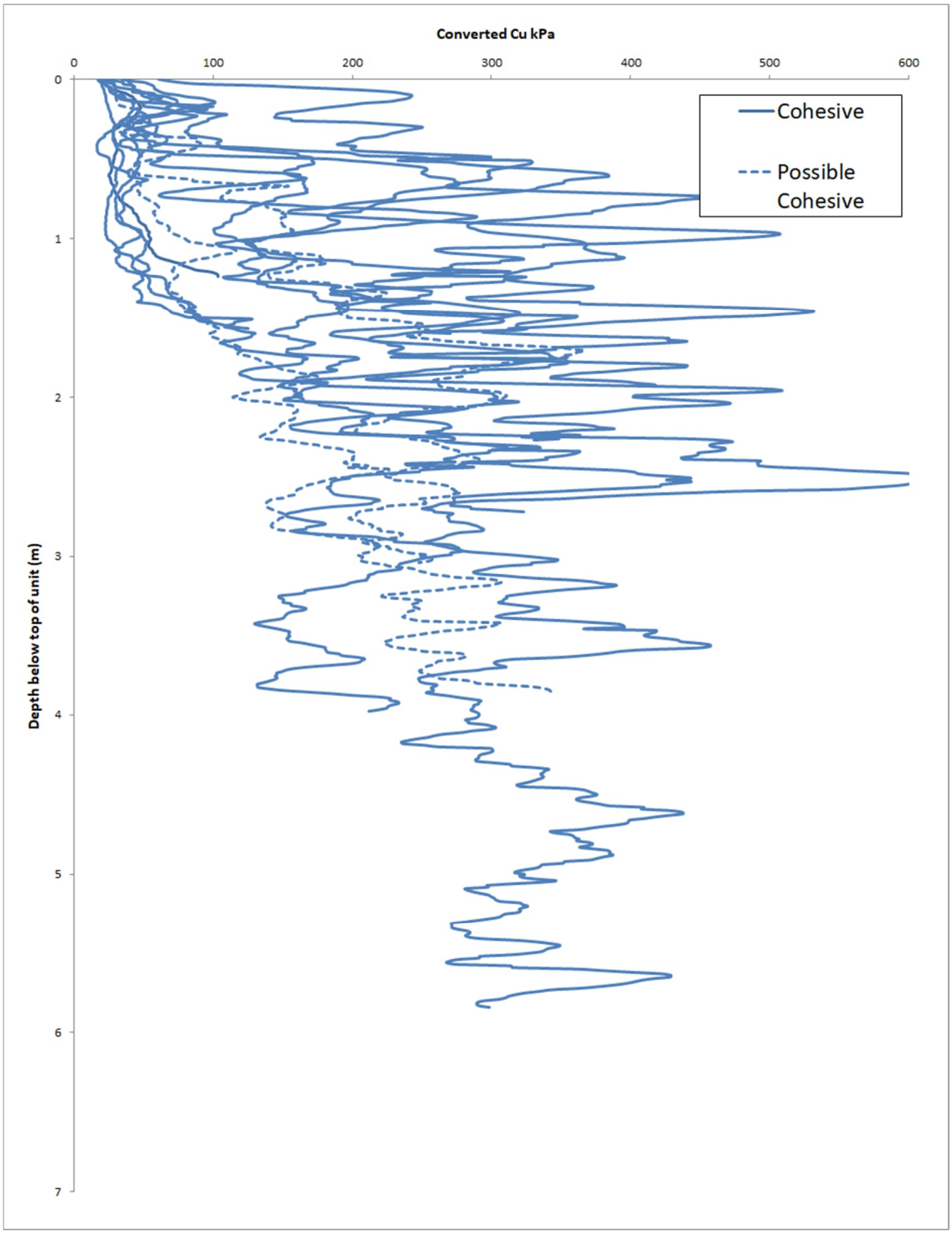
5.4.6 In-situ Cone Penetration Testing (CPT)

Cone Penetration Tests (CPT's) were completed at a number of locations as part of the ground investigation and encountered the Thanet Formation.

Results from CPTs have been converted to an undrained shear strength, using the equation presented within Section 5.3.6, with results presented in Figure 5.35. Where it is uncertain whether cohesive material may be present but based on interpretation of CPT data this is considered likely, these are presented as dashed lines, and where granular materials were encountered upon review of CPT results these are not shown on the below plot, generally inferred from comparison to engineering log data and interpretation of the CPT results. Due to the thin nature of the granular beds identified, these have not been presented in this section but reference should be made to the factual report for full details.

The results suggest a general increase in undrained strength with depth below the top of the unit, with sharp increases noted in several areas. This is likely to represent potential presence of a weathered top surface (correlating with observations from classification testing) and presence of cemented materials with depth. For example, many of the engineering logs record the unit with depth as a siltstone, including R22-CPT104, where results are shown to exceed 300kPa and should therefore be treated with caution as this is likely to be unrepresentative of undrained strength. Other tests record much more gradual increases with depth including for example R22-CPT 101, R22-CPT102, and R22-CPT111. These tests were terminated at an undrained shear strength of approximately 100 – 150kPa due to refusal.

Figure 5.35: Thanet Formation – CPT converted Cu versus depth



5.4.7 Dissipation testing

Dissipation tests were completed in a select number of locations as part of the CPT testing, to derive the horizontal coefficient of consolidation where sufficient information was available to determine the t_x (time taken to achieve a given percentage of degree of dissipation – this varied per test due to the ground conditions but was generally 50%), as well as having enough information available to enable choice of a suitable T_{50}. The coefficient of consolidation was estimated using the equation presented in Section 5.3.6.1.

A summary of the dissipation test results is presented in Table 5.15. Tests in most instances were undertaken to t_{50}. A large range in the vertical and horizontal coefficient of consolidation is recorded suggesting variable permeability and consolidation characteristics associated with this material. Several of the tests dissipated to 50% excess pore pressure within anywhere between c. 9 – 43 seconds, suggesting a reasonable permeability and this may result in reported values of the coefficient of consolidation being unrepresentative due to the quick draining behaviour of the material.

Table 5.15: Thanet Formation – Summary of dissipation testing

Hole ID	Depth (m bgl)	Vertical Coefficient of Consolidation, c_v (m2/yr)	Horizontal Coefficient of Consolidation, c_v (m2/yr)	Remarks
CPT101	7.28	16.1	20.2	50% dissipation reached.
CPT103	6.05	-	837	50% dissipation reached. Test was quick – t_{50} of 9.9 seconds
CPT104	5.54	-	1160	50% dissipation reached. Test was quick – t_{50} of 15.2 seconds
CPT105	8.97	80.1	100	50% dissipation reached
CPT106	6.56	-	789	50% dissipation reached. Test was quick – t_{50} of 23.3 seconds
CPT106	7.1	-	418	50% dissipation reached. Test was quick – t_{50} of 42.8 seconds
CPT107	6.63	-	330	50% dissipation reached. Test was quick – t_{50} of 30.9 seconds.
CPT108	5.29	-	-	Dissipation (t_{50}) not reached
CPT109	9.61	54.9	68.6	50% dissipation reached
CPT110	6.22	-	623	50% dissipation reached. Test was quick – t_{50} of 29.3 seconds
CPT111	6.1	4.5	5.6	30% dissipation reached

5.4.8 Undrained shear strength (C_u) testing

Eighteen unconsolidated undrained triaxial tests were undertaken on the Thanet Formation to determine its undrained shear strength. In addition, three laboratory vane tests and 47 in-situ hand vane tests were conducted on this unit. Data from these tests is plotted on Figure 5.36. It should be noted that although the formation was logged as varying between a cohesive and granular soil (which is indicated to be borderline to cohesive engineering behaviour) as well as the presence of an extremely to very weak siltstone, SPT data has been presented indicatively as a comparison and should be treated with caution.

Table 5.16: Thanet Formation – Summary of Undrained Shear Strength data

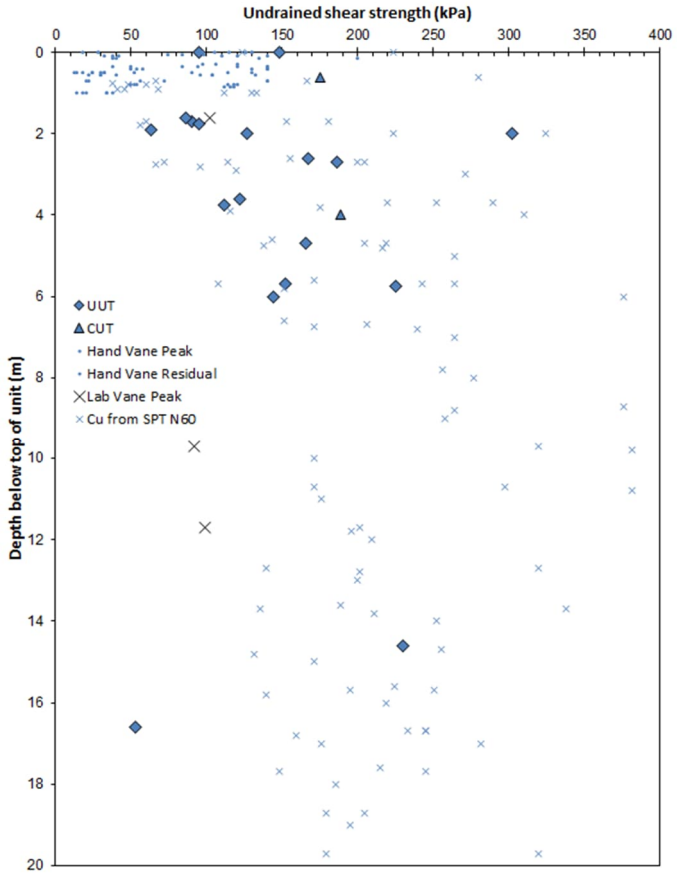
Test Type	Number of tests	C_u (kPa)			
		Minimum	Maximum	Mean	Median
UUT	18	53	302	142.4	135.5
In-situ Hand Vane (peak)	47	30	200	106.3	114
In-situ hand vane (residual)	32	12	58	33.9	31

Test Type	Number of tests	C_u (kPa)			
		Minimum	Maximum	Mean	Median
Laboratory Vane (peak)	3	92	102	97.7	99
Laboratory Vane (residual)	0	-	-	-	-

The undrained shear strength data records a general increase with depth below the top of the unit and this correlates with the in-situ testing including CPT data and SPT values. Data associated with siltstone (Pegwell Marls) on the engineering logs has not been presented as this is considered unrepresentative to have an undrained shear strength.

Some tests including a UUT sample at c. 16.5m below the top of the unit records a lower undrained shear strength of 53kPa, however no distinguishing features are recorded on the engineering log or laboratory test sheets for this sample. Two laboratory vane tests undertaken between c. 9.5 – 12m below top of unit also record a slightly lower than expected undrained strength based on the other test results shown. These samples although recovered as soft gravelly clayey silt were likely in-situ to be extremely weak to very weak calcareous siltstone, based on the engineering log descriptions. Therefore, the presence of granular content / cementation is likely to have influenced the results. These should be treated with caution as the material tested may not necessarily represent the in-situ condition of the material.

Figure 5.36: Thanet Formation – Undrained shear strength versus level



5.4.9 Effective stress testing

5.4.9.1 Shear box testing

Twenty-six small shear box tests were carried out on remoulded samples of the Thanet Formation in the lab, the results of which are summarised in Table 5.17.

Table 5.17: Thanet Formation – Summary of shear box testing

Hole ID	Depth (m bgl)	Normal stress increments, σ (kPa)	Peak angle of friction, ϕ' (°)	Cohesion intercept, c' (kPa)
R22-BH101	18.5	185, 370, 740	25	33
R22-BH101	23.5	235, 470, 940	20	33
R22-BH102	13.5	135, 270, 540	29.5	34
R22-BH102	21.5	215, 430, 860	19.5	60
R22-BH103	7.5	75, 150, 300	30	28
R22-BH103	23.5	235, 470, 940	16.5	46
R22-BH104	10.5	105, 210, 420	26	13
R22-BH104	14.5	145, 290, 580	29	25
R22-BH104	18.5	185, 370, 740	26	13
R22-BH104	22.5	225, 450, 900	21	43
R22-BH105	8.7	50, 100, 200	28.5	11
R22-BH106A	7.5	75, 150, 300	34.5	2
R22-BH203	3.5	35, 70, 140	30	6
R22-BH203	5.5	55, 110, 220	24.5	11
R22-BH203	8.5	85, 170, 340	32	8
R22-BH204	4.55	45, 90, 180	25.5	12
R22-BH204	8.6	85, 170, 340	31.5	10
R22-BH204	18.6	185, 370, 740	23	23
R22-BH205	11.5	115, 230, 460	24.5	36
R22-BH205	17.5	175, 350, 700	23	31
R22-BH501	12.5	125, 250, 500	29	11
R22-BH501	20.5	205, 410, 820	23.5	19
R22-BH502	14.5	145, 290, 580	29	19
RedP-BH-11	4.6	45, 90, 180	28	12
RedP-BH-11	16.6	165, 330, 660	21	31
RedP-BH-11	19.6	195, 390, 780	20.5	74

The reported peak angle of friction varies between 16.5 – 34.5° while the reported peak cohesion ranges between 2 – 74kPa. The upper end of cohesion values are anomalously high and may be a result of cemented silt / siltstone gravel within the sample giving it a higher overall strength. Such high cohesion values may also be a result of the curve-fitting used to calculate the results.

In general, both the effective angle of friction, and the cohesion, show a trend with depth below ground level, this may be related to an increase in cemented silts / beds of Marl with depth, changing the overall behaviour of the material.

5.4.9.2 Consolidated Undrained Triaxial (CUT) testing

Two single stage consolidated undrained triaxial tests were also conducted on undisturbed samples of the Thanet Formation.

Due to limited data as the tests were single stage only, it is difficult to determine representative shear strength parameters at this may make it difficult to determine the angle of shearing resistance and cohesion with confidence. As a result, data has only been plotted as an undrained shear strength on Figure 5.36 using the peak shear stress from each test.

5.4.10 Consolidation testing

Two one-dimensional consolidation tests were conducted on the Thanet Formation, using undisturbed samples from boreholes R22-BH103 (at 10.09m depth) and R22-BH204 (at 4.36m depth). The resultant coefficients of volume compressibility and consolidation are plotted in Figure 5.37 and Figure 5.38 respectively.

The m_v values determined from the consolidation testing suggest the unit has a low to very low compressibility, which is typical of very stiff or hard clay and stiff weathered rocks, which is consistent with the engineering descriptions of the unit and classification testing presented earlier in this report.

Figure 5.37: Thanet Formation – Coefficient of volume compressibility (m_v) versus stress increment

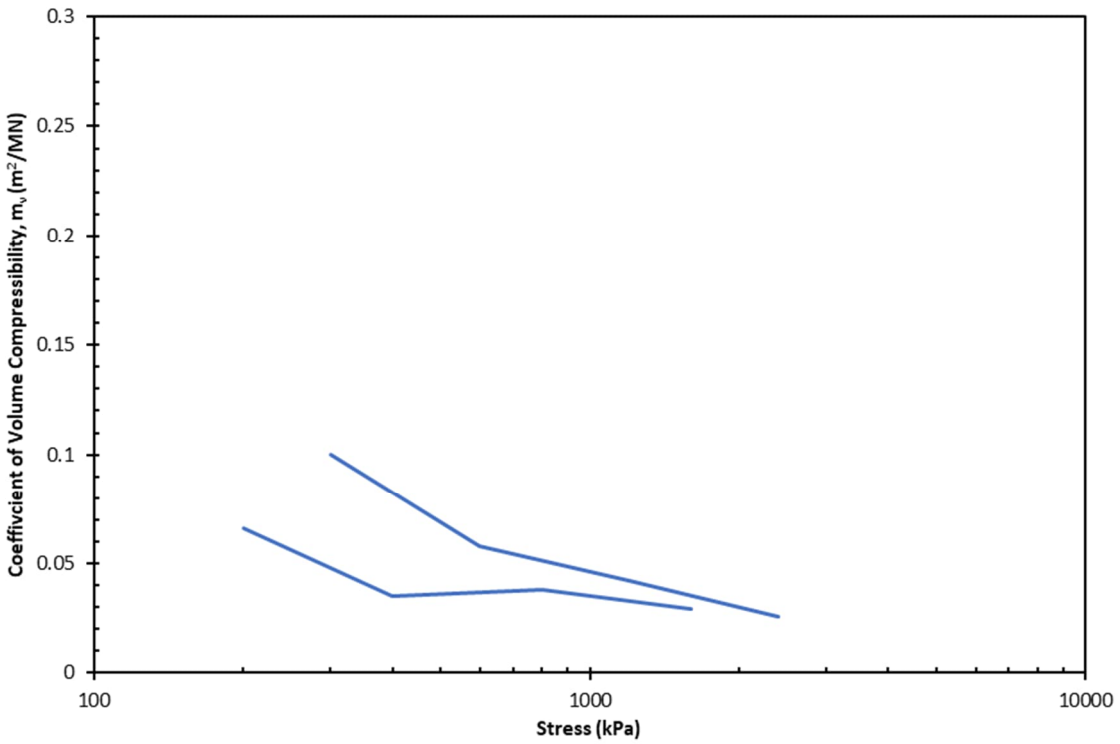
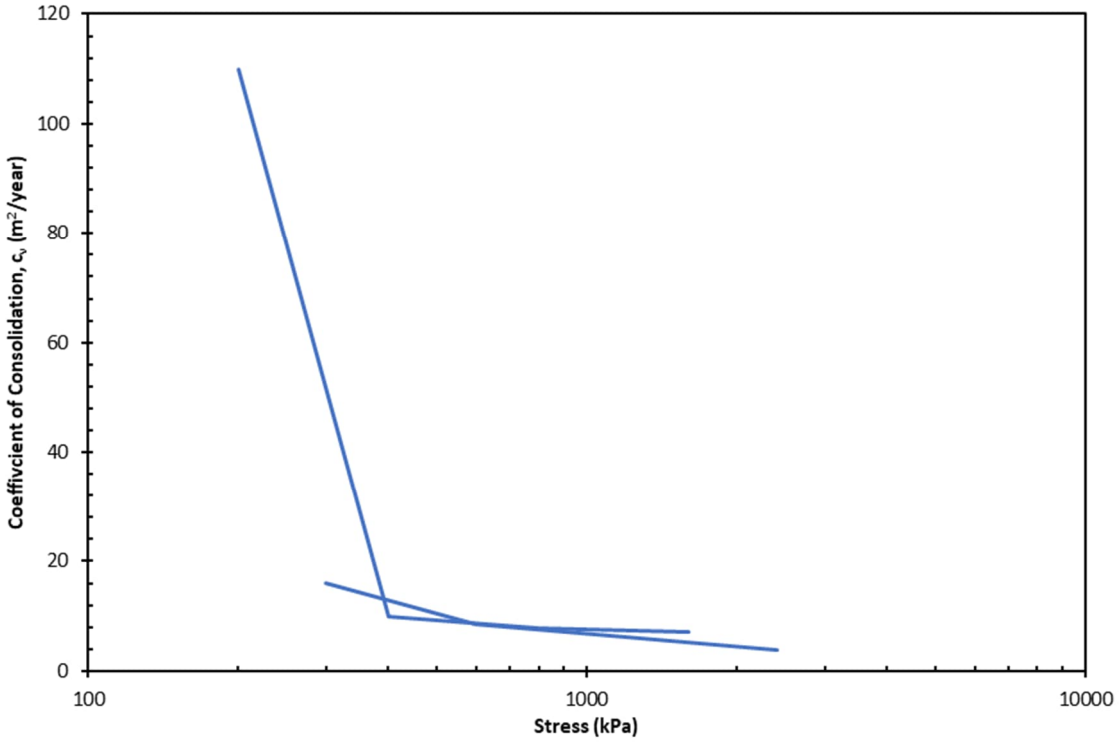


Figure 5.38: Thanet Formation – Coefficient of consolidation (c_v) versus stress



The coefficient of consolidation, c_v, has been derived using the root-time method. There is a large variation in c_v shown in Figure 5.38 however above test pressures of 400kPa the value varies only between ~3.8 – 10m2/year. Due to the variation at low test pressure it is recommended that the data is treated with caution. It should be noted that generally the rate of settlement observed for full scale structures is much greater than estimates from laboratory testing.

5.4.11 Earthworks

A series of earthworks relationship tests were undertaken in accordance with BS 1377-2 (2022), including compaction tests utilising a 2.5kg compactive effort, laboratory California Bearing Ratio (CBR) and Moisture Condition Value (MCV) tests. The CBR and MCV tests were generally undertaken at the same moisture content as the corresponding compaction test to investigate the relationships between these properties:

- Compaction test – 2.5kg rammer (light compaction) with an assumed particle density of 2.68 Mg/m^3.
- CBR relationship test
- MCV relationship test

The results of the earthworks testing are summarised in Table 5.18 and Figure 5.39 and described in detail below. It should be noted that for the purpose of Table 5.18 the full range of results of CBR and MCV tests are reported over the compaction relationship, hence a large variation in the test results observed.

Table 5.18: Thanet Formation – Earthworks classification testing summary

Compaction

Test type	No. of tests	Maximum Dry Density (Mg/m^3)			Optimum Moisture Content (&)		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Light compaction (2.5kg rammer)	5	1.31	1.77	1.60	14	30	20

California Bearing Ratio

Test type	No. of tests	Minimum	Maximum	Average	Median
Laboratory CBR relationship test	5 (sets of 5 tests)	1.6	33.5	17.6	19.5

Moisture Condition Value (MCV)

Test type	No. of tests	Minimum	Maximum	Average	Median
Laboratory MCV test	5 (sets of 5 tests)	5	17.6	12.7	13.5

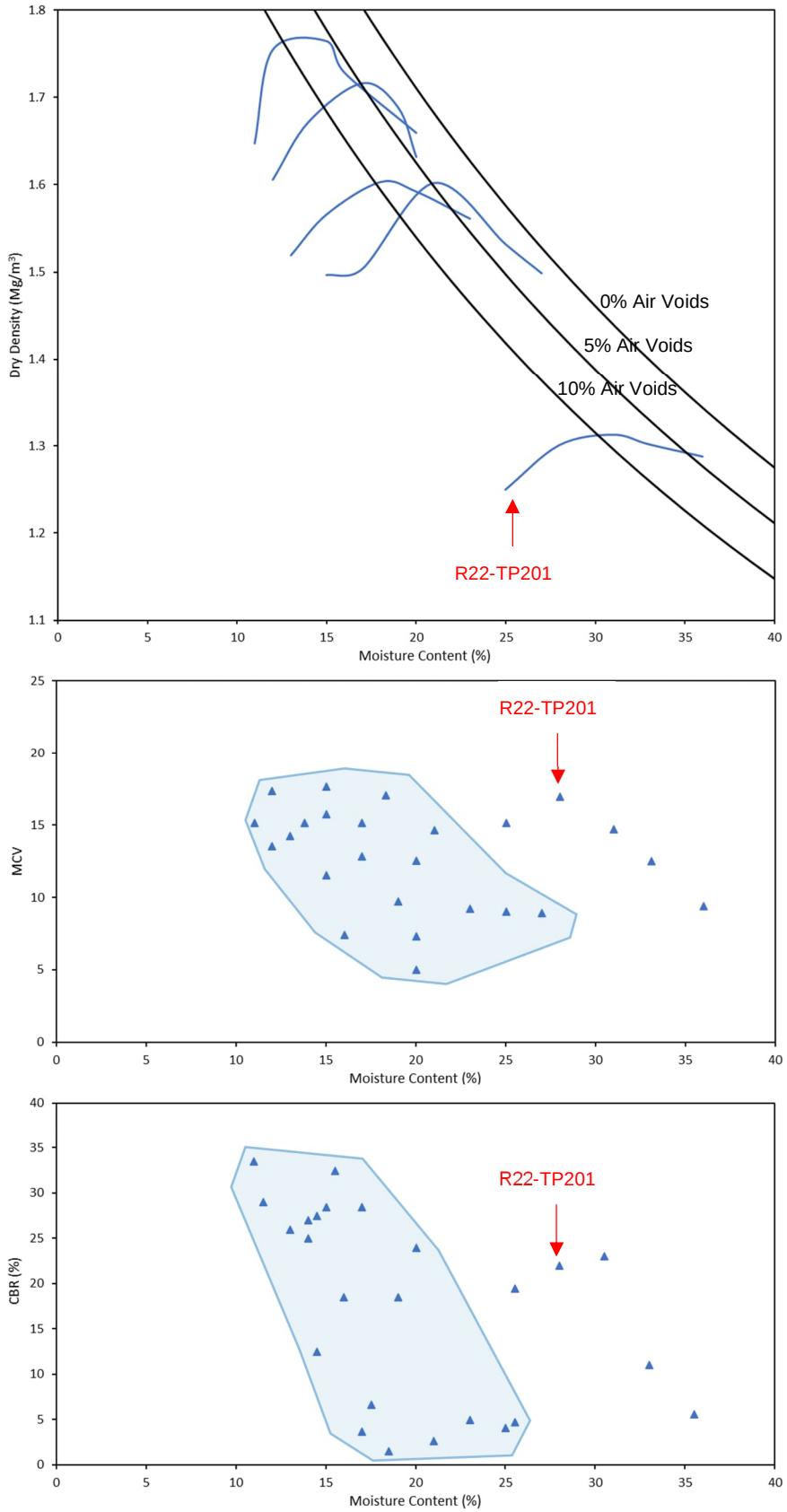
The relationship testing presented in Figure 5.39 suggests that two different material types may have been tested. One compaction test (R22-TP201) records a significantly higher Optimum Moisture Content (30%) and lower Maximum Dry Density (1.31Mg/m^3) than the rest of the ranges (14-21% and 1.60-1.77Mg/m^3 respectively). The sample from R22-TP201 is similar in its compaction properties to the lower end of results from the Tidal Flat Deposits (see Section 5.3.10) and while it is mapped by the BGS to be in an area of Thanet Formation, it is close (<50m south-east) to a mapped boundary where the Tidal Flat Deposits overlie the Thanet Formation. The engineering description of the sample material (“Stiff greyish brown mottled yellow and orange sandy clayey SILT with rare rootlets up to 5mm diameter. Sand is fine to medium“). It is thought this sample is likely to be attributed to the Thanet Formation due to the elevation of the location in comparison to surrounding areas where the Tidal Flat Deposits are recorded. This sample could potentially be associated with a superficial Head deposit derived from the Thanet Formation, which are known to exist within this area (see Section 2.2 for further information and geological sections in Section 4.2). This is denoted in Figure 5.49 being labelled in red.

Compaction reached between approximately 5-10% air voids around the optimum moisture content of the material for each of the remaining four samples, of which three reached ~5%. The natural moisture content data for the Thanet Formation over the depth range of the earthworks testing (between approximately 9.8 - 45% between 0-4m depth) suggests it could be present either dry or wet of its optimum moisture content.

The CBR testing generally shows greater values at lower moisture contents, with a decreasing trend as moisture content increases, as expected. Over the range of optimum moisture content, CBR varies between ~1.6 – 32.5%. This is likely due to inherent variability in the material and indicates that some material may be untrafficable and require treatment such as drying.

MCV testing records a similar trend to CBR testing with values decreasing with increasing moisture content. Over the range of optimum moisture content, MCV ranges between 5 – 17.6, the variation likely being caused by inherent spatial variability in the composition of the unit.

Figure 5.39: Thanet Formation – Earthworks relationships



5.4.12 Thermal resistivity

In-situ and laboratory measurements of thermal resistivity were undertaken along the length of the cable route and at the proposed converter station site in a series of trial pits, to inform cable design through obtaining thermal conductivity values. The results are presented in the factual report and are summarised in Table 5.19.

Interpretation of these results are documented separately as part of the cable design and are therefore not reviewed in detail in the scope of this report.

Table 5.19: Thanet Formation – Summary of thermal conductivity testing

Material	No. of tests	Thermal conductivity (W/m K)				Test temperature
		Minimum	Maximum	Average	Median	
Cable Route						
Thanet Formation	27	0.46	0.95	0.64	0.63	13 – 17(°C)

5.4.13 Electrical Resistivity

Two electrical resistivity tests were carried out on recompacted bulk samples of Thanet Formation. The tests were undertaken at an as received moisture content, and were remoulded to maximum achievable density. It should be noted that as these were undertaken on bulk samples, their moisture contents should be treated with appropriate caution. Both tests yielded a result of 1 Ωm.

Table 5.20: Thanet Formation – Summary of electrical resistivity testing

Hole ID	Sample Depth (m)	Moisture content (%)	Electrical Resistivity (Ω m)
R22-BH103	10.6	52.3	1
R22-BH105	15.6	65.5	1

Reference should also be made to the RSK Geosciences Soil Electrical Resistivity Test (VES) Report included in the Factual Report which summarises the findings of the in-situ electrical resistivity testing carried out. The results of the soil resistivity testing are to be utilised in the earthing design which is to be documented separately, therefore further discussion is not within the scope of this report.

5.5 Margate Chalk Member (Newhaven Chalk Formation)

Margate Chalk Member was identified in R22-BH204, where it was present as a clast dominated structureless Chalk, as well as a series of the Red Penguin boreholes (RedP-BH-6,7,8,9 and 10). The full thickness of the weathered Chalk was not proven, however to the east as part of the offshore scheme, relatively little structureless Chalk was identified in the rotary drilled boreholes (<1.6m), overlying Grade B4 to B2 very weak to weak Chalk, with no flint. It is therefore interpreted that the Margate Chalk in R22-BH204, which was drilled by cable percussion methods, is likely at least in part a structured Chalk which has been heavily disturbed by drilling and recovered as a clast dominated material (gravel).

5.5.1 Classification testing

Results of the classification testing undertaken on the Margate Chalk Member are summarised in Table 5.21.

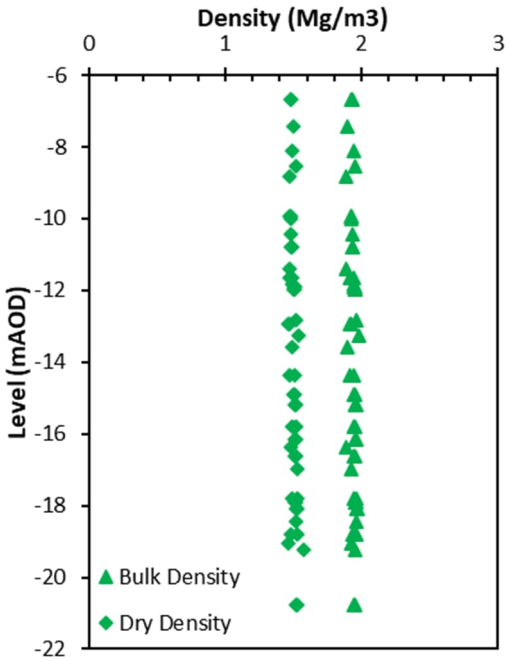
Table 5.21: Margate Chalk Member – Summary of classification testing

Parameter	No. of tests	Minimum	Maximum	Average	Median
Moisture content of soil (%)	3	44	51	49	51
Moisture content of rock (%)	34	26	31	29	29
Saturation moisture content (%)	10	28	31	30	29
Porosity (%)	23	37	46	43	44
Bulk Density (Mg/m^3)	52	1.89	1.98	1.94	1.95
Dry Density (Mg/m^3)	52	1.46	1.58	1.50	1.51

Bulk and dry density of intact samples of Chalk is presented with level in Figure 5.40, with results suggesting the materials density is fairly consistent with depth.

A series of saturated moisture content tests were undertaken on Chalk, suggesting saturated moisture contents between 28 -31%, with dry densities varying between 1.46 – 1.58 Mg/m^3. CIRIA C574 suggests that the majority of the results infer a low density Chalk, with a few tests suggesting medium density.

Figure 5.40: Margate Chalk Member – Bulk and dry density versus level



5.5.2 In-situ testing – SPTs

Twenty-nine SPTs were carried out within the Margate Chalk Member (Newhaven Chalk Formation). The majority of these were within the Red Penguin boreholes, however the data is used here to give greater understanding of the unit, as it was only encountered within R22-BH204 in the onshore part of this scheme.

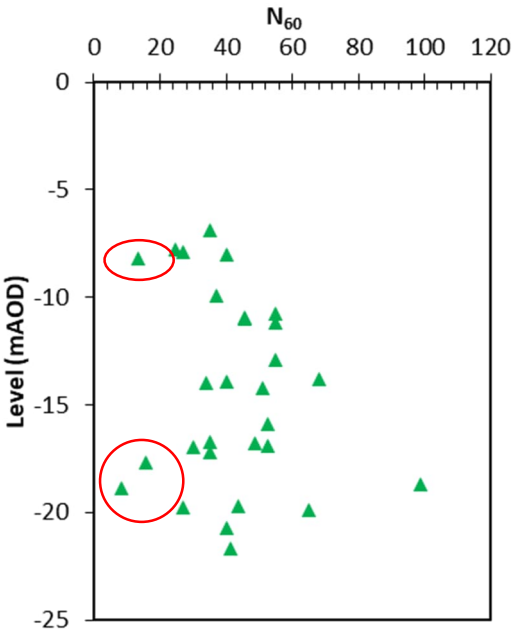
SPT Hammer Energy Test Reports have been provided by the Contractor, hence raw 'N' values have been converted to N_{60} values. One test has been extrapolated past an N value of 50. N=100 has generally been used as the refusal value for SPTs in weak rock otherwise.

Table 5.22: Margate Chalk Member – Summary of SPT Results

Parameter	Number of tests	Minimum	Maximum	Mean	Median
SPT N Value	29	8	66	38	36
Extrapolated SPT N Value	29	8	81	39	36
SPT N_{60} Value	29	8	99	42	40

The results are plotted against level in Figure 5.41. There is a loose increase with depth between approximately -8 to -12m AOD, below which a greater scatter in the data is present with some results recording low SPT N values at depth. The lower values recorded are indicated to be within structureless material, either at depth or close to the top of the unit suggesting it lies within the Chalk's upper weathered zone, which is likely to have influenced the results observed.

Figure 5.41: Margate Chalk Member – Extrapolated SPT N_{60} versus level



5.5.3 Strength testing – Point load index

Eighty-seven point load index tests were carried out on samples of Chalk from the Margate Chalk Member. These tests were carried out following ISRM 1976-2006:1985 and comprised 24 axial tests, 34 diametral tests, and 29 irregular lump tests. The results are summarised in Table 5.23. Due to the very low range of data these results are not plotted against depth or level in this section.

Table 5.23: Margate Chalk Member – Summary of point load test results

		Point Load Index $I_{s(50)}$ MN/m^2			
Test type	**No. of tests**	**Minimum**	**Maximum**	**Average**	**Median**
Axial – size corrected	24	0.1	0.2	0.1	0.1
Diametral – size corrected	34	0	0.3	0.1	0.1
Irregular lump – size corrected	29	0	0.2	0.1	0.1

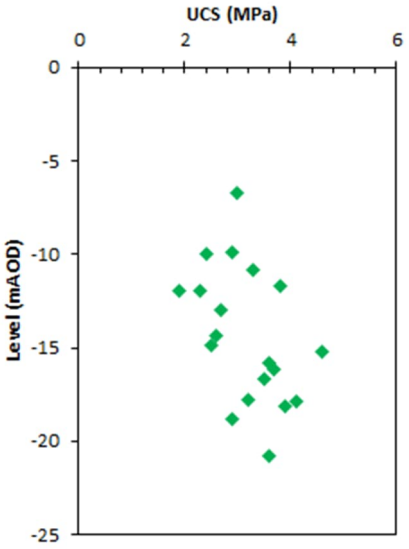
5.5.4 Strength testing – Uniaxial compressive strength

A series of Uniaxial Compressive Strength (UCS) tests were undertaken in the Margate Chalk Member, presented with level in Figure 5.42 and summarised in Table 5.24. These broadly suggest a loose increase in strength with level in the unit.

Table 5.24: Margate Chalk Member – Summary of UCS Results

Parameter	Number of tests	Minimum	Maximum	Mean	Median
Unconfined Compressive Strength (MPa)	19	1.9	4.6	3.2	3.2

Figure 5.42: Margate Chalk Member – Uniaxial compressive strength versus level



5.5.5 In-situ Testing – Permeability

Two falling head permeability tests were conducted within the Newhaven Chalk (within RedP-BH-6 and RedP-BH-8). It was not possible to calculate a permeability value for either test due to the Chalk being too permeable to enable the test head to be raised sufficiently high to obtained adequate test data.

5.6 Seaford Chalk Formation

The Seaford Chalk Formation was identified in R22-BH501, where it was described as a white Chalk recovered as slightly gravelly slightly sandy SILT with frequent flint fragments up to 50mm in diameter. The gravel was very weak, low-density white and subangular. While the recovery was of structureless Chalk, the SPT results of 21-30 in this unit likely indicate that it a structured Chalk, disturbed by drilling.

5.6.1 Classification testing

The results of classification testing carried out on the Seaford Chalk Formation are presented in Table 5.25.

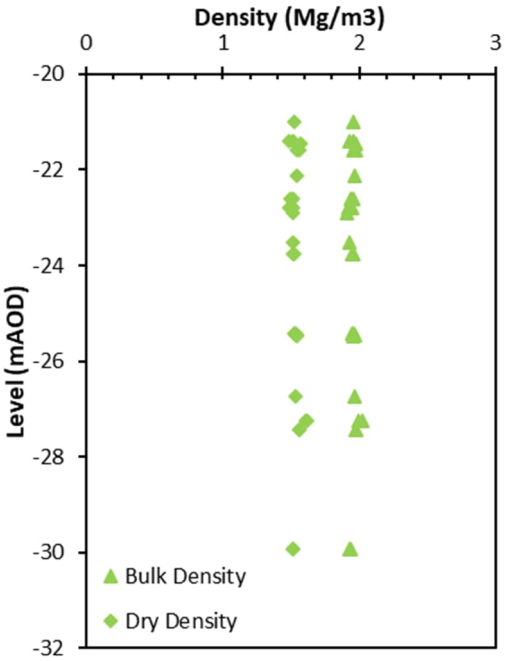
Table 5.25: Seaford Chalk Formation – Summary of classification testing

Parameter	No. of tests	Minimum	Maximum	Average	Median
Moisture content of soil (%)	1	34	-	-	-
Moisture content of rock (%)	17	23	30	28	29
Saturation moisture content (%)	4	26	29	28	29
Porosity (%)	13	41	44	43	44
Bulk Density (Mg/m^3)	27	1.91	2.02	1.96	1.95
Dry Density (Mg/m^3)	27	1.49	1.62	1.53	1.51

Bulk and dry density of intact samples of Chalk is presented with level in Figure 5.43, with results suggesting the materials density is fairly consistent with depth.

Saturated moisture contents were shown to range between 26 – 29%, and dry densities between 1.49 – 1.62% suggesting that in accordance with CIRIA C574 that the Chalk is of low to medium density.

Figure 5.43: Seaford Chalk Formation – Bulk and dry density versus level



5.6.2 In-situ testing – SPTs

Twenty-nine SPTs were carried out within the Seaford Chalk Formation. The majority of these were within the Red Penguin boreholes, however the data is used here to give greater understanding of the unit, as it was only encountered within one borehole in the onshore part of this scheme.

SPT Hammer Energy Test Reports have been provided by the Contractor, hence raw 'N' values have been converted to N_{60} values. One test has been extrapolated past an N value of 50. N=100 has been used as the refusal value for SPTs in weak rock otherwise.

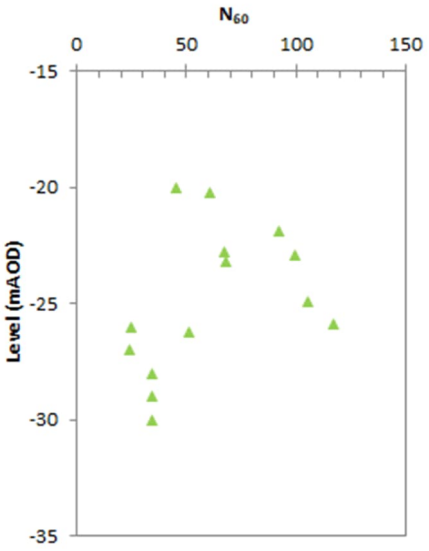
Table 5.26: Seaford Chalk Formation – Summary of SPT results

Parameter	Number of tests	Minimum	Maximum	Mean	Median
Raw SPT N Value	15	21	100	58	50
Extrapolated SPT N Value	14*	21	113	56	47
Extrapolated SPT N_{60} Value	14*	24	117	61	56

* One anomalous SPT (refusal at N=100 for 5mm penetration) excluded, as the extrapolated N_{60} value (6200) is unrealistic. It is probable that the test was obstructed by a flint cobble. This test has not been plotted on Figure 5.44.

The SPT results are plotted against level in Figure 5.44, which shows no distinct relationship with depth within the formation. The wide spread of data may be attributed to the presence of flints in the unit locally increasing the SPT N Value.

Figure 5.44: Seaford Chalk Formation – Extrapolated SPT N_{60} versus level



5.6.3 In-situ Testing – Permeability

Two falling head permeability tests were conducted within the Seaford Chalk Formation (within RedP-BH-6 and RedP-BH-8). It was not possible to calculate a permeability value for either test due to the Chalk being too permeable to enable the test head to be raised sufficiently high to obtained adequate test data.

5.6.4 Strength testing – Point load index

Forty-seven point load index tests were carried out on samples of Chalk from the Seaford Chalk Formation. These tests were carried out following ISRM 1976-2006:1985 and comprised 14 axial tests, 19 diametral tests, and 14 irregular lump tests. The results are summarised in Table 5.27. Due to the low range of data these results are not plotted against depth or level in this section.

Table 5.27: Seaford Chalk Formation – Summary of point load index testing results

		Point Load Index $I_{s(50)}$ MN/m^2			
Test type	**No. of tests**	**Minimum**	**Maximum**	**Average**	**Median**
Axial – size corrected	14	0.1	0.2	0.1	0.1
Diametral – size corrected	19	0	0.2	0.1	0.1
Irregular lump – size corrected	14	0	0.1	0.1	0.1

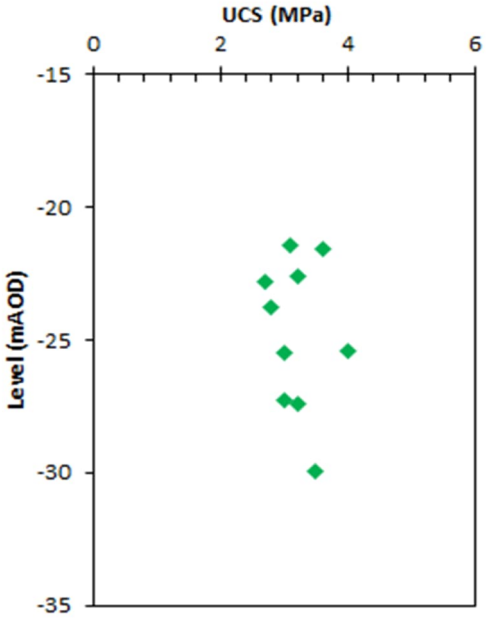
5.6.5 Strength testing – Uniaxial compressive strength

A series of ten UCS tests were undertaken in the unit, presented with level in Figure 5.45, and summarised in Table 5.28. The results suggest a loose increase in strength with depth.

Table 5.28: Seaford Chalk Formation – Summary of UCS Results

Parameter	Number of tests	Minimum	Maximum	Mean	Median
Unconfined Compressive Strength (MPa)	10	2.7	4.0	3.2	3.2

Figure 5.45: Seaford Chalk Formation – UCS versus level



6 Geo-environmental considerations

Alongside this report, a Generic Quantitative Risk Assessment (GQRA) has been produced by Mott MacDonald Limited. Reference should be made to the report for geo-environmental information.

- Mott MacDonald Limited, Sea Link FEED, Generic Qualitative Risk Assessment (GQRA) – Kent, May 2024. Document reference: SEAL-MMD-SEAL-ENG-REP-0691

It should be acknowledged that this report has been issued since production of the above report, and this report should be referred to for geological interpretation and engineering description of materials, superseding information within the GQRA.

7 Preliminary ground models and geotechnical parameters

This section summarises a series of preliminary ground models and geotechnical parameters based on information presented in the above sections.

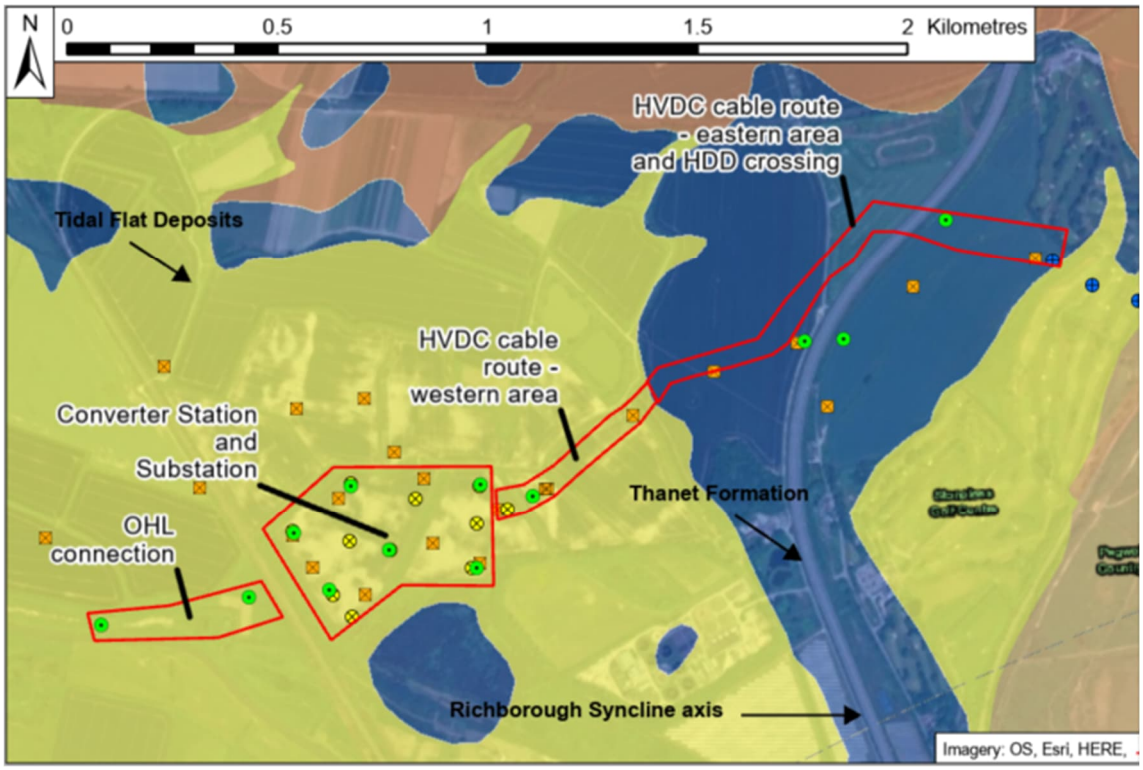
This assessment is based on the geological unit allocations and information available at the time of writing from current ground investigation information. These parameters and ground models are subject to review and development to inform specific geotechnical design aspects and are to be reviewed upon the receipt of any additional GI information at later design stages.

7.1 Ground models

The preliminary ground models laid out in Section 1.1.1 are outlined below with regard to the recent ground investigation data. For further details on the geological strata reference should be made to earlier Sections in this report, and to Section 7.2 which discusses preliminary geotechnical parameters. The approximate spatial distribution of the ground models discussed below is presented in Figure 7.1.

The ground models have been prepared based on the anticipated ground conditions, with the Converter Station and HVDC cable ground models being collated due to presence of Tidal Flat Deposits at surface. The eastern area of the HVDC cable route is presented within a separate ground model due to absence of Tidal Flat Deposits, and the presence of the Thanet Formation at surface (see Figure 7.1).

Figure 7.1: Preliminary ground models



Mott MacDonald Restricted

7.1.1 Converter Station / Substation area and western part of HVDC cable route

A summary of the ground conditions encountered within this area of the site are presented below in Table 7.1.

Table 7.1: Preliminary ground model – Converter station / substation area and western part of HVDC cable route

Strata	Top depth (m bgl)	Bottom depth (m bgl)	Thickness (m)
Topsoil / Reworked Topsoil	0.0	0.4	0.4
Tidal Flat Deposits [thickest beneath the converter site, thinning eastwards along the HVDC route]	0.4	8.3	7.9
Thanet Formation	8.3	>25.5m	>17.2

Groundwater in this model varies between approximately 1m below ground level at the converter station site. Eastwards along the HVDC cable route groundwater was not encountered in the trial pits.

7.1.2 Eastern part of HVDC cable route and HDD crossing

A summary of the ground conditions encountered within this area of the site are presented below in Table 7.2.

The Thanet Formation here has a wide range in thicknesses observed, due to the combination of the ground level decreasing eastwards of the A256 road, and the lower boundary with the Margate Chalk Member deepening broadly westwards.

Table 7.2: Preliminary ground model – Eastern part of HVDC cable route and HDD crossing

Strata	Top depth (m bgl)	Bottom depth (m bgl)	Thickness (m)
Topsoil	0.0	0.3	0.3
Thanet Formation	0.3	10.0-27.0	9.7-23.7
Margate Chalk Member	10.0	22.3	12.3
Seaford Chalk Formation	22.3	>26	>3.7

Due to the undulating topography, the groundwater in this model was encountered at varied depth between 6.5-10.5m, equivalent to a level of approximately 0-3mAOD.

7.1.3 Converter station / substation connection to existing OHL

The below ground model summarises the connection between the Converter Station / Substation to the existing OHL to the south-west in Table 7.3.

Table 7.3: Preliminary ground model – Converter station / substation connection to existing OHL

Strata	Top depth (m bgl)	Bottom depth (m bgl)	Thickness (m)
Topsoil	0.0	0.4	0.4
Tidal Flat Deposits	0.4	10.3	9.9
Thanet Formation	10.3	>25.5	>15.5

Groundwater is expected to lie around 1m bgl across the area of this model and is likely in continuity with the nearby River Stour.

7.2 Geotechnical characteristic parameters

A series of characteristic preliminary geotechnical parameters have been derived from the information obtained during the ground investigation and relevant historical site information.

The parameters have been derived based on the strata likely to be present and information presented in the above sections alongside published correlations available for the materials, papers and standards (where relevant) as well as engineering judgement. The below sections summarise the relevant parameters, with a summary of the parameters presented in Section 7.2.6.

No engineering properties are provided for Topsoil. It is understood that there is an option in the proposed design for haul roads to be constructed on top of Topsoil to preserve potential archaeological artifacts. If this option is taken forwards it may be necessary to gather additional geotechnical data for the Topsoil to enable suitable design of the haul roads.

Elsewhere it is understood that Topsoil is likely to be stripped from the site during construction, and in areas of the cable route this is envisaged to be reinstated after construction.

No engineering properties have been included for Made Ground, as this was only locally encountered and is expected to be removed and replaced due to its variable engineering properties.

No properties of the materials anticipated to be encountered along the Red Penguin off-shore HDD connection have been included, as it is understood this will be reported separately and is the design responsibility of Red Penguin.

For the purpose of this stage of design, the Thanet Formation has been treated entirely as a high strength cohesive soil. This is considered to be conservative due to the presence of the Pegwell Marls which form a significant component within the central part of the unit (see Section 5.4). It is acknowledged that parameters obtained from the Pegwell Marls are likely to offer improved geotechnical properties than those presented below and it is recommended this is reviewed at the detailed design stage.

7.2.1 Unit weight

Unit weight has been derived from BS 8004:2015 (Section 4.3.1, soils above / below the groundwater table) in combination with information presented in Sections 5 and 6 including bulk density tests from undisturbed samples, their variation across the strata as well as unit strength descriptions/data. The selected bulk density used for each unit to derive the unit weight is listed below:

- Tidal Flat Deposits – 1.74Mg/m^3 (in areas of the unit where higher organic contents are encountered this could be as low as 1.3Mg/m^3 and requires review for specific design tasks)
- Thanet Formation – 1.82Mg/m^3
- Margate Chalk Member – 1.94Mg/m^3
- Seaford Chalk Formation – 1.96Mg/m^3

7.2.2 Undrained shear strength

Undrained shear strength has been derived based on data presented in Section 6 as well as the engineering log information captured in Section 5. This includes a review of in-situ and laboratory measurements of undrained shear strength.

The rationale for the selected parameters is explained below:

- Tidal Flat Deposits – 20kPa between 1 to 0m AOD decreasing to 10kPa 0m AOD. Beneath 0m AOD, increasing by approximately 1kPa per metre to a maximum of c.16kPa at approximately -7m AOD. If material is encountered with significant organic content, this should be reviewed in further detail.
- Thanet Formation (Cohesive beds) – at the top of the unit, 40kPa until 1.5m below top of the unit, and thereafter 100kPa based on UUT, Lab vane and in-situ CPT testing as well as review against in-situ SPT and engineering log descriptions. It is anticipated that this value can likely be improved upon at the detailed design stage.

7.2.3 Uniaxial compressive strength

Uniaxial compressive strength has been derived based on data presented in Section 6 as well as the engineering log information captured in Section 5. This includes a review of in-situ SPT tests, engineering log descriptions and laboratory measurements of UCS from core samples. The rationale for the selected parameters is explained below:

- Margate Chalk Member – 2MPa at -8mAOD, increasing by 0.125MPa per metre to c.-21mAOD, based on UCS test results.
- Seaford Chalk Formation – 3MPa, based on UCS test results.

7.2.4 Effective angle of shearing resistance and cohesion

The effective stress parameters have been derived based on the data presented in Sections 5 and 6 as well as published correlations. The rationale for the selected parameters is explained below:

Effective angle of shearing resistance:

- Tidal Flat Deposits – Correlation with plasticity index (conservative value of 50%) from BS 8004:2015 of 20.5 degrees, with CUT testing suggesting a value of up to c. 29 degrees could also be appropriate. This should be subject to further review at the detailed design stage, and may also vary significantly if organic rich materials are encountered, requiring more detailed review.
- Thanet Formation – Conservative estimate based on shear box testing and plasticity index data from BS 8004:2015 of 20.5 degrees. It is likely this could be improved upon at the detailed design stage.
- Chalk (Newhaven and Seaford Chalk) – Based on CIRIA C574, an angle of shearing resistance of 31 is considered to be conservative at the current stage of design.

A cohesion of 0kPa has been adopted for all units based on guidance provided within BS 8004:2015.

7.2.5 Coefficient of volume compressibility

The coefficient of volume compressibility has been derived through one dimensional consolidation testing for the Tidal Flat Deposits and the Thanet Formation. The data should be treated with caution as laboratory values of consolidation parameters are typically lower than in-situ conditions.

- Tidal Flat Deposits – Ranging between 0.10 – 4.0 based on in-situ and laboratory testing, engineering judgement and published values for similar materials. There is a reasonable range associated with this material, likely attributed to its variable formation environment and potential presence of organic materials.

- Thanet Formation – Ranging between 0.04 – 0.10 based on in-situ and laboratory testing and engineering judgement / published values for similar materials.

7.2.6 Characteristic parameters – summary

Table 7.4 presents a summary of the characteristic parameters from information presented in the above sections. Reference should be made to the above sections for further information on their derivation. Selection of design values must consider the design task they are being adopted for.

Table 7.4: Preliminary characteristic geotechnical parameters

Strata	Unit Weight (kN/m^3)	Undrained Shear Strength (c_u, kPa)**	Uniaxial Compressive Strength (MPa)	Effective Angle of Friction (ϕ', °)**	Effective cohesion (c', kPa)	Coefficient of volume compressibility (m_v, m^2/MN)
Tidal Flat Deposits	17.0	20kPa at 1 to 0m AOD, decreasing to 10kPa at 0m AOD, increasing by c. 1kPa per metre to a maximum of 16kPa at -7m AOD	N/A	20.5 – 29	0	0.1-4
Thanet Formation	18.0	At the top of the unit, 40kPa until 1.5m below its top. Beneath this, 100kPa for the remainder of the unit	-*	20.5	0	0.04-0.1
Margate Chalk Member	19.0	N/A	2-3.6 (see Section 7.2.3)	N/A	N/A	N/A
Seaford Chalk Formation	19.2	N/A	3	N/A	N/A	N/A

*No laboratory UCS testing undertaken, it is recommended that the Thanet Formation is treated as a cohesive material for the purpose of any deep foundation design to remain conservative at this stage of design. At the next design stage it is recommended that this is reviewed, particularly with respect to the presence of the Pegwell Marls.

**It is likely that at the detailed design stage, selected parameters can be improved upon including for example undrained shear strength and effective angle of shearing resistance within the Thanet Formation.

7.3 Ground aggressivity

Ground conditions have been assessed according to the BRE Special Digest 1: Concrete in Aggressive Ground (2005) recommended method for natural ground locations containing pyrite. A summary of laboratory testing results, as well as the assessed Design Sulphate (DS-) class and Aggressive Chemical Environment for Concrete (ACEC-) class is presented in Table 7.5.

The assessment has been carried out assuming mobile groundwater in all cases, as groundwater was encountered from shallow depth during the GI. The Tidal Flat Deposits, while low permeability, may have sand beds as identified in the CPT data (Section 5.3.6).

Test results from the Tidal Flat Deposits and Thanet Formation indicate high amounts of organic matter or sulphates, as well as oxidisable sulphides, which suggest the potential presence of pyrites. These materials are likely to be aggressive to buried concrete elements, and information on its classification is summarised below.

A number of samples identified high concentrations of chloride ions, however, since the site is not brownfield land, and due to the proximity to the sea, the source of chloride ions is interpreted to be seawater/brackish water from the River Stour, which is tidal close to the site. Following BRE guidance there is therefore no chloride adjustment necessary, as it is not likely that hydrochloric acid is present in the ground.

Table 7.5: BRE SD1 Ground Aggressivity Assessment

Stratum	Characteristic Values			No disturbance of pyrite bearing strata		Disturbance of pyrite bearing strata	
	Water Soluble Sulphate (SO4 mg/l)	Total potential sulphate (SO4 %)	Soil pH	Design Sulphate Class	ACEC Class	Design Sulphate Class	ACEC Class
Tidal Flat Deposits	2000	5.9	7.7	DS-3	AC-3	DS-4*	AC-4*
Thanet Formation	2200	3.3	7.8	DS-3	AC-3	DS-4*	AC-4*
Margate Chalk Member	1000	-	7.7	DS-2	AC-2	DS-1	AC-1
Seaford Chalk Formation	0	-	8.8	DS-1	AC-1	DS-1	AC-1

*The Thanet Formation and Tidal Flat Deposits based on disturbance of pyrite bearing strata in accordance with BRE Special Digest 1, both return a Design Sulphate class of DS-5, AC-5. However, in accordance with Figure C5 (to determine the appropriate design class where disturbance of pyrite bearing ground could result in additional sulphate), where the total potential sulphate is taken as the greatest value, then the Design Sulphate Class is limited to DS-4.

8 Engineering Considerations

8.1 General

Following completion of the site-specific GI, there is an opportunity to review the design proposals and constraints / considerations with respect to the ground conditions. These are summarised in the below sections, based on information presented on the drawings in Appendix A.

8.2 Cable Route

8.2.1 Trenches

A typical cross-section of an open cut trench is presented within Appendix A, alongside typical construction easements along the proposed works corridor.

The cable trenches are anticipated to be up to c. 1.5 – 2m in depth and will predominantly encounter the Thanet Formation or the Tidal Flat Deposits (TFDs) dependent on the area of the site.

Excavation is anticipated to be straightforward and side slopes will be stable with a suitable temporary batter in granular deposits (say 1V:1.5H) or installation using a temporary support system e.g. drag box may also locally be appropriate. Where excavations are within cohesive TFDs, temporary excavation support such as a trench box or sheet piles will likely be required. Groundwater is expected at around 1m below ground level in the Tidal Flat Deposits, however it is likely to comprise only slow inflow and should be manageable with simple sump-pump drainage. The uppermost c. 1.5m of the Tidal Flat Deposits is anticipated to have a desiccated crust, and beneath this material is likely to be very soft / organic. This could potentially result in any infrastructure being founded within the desiccated crust experiencing punching through into the underlying soft material dependent on the depth of excavation, and excavations may be more unstable if the underlying soft materials are encountered. It is recommended that given excavation depths of 1.5-2.0m bgl, the desiccated crust is not relied upon from a strength perspective, and it should be assessed in further detail at the detailed design stage.

Cement Bound Sand (CBS) would be used as backfill above and below the cables. The trench will then be backfilled with well compacted thermally suitable backfill. The sand required for the CBS will need to comply with BS 12620:2002+A1:2008 – Aggregates for concrete. Based on a high-level review, it is likely that all of the site-won material may have too greater fines content for filler aggregate. Additional laboratory testing is likely to be required to fully determine the suitability of the material for re-use as CBS, and it is recommended this is undertaken at the next design stage.

It is envisaged that the majority of the Thanet Formation would be suitable for re-use as a general backfill material, though an element of treatment such as by drying and/or wetting could be required. The following should be noted:

- The Thanet formation is likely to be encountered in the eastern area of the cable route, generally as a silt / clay with some gravel / cobble content of flint which may be attributed to potential Head deposits formed from the unit. This material could be subject to frost heave / degrade with exposure to moisture dependent on its particle grading and should be treated carefully if utilised on site. In addition, there is potential for the Head deposits to have, dependent on their lithology, historical slip surfaces which may act to destabilise excavations

- Presence of obstructions such as cobbles in the upper parts of the Thanet (possible Head deposit) could act as obstructions to construction.
- Topsoil should be stripped and stockpiled for replacement on completion of the backfilling.

8.2.2 Structures

Two joint bays are proposed along the cable alignment, to connect lengths of cable through the ducting, which are proposed to be reinforced concrete ground bearing slabs. In addition, other structures such as culverts are required as part of the haul road to allow construction vehicles to cross over small drainage ditches. Based on the materials which are likely to be encountered, and as these concrete elements are envisaged to be relatively lightly loaded, it is likely that bearing onto or within the underlying Thanet Formation would be suitable. The formation should be reviewed during construction with removal of any soft/loose spots, and it should be protected from inclement weather. The Tidal Flat Deposits may require limited ground improvement to increase its bearing capacity and limit the potential settlement to allowable levels. Any concrete should be designed in accordance with the relevant concrete class (see Section 7.3), and design of elements should be assessed at the next stage.

In addition to the above, structures including for example new pylons and pylon modification works are required in vicinity of the proposed Minster substation. Dependent on the structural loads, it is likely that a deeper foundation solution such as piles could be required. It is recommended that this is assessed in detail at the next design stage. The design solution adopted for the nearby Richborough to Canterbury Overhead Line (OHL) pylons should be consulted as these are likely to have been constructed within similar geological materials in the vicinity of the proposed works.

8.2.3 Trenchless crossings

The main trenchless crossing is proposed as part of the offshore connection, which is the design responsibility of Red Penguin. This crossing is expected to pass through the Margate Chalk Member and Seaford Chalk Formation for the majority of its length and may encounter significant groundwater flow. Groundwater is unlikely to be encountered within the reception pit, having been struck within RedP-BH-8 at 6.5m below ground level.

A summary of the potential trenchless sections anticipated along the cable route alignments is given in Table 8.1 along with the envisaged ground conditions based on available information at the locations of the launch and reception pits and within the main drive. For the purposes of this assessment, it has been assumed that the convertor station/ substation connection to the existing OHL will be by buried HVAC cable route. Refer to Table 2.1 for details of the various stratum.

Table 8.1: Summary of HDD Sections and Anticipated Ground Conditions

HDD Section Reference	Location	Stratum		
		Launch	Reception	Drive
1	HVDC cable route Option 2	TAB	TAB	TAB
2	HVDC cable route A256 Richborough Way crossing	TAB	TAB	TAB
3	HVAC cable route railway crossing	TFD	TFD	TFD
4	HVAC cable route Minster Stream crossing	TFD	TFD	TFD

8.2.3.1 HVDC cable Route

There are two anticipated HDD crossings on the HVDC cable route, the anticipated ground conditions are summarised in Appendix C. The drive for both crossings is expected to be within

the Thanet Formation. This unit is anticipated to comprise a sandy silt or siltstone (Marl) within the depth range of the HDD and the launch / reception pits.

The water table at these locations will be high. Care will be required to balance drilling fluid pressures and groundwater pressures to ensure stability at the drill head e.g. over-pressure may “blow” the material whilst under-pressure may result in internal erosion of any coarser particles. In addition, there are significant thicknesses of siltstone / marl which may pose as obstructions to construction.

In order to select a competent contractor, it is recommended that tender documents for the HDD require a method statement to address the specific issue of drill head / face stability in Thanet Formation.

8.2.3.2 HVAC Cable Route

There are two anticipated HDD crossings on the HVAC cable route. The drive for both crossings is expected to be within the TFD. HDD in this material should be relatively routine provided it is within the cohesive soils. If the drive is deep enough to encounter the TFD Granular layer, the same issues of face stability as described above will apply.

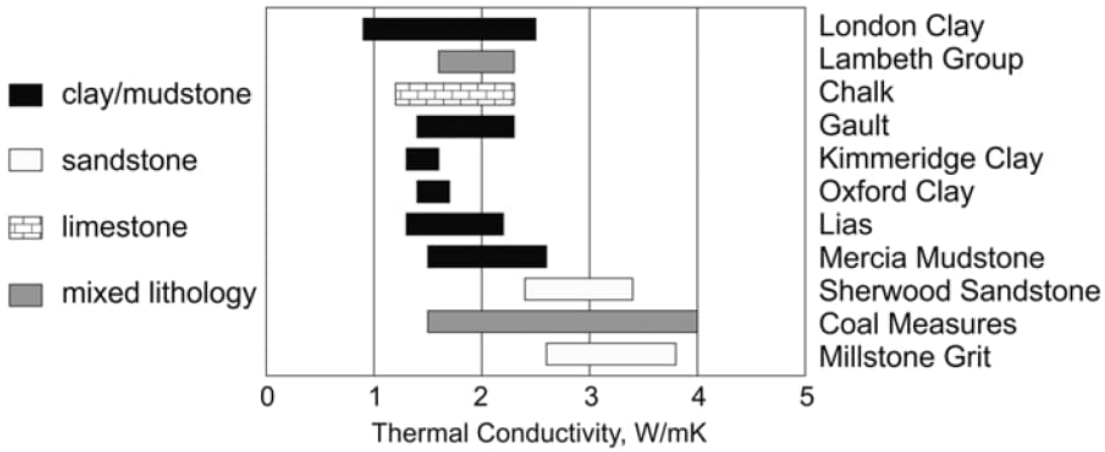
8.2.3.3 Launch and Reception Pits

Groundwater control for the launch and reception pits is likely to be required in all locations, particularly at the locations along the HVDC cable route where groundwater can be expected within the top few metres below ground level.

8.2.4 Thermal Conductivity

In-situ thermal conductivity tests were carried out within trial pits along the cable route. The recorded thermal conductivity values generally range between 0.45 – 0.95 W/mK for the materials encountered – reference should be made to Sections 5.3.11 and 5.4.12 for further details. These values are generally lower than the published general range of values in the UK, as indicated in Figure 8.1.

Figure 8.1: Range of Thermal Conductivity Values for Selected UK Strata



Source: Taken from Site Investigation for Energy Structures, Fleur Loveridge, Jasmine Low & Willian Powrie, 24th April 2017, Quarterly Journal of Engineering Geology

8.3 Convertor Station and Substation

8.3.1 Foundations and platform

The site is located at very low level, and it is likely that the whole site will need to be raised above the design flood level.

The engineering logs and geotechnical laboratory testing data presented show the undrained shear strength (cu) of the Tidal Flat Deposits to be generally between 10 – 20kPa though is slightly greater at the top of the unit associated with a thin desiccated crust. Although test results including in-situ hand vane tests suggest strengths of up to c. 100 kN/m^2 over this area , the desiccated crust should not be relied upon from a design perspective due to potential for risk of concrete/buried elements punching through this layer into the very soft soils underneath. The undrained shear strength is highest above the groundwater table, within the top metre and then rapidly decreases where the material is saturated.

Given the low-lying nature of the site, it is envisaged that the ground revealed below topsoil strip will be soft, potentially with a CBR<2 as shown from in-situ DCP testing The following sequence of work is envisaged subject to a detailed ground investigation being completed after which the recommendations should be reviewed and revised accordingly.

- Remove topsoil (assume average 400mm thickness),
- Remove and replace any soft areas with well compacted imported granular material,
- Place geotextile separator,
- Construct raised platform 600mm thick with imported compacted MoT Type 3 material.

A programme of trial pitting with hand vane testing is recommended as part of the **detailed** ground investigation in order to characterise the upper 2 to 4m of soils across the site as well as Cone Penetration Testing (CPT) to obtain a stiffness profile with depth through the TFD. This will allow better quantification of required volume of import material. It is suggested a provisional allowance of an additional 35% granular material over and above the volume required for site raising be made for replacement of soft spots based on preliminary available information.

For discreet footing and strip foundations founded at least 600 mm above the base of the platform, a preliminary allowable bearing capacity of 70 kPa is appropriate for limiting total and differential settlement to 25 mm.

Larger raft foundations, gantry foundations and/ or foundations with a settlement tolerance <25mm will require a bespoke assessment and, in most probability **will require piles**.

At the time of writing, a piled foundation solution is an option for the proposed Converter Station, and alternatives including ground improvement should be considered as part of an engineering optioneering assessment at the detailed design stage.

Various forms of ground improvement may be suitable, and are required primarily to mitigate ground risks associated with the compressive, low strength Tidal Flat Deposits under the site. This may include options to increase its consolidation ahead of the proposed platform construction – such as through placement of additional fill to accelerate consolidation. It is understood that as part of the proposed works a platform is to be constructed to raise site levels by 2m.

Other options include methods to distribute loads through soft soils and reinforce them to increase strength / bearing capacity, with columns founded into the underlying competent material of the Thanet Formation. Techniques such as Controlled Modulus Columns (CMC) could be appropriate and will require further assessment for the detailed design stage. These techniques can also be used in combination with other methods to make them more effective,

including for example increasing the rate of consolidation through installation of pre-fabricated vertical drains.

To review the most appropriate methods it is recommended that as part of the detailed design stage that an optioneering assessment is undertaken to review the most suitable methods to meet the design requirements and programme.

8.3.2 Permanent Drainage

Due to the relatively low permeability of the Tidal Flat Deposits, infiltration drainage is unlikely to be feasible where a significant thickness of this material is present. In addition, an infiltration test within the Thanet Formation at R22-TP501 also showed low permeability, likely due to the high fines content within the unit.

8.4 Unsuitable material

Any unsuitable material encountered, including Made Ground or Tidal Flat Deposits, not considered to be suitable for re-use due to its potential variable properties and organic content, where encountered should be excavated and replaced with a suitable compacted granular engineered fill where possible.

It will not be possible to carry out dig-and-replace beneath the main Converter Station site due to the thickness of Tidal Flat Deposits present.

8.5 Pavements

Pavements are required to be constructed to form the permanent access roads, providing suitable formation for areas of proposed construction compounds along the length of the project as well as temporary haul roads which are envisaged along the length of the cable route to assist with its construction. Pavements are also required within the Converter / Substation area which can accommodate larger wheel loadings associated with plant and equipment movements.

From review of laboratory and in-situ testing information, the following California Bearing Ratios are considered to be appropriate for the current level of design, dependent on the materials which are encountered:

- The soft Tidal Flat Deposits will have an equilibrium CBR<=2% and will require a full thickness capping layer (600 mm) as well as potentially an integral geogrid within the unbound pavement layers.
- Pavements on the raised site platform should have a long term CBR of >15% provided the base of the sub-base layer is >600 mm above the base of the platform layer.
- A long-term equilibrium CBR of 3.5% should be achievable for pavements on the Thanet Formation, based on the results of in-site and laboratory testing. Localised hard spots are likely to be present where the CBR achieved is greater than 3.5%.
- Construction of the platform is likely to be required to achieve sufficient CBR to support the larger wheel loadings associated with construction plant and equipment for the proposed Converter Station. Determination of the CBR for the platform is anticipated to be specified within the project earthworks specification, and will depend on the material selected for platform construction. CBR's in the range of 10%+ should be achievable assuming a granular engineered fill is utilised and compacted in accordance with a comprehensive specification (e.g. Specification for Highways Works Series 600). The specification should be prepared at the detailed design stage and capture material requirements, as well as laboratory and in-situ compliance testing.

9 Geotechnical Risk Register

Table 9.4 details the Geotechnical Risk Register for the project. The risks associated with other aspects of the scheme, such as such as procedures and contractual and strategic issues are not dealt with here and the scheme risk register should be consulted for information on these elements.

The Geotechnical Risk Register should be considered as a live document and updated throughout the course of the scheme. It is incumbent on all parties involved in the scheme to advise the other members when the risks change.

Various threats are identified, and the potential consequences of these occurring are described. The risk is derived by considering the severity and likelihood for each threat and opportunity. Both the severity and likelihood have been assessed using a scale of 1 to 5, corresponding to "Minor" to "Catastrophic" for severity and "Extremely unlikely" to "Almost certain" for likelihood. These ratings are summarised in Table 9.1 and Table 9.2, with the risk classification summarised in Table 9.3.

Table 9.1: Risk level matrix

Likelihood		Severity				
		1	**2**	**3**	**4**	**5**
		Minor	**Moderate**	**Serious**	**Major**	**Catastrophic**
1	**Extremely unlikely**	1	2	3	4	5
2	**Unlikely**	2	4	6	8	10
3	**Likely**	3	6	9	12	15
4	**Extremely likely**	4	8	12	16	20
5	**Almost certain**	5	10	15	20	25

Table 9.2: Hazard severity table

Potential severity of harm occurring		
1	**Minor**	Minor damage or loss – (no human injury)
2	**Moderate**	Moderate damage or loss – (Slight injury or illness)
3	**Serious**	Substantial damage or loss – (Serious injury or illness)
4	**Major**	Major damage or loss – (Fatal injury)
5	**Catastrophic**	Catastrophic loss or damage – (Multiple Fatalities)

Table 9.3: Risk classification table

Risk classification	
Low (1 – 8)	Ensure assumed control measures are maintained and reviewed as necessary.
Medium (9 – 19)	Additional control measures needed to reduce risk rating to a level that is equivalent to a test of "reasonably required" for.
High (20 – 25)	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable level.

Ground investigation can help to mitigate ground and groundwater risks; however, these risks cannot be eliminated. Ground investigations by their nature can only investigate and monitor a small part of the sub-surface conditions for a limited duration. Conditions on site identified

during construction could reveal ground conditions that could not have been taken into account from the results of the ground investigation.

It is recommended that adequate and appropriate supervision must be provided during construction to assess the ground conditions encountered and interpret the results of the site testing. When appropriate this supervision during construction should be undertaken by a suitably experienced and qualified Engineering Geologist / Geotechnical Engineer.

highlights the potential hazards that could be encountered during the site investigation and/or construction. The consequence of the hazard is outlined, and a score is given for the impact and likelihood of this hazard, giving an overall risk, which is categorised as either a cost, time, environment or health and safety risk. From this, potential control measures are stated to alleviate the hazard, leading to a rescoring of the impact and likelihood, resulting in a residual risk.

Table 9.4: Geotechnical Risk Register

Hazard	Consequences	Severity	Likelihood	Risk	Mitigation	Severity	Likelihood	Risk
1. Topsoil	Topsoil encountered across majority of site footprint at surface. Potential for contamination (see 9, 10).	3	3	9	Undertake topsoil resource survey to determine suitability for re-use where required. Best practice during construction, including segregation of materials during excavation	1	3	3
2. Made Ground	Made Ground may locally be encountered, particularly in vicinity of developed areas. Limited Made Ground was recorded in site-specific GI. Potential for Made Ground to be unacceptable for re-use and require disposal / remediation. Potential for material or groundwater in the deposit to be contaminated (see 9, 10) Risk of buried known / unknowable obstructions to be encountered during construction	3	3	9	Early consultation required with regulatory bodies. Construction strategy to be in place by Contractor to eliminate risk of contaminant migrations. Obtain as-built information, GPR surveys and confirm locations of any known obstructions, or demolish in advance of construction works. Mitigation plan to be in place for dealing with unexpected obstructions.	2	3	6
4. Tidal Flat Deposits	Encountered across converter station area, including connection to existing OHL and western part of HVDC cable route as very soft to soft organic clays and peat. Highly compressible, low bearing capacity Excessive total / differential settlement of access haul roads due to potential presence of organic materials Shallow groundwater likely to be present associated with River Stour. Unlikely to be suitable for material re-use, except for landscape fill and is likely to require improvement / treatment or disposal off site where present. Aggressive to buried concrete and infrastructure (see 12). Variable permeability. Poor infiltration characteristics of near-surface materials meaning SuDS drainage is unlikely to be feasible.	4	4	16	Contractor to carry out temporary works design including design of any necessary excavation support and stability analysis as well as control of groundwater inflows. Ground improvement to be considered during the detailed design of foundations within the Tidal Flat Deposits due to low bearing capacity and high compressibility of the unit. Soft spots to be removed and replaced with an appropriate granular engineered fill where possible. Drainage design to consider poor infiltration characteristics of this material. Concrete to be design in accordance with relevant sulphate class (see 12).	2	4	8
5. Tidal Flat and Beach Deposits (Undifferentiated)	Encountered in vicinity of the Red Penguin HDD alignment near surface as gravel. Variable permeability. Excavation instability.	2	2	4	Red Penguin to consider potential risks with the proposed HDD alignment. It is envisaged that the alignment will pass beneath this material, therefore no additional mitigations may be required (subject to confirmation by Red Penguin).	1	2	2

Hazard	Consequences	Severity	Likelihood	Risk	Mitigation	Severity	Likelihood	Risk
6. Thanet Formation	Presence of unmapped former pits. Minimal or no superficial cover over the Thanet Formation with high groundwater table in location of trenchless sections and open cut. Potential for near-surface Head deposits which may show signs of instability in excavations Variable material with several sub-units including firm to very stiff SILT / silty CLAY, silty to very silty SANDS (Reculver Silts and Stourmouth Clays). Significant thickness of extremely weak to very weak SILTSTONE (Pegwell Marls), and at its base the Bullhead Beds were occasionally recorded (basal bed of black fine to coarse GRAVEL with flint cobbles) Aggressive to buried concrete and infrastructure (see 12) Secondary A Aquifer. Horizontal drilling within both clay and sand/ cemented sand potentially with hard bands.	3	4	12	Contractor to carry out temporary works design including design of any necessary excavation support and stability analysis as well as control of groundwater inflows. Contractor to choose plant and techniques appropriate for excavation/drilling in hard materials. Concrete to be design in accordance with relevant sulphate class (see 12).	2	4	8
7. White Chalk Subgroup (Margate Chalk Member and Seaford Chalk Formation)	Chalk encountered at shallower depth than expected. Natural obstruction (flint cobbles/ hardgrounds) resulting in difficulty progressing exploratory holes and HDD. Increased cost and programme delay Chalk is designated as a Principal Aquifer Presence of solution features - bearing capacity failure leading to structural damage. Increased vulnerability due to concentrated run-off from structures/ paved areas	3	2	6	Chalk present beneath the entire site, but only likely to be encountered in the offshore connection HDD, which is the responsibility of Red Penguin. Red Penguin to consider geotechnical properties of material in vicinity of HDD alignment and appropriate methods of construction based on the ground conditions. Formation should be inspected for signs of infilled pits or solution features, and any localised soft and/or loose spots removed and replaced or improved.	2	2	4
8. Groundwater	Groundwater depth varies across the site (see Section 4.2). Potential for perched and shallow groundwater within some deposits (e.g., Tidal Flat Deposits). Groundwater ingress may cause excavation instability. Groundwater in vicinity of Red Penguin HDD area indicated to be tidally influenced. Protected Aquifer (e.g. Thanet Formation – see 6, and Chalk – see 7)	3	4	12	Best practice during construction including following design drawings and suitable method statements, ensuring correct use of temporary works when necessary and highlighting any hazards which may arise. Ensure temporary works design considers the ground conditions, in particular if groundwater is encountered during excavations. Aquifers to be suitably protected from any risk of contamination during construction	3	2	6
9. Groundwater contamination	The GQRA report (see Section6) has been prepared alongside this GIR. This identified the risk to the water environment and groundwater to be moderate.	3	3	9	Should any dewatering of excavations be required, water may require to be disposed of off-site. Consultation should be undertaken with the Environment Agency should this be required. Reference should be made to the recommendations within the GQRA for further information.	3	1	3

Hazard	Consequences	Severity	Likelihood	Risk	Mitigation	Severity	Likelihood	Risk
					Any below-ground infrastructure and services should be appropriately designed to endure contact with any contaminants in groundwater.			
10. Soil contamination	The GQRA report (see Section 6) has been prepared alongside this GIR. This identified pollutant linkages at the site as low to very low risk, with no visual or olfactory evidence of potential contamination at the site. The risk to human health is considered to be negligible to low.	3	2	6	A robust CPP and CEMP should be put in place to ensure no undue risks are posed to human health and controlled waters receptors during the construction phase. In the event that unexpected contamination is found when carrying out the proposed development, such as oily, odorous, brightly coloured or fibrous material in soils, works are to cease, and the local planning authority are to be advised. The re-use of this material including earthworks may need to be covered by a CL:AIRE Materials Management Plan, or another suitable permitting regime. Additional assessments may be required dependent on the quantity of material to be re-used. A waste Contractor should be contacted to discuss appropriate soil disposal options should soils require removal from site. Reference should be made to the GQRA (see Section 6) for full details on contaminated land related recommendations.	3	1	3
11. Unexploded Ordnance	The detailed UXO risk assessments undertaken for the site indicated a risk level ranging between medium to high. See Section 2.11 for further detail. Potential to encounter UXO during construction works and excavations. Reference should be made to the reports for further information.	5	3	15	Implementation of mitigation measures recommended as detailed in the Detailed UXO Assessment reports. Adopt best practice, due skill, and care in executing ground investigation and in-ground construction activities	5	2	10
12. Aggressive ground conditions	Potentially high levels of sulphate within the ground. This can lead to degradation of concrete strength and quality. Soil and groundwater samples were tested and reported in Section 7.3. Most pertinent includes aggressive ground conditions identified within the Thanet Formation and Tidal Flat Deposits (DS-3, AC-3 to DS-4, AC-4 dependent on level of disturbance during construction)	3	4	12	Ensure any concrete on site is designed in accordance with measured levels of sulphates within the soil and groundwater, and the appropriate class is taken based on the design activity. See Section 7.3 for further detail.	3	2	6
13. Ground gases and vapours	Potential for gases to accumulate in confined space, impacting health of workers. Potential gas sources identified at the site include infilled pits and any Made Ground / Tidal Flat Deposits. The derived ground gas Characteristic Situation (CS) for the area, based on CIRIA C665 guidance, was CS-1, very low risk (	4	1	4	Refer to GQRA for further details.	4	1	4

Hazard	Consequences	Severity	Likelihood	Risk	Mitigation	Severity	Likelihood	Risk
14. Radon	An exposure to elevate radon levels overtime may lead to disease. The site is in an area where <1% of dwellings exceed the Radon Action Level – no radon protection measures are required as reported in the Groundsure report	2	2	4	No radon protective measures are necessary in the construction of new dwellings or extensions. More information can be found at www.ukradon.org	2	2	4
15. Flooding	Low-lying ground and impermeable geology - requirement to raise site level due to surface water and groundwater flood risk. Increased cost and requirement to import material to raise site platform level	4	3	12	Identify local sources of suitable material for import. Detailed design including assessment of flood risk.	4	2	8
16. Ecology	Potential damage and impacts on important habitats, protected / notable species or non-statutory designated sites, as well as delays to construction. Existing infrastructure/ environmental features/ land access issues constrain the working area available resulting in reduced efficiency/ buildability and increase in safety hazards. Reference should be made to information provided by National Grid's Environmental Consultant.	3	3	9	Reference should be made to National Grid's Environmental Consultant's reporting and relevant information to inform detailed design and construction processes, including any required mitigation measures for the sites ecological constraints.	3	2	6
17. Archaeology	Programme delays if statutory obligations to investigate/ survey are not fulfilled prior to commencement of construction. Potential areas of archaeological importance noted across the scheme.	2	3	6	Any potential archaeological constraints which may influence construction should be assessed in detail during the detailed design stage. It is understood that separate archaeological surveys are being carried out to assess this in further detail.	2	1	2
18. Design elements – Cable route	Thanet Formation and Tidal Flat Deposits are likely to be encountered – refer to no 4 and 6 for further detail. Refer to 21 for earthworks and 24 for pavements. Dependent on structural loads, deeper foundations such as piles may be required for some elements such as pylons. Potential for groundwater inflow e.g. perched water tables may lead to local instability and obstructions with the Tidal Flat Deposits.	2	3	6	Undertake ground investigation at the next design stage to inform detailed design development. Formation should be inspected, and any localised soft and/or loose spots removed and replaced or improved. Best practice during construction including following design drawings and suitable method statements, ensuring correct use of temporary works when necessary and highlighting any hazards which may arise. Concrete to be designed in accordance with BRE SD:1 (see 12)	1	3	3
19. Design elements – Converter Station	Raft foundation, ground improvement and/or piles may be required dependent on structural loads and structural settlement tolerances. Potential for aggressive ground – see 12	3	3	9	Undertake ground investigation at the next design stage to inform detailed design and optioneering development. Formation should be inspected, and any localised soft and/or loose spots removed and replaced or improved. Best practice during construction including following design drawings and suitable method statements, ensuring correct use of temporary works when necessary and highlighting any hazards which may arise. Concrete to be designed in accordance with BRE SD:1 (see 12)	3	2	6

Hazard	Consequences	Severity	Likelihood	Risk	Mitigation	Severity	Likelihood	Risk
20. HDD sections	Offshore HDD in predominantly Chalk geology with high groundwater flow in fractures. A256 HDD may encounter both silt and sand / cemented sands, potentially with hard bands (see 6). Potential for variable conditions including localised loose or running sands. Groundwater ingress into launch / reception pits leading to excavation instability.	4	3	12	Off-shore connection HDD is the responsibility of Red Penguin. Red Penguin to consider geotechnical properties of material in vicinity of HDD alignment and appropriate methods of construction based on the ground conditions. A256 road HDD crossing to be designed at a later design stage.	4	2	8
21. Earthworks	Volumes of re-usable material and material requiring any kind of treatment to be assessed at the detailed design stage. Thanet Formation and Tidal Flat Deposits are anticipated to be predominant sources of site-won material. Most of the Thanet Formation is likely to be suitable for re-use, dependent on its required end-use (see high-level assessments presented in Section 5 and Section 9). Tidal Flat Deposits is unlikely to be suitable for re-use, however this is dependent on the required end-use. Treatment such as wetting or drying is envisaged to be required to ensure appropriate level of compaction	3	3	9	Make sufficient allowance for unsuitable material in the cut to fill design. Prepare earthworks specification including classification testing prior to and during site works to ensure material is suitable for re-use. Segregation of materials during construction. Earthworks to be undertaken with good workmanship and to avoid inclement weather. Undertake further assessment at the next design stage to determine suitability for site-won material for treatment such as lime and/or cement stabilisation where required).	3	2	6
22. Below ground and overhead utilities (including known and unknown)	Unexpected delay and additional measures to repair and divert unknown utilities. Temporary loss of utility. Possible injury or death during intrusive works. Revision to proposed alignment/ design revision required. Cost and programme implication. Overhead services - space constraint on construction plant access, service strike during ground investigation/ construction works, temporary loss of utility, cost of repair and programme delays	4	3	12	Additional GPR surveys plus mitigation plan for dealing with unplanned utilities. Early liaison to arrange overhead lines to be temporarily switched off during construction activities. All works to be carried out in accordance with HSE Guidance Note GS6: Avoiding Danger from Overhead Power Lines (4th Edition). Due skill and care in executing in-ground activities. Obtain any plans from landowners where relevant.	4	1	4
23. River Stour crossing	Potential for large differential settlements between structural elements and/or riverine sediments. Potential for impacts on adjacent watercourse during construction. Potential aggressive ground (see 12)	4	4	16	Undertake ground investigation at the next design stage to inform detailed design development including for example settlement analyses, ground improvement and embankment design. Best practice during construction including following design drawings and suitable method statements, ensuring correct use of temporary works when necessary and highlighting any hazards which may arise. Concrete to be designed in accordance with BRE SD:1 (see 12)	4	1	4
24. Pavements	Pavements are expected to encounter the Thanet Formation and/or Tidal Flat Deposits (see 4, 6). Potential presence of localised silts which may have a poor CBR. Potential for soft / loose spots.	3	3	9	Remove soft/loose spots and replace with a suitable granular fill, compacted to achieve the required design CBR value.	3	1	3

Hazard	Consequences	Severity	Likelihood	Risk	Mitigation	Severity	Likelihood	Risk
	Platform construction required to provide suitable subgrade for construction of Converter Station / transport of heavy elements such as transformers. Section 8.5 covers potential CBR values for pavement design. The Tidal Flat Deposits and/or Thanet Formation may be moisture sensitive or susceptible to shrink / swell.				Material to be suitability protected from moisture ingress during construction and from inclement weather. Sub-formation only to be exposed immediately prior to construction. Review required design CBR for platform construction at the detailed design stage, and requirements to be captured within the project earthworks specification (see 21).			
25 Limited GI information	GI coverage across the proposed site generally considered good, however some limited areas inaccessible for GI (e.g., railway line, A256 road, River Stour). Potential for variable ground conditions particularly in Tidal Flat Deposits.	3	2	6	Undertake additional investigation at the next design stage in accordance with BS EN 1997-2.	3	1	3
26. Presence of field drains	May lead to seepage into trench excavations. May require diversion or reinstatement.	2	2	4	Obtain any plans from landowners. Contingency allowance for managing damaged field drains and water inflows.	1	2	2
27. Interaction with third-parties / asset owners	Potential for construction delay associated with works crossing / altering or impacting third parties or asset owners such as Kent Highways associated with A256 amendments and HDD crossing, proposed works in vicinity of Network Rail infrastructure south-west of the proposed Converter Station, and crossing of Minster Stream / River Stour (e.g. liaison with Environment Agency	3	4	12	Liaison with third parties including Environment agency, Network Rail and Kent Highways at an early stage to reduce risk of construction / programme delay. Adherence to the relevant process for each organisation e.g. Kent Highways / Network Rail process	3	2	6

10 Conclusions and Recommendations

This summary contains an overview of the key findings and conclusions of this report. However, no reliance should be placed on any part of this summary without referring to the relevant Sections in the report. Sections within the main body of the report contain information which puts into context the findings that are captured within this summary. The key findings of this report are summarised below.

10.1 Conclusions

10.1.1 Geotechnical

The ground conditions across the site vary, with the main part of the site located on low-lying arable farmland in Kent. The superficial geology is made up of Tidal Flat Deposits, which are absent from part of the HVDC cable route. The underlying bedrock comprises the Thanet Formation and Upper Chalk Group (Margate Chalk Member and Seaford Chalk Formation).

Ground models have been developed in the Preliminary Risk Assessment (see Section 1.1.1) and revised in this report (see Section 7.1) based on information from the preliminary GI undertaken at the site in 2023.

A high-level summary of the main strata likely to be encountered is presented below:

- Tidal Flat Deposits – Generally encountered as stiff, becoming very soft to soft slightly sandy silty CLAY, locally clayey SILT or PEAT, with rare to occasional shell fragments, gravel, and organic matter (rotting wood and peat). These deposits are of significant thickness in the western areas of the site (see Section 4.2 and 5.3 for further detail).
- Thanet Formation – This unit forms a series of interbedded beds / bands of firm to very stiff clayey SILT / silty CLAY likely forming the Reculver Silts and Stourmouth Clays respectively, and a significant portion of this unit is encountered as extremely weak to weak SILTSTONE (interpreted to be the Pegwell Marks). A basal bed of sandy flint GRAVEL known as the Bullhead Beds is typically present at the base of the unit.
- Upper Chalk Group – Comprising the Margate Chalk Member of the Newhaven Chalk Formation, and the Seaford Chalk Formation, present in the Margate Chalk Member as a very weak medium density yellowish white CHALK, becoming the Seaford Chalk Formation, described as a weak high density white mottled light grey CHALK with nodular flint bands.
- Beach and Tidal Flat Deposits (Undifferentiated) were identified in one borehole, however this was within the area of responsibility of Red Penguin, associated with the offshore HDD connection, and is not relevant to the scope of this report.
- Groundwater was present at around 1m below ground level across much of the site, within the Tidal Flat Deposits. Around the A256, groundwater was initially struck deeper, between 6-10m below ground level, however the monitoring standpipes installed recorded groundwater levels generally at 1m and 5m bgl, dependant on the level of the response zone.
- A series of earthworks relationship tests were undertaken on the Tidal Flat Deposits and Thanet Formation. These suggest that the Tidal Flat Deposits will be unsuitable for re-use in earthworks, while the Thanet Formation may be suitable for re-use with appropriate treatment including wetting and/or drying, however further assessments will be required prior to construction.

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- A series of recommended preliminary design parameters are presented within Section 7, and these are subject to review and development to inform specific design elements and should any additional ground investigation be undertaken. Consideration should be given to the design task to adapt appropriate parameters. It is likely that further assessment could improve on selected parameters.
- A geotechnical risk register is presented in Section 9 and highlights the risks that require further mitigation during design and construction. The key risks are thought to include the following:
  - No GI has been undertaken in the area south of the River Stour, there is potential for further GI to be undertaken to inform the OHL detailed design
  - Potential delays to construction / programme – The trenchless crossing of the A256 dual-carriageway using Horizontal Directional Drilling (HDD) methods, as well as highways improvements, and a permanent bellmouth junction off the A256. This will require liaison / interaction with Kent Highways and adherence to the Kent Highways process. In addition, works associated with crossing of Minster Stream / River Stour will require a level of involvement with the Environment Agency, and works within proximity to railways requiring liaison / adherence to Network Rail process dependent on the proposed works.
  - Excavations are likely to require some form of support during temporary works, due to the low shear strength within the Tidal Flat Deposits and shallow groundwater.
  - Soft clay in the Tidal Flat Deposits gives a high risk of long-term excessive total and differential settlement, including for the converter station / substation and proposed OHL pylons. The desiccated crust present in the top c. 1.5m of the deposit should not be relied upon for the purpose of design, as this overlies a thick sequence of very soft / extremely low strength soils.
  - The Thanet Formation contains significant thicknesses of cemented silt/ siltstone, which may present an obstruction depending on the construction techniques employed. On the contrary, this may offer a suitable founding medium for foundations.
  - Groundwater is likely to be encountered during construction, either as the permanent groundwater table or perched water tables. This will require consideration during construction and any trenching / excavations. Dewatering is unlikely to be suitable to discharge back to ground and may require treatment before discharge or taken off-site for disposal (refer to GQRA for further details).
  - Aggressive ground conditions are expected, with particularly high levels of sulphate noted in the Tidal Flat Deposits and Thanet Formation.
  - Low-lying ground and poor drainage characteristics of the shallow geology present a risk of temporary flooding, for which SuDS drainage is unlikely to be feasible.
  - There is potentially low quantities of site material suitable for re-use in earthworks, resulting in both high quantities of imported material being required, and a significant amount of off-site disposal. Thanet Formation is likely to require treatment (wetting or drying) prior to being re-used.
  - CBR values achievable at shallow depth are expected to be poor in Tidal Flat Deposits, and potentially only marginally better in Thanet Formation, requiring more substantial pavement designs. Construction of the platform for the Converter Station is anticipated to facilitate suitable CBR values for permanent design.
  - The potential for unexploded ordnance at the site remains a residual risk, mitigation measures provided within UXO reporting should be adhered to during construction works.

10.1.2 Geo-environmental

Reference should be made to the GQRA report for further details on the geo-environmental conclusions:

- Mott MacDonald Limited, Sea Link FEED, Generic Qualitative Risk Assessment (GQRA) – Kent, May 2024. Document reference: SEAL-MMD-SEAL-ENG-REP-0691.

10.2 Recommendations

The following recommendations are proposed to address the geotechnical risks identified at the site and as detailed in the Geotechnical Risk Register in Section 9:

- It is recommended that additional ground investigation is undertaken at the next design stage to further investigate particular elements including, for example, earthworks re-use and treatment assessment (such as lime and/or cement stabilisation feasibility) and ground improvement, as well as further assessment into the sub-units of the Thanet Formation and their relationship across the site, particularly within the OHL / Converter Station areas.
- Earthworks acceptability and testing of site-won materials should be carried out prior to and during construction, and the requirements of this should be captured within a project earthworks specification.
- The trenchless crossing of the A256 dual-carriageway using Horizontal Directional Drilling (HDD) methods, as well as highways improvements, and a permanent bellmouth junction off the A256. This will require liaison / interaction with Kent Highways and adherence to the Kent Highways process and it is recommended that this is undertaken at earliest convenience to avoid potential delays to the construction timeframe.
- Early liaison will be required with other parties related to crossings as part of the proposed works such as railways (Network Rail) and river crossings (Environment Agency).
- Ground improvement is anticipated to be required to reduce the risk of the significantly thick, compressible and low strength tidal flat deposits. It is recommended that an optioneering assessment is undertaken of ground improvement methods to determine the most suitable method(s) to achieve the required design and programme.
- If dewatering is required during construction, pumped water may require storage and testing prior to disposal. Reference should be made to the GQRA for further details.
- Should any loose/soft material be present at formation or foundation levels, it should be removed and replaced with a suitable granular engineered fill where possible.
- Excavations are likely to require support due to potential for soft materials, and presence of shallow groundwater.

Reference should be made to the GQRA report for further details on the geo-environmental recommendations (Document reference: SEAL-MMD-SEAL-ENG-REP-0691).

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A. Drawings

Design drawings

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The Great Grid Upgrade

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Design Drawings

Version A

October 2023

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**



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	01-04	HVDC & HVAC Arrangement & Cross Sections
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	02-08	Landfall Installation - Pegwell Bay

The Great Grid Upgrade

Sea Link

01. Onshore Design Drawings

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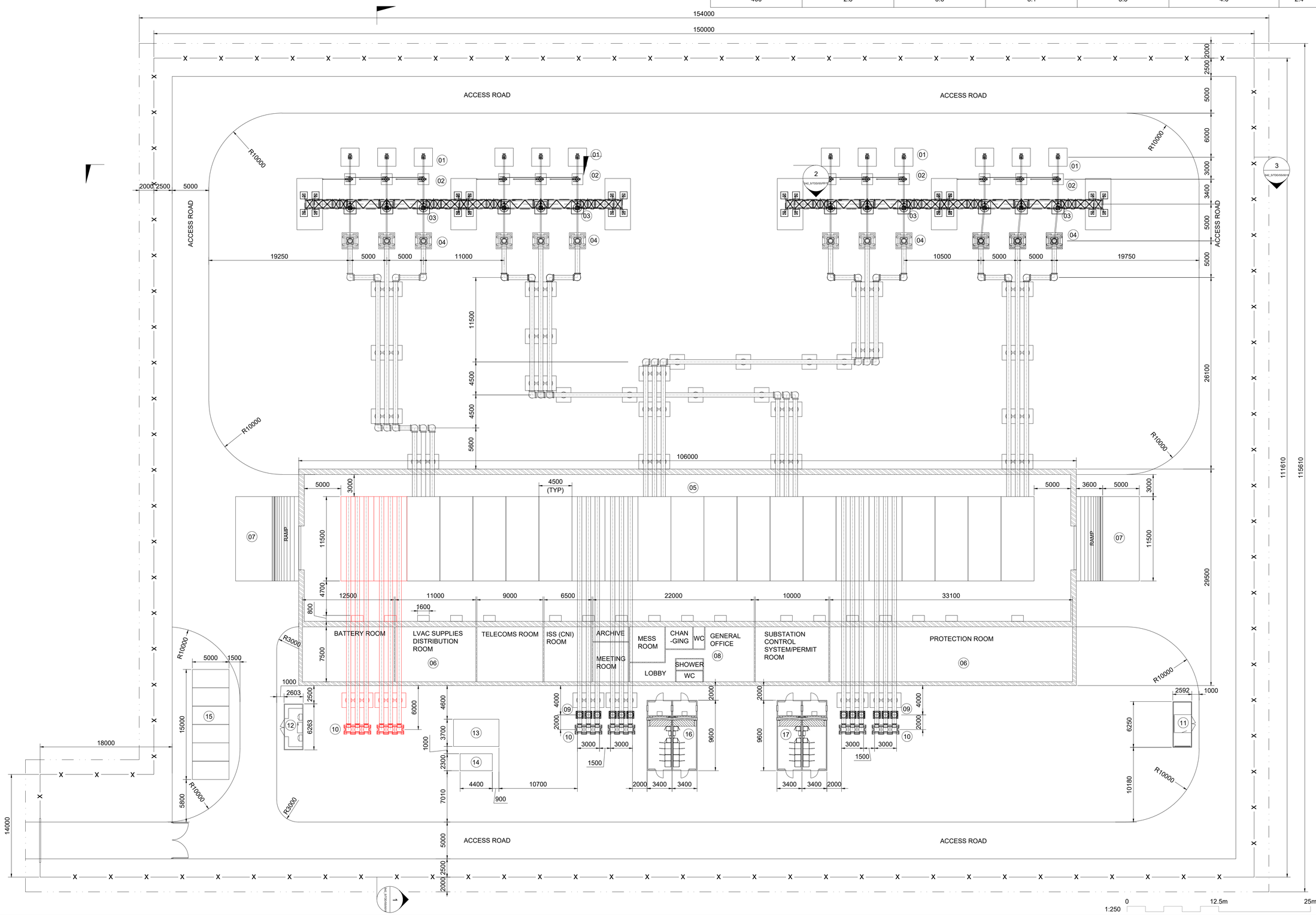
01-01. Friston 400kV Substation

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Friston 400kV Substation	Typical Sea Link works should Friston 400kV GIS substation be developed by others	Suffolk Onshore Scheme	S42_S/TDD/SS/0001
	Typical Friston 400kV GIS substation in scenario where not construction by third party	Suffolk Onshore Scheme	S42_S/TDD/SS/0003
	Typical Friston 400kV GIS substation - elevation drawing	Suffolk Onshore Scheme	S42_S/TDD/SS/0019

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL SEA LINK WORKS SHOULD FRISTON 400kV GIS SUBSTATION BE DEVELOPED BY OTHERS
SHEET 1 OF 1

NOMINAL SYSTEM VOLTAGE	PHASE TO EARTH	PHASE TO PHASE	SAFETY DISTANCE (FROM NATIONAL GRID SAFETY RULES)	DESIGN CLEARANCE FOR SAFETY (VERTICAL) Ds	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL) Dsh	INSULATION HEIGHT Ih
kV	M	M	M	M	M (SEE POINT ii FROM NOTE 6)	M
400	2.8	3.6	3.1	5.5	4.6	2.4



Notes

For statutory consultation purposes only.

1. These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.
2. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
3. Abbreviations
   - AIS - Air Insulated Switchgear
   - CVT - Capacitive Voltage Transformer
   - GIS - Gas Insulated Switchgear
   - ISS - Integrated Security Solutions
   - CNI - Critical National Infrastructure
   - LVAC - Low Voltage Alternating Current
4. Elevation sections relate to S42_S/TDD/SS/0019.

Legend

- EXISTING EQUIPMENT
- NEW EQUIPMENT
- LIMIT OF LAND
- X FENCE

ID	DESCRIPTION
01	400kV AIS CVT
02	400kV AIS EARTH SWITCH
03	400kV AIS SURGE ARRESTOR
04	400kV GIS / AIR BUSHING
05	400kV GIS HALL
06	400kV ANNEX BUILDING
07	HARDSTANDING AREA
08	AMENITIES BLOCK
09	400kV GIS SURGE ARRESTOR
10	400kV GIS / CABLE INTERFACE
11	STORAGE
12	WORKSHOP
13	EMERGENCY DIESEL GENERATOR
14	DIESEL TANK
15	PARKING
16	DISTRIBUTED RELAY ROOM (OFTO EA2)
17	DISTRIBUTED RELAY ROOM (OFTO EA1N)

Issue	Date	Remarks	Drawn	Checked	Approved
A	07/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER DESIGN DRAWINGS FOR CONSULTATION

TYPICAL SEA LINK WORKS SHOULD FRISTON 400KV GIS SUBSTATION BE DEVELOPED BY OTHERS
SHEET 1 of 1

nationalgrid

Application Number: EN020026

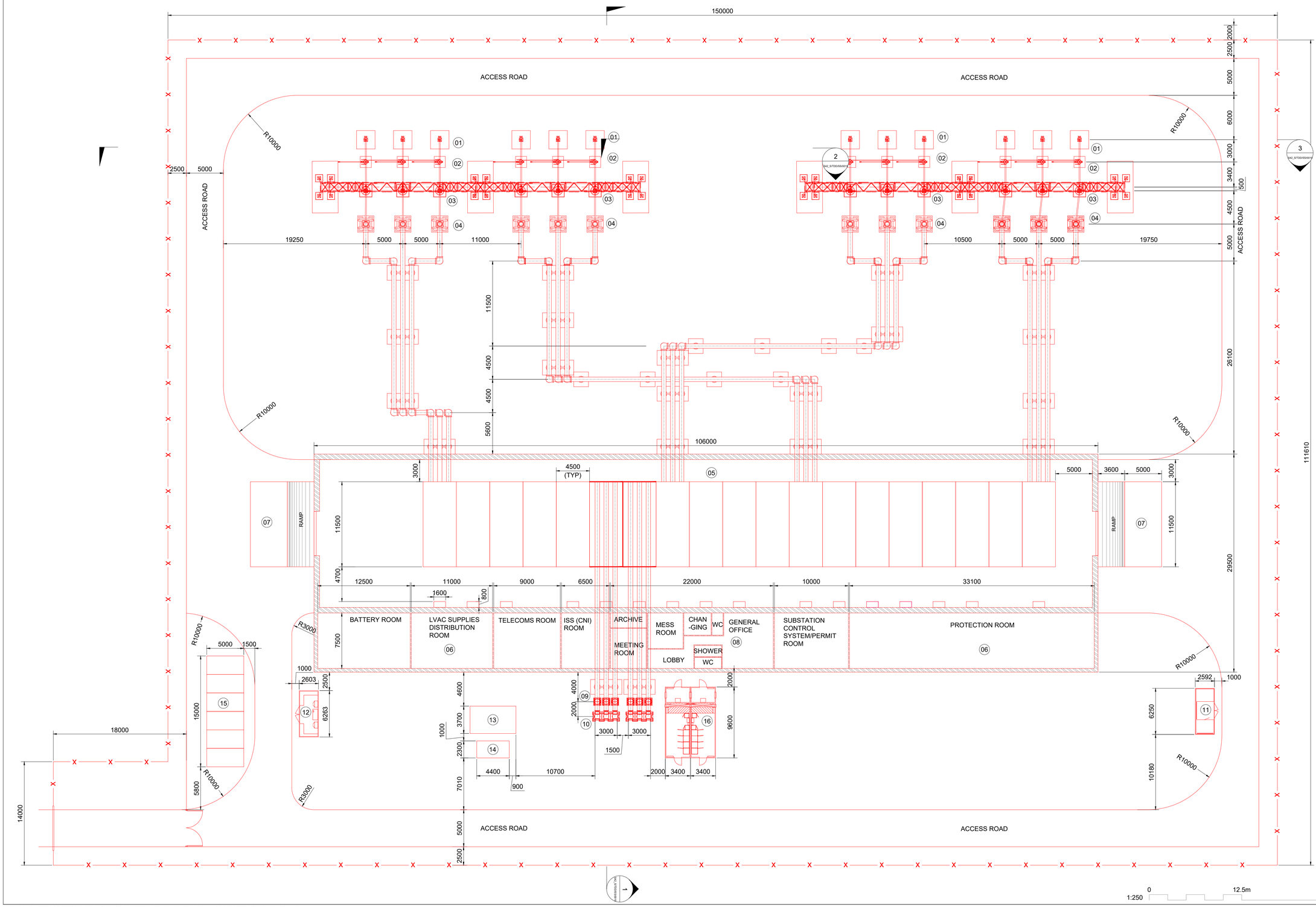
National Grid Drawing Reference: S42_S/TDD/SS/0001

Scale	Sheet Size	Sheet	Issue
1:250	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL FRISTON 400kV GIS SUBSTATION IN SCENARIO WHERE NO CONSTRUCTION BY THIRD PARTY
SHEET 1 OF 1

NOMINAL SYSTEM VOLTAGE	PHASE TO EARTH	PHASE TO PHASE	SAFETY DISTANCE (FROM NATIONAL GRID SAFETY RULES)	DESIGN CLEARANCE FOR SAFETY (VERTICAL) Ds	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL) Dsh	INSULATION HEIGHT Ih
kV	M	M	M	M	M (SEE POINT ii FROM NOTE 6)	M
400	2.8	3.6	3.1	5.5	4.6	2.4



Notes

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1. These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.
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   - GIS - Gas Insulated Switchgear
   - ISS - Integrated Security Solutions
   - CNI - Critical National Infrastructure
   - LVAC - Low Voltage Alternating Current
4. Elevation sections relate to S42_S/TDD/SS/0019.

Legend

- X — FENCE
- NEW INFRASTRUCTURE EQUIPMENT

ID	DESCRIPTION
01	400kV AIS CVT
02	400kV AIS EARTH SWITCH
03	400kV AIS SURGE ARRESTOR
04	400kV GIS / AIR BUSHING
05	400kV GIS HALL
06	400kV ANNEX BUILDING
07	HARDSTANDING AREA
08	AMENITIES BLOCK
09	400kV GIS SURGE ARRESTOR
10	400kV GIS / CABLE INTERFACE
11	STORAGE
12	WORKSHOP
13	EMERGENCY DIESEL GENERATOR
14	DIESEL TANK
15	PARKING
16	DISTRIBUTED RELAY ROOM (OFTO EA2)
17	DISTRIBUTED RELAY ROOM (OFTO EA1N)

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL FRISTON 400kV GIS SUBSTATION IN SCENARIO WHERE NO CONSTRUCTION BY THIRD PARTY
SHEET 1 OF 1

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_S/TDD/SS/0003

Scale	Sheet Size	Sheet	Issue
1:250	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

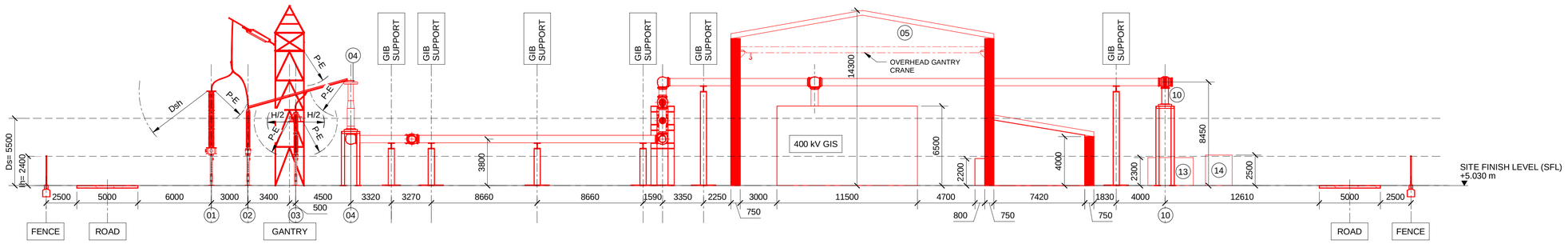
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL FRISTON 400kV GIS SUBSTATION - ELEVATION DRAWING

SHEET 1 of 1

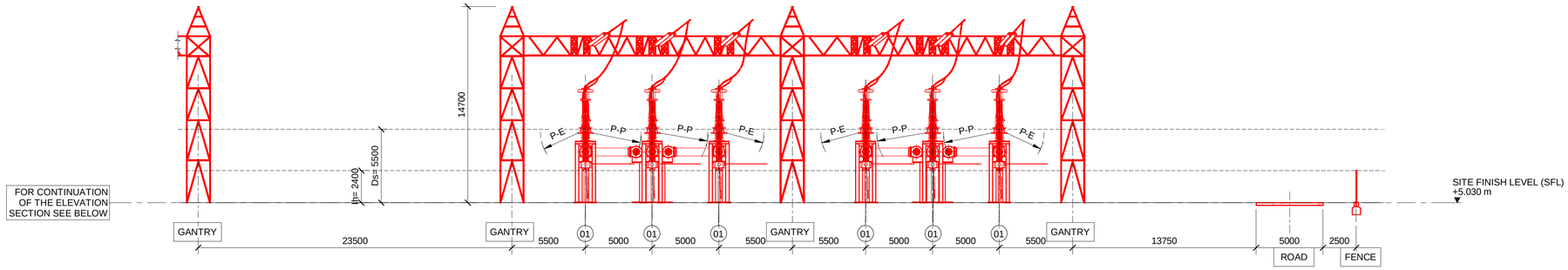
SUBSTATION MINIMUM ELECTRICAL CLEARANCES

REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
Ih	INSULATION HEIGHT	2400



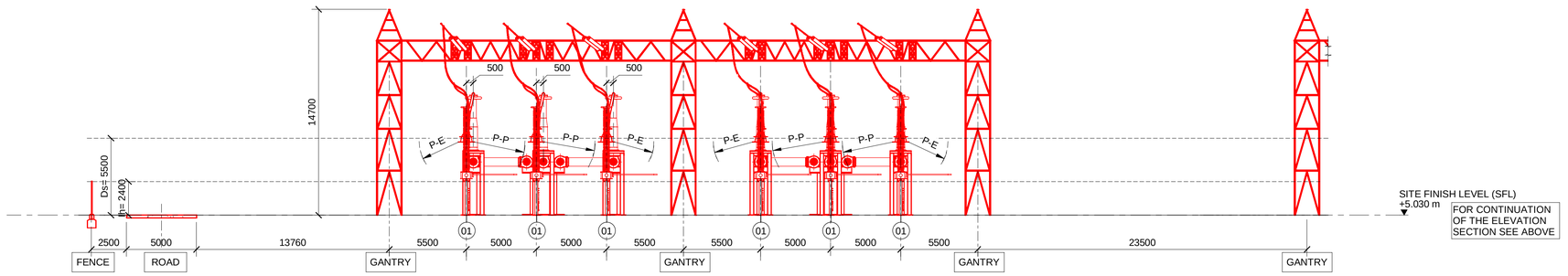
ELEVATION 1

1 : 200



ELEVATION 2

1 : 200



ELEVATION 3

1 : 200

Notes

FOR STATUTORY CONSULTATION PUPOSES ONLY.

1. THESE PLANS SHOW THE DRAFT ORDER LIMITS AND DRAFT CABLE ALIGNMENT AND POTENTIAL PYLON LOCATIONS. DUE TO THE NEED FOR FUTURE FLEXIBILITY, NATIONAL GRID WILL BE APPLYING FOR ORDER LIMITS AND LIMITS OF DEVIATION WITHIN ITS DEVELOPMENT CONSENT ORDER, WITHIN WHICH ANY FINAL ALIGNMENT (INCLUDING PYLON LOCATIONS) WOULD LIE. THEREFORE THE DRAFT CABLE ALIGNMENT AND PYLON LOCATIONS SHOULD BE TREATED AS INDICATIVE ONLY. FURTHER INFORMATION IS PROVIDED IN OUR 'GUIDE TO INTERACTING WITH OUR CONSULTATION PLANS' DOCUMENT.
2. FOR FURTHER INFORMATION ON CONSTRUCTION PLEASE REFER TO THE CONSTRUCTION SECTION OF THE PRELIMINARY ENVIRONMENTAL IMPACT REPORT, VOLUME 1, PART 1, CHAPTER 4.
3. ABBREVIATION

PLC - POWER LINE CARRIER
AIS - AIR INSULATED SWITCHGEAR
CVT - CAPACITIVE VOLTAGE TRANSFORMER
GIS - GAS INSULATED SWITCHGEAR
PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	400kV AIS SURGE ARRESTOR
02	400kV AIS EARTH SWITCH
03	400kV AIS CVT
04	400kV GIS / AIR BUSHING
05	AMENITIES BUILDING
10	WORKSHOP
13	400 kV HARMONIC FILTER - CURRENT TRANSFORMER
14	400 kV HARMONIC FILTER - CAPACITOR

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL FRISTON 400kV GIS SUBSTATION - ELEVATION DRAWING

SHEET 1 of 1

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_S/TDD/SS/0019

Scale	Sheet Size	Sheet	Issue
1 : 200	A1	SHEET 1 of 1	A

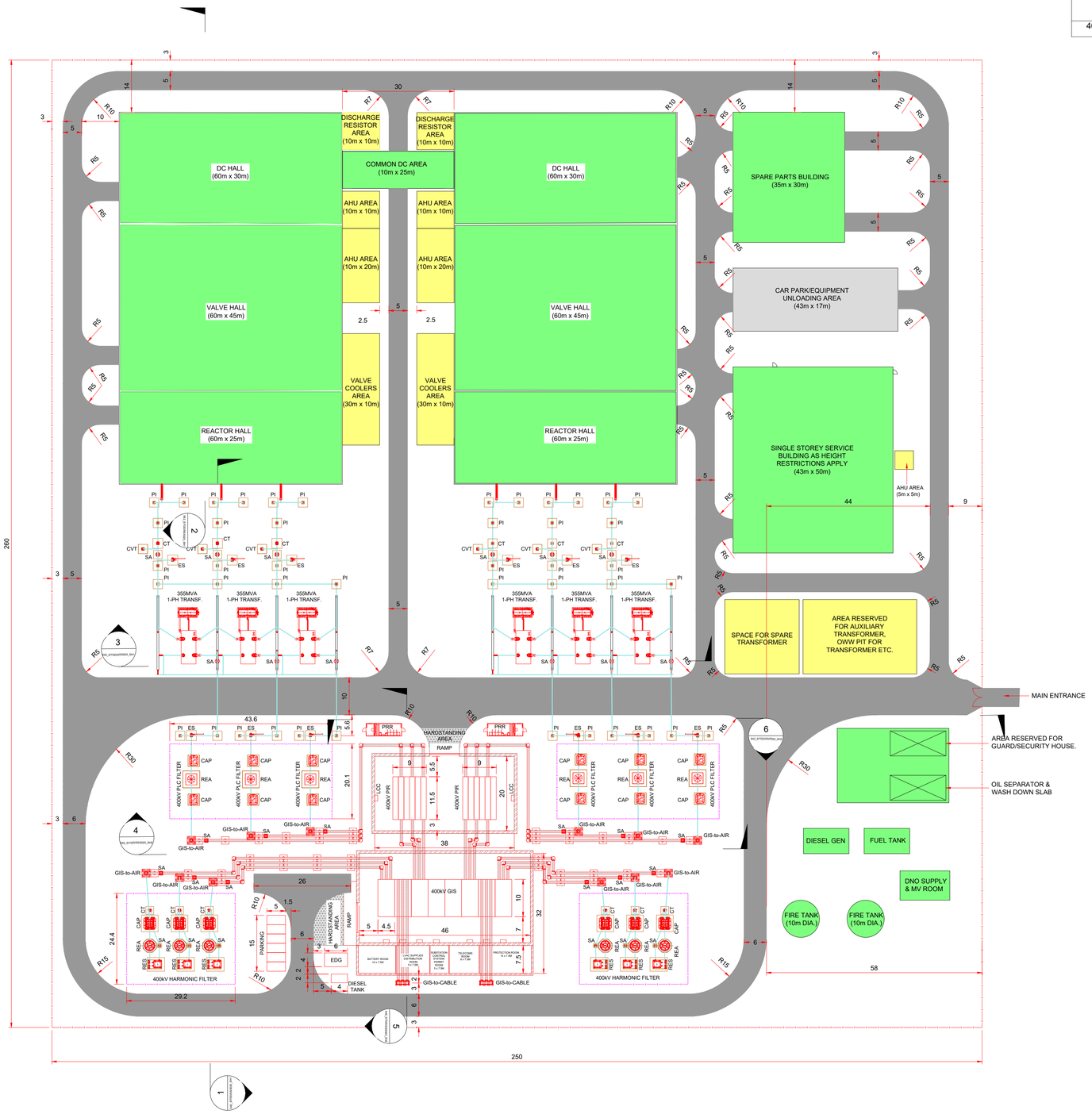
01-02. Saxmundham Converter Station

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Saxmundham Converter Station	Typical Saxmundham converter station layout plan (GIS)	Suffolk Onshore Scheme	S42_S/TDD/SS/0015
	Typical Saxmundham converter station - elevation drawing	Suffolk Onshore Scheme	S42_S/TDD/SS/0020_SH1 S42_S/TDD/SS/0020_SH2

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL SAXMUNDHAM CONVERTER STATION LAYOUT PLAN (GIS)
SHEET 1 of 1

NOMINAL SYSTEM VOLTAGE	PHASE TO EARTH	PHASE TO PHASE	SAFETY DISTANCE (FROM NATIONAL GRID SAFETY RULES)	DESIGN CLEARANCE FOR SAFETY (VERTICAL) Ds	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL) Dsh	INSULATION HEIGHT Ih
kV	M	M	M	M	M (SEE POINT ii FROM NOTE 10)	M
400	2.8	3.6	3.1	5.5	4.6	2.4



Notes

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2. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
3. Abbreviations
   - PIR - Pre-Insertion Resistor
   - CAP - Capacitor
   - RES - Resistor
   - REA - Reactor
   - PI - Post Insulator
   - CT - Current Transformer
   - CVT - Capacitive Voltage Transformer
   - ES - Earth Switch
   - SA - Surge Arrester
   - PRR - Portable Relay Room
   - LCC - Local Control Cubicle
4. Elevation sections relate to S42_S/TDD/SS/0020_SH1 & S42_S/TDD/SS/0020_SH2.

Legend

- PERIMETER FENCE
- INTERNAL FENCE
- BUILDINGS
- EXTERNAL EQUIPMENT AREAS
- CAR PARK

Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL SAXMUNDHAM CONVERTER STATION LAYOUT PLAN (GIS)
SHEET 1 of 1

nationalgrid

Application Number
EN020026

National Grid Drawing Reference
S42_S/TDD/SS/0015

Scale	Sheet Size	Sheet	Issue
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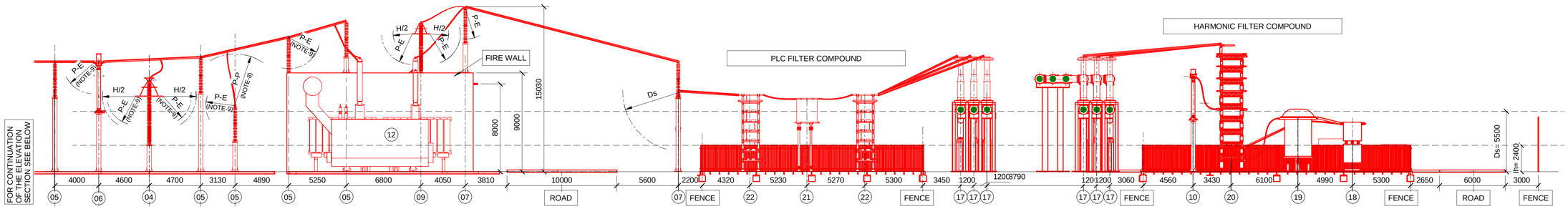
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL SAXMUNDHAM CONVERTER STATION -ELEVATION DRAWING

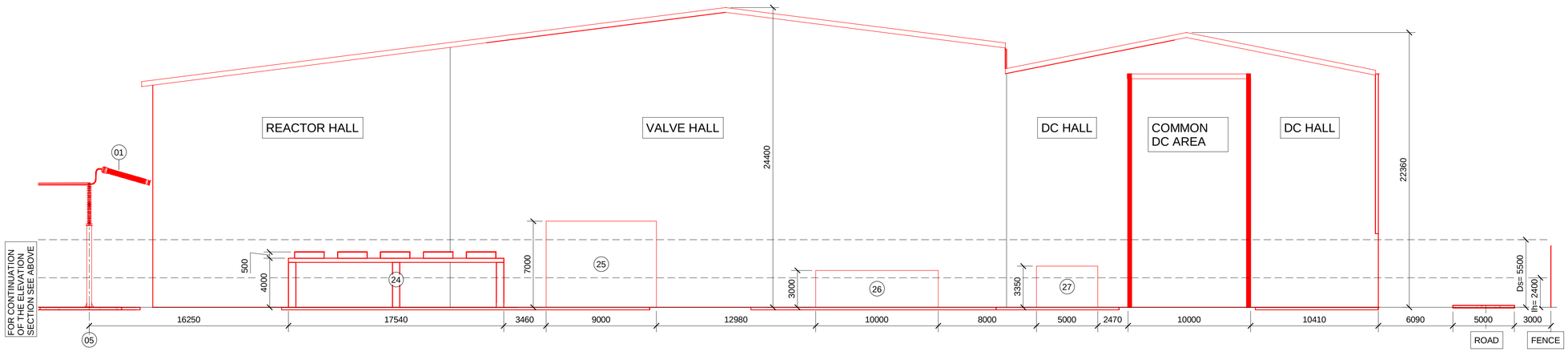
SHEET 1 OF 2

SUBSTATION MINIMUM ELECTRICAL CLEARANCES

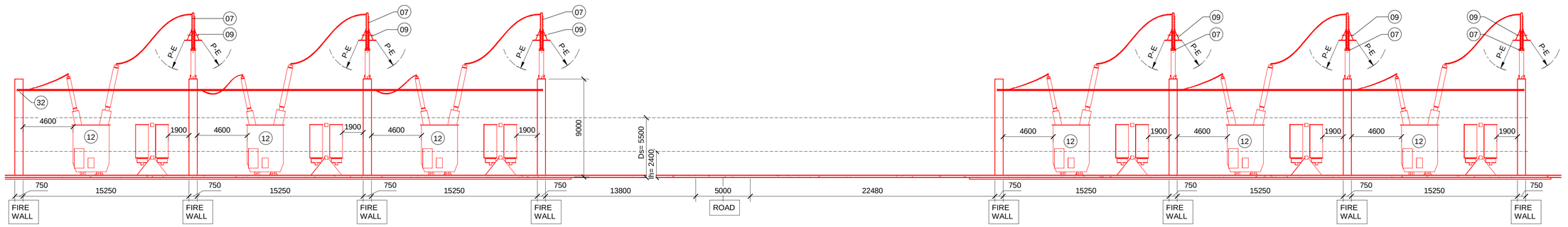
REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
Ih	INSULATION HEIGHT	2400



ELEVATION 1
1 : 200



ELEVATION 2
1 : 200



ELEVATION 3
1 : 200

Notes

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GIS - GAS INSULATED SWITCHGEAR
PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	AIR BUSHING WALL PENETRATION
02	550KV AIS CVT
03	550KV AIS EARTH SWITCH
04	550KV AIS SURGE ARRESTOR
05	550KV POST INSULATOR
06	550KV CURRENT TRANSFORMER
07	400 kV AIS POST INSULATOR
08	400 kV AIS EARTH SWITCH
09	400 kV AIS SURGE ARRESTOR
10	400 kV AIS CURRENT TRANSFORMER
11	400 kV GIS
12	400 kV 1PH TRANSFORMER
13	400 kV GIS / CABLE INTERFACE
14	400 kV GIS SURGE ARRESTOR
15	EMERGENCY DIESEL GENERATOR
16	DIESEL TANK
17	400 kV GIS / AIR BUSHING
18	400 kV HARMONIC FILTER - RESISTOR
19	400 kV HARMONIC FILTER - REACTOR
20	400 kV HARMONIC FILTER - CAPACITOR
21	400 kV PLC FILTER - REACTOR
22	400 kV PLC FILTER - CAPACITOR
23	HARMONIC FILTER - SURGE ARRESTOR
24	EXTERNAL FIN FAN COOLER
25	BUILDING FOR PUMP SKID COOLING SYSTEM
26	AHU FOR REACTOR & VALVE HALL BUILDING
27	AHU FOR DC HALL BUILDING
28	PORTABLE RELAY ROOM
29	400 kV PIR
30	400 kV LCC
31	ROLLING SHUTTER DOOR
32	11kV POST INSULATOR

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL SAXMUNDHAM CONVERTER STATION -ELEVATION DRAWING

SHEET 1 OF 2

nationalgrid

Application Number
EN020026

National Grid Drawing Reference
S42_S/TDD/SS/0020

Scale	Sheet Size	Sheet	Issue
1 : 200	A1	SHEET 1 OF 2	A

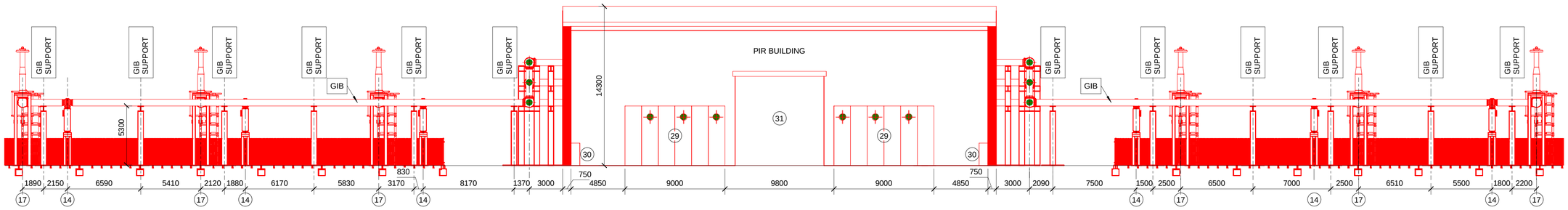
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC(SEA LINK)
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL SAXMUNDHAM CONVERTER STATION -ELEVATION DRAWING

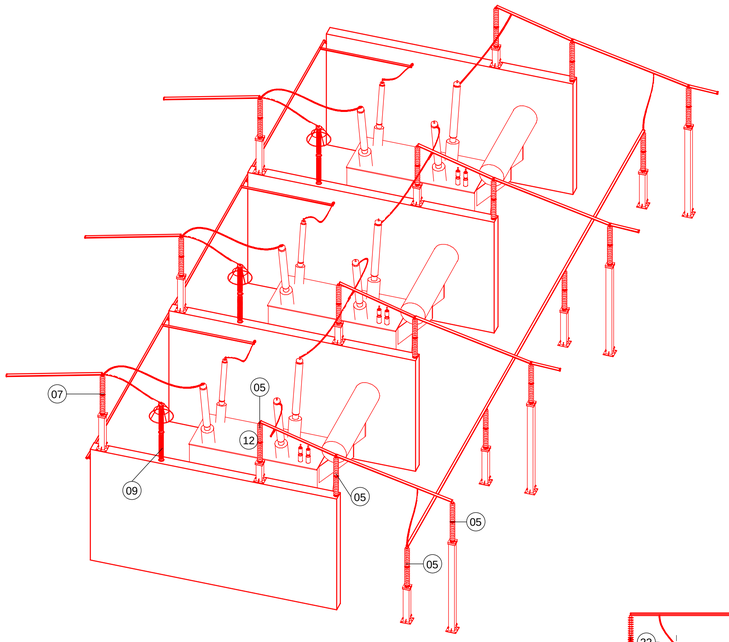
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SUBSTATION MINIMUM ELECTRICAL CLEARANCES

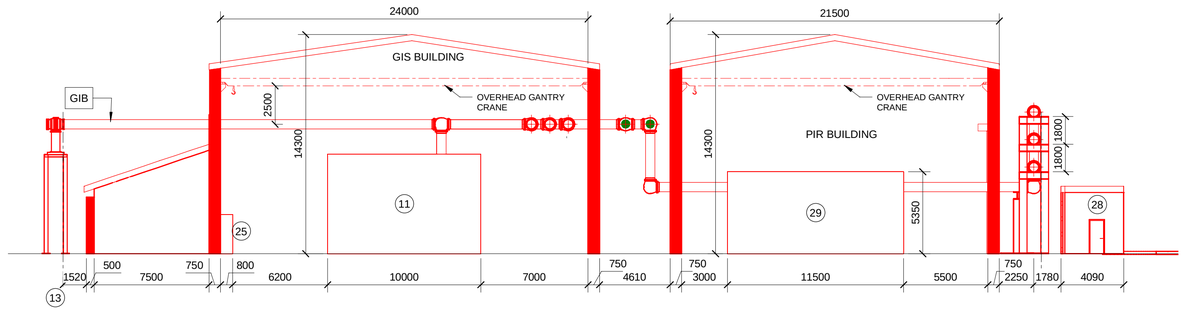
REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
Ih	INSULATION HEIGHT	2400



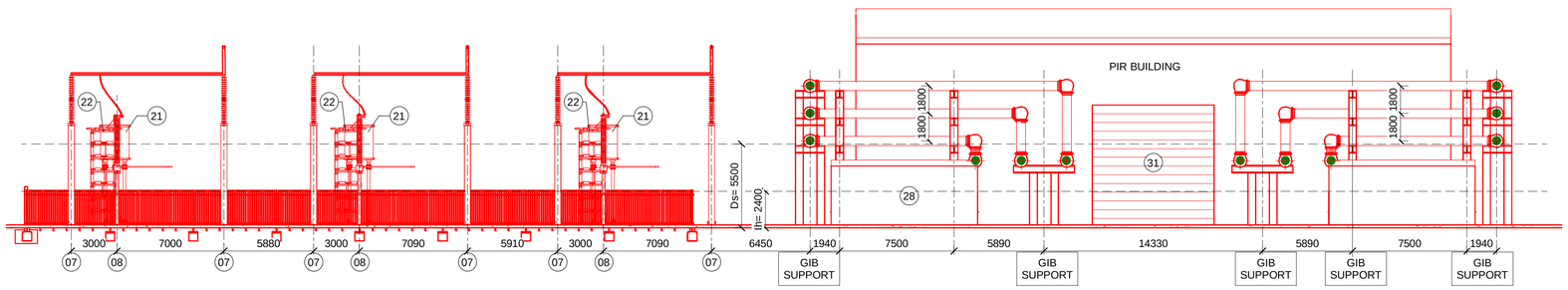
ELEVATION 4
1 : 200



Transformer Area ISO View



ELEVATION 5
1 : 200



ELEVATION 6
1 : 200

Notes

FOR STATUTORY CONSULTATION PUPOSES ONLY.

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PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	AIR BUSHING WALL PENETRATION
02	550KV AIS CVT
03	550KV AIS EARTH SWITCH
04	550KV AIS SURGE ARRESTOR
05	550KV POST INSULATOR
06	550KV CURRENT TRANSFORMER
07	400 kV AIS POST INSULATOR
08	400 kV AIS EARTH SWITCH
09	400 kV AIS SURGE ARRESTOR
10	400 kV AIS CURRENT TRANSFORMER
11	400 kV GIS
12	400 kV 1PH TRANSFORMER
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14	400 kV GIS SURGE ARRESTOR
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25	BUILDING FOR PUMP SKID COOLING SYSTEM
26	AHU FOR REACTOR & VALVE HALL BUILDING
27	AHU FOR DC HALL BUILDING
28	PORTABLE RELAY ROOM
29	400 kV PIR
30	400 kV LCC
31	ROLLING SHUTTER DOOR
32	11kV POST INSULATOR

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC(SEA LINK)

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL SAXMUNDHAM CONVERTER STATION -ELEVATION DRAWING

SHEET 2 OF 2

nationalgrid

Application Number
EN020026

National Grid Drawing Reference
S42_S/TDD/SS/0020

Scale	Sheet Size	Sheet	Issue
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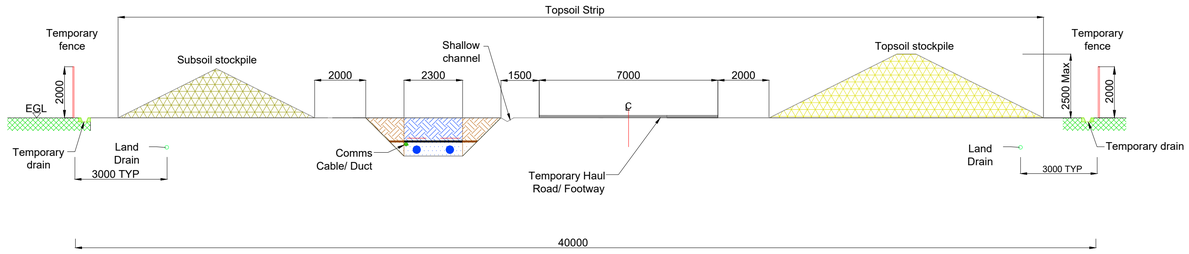
01-03.

Suffolk Only - HVDC & HVAC Cross Sections for Sea Link plus ducts for up to two other projects

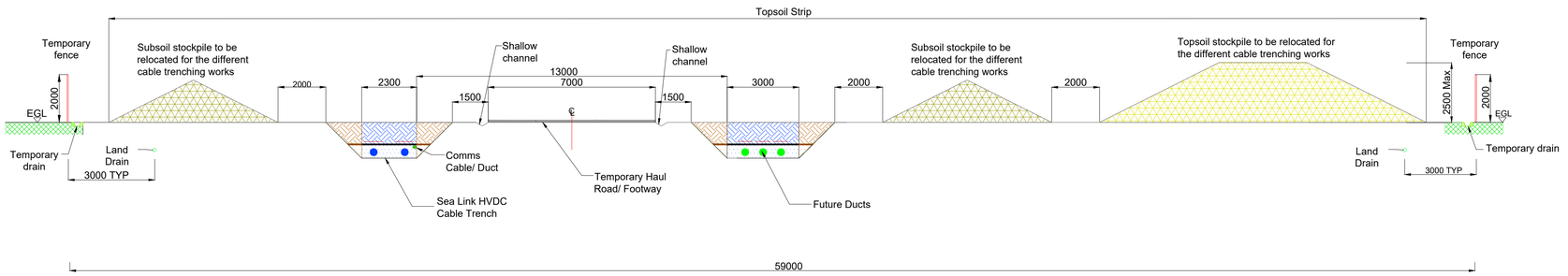
Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Suffolk Only - HVDC & HVAC Cross Sections for Sea Link plus ducts for up to two other projects	Typical HVDC construction area for Sea Link plus ducts for up to two further projects	Suffolk Onshore Scheme	S42_S/TDD/SS/0018
	Typical HVAC construction area for Sea Link plus ducts for up to two further projects	Suffolk Onshore Scheme	S42_S/TDD/SS/0013
	Typical HVAC and HVDC combined construction area for Sea Link plus ducts for up to two further projects	Suffolk Onshore Scheme	S42_S/TDD/SS/0014

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

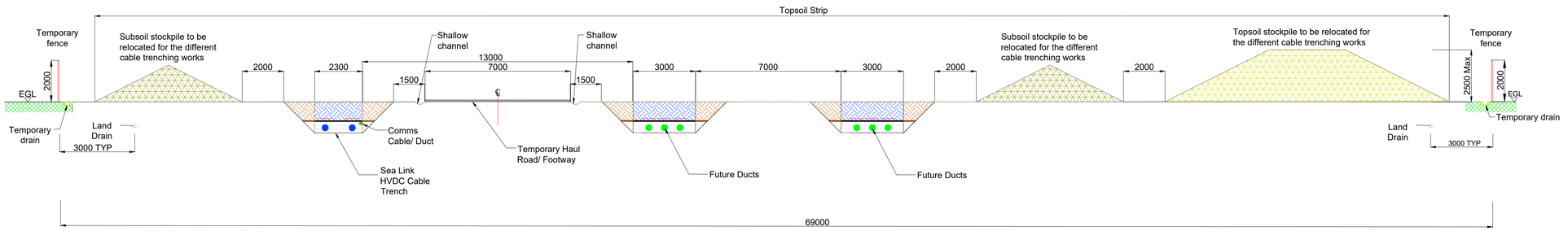
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVDC CONSTRUCTION AREA FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS
SHEET 1 OF 1



Typical HVDC Construction Area - Sea Link
Scale 1:150



Typical HVDC Construction Area - Sea Link + One Further Project
Scale 1:150



Typical HVDC Construction Area - Sea Link + Two Further Projects
Scale 1:150

SCALE BAR (METRES)

1:150 | 0 | 7.5m | 15m

Notes

For statutory consultation purposes only.

These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Well-compacted thermally suitable backfill
- Well-compacted thermally suitable backfill (Splayed Excavation)
- Cement-bound sand cable surround
- Cement-bound sand cable surround (Splayed Excavation)
- Cable protection tiles
- Cable warning tape
- Topsoil stockpile
- Subsoil stockpile
- Existing Ground
- Temporary Haul Road/ Footway

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVDC CONSTRUCTION AREA FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS
SHEET 1 OF 1

nationalgrid

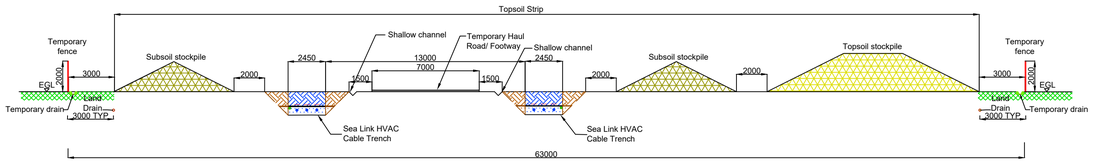
Application Number: EN020026

National Grid Drawing Reference: S42_S/TDD/SS/0018

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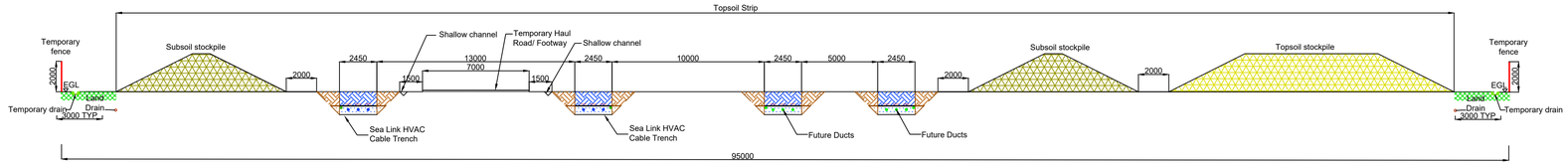
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVAC CONSTRUCTION AREA FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS
SHEET 1 OF 1



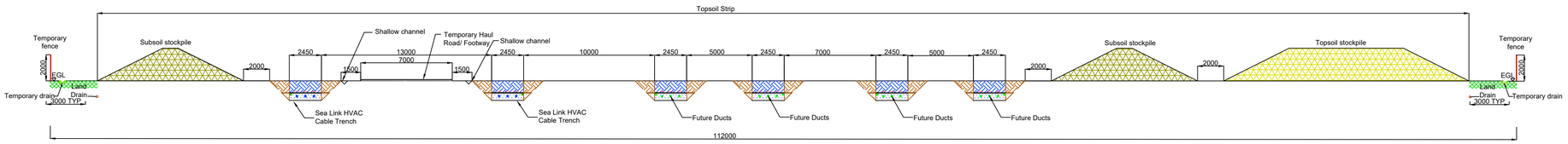
Typical Construction Area - Sea Link

Scale 1:200



Typical Construction Area - Sea Link + One Further Project

Scale 1:200



Typical Construction Area - Sea Link + Two Further Projects

Scale 1:200

SCALE BAR (METRES)

1:200 0 10m 20m

Notes

For statutory consultation purposes only.

These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Well-compacted thermally suitable backfill
- Well-compacted thermally suitable backfill (Splayed Excavation)
- Cement-bound sand cable surround
- Cement-bound sand cable surround (Splayed Excavation)
- Cable protection tiles
- Cable warning tape
- Topsoil stockpile
- Subsoil stockpile
- Existing Ground
- Temporary Haul Road/ Footway

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVAC CONSTRUCTION AREA FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS
SHEET 1 OF 1

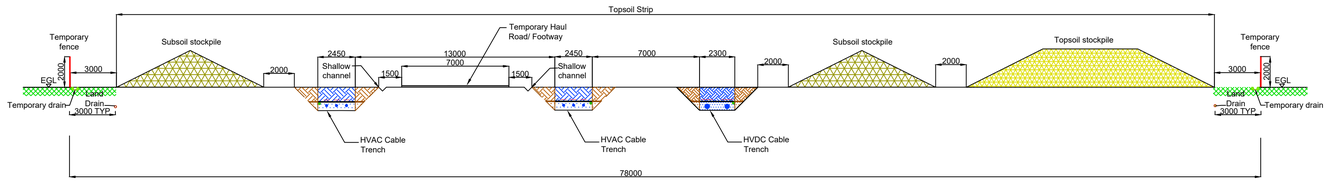
nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_S/TDD/SS/0013

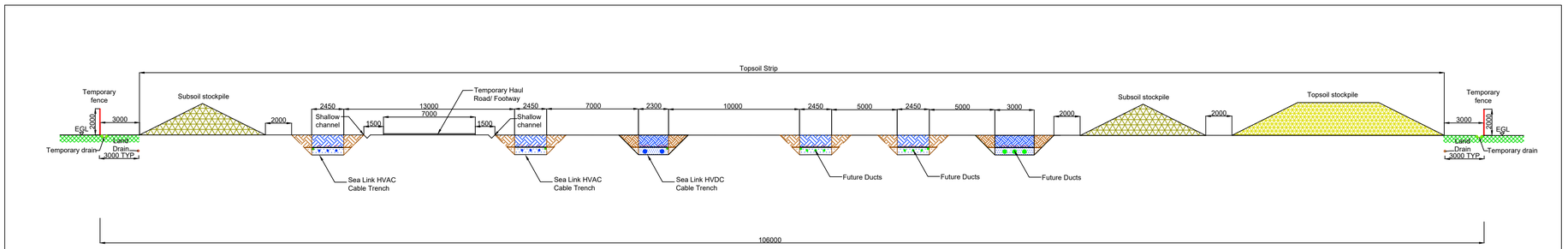
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVAC AND HVDC COMBINED CONSTRUCTION AREA
FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS
SHEET 1 OF 1



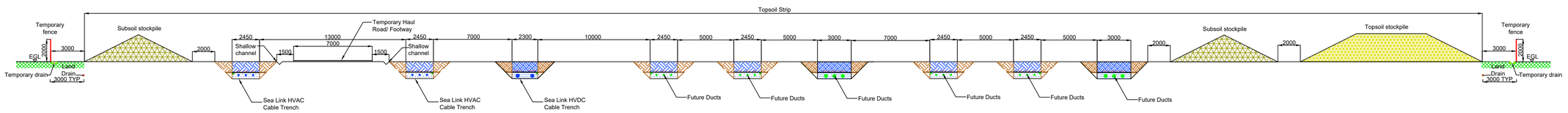
Typical Construction Area - Sea Link

Scale 1:200



Typical Construction Area - Sea Link + One Further Project

Scale 1:200



Typical Construction Area - Sea Link + Two Further Projects

Scale 1:200

SCALE BAR (METRES)

1:200 | 0 | 10m | 20m

Notes

For statutory consultation purposes only.

These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Well-compacted thermally suitable backfill
- Well-compacted thermally suitable backfill (Splayed Excavation)
- Cement-bound sand cable surround
- Cement-bound sand cable surround (Splayed Excavation)
- Cable protection tiles
- Cable warning tape
- Topsoil stockpile
- Subsoil stockpile
- Existing Ground
- Temporary Haul Road/ Footway

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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A	01/09/2023	FINAL	SC	JW	KJ

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVAC AND HVDC COMBINED CONSTRUCTION AREA
FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS
SHEET 1 OF 1

nationalgrid

Application Number

EN020026

National Grid Drawing Reference

S42_S/TDD/SSI/0014

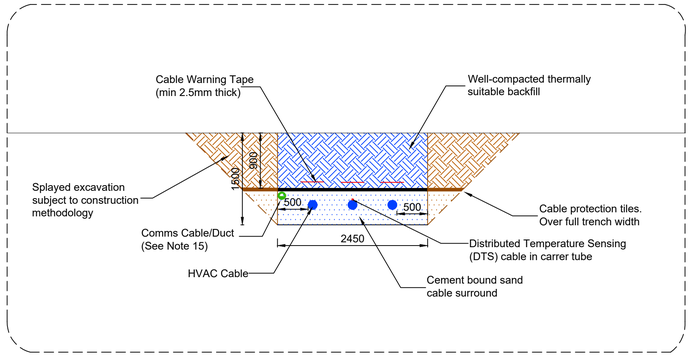
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01-04. HVDC & HVAC Arrangement & Cross Sections

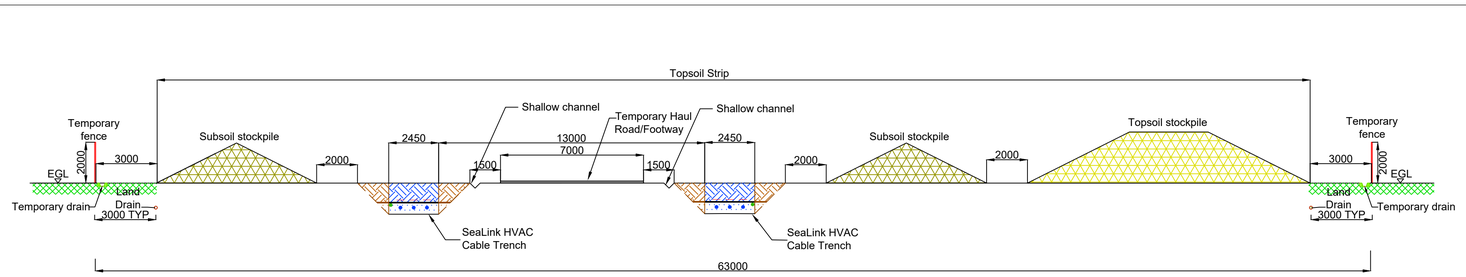
Drawing Category Name	Plan Title	Scheme	Drawing Numbers
HVDC & HVAC Arrangement & Cross Sections	Typical HVAC direct buried cross section and construction area	Suffolk Onshore Scheme	S42_S/TDD/SS/0010
	Typical 400kv HVAC joint bay arrangement	Suffolk Onshore Scheme	S42_S/TDD/SS/0011
	Typical HVAC direct buried cross section and construction area	Onshore Schemes	S42_T/TDD/SS/3001
	Typical HVAC joint bay arrangements	Onshore Schemes	S42_T/TDD/SS/3003
	Typical HVAC and HVDC combined construction area	Suffolk Onshore Scheme	S42_S/TDD/SS/0012

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVAC DIRECT BURIED CROSS SECTION AND CONSTRUCTION AREA
SHEET 1 OF 1



Direct Buried Cable Cross Section
Scale 1:50



Typical Construction Area - Two Trenches
Scale 1:150

Notes

For statutory consultation purposes only.
These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Well-compacted thermally suitable backfill
- Well-compacted thermally suitable backfill (Splayed Excavation)
- Cement-bound sand cable surround
- Cement-bound sand cable surround (Splayed Excavation)
- Cable protection tiles
- Cable warning tape
- Topsoil stockpile
- Subsoil stockpile
- Existing Ground
- Temporary Haul Road/ Footway

1:50 — 0 — 2.5m — 5m
1:150 — 0 — 7.5m — 15m

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Title
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL HVAC DIRECT BURIED CROSS SECTION AND CONSTRUCTION AREA
SHEET 1 OF 1

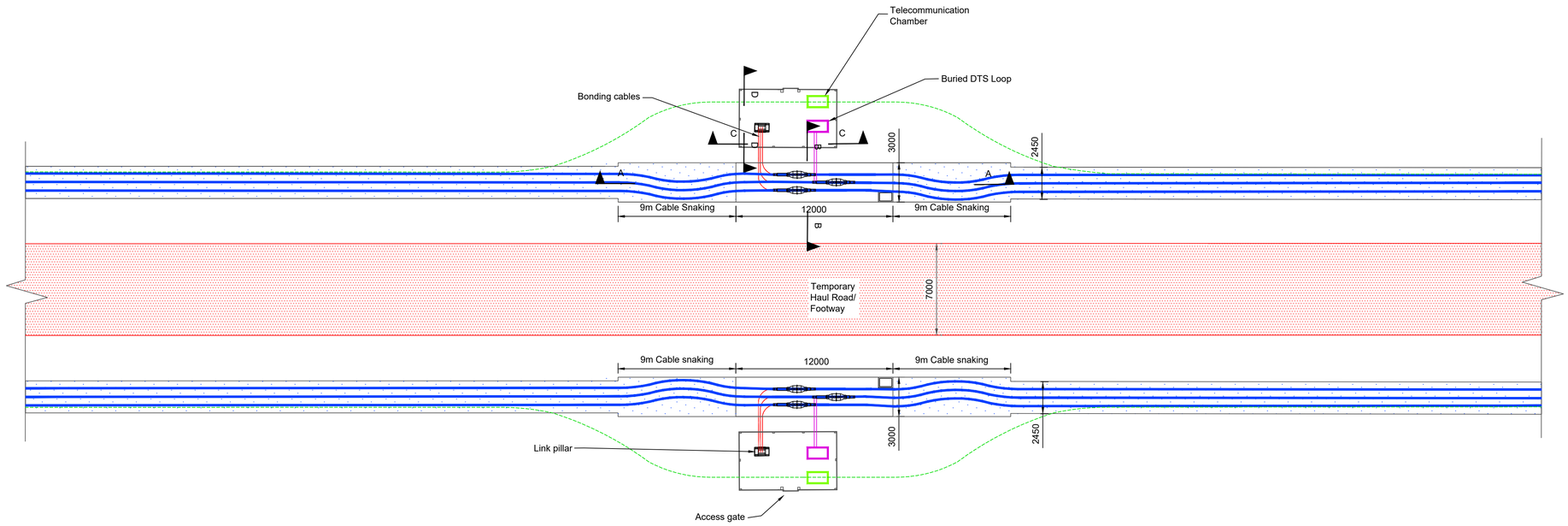
nationalgrid

Application Number
EN020026

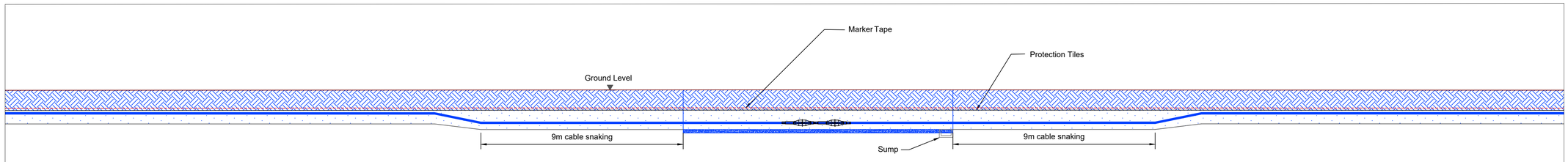
National Grid Drawing Reference
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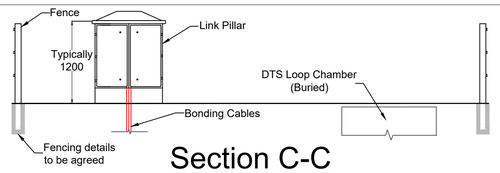
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL 400kV HVAC JOINT BAY ARRANGEMENT
SHEET 1 OF 1



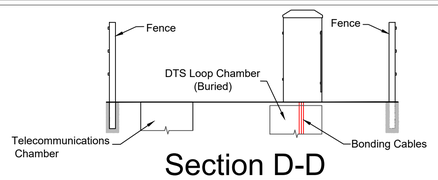
Typical HVAC Cable Joint Bay Layout
Scale 1:200



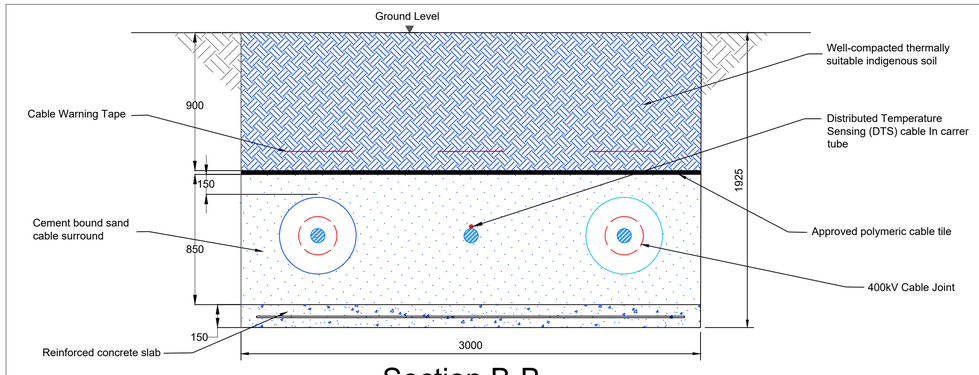
Section A-A
Typical HVAC Cable Joint Bay Long Section
Scale 1:100



Section C-C
Typical Link Pillar Cross Section
Scale 1:50



Section D-D
Typical Link Pillar Cross Section
Scale 1:50



Section B-B
Typical HVAC Cable Joint Bay Cross Section
Scale 1:20

Notes

For statutory consultation purposes only.
These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Cable protection cover
- 400 kV Power Cable
- Bonding Cable
- Cement-bound Sand (CBS)
- Well-compacted thermally suitable indigenous soil
- Concrete
- Temporary Haul Road/ Footway
- Cable Warning Tape
- Telecommunication Chamber
- Distributed Temperature Sensing (DTS) Loop
- Timber Fence
- DTS Cables
- Communication Cable Duct

SCALE BAR (METRES)

1:20	0	1m	2m
1:50	0	2.5m	5m
1:100	0	5m	10m
1:200	0	10m	20m

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Title
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL 400kV HVAC JOINT BAY ARRANGEMENT
SHEET 1 OF 1

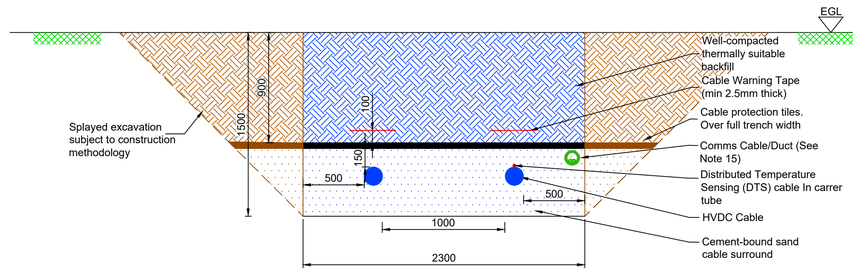
nationalgrid

Application Number
EN020026

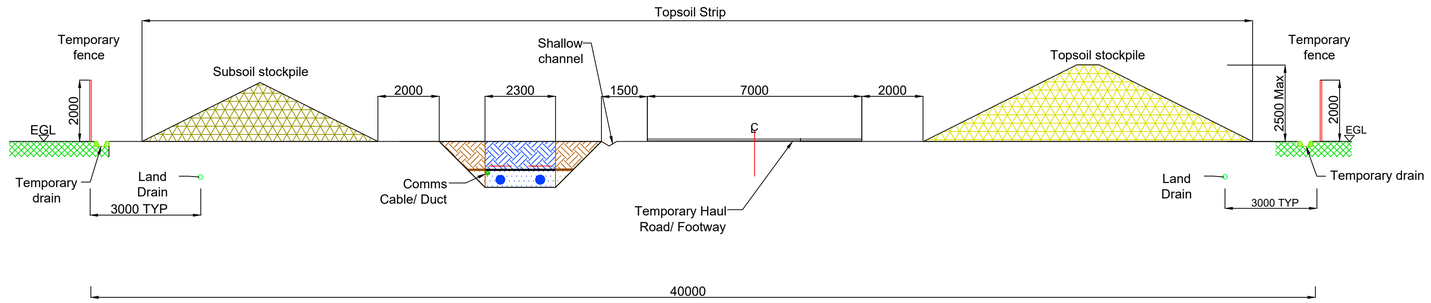
National Grid Drawing Reference
S42_S/TDD/SS/0011

Scale	Sheet Size	Sheet	Issue
AS SHOWN	A1	SHEET 1 OF 1	A

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVDC DIRECT BURIED CABLE
CROSS SECTION AND CONSTRUCTION AREA
SHEET 1 OF 1



Direct Buried Cable Cross Sections - One Trench
Scale 1:25



Typical Construction Area - One Trench
Scale 1:100

Notes

For statutory consultation purposes only.

These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Well-compacted thermally suitable backfill
- Well-compacted thermally suitable backfill (Splayed Excavation)
- Cement-bound sand cable surround
- Cement-bound sand cable surround (Splayed Excavation)
- Cable protection tiles
- Cable warning tape
- Topsoil stockpile
- Subsoil stockpile
- Existing Ground
- Temporary Haul Road/ Footway

SCALE BAR (METRES)

1:25 — 0 — 1.250m — 2.5m

1:100 — 0 — 5m — 10m

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL HVDC DIRECT BURIED CABLE
CROSS SECTION AND CONSTRUCTION AREA
SHEET 1 OF 1

nationalgrid

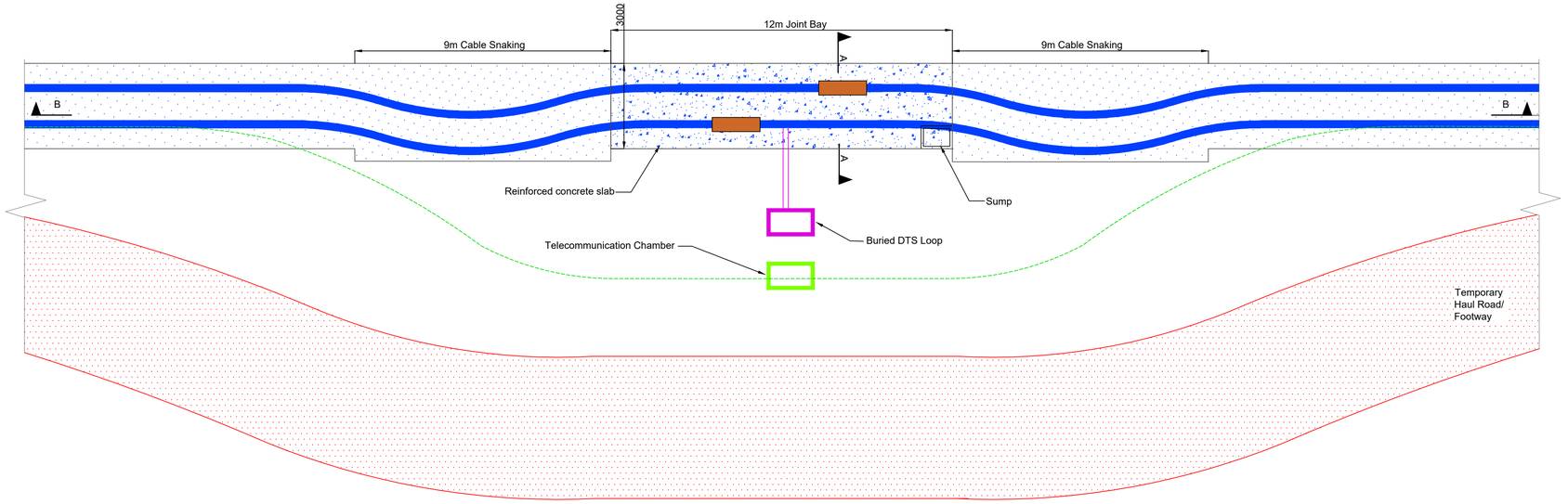
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National Grid Drawing Reference: S42_T/TDD/SS/3001

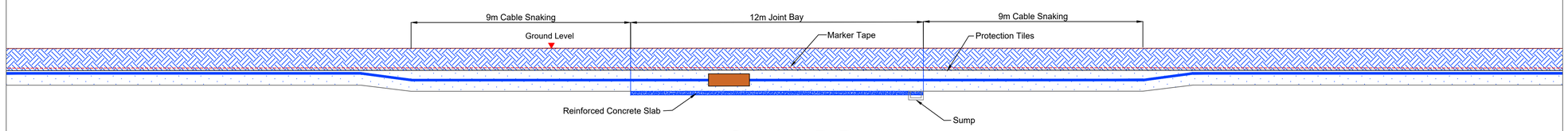
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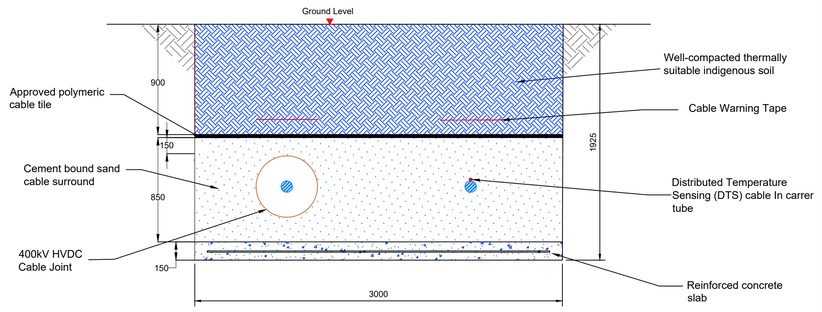
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVDC JOINT BAY ARRANGEMENT
SHEET 1 OF 1



Typical HVDC Cable Joint Bay Layout
Scale 1:100



Section B-B
Typical HVDC Cable Joint Bay Long Section
Scale 1:100



Section A-A
Typical HVDC Cable Joint Bay Cross Section
Scale 1:25

SCALE BAR (METRES)

1:25 — 0 — 1.250m — 2.5m

1:100 — 0 — 5m — 10m

Notes

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For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Cable protection tiles
- HVDC Cable
- 400kV HVDC Cable Joint
- Cement-bound Sand (CBS)
- Well-compacted thermally suitable backfill
- Concrete
- Temporary Haul Road/ Footway
- Cable Warning Tape
- Telecommunication Chamber
- Distributed Temperature Sensing (DTS) Loop
- DTS Cables
- Communication Cable Duct

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL HVDC JOINT BAY ARRANGEMENT
SHEET 1 OF 1

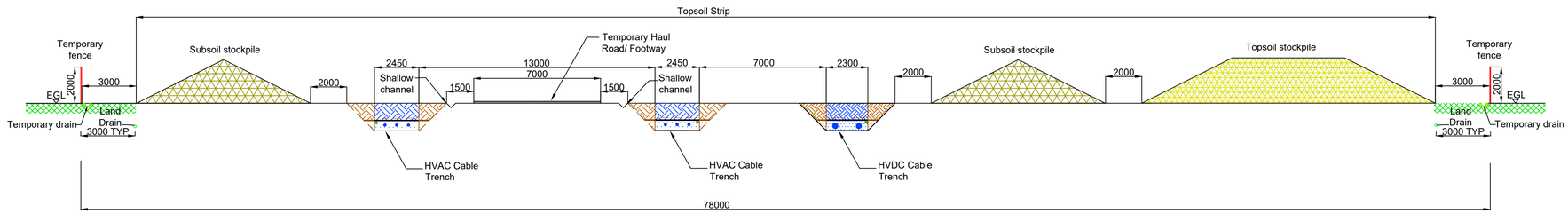
nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_T/TDD/SS/3003

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AS SHOWN	A1	SHEET 1 OF 1	A

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL HVAC AND HVDC COMBINED CONSTRUCTION AREA
SHEET 1 OF 1



Typical Construction Area - HVAC + HVDC

Scale 1:150

SCALE BAR (METRES)

1:150 0 7.5m 15m

Notes

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Legend

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- Well-compacted thermally suitable backfill (Splayed Excavation)
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- Temporary Haul Road/ Footway

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL HVAC AND HVDC COMBINED CONSTRUCTION AREA
SHEET 1 OF 1

nationalgrid

Application Number
EN020026

National Grid Drawing Reference
S42_S/TDD/SS/0012

Scale	Sheet Size	Sheet	Issue
AS SHOWN	A1	SHEET 1 OF 1	A

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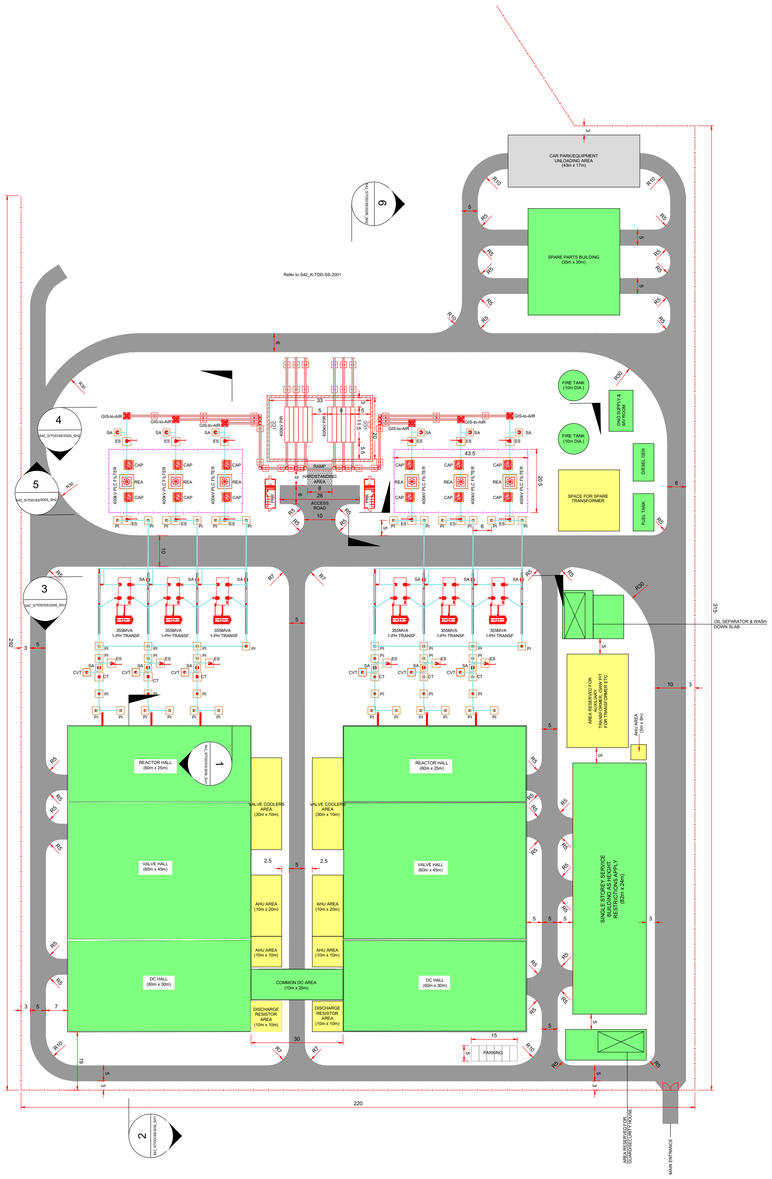
01-05. Minster Converter Station

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Minster Converter Station	Typical Minster converter station - layout plan (GIS)	Kent Onshore Scheme	S42_K/TDD/SS/2002
	Typical minster converter station - elevation drawing	Kent Onshore Scheme	S42_K/TDD/PS/2005_SH1 S42_K/TDD/PS/2005_SH2

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL MINSTER CONVERTER STATION - LAYOUT PLAN (GIS)
SHEET 1 of 1

NOMINAL SYSTEM VOLTAGE	PHASE TO EARTH	PHASE TO PHASE	SAFETY DISTANCE (FROM NATIONAL GRID SAFETY RULES)	DESIGN CLEARANCE FOR SAFETY (VERTICAL) Ds	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL) Dsh	INSULATION HEIGHT Ih
kV	M	M	M	M	M (SEE POINT ii FROM NOTE 10)	M
400	2.8	3.6	3.1	5.5	4.6	2.4



Notes

For statutory consultation purposes only.

1. These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.
2. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
3. Abbreviations
   - PIR - Pre-Insertion Resistor
   - CAP - Capacitor
   - RES - Resistor
   - REA - Reactor
   - PI - Post Insulator
   - CT - Current Transformer
   - CVT - Capacitive Voltage Transformer
   - ES - Earth Switch
   - SA - Surge Arrester
   - PRR - Portable Relay Room
   - LCC - Local Control Cubicle
4. Elevation sections relate to S42_S/TDD/SS/2005_SH1 & S42_S/TDD/SS/2005_SH2.

Legend

- PERIMETER FENCE
- INTERNAL FENCE
- BUILDINGS
- EXTERNAL EQUIPMENT AREAS
- CAR PARK

Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL MINSTER CONVERTER STATION - LAYOUT PLAN (GIS)
SHEET 1 of 1

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_K/TDD/SS/2002

Scale	Sheet Size	Sheet	Issue
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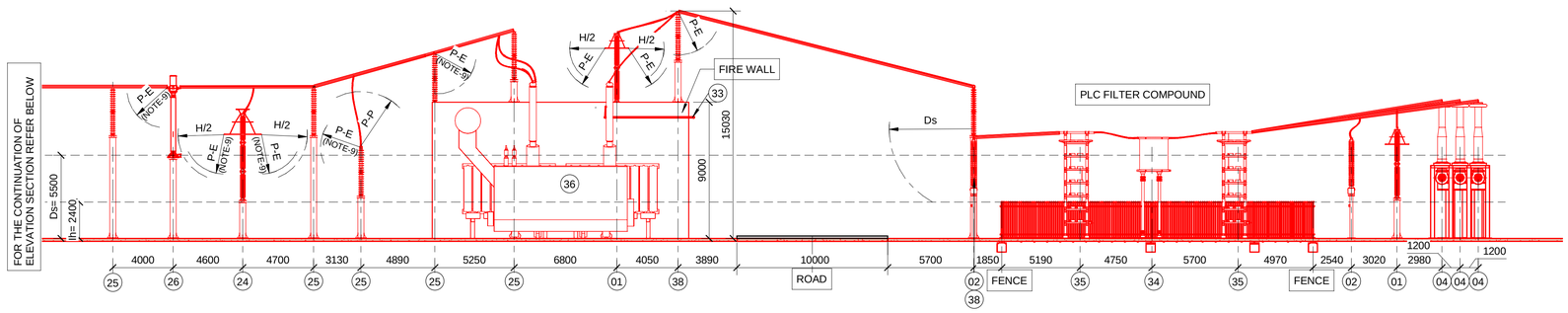
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

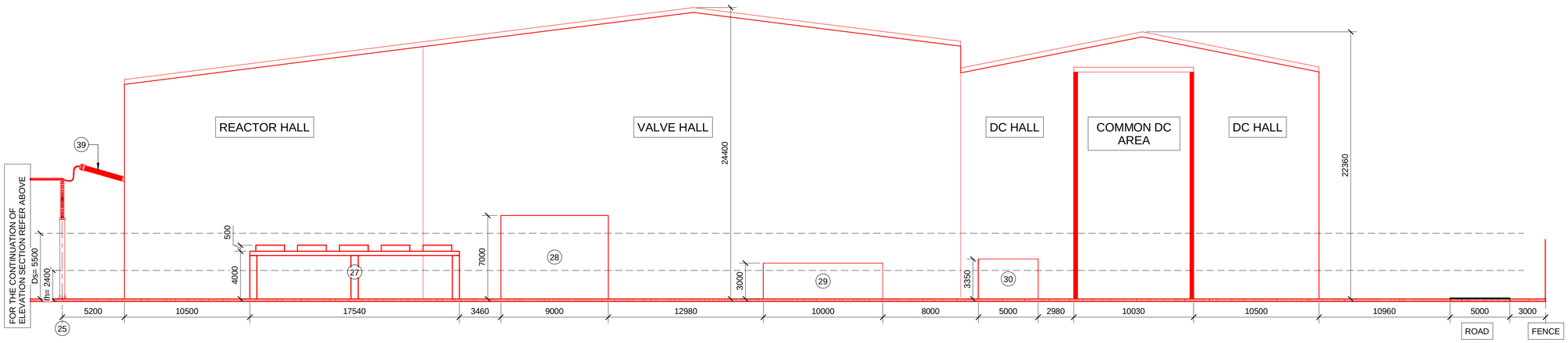
TYPICAL MINSTER CONVERTER STATION - ELEVATION DRAWING

SHEET 1 OF 2



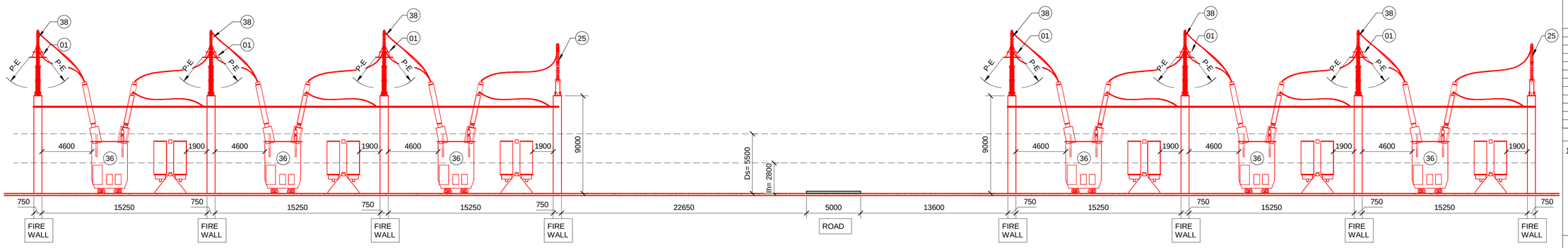
ELEVATION 1

1 : 200



ELEVATION 2

1 : 200



ELEVATION 3

1 : 200

SUBSTATION MINIMUM ELECTRICAL CLEARANCES

REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
Ih	INSULATION HEIGHT	2400

Notes

FOR STATUTORY CONSULTATION PUPOSES ONLY.

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2. FOR FURTHER INFORMATION ON CONSTRUCTION PLEASE REFER TO THE CONSTRUCTION SECTION OF THE PRELIMINARY ENVIRONMENTAL IMPACT REPORT, VOLUME 1, PART 1, CHAPTER 4.
3. ABBRIVIATION

PLC - POWER LINE CARRIER
AIS - AIR INSULATED SWITCHGEAR
CVT - CAPACITIVE VOLTAGE TRANSFORMER
GIS - GAS INSULATED SWITCHGEAR
PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	400kV AIS SURGE ARRESTOR
02	400kV AIS EARTH SWITCH
03	400kV AIS CVT
04	400kV GIS / AIR BUSHING
06	400kV GIS HALL
20	LCC
21	ROLLING SHUTTER
22	550KV AIS CVT
23	550KV AIS EARTH SWITCH
24	550KV AIS SURGE ARRESTOR
25	550KV POST INSULATOR
26	550KV CURRENT TRANSFORMER
27	EXTERNAL FIN FAN COOLER
28	BUILDING FOR PUMP SKID COOLING SYSTEM
29	AHU FOR REACTOR & VALVE HALL BUILDING
30	AHU FOR DC HALL BUILDING
31	PORTABLE RELAY ROOM
32	400 kV PIR
33	11kV POST INSULATOR
34	400 kV PLC FILTER - REACTOR
35	400 kV PLC FILTER - CAPACITOR
36	400 kV 1PH TRANSFORMER
38	400 kV AIS POST INSULATOR
39	AIR BUSHING WALL PENETRATION

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL MINSTER CONVERTER STATION - ELEVATION DRAWING

SHEET 1 OF 2

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_K/TDD/PS/2005

Scale	Sheet Size	Sheet	Issue
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

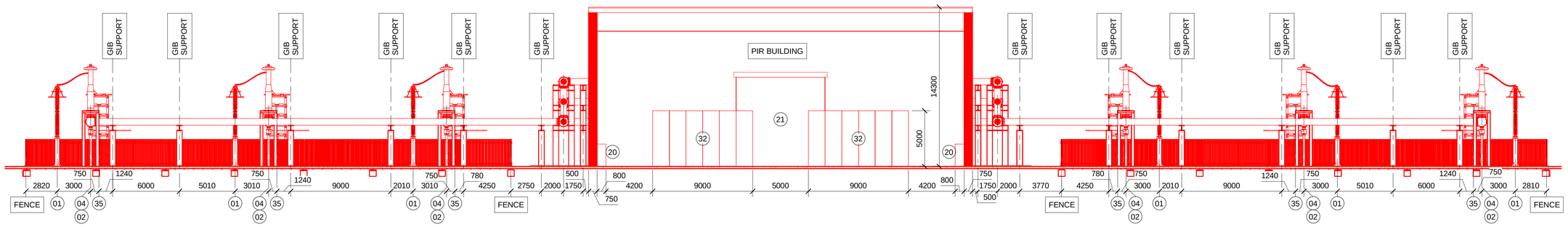
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL MINSTER CONVERTER STATION - ELEVATION DRAWING

SHEET 2 OF 2

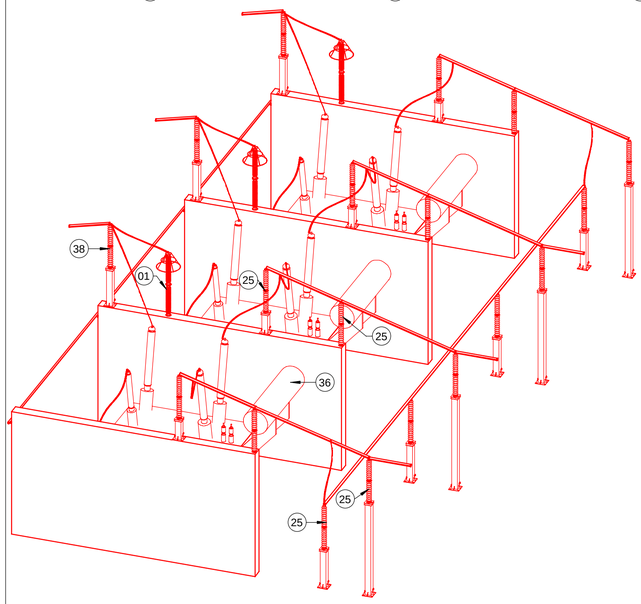
SUBSTATION MINIMUM ELECTRICAL CLEARANCES

REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
Ih	INSULATION HEIGHT	2400

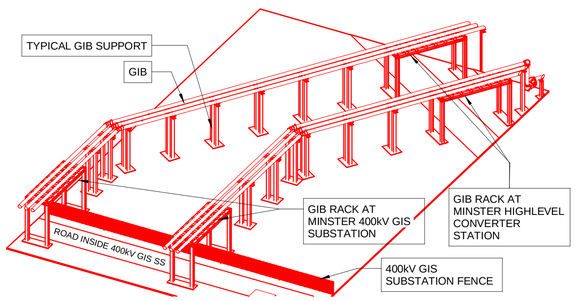


ELEVATION 4

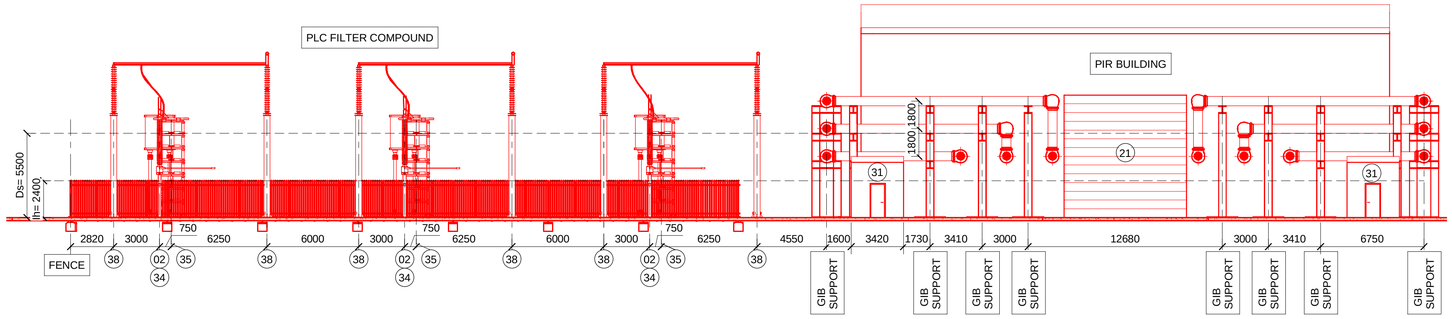
1 : 200



Transformer Area Isometric View

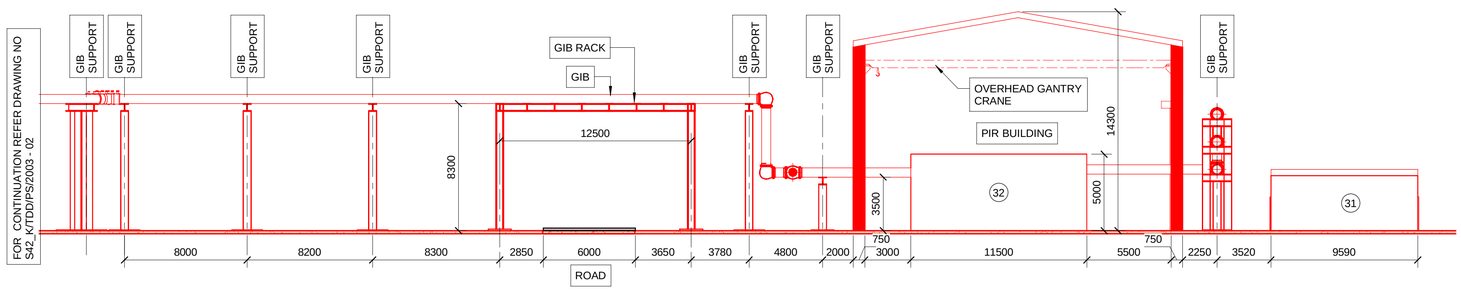


Isometric View for GIB connection between Minster 400 kV Substation and HVDC converter station



ELEVATION 5

1 : 200



ELEVATION 6

1 : 200

Notes

FOR STATUTORY CONSULTATION PUPOSES ONLY.

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3. ABBRIVIATION

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AIS - AIR INSULATED SWITCHGEAR
CVT - CAPACITIVE VOLTAGE TRANSFORMER
GIS - GAS INSULATED SWITCHGEAR
PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	400kV AIS SURGE ARRESTOR
02	400kV AIS EARTH SWITCH
03	400kV AIS CVT
04	400kV GIS / AIR BUSHING
06	400kV GIS HALL
20	LCC
21	ROLLING SHUTTER
22	550kV AIS CVT
23	550KV AIS EARTH SWITCH
24	550KV AIS SURGE ARRESTOR
25	550KV POST INSULATOR
26	550KV CURRENT TRANSFORMER
27	EXTERNAL FIN FAN COOLER
28	BUILDING FOR PUMP SKID COOLING SYSTEM
29	AHU FOR REACTOR & VALVE HALL BUILDING
30	AHU FOR DC HALL BUILDING
31	PORTABLE RELAY ROOM
32	400 kV PIR
33	11kV POST INSULATOR
34	400 kV PLC FILTER - REACTOR
35	400 kV PLC FILTER - CAPACITOR
36	400 kV 1PH TRANSFORMER
38	400 kV AIS POST INSULATOR
39	AIR BUSHING WALL PENETRATION

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL MINSTER CONVERTER STATION - ELEVATION DRAWING

SHEET 2 OF 2

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_K/TDD/PS/2005

Scale	Sheet Size	Sheet	Issue
1 : 200	A1	SHEET 2 OF 2	A

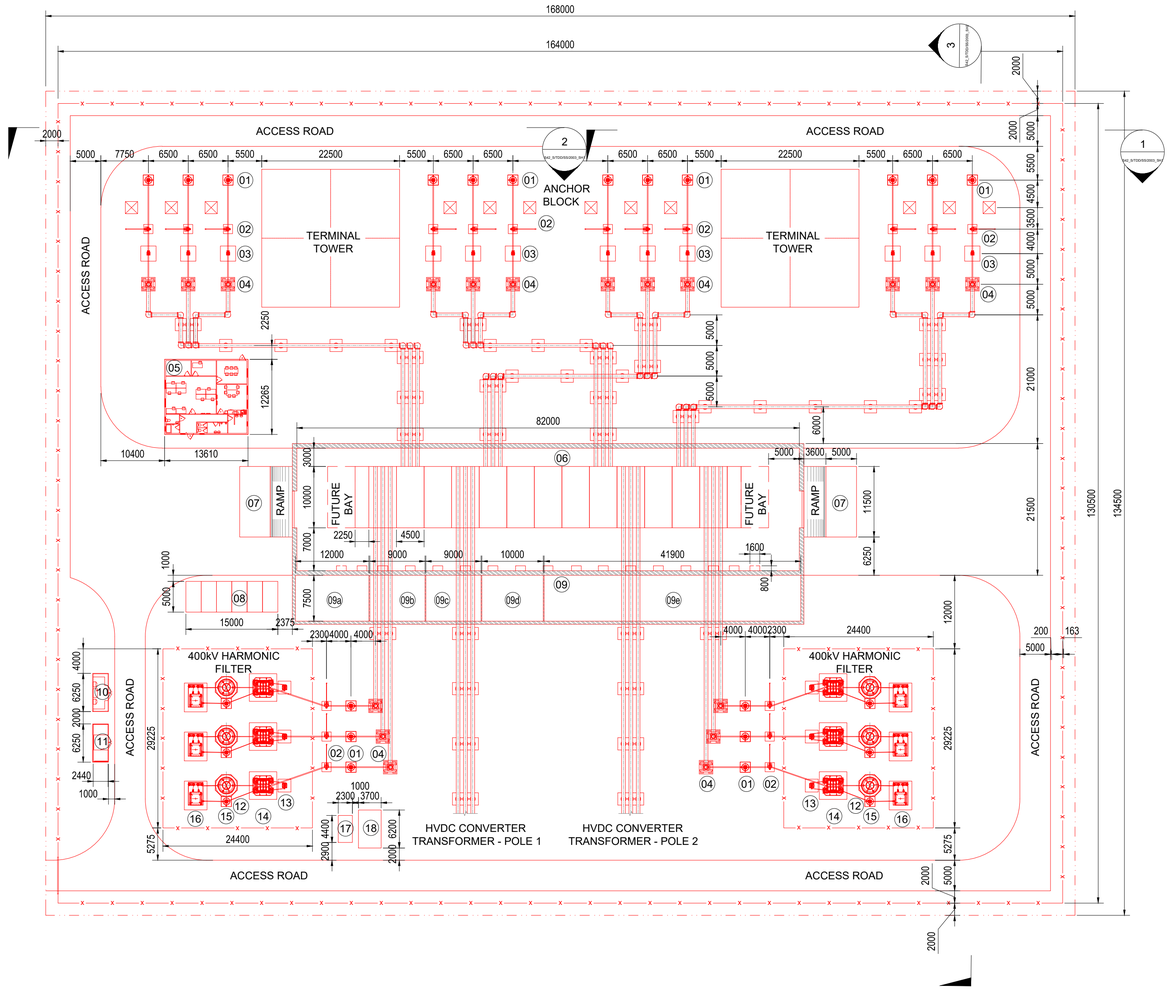
01-06. Minster 400kV Substation

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Minster 400kV Substation	Typical Minster 400kV GIS substation - overall layout	Kent Onshore Scheme	S42_K/TDD/SS/2001
	Typical 400kV GIS substation - elevation drawing	Kent Onshore Scheme	S42_K/TDD/PS/2003_SH1 S42_K/TDD/PS/2003_SH2

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL MINSTER 400KV GIS SUBSTATION - OVERALL LAYOUT
SHEET 1 of 1

NOMINAL SYSTEM VOLTAGE	PHASE TO EARTH	PHASE TO PHASE	SAFETY DISTANCE (FROM NATIONAL GRID SAFETY RULES)	DESIGN CLEARANCE FOR SAFETY (VERTICAL) Ds	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL) Dsh	INSULATION HEIGHT Ih
kV	M	M	M	M	M (SEE POINT ii FROM NOTE 6)	M
400	2.8	3.6	3.1	5.5	4.6	2.4



Notes

For statutory consultation purposes only.

1. These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

2. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

3. Abbreviations
   AIS - Air Insulated Switchgear
   CVT - Capacitive Voltage Transformer
   GIS - Gas Insulated Switchgear
   LVAC - Low Voltage Alternating Current
   HVDC - High Voltage Direct Current

4. Elevation sections relate to S42_S/TDD/SS/2003_SH1 & S42_S/TDD/SS/2003_SH2.

Legend

LIMIT OF LAND

FENCE

NEW EQUIPMENT

ID	DESCRIPTION
01	400kV AIS SURGE ARRESTOR
02	400kV AIS EARTH SWITCH
03	400kV AIS CVT
04	400kV GIS / AIR BUSHING
05	AMENITIES BUILDING
06	400kV GIS HALL
07	HARDSTANDING AREA
08	PARKING
09	400kV ANNEX BUILDING
09a	BATTERY ROOM
09b	LVAC SUPPLIES DISTRIBUTION ROOM
09c	TELECOMS ROOM
09d	SUBSTATION CONTROL SYSTEM/PERMIT ROOM
09e	PROTECTION ROOM
10	WORKSHOP
11	STORAGE
12	SURGE ARRESTOR
13	CURRENT TRANSFORMER
14	CAPACITOR
15	REACTOR
16	RESISTOR
17	DIESEL TANK
18	EMERGENCY DIESEL GENERATOR

Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL MINSTER 400KV GIS SUBSTATION - OVERALL LAYOUT
SHEET 1 of 1

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_K/TDD/SS/2001

Scale	Sheet Size	Sheet	Issue
1:500	A1	SHEET 1 OF 1	A

0 25m 50m
1:500

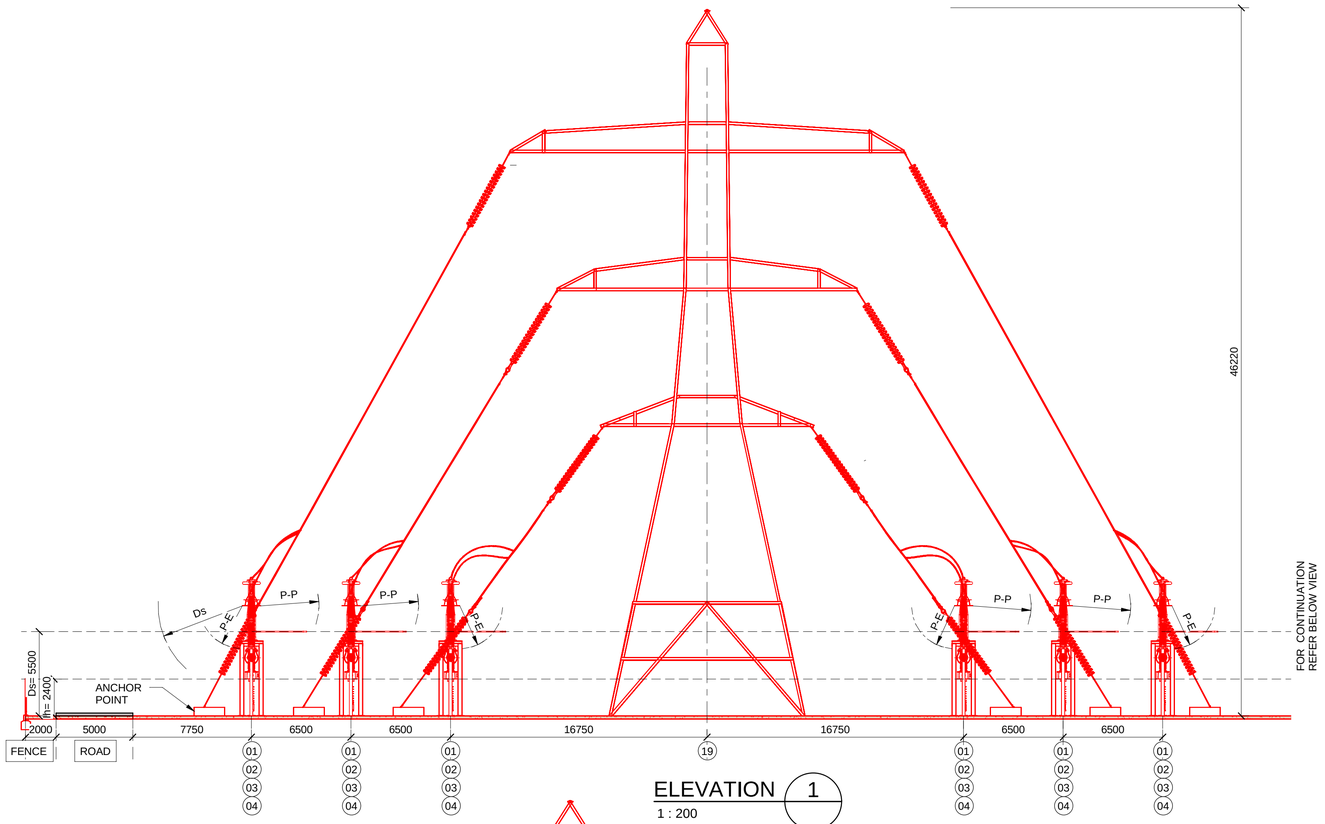
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

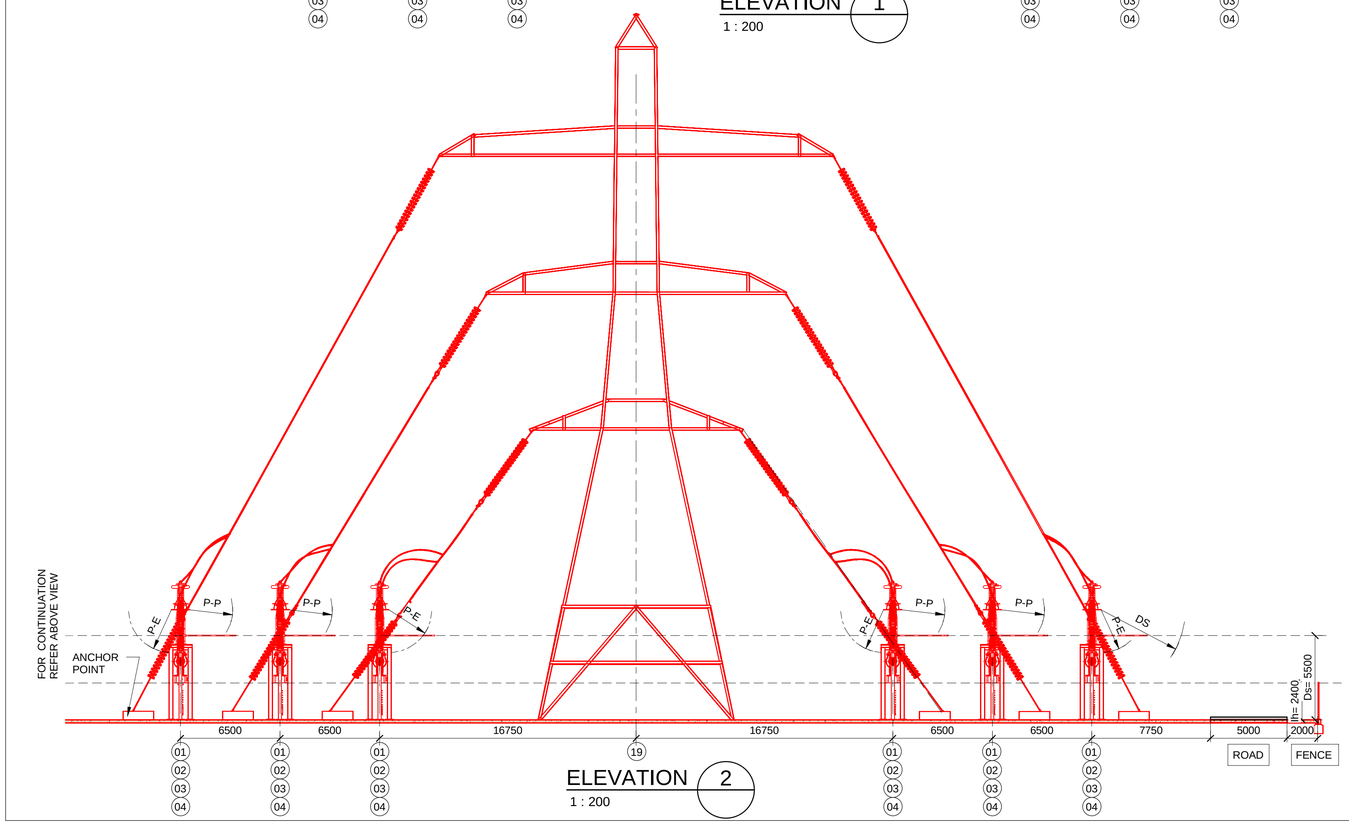
TYPICAL 400kV GIS SUBSTATION - ELEVATION DRAWING

SHEET 1 of 2



ELEVATION 1

1 : 200



ELEVATION 2

1 : 200

SUBSTATION MINIMUM ELECTRICAL CLEARANCES

REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
lh	INSULATION HEIGHT	2400

Notes

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GIS - GAS INSULATED SWITCHGEAR
PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	400kV AIS SURGE ARRESTOR
02	400kV AIS EARTH SWITCH
03	400kV AIS CVT
04	400kV GIS / AIR BUSHING
06	400kV GIS HALL
13	400 kV HARMONIC FILTER - CURRENT TRANSFORMER
14	400 kV HARMONIC FILTER - CAPACITOR
15	400 kV HARMONIC FILTER - REACTOR
16	400 kV HARMONIC FILTER - RESISTOR
19	400kV TERMINAL TOWER
20	LCC

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL 400kV GIS SUBSTATION - ELEVATION DRAWING

SHEET 1 of 2

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_K/TDD/PS/2003

Scale	Sheet Size	Sheet	Issue
1 : 200	A1	SHEET 1 of 2	A

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

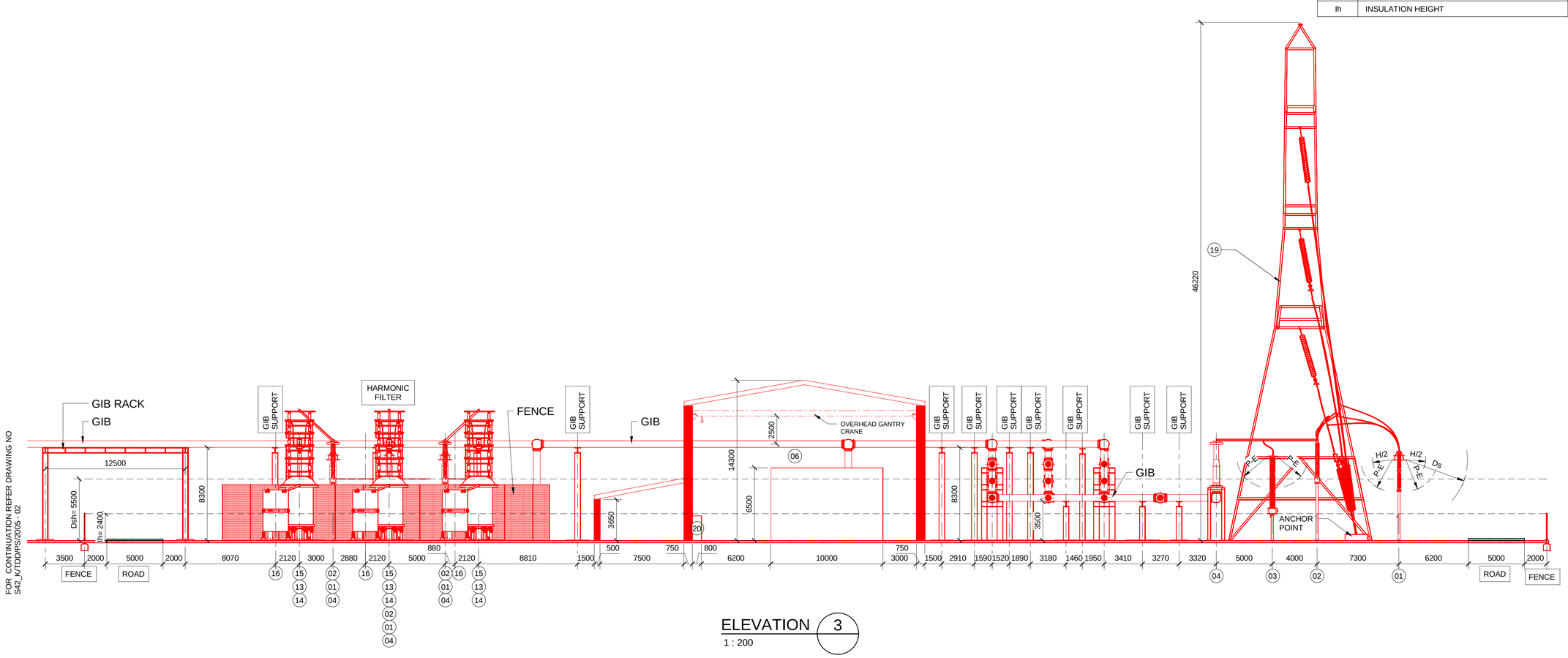
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL 400kV GIS SUBSTATION - ELEVATION DRAWING

SHEET 2 OF 2

SUBSTATION MINIMUM ELECTRICAL CLEARANCES

REF	CLEARANCE (mm)	NOMINAL SYSTEM VOLTAGE
		400kV
P-E	PHASE TO EARTH	2800
P-P	PHASE TO PHASE	3600
SD	SAFETY DISTANCE NATIONAL GRID SAFETY RULES	3100
Ds	DESIGN CLEARANCE FOR SAFETY (VERTICAL)	5500
Dsh	DESIGN CLEARANCE FOR SAFETY (HORIZONTAL)	4600
Ih	INSULATION HEIGHT	2400



ELEVATION 3

1 : 200

Notes

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CVT - CAPACITIVE VOLTAGE TRANSFORMER
GIS - GAS INSULATED SWITCHGEAR
PIR - PRE INSERTION RESISTOR
LCC - LOCAL CONTROL CUBICLE
PH - PHASE
GIB - GAS INSULATED BUSDUCT

Legend

New Equipment

Equipment Schedule

Item	Description
01	400kV AIS SURGE ARRESTOR
02	400kV AIS EARTH SWITCH
03	400kV AIS CVT
04	400kV GIS / AIR BUSHING
06	400kV GIS HALL
13	400 kV HARMONIC FILTER - CURRENT TRANSFORMER
14	400 kV HARMONIC FILTER - CAPACITOR
15	400 kV HARMONIC FILTER - REACTOR
16	400 kV HARMONIC FILTER - RESISTOR
19	400kV TERMINAL TOWER
20	LCC

Issue	Date	Remarks	Drawn	Checked	Approved
A	08/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

TYPICAL 400kV GIS SUBSTATION - ELEVATION DRAWING

SHEET 2 OF 2

nationalgrid

Application Number: EN020026

National Grid Drawing Reference: S42_K/TDD/PS/2003

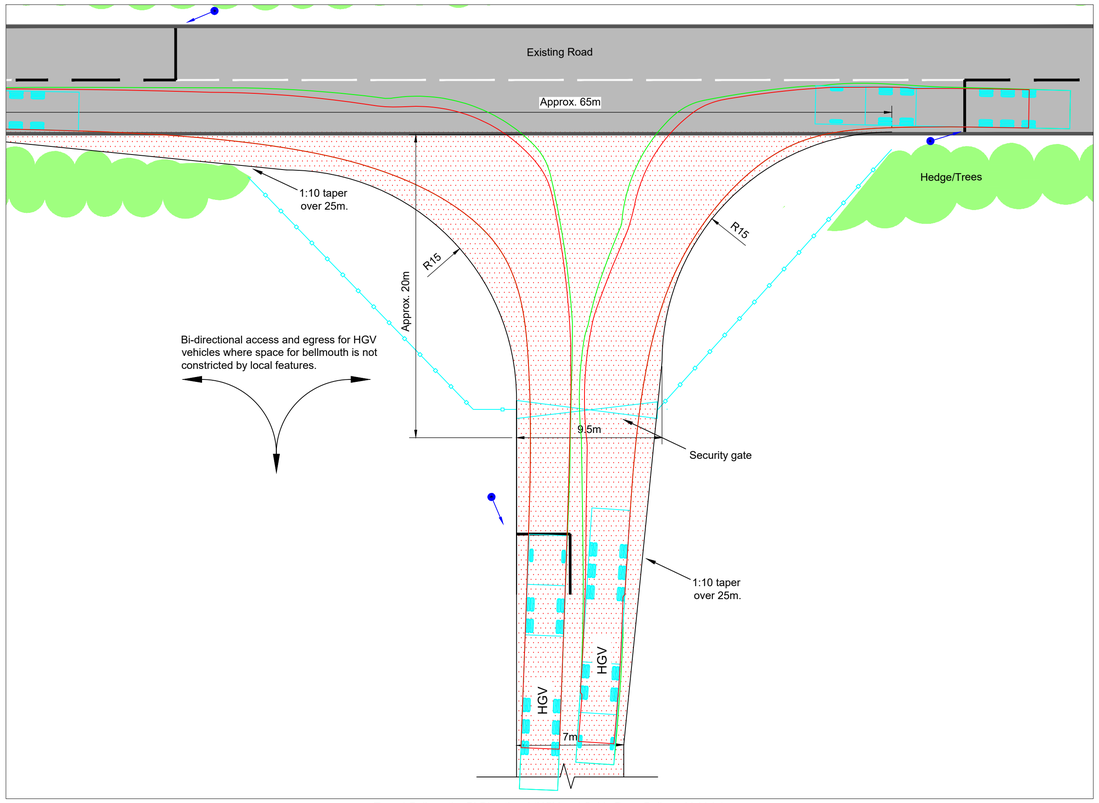
Scale	Sheet Size	Sheet	Issue
1 : 200	A1	SHEET 2 OF 2	A

01-07. Bellmouths, Compounds & Pylon Types

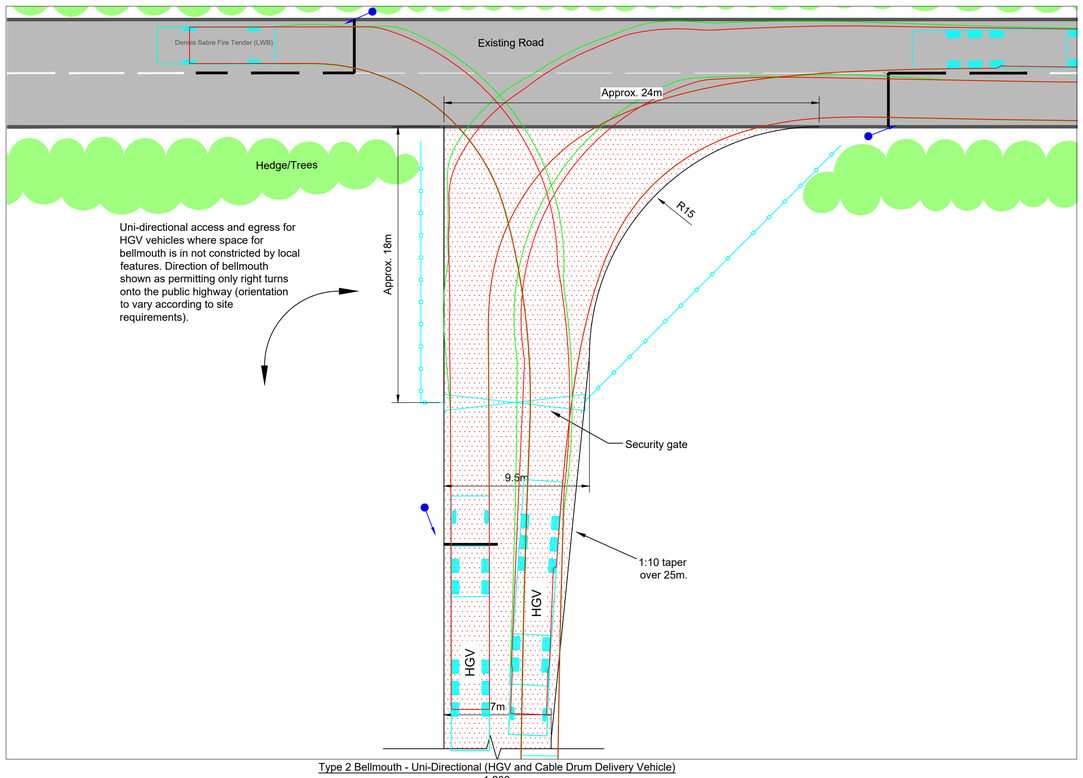
Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Compounds, Bellmouths & Pylon Types	Typical bellmouth arrangement details	Onshore Schemes	S42_T/TDD/SS/3002
	Typical OHL and construction works construction compound	Onshore Schemes	S42_T/TDD/SS/3004
	Typical converter and substation works construction compounds	Onshore Schemes	S42_T/TDD/SS/3005
	Typical OHL pylon detail	Onshore Schemes	S42_T/TDD/SS/3006

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

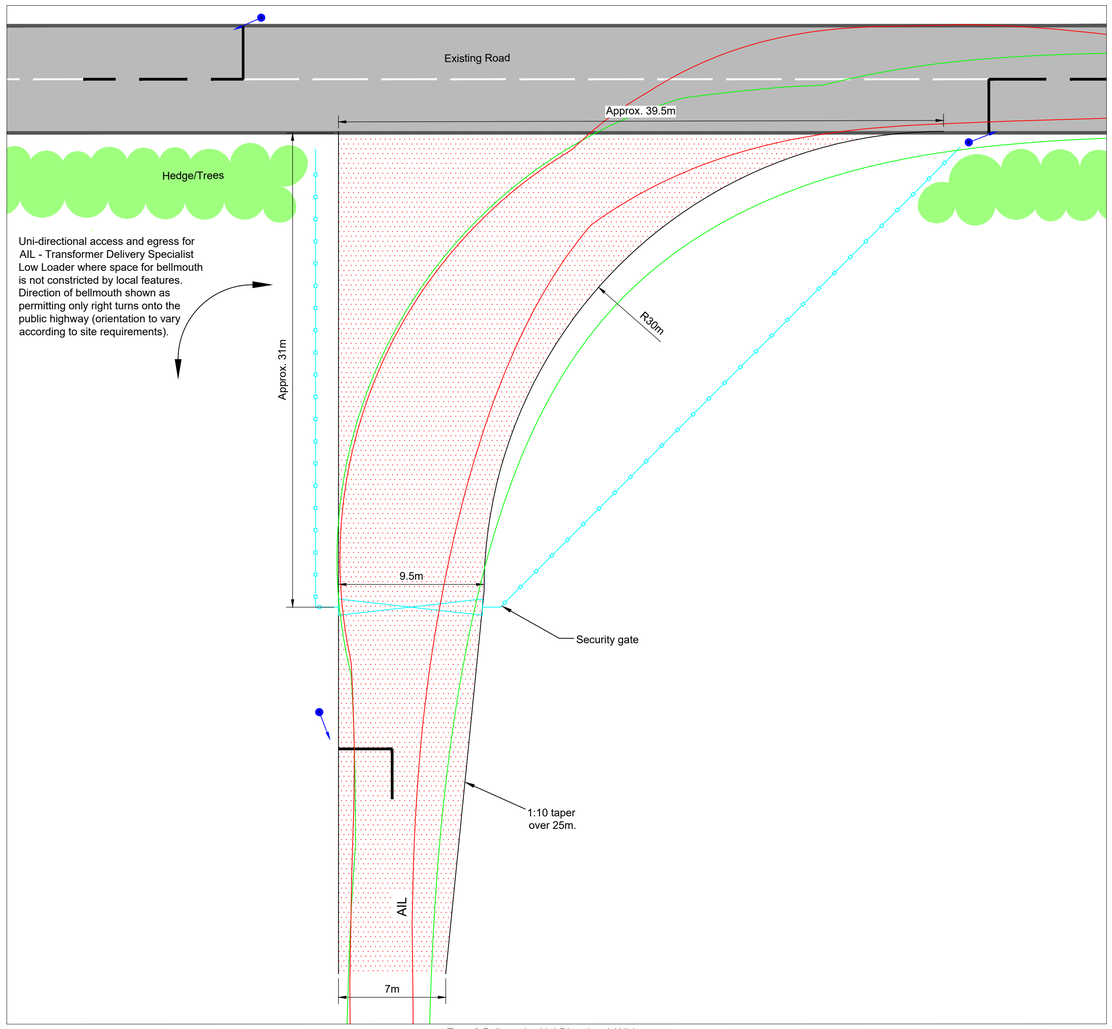
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL BELLMOUTH ARRANGEMENT DETAILS
SHEET 1 OF 1



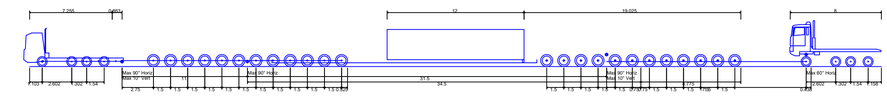
Type 1 Bellmouth - Bi-Directional (HGV and Cable Drum Delivery Vehicle)
1:200



Type 2 Bellmouth - Uni-Directional (HGV and Cable Drum Delivery Vehicle)
1:200

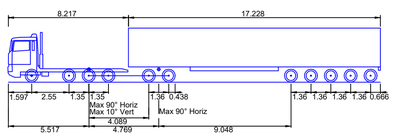


Type 3 Bellmouth - Uni-Directional (AIL)
1:200



Abnormal Indivisible Load (AIL)- AL50 Girder 12 Axial (with trailer)

Overall Length	74.720m
Overall Width	5.336m
Overall Body Height	4.020m
Min Body Ground Clearance	0.337m
Max Track Width	3.000m
Lock to lock time	6.00s
Wait to Wait Turning Radius	11.550m



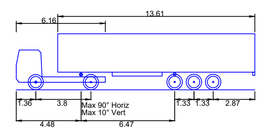
CABLE DRUM DELIVERY VEHICLE 25.44m

Overall Length	25.440m
Overall Width	4.500m
Overall Body Height	3.695m
Min Body Ground Clearance	0.332m
Track Width	2.500m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	14.500m



Dennis Sabre Fire Tender (LWB)

Overall Length	7.700m
Overall Width	2.430m
Overall Body Height	3.512m
Min Body Ground Clearance	0.397m
Track Width	2.380m
Lock to lock time	5.00s
Kerb to Kerb Turning Radius	7.400m



Heavy Goods Vehicle (HGV) DESIGN ARTICULATED VEHICLE (2016)

Overall Length	16.480m
Overall Width	2.550m
Overall Body Height	3.870m
Min Body Ground Clearance	0.515m
Max Track Width	2.470m
Lock to lock time	3.00s
Kerb to Kerb Turning Radius	6.600m

Autotrack Model
NTS

1:200 0 10m 20m

Notes

For statutory consultation purposes only.

These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

Legend

- Hedges/Trees
- Temporary 3 or 4 Way Traffic Lights
- Security Gate
- Access Track and Bellmouth
- Security Fence
- Stop Line
- Vehicle total width swept path
- Vehicle wheelbase swept path

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

TYPICAL BELLMOUTH ARRANGEMENT DETAILS
SHEET 1 OF 1

nationalgrid

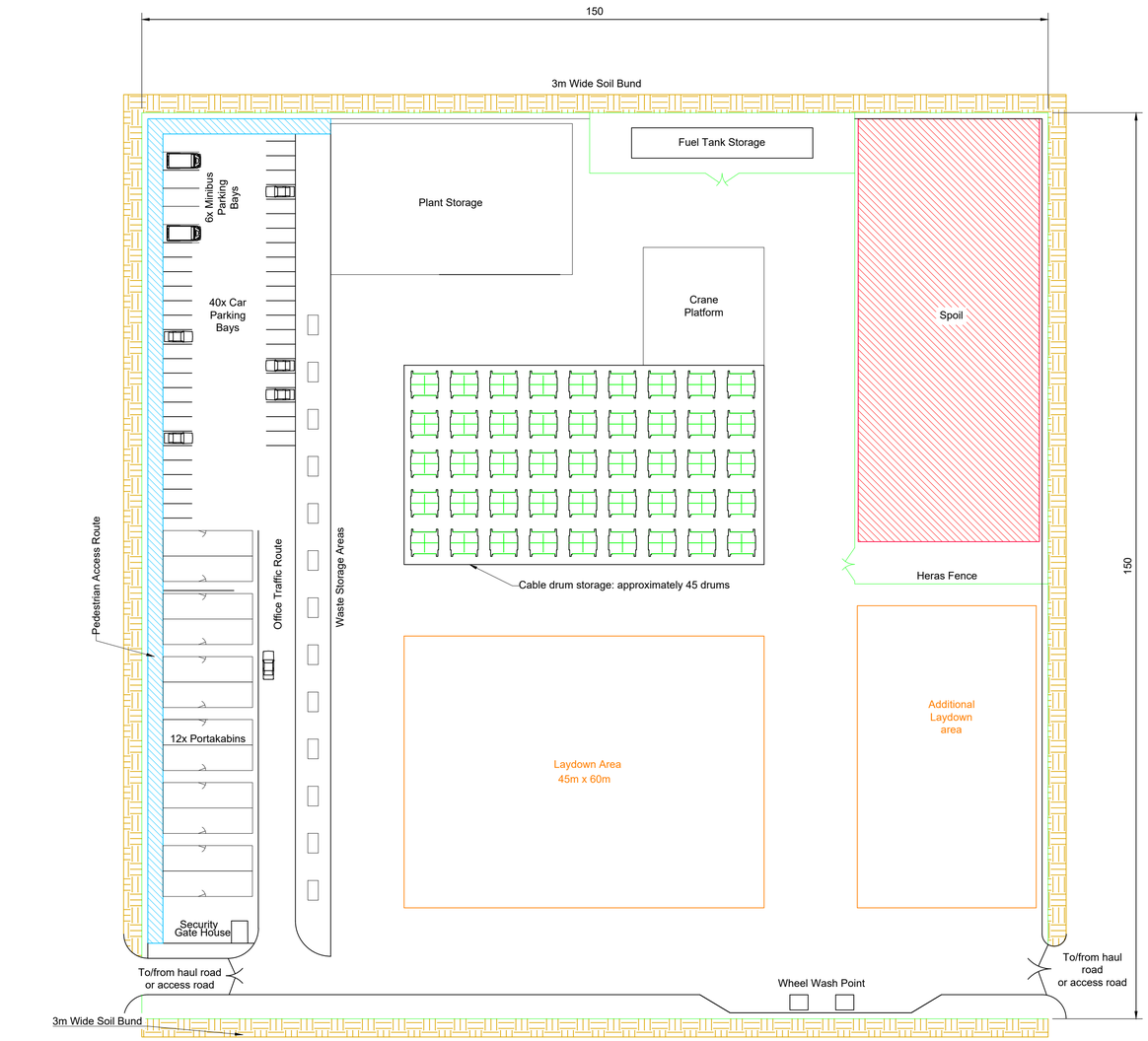
Application Number
EN020026

National Grid Drawing Reference
S42_T/TDD/SS/3002

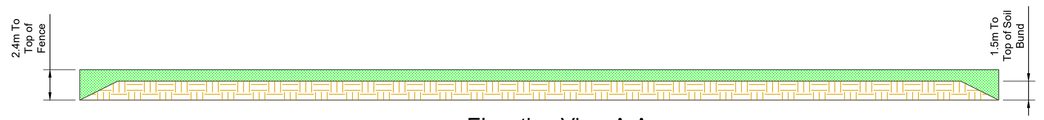
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL OHL AND CONSTRUCTION WORKS CONSTRUCTION COMPOUND
SHEET 1 OF 1



Typical Cable Construction Layout Plan
1:500



Elevation View A-A
1:500

1:500 0 25m 50m

Notes

For statutory consultation purposes only.
These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

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Legend

- Pedestrian Access
- Soil Bund
- Spoil
- Laydown Area

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	SC	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL OHL AND CONSTRUCTION WORKS CONSTRUCTION COMPOUND
SHEET 1 OF 1

nationalgrid

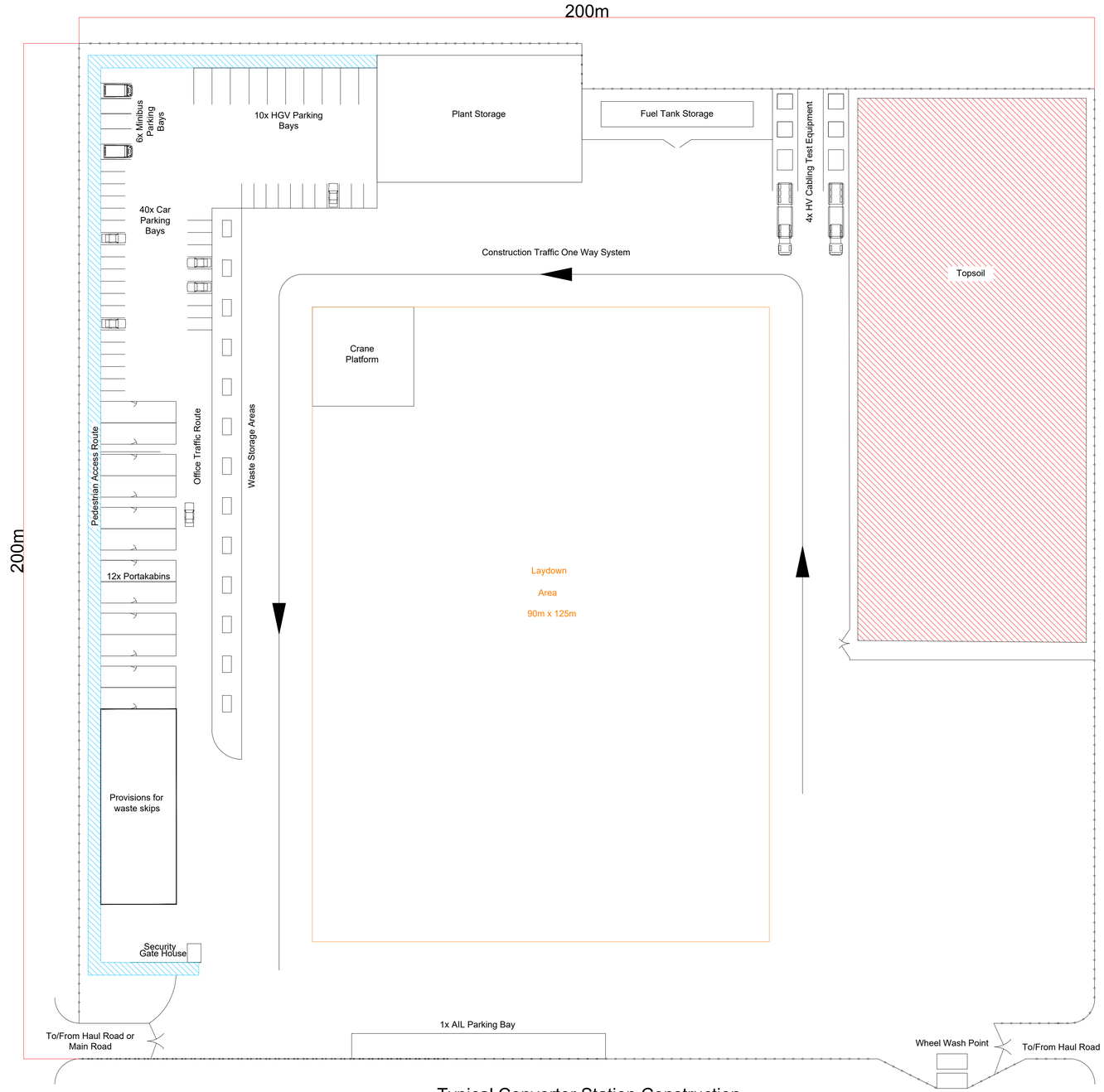
Application Number
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National Grid Drawing Reference
S42_T/TDD/SS/3004

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL CONVERTER AND SUBSTATION WORKS CONSTRUCTION COMPOUNDS
SHEET 1 of 1



Typical Convertor Station Construction Layout Plan



Elevation View A-A

1:500 0 25m 50m

Notes

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1. These plans show the Draft Order Limits and Draft Cable Alignment and potential pylon locations. Due to the need for future flexibility, National Grid will be applying for Order Limits and Limits of Deviation within its Development Consent Order, within which any final alignment (including pylon locations) would lie. Therefore the Draft Cable Alignment and pylon locations should be treated as indicative only. Further information is provided in our 'Guide to interacting with our consultation plans' document.

2. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.

3. Abbreviations
   AIL - Abnormal Indivisible Loads
   HGV - Heavy Goods Vehicle
   HV - High Voltage

Legend

Pedestrian Access

Topsoil

Security Fence

Sheet X Centroid Coordinate: Sheet Y Centroid Coordinate:

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Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL CONVERTER AND SUBSTATION WORKS CONSTRUCTION COMPOUNDS
SHEET 1 of 1

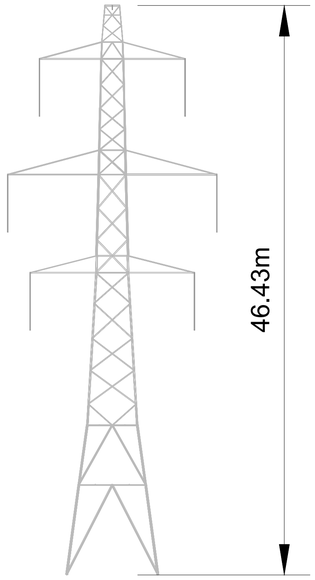
nationalgrid

Application Number: EN020026

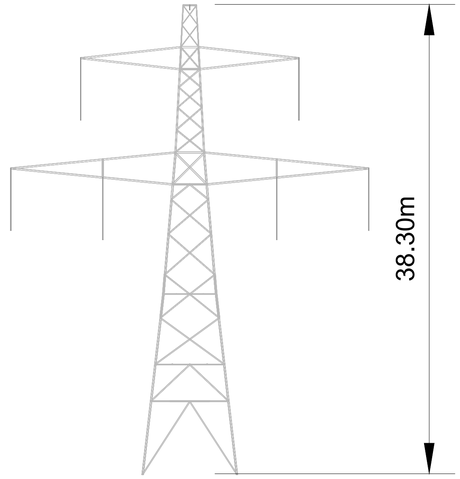
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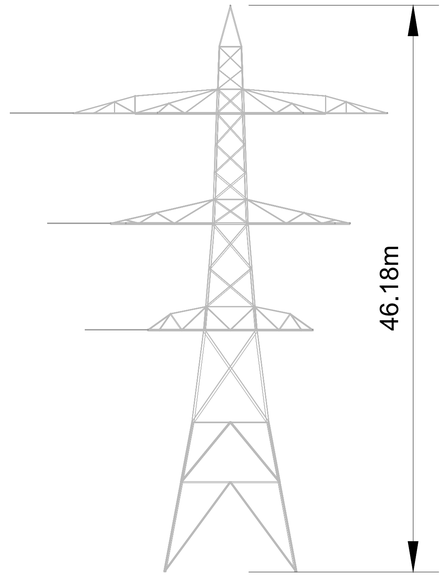
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL OHL PYLON DETAIL
SHEET 1 of 1



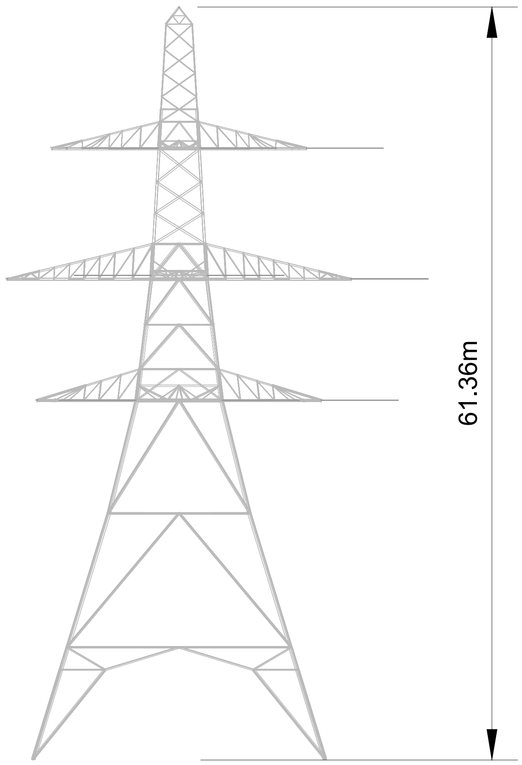
L8 D STD: Suspension Tower



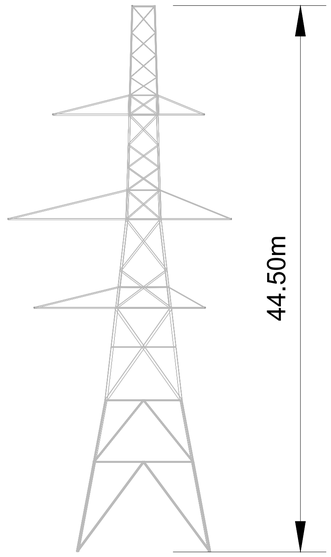
L12 LD E3: Suspension Tower



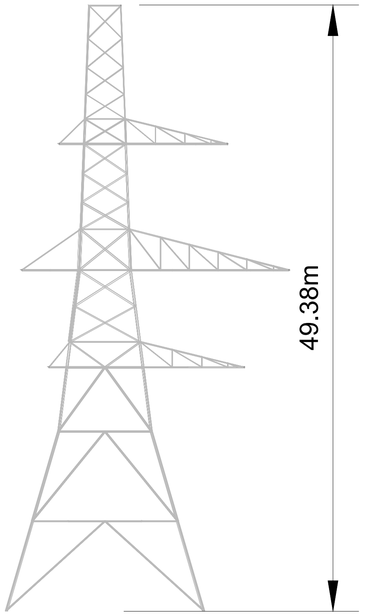
L8 DT STD (Extended Cross Arms): Tension Tower



L6 DJT E3: Tension Tower



L8 D60 STD: Tension Tower



L8 D90 STD: Tension Tower

1:250 0 12.5m 25m

Notes

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Issue	Date	Remarks	Drawn	Checked	Approved
A	01/09/2023	FINAL	MS	JW	KJ

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
TYPICAL OHL PYLON DETAIL
SHEET 1 of 1

nationalgrid

Application Number
EN020026

National Grid Drawing Reference
S42_T/TDD/SS/3006

Scale	Sheet Size	Sheet	Issue
1:250	A1	SHEET 1 OF 1	A

02. Offshore Design Drawings

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

nationalgrid

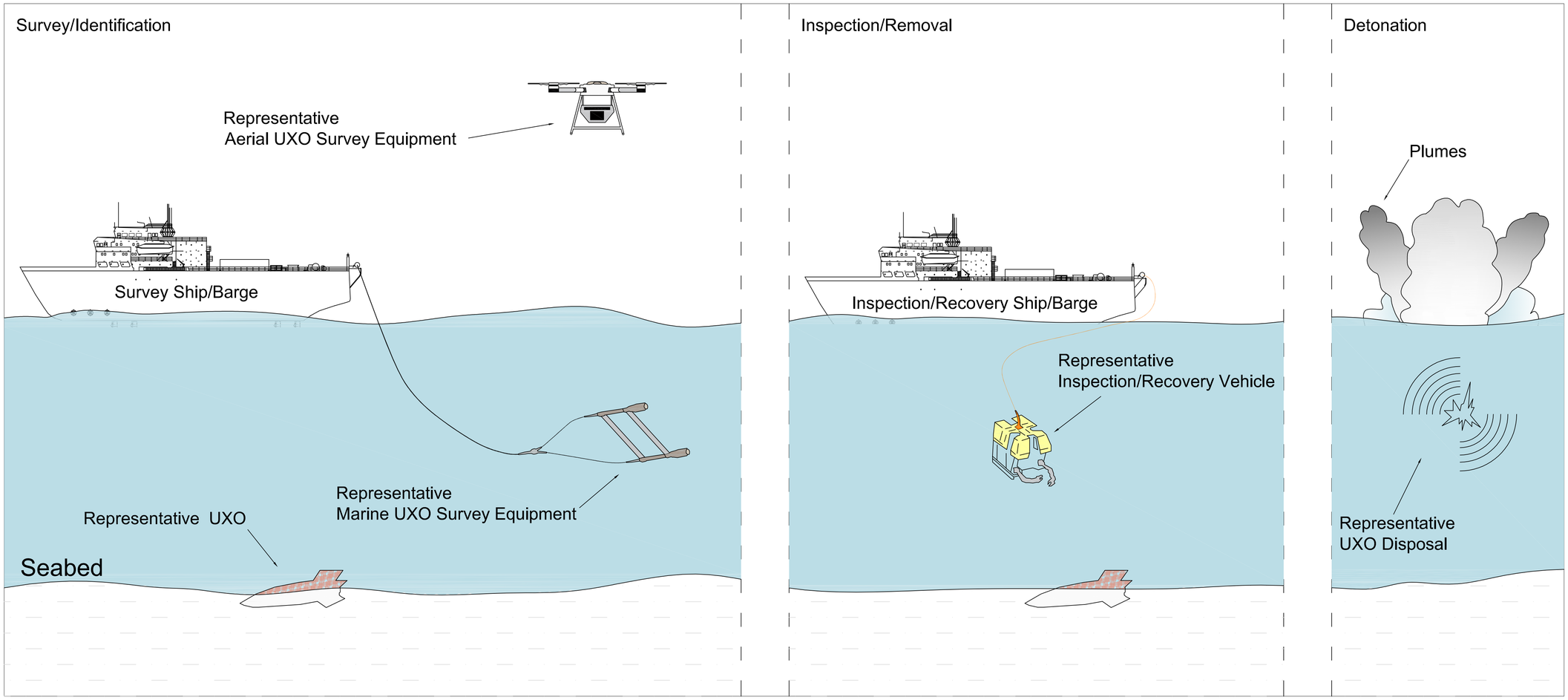
02-01. Pre-Cable Installation Works

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Pre-Cable Installation Works	Illustration of unexploded ordnance, removal and detonation	Offshore Scheme	S42_M/TDD/SS/1030
	Illustration of boulder clearance	Offshore Scheme	S42_M/TDD/SS/1027
	Illustration of pre-lay grapnel run	Offshore Scheme	S42_M/TDD/SS/1028
	Illustration of indicative pre-sweeping and sidecasting	Offshore Scheme	S42_M/TDD/SS/1029

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
UNEXPLODED ORDNANCE, REMOVAL AND DETONATION
SHEET 1 of 1



Notes

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2. All dimensions are in metres/millimetres unless otherwise stated.
3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. UXO = Unexploded Ordnance
7. For further explanation of these plans see the Guide to the Plans Document.
8. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

Water

Seabed Sediment

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
UNEXPLODED ORDNANCE, REMOVAL AND DETONATION
SHEET 1 of 1

nationalgrid

Application Number
-

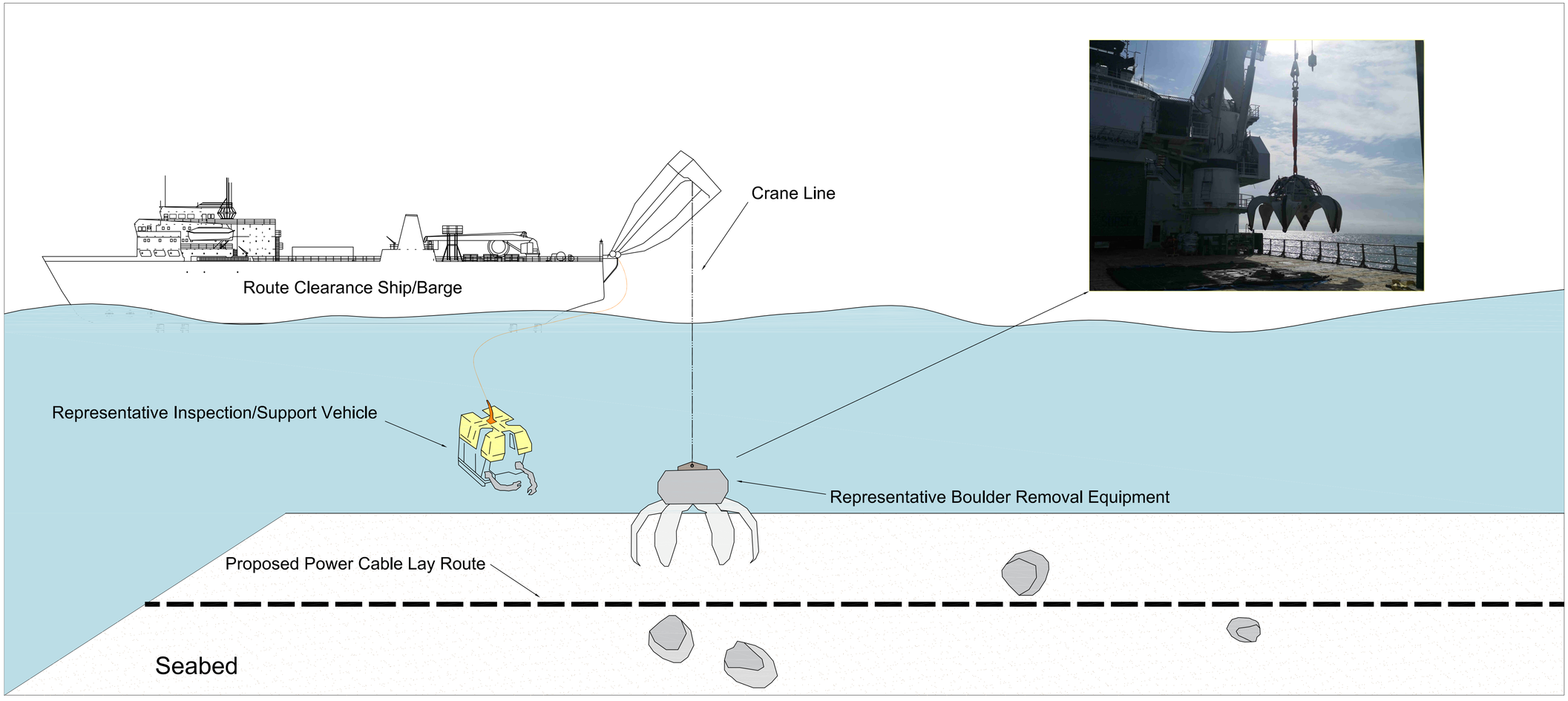
National Grid Drawing Reference
S42_M/TDD/SS/1030

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF BOULDER CLEARANCE
SHEET 1 of 1



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7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Water
- Seabed Sediment
- Boulder

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF BOULDER CLEARANCE
SHEET 1 of 1

nationalgrid

Application Number

-

National Grid Drawing Reference

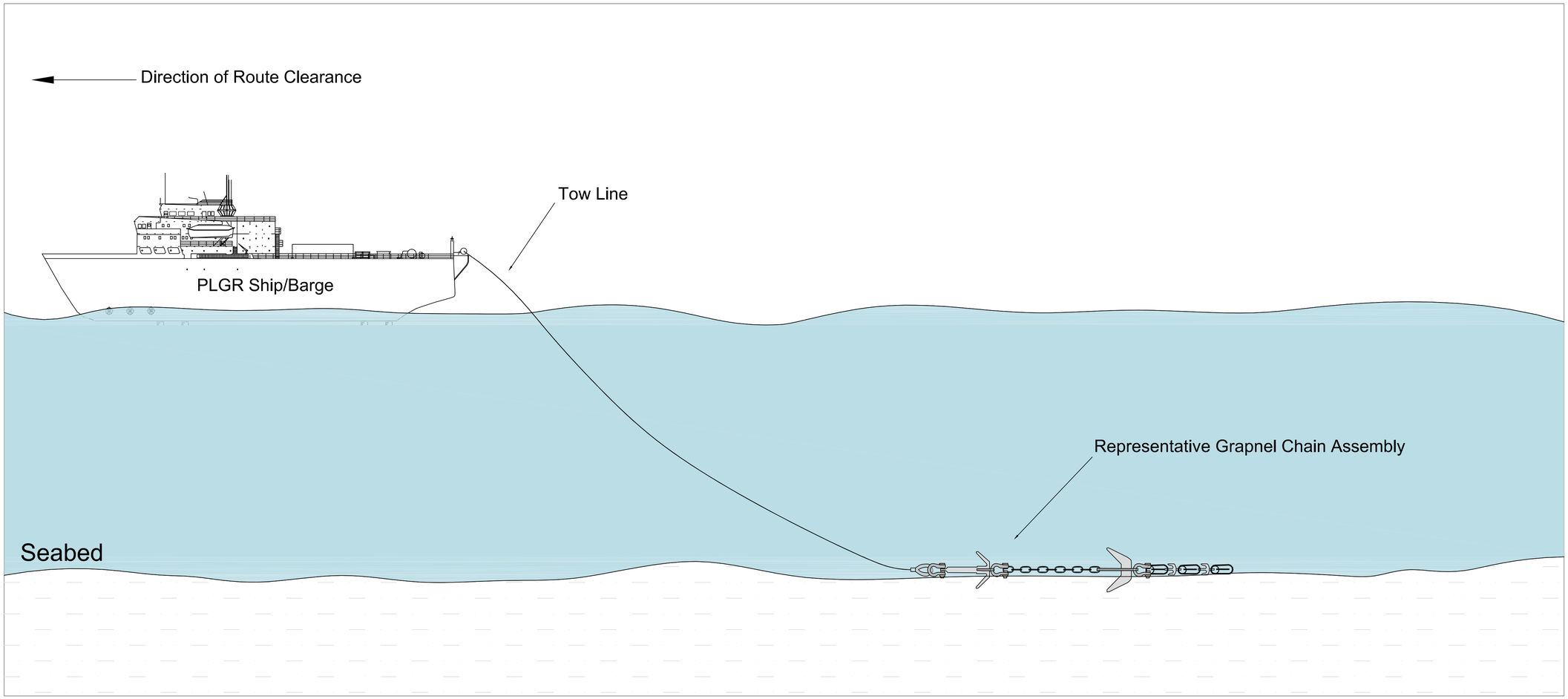
S42_M/TDD/SS/1027

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
PRE LAY GRAPNEL RUN
SHEET 1 of 1



Notes

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5. Detailed design, including final dimensions, to be decided at a later date.
6. PLGR = Pre Lay Grapnel Run
7. For further explanation of these plans see the Guide to the Plans Document.
8. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

Water

Seabed Sediment

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
PRE LAY GRAPNEL RUN
SHEET 1 of 1

nationalgrid

Application Number

-

National Grid Drawing Reference

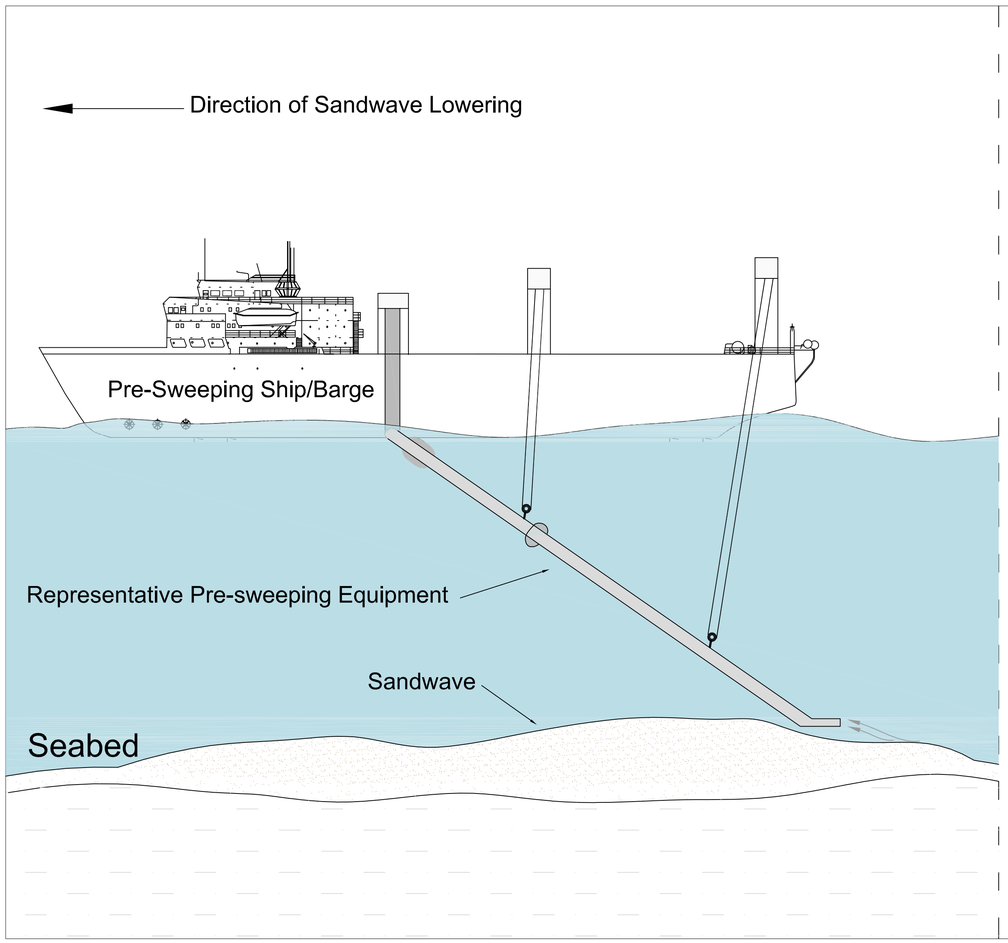
S42_M/TDD/SS/1028

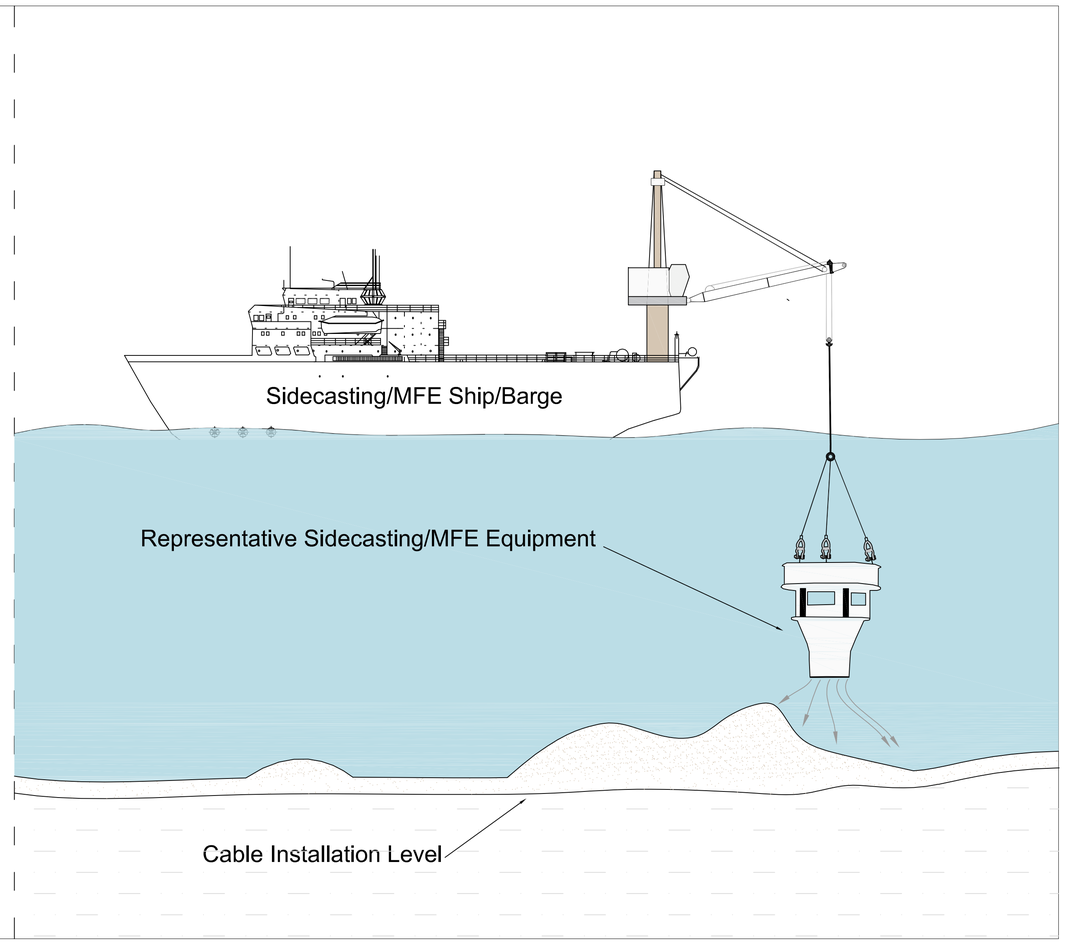
Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
INDICATIVE PRE-SWEEPING AND SIDECASTING
SHEET 1 of 1





Notes

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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. MFE = Mass Flow Excavator.
7. For further explanation of these plans see the Guide to the Plans Document.
8. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

Water

Sandwave

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

A	24/10/2023	FINAL	AMN	FSS	KG
Issue	Date	Remarks	Drawn	Checked	Approved

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
INDICATIVE PRE-SWEEPING AND SIDECASTING
SHEET 1 of 1

nationalgrid

Application Number

-

National Grid Drawing Reference

S42_M/TDD/SS/1029

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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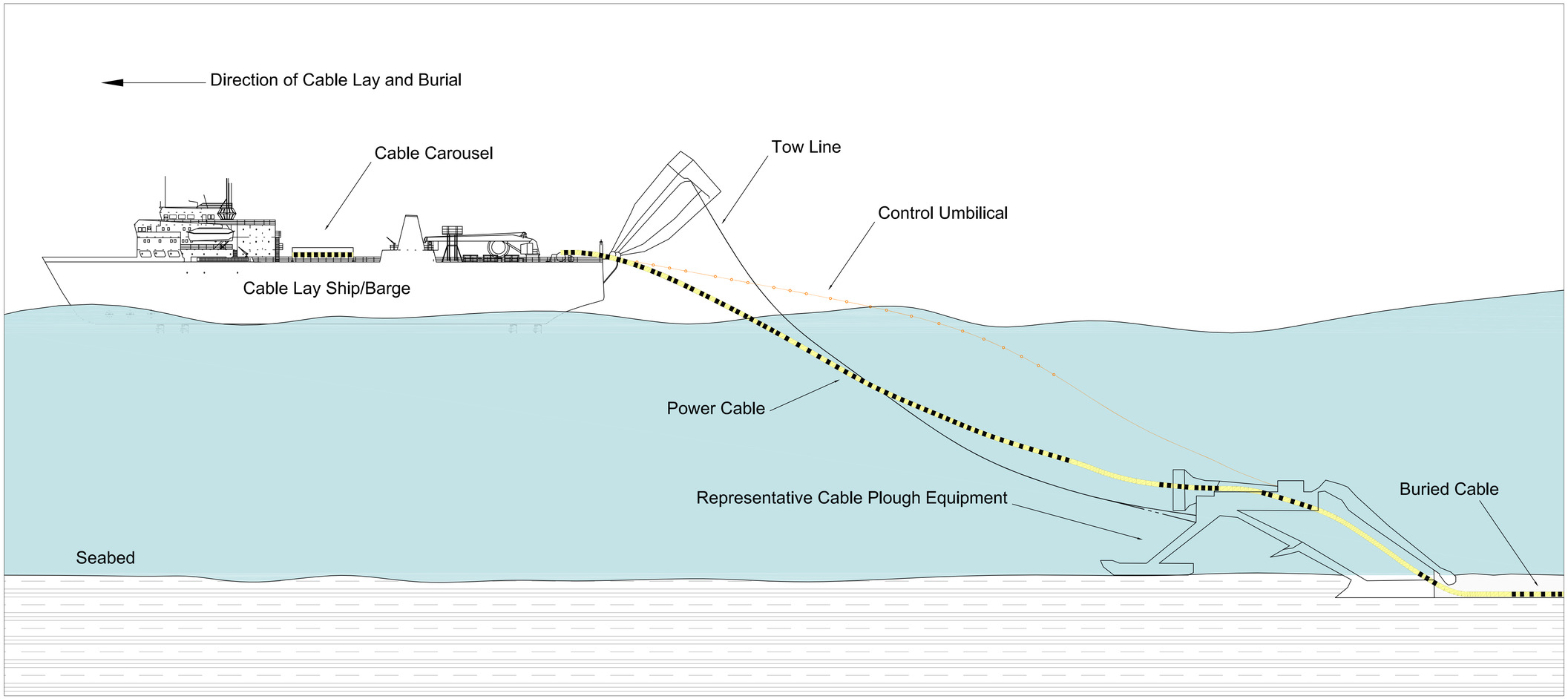
02-02. Cable Installation Works

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Cable Installation Works	Illustration of simultaneous lay and burial	Offshore Scheme	S42_M/TDD/SS/1032
	Illustration of lay and post-lay burial	Offshore Scheme	S42_M/TDD/SS/1033
	Illustration of illustration of omega and inline joint	Offshore Scheme	S42_M/TDD/SS/1031

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
SIMULTANEOUS LAY AND BURIAL
SHEET 1 of 1



Notes

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5. Detailed design, including final dimensions, to be decided at a later date.
6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Water
- Seabed Sediment
- Control Umbilical of Burial Equipment
- Tow Line of Burial Equipment
- New HVDC Bundle

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
SIMULTANEOUS LAY AND BURIAL
SHEET 1 of 1

nationalgrid

Application Number

-

National Grid Drawing Reference

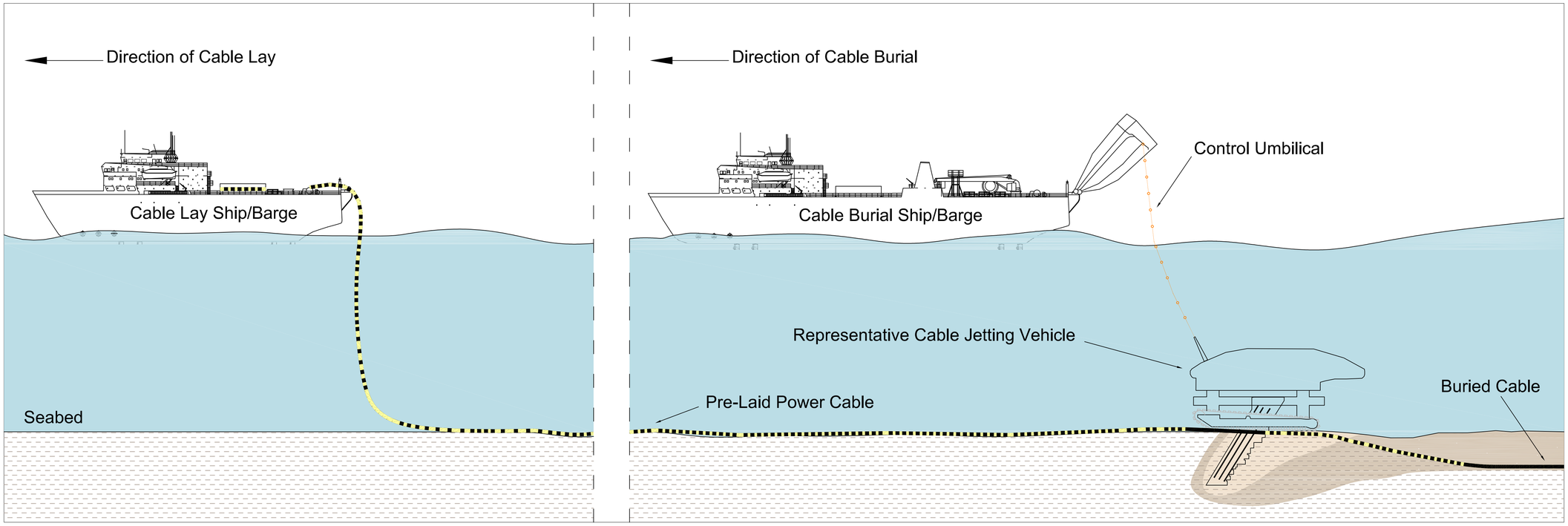
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Scale	Sheet Size	Sheet	Issue
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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
LAY AND POST-LAY BURIAL
SHEET 1 of 1



Notes

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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Water
- Seabed Sediment
- Fluidization Area
- Sedimentation Area
- Control Umbilical of Burial Equipment
- New HVDC Bundle

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
LAY AND POST-LAY BURIAL
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1033

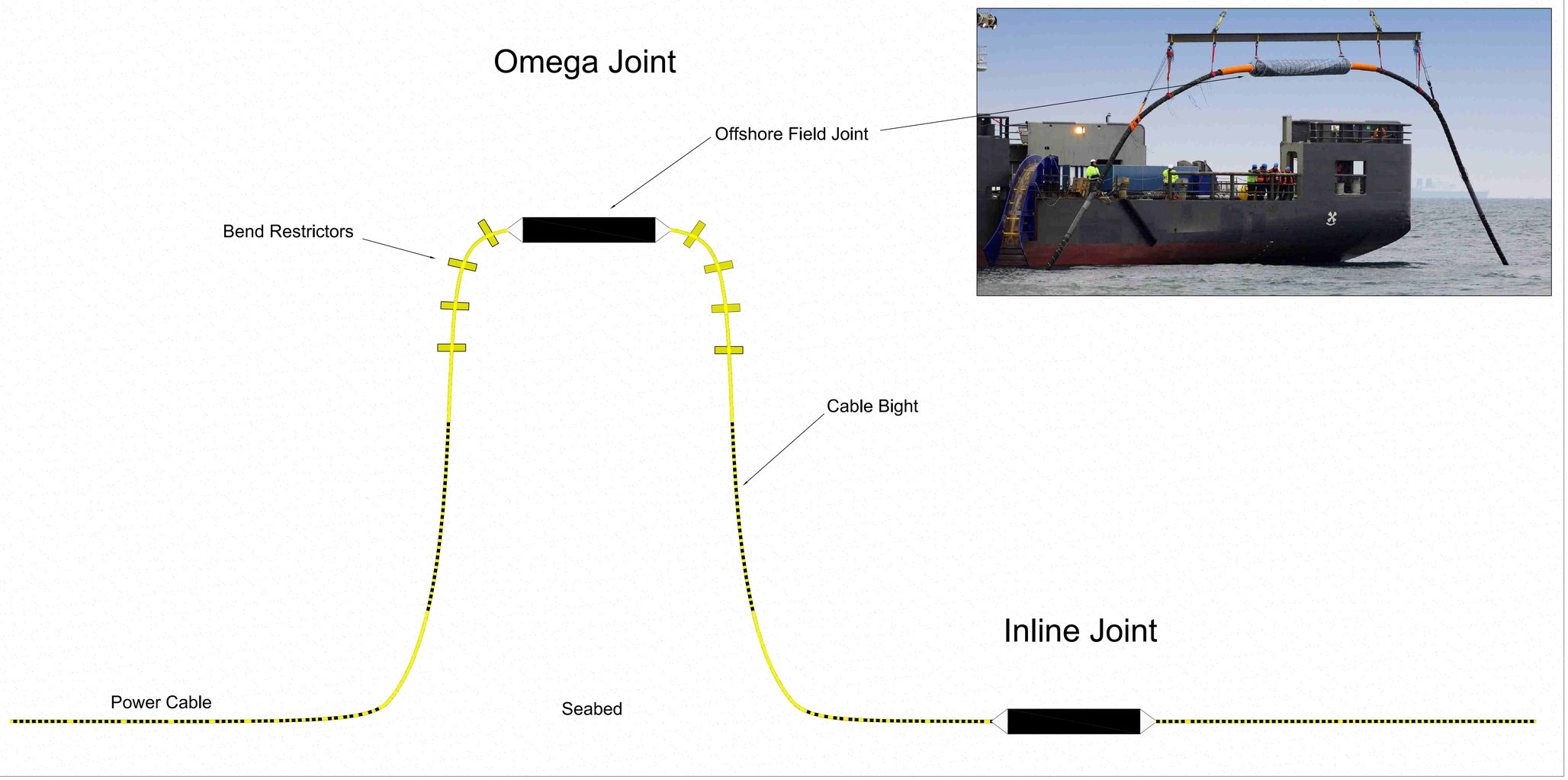
Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
OMEGA AND INLINE JOINT
SHEET 1 of 1

Omega Joint



Notes

For statutory consultation purposes only

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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. Infield joint is a joint made on board a cable laying vessel or barge, or in the beach areas, between cable lengths which have been armoured. They are generally used to connect two delivery lengths offshore creating a continuous linear 'in-line' asset.
7. Omega joint is a joint made during cable lay or during a cable repair. The joint get its name because it results in a bight of cable laid to the side of the main cable route and looks like an 'Ω' when viewed from above.
8. For further explanation of these plans see the Guide to the Plans Document.
9. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Seabed Sediment
- New HVDC Bundle
- Inline/Omega Joint

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
OMEGA AND INLINE JOINT
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1031

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

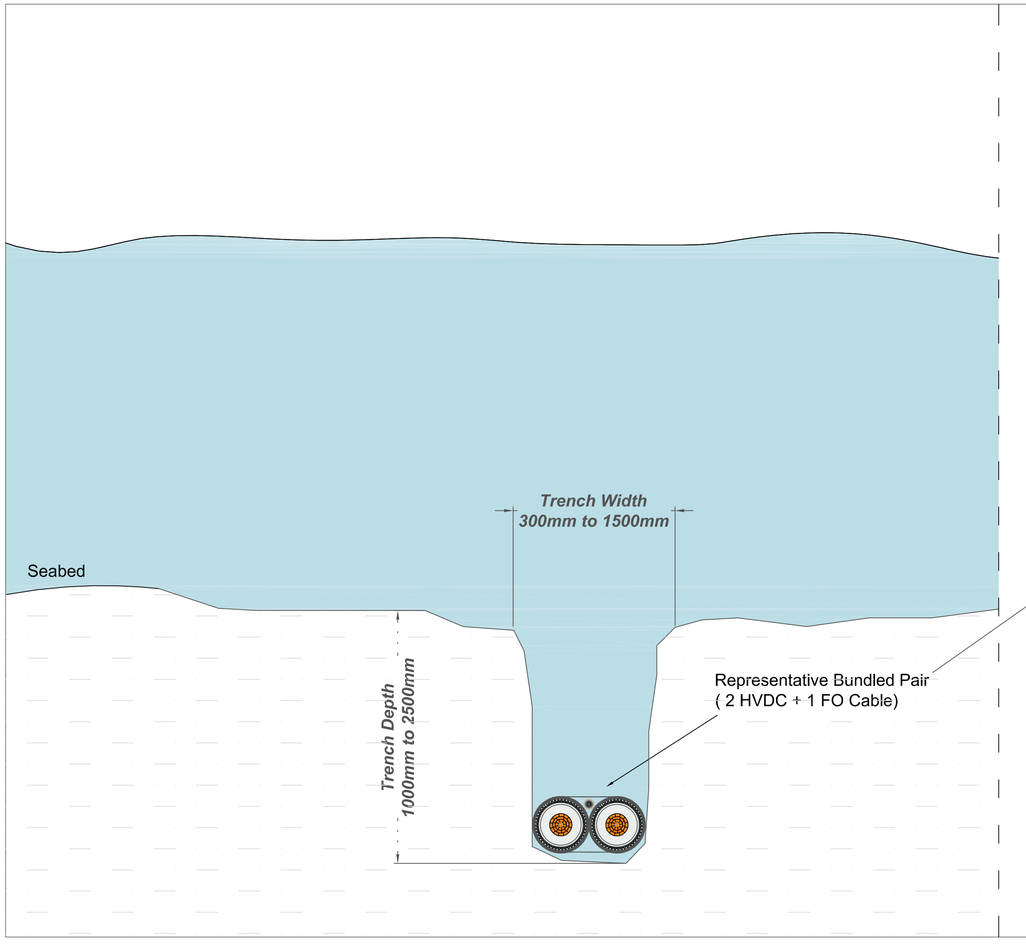
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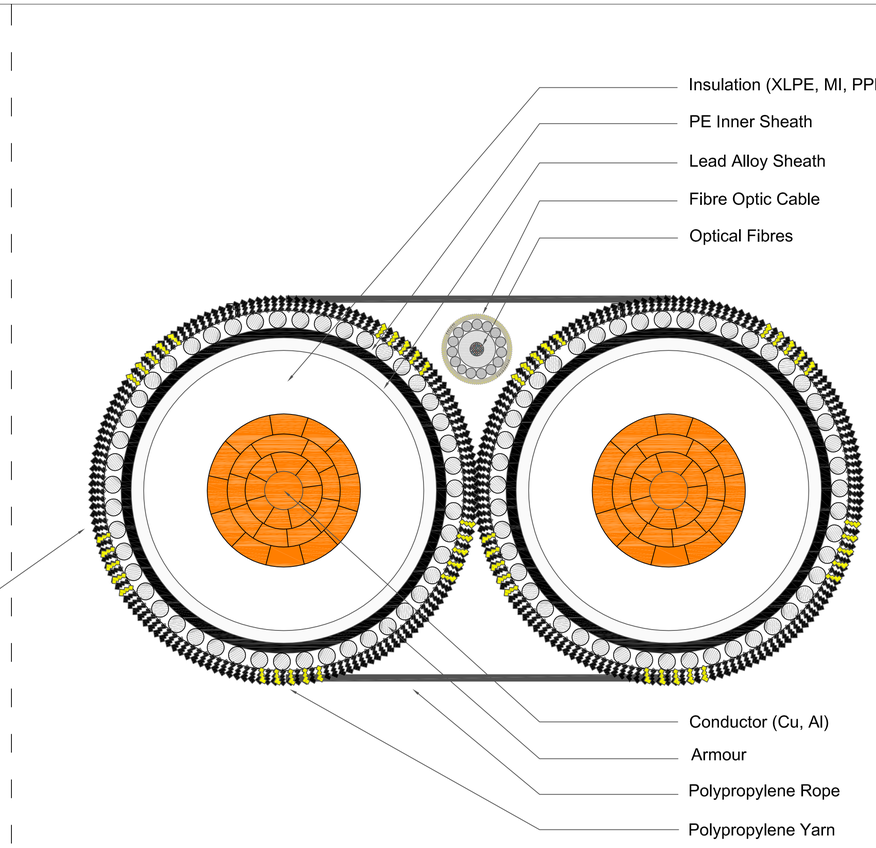
02-03. Cable Configuration and Trench Profiles

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Cable Configuration and Trench Profiles	Illustration of bundled cable profile/ configuration	Offshore Scheme	S42_M/TDD/SS/1026
	Illustration of typical marine trench profiles	Offshore Scheme	S42_M/TDD/SS/1036

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
HVDC BUNDLED CABLE PROFILE / CONFIGURATION
SHEET 1 of 1





Notes

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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. The possibility of 'V' shaped trench due to shallow soil types and/or trench collapse cannot be ruled out.
7. For further explanation of these plans see the Guide to the Plans Document.
8. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

Water

Sub-seabed Sediment

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
HVDC BUNDLED CABLE PROFILE / CONFIGURATION
SHEET 1 of 1

nationalgrid

Application Number

-

National Grid Drawing Reference

S42_M/TDD/SS/1026

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

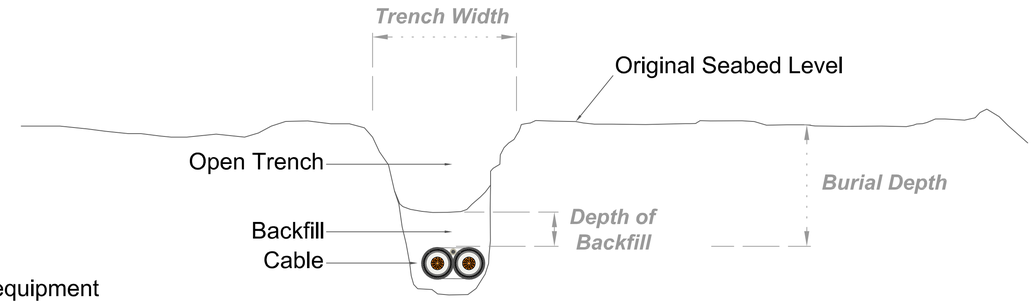
ILLUSTRATION OF
TYPICAL MARINE TRENCH PROFILES
SHEET 1 of 1

Notes

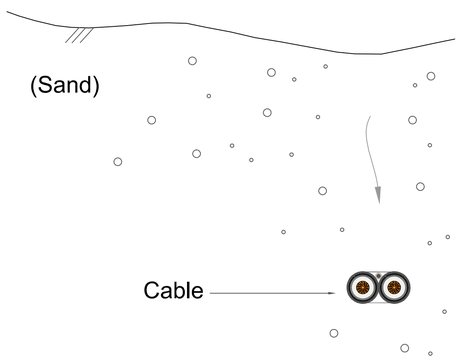
For statutory consultation purposes only

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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

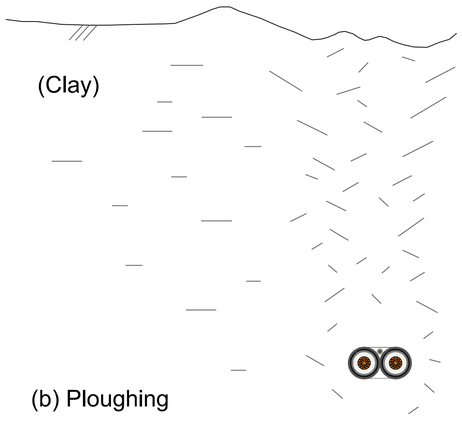
Typical Trench Profile



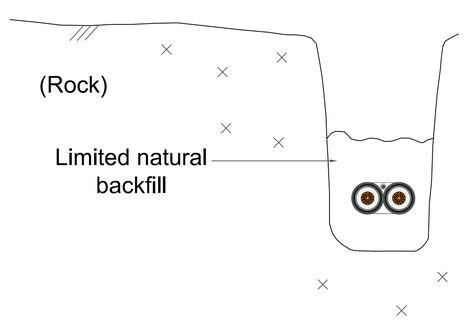
Trench profiles from different installation equipment



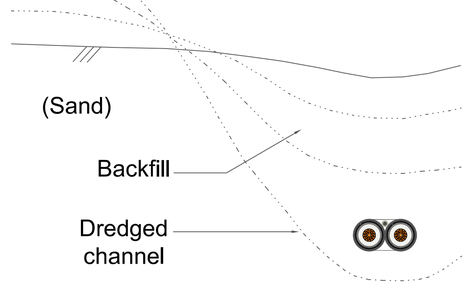
(a) Jetting/fluidisation



(b) Ploughing



(c) Mechanical Cutting



(d) Open trench dredging

(after: Subsea power cables in shallow water, DNVGL-RP-0360)

Legend

Sand

Clay

Rock

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
TYPICAL MARINE TRENCH PROFILES
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1036

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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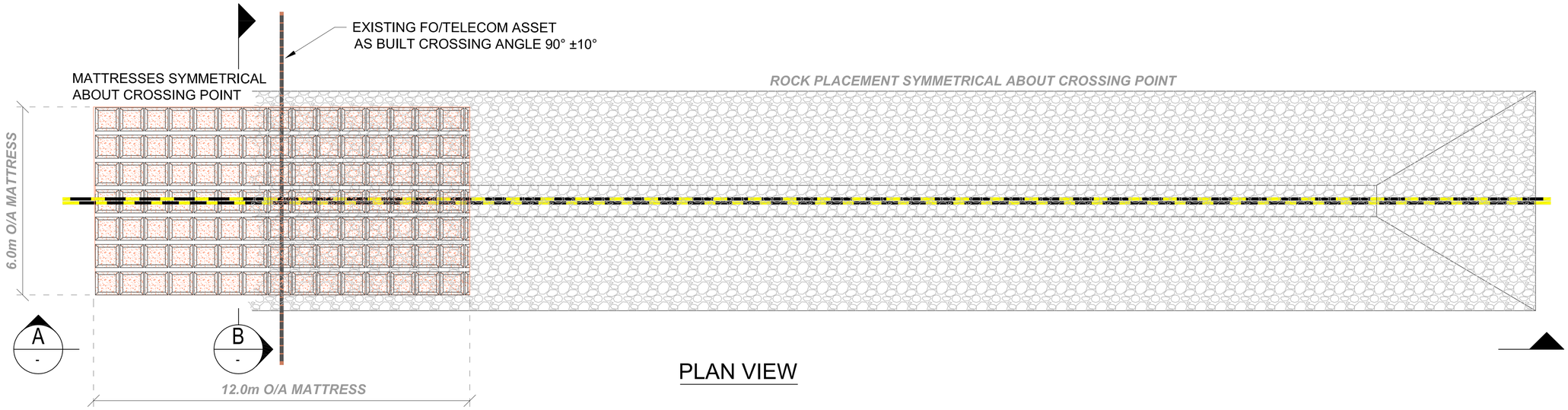
02-04. Cable Crossings and Protection

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Cable Crossings and Protection	Indicative HVDC bundled cable crossing over unburied fibre optic/telecoms asset	Offshore Scheme	S42_M/TDD/SS/1021
	Indicative HVDC bundled cable crossing over buried FO/telecoms asset	Offshore Scheme	S42_M/TDD/SS/1022
	Indicative HVDC bundled cable crossing over buried power cable asset	Offshore Scheme	S42_M/TDD/SS/1023
	Indicative HVDC bundled cable crossing over pre lay berm	Offshore Scheme	S42_M/TDD/SS/1024
	Indicative rock berm schematics pre lay and post lay	Offshore Scheme	S42_M/TDD/SS/1025
	Illustration of cable protective systems	Offshore Scheme	S42_M/TDD/SS/1034
	Illustration of rock placement sections	Offshore Scheme	S42_M/TDD/SS/1035

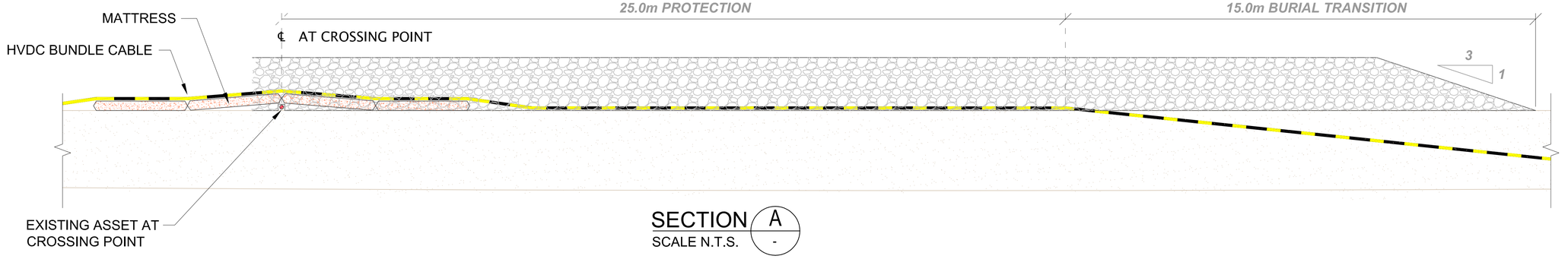
To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

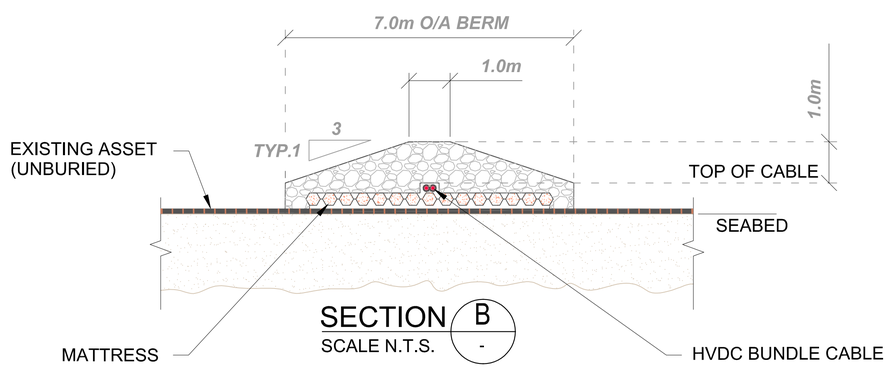
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER UNBURIED FO/TELECOMS ASSET
SHEET 1 of 1



PLAN VIEW



SECTION A
SCALE N.T.S.



SECTION B
SCALE N.T.S.

Notes

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5. Detailed design, including final dimensions, to be agreed during crossing agreement discussions with third parties including burial technique.
6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Post Lay Rock Berm
- Mattress (Plan View)
- Mattress (Section A)
- Mattress (Section B)
- Existing Asset
- New HVDC Bundle

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER UNBURIED FO/TELECOMS ASSET
SHEET 1 of 1

nationalgrid

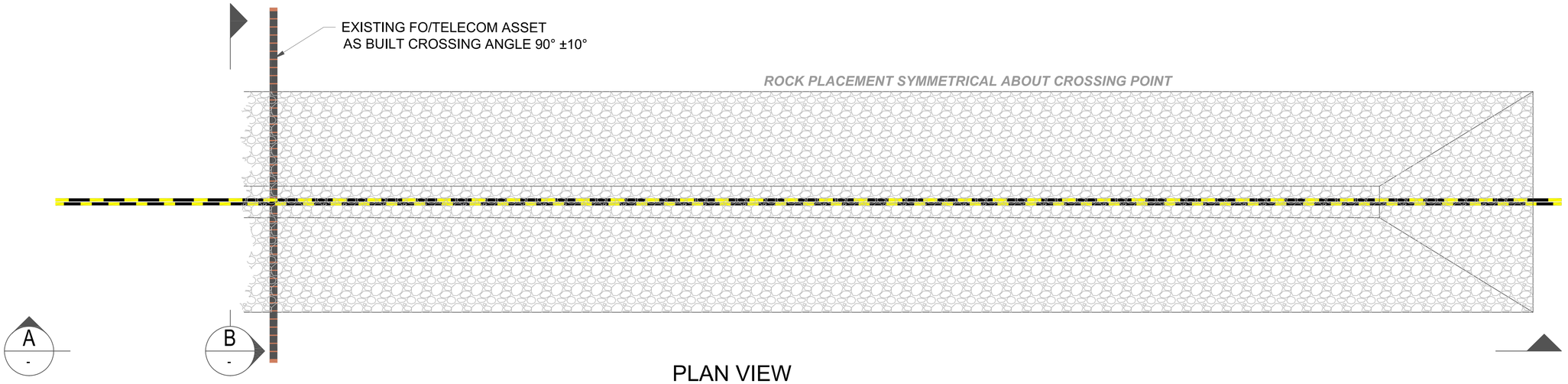
Application Number
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National Grid Drawing Reference
S42_M/TDD/SS/1021

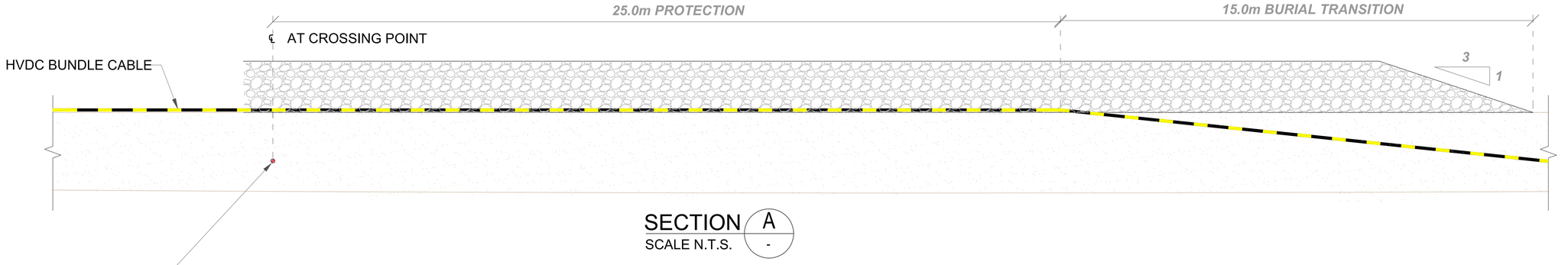
Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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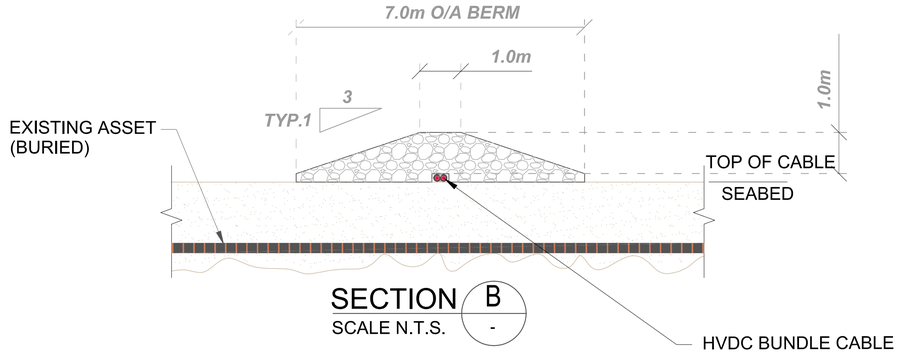
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER BURIED FO/TELECOMS ASSET
SHEET 1 of 1



PLAN VIEW



SECTION A
SCALE N.T.S.
-



SECTION B
SCALE N.T.S.
-

Notes
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5. Detailed design, including final dimensions, to be agreed during crossing agreement discussions with third parties including burial technique.
6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Post Lay Rock Berm
- Existing Asset
- New HVDC Bundle

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER BURIED FO/TELECOMS ASSET
SHEET 1 of 1

nationalgrid

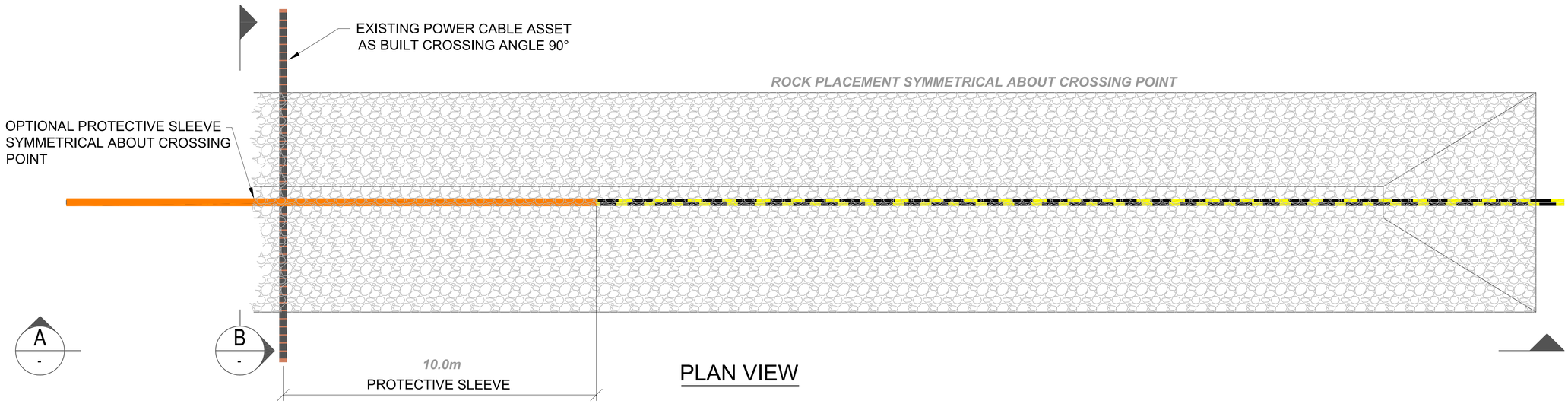
Application Number
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National Grid Drawing Reference
S42_M/TDD/SS/1022

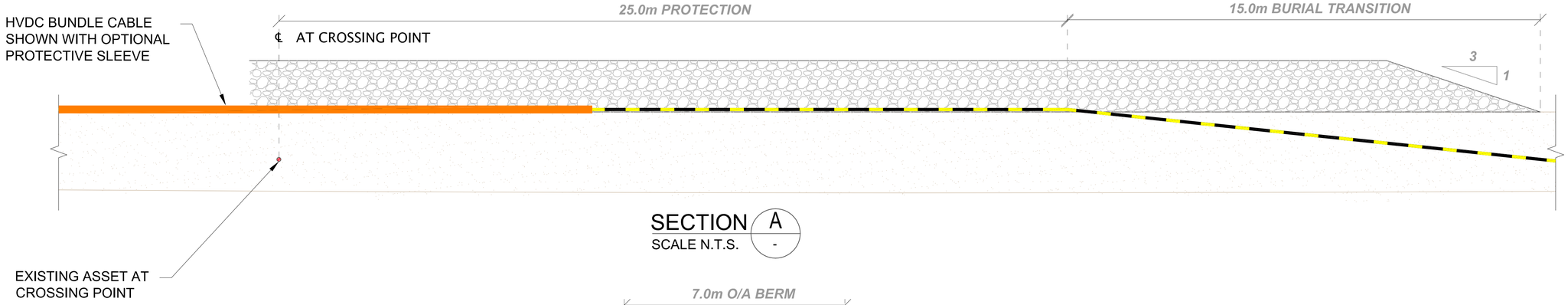
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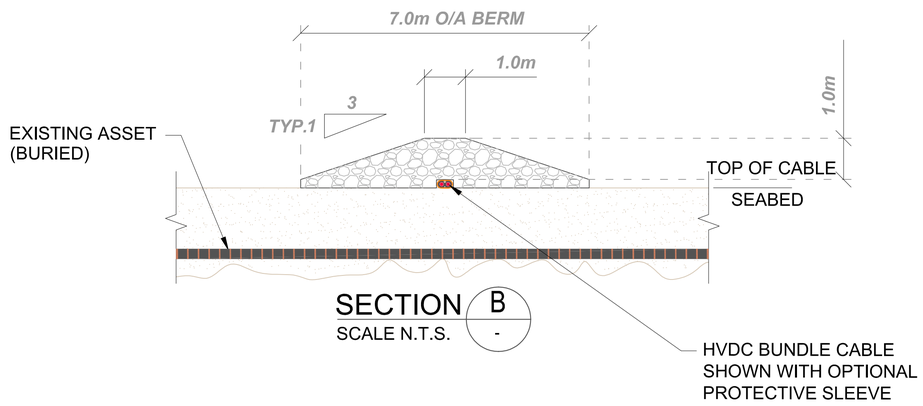
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER BURIED POWER CABLE ASSET
SHEET 1 of 1



PLAN VIEW



SECTION A
SCALE N.T.S.



SECTION B
SCALE N.T.S.

Notes
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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be agreed during crossing agreement discussions with third parties including burial technique.
6. Minimum vertical offset between the crossing power cables to be agreed as part of crossing agreement.
7. Protective sleeves can be added ±10m from crossing point, if required as part of crossing agreement.
8. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Post Lay Rock Berm
- Existing Asset
- New HVDC Bundle
- Protective Sleeve

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER BURIED POWER CABLE ASSET
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1023

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER PRE LAY BERM
SHEET 1 of 1

EXISTING POWER CABLE ASSET
AS BUILT CROSSING ANGLE 90°

OPTIONAL PROTECTIVE SLEEVE
SYMMETRICAL ABOUT CROSSING
POINT

ROCK PLACEMENT SYMMETRICAL ABOUT CROSSING POINT

A - B -

EXISTING POWER CABLE ASSET
AS BUILT CROSSING ANGLE 90°

ROCK PLACEMENT SYMMETRICAL ABOUT CROSSING POINT

C - D -

10.0m
PROTECTIVE SLEEVE

25.0m (PRE LAY BERM UNDER)

PLAN VIEW OF PRE LAY BERM

25.0m

℄ AT CROSSING POINT

3 *1*

SECTION A - SCALE N.T.S.

EXISTING ASSET AT
CROSSING POINT

HVDC BUNDLE CABLE
SHOWN WITH OPTIONAL
PROTECTIVE SLEEVE

PLAN VIEW OF POST LAY BERM

250.0m

BURIAL TRANSITION SYMMETRICAL
ABOUT CROSSING POINT, OCCURS
AT END OF PRE LAY BERM

℄ AT CROSSING POINT

3 *1*

SECTION C - SCALE N.T.S.

EXISTING ASSET AT
CROSSING POINT

EXISTING ASSET
(UNBURIED)

4.0m O/A BERM

1.0m

3

TYP.1

0.5m

SEABED

SECTION B - SCALE N.T.S.

EXISTING ASSET
(UNBURIED)

10.0m O/A BERM

1.0m

1.5m

3

TYP.1

TOP OF CABLE

SEABED

SECTION D - SCALE N.T.S.

HVDC BUNDLE CABLE
SHOWN WITH OPTIONAL
PROTECTIVE SLEEVE

Notes

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4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be agreed during crossing agreement discussions with third parties including burial technique.
6. Protective sleeves can be added ±10m from crossing point, if required as part of crossing agreement.
7. For further explanation of these plans see the Guide to the Plans Document.
8. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Post Lay Rock Berm
- Pre Lay Rock Berm
- Existing Asset
- New HVDC Bundle
- Protective Sleeve

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	For Information	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY
TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE HVDC BUNDLED CABLE CROSSING
OVER PRE LAY BERM
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1024

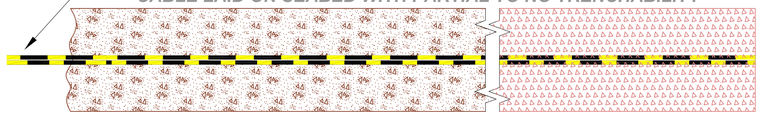
Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE ROCK BERM SCHEMATICS
PRE LAY AND POST LAY
SHEET 1 of 1

HVDC BUNDLE CABLE

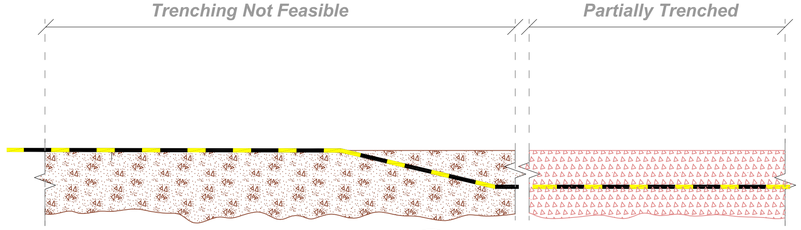
CABLE LAID ON SEABED WITH PARTIAL TO NO TRENCHABILITY



C - A - B -

PLAN VIEW OF PRE LAID CABLE TARGET TRENCH DEPTH NOT ACHIEVED

Trenching Not Feasible | *Partially Trenched*



SECTION A - SCALE N.T.S.

HVDC BUNDLE CABLE (EXPOSED)



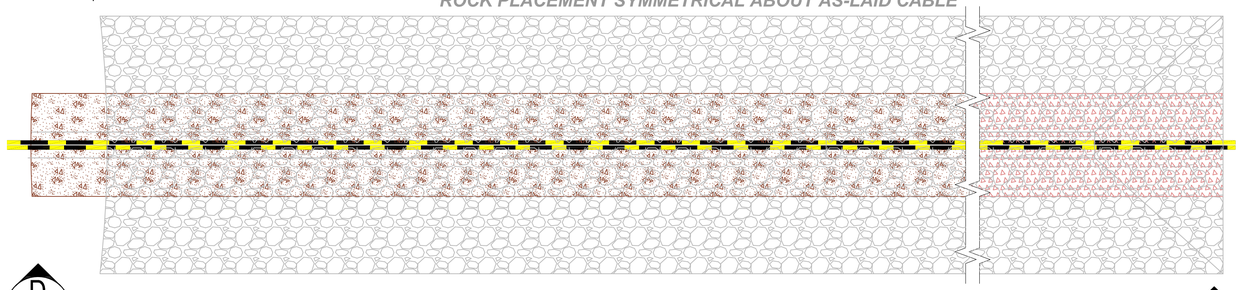
SECTION B - SCALE N.T.S.

HVDC BUNDLE CABLE (PARTIALLY BURIED)



SECTION C - SCALE N.T.S.

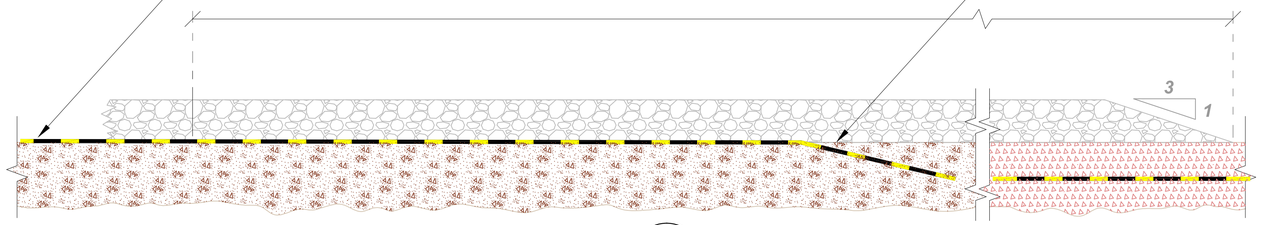
ROCK PLACEMENT SYMMETRICAL ABOUT AS-LAID CABLE



D - E - F -

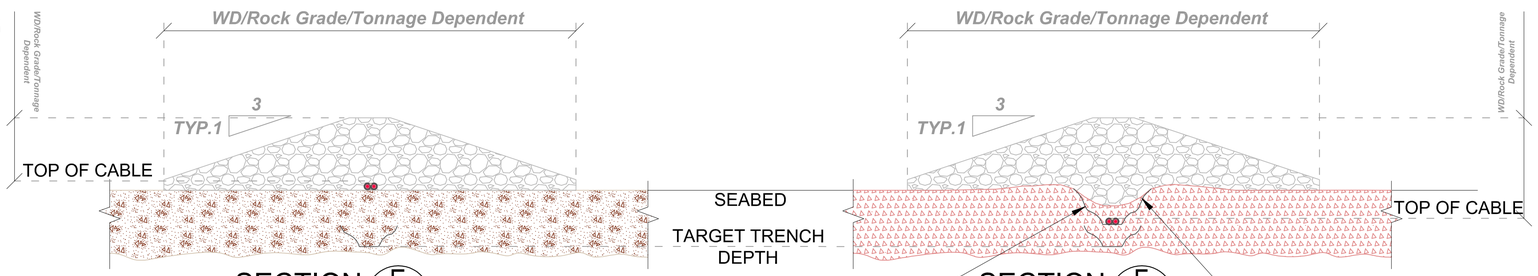
PLAN VIEW OF POST LAY BERM

HVDC BUNDLE CABLE | BURIAL TRANSITION POINT



SECTION D - SCALE N.T.S.

WD/Rock Grade/Tonnage Dependent



SECTION E - SCALE N.T.S.

SECTION F - SCALE N.T.S.

Notes

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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be agreed during crossing agreement discussions with third parties including burial technique.
6. Height of berms dependent on water depth, grade of rock & tonnage of rock required for protection.
7. For further explanation of these plans see the Guide to the Plans Document.
8. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Post Lay Rock Berm
- Non-Trenchable Soil
- Semi-Trenchable Soil
- New HVDC Bundle

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION
INDICATIVE ROCK BERM SCHEMATICS
PRE LAY AND POST LAY
SHEET 1 of 1

nationalgrid

Application Number: -

National Grid Drawing Reference: S42_M/TDD/SS/1025

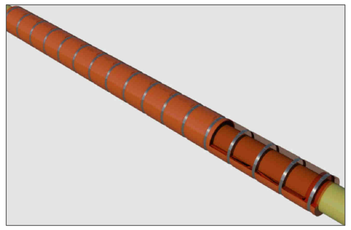
Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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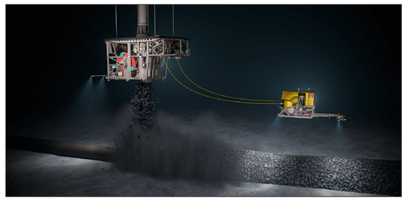
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
CABLE PROTECTION SYSTEMS
SHEET 1 of 1

Representative images of various Cable Protection Methodologies









Representative Cable Protection System

Representative Mattress

Representative Rock Berm

Representative Rock Bags

Section View

Representative Bundled Pair (2 HVDC + 1 FO Cable)

Seabed

Notes

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Legend

- Water
- Seabed Sediment
- Mattress
- Rock Berm
- Rock Bag

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
CABLE PROTECTION SYSTEMS
SHEET 1 of 1

nationalgrid

Application Number

-

National Grid Drawing Reference

S42_M/TDD/SS/1034

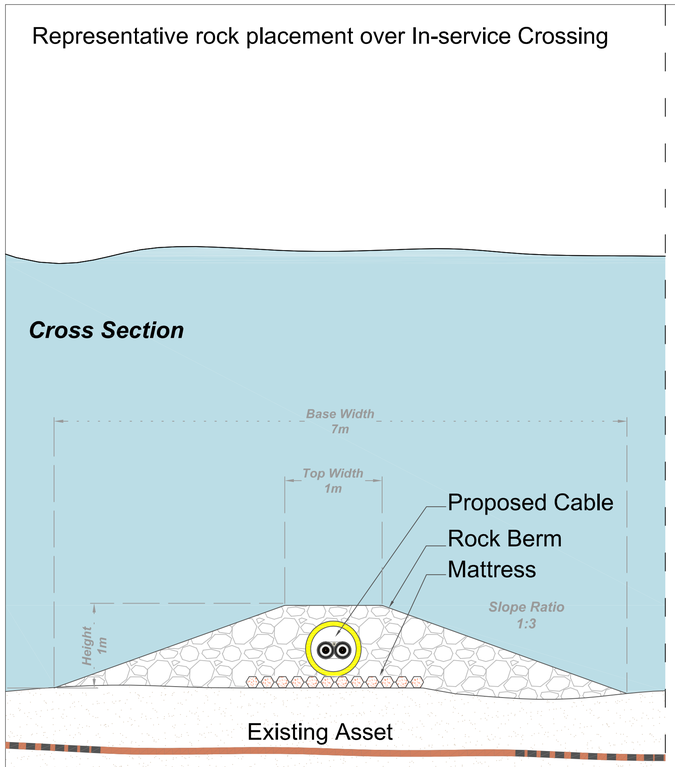
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NTS	A1	SHEET 1 OF 1	A

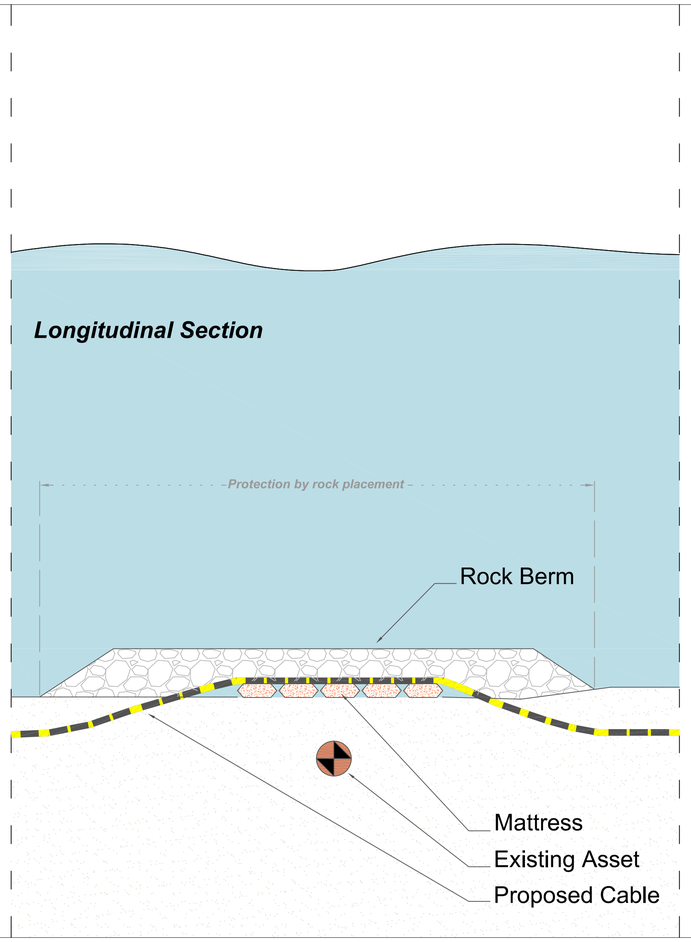
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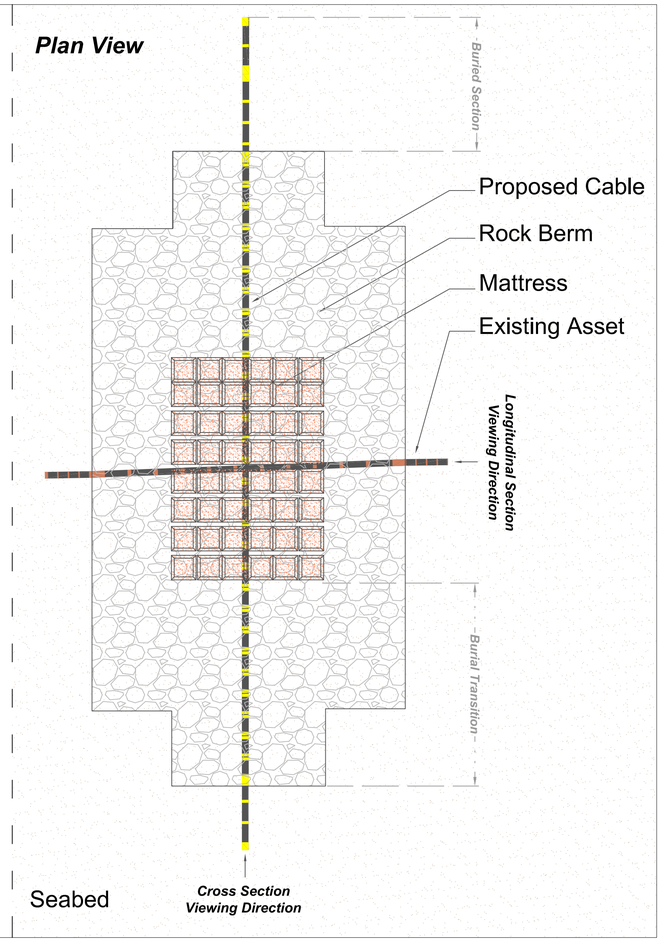
THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
ROCK PLACEMENT SECTIONS
SHEET 1 of 1

Representative rock placement over In-service Crossing







Notes

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7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Water
- Seabed Sediment
- Mattress (Plan View)
- Mattress (Longitudinal Section)
- Mattress (Cross Section)
- Rock Berm
- Existing Asset
- New HVDC Bundle

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

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THE NATIONAL GRID ELECTRICITY
TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
ROCK PLACEMENT SECTIONS
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1035

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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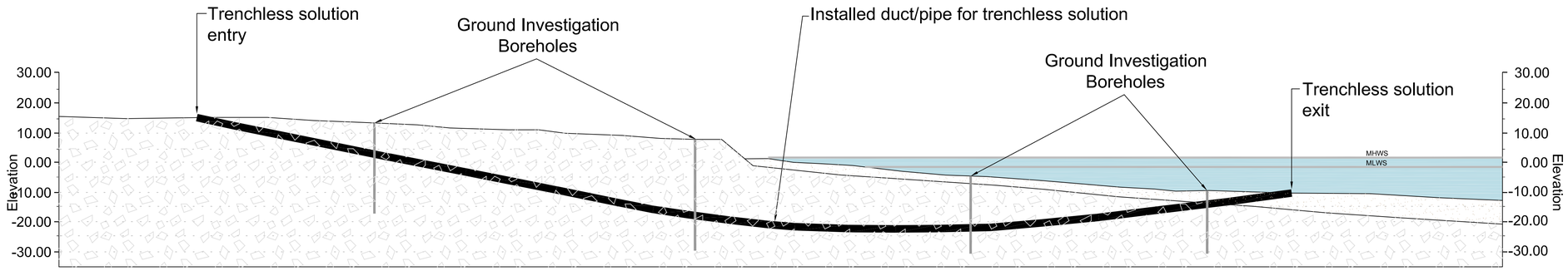
02-05. Landfall Trenchless Installation Technique

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Landfall Trenchless Installation Technique	Illustration of typical HDD landfall	Offshore Schemes	S42_M/TDD/SS/1043

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

ILLUSTRATION OF
TYPICAL HDD LANDFALL
SHEET 1 of 1



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4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. Typical lengths for example can vary between 800m to 1500m, depending on the local geological ground conditions.
7. HDD = Horizontal Directional Drilling
8. DP = Direct Pipe
9. A trenchless solution may utilise either Horizontal Directional Drilling or Direct Pipe.
10. MHWS = Mean High Water Springs
11. MLWS = Mean Low Water Springs
12. For further explanation of these plans see the Guide to the Plans Document.
13. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4

Legend

- Water
- Seabed Sediment
- Bedrock

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate:N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	24/10/2023	FINAL	AMN	FSS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION
ILLUSTRATION OF
TYPICAL HDD LANDFALL
SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1043

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	A

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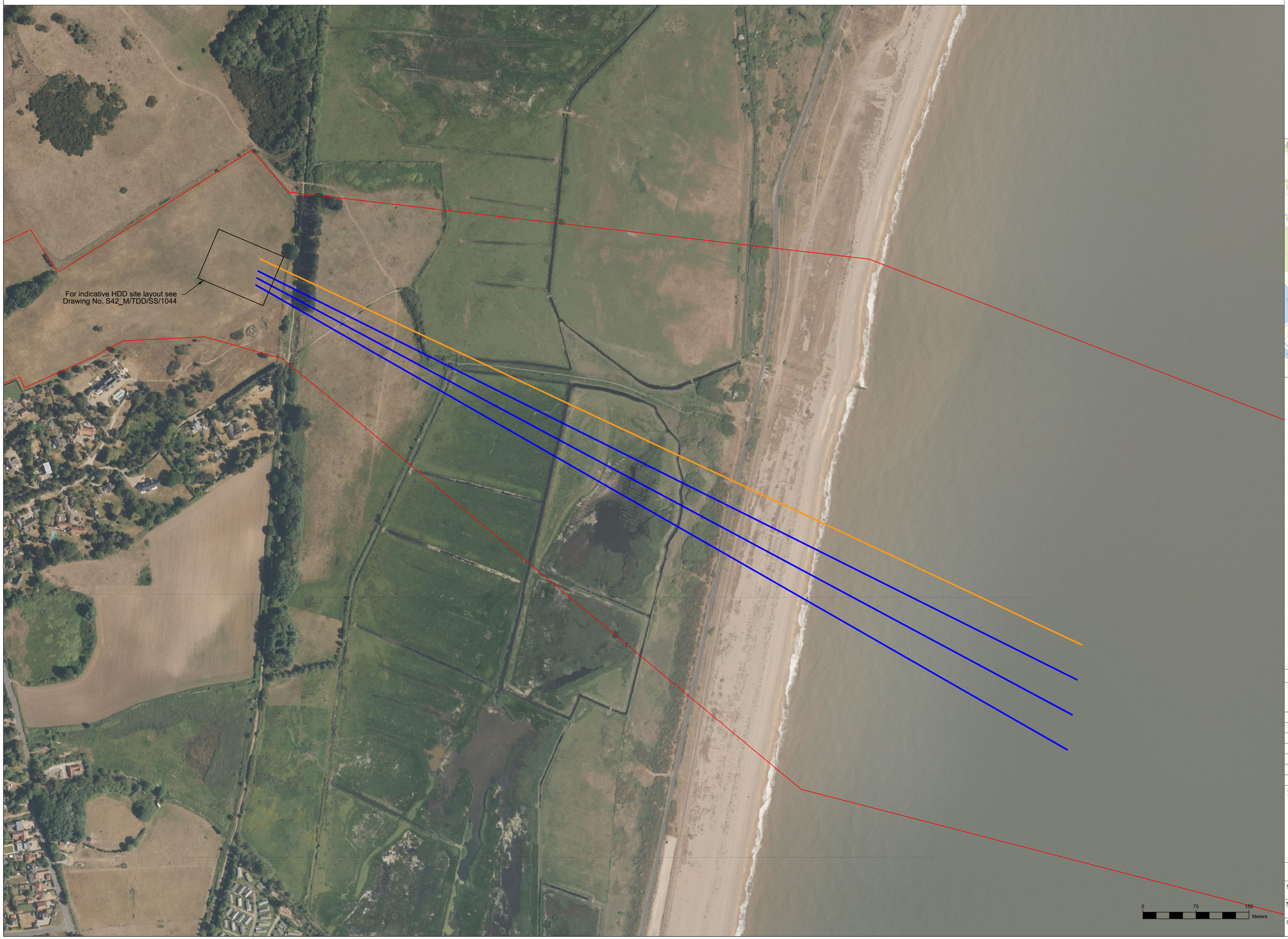
02-06. Landfall Installation - Aldeburgh For Sea Link Only

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Landfall Installation - Aldeburgh For Sea Link Only	Indicative horizontal direction drill solution for sea link only Aldeburgh	Suffolk Onshore Scheme	S42_M/TDD/SS/1042
	Indicative layout of HDD construction compound for sea link only Aldeburgh	Suffolk Onshore Scheme	S42_M/TDD/SS/1044

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

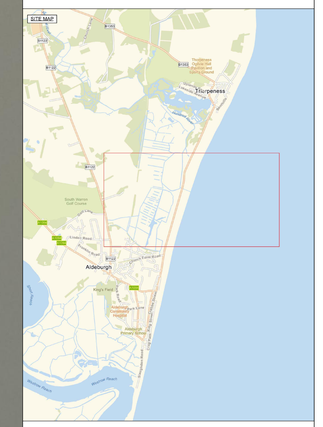
INDICATIVE HORIZONTAL DIRECTIONAL DRILL SOLUTION FOR SEA LINK ONLY ALDEBURGH
SHEET 1 of 1



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6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.
10. HDD = Horizontal Directional Drill.



Legend

- Indicative Sea Link HDD Alignment
- Indicative Reserve HDD Alignment - duct only
- Draft Order Limit

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE HORIZONTAL DIRECTIONAL DRILL SOLUTION FOR SEA LINK ONLY ALDEBURGH

SHEET 1 of 1

nationalgrid

Application Number: -

National Grid Drawing Reference: S42_M/TDD/SS/1042

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	01

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

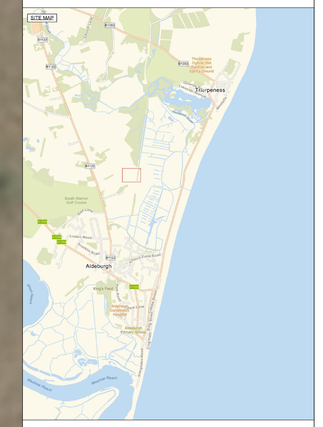
INDICATIVE LAYOUT OF HDD CONSTRUCTION COMPOUND FOR SEA LINK ONLY ALDEBURGH
SHEET 1 of 1



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8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.
9. For indicative HDD alignments see Drawing No. S42_M/TDD/SS/1042
10. HDD = Horizontal Directional Drill.



Legend

- Indicative Sea Link HDD Alignment
- Indicative Reserve HDD Alignment - duct only
- Draft Order Limit

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE LAYOUT OF HDD CONSTRUCTION COMPOUND FOR SEA LINK ONLY ALDEBURGH

SHEET 1 of 1

nationalgrid

Application Number
-

National Grid Drawing Reference
S42_M/TDD/SS/1044

Scale	Sheet Size	Sheet	Issue
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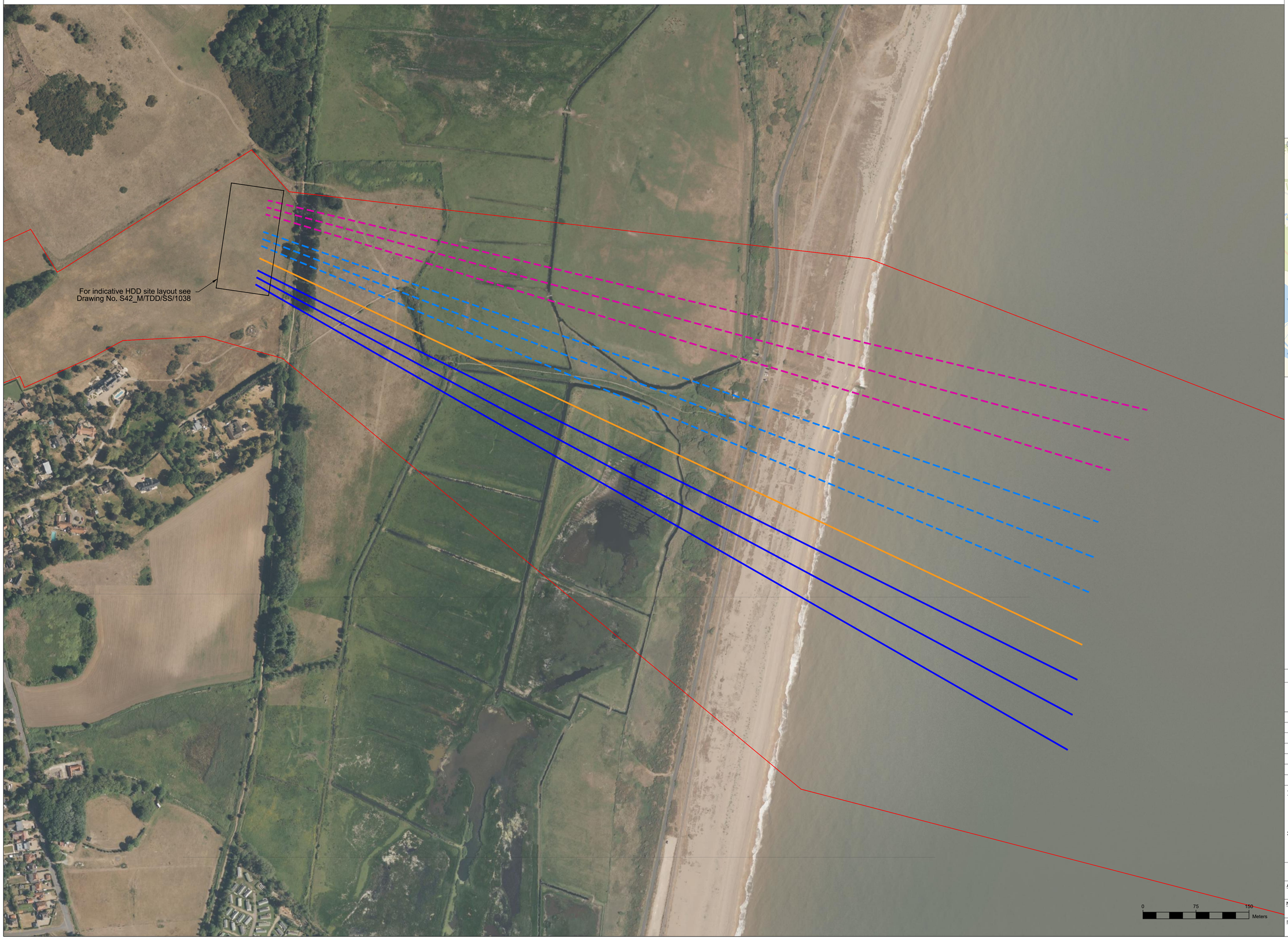
02-07. Landfall Installation - Aldeburgh For Sea Link Plus Ducts for up to two further projects

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Landfall Installation - Aldeburgh For Sea Link Plus Ducts for up to two further projects	Indicative horizontal directional drill solution for sea link plus ducts for up to two further projects Aldeburgh	Suffolk Onshore Scheme	S42_M/TDD/SS/1041
	Indicative layout of HDD construction compound for sea link plus ducts for up to two further projects Aldeburgh	Suffolk Onshore Scheme	S42_M/TDD/SS/1038

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

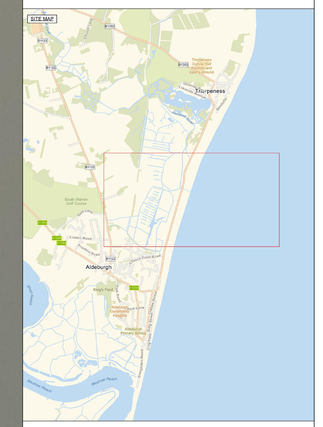
INDICATIVE HORIZONTAL DIRECTIONAL DRILL SOLUTION FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS ALDEBURGH
SHEET 1 of 1



Notes

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8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.
10. HDD = Horizontal Directional Drill.



Legend

- Indicative Sea Link HDD Alignment
- Indicative Reserve HDD Alignment - duct only
- Indicative Additional Co-Location Ducts
- Indicative Additional Co-Location Ducts
- Draft Order Limit

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE HORIZONTAL DIRECTIONAL DRILL SOLUTION FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS ALDEBURGH

SHEET 1 of 1

nationalgrid

Application Number: -

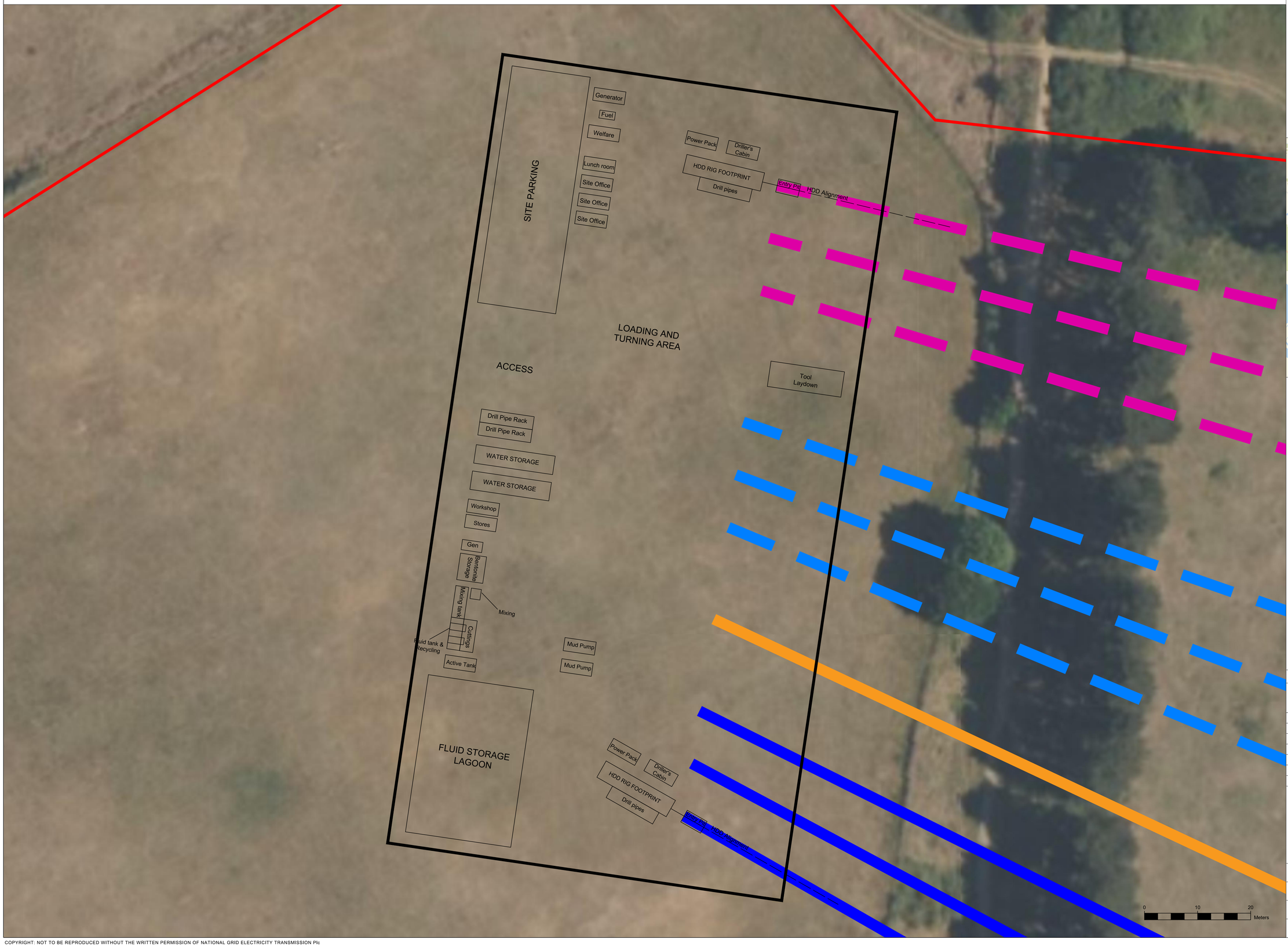
National Grid Drawing Reference: S42_M/TDD/SS/1041

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	01

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

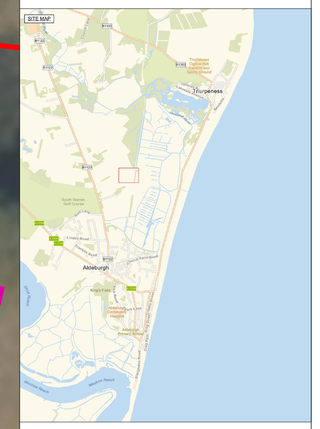
INDICATIVE LAYOUT OF HDD CONSTRUCTION COMPOUND FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS ALDEBURGH
SHEET 1 of 1



Notes

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8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.
9. For indicative HDD alignments see Drawing No. S42_M/TDD/SS/1041
10. HDD = Horizontal Directional Drill.



Legend

- Indicative Sea Link HDD Alignment
- Indicative Reserve HDD Alignment - duct only
- Indicative Additional Co-Location Ducts
- Indicative Additional Co-Location Ducts
- Draft Order Limit

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE LAYOUT OF HDD CONSTRUCTION COMPOUND FOR SEA LINK PLUS DUCTS FOR UP TO TWO FURTHER PROJECTS ALDEBURGH

SHEET 1 of 1

nationalgrid

Application Number: -

National Grid Drawing Reference: S42_M/TDD/SS/1038

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	01

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02-08. Landfall Installation - Pegwell Bay

Drawing Category Name	Plan Title	Scheme	Drawing Numbers
Landfall Installation - Pegwell Bay	Indicative horizontal directional drill solution Pegwell bay	Kent Onshore Scheme	S42_M/TDD/SS/1039
	Indicative layout of HDD construction compound Pegwell bay	Kent Onshore Scheme	S42_M/TDD/SS/1037
	Indicative direct pipe solution Pegwell bay	Kent Onshore Scheme	S42_M/TDD/SS/1040

To assist with understanding these drawings please see the **Guide to Interacting with the Consultation Plans and Drawings**

THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

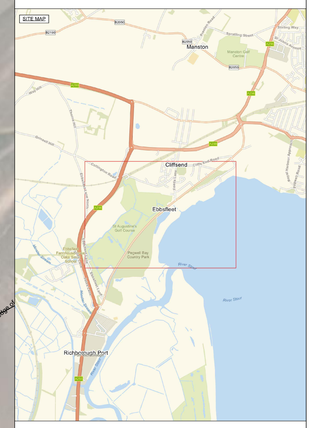
INDICATIVE HORIZONTAL DIRECTIONAL DRILL SOLUTION PEGWELL BAY
SHEET 1 of 1



Notes

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7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.
9. HDD = Horizontal Directional Drill.



Legend

- Indicative HDD Alignment
- Indicative Reserve HDD Alignment - duct only
- Indicative HDD duct stringing for pushed installation
- Draft Order Limit
- Historic Landfill

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE HORIZONTAL DIRECTIONAL DRILL SOLUTION PEGWELL BAY

SHEET 1 of 1

nationalgrid

Application Number: -

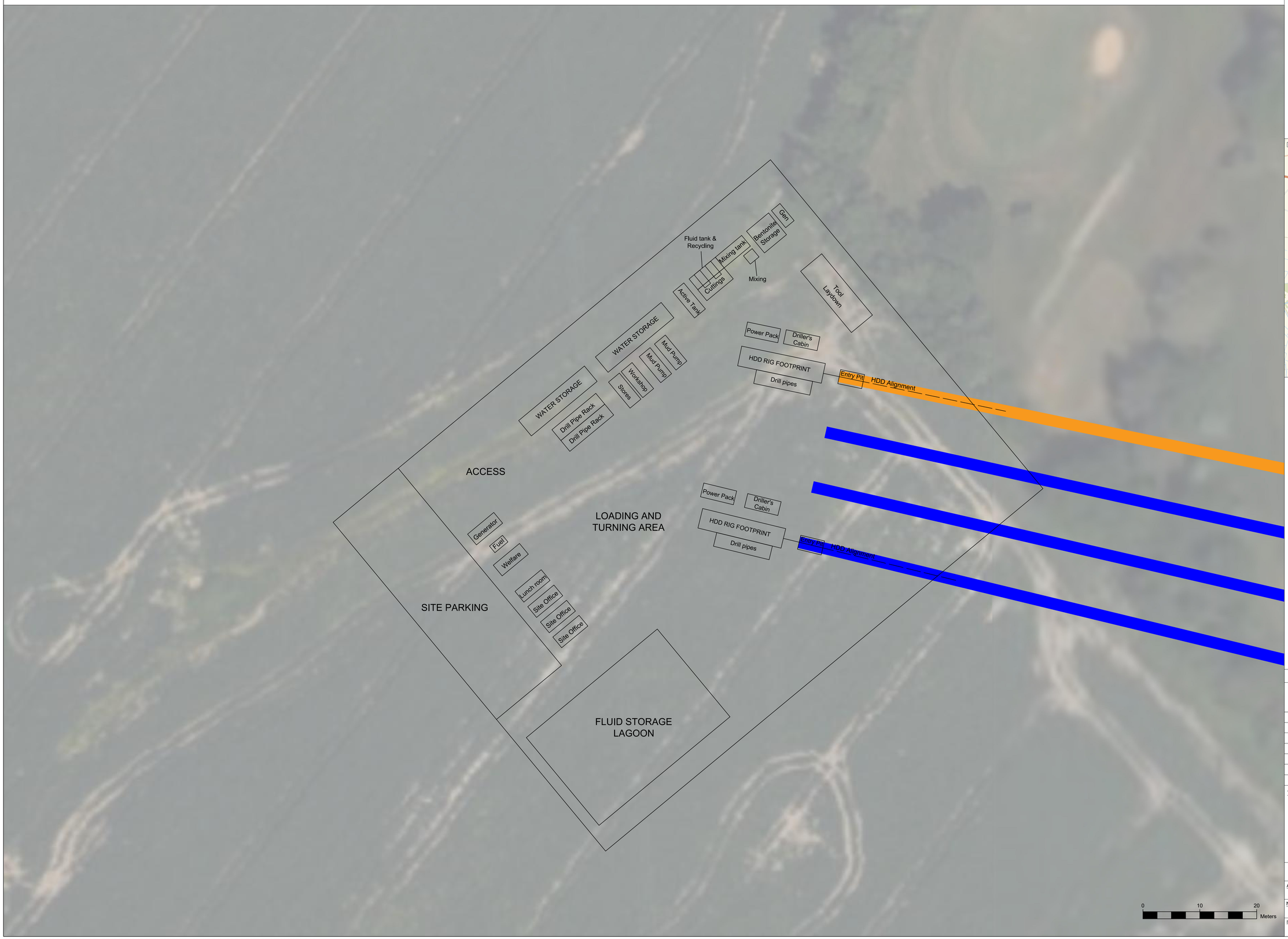
National Grid Drawing Reference: S42_M/TDD/SS/1039

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	01

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

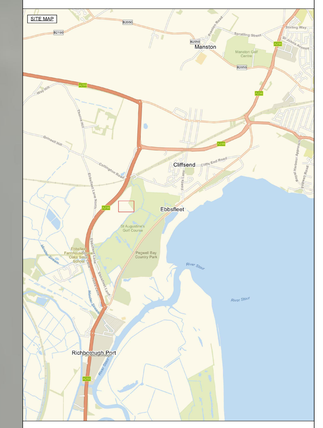
INDICATIVE LAYOUT OF HDD CONSTRUCTION COMPOUND PEGWELL BAY
SHEET 1 of 1



Notes

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7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.
9. For indicative HDD alignments see Drawing No. S42_M/TDD/SS/1039
10. For General Arrangement Plan see Drawing No. S42_K/IGA/PS/2003
11. HDD = Horizontal Directional Drill.



Legend

- Indicative HDD Alignment
- Indicative Reserve HDD Alignment - duct only
- Draft Order Limit

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE LAYOUT OF HDD CONSTRUCTION COMPOUND PEGWELL BAY

SHEET 1 of 1

nationalgrid

Application Number: -

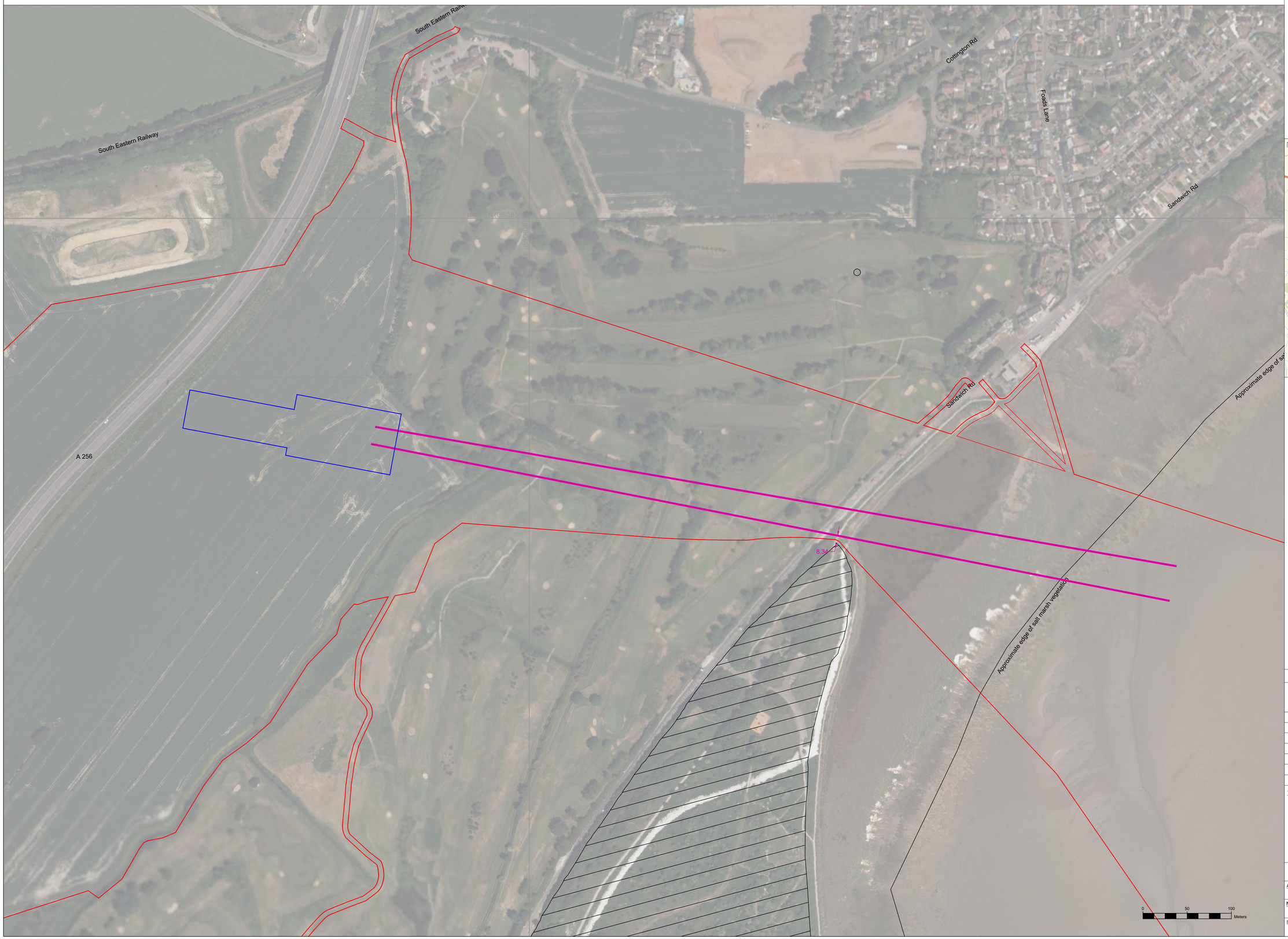
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Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	01

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THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER
DESIGN DRAWINGS FOR CONSULTATION

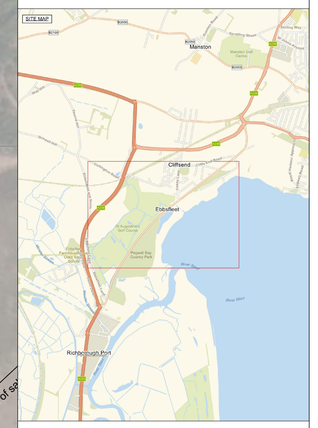
INDICATIVE DIRECT PIPE SOLUTION PEGWELL BAY
SHEET 1 of 1



Notes

For statutory consultation purposes only

1. Do not scale from this drawing.
2. All dimensions are in metres/millimetres unless otherwise stated.
3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. Detailed design, including final dimensions, to be decided at a later date.
6. For further explanation of these plans see the Guide to the Plans Document.
7. For further information on construction please refer to the construction section of the Preliminary Environmental Impact Report, Volume 1, Part 1, Chapter 4.
8. Background Bing Maps aerial photography from Spatial Manager application, © 2019 Microsoft.



Legend

- Indicative Direct Pipe Alignment
- Indicative Direct Pipe Working Area
- Draft Order Limit
- Historic Landfill

Sheet X Centroid Coordinate: N/A Sheet Y Centroid Coordinate: N/A

Issue	Date	Remarks	Drawn	Checked	Approved
A	25/08/2023	FINAL	TR	FS	KG

Title: THE NATIONAL GRID ELECTRICITY TRANSMISSION PLC (SEA LINK) ORDER

DESIGN DRAWINGS FOR CONSULTATION

INDICATIVE DIRECT PIPE SOLUTION PEGWELL BAY

SHEET 1 of 1

nationalgrid

Application Number: -

National Grid Drawing Reference: S42_M/TDD/SS/1040

Scale	Sheet Size	Sheet	Issue
NTS	A1	SHEET 1 OF 1	01

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Figures

Figure A.1: Source Protection Zones

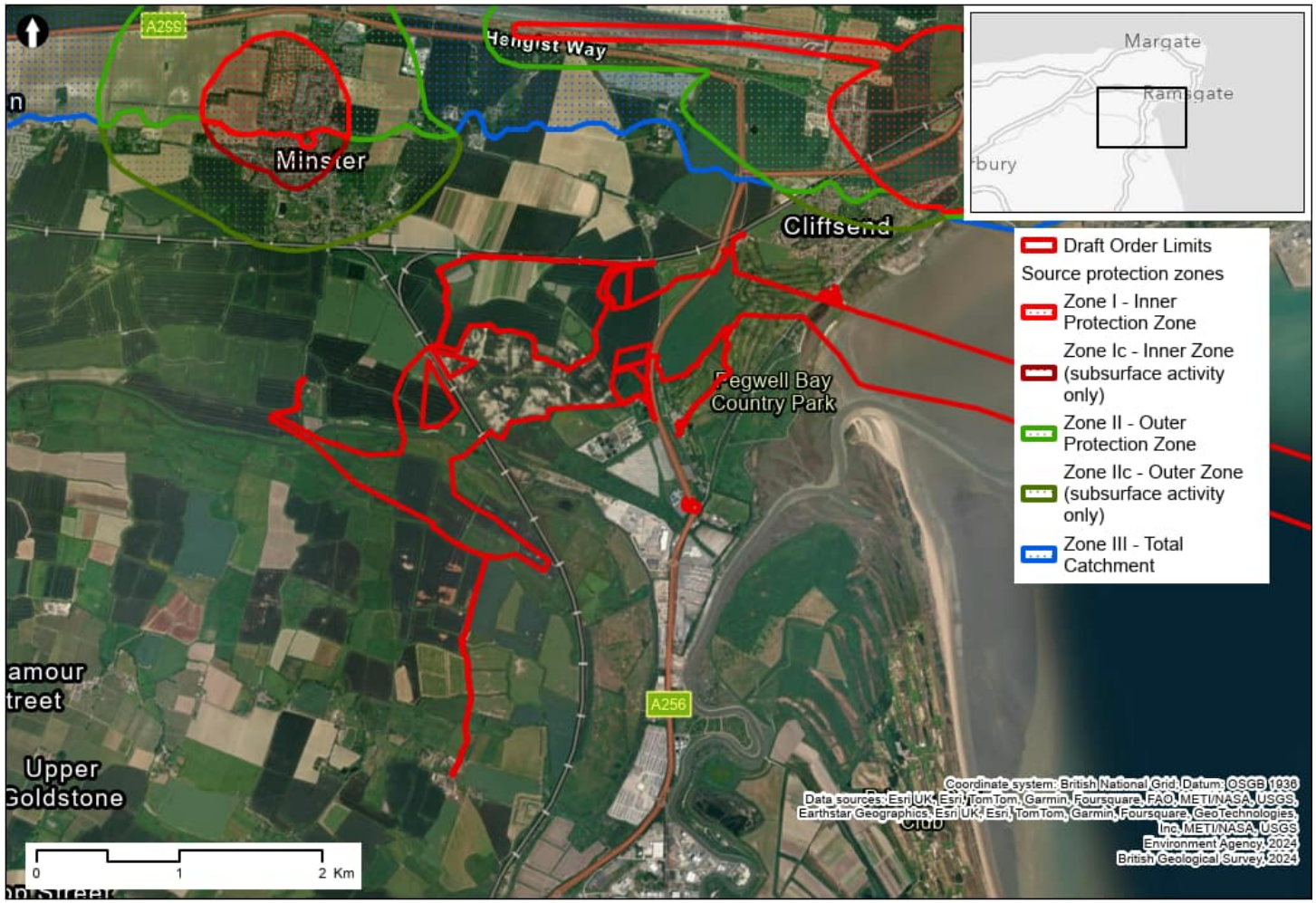


Figure A.2: British Geological Survey – Soluble Rock Risk

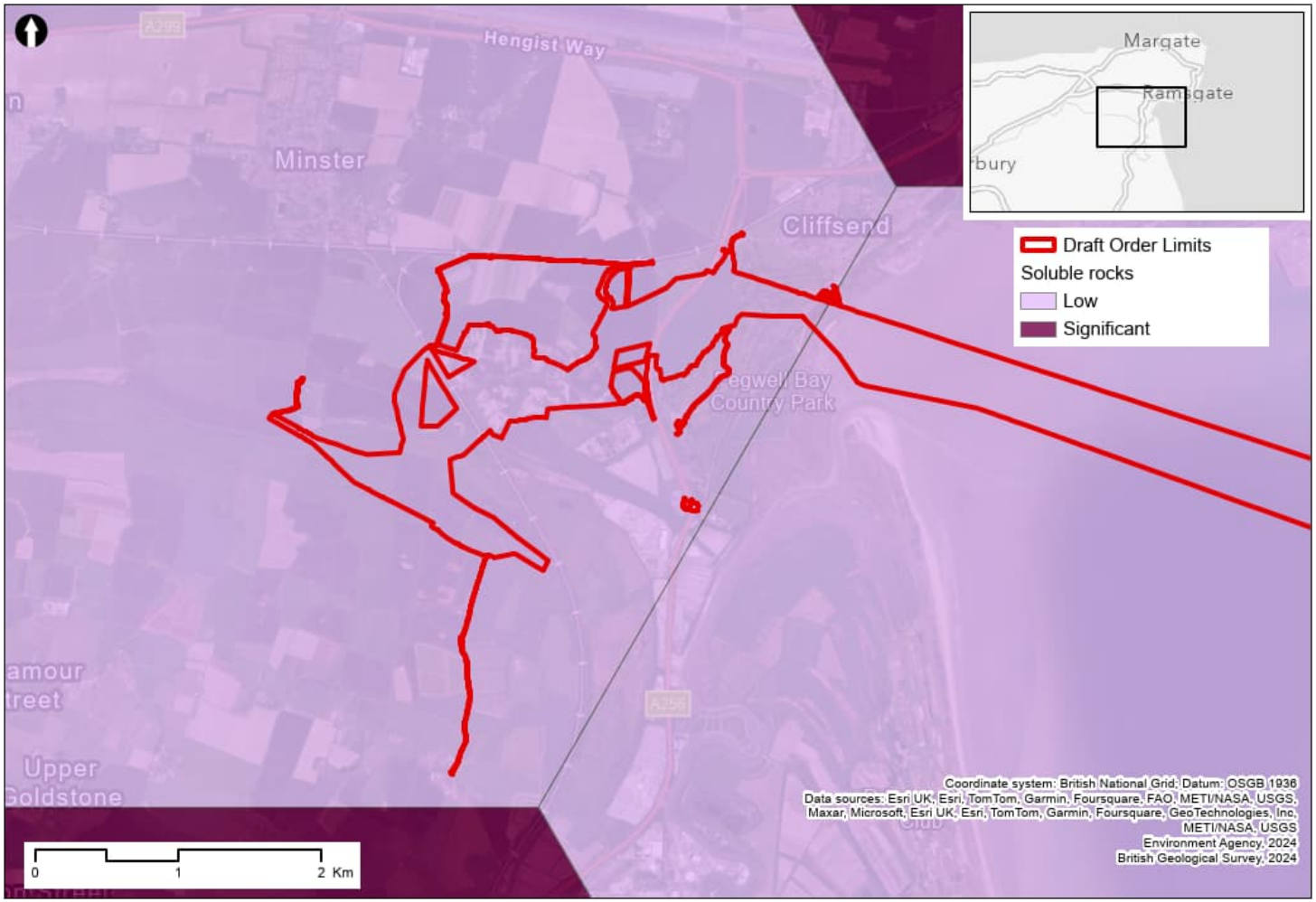


Figure A.3: British Geological Survey – Shrink Swell Risk

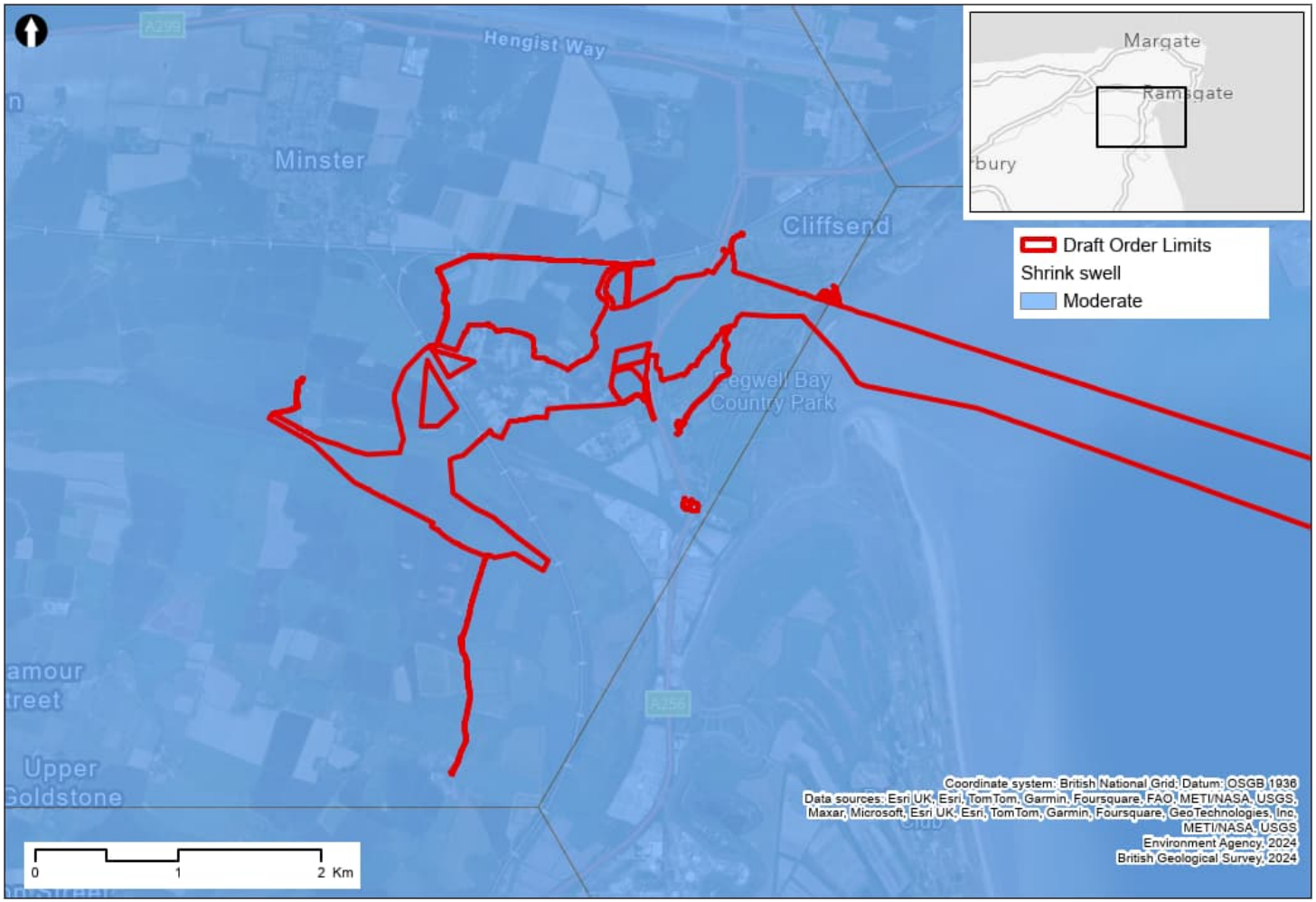


Figure A.4: British Geological Survey – Running Sand Risk

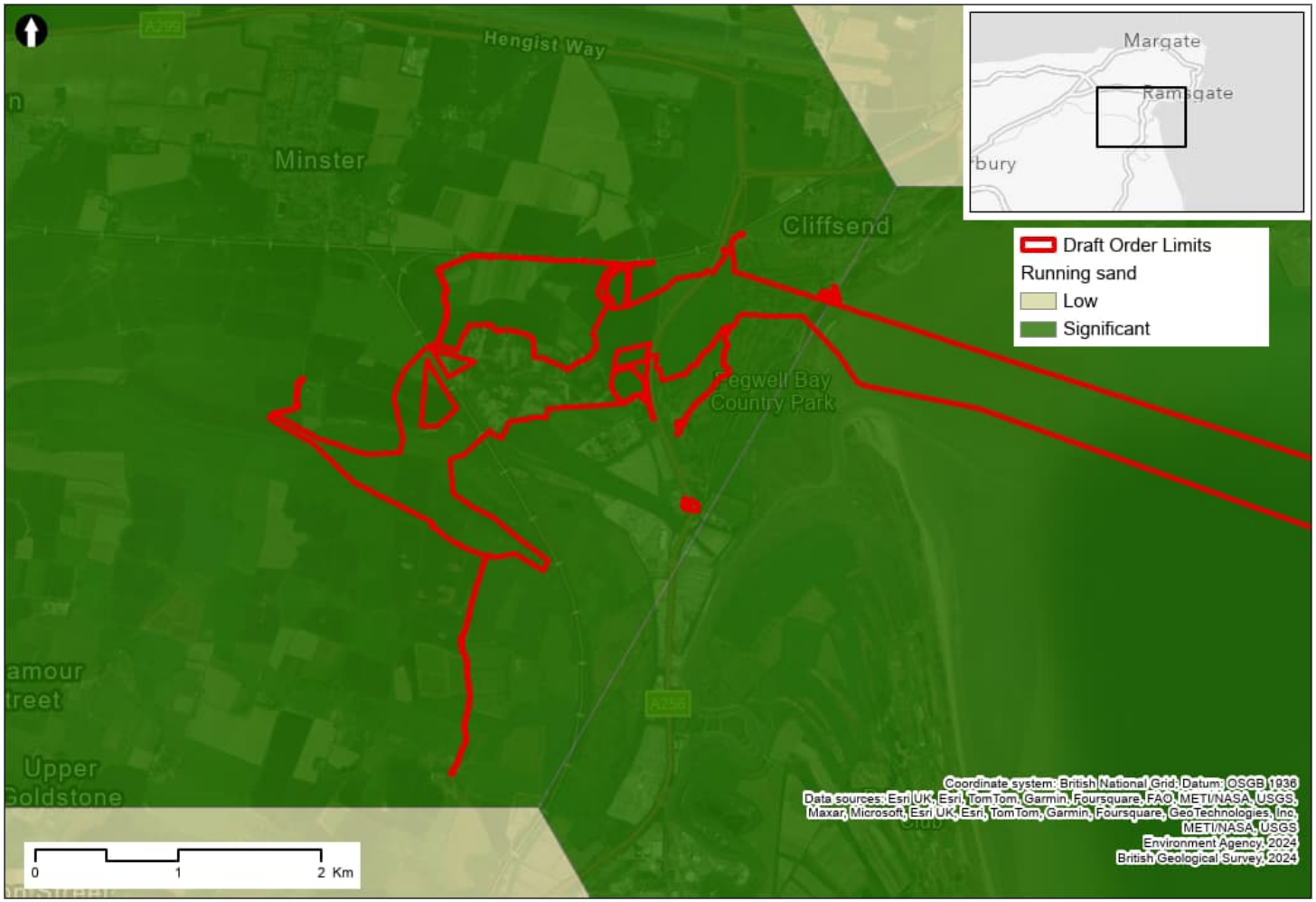


Figure A.5: British Geological Survey – Compressible Ground Risk

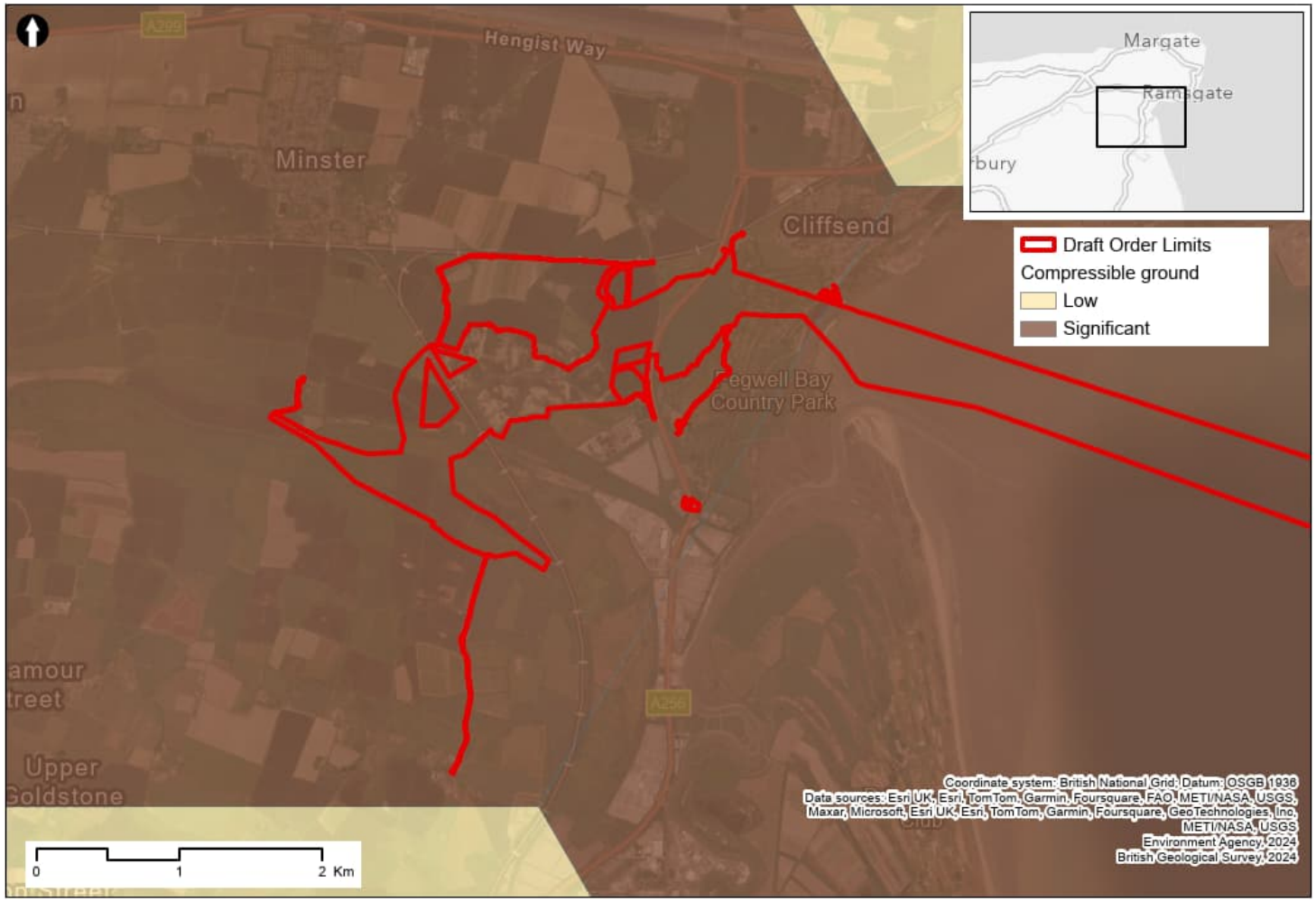


Figure A.6: British Geological Survey – Collapsible Deposits Risk

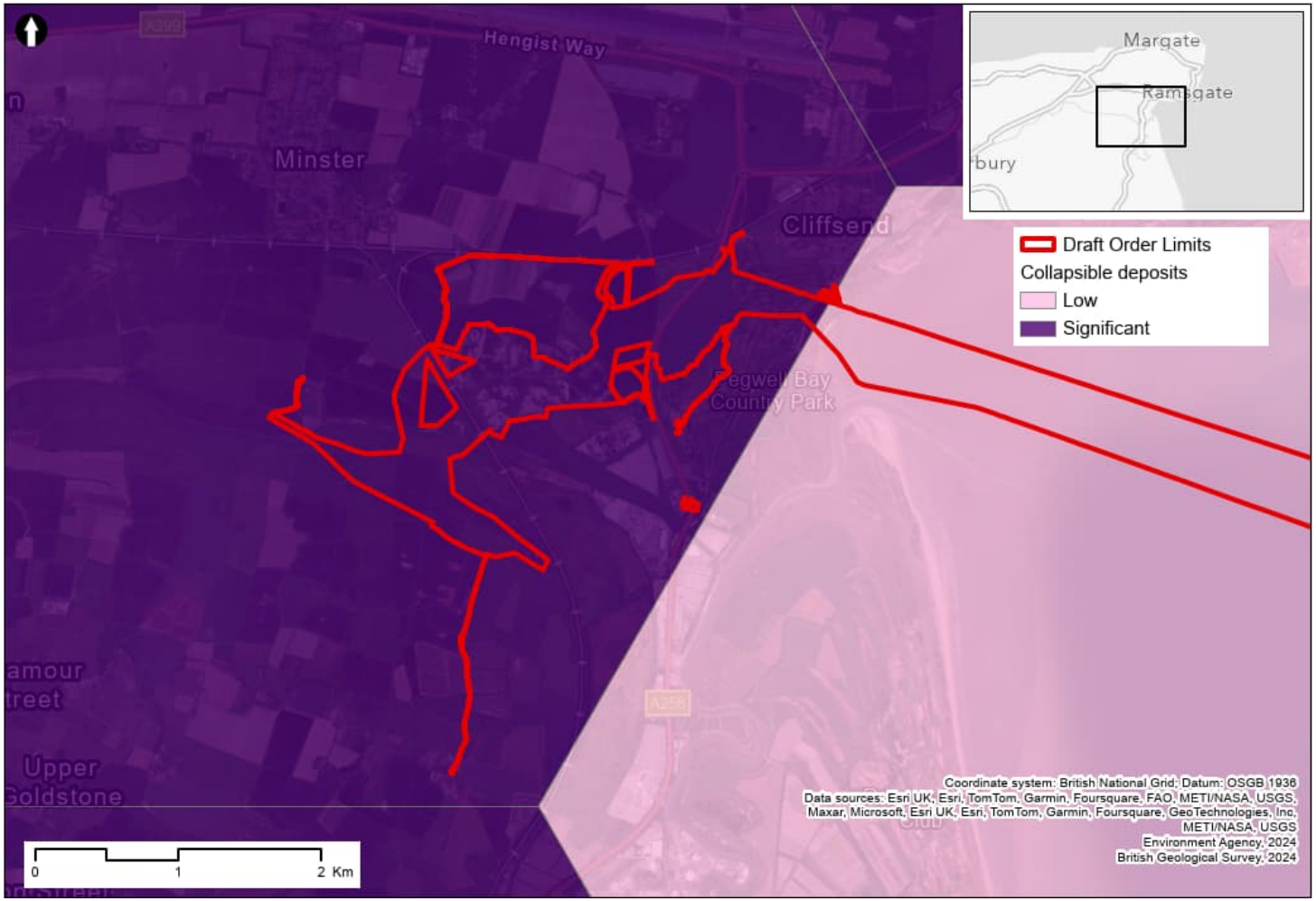


Figure A.7: British Geological Survey – Landslide Risk

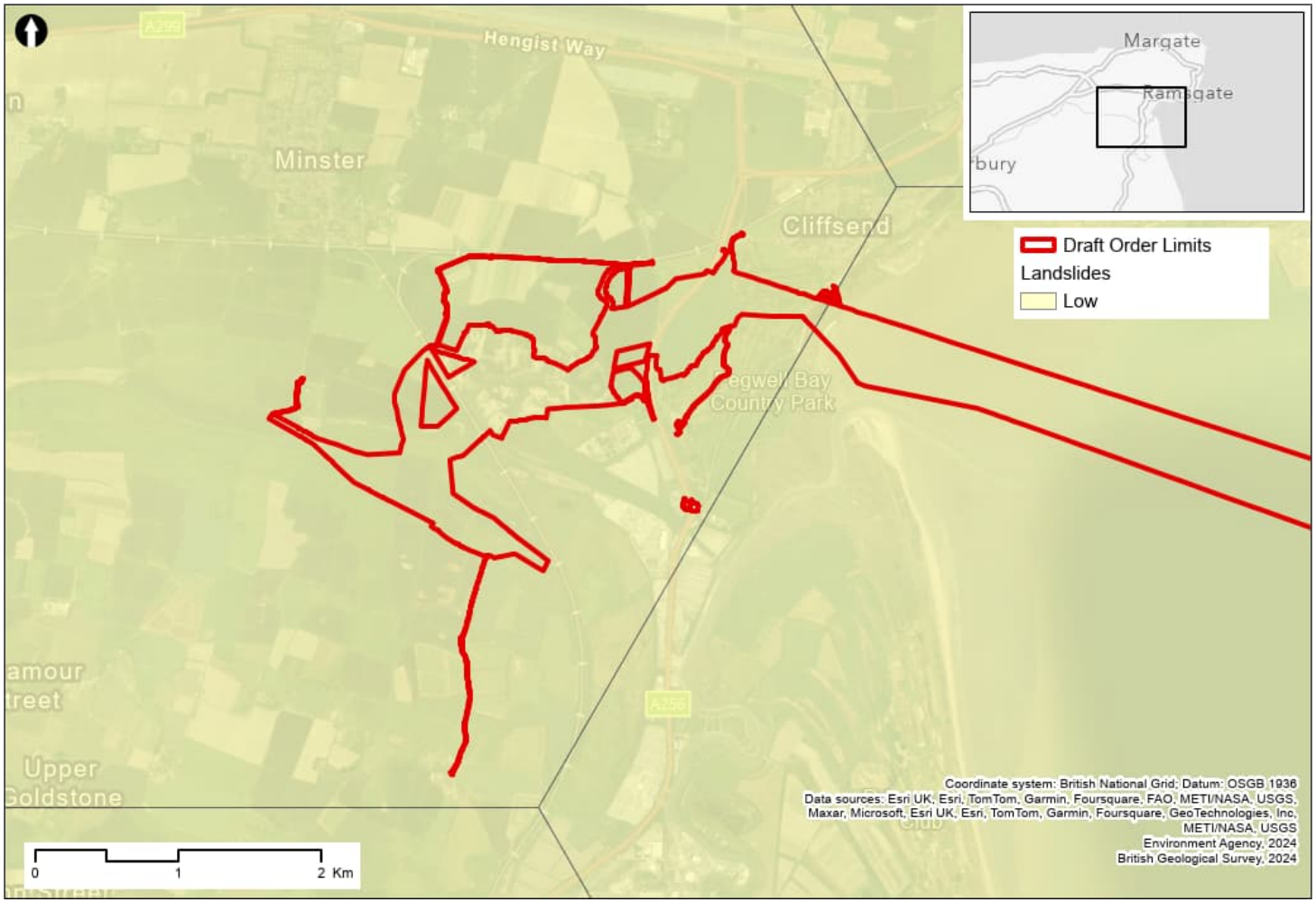


Figure A.8: British Geological Survey – Superficial Thickness Model (Mean Thickness)

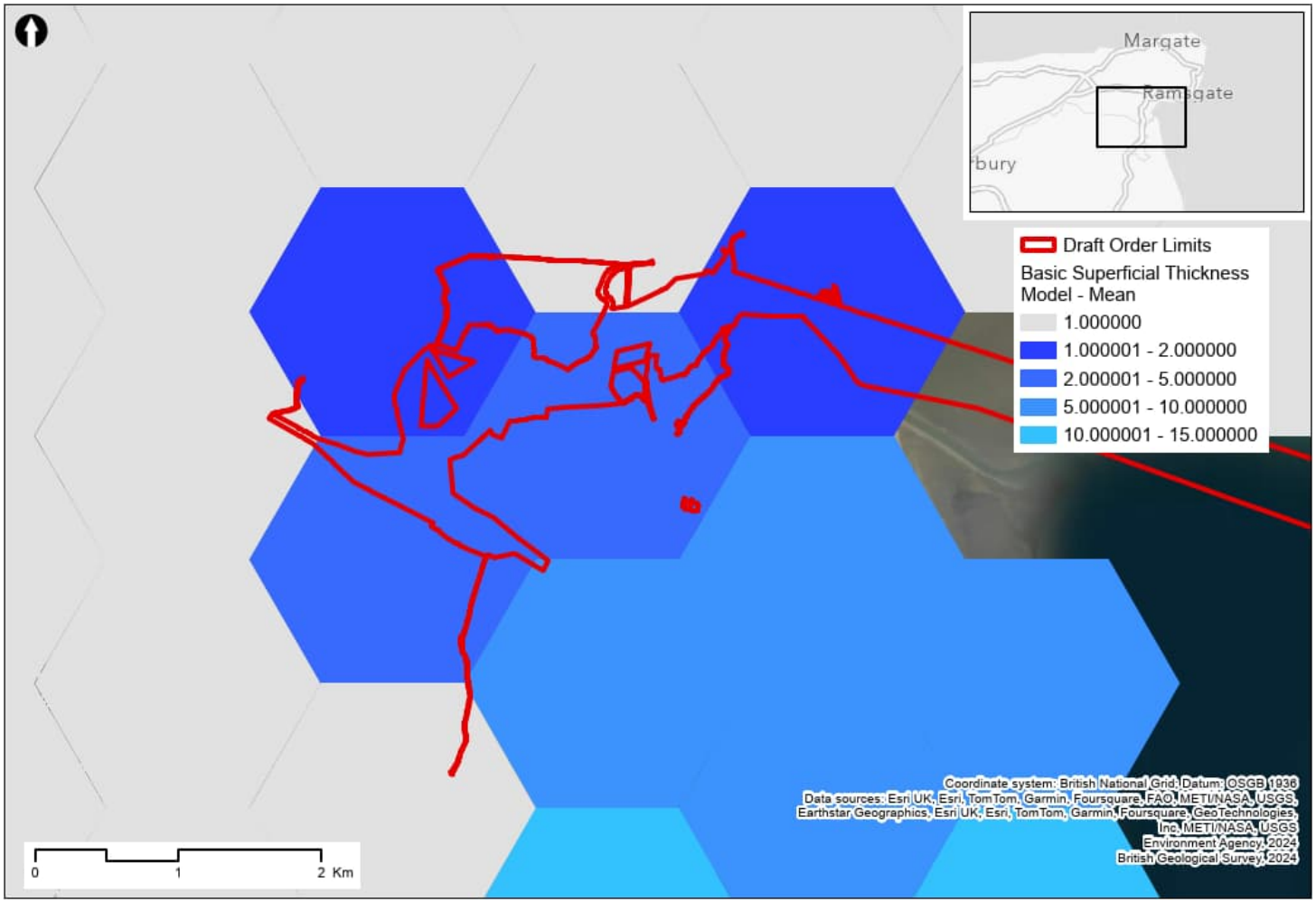
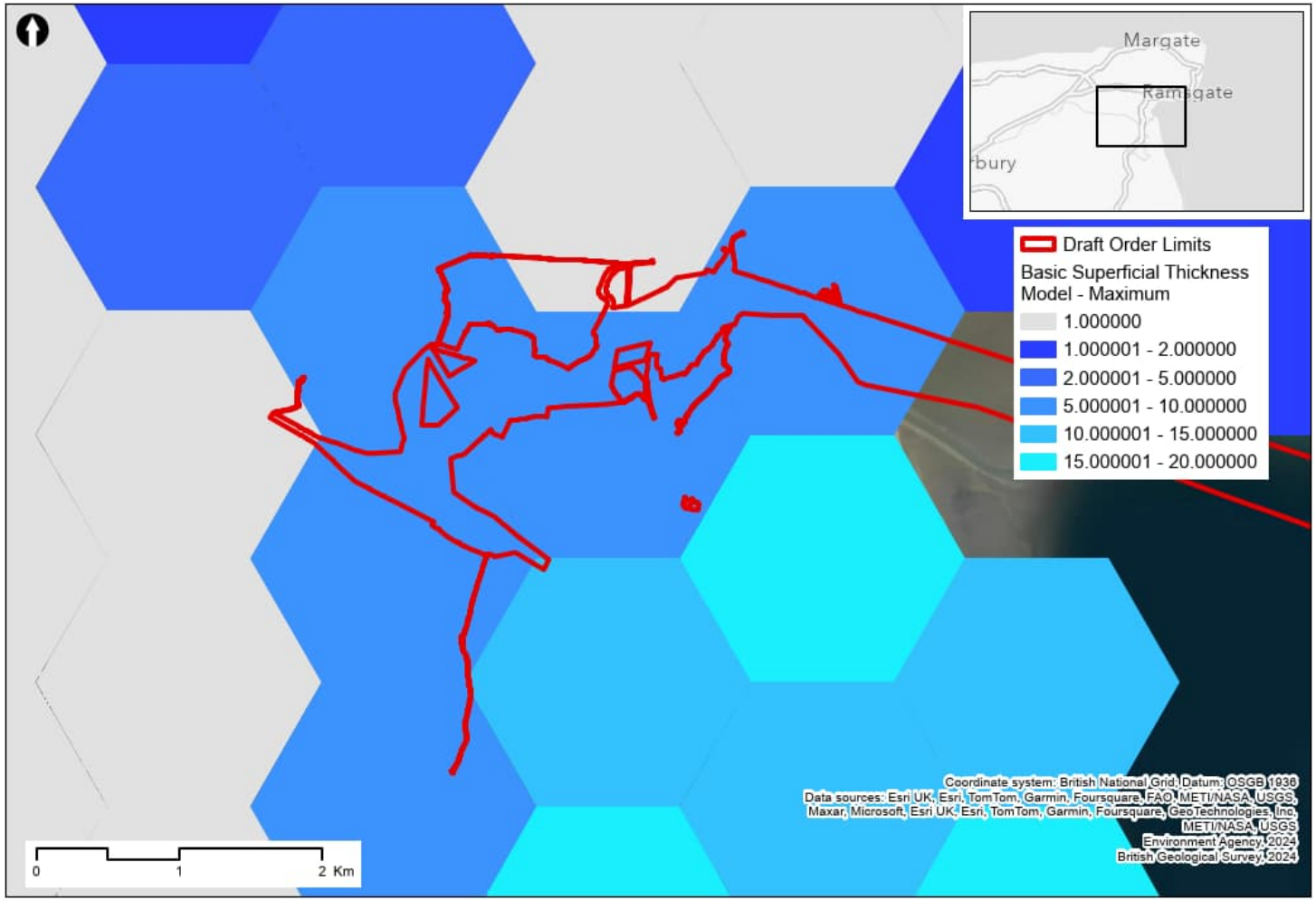


Figure A.9: British Geological Survey – Superficial Thickness Model (Maximum Thickness)



B. Geological Cross Sections

Geological Cross Sections – Plan Views

Figure B.1: Borehole and section location plan – Sheet 1

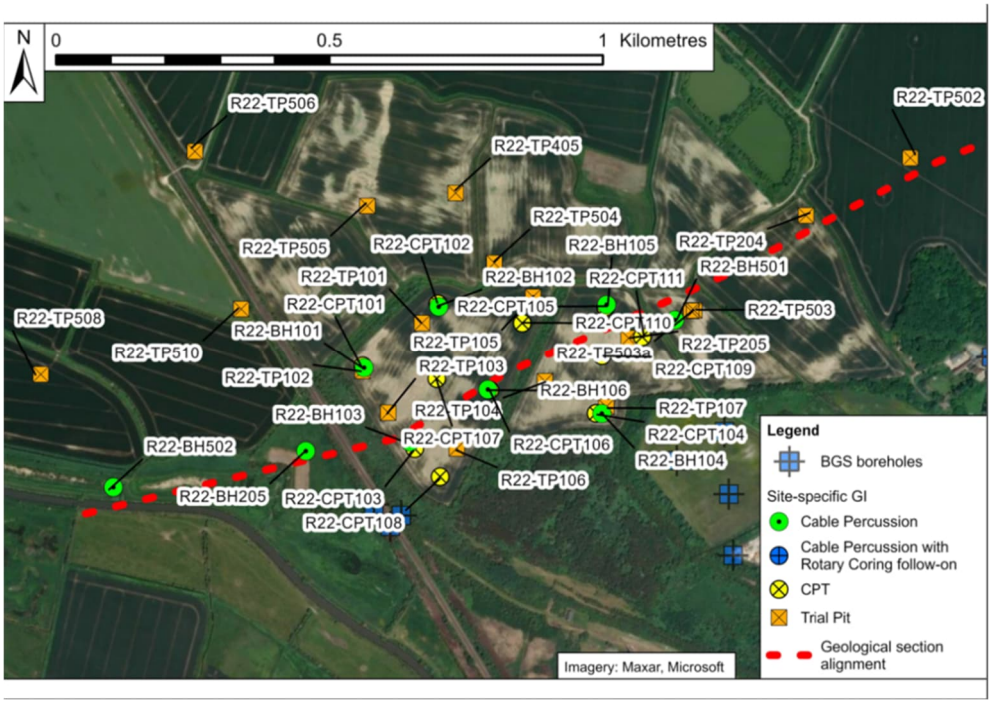


Figure B.2: Borehole and section location plan – Sheet 2

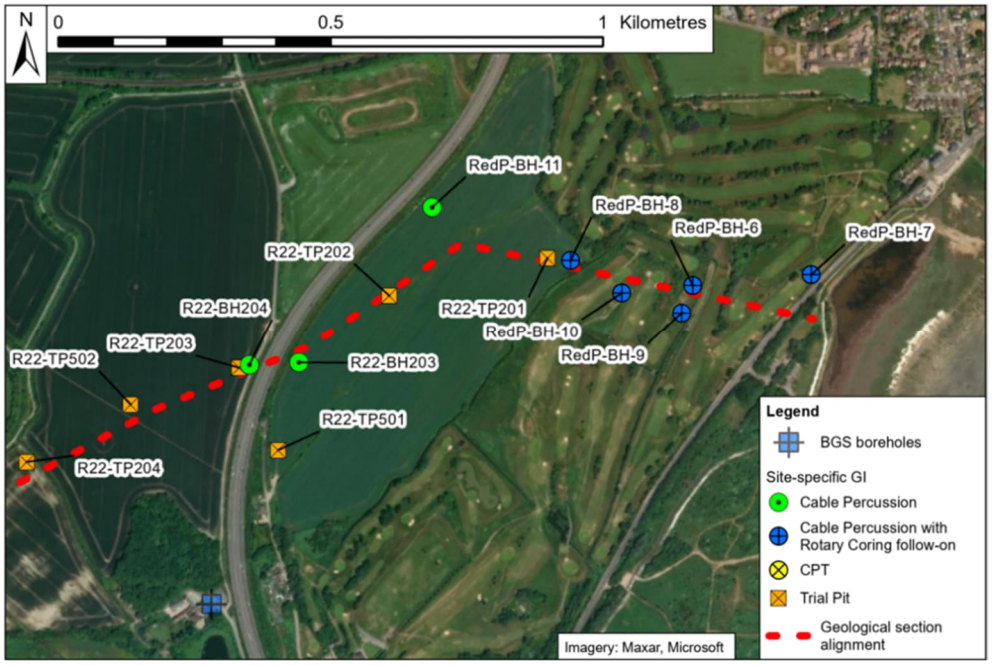


Figure B.3: Sketch geological section – Sheet 1

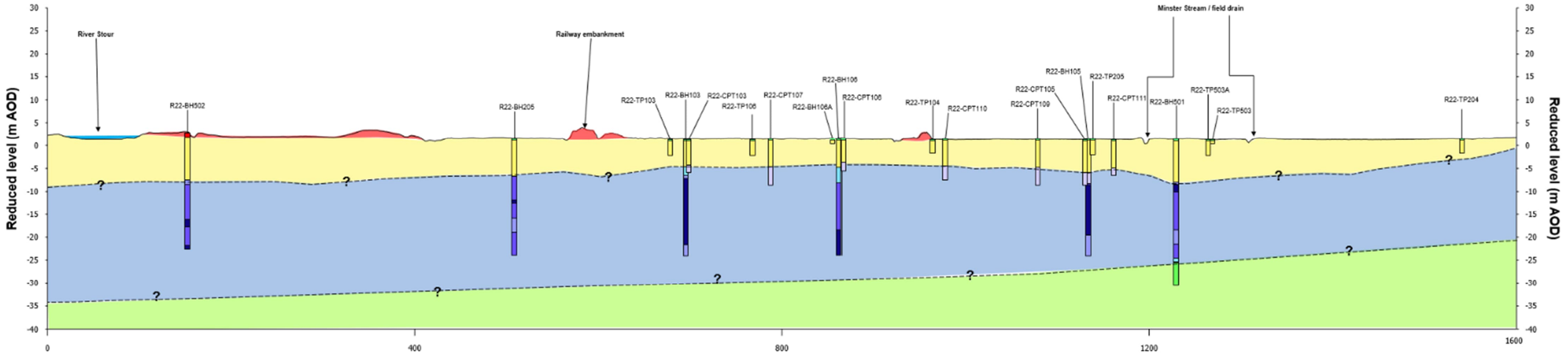
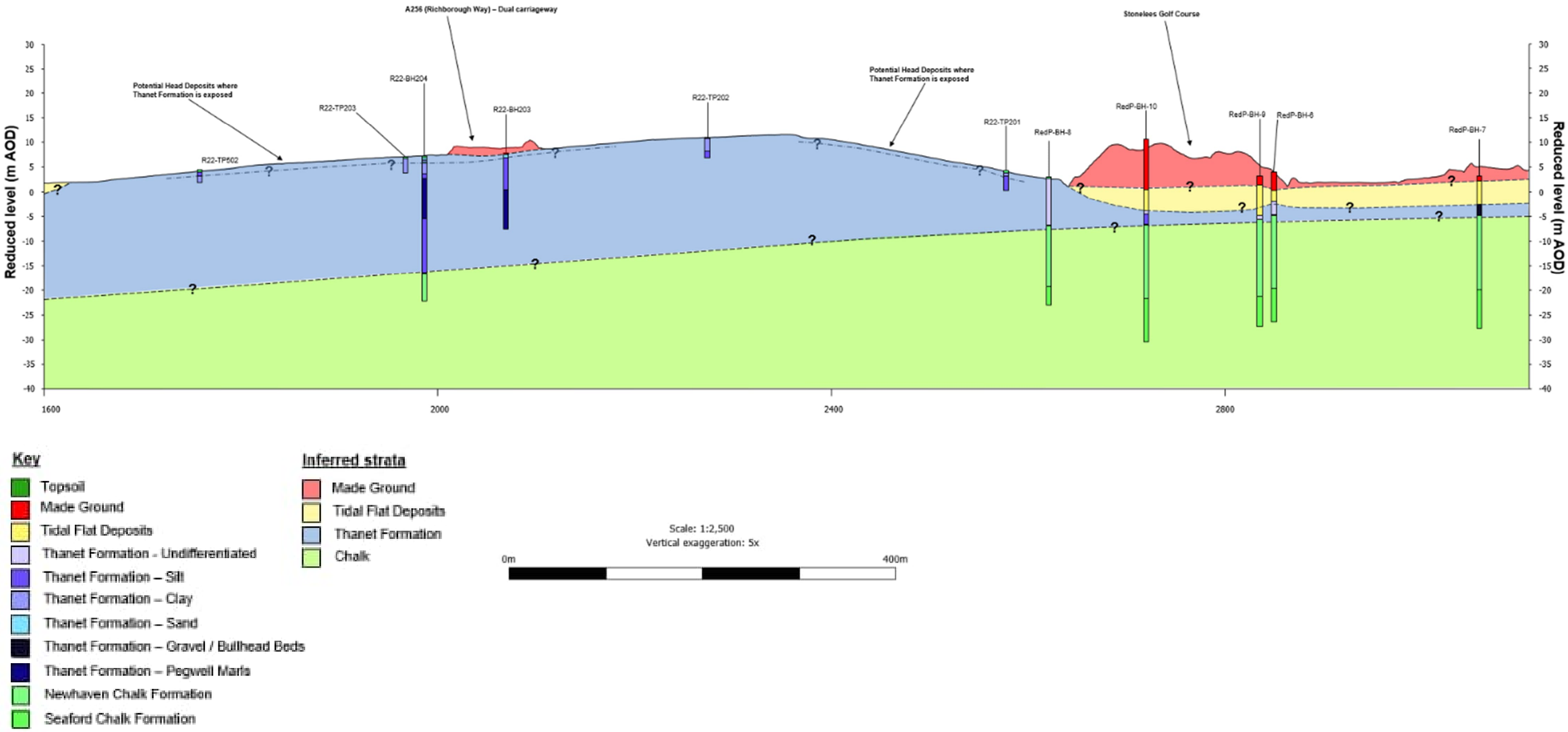


Figure B.4: Sketch geological section – Sheet 2



C. Ground models

C.1.1 Converter station / substation area

Table C.1 above presents the ground model for the converter station area. The site is surfaced with topsoil owing to its location within agricultural fields. Most of the site is located at a similar level, so units are presented as metres below ground level.

Table C.1: Ground model – converter station / substation area

Geological Unit (Code) Typical Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Made Ground (MG) Very stiff brown slightly gravelly slightly sandy organic clayey SILT with occasional rootlets. Sand is fine. Gravel is subangular to subrounded fine to coarse Chalk, clinker, and ceramic. Present in one location only, likely reworked topsoil.	0.00	0.30	0.30
Topsoil (TPS) Grass over friable dark brown to brown slightly sandy silty occasionally organic CLAY. Localised areas slightly gravelly and rarely with low cobble content. Sand is fine to coarse. Gravel, where present, is subangular to subrounded, fine to coarse flint, Chalk and siltstone. Cobbles, where present, are subangular to subrounded flint.	0.00	0.25-0.50	0.25-0.50
Tidal Flat Deposits (TFD) Stiff to very stiff, becoming firm, and in turn soft to very soft in the first 1-2 metres, grey mottled orange or yellow silty, occasionally slightly sandy CLAY. In some locations with occasional shells or shell fragments, or rare organic matter. In one location with abundant semi-rotten organic material. Sand where present is typically fine, rarely fine to medium. OR Soft to very soft grey slightly to very sandy clayey SILT, In one location present as soft dark brown pseudo-fibrous PEAT with a strong organic odour.	0.25-0.50	5.00-8.30	4.60-8.00
Thanet Formation (TAB) Interbedded beds / bands of: ● Stiff to very stiff grey occasionally brownish or bluish slightly to very sandy micaceous SILT with occasional shell fragments. In one location slightly gravelly with a low cobble content. Sand is fine to coarse. ● Extremely weak to weak grey occasionally greyish green mottled bluish grey slightly sandy rarely calcareous micaceous SILTSTONE with occasional shell fragments, recovered as very dense grey silty sandy angular to subangular fine to coarse GRAVEL, occasionally with medium cobble content. It is likely that this unit although logged as a siltstone, is associated with the Pegwall Marls (see Section 2.2 and 5.4 for further information) ● Medium dense to dense grey mottled blue, yellow, green, or white silty to very silty fine to medium SAND, with occasional shell fragments and bands of silt.	5.00-8.30	>25.45*	>20.45*

* - base / thickness not proven

C.1.2 HVDC cable route and HDD crossings

Table C.2 above presents the ground model for the HVDC cable route, from the landfall through to the converter station. It should be noted that significant zones of core loss were recorded in some exploratory holes during the GI (e.g. RedP-BH-7) which results in less certainty of the exact level of geological boundaries, therefore the below should be treated with caution.

Table C.2: Ground model – HVDC cable route and HDD crossings

Geological Unit (Code) Typical Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Made Ground (MG) Brown slightly gravelly silty fine to coarse SAND. Gravel is angular to subrounded fine to coarse Chalk, sandstone and brick. Present in one location only, likely reworked topsoil.	0.00	0.40	0.40
Topsoil (TPS) Stiff friable brown to dark brown slightly sandy occasionally slightly gravelly clayey SILT or silty CLAY with frequent roots and rarely with low cobble content. Sand is fine to medium. Gravel and cobbles are subangular to subrounded fine to coarse flint and Chalk. In one location only, present as brown slightly gravelly very silty organic fine to medium SAND. Gravel is subangular to rounded medium to coarse flint.	0.00	0.20-0.50	0.20-0.50
Tidal Flat Deposits (TFD) Present only to the western portion of the HVDC cable route. Stiff to very stiff, becoming very soft to soft brown mottled light grey becoming bluish grey to dark blue slightly sandy or slightly gravelly CLAY rarely with medium cobble content, semi-rotten organic material, or rare rootlets.	0.20-0.40	4.50-9.50	4.10-9.10
Thanet Formation (TAB) Interbedded beds / bands of: ● Stiff to very stiff grey to bluish grey (in upper 4 metres, occasionally orangish or yellowish-brown mottled grey) micaceous sandy or clayey SILT or silty CLAY with rare shell fragments. Occasionally slightly gravelly with a low cobble content. Sand is fine or fine to medium. Gravel where present is subangular to rounded fine to coarse siltstone, cobbles are subangular siltstone or subrounded to rounded flint. ● Extremely weak to weak grey SILTSTONE recovered as dense to very dense grey silty angular to subangular fine to coarse GRAVEL with a low cobble content and occasional shell fragments. Cobbles are angular siltstone. As described in Table 4.1, its likely this sub-unit represents the Pegwell Marls. Sand, which where present at shallow depth is loose yellow or greenish brown silty fine to medium SAND. At greater depths the sand is dense to very dense grey very silty fine or fine to coarse SAND. ● 0.2-0.3m basal bed of black subangular to subrounded fine to coarse flint GRAVEL with a low to medium flint cobble content, known in literature as the Bullhead Beds. Zones of core loss noted particularly within RedP-BH-7 within the Bullhead Beds	0.30-9.50	9.80-27.00	17.50-23.70
Margate Chalk Member – Newhaven Chalk Formation (MECK) Structureless Chalk recovered as dense to very dense white slightly sandy silty angular to subangular fine to coarse GRAVEL. Clasts are extremely weak to very weak low to medium density white with occasional black specks. Matrix is off-white. Zones of core loss noted particularly within RedP-BH-7 at the top of the unit	24.00	>29.45*	>5.45*
Seaford Chalk Formation (SECK) Structureless Chalk recovered as white slightly gravelly slightly sandy SILT with frequent rinded flint fragments up to 50mm diameter. Gravel is weak low-density white subangular.	27.00	>32*	>5*

* - base / thickness not proven

C.1.3 Converter station / substation connection to existing OHL

Table C.3 presents the ground model summarising ground conditions at the connection to existing OHL west of the proposed Substation / Converter station.

Table C.3: Ground model – converter station / substation connection to existing OHL

Geological Unit (Code) Typical Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Made Ground (MG) Firm becoming stiff locally friable brown mottled orangish brown and dark brown slightly sandy gravelly silty CLAY with occasional rootlets. Sand is fine to coarse. Gravel is angular to subangular fine to coarse Chalk, flint, brick and shell fragments with some wood fragments. Present in one location only, likely reworked topsoil/subsoil.	0.00	0.90	0.90
Topsoil (TPS) Stiff to very stiff friable brown slightly gravelly slightly sandy to sandy silty CLAY or clayey SILT with rare to frequent rootlets. Sand is fine to coarse. Gravel is subangular fine to coarse Chalk.	0.00	0.30-0.40	0.30-0.40
Tidal Flat Deposits (TFD) Stiff to very stiff in the first 1-2 metres, becoming very soft to soft grey mottled brown (occasionally bluish, orangish or black) slightly sandy to sandy clayey SILT or silty CLAY, with occasional to frequent pockets of black peat, wood fragments, shell fragments and rootlets. In TP508 an organic odour was noted, increasing from a slight to strong odour with depth.	0.30-0.40	8.20-10.30	7.85-9.40
Thanet Formation (TAB) Firm becoming stiff grey slightly gravelly slightly sandy clayey SILT. With occasional bands of extremely weak siltstone. Sand is fine to coarse. Gravel is subangular fine to coarse of siltstone. OR With depth, becoming extremely weak to weak grey SILTSTONE recovered as very dense grey slightly sandy silty angular to subangular fine to coarse GRAVEL of extremely weak to weak siltstone with rare shell fragments. Sand is fine to coarse. Interbedded with bands of very stiff slightly sandy clayey SILT. [Interpreted as Pegwell Marls]	8.20-10.30	>25.45*	>15.15-17.25*
Margate Chalk Member – Newhaven Chalk Formation (MECK)** Not encountered	-	-	-
Seaford Chalk Formation (SECK)** Not encountered	-	-	-

* - base / thickness not proven
** - not encountered



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