The Great Grid Upgrade

Eastern Green Link 3 (EGL 3) and
Eastern Green Link 4 (EGL 4)

Preliminary environmental information report (PEIR)

Volume 1, Part 1, Chapter 4: Description of the Projects

May 2025

nationalgrid

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4. Description of the Projects

4.1 Introduction

4.1.1 This chapter presents a description of the Projects, including details of design, construction and operation. It represents the current understanding of the key design parameters which have evolved in response to feedback received during pre-application consultation with stakeholders in 2023 (for the English Offshore Scheme) and the 2024 non-statutory consultation (for the English Onshore Scheme), together with further ongoing environmental and design work. Following statutory consultation, a detailed description of the Projects will be included in the Environmental Statement (ES) for which consent will be sought.

4.2 Eastern Green Link 3 (EGL 3) and Eastern Green Link 4 (EGL 4)

4.2.1 EGL 3 would comprise a 2 Gigawatt (GW) High Voltage Direct Current (HVDC) link between Aberdeenshire in Scotland, and King's Lynn and West Norfolk in England. EGL 4 would comprise a 2 GW HVDC link between Fife in Scotland and King's Lynn and West Norfolk. Each of EGL 3 and EGL 4 would comprise over 600 km of subsea and underground HVDC cables between new converter stations at each end of the electricity transmission link. These in turn are connected to the existing National Electricity Transmission System (NETS) via High Voltage Alternating Current (HVAC) cables between the new converter stations and new substations. Although EGL 3 and EGL 4 would be independent of one another, the EGL 3 and EGL 4 components of the English Onshore Scheme are being developed in parallel. This coordinated development allows for a single set of draft Order Limits onshore which provides the opportunity for co-located construction, reducing disturbance to local communities and the environment when compared to EGL 3 and EGL 4 being developed individually and separately.

4.2.2 The existing electricity distribution networks in England and Scotland both operate using predominantly HVAC systems. However, transmission projects such as EGL 3 and EGL 4 use HVDC technology because it is more efficient at transmitting large volumes of electricity over longer distances with lower losses compared to an equivalent HVAC system. A HVDC system also provides a greater degree of control over the magnitude and direction of flow of power and this flexibility delivers complementary operational benefits. For large scale transmission projects such as EGL 3 and EGL 4, specialised electrical plant and equipment contained within converter stations is required at either end of the transmission link to convert electricity from HVAC to HVDC (or vice versa).

4.2.3 For the purposes of seeking the necessary consents, EGL 3 and EGL 4 have been split into different 'Schemes' i.e. English Onshore Scheme, English Offshore Scheme, Scottish Onshore Scheme and Scottish Offshore Scheme. These Schemes are outlined in **Volume 1, Part 1, Chapter 1: Introduction**. This Preliminary Environmental Information Report (PEIR) is written with specific regard to the English Onshore Scheme and English Offshore Scheme for which a single application for a Development Consent Order (DCO) will be made. The Scottish Onshore Scheme and Scottish

Offshore Scheme will be consented separately. Further information is provided in **Volume 1, Part 1, Chapter 1: Introduction.**

English Onshore Scheme

4.2.4 As detailed in **Volume 1, Part 1, Chapter 1: Introduction**, the English Onshore Scheme would be sited within Lincolnshire, Norfolk and Cambridgeshire. The most northerly elements of the English Onshore Scheme would be located along the Lincolnshire coast in East Lindsey, where the Projects intend to make landfall, north of Anderby Creek. The English Onshore Scheme would extend from Mean Low Water Springs (MLWS) at landfall and continue southwest of Boston, before terminating in the vicinity of the existing Walpole substation (described as 'Walpole A substation' in this report) within King's Lynn and West Norfolk, where the Projects would connect into the 400 kV transmission system. The English Onshore Scheme would comprise the construction of:

- EGL 3 Project:
  - a new converter station, in the vicinity of the existing Walpole A substation within King's Lynn and West Norfolk;
  - approximately 100 km of new underground 525 kV HVDC cable (described interchangeably as 'DC cable' in this report), from the landfall point (at Anderby Creek) to the proposed EGL 3 converter station in the vicinity of the existing Walpole A substation within King's Lynn and West Norfolk; and
  - approximately 5 km of new underground 400 kV HVAC cable, between the EGL 3 Walpole converter station and a new 400 kV Walpole substation in the vicinity of the existing Walpole A substation, within King's Lynn and West Norfolk.
- EGL 4 Project:
  - a new converter station, in the vicinity of the existing Walpole A substation within King's Lynn and West Norfolk;
  - approximately 100 km of new underground 525 kV HVDC cable, from the landfall point (at Anderby Creek) to the proposed EGL 4 converter station in the vicinity of the existing Walpole A substation within King's Lynn and West Norfolk; and
  - approximately 5 km of new underground 400 kV HVAC cable, between the EGL 4 Walpole converter station and a new 400 kV Walpole substation in the vicinity of the existing Walpole A substation within King's Lynn and West Norfolk.

4.2.5 To connect the Projects into the NETS, a new 400 kV substation in the vicinity of the existing Walpole A substation within King's Lynn and West Norfolk would be required i.e., the new Walpole substation (referred to as the 'Walpole B Substation' in this report). The Walpole B Substation would be required to enable the connection of the Grimsby to Walpole Project, the EGL 3 Project and the EGL 4 Project (as identified in **Volume 1, Part 1, Chapter 1: Introduction**) to the NETS, and would therefore serve as a common connection point. The need for the Walpole B Substation exists as a part of either EGL 3 and EGL 4 or the Grimsby to Walpole Project and therefore will form part of their respective DCOs.

4.2.6 The Walpole B Substation would be required to connect into the existing Burwell Main to Walpole 4ZM 400 kV overhead line. Works to the existing 400 kV overhead line will be required to enable a connection with the Walpole B Substation.

English Offshore Scheme

4.2.7 As detailed in **Volume 1, Part 1, Chapter 1: Introduction**, the English Offshore Scheme would be sited within the English marine environment, including inshore and offshore waters, and up to Mean High Water Springs (MHWS) in England. The most northerly elements of the English Offshore Scheme would be located at the boundary of English waters where it meets Scottish waters, and the most southerly elements would be located at MHWS at Anderby Creek Landfall, along the Lincolnshire coastline.

4.2.8 The key elements of the English Offshore Scheme are summarised below:

- EGL 3 Project:
  - Approximately 436 km of subsea HVDC cable from the landfall at Anderby Creek, Lincolnshire, England to where it meets the marine boundary between English and Scottish waters. The submarine cable system would consist of two bundled HVDC cables and a fibre optic cable (up to the first offshore joint) for control and monitoring purposes.
- EGL 4 Project
  - Approximately 425 km of subsea HVDC cable from the landfall at Anderby Creek, Lincolnshire, England to where it meets the marine boundary between English and Scottish waters. The submarine cable system would consist of two bundled HVDC cables and a fibre optic cable (up to the first offshore joint) for control and monitoring purposes.

4.3 Design Parameters

4.3.1 The Projects would be constructed within the draft Order Limits and such Limits of Deviation (LoD), or other parameters as may be specified for the individual works. All parameters will be confirmed in the ES and DCO.

Draft Order Limits

4.3.2 **Volume 3, Part 1, Figure 1-2** illustrates the proposed draft Order Limits, which is presently the anticipated maximum extent of land in which the construction and operation of the Projects may take place. The draft Order Limits cover the entire area within which development could take place comprised of both temporary and permanent components of the Projects. These include the proposed temporary and permanent access roads, widening works to existing highways, utility diversions, drainage and agricultural land drainage, construction compounds and laydown areas, two converter stations, the Walpole B Substation, the offshore and onshore HVDC cables, HVAC cables and any works required to existing infrastructure such as works to existing overhead lines. The draft Order Limits also include for all proposed offshore construction and operations and include seabed preparation and maintenance works which would take place.

4.3.3 In addition, the draft Order Limits include for areas of mitigation planting and reinstatement which will be identified as part of the Projects design measures. These would typically include areas to mitigate potential landscape, visual and ecological effects. At this stage of design, preliminary areas for mitigation have only been identified for the Walpole B Substation. Design measures in the form of mitigation areas for the remainder of the English Onshore Scheme will be defined as further baseline data is collected and discussions take place with consultees and landowners. These areas will be developed and detailed in the ES and will include the planting proposals specific for each area and will include a range of native habitat types.

4.3.4 If approved, the DCO provides consent for the Projects to take place within the Order Limits. The land within the draft Order Limits is referred to as 'the Site' in some of the chapters in this PEIR. The extent of the draft Order Limits may be altered prior to the submission of the DCO application, based on detailed design matters and representations received during consultation.

Limits of Deviation

4.3.5 As recognised in guidance provided by Planning Inspectorate Advice Note Nine (Ref 4.1), a necessary and proportionate degree of flexibility often needs to be incorporated into the design of a proposed development so that unforeseen issues, that are encountered after a development has been consented, can be dealt with. For example, previously unidentified poor ground conditions may require proposed infrastructure to be re-sited slightly for geotechnical reasons. Therefore, to allow for this, works would be constructed within specified LoD which identify a maximum distance or measurement of variation within which the permanent works must be constructed.

4.3.6 At this stage of the design, the LoD has not yet been defined; however, flexibility has been retained within the draft Order Limits through the provision of several development zones. These include the following zones shown on **Volume 3, Part 1, Figure 4-1 to 4-6**:

- Indicative zone for construction compounds: identifies an area within which a temporary construction compound could be located. A preferred location within such area will be determined and reported in the ES.
- Indicative zone for underground cable assets: identifies the areas within which the permanent cable assets would be constructed, comprising the trench (or installation area) and the associated temporary working width which would be required for cable installation.
- Indicative zone for converter stations: identifies the areas within which the permanent converter stations would be located.
- Indicative converter station siting: identifies the potential location of the converter station platform within the Indicative zone for converter stations.
- Indicative Walpole B Substation: identifies the indicative location proposed for siting Walpole B Substation.
- Indicative Cable Sealing End Compound: identifies the indicative location proposed for siting the Indicative Cable Sealing End Compound.
- Indicative transition joint bay siting area: shows the indicative location proposed for siting of the Transition Joint Bay (TJB) connecting the offshore and onshore HVDC underground cables.
- River Nene Indicative temporary quay: shows the indicative location proposed for temporary dredged quay area, quay wall, quay apron, access haul road and temporary laydown area.
- Indicative zone for temporary construction works: identifies the areas within the draft Order Limits but outside of the Indicative zone for underground cable assets and Indicative zone for construction compounds required for other works including,

construction works and areas for design measures such as landscape planting or ecological mitigation.

- Indicative extent of draft Order Limits not required for proposed option (relevant to Walpole area only): identifies an area not likely to be required for development, should the relevant Walpole converter station Option be selected at the time of DCO submission.

4.3.7 No lowest below ground vertical LoD has been specified. Whilst a standard below ground LoD is not proposed, the Projects would never go deeper than necessary for technical or environmental reasons as this would add engineering operational complexity and cost.

4.3.8 The LoD will be confirmed at detailed design and reported in the ES.

Rochdale Envelope approach

4.3.9 At this stage of the Environmental Impact Assessment (EIA) and consenting process, the project description for the Projects is indicative. It is often the case that, where consent is applied for and obtained before construction commences, there may be design elements that are unknown to an applicant at the time of application.

4.3.10 In such cases, a Rochdale Envelope approach may be used. The Rochdale Envelope approach defines a design envelope and parameters within which the final design would sit (Ref 4.1). It allows flexibility for elements that are likely to require more detailed design subsequent to submission of a PEIR or ES, such as the routeing and siting of infrastructure, foundation types and construction and installation methods. It also allows the findings of the consultation process and feedback from statutory and non-statutory stakeholders to be considered during the design process, where appropriate.

4.3.11 The adoption of this approach allows meaningful EIA to take place by defining a ‘maximum design scenario’ on which to base the identification of likely environmental effects. The maximum design scenario is the scenario that would give rise to the greatest impact (and subsequent effect), allowing for a realistic worst-case assessment to be undertaken. For example, where design options are under consideration, the assessment is based on the option predicted to have the largest magnitude of impact. This may be the option with the largest footprint, the greatest height or the largest area of disturbance during construction and installation, depending on the topic under consideration. By identifying the maximum design scenario, it can be concluded that the impact (and therefore the resulting effect) would be no greater for any other design scenario.

4.3.12 This approach is recognised in the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) (Ref 4.2), the NPS for Renewable Energy Infrastructure (NPS EN-3) (Ref 4.3) and the NPS for Electricity Networks Infrastructure (NPS EN-5) (Ref 4.4).

4.3.13 This chapter describes the Rochdale Envelope for the Projects, taking into account the policy set out in the NPSs and the advice in the Planning Inspectorate’s Advice Note Nine. The Rochdale Envelope described within this chapter has been designed to:

- take into account site and route selection and design refinement work undertaken to date (see **Volume 1, Part 1, Chapter 3: Reasonable Alternatives Considered**); and
- include sufficient flexibility to accommodate future stages of design refinement.

4.3.14 It should be noted that the Rochdale Envelope presented in this chapter is generally considered to represent a realistic, reasonable worst-case design scenario and in most instances these design parameters form the basis of assessment for each of the aspect chapters presented in **Volume 1, Parts 2: English Onshore Scheme & 3: English Offshore Scheme** of this PEIR. However, there are instances where the reasonable worst-case scenario for a given design parameter might vary by environmental aspect, depending on how that particular parameter interacts with the receptor being considered. Therefore, each technical aspect chapter in **Volume 1, Parts 2: English Onshore Scheme & 3: English Offshore Scheme** of this PEIR sets out the assumptions made regarding the Rochdale Envelope specific to that particular environmental aspect. The methodology for assessment for the Projects is set out in more detail in **Volume 1, Part 1, Chapter 5: PEIR Approach and Methodology**.

4.3.15 The design described within this chapter will continue to be refined, taking into account the findings of the ongoing EIA process and engagement with stakeholders. Refined design parameters will be presented in the ES and draft DCO that will accompany the application for development consent. The final design for the Projects will be selected after development consent has been granted, from within the parameters set out in the project description chapter of the ES and the DCO.

4.4 Development Proposals

English Onshore Scheme

4.4.1 As outlined in **Volume 1, Part 1, Chapter 1: Introduction**, the English Onshore Scheme would extend from MLWS where the English Offshore Scheme intends to make landfall at the Lincolnshire coastline before continuing to the proposed Walpole converter stations and proposed Walpole B Substation in the vicinity of the existing Walpole A substation. It is noted that the boundaries for the English Onshore Scheme and the English Offshore Scheme would overlap in the intertidal zone between MLWS and MHWS. This area of overlap (i.e. the area from MLWS to MHWS) will be characterised and assessed within **Volume 1, Part 3, English Offshore Scheme** only.

4.4.2 **Volume 3, Part 1, Figure 1-3** shows the extents of the English Onshore Scheme draft Order Limits, which is located within Lincolnshire, Norfolk and Cambridgeshire. The English Onshore Scheme draft Order Limits extend into eight local authority boundaries:

- East Lindsey District Council;
- Boston Borough District Council;
- South Holland District Council;
- Borough Council of King’s Lynn and West Norfolk;
- Lincolnshire County Council;
- Norfolk County Council;
- Fenland District Council; and
- Cambridgeshire County Council.

4.4.3 The temporary and permanent components of the English Onshore Scheme are illustrated in **Volume 3, Part 1, Figures 4-1 to 4-6.** Specifically, these illustrate:

- **Volume 3, Part 1, Figures 4-1 to 4-4:** show the temporary and permanent components and development zones within the Walpole area (with Sheet 1 of each figure showing temporary works and Sheet 2 showing permanent infrastructure) and in the vicinity of the existing Walpole A substation where the Projects would connect into the 400 kV transmission system.
- **Volume 3, Part 1, Figures 4-5 to 4-6:** show the temporary and permanent components and development zones of the English Onshore Scheme from the most northerly extents where the Projects intend to make landfall before continuing southwest towards Boston and west of Walpole.

4.4.4 The specific elements and planned works at each location of the English Onshore Scheme are described in the following sections. All dimensions in the sections below are approximate.

Walpole converter stations

Walpole converter station options

4.4.5 At this stage in the design process, four options have been identified with regards to the proposed siting of the Walpole converter stations. All four options (Options A-D) have been assessed within this PEIR. Of the four options considered, it is intended that only the preferred option will be taken forward into the DCO and the remaining three options will not be considered any further due to not being preferred. This decision will be informed by further engineering and environmental studies and following the feedback received during statutory consultation.

4.4.6 At this stage, the exact location and position of the converter station buildings (known as micro-siting) has not been determined however, indicative locations for converter station siting have been identified and are shown on **Volume 3, Part 1, Figures 4-1** to **4-4 (Sheet 2)**. For the purposes of reasonable worst-case assessment within this PEIR, it has been assumed that the converter stations for all four options would be located anywhere within the 'indicative zone for converter stations' which are shown on **Volume 3, Part 1, Figures 4-1** to **4-4.**

Option A

4.4.7 The converter stations would be sited in a split arrangement. One of the converter stations would be located to the east of settlement in Ingleborough and the other converter station would be located to the west of West Drove North, east of the existing operational Rose and Crown Farm Solar Farm. At their closest point, the indicative zones for the converter stations are approximately 700 m apart therefore, subject to further studies, the indicative converter station siting would be 700 m apart as a minimum.

4.4.8 Each converter station would require a permanent access road. The eastern most converter station, in the vicinity of Rose and Crown Farm Solar Farm, would require an access road connecting to West Drove North. The converter station located east of Ingleborough would require an access road connecting to Mill Road. Where the permanent accesses connect to the public highway, a permanent bellmouth would also be required.

Option B

4.4.9 Both converter stations would be sited together to the west of West Drove North, partially within the boundary of, and east of, the Rose and Crown Farm Solar Farm. Each converter station would require a separate permanent access road. Both accesses would connect to West Drove North. To avoid a cluster of residential properties located to the east of both converter stations, one access would take a more northernly route and the other access would take a route south of the residential properties. For both accesses, a permanent bellmouth would be required where the access roads meet West Drove North.

Option C

4.4.10 The converter stations would be sited in a split arrangement. One converter station would be located to the west of West Drove North, east of the Rose and Crown Farm Solar Farm and the other converter station would be located to the east of the River Nene, northwest of the settlement at Ingleborough. At their closest point, the indicative zones for the converter stations are approximately 1.8 km apart therefore, subject to further studies, the indicative converter station siting would be 1.8 km apart as a minimum.

4.4.11 Each converter station would require a permanent access road, one from West Drove North connecting to the converter station in the vicinity of Rose and Crown Farm Solar Farm, and one from Mill Road connecting to the converter station northwest of settlement at Ingleborough. Where the permanent accesses connect to the public highway, a permanent bellmouth would also be required.

Option D

4.4.12 The converter stations would be sited in a split arrangement. One converter station would be located to the east of the settlement in Ingleborough, and the other converter station would be located to the east of the River Nene, northwest of the settlement at Ingleborough. At their closest point, the indicative zones for the converter stations are approximately 580 m apart therefore, subject to further studies, the indicative converter station siting would be 580 m apart as a minimum.

4.4.13 Each converter station would require a permanent access road. For both converter stations, the access roads would connect to Mill Road in the vicinity of settlement at Ingleborough. A permanent bellmouth would be required where the access roads meet Mill Road.

Physical description of the Walpole converter stations

4.4.14 The Walpole converter stations would house the main equipment indoors to facilitate the conversion of electricity between alternating current (AC) and direct current (DC), depending on direction of electricity transmission. Additionally, the Walpole converter stations would incorporate an air-insulated substation (typically outdoor Air Insulated Switchgear (AIS)) to connect to the 400 kV HVAC transmission system. The height of the Walpole converter stations is determined by the size of the equipment required, the space required around the equipment, any permanently installed lifting equipment and any required roof structures.

4.4.15 Two new converter stations would be required, one for the EGL 3 Project and one for the EGL 4 Project. These would be located in the Walpole area in proximity to the proposed Walpole B Substation (which would be a new connection point on the network for the Walpole converter stations).

4.4.16 The platform dimensions for each converter station would be approximately 350 m x 250 m, 8.8 ha. It should be noted that this excludes related development including permanent access, peripheral landscaping, earthworks, drainage (i.e. attenuation basins) and other related works.

4.4.17 Each converter station would comprise the following main components within a secure fenced compound. The parameters, as set out below, set the maximum parameters within which the detailed design would be developed:

- **DC Hall** - the underground DC cables terminate here. The DC Hall would also contain indoor DC switchgear to connect to power electronics. This equipment would be enclosed in a building up to 30 m in height (not including aerials and lightning protection that may be required for safety).
- **Valve Hall** – contains high voltage power electronics equipment that would convert electricity from DC to AC and vice-versa. This equipment must be located indoors in buildings up to 30 m in height within a clean and controlled environment.
- **Control Building** – would contain control panels and associated operator stations, protection and communication equipment, offices and welfare facilities and other auxiliary systems all located within an enclosed building up to 15 m in height.
- **Transformer bays** – these change the AC voltage to an appropriate level for onward transmission via the AC system/or prior to conversion to DC. The transformers are normally sited outdoors and separated by concrete fire protection walls. Typical dimensions are 15 m long by 15 m wide by 16 m high. Cooling fans are also provided on transformers. Noise enclosures can be fitted around the transformers if required.
- **AC Switchgear and filters (“switchyard”)** – connects the converter station to the 400 kV AC transmission system. It includes a range of electrical equipment including harmonic filtration and reactive compensation equipment, circuit breakers, transformers, busbars and insulators. The main function is to allow the effective integration of the DC system into the AC system. Commonly the AC switchyard and associated equipment is located outdoors although this equipment can be enclosed in a building or series of buildings to be determined through detailed design.
- **Diesel Backup Generator** – the converter station requires its own power typically provided at 11 kV; the diesel back-up generator would be used to provide back-up electricity supply in the event of a failure of the low voltage electricity supply. Approximate dimensions are 15 m long, 3 m wide and 5 m high.
- **Spares Building** – a building to house spare parts and components; this would be supplemented by hardstanding areas provided for storage of a spare transformer and spare cable drums.

4.4.18 These components could be arranged differently, subject to the ongoing design process taking into account engineering, environmental and other requirements.

4.4.19 Each converter station site would be within a fenced compound with restricted access. A palisade fence would be erected around the converter station site established at the start of construction and retained for operation. The site would also be monitored by CCTV and security gates would be in place for restricted/controlled access.

4.4.20 Normally, the converter stations would not be occupied overnight (although a standby arrangement will be in place) and would not be lit. However, external lighting would be installed on the perimeter and within the converter stations for safety and security purposes and to facilitate maintenance or repair works during the hours of darkness or low light. Additional temporary task lighting will also be used in any area in which maintenance or repair works are being undertaken. All lighting would be designed in accordance with the appropriate design standards and would be designed to be environmentally sensitive. Further information regarding lighting design will be provided within the project description within the ES.

4.4.21 As described above, each converter station would require a new permanent access road, which would need to be suitable for operational works and would likely consist of a bituminous surface. There may also be a need for an additional permanent access route for the replacement of the transformer unit which would be transported as an abnormal indivisible load (AIL). If the main access road is not suitable for this purpose, provision of another AIL permanent access route will be identified. This may involve having the permanent rights to build an access route to the converter site/s or installation of a new road (typically grasscrete or similar). Further definition of the access routes and requirements will be provided as the design of the English Onshore Scheme progresses.

4.4.22 A summary of the key characteristics of each of the Walpole converter stations is outlined in **Table 4-1** and an indicative model of a typical converter station is shown in **Plate 4-1.** Please note, **Plate 4-1** represents a single converter station; two of these would be required, one for the EGL 3 Project and one for the EGL 4 Project.

Plate 4-1: Indicative model for a single Walpole converter station

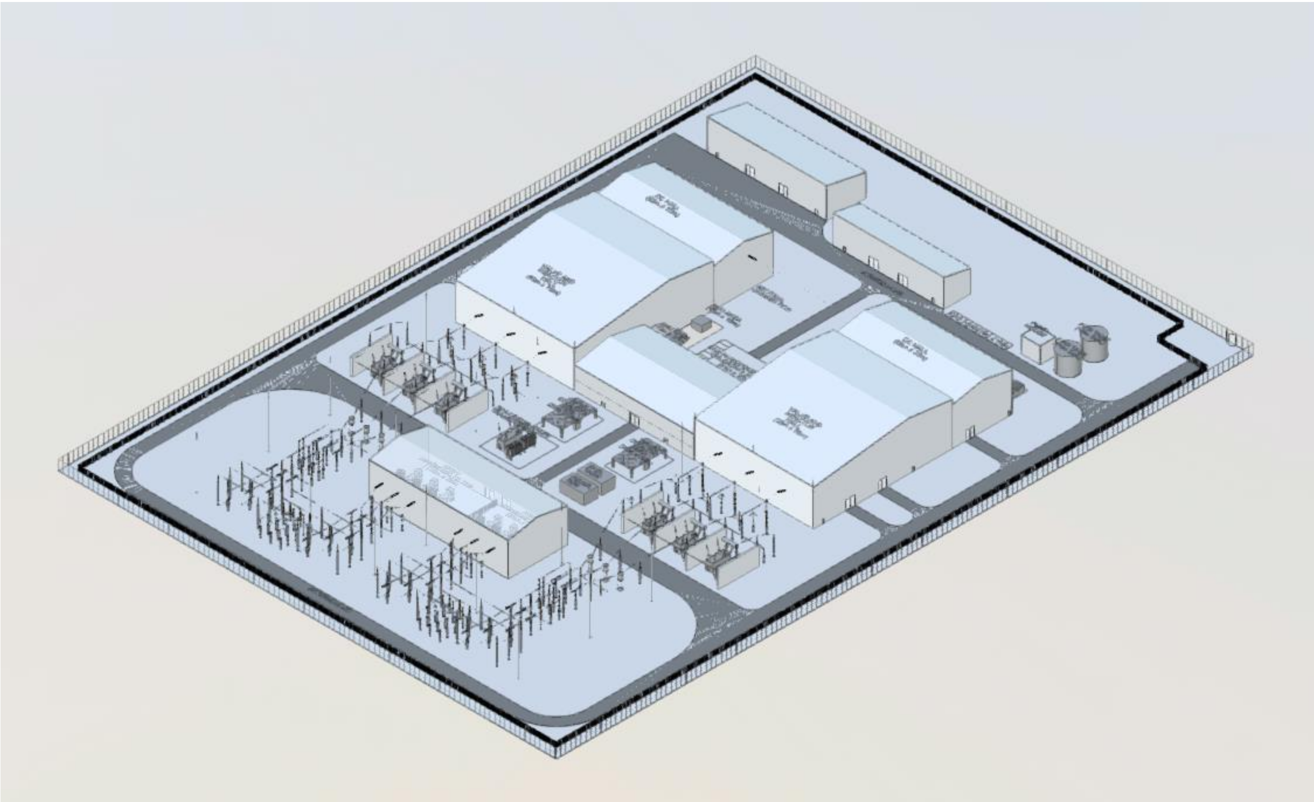


Table 4-1 – Rochdale Envelope - Walpole Converter Stations

Parameter	Maximum design parameter (for each converter station)
Indicative converter station platform footprint	250 m x 350 m, 8.8 ha. The footprint excludes any drainage (i.e. attenuation basins), permanent access roads or landscaping requirements
Converter station platform height	1.7 m from existing ground level. This is in addition to the converter station building heights.
Maximum height of structures	30 m (excluding lightning protection and aerials). Not including the 1.7 m platform.
Height of lightning protection	To be established at detailed design

Anderby Creek Landfall

Physical description of the landfall

4.4.23 The landfall is the interface between the English Onshore Scheme and the English Offshore Scheme and would be located at Anderby Creek, East Lindsey, Lincolnshire. This is the location where subsea cables (which are commonly of a greater diameter compared to the onshore cables due to increased protection), would connect to the onshore underground cables at a buried transition joint bay (TJB) located above MHWS illustrated on **Volume 3, Part 1, Figures 4-5 and 4-6**. More specifically, the landfall is considered to extend from the Horizontal Directional Drilling (HDD) exit point below MLWS (where it overlaps with the English Offshore Scheme components) across the intertidal zone to terminate at a buried TJB located a short distance inland. A TJB is a permanent underground chamber constructed of reinforced concrete that houses the cable joints and a fibre chamber/link pit. A single TJB typically comprises an area of 15 m by 4 m (60 m^2). It is currently anticipated that two single TJBs would be required for the English Onshore Scheme, one for the EGL 3 Project and one for the EGL 4 Project. This would be confirmed at the detailed design stage.

4.4.24 No permanent above ground infrastructure would be required for the TJBs; however, there may be a requirement to permanently raise the platform for the TJBs. The height of the platform is not yet known, this will be confirmed by the Contractor at the detailed design stage. Once installation has been completed, the land would be reinstated to pre-existing conditions (but at a higher elevation due to the raised platform); the only infrastructure visible on the surface (on otherwise fully reinstated land) would be the cover of the link box pit.

4.4.25 All aspects of the landfall that are above MHWS will be assessed as part of the English Onshore Scheme and conversely everything that is below MHWS will be assessed as part of the English Offshore Scheme. Therefore, the overlap between the English Onshore Scheme and English Offshore Scheme i.e. in the intertidal zone between MLWS and MHWS will be considered within **Volume 1, Part 3, English Offshore Scheme** only.

4.4.26 The landfall would be constructed using a trenchless technique such as HDD. Four cable ducts (i.e. two ducts for the EGL 3 Project and two for the EGL 4 Project) would be installed from the TJB, positioned above the MHWS mark, to a point below 0 m lowest astronomical tide (LAT). Within each cable duct there would be a fibre optic cable for monitoring purposes. The fibre optic cable would be both distributed temperature sensing (DTS) and distributed acoustics sensing (DAS). The exact exit points for the HDD and the cable ducts would depend on further technical studies and design. The HDD would 'punch out' (exit the seabed) between the 0 m and 8 m LAT water depth contours.

4.4.27 A summary of the key characteristics of the landfall is outlined in **Table 4-2**.

Table 4-2 – Rochdale Envelope – Anderby Creek Landfall and transition joint bay

Parameter	Maximum design parameter
Transition Joint Bays	
Number of transition joint bays	It is currently anticipated that two single TJBs would be required for the English Onshore Scheme, one for the EGL 3 Project and one for the EGL 4 Project. This would be confirmed at the detailed design stage.
Maximum permanent area of above ground transition joint bay covers (m^2)	TJB is typically a buried concrete chamber. No above ground infrastructure; however, there may be a requirement to permanently raise the platform for the TJBs. TJB dimensions are approximately 15 m by 4 m (60 m^2) per HVDC link.
Landfall	
Type of trenchless technique	Trenchless construction techniques include HDD, micro-tunnelling and using a direct pipe. These are techniques commonly used to install cable duct(s) underneath sensitive environmental features (such as sea defences, dune system, etc) or technical constraints (cliffs, shallow bedrock etc.). The information contained within this PEIR relates to the typical approach for a HDD construction as this is the most likely trenchless technique that would be used at the Landfall. It is expected that up to four permanent cable ducts (i.e., two ducts for the EGL 3 Project and two for the EGL 4 Project) would be installed at the landfall, although solutions to reduce this are being investigated.
Number of cable ducts	Up to four permanent ducts (i.e., two ducts for the EGL 3 Project and two for the EGL 4 Project) would be installed between the onshore TJB and the offshore exit location.
Indicative length of HDD or equivalent (m)	It is currently assumed that the length of each duct would likely extend from a compound location above MHWS to a punch-out point below MLWS, indicatively 1.6 km from MHWS.
Number of exit pits (below MHWS)	Two for the EGL 3 Project and two for the EGL 4 project (if required).

Parameter	Maximum design parameter
Volume of excavated material per exit pit (below MHWS)	10 – 1,500 m^3

Underground HVDC Cables

4.4.28 The term Indicative Zone of Underground Cable Assets is used throughout this PEIR and refers to the areas within which the permanent cable assets would be constructed, comprising the trench (or installation area) and the associated temporary working width which would be required for cable installation as described below. **Volume 3, Part 1, Figures 4-5 and 4-6** show the temporary and permanent elements and development zones of the English Onshore Scheme starting from Anderby Creek before continuing to the west of Boston towards Walpole.

4.4.29 The exact configuration of the underground HVDC cables route would depend on a number of factors including the constraints (such as crossings of major rivers, roads, utilities and railways) which are present, prevailing ground conditions, the length of each cable section, suitability of jointing positions and the number of bends and topography of the route.

Underground HVDC Cable Route Overview

4.4.30 At the landfall, where the English Onshore Scheme and English Offshore Scheme are expected to overlap, the DC cables would continue from offshore to onshore environment. The English Onshore Schemes DC cables would begin at MLWS and extend across the intertidal zone (via HDD) to connect into a buried TJB (where the submarine and onshore DC cables connect). From the TJB, the DC cables for both the EGL 3 Project and the EGL 4 Project would be co-located, routeing south and to the west of Boston towards the two new converter stations at the Walpole area.

4.4.31 In response to technical studies and having acquired a greater understanding of the engineering complexities along the indicative cable route, cable route options have been incorporated into the design at four separate locations. Each option and associated crossings have been assessed in the PEIR to help inform statutory consultation. For each of the locations, a preferred option will be derived at the detailed design stage. The options proposed at each location are outlined below:

- **North of Sibsey:**
  - Two options have been identified; the Northern Option and Southern Option. Both options have been taken forward to allow for flexibility in the crossing of A16 Main Road. Both options are shown on **Volume 3, Part 1, Figure 4-6.**
- **North of Cowbridge:**
  - Two options have been identified; the Northern Option and the Southern Option. Both options have been taken forward to allow for flexibility in the crossing of West Fen Drain. Both options are shown on **Volume 3, Part 1, Figure 4-6.**
- **Hubberts Bridge, west of Boston:**
  - Two cable route options have been identified; the Eastern Option and the Western Option. Both options have been taken forward to avoid a potential area of settlement remains (identified through Historic Environment Records) and a

Grade II listed milepost, and to allow for additional flexibility at two crossing points. Both options are shown on **Volume 3, Part 1, Figure 4-6.**

- **River Nene crossing, Foul Anchor:**
  - Three options have been identified; a Northern Option, Central Option and Southern Option. These options are proposed in response to the 2024 non-statutory consultation feedback received identifying potential interactions with other proposed developments and further reviews of planned and potential developments and other forms of constraints identified to the east of River Nene and within the surroundings of Walpole Marsh. All options are shown on **Volume 3, Part 1, Figure 4-6.**

Physical description of the DC Cables

4.4.32 The English Onshore Scheme would comprise two sets of two DC cables (four cables in total). Each DC cable is typically 15 cm in diameter and would be installed in plastic ducts; cable installation methods are outlined in detail in **Section 4.5** below. On each DC cable, there would be a Peak Particle Velocity cable for monitoring purposes. The fibre optic cable would be both DTS and DAS.

4.4.33 The type of underground cable proposed for this installation has not yet been determined. For example, the cable may comprise a single core copper conductor, insulated with cross linked polyethylene, shielded with a metallic screen and finished with a non-metallic outer sheath. Cable conductors are most often either aluminium or copper, depending on the electrical capacity required.

4.4.34 The English Onshore Scheme would require the construction of approximately 100 km of DC cables, for each of EGL 3 and EGL 4, connecting from the Anderby Creek Landfall to the proposed new Walpole converter stations. The exact configuration of the DC cables is subject to detailed design following appointment of the Contractor; however, the general characteristics below have informed this PEIR.

4.4.35 The DC cables would have a permanent easement. The exact width of the permanent easement is still to be determined, this would be established during the detailed design stage of the Projects.

4.4.36 The DC cables would be installed in sections, typically every 800 m to 1.5 km. These sections would be connected at buried cable joint bays. The number, location and dimensions of cable joint bays required would be determined through consultation feedback, information from surveys and ongoing design studies.

4.4.37 There would be no permanent above ground infrastructure required along the new DC cables route except for small marker posts. These may be installed at field boundaries, crossings, and other locations as appropriate to highlight the presence of the DC cables to landowners, asset owners and those undertaking works within the vicinity.

4.4.38 The construction and cable installation methodology are detailed in **Section 4.5** below.

4.4.39 A summary of the key characteristics of the underground DC cable route are outlined in **Table 4-3**.

Table 4-3 – Rochdale Envelope - Underground DC Cables Route

Parameter	Maximum design parameter
Indicative Length of Route	Approximately 100 km
Cable number	Four DC cables would be installed, two DC cables for the EGL 3 Project and two DC cables for the EGL 4 Project. Each cable would be contained within a plastic duct, therefore there would be four ducts in total There would be a fibre optic cable for monitoring purposes on each DC cable. The fibre optic cable would be both distributed temperature sensing (DTS) and distributed acoustics sensing (DAS).
Indicative cable dimensions	Each DC cable is approximately 15 cm in diameter. Each cable duct has an outer diameter of 250 mm.
Number of trenches	Two trenches, one which would contain the two DC cables (and fibre optic cables) for the EGL 3 Project and one the two DC cables (and fibre optic cables) for the EGL 4 Project.
Number of cable joint bays	Required approximately every 800 m to 1.5 km
Permanent easement	The exact width of the permanent easement is still to be determined, this would be established during the detailed design stage.
Permanent above ground infrastructure	Cable markers may be installed at field boundaries, crossings, and other locations as appropriate to highlight the presence of the DC cables to landowners, asset owners and those undertaking works within the vicinity.
Trench width at base	Approximately 1.4 m wide (subject to local ground conditions and obstacles).
Trench width at surface	Approximately 1.4 m wide (subject to local ground conditions and obstacles). The surface width of the trench would however be dependent on the Contractor's construction methodology. If the excavation is splayed (i.e. if the trench is battered (sloped) back) to eliminate the risk of collapse, the surface width could extend to approximately 7.4 m, assuming a slope angle of 1:2.
Target depth of trench	The depth of the cables would vary, subject to the outcome of soil Agricultural Land Classification (ALC), agricultural land drainage, engineering and ground investigation surveys. The minimum depth coverage would be 900 mm to the cable protective tiles. Where justified, it may be laid deeper. The depth of installation would also be deeper at locations where trenchless methods e.g. HDD, are required.
Depth/thickness of specialised backfill	The cement bound sand (CBS) (or equivalent) would have an approximate depth of 550 mm; however, this is subject to further engineering studies, including the undertaking of a final cable system study.

Parameter	Maximum design parameter
	Above the CBS (or equivalent) would be a well compacted thermally suitable backfill (including the topsoil) to a depth of approximately 900 mm from the ground surface level.
Working width (temporary)	Approximately 76 m where open-cut installation methods would be used. Working width includes provision for both cable trenches, cable joint bays, temporary drainage, soil storage, materials and equipment laydown, and temporary haul road. For trenchless cable installation, the working width would extend up to 60 m at the entry and exit compounds. The width below ground would span approximately 40 m, assuming a 10 m separation between drills.
Number of haul roads	There would be one haul road which would typically be positioned between each trench. At certain locations, i.e. pinch points, or where physical constraints dictate, there may be a requirement for more than one haul road. Additional haul roads may also be required to access the working area.
Width of haul road excluding passing bays	7 m

Underground HVAC Cables

4.4.40 The term Indicative Zone of Underground Cable Assets is used throughout this PEIR and refers to the areas within which the permanent cable assets would be constructed, comprising the trench (or installation area) and the associated temporary working width which would be required for cable installation as described below.

4.4.41 The underground HVAC cables would connect the Walpole converter stations to the Walpole B Substation as shown on **Volume 3, Part 1, Figures 4-1 to 4-4** for each Walpole converter station Option.

4.4.42 The exact configuration of the underground HVAC cable route would depend on several factors including the constraints which are present (such as crossings of major rivers, roads, utilities and railways), prevailing ground conditions, the length of each cable section, suitability of jointing positions and the number of bends and topography of the route.

4.4.43 The following sections provide a high-level description of the design, construction and operation of the underground HVAC cables (described interchangeably as ‘AC cables’ in this PEIR).

Physical description of the Underground AC Cables

4.4.44 The English Onshore Scheme would require the construction of approximately 5 km of AC Cables, for each of the EGL 3 Project and the EGL 4 Project, between the Walpole converter stations and the Walpole B Substation. The exact configuration of the AC cables would be subject to detailed design following appointment of a Contractor; however, the general characteristics below have informed this PEIR.

4.4.45 Each connection from the proposed Walpole converter stations to the Walpole B Substation would require two sets of three AC cables (i.e. a total of six AC cables from the EGL 3 Walpole converter station and a total of six AC cables from the EGL 4 Walpole converter station). These would be installed in four separate cable trenches (two trenches for the EGL 3 Project and two trenches for the EGL 4 Project). Each AC cable is typically 15 cm in diameter and would be installed in plastic ducts; cable installation methods are outlined in detail in **Section 4.5** below. Each AC circuit would require both a fibre optic cable for monitoring purposes, and a communications cable. These would be installed in a separate carrier duct to the cable ducts.

4.4.46 The AC cables would have a permanent easement. The exact width of the permanent easement is still to be determined.

4.4.47 The AC cables would be installed in sections, typically every 800 m to 1.5 km. These sections would be connected at buried cable joint bays. The number, location and dimensions of cable joint bays required would be determined through consultation feedback, information from surveys and ongoing design studies.

4.4.48 There would be very minimal above ground infrastructure required along the proposed AC cables route. The exception to this is at cable joint bays where link pillars and small marker posts would be required along the cable alignment. Link pillars would be required at buried cable joint bays, where the AC cable sections would be joined. Link pillars are typically 0.5 m by 1.2 m and are at a height of 1.5 m and are typically enclosed within a timber fence, typically at a height of 1.4 m. Underground link boxes could also be used instead of link pillars at buried cable joint bays, however, from an operational perspective, these are less preferred and would typically only be considered at specific locations (e.g. roads). Marker posts may be installed at field boundaries, crossings, and other locations as appropriate to highlight the presence of the AC cables to landowners, asset owners and those undertaking works within the vicinity.

4.4.49 A summary of the key characteristics of the underground AC cable route are outlined in **Table 4-4**.

Table 4-4 – Rochdale Envelope - Underground AC Cables Route

Parameter	Maximum design parameter
Indicative Length of Route	Approximately 5 km for both the EGL 3 Project and EGL 4 Project.
Cable number	Twelve cables in total, i.e. two sets of three (totalling six AC cables) for the EGL 3 Project and two sets of three (totalling six AC cables) for the EGL 4 Project. Each cable would be contained within a plastic duct, therefore there would be 12 ducts in total.
Indicative cable dimensions	Each AC cable is approximately 15 cm in diameter.
Number of trenches	Two trenches would be required for the EGL 3 Project AC Cables, and two trenches would be required for the EGL 4 Project AC cables. Four trenches required in total. Each trench would contain three AC cables and (subject to cable system design)
Number of cable joint bays	Required approximately every 800 m to 1.5 km.

Parameter	Maximum design parameter
Permanent above ground infrastructure	Cable markers may be installed at field boundaries, crossings, and other locations as appropriate to highlight the presence of the AC cables to landowners, asset owners and those undertaking works within the vicinity. Link pillars at buried cable joint bays which are typically 0.5 m by 1.2 m and are at a height of 1.3 m. Link pillars are typically enclosed within a timber fence typically at a height of 1.4 m.
Trench width at base (m)	Approximately 3 m at the base.
Trench width at surface (m)	Approximately 3 m wide at the surface; however, this would be dependent on the Contractor's construction methodology. If the excavation is splayed (i.e. the trench would be battered (sloped) back) to eliminate the risk of collapse, the surface width could extend to approximately 9 m, assuming a slope angle of 1:2.
Target depth of trench (m)	The depth of the cables would vary, subject to the outcome of soil ALC, agricultural land drainage, engineering and ground investigation surveys. The minimum depth coverage would be 900 mm to the cable protective tiles. Where justified, it may be laid deeper. The depth of installation would also be deeper at locations where trenchless methods, e.g. HDD, are required.
Trench depth of specialised backfill	The CBS (or equivalent) would have an approximate depth of 550 mm; however, this is subject to further engineering studies, including the undertaking of a final cable system study. Above the CBS (or equivalent) would be a well compacted thermally suitable backfill (including the topsoil) to a depth of approximately 900 mm from the ground surface level.
Working width (temporary)	Approximately 135 m in total, where open-cut installation methods. For trenchless installation methods, the working width would extend up to 140 m at the entry and exit compounds.
Number of haul roads	Should the HVAC cable trenches be located next to each other, there would be one haul road which would typically be positioned in the centre of the two sets of trenches. If it is not possible to locate the HVAC cables alongside each other, for example, if the Walpole converter stations are sited separately, then two separate haul roads may be required to facilitate the transport and delivery of materials to the site. Additional haul roads may be required to provide access to the HVAC cable alignments.
Width of haul road, excluding passing bays	7 m

Walpole B 400 kV Substation

4.4.50 The location of the proposed Walpole B Substation would be west of West Drove North, as shown on **Volume 3, Part 1, Figures 4-1 to 4-4** for each Walpole converter station Option.

4.4.51 The Walpole B Substation would be needed to connect future transmission and generation projects, which include:

- EGL 3;
- EGL 4;
- the Grimsby to Walpole Project; and
- Customer Connection projects.

4.4.52 As a key connection point for the EGL 3 Project, the EGL 4 Project and the Grimsby to Walpole Project, the proposed Walpole B Substation would be developed as part of these projects and would be constructed by National Grid Electricity Transmission plc (NGET). For the purpose of EIA and the DCOs, the Walpole B Substation will be included in both DCOs and assessed in both ESs.

4.4.53 The Grimsby to Walpole Project's proposed 400 kV overhead line will require a separate consent to bring the overhead line to the Walpole B Substation. As such, this component does not form part of the English Onshore Scheme. However, as the Walpole B Substation would facilitate the connection of this project (and its associated infrastructure), a coordinated approach has been adopted from the outset.

Physical description of the Walpole B Substation

4.4.54 For the purposes of the PEIR, it has been assumed that the proposed Walpole B Substation will be an AIS substation. The functional footprint of the proposed Walpole B Substation could extend up to 793 m by 190 m (approximately 15.4 ha including an area for ancillary works and parking). The tallest structures within the substation compound would be the overhead line gantries, which are typically steel or concrete structures used as an intermediate connection point for the downleads, which connect between the terminal towers of the overhead lines and equipment within the substation. They are approximately 15 m high (with technical deviation). The maximum height for High Voltage (HV) plant and buildings within the substation is 12.5 m.

4.4.55 The proposed Walpole B Substation would contain the necessary transmission equipment and have a total of 31 bays for the connections it is required to accommodate, including transformers which will connect into the local 132 kV distribution network. It would also house switchgear and controls, as well as welfare facilities for operational staff. It should be noted that this footprint excludes related development including permanent access which would be needed to the Walpole B Substation, together with peripheral landscaping, drainage, and other related works.

4.4.56 The Walpole B Substation would connect to the existing 400 kV 4ZM transmission line that runs north from Burwell towards the existing Walpole A Substation. To facilitate this connection, it is currently anticipated that the route of the existing overhead line would need to be permanently diverted to connect into the Walpole B Substation. As part of this modification to the existing overhead line, two existing pylons would need to be removed and up to four new pylons installed, ranging from a height of approximately 49 m to 56 m. A cable sealing end compound of approximately 56 m by 52 m would also be required close to the alignment of the existing overhead line, which would connect one of the existing overhead line circuits onto a short run of new 400 kV single circuit underground cable into the Walpole B Substation. Four gantry towers would also be required, three within the substation compound and one within the cable sealing end compound associated with the overhead line diversion works. These are illustrated along with the Walpole B Substation on **Volume 3, Part 1, Figures 4-1 to 4-4** for each Walpole converter station Option.

4.4.57 The Walpole B Substation would be within a fenced compound with restricted access. It would be monitored by CCTV and security gates would be in place for restricted/controlled access.

4.4.58 During operation, lighting would be required at the substation sites to allow for safe movement and the operation of equipment. Security lighting would also be required. All lighting would be designed in accordance with the appropriate design standards and National Grid technical specifications. For the purpose of the PEIR, it is assumed that the security lighting would be event-activated (i.e. would not be continuous) and would be designed to be environmentally sensitive (e.g. directional and low light not exceeding 50 lux). Further information regarding substation lighting design will be provided within the project description within the ES.

4.4.59 Permanent access to the Walpole B Substation would be acquired via the provision of a new road connecting West Drove Road to the south of the substation.

4.4.60 Indicative areas for environmental mitigation are proposed around the Walpole B Substation in the form of landscape screening or ecological mitigation. These would comprise land proposed for ditch mitigation, creation of space for water vole mitigation, planting of native hedgerows with trees to aid landscape integration, planting of woodland around the substation to provide visual screening, and management regime for grassland to provide habitat for skylark.

4.4.61 A summary of the key characteristics of the Walpole B Substation are outlined in **Table 4-5.**

Table 4-5 – Rochdale Envelope - Walpole B Substation

Parameter	Maximum design parameter
Indicative platform footprint including parking area	15.4 Ha
Maximum height	15 m maximum for gantries assumed (with technical deviation)
Height of main structure/buildings	12.5 m
Cable sealing end compound dimensions	56 m x 52 m
New NGET overhead line	Four new pylons installed, ranging from a height of approximately 49 m to 56 m.

English Offshore Scheme

Subsea cables

4.4.62 EGL 3 and EGL 4 would each comprise a 2 GW HVDC system linking Scotland and Norfolk in England, making landfall in Lincolnshire. The subsea cables forming the English Offshore Scheme would be buried along the length of the cable with the exception of infrastructure crossing points and areas where sufficient depth of burial cannot be achieved.

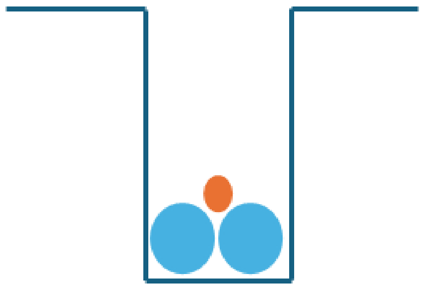
4.4.63 The draft Order Limits encompass the English Offshore Scheme as shown in **Volume 3, Part 1, Figure 1-4**. Where the separation between the EGL 3 Project cables and EGL 4 Project cables is greater than 500 m, the English Offshore Scheme draft Order Limits is split and has separate corridors of 500 m minimum width, as shown in **Volume 3, Part 1, Figure 1-4**. Where the separation of the English Offshore Scheme draft Order Limits is less than 500 m, the draft Order Limits have been combined to show the English Offshore Scheme as a single corridor. However, where the indicative cable route is within one combined corridor, a separation distance of approximately 1.5 km between the EGL 3 and EGL 4 cables has been allowed for. At the landfall and nearshore approach (0-5 km from MHWS), the cables would converge and have a separation of approximately 150 - 200 m narrowing to 50 m at MHWS.

Cable configuration

4.4.64 The HVDC cables would each comprise two single core metallic conductors (one positive, one negative) and a fiber optic cable. The cables would be installed for each of the EGL3 Project and EGL 4 Project as a single bundle of two conductors and the fiber optic cable laid in a single trench. The configuration is shown in the **Plate 4-2.** Separation between EGL 3 Project and EGL 4 Project at the landfall specifically where they cross MHWS would be approximately 50 m between the ducts. As the cables approach the landfall the cables would be unbundled and each core passed through its own ducts. Four ducts in total would be installed at the landfall, two for the EGL 3 Project and two for EGL 4 Project.

Plate 4-2: Indicative configuration of cables within the trenches (for each of EGL 3 & EGL 4).

Bundled cables showing 2 conductors and fibre optic



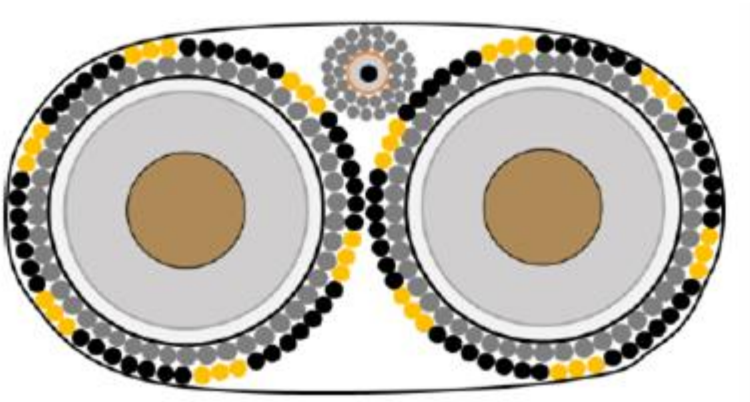
4.4.65 Cable lay vessels vary in carrying capacity from 5,000 up to approximately 28,000 tonnes. The vessel contracted to undertake the installation would determine the length of cable stored on the vessel and therefore the number of campaigns required to install the full length of cable. It is anticipated that approximately 80 – 100 km could be stored on the vessel. This would mean installing the cable system in a minimum of four sections, with each section connected by a joint. However, there could be up to 10 campaigns.

HVDC cable design

4.4.66 The cables would likely be cross linked polyethylene (XLPE). As illustrated in **Plate 4-3,** the cables would have a central core (comprising of aluminium or copper), protected by insulation and a lead sheath. Heavy steel wire is wound in a helical form around the cable as armour to protect the cable from external damage during construction and operation.

4.4.67 The cables would have a nominal voltage of 525 kV and typically have an outer diameter of 150 to 190 mm. The cables would be non-draining, containing no free liquid or gases that could be released into the marine environment even in the event of severe mechanical damage to the cables.

Plate 4-3: Example Illustration of bundled HVDC cable with fibre optic cable (illustration shows double wire armoured sheathing and is indicative only)



Fibre Optic cable design

4.4.68 One fiber optic cable would be required for each of EGL 3 and EGL 4 Projects. The fibre optic cables would not run through the entire length of the cables offshore, typically up to the first joint offshore from the landfall. The cable(s) would comprise a core of optical fibres, armoured with layers of steel wires, and sheathed with either a polypropylene or polyethylene material for outer protection. The outer diameter of the fibre optic cable would be expected to be between 20 mm and 30 mm.

4.4.69 The fibre optic cables would not include any repeaters and would not have an electrical current running through them.

Summary of the offshore draft Order Limits and cable parameters

4.4.70 Key aspects of the proposed English Offshore Scheme and parameters are summarised below in **Table 4-6**. Unless otherwise stated, the parameters are given for each of the EGL 3 Project and EGL 4 Project.

Table 4-6 – Rochdale Envelope – Cable corridor and cable configuration

Aspect	Parameter	Maximum Design Parameters
offshore draft Order Limits	Width	The EGL 3 Project and the EGL 4 Project have been assessed within a single draft Order Limits. Where the separation between the EGL 3 Project cables and EGL 4 Project cables is greater than 500 m, the English Offshore Scheme draft Order Limits is split and has separate corridors of 500 m minimum width. Where the

Aspect	Parameter	Maximum Design Parameters
		draft Order Limits for EGL 3 and EGL 4 are less than 500 m apart, this is shown as a single corridor and a separation distance of approximately 1.5 km between the EGL 3 and EGL 4 cables has been allowed for. The surveyed corridor for each project is 500 m wide but widens in certain sections to allow for future micro-routing around seabed features such as sand waves, challenging seabed conditions or sensitive habitats.
	Maximum Total length in English Waters	EGL 3 Project – ~ 436 km EGL 4 Project – ~ 425 km
HVDC Cables	Configuration	Bi pole One cable per pole
	Number	Two per project (two for the EGL 3 Project and two for EGL 4 Project)
	Joints	EGL 3 Project**:** Maximum 9 joints **(maximum 10 installation campaigns)** for the **full route** EGL 4 Project: Maximum 6 joints (**maximum 7 campaigns**) for the **full route**
	Outer Diameter	150 - 190 mm
Fibre Optic Cable	Number	1 per project
	Joints	To be determined based on the agreed installation solution. The EGL 3 Project and EGL 4 Project would not have a fibre optic cable running through the whole offshore route, only up to the first joint either end from landfall offshore. Joints and number of installation campaigns will be dependent on the selected Contractor’s agreed solution, which would determine the length of the fibre optic cable.
	Outer Diameter	20 - 30 mm
Cable trench	Number	1 per project
	Maximum Depth of trench	EGL 3 Project – 3 m EGL 4 Project – 4 m

Aspect	Parameter	Maximum Design Parameters
		Below seabed level
	Maximum trench width	5 m
	Disturbed area (from trenching)	20 m
	Maximum separation between trenches	The EGL 3 Project and EGL 4 Project would be at least 500 m apart, narrowing as they approach the landfall to 50 m as it crosses MHWS.
	Maximum width of external cable protection	15 m

4.5 Construction

Construction Programme

English Onshore Scheme

4.5.1 Subject to gaining development consent in 2028, it is anticipated that access and enabling works would commence in 2028 once pre-commencement DCO requirements are discharged, including site clearance activities, the installation of construction compounds and access roads. It is expected the main construction works would continue through to 2033 (approximately 6 years).

4.5.2 Reinstatement, comprising removal of construction haul roads, construction compounds, reinstatement of subsoil and topsoil and replacement of planting, would be required following construction. However, for specific components of the Projects and at specific locations along the cable route, reinstatement would overlap with the wider construction programme. It is currently envisaged that some reinstatement of temporary trackways could commence in late 2029/early 2030 once trenchless crossings had been installed. Reinstatement of land around the TJBs could also commence in 2030. Reinstatements works would be expected to continue through to 2034. Based on the currently available design information, the earliest in service date when EGL 3 and EGL 4 would be operational is Q4 2033.

4.5.3 The construction programme would be developed as the Projects progress and would take account of seasonal constraints such as protected species breeding or hibernation seasons.

4.5.4 The exact phasing of some activities would depend on the Contractor and detailed design, but the main construction activities for the English Onshore Scheme would typically include:

- preliminary works, including diversion of distribution network overhead lines;
- access road construction;

- site establishment;
- earthworks;
- civil engineering works;
- building works;
- cable installation;
- provision/ installation of permanent services;
- mechanical and electrical works;
- commissioning; and
- site reinstatement and landscape works.

4.5.5 The current indicative construction programme for the English Onshore Scheme is provided in **Table 4-7.** Further details on the phasing of the Projects will be set out within the ES.

Table 4-7 – Summary of indicative construction programme

Year	2028	2029	2030	2031	2032	2033	2034	2035
Converter stations								
Access and Enabling works								
Construction								
Underground Cable								
Access and Enabling works								
Cable installation and reinstatement works								
Substation and connection to NETS								
Access and Enabling works								
Construction and installation								
Commissioning								
Reinstatement works								
Testing and commissioning								
Final testing and commissioning								
Earliest in service date								
EGL 3 and 4 would be in service (operational)								
Reinstatement works								

English Offshore Scheme

4.5.6 The construction programme for the English Offshore Scheme is expected to take approximately 55 months, commencing in 2028 / 2029 for both the EGL 3 Project and EGL 4 Project.

4.5.7 Works at the landfall may commence in 2028 / 2029 with installation of the HDD and ducts ahead of the main works.

4.5.8 Flexibility is required in the construction programme in order to accommodate a range of uncertainties. This would include the time taken to undertake procurement activities, variable lead times for components and equipment, and variable task durations dependent on the suppliers, technologies and methodologies selected. This may be affected by factors such as supply chain bottlenecks as well as implementation of any required mitigation measures for environmental sensitivities or sensitive receptors.

Construction Scenarios

English Onshore Scheme

4.5.9 As noted in **Volume 1, Part 1, Chapter 1: Introduction**, the EGL 3 Project and the EGL 4 Project are two separate projects, however they will be part of the same DCO application and will be consented at the same time. Despite this, being separate projects, they would also have different construction contracts (and therefore, potentially different contractors) and as such, there is the potential for different construction timelines for both projects.

4.5.10 For the purposes of the EIA and to allow for reasonable worst case construction scenario to be assessed, construction scenarios for the English Onshore Scheme will be identified in the ES. At this stage, there is insufficient detail regarding the onshore construction programme to determine where differences in the construction programme between the EGL 3 Project and EGL 4 Project could occur. However, the scenarios will take into account the potential for:

- elements of both projects to be constructed at the same time (concurrent scenario); and
- elements of each project to be constructed one after the other (sequential scenario).

4.5.11 **Table 4-8** below outlines, at present, the current contract arrangements for the English Onshore Scheme.

Table 4-8 – English Onshore Scheme: Construction contract arrangements

English Onshore Scheme	Contract arrangement	Concurrent or sequential construction
Landfall: HDD works	Two contracts (one contract each per EGL 3 Project and EGL 4 Project).	Potential for either scenario

English Onshore Scheme	Contract arrangement	Concurrent or sequential construction
Onshore HVDC and HVAC cables (civils works): Installation of construction compounds, haul routes, excavation of cable trenches, TJBs and trenchless works (and reinstatement post construction), installation of cable ducts	One contract (combined) for the EGL 3 Project and EGL 4 Project.	Concurrent only
Onshore HVDC and HVAC cables (cable installation): Pulling of cables through ducts	Two contracts (one contract each per EGL 3 Project and EGL 4 Project).	Potential for either scenario
Converter stations	Two contracts (one contract each per EGL 3 Project and EGL 4 Project).	Potential for either scenario
Walpole B Substation and connection to NETS	One contract for the Walpole B Substation and connection to NETS.	Not applicable

4.5.12 The trenchless cable installation at the landfall for the EGL 3 Project and EGL 4 Project would take place in 2028 / 2029 ahead of the main offshore works and the onshore cable HVDC civil works would be under the same contract for both the EGL 3 Project and EGL 4 Project. Therefore, because some elements of the EGL 3 Project and EGL 4 Project would be undertaken under the same contract and early in the construction programme, there is no scenario where all elements for one project would be completed, a period of no activity would occur and then the other project would start construction.

English Offshore Scheme

4.5.13 The chart below provides an indicative programme for the English Offshore Scheme and presents a number of sequencing scenarios when offshore works would be expected to take place. The activity duration would depend on the final scope of works, cable installation method, vessels and equipment, and weather and operational downtime.

4.5.14 It is anticipated that the offshore construction works would be split into 4 to 10 campaigns each for the EGL 3 Project and EGL 4 Project:

- Landfall HDD preparation and installation.
- Route Preparation.
- Up to 10 cable lay and burial campaigns.

4.5.15 Preparation activities that would be required for the cable installation are listed below, along with indicative durations. Cable route preparation may be undertaken in one single campaign along the entire length of the cables within the English Offshore Schemes, or may be split and undertaken separately.

- pre-installation surveys;
- pre-construction unexploded ordnance (UXO) survey and identification (clearance excluded from the DCO); and
- cable route preparation, Pre-Lay Grapnel Run (PLGR), boulder clearance, pre-sweeping, infrastructure crossing preparation.

4.5.16 For the purposes of assessment, it has been assumed that there would be up to 10 cable lay and burial campaigns each for the EGL 3 Project and EGL 4 Project, each campaign covering approximately 60 to 150 km, depending on the cable lay and burial solution selected. The activities that would comprise the campaigns are listed below along with indicative durations.

- Pre-lay survey: 4 weeks – 30 weeks.
- Cable Installation: 10 weeks – 30 weeks.
- Jointing: 4 weeks – 30 weeks.
- Remedial external cable protection: 8 weeks – 30 weeks.
- Post lay survey: 4 weeks – 30 weeks.

Sequencing

4.5.17 The EGL 3 Project and EGL 4 Project would be distinct projects and likely be installed using different Cable Contractors, each with their own programme of installation activities.

4.5.18 The key permutations with regards to the programme and timetable for the installation of the English Offshore Scheme as shown in **Table 4-9** include:

- Construction of the EGL 3 and EGL 4 offshore projects may take place continuously or in phases, within a specified duration. This specified duration is referred to as a construction window.
- Construction start may only occur within a specified time period after consent would be achieved.
- If constructed at different times, either project may be first.
- The timescales for construction of the EGL 3 Project and EGL 4 Project are not linked. The first of the projects to be constructed will likely carry out onshore enabling works for the second project to reduce overall construction effort of both projects combined.

Table 4-9 – Indicative programme for the English Offshore Scheme

Parameter	EGL 3 Project	EGL 4 Project
Earliest construction starts (HDD)	At consent award (subject to discharge of DCO/deemed Marine Licence (DML) conditions)	At consent award (subject to discharge of DCO/DML conditions)

Parameter	EGL 3 Project	EGL 4 Project
Earliest construction starts offshore	2028	2028
Latest construction starts offshore	2031	2031
Offshore construction duration window	2028 - 2033	2028 - 2033
Latest construction finish offshore	2033	2033

4.5.19 Based on these programme parameters, the following overarching scenarios could occur for the construction of the English Offshore Scheme and have been considered in the assessment:

- Concurrent – The EGL 3 Project and EGL 4 Project are built together at the same time.
- Sequential – Construction of one project commences after the start of the other. This may result in projects overlapping or occurring in series.
- Enabling – Partial installation of some onshore elements for the second project takes place while constructing the first project, i.e., landfall HDD.

4.5.20 In all instances, the landfall trenchless solution would be installed for both of the EGL 3 and Projects ahead of the main offshore installation campaign. There is no scenario where one project would be completed, a period of no activity would occur, and then the other project would start construction.

4.5.21 For the landfall HDD works, the construction scenarios modelled are as described in **Table 4-10.**

Table 4-10 – Construction scenarios

Scenario	Summary	First construction phase (either EGL 3 Project or EGL 4 Project)	Second construction phase (either EGL 3 Project or EGL 4 Project)
Concurrent	2 projects constructed in parallel	Setup landfall works HDD activities Cable pull through Reinstate landfall	none
Sequential	1 project no-gap	Setup landfall works HDD activities	Cable pull through

Scenario	Summary	First construction phase (either EGL 3 Project or EGL 4 Project)	Second construction phase (either EGL 3 Project or EGL 4 Project)
	1 project	Cable pull through Reinstate landfall	Reinstate landfall
Enabling	1 project plus ducts no-gap 1 project	Setup landfall works HDD activities Cable pull through Reinstate landfall	Cable pull through

4.5.22 All three overarching scenarios have been considered in the PEIR. Dependant on the type of effect being assessed, each technical aspect chapter in **Volume 1, Part 3 English Offshore Scheme** has assessed the most appropriate worst case scenarios.

Construction Workforce

4.5.23 It is anticipated that the peak workforce for the English Onshore Scheme would be up to 1,140 workers. The peak workforce for the English Offshore Scheme workforce would be approximately >500 workers.

Construction Working Hours

4.5.24 The proposed construction working hours for the English Onshore Scheme would be:

- Monday – Friday: 07:00 – 19:00;
- Saturdays, Sundays and Bank Holidays: 08:00 – 17:00.

4.5.25 Exceptions to the above include but are not limited to:

- Continuous periods of operation such as concrete pouring, dewatering, cable pulling, cable jointing and drilling during the operation of a trenchless technique (e.g. HDD), installation and removal of conductors, pilot wires and associated protective netting across highways or public footpaths;
- Internal fitting out works within buildings associated with the onshore substations and converter stations;
- Delivery of abnormal loads that may cause congestion on the local road network (e.g. transformer delivery vehicles, cable drum delivery) or any other highway works requested by the highway authority to be undertaken on a Saturday, Sunday or Bank Holiday outside of core working hours;
- Testing or commissioning;
- Completion of construction activities commenced during the approved working hours, which cannot safely be stopped;

- Activities necessary in the instance of an emergency where there is a risk to persons, delivery of electricity or property; and
- Survey works.

4.5.26 For the English Offshore Scheme, including the HDD trenchless crossing at landfall, construction would be a 24-hour operation to minimise overall installation time, maximise the use of suitable weather windows and take advantage of vessel and equipment availability.

4.5.27 In order for the elements of the English Onshore Scheme to be constructed, enabling works would be required such as the establishment of construction compounds, temporary bellmouths and access tracks and drainage works. The enabling works would be consistent across all elements of the English Onshore Scheme and have therefore been described once below rather than for each individual element.

English Onshore Scheme Enabling Works

4.5.28 The following construction methods relate to temporary components of the installation process which would be required to facilitate the construction and installation of the permanent assets. Termed ‘enabling works’, these would be removed upon completion of construction and commissioning of the system. The activities outlined below apply to all of the permanent assets, i.e. the landfall, underground cables, Walpole converter stations and the Walpole B Substation. Where enabling works are specific to the landfall and Walpole converter station (and Walpole B Substation), these are outlined within the relevant sub-sections under **English Onshore Scheme Construction Activities** below**.**

Haul Road

4.5.29 Primary access to the construction sites (including the cable working width) would be from the existing road network. However, existing accesses from public highways may need to be widened, due to the size of the construction vehicles. Where there is no opportunity to utilise existing access from public highways, temporary new access tracks (including culverts and bridges) from the existing road network may be required, given the nature of works required and plant to be used. These would be connected to the haul roads that are located adjacent to the construction areas. Construction haul roads are often required to facilitate access and construction of the cable route, and to provide a stable platform on which to store or manoeuvre materials. There are a number of different options available including temporary track way, stone roads and soil stabilisation. The Contractor would choose which option is preferred based on which solution is most suited for the particular works being undertaken. Track way is often more efficient where limited access is required, whereas stone roads or soil stabilisation typically provide a more effective solution for heavily trafficked areas.

4.5.30 Track way consists of metal or plastic panels that interlink and or overlap to create a running surface, they are quick to install and remove but are expensive and can suffer from settlement if trafficked over a longer period or with very heavy vehicles.

4.5.31 Stone haul roads would be constructed of an unbound stone material bedded on a separation membrane and polymer-based geogrid reinforcement. The separation membrane would serve to prevent ingress into the underlying ground (subgrade) and to aid removal upon completion of the works. The reinforcement layer would provide additional mechanical stability, significantly reducing the overall road (pavement) thickness and the associated volume of imported material required. These are overlain by a layer of stone, placed, and compacted in layers, up to the required thickness and/or finished surface level. Two layers of different stone types may be used if the design dictates (capping and subbase design).

4.5.32 Soil stabilisation may be used to give a similar performance to a stone road, by chemically strengthening the existing soils. The chemical admixtures are site specific and depend on the chemical composition of the existing ground. Following topsoil removal, the subsoil is mixed with the chemical admixtures and compacted to create the haul road. Soil stabilisation can be combined with a stone layer or be used in isolation, depending on the traffic requirements and ground conditions.

4.5.33 In most scenarios, the topsoil is first stripped from the working width, exposing the underlying ground (subgrade), and is stored adjacent to the works. The exposed ground is then excavated to the required formation level and tested for strength. Where soft grounds are encountered, further excavation would be undertaken until a stable subgrade is reached.

4.5.34 The ultimate thickness of the haul road is determined by the subgrade strength, vehicle type and vehicle numbers. A soft subgrade would dictate a thicker construction than a stronger subgrade. The haul road width is envisaged to be 7 m, to allow for passing vehicles and topography, although this may extend in limited areas to provide turning for Heavy Goods Vehicles (HGVs) and construction plant.

4.5.35 The haul road may be installed above existing ground level to aid drainage, however subject to the Flood Risk Assessment (FRA) to mitigate against potential flooding, perpendicular cross drains may be installed beneath the haul road to allow water to flow across the road. Alternatively, the road could be installed at or near grade to prevent it acting as a barrier to surface water runoff.

4.5.36 To prevent overland greenfield flows from crossing the haul road, header drains would be installed along the working width to intercept clean surface water runoff and prevent the haul road from becoming silty. The header drains would run parallel to the haul roads and discharge into the nearest watercourse or dispersion point along the route with intermittent check dams and other appropriate measures to control the quality and flow rate of the runoff.

4.5.37 It is likely that filter drains or swales would be used alongside the haul road. They collect runoff from the haul road and discharge into various ponds. The design would include pollution control measures such as check dams, and the Contractor would implement suitable mitigation measures to manage the risk along the route.

4.5.38 The access tracks and working areas along the cable route would be removed and the ground reinstated by removing stone and trackways. All topsoil stripped within the construction areas would be retained and used during reinstatement. Where suitable, sub soil would be retained and used to backfill the trenches. It is recognised that there may be excess sub soil following reinstatement. Any excess sub soil would either be retained for use on site, such as for landscaping or removed from site. Other surfaces would be reinstated and widened accesses would be restored to the condition they were in at the commencement of the works.

4.5.39 An Outline Code of Construction Practice (Outline CoCP) and an Outline Construction Traffic Management Plan (Outline CTMP) will be developed for the English Onshore Scheme for DCO submission which will outline the modes of transport proposed for the delivery of construction materials, plant, the construction workforce and the removal of waste materials. The aim of the Outline CTMP will be to reduce and manage HGV and road traffic movements generated by the English Onshore Scheme where practical and possible. An Outline Public Rights of Way management plan (Outline PRoWMP) will also be developed for DCO submission, setting out any temporary and permanent diversions of PRoW.

Bellmouth junctions

4.5.40 Sizing of the bellmouths would be in accordance with the relevant design guidance and the vehicles required to access/egress the Site. Visibility requirements would dictate where the bellmouths can be positioned. The installation of bellmouths may require realignment of existing overhead or underground services, and clearance works along visibility splays to create a line of sight for the safe use of the junction. Visibility splays would need to be maintained throughout the duration of construction.

4.5.41 Normally, traffic management measures and/or a reduced speed limit would be required to safely manage the interaction between works traffic and the public highway at bellmouths, particularly where visibility may be limited. It is sometimes necessary to alter or upgrade elements of the public highway for similar reasons.

4.5.42 Following top-soil stripping, the subbase would be compacted in layers prior to the running surface being laid. To provide better longevity from turning vehicles, particularly articulated HGVs, the finished surface would normally be constructed of a bituminous material or concrete. Existing pavement material may be removed at the interface between the existing highway in order to join the two constructions and prevent degradation during use. Road signs, site demarcation and linework would be installed in accordance with the relevant highway design to provide a safe environment for road users and construction traffic. Finally, fencing is erected surrounding the site and gates installed, usually setback approximately 15 – 20 m from the highway to allow vehicles to stop clear of passing traffic.

4.5.43 Subject to ground conditions, runoff from bellmouths would typically be attenuated via attenuation basins at the adjoining section of the haul road with a controlled discharge to the nearest watercourse or drainage ditch. Attenuation may take the form of linear ditches with check dams.

Temporary Culverts

4.5.44 Temporary culverts would require where the construction haul road crosses existing watercourses, i.e., ditches, field drains, dykes and small rivers. Culverts would be in place for the duration of the works and removed upon completion. The type and size of culvert is dependent upon the size and the ecological and hydrological properties of the ditch. Typical culvert types include concrete pipes, plastic (twin wall) pipes and pre-cast concrete modular units (box or portal culverts). Each culvert type has slightly varying and specific methods of installation, but the key stages are described below.

4.5.45 Following ecological surveys (and watching briefs, subject to requirements), the crossing location would firstly be cleared of vegetation and any bankside furniture removed. Bunds would then be installed upstream and downstream of the crossing location to prevent the ingress of water to the excavation. A series of pumps and pipes would then be installed to transfer the flow of water from the upstream side to the downstream side, bypassing the worksite.

4.5.46 Once the worksite is sufficiently dewatered, the bed of the watercourse would be excavated to the required depth. Generally, this is to a depth such that the pipe or culvert invert is at bed level once placed on the required thickness of bedding. A geotextile separation membrane would be placed into the excavated trench followed by bedding material, placed, and compacted to the required depth and gradient. The pipe or culvert sections would then be lifted into the trench and jointed. Further material would be placed around and above the pipe/culvert and compacted to a level required to provide adequate protection from traffic. A prefabricated concrete or concrete bag headwall and temporary fencing would subsequently be installed around the culvert followed by the haul road construction. Upon completion, the temporary bunds and pumps would be removed, allowing water to flow freely through the newly laid culvert sections.

4.5.47 As an alternative to traditional culverts, portal culverts could be proposed as it reduces adverse ecological impacts on the watercourse. The abutments would be installed in a way that they would not reduce the flow area/width of the watercourse and therefore would not interfere with the watercourse flow.

4.5.48 To prevent any mud and debris entering the water course from the haul road, straw bales or sandbags should be placed along the haul road. This would reduce the risk of silty water running off and contaminating the water course below.

Temporary bridges

4.5.49 At main rivers, bridges would be required, and also in locations where the watercourses are large and a culvert solution is not reasonably practicable, or where specified by the relevant stakeholder. These would be temporary or permanent depending on whether they would be on the temporary haul road network or along one of the permanent accesses. Access to both sides of the bridge location would be required using mobilisation accesses to undertake vegetation clearance and foundation and abutment construction, the primary access would then be used to bring in elements of the bridge deck which would be lifted into place using a mobile crane.

Construction compounds

4.5.50 Temporary construction compounds and laydown areas would be set up at strategic locations along the alignment, with associated access points from the existing road network where practical. These compounds store all materials necessary for the works, including plant, waste, cable ducts, cable drums and accessories. In addition to storage, compounds also provide a location for site offices and welfare facilities for construction operatives. For the English Onshore Scheme, it is assumed for the purposes of this PEIR that construction compounds would be required at the following locations within the draft Order Limits:

- Along the HVDC / HVAC cables route;
- Landfall;
- Walpole converter stations; and
- Walpole B Substation.

4.5.51 It is assumed that laydown areas will be required within the Walpole area for the duration of the construction works. The following areas have been identified as potential laydown areas:

- Land to the north of the existing Port of Sutton Bridge
- Land to the north and west of Centenary Way and south of Chalk Lane

- Land to the south of Gunthorpe Road within the development zone identified for River Nene temporary quay (as identified on **Volume 3, Part 1, Figures 4-1 to 4-4**).

4.5.52 **Volume 3, Part 1, Figure 4-1 to 4-4 (Sheet 1 only) and Figure 4-5** show the field boundaries within which temporary construction compounds are anticipated to be located. The exact location where the construction compounds may be located within these fields is not known at this stage; this decision will be subject to further environmental and engineering studies and will be decided at the detailed design stage. To allow for a reasonable worst-case assessment to be undertaken, the EIA for the PEIR have assumed that the location of the construction compound would be within an area of the field that has the potential to cause the comparatively most adverse impact on a particular receptor, when compared to alternative locations within the same field. In most instances, the assumption is that the construction compound would be located at the field boundary, closest to the sensitive receptor being assessed.

4.5.53 Compound locations have been identified considering a number of constraints and opportunities. These include the existing environmental sensitive features and receptors, and technical opportunities such as accessibility for HGVs and access to existing services. It is recognised that the importation of material would be required to provide hardstanding if suitable material is not already in place.

4.5.54 Construction would begin by securely fencing the site. The specification and construction of fences would depend on factors such as the level of security required and the degree of visual impact. Lighting of construction compounds would be designed to limit light pollution to the surrounding area.

4.5.55 Topsoil would be removed (stripped) and stored in bunds adjacent to the site. Once soil stripping has been completed, the compound area is would be excavated to the required formation level and the associated material either stored in the same manner or removed offsite. The formation level would be determined by the pavement thickness applicable to the individual ground conditions at each location. Where existing ground conditions are poor, the pavement layer would be thicker, and consequently a greater volume of excavation would be required.

4.5.56 Once excavation has been completed, a geotextile layer would be laid followed by compacted layers of stone in the same manner as the haul road construction. The majority of the compound would be left as natural stone, however, car parks may be surfaced with a bituminous surface layer to prevent damage to road-going vehicles, such as cars and vans. Alternatively, soil stabilisation may be employed, where the existing ground is chemically strengthened, allowing the volume of imported stone to be reduced. Soil stabilisation would normally be undertaken by specialist contractors, with the stabilisation reversed following completion of the works.

4.5.57 The construction compounds would generally comprise of temporary cabins or modular style units that would be positioned to maximise construction space and limit the area of land take required. Such units would be used for the purposes of site management activities and also provide welfare accommodation for the construction workforce. As well as this, the construction compounds would provide distinct laydown areas for the storage of construction plant and the delivery and removal of materials. Compounds may also be used for the stockpiling of materials to facilitate their transfer to and from the construction working area. Storage areas within a construction compound should sit away from sensitive receptors, at least 10 m from a watercourse or a drain. Defined areas for staff parking would also be provided as part of the construction compound. Details of the drainage measures which would be employed at the construction compounds are provided in **Paragraph 4.5.63.**

4.5.58 Compounds would comprise a mix of satellite and main compounds for the underground cable installations and main compounds for the substation and converter stations; approximate dimensions are provided in **Table 4-11** below. Satellite compounds are smaller compounds with storage and laydown areas but unlike main compounds would not include offices.

4.5.59 All compound areas would be reinstated as soon as reasonably practicable after completion of the construction works and demobilisation.

4.5.60 A typical construction compound, which the cable, converter stations and substation compounds would likely to resemble, is shown on **Plate 4-4.**

Plate 4-4:Typical construction compound

Table 4-11 – Rochdale Envelope – Construction Compounds

Parameter	Maximum Design Parameter
Typical construction compound element heights*	
Single storey site cabin (height)	2.6 m
Two storey site cabin (height)	5.2 m
Small crane (height)	54 m
Medium crane (height)	76 m
Large crane (height)	120 m
Concrete batching plant (height)	7.1 m
Lighting mast (height)	8 – 10 m
Soil bund (height)	2.5 m
Fencing (height)	2 – 3 m
Underground cable installation (AC / DC)	

Parameter	Maximum Design Parameter
Typical footprint of construction compound for cables (main compound)	Construction compounds and other working areas for installation of DC and AC cables would be required at various locations along the length of route. Approximately 150 m by 150 m (2.25 ha).
HVDC typical trenchless crossing (terrestrial) construction compound	Approximately 35 m by 60 m (0.21 ha).
HVAC typical trenchless crossing (terrestrial) construction compound	Approximately 35 m by 140 m (0.49 ha).
Converter station/s main compound	
Footprint	One construction compound for each converter station of approximately 200 m by 200 m (4 ha).
Walpole B Substation main compound	
Footprint	Approximately 300 m by 150 m (5.25 ha).
Anderby Creek Landfall main compound	
Footprint	Approximately 150 m by 150 m (2.25 ha).

*All element heights are approximate and subject to Contractor requirements

English Onshore Scheme Construction Activities

Walpole Converter Stations

Enabling works and earthworks

4.5.61 Construction of the Walpole converter stations would commence with site establishment, involving demarcation of the site, stripping of topsoil, establishment of the construction compound (see **Paragraph 4.5.50** to **4.5.60**) and erection of temporary facilities, i.e., site offices, storage areas and hardstands. Bellmouths (see **Paragraphs 4.5.40** to **4.5.43**) and access roads (see **Paragraph 4.5.29**) would also be constructed at this stage to ensure prior access from the highway network for construction traffic.

4.5.62 Earthworks would begin upon completion of site establishment, involving levelling of the site and creation of the necessary levels or benching according to the topography and to prevent flooding. Due to the ground conditions being poor in the site area, ground improvement would likely be required as part of these works. The type of ground improvement works that would be required is subject to a ground investigation and a ground improvement design but could involve rigid inclusions (Controlled Modulus Columns) / Prefabricated Vertical Drains. Landscaping involving earth bunds may also be completed at this stage to improve the visual impact of the converter station once built. Once initial earthworks have been completed, all drainage should be installed to prevent any flooding during the construction stage before the formation levels of the converter station site would be created, by importing and compacting sub-base materials.

Utilities and drainage

4.5.63 Drainage works would be undertaken on the site, including diversions of existing watercourses, installation of new stormwater and foul water drainage, and construction of any interceptor tanks and/or attenuation/infiltration ponds.

4.5.64 Third party utility connections to the site would be established, including, water, foul, communications, and power, as required. Specific easements would be utilised for each of the assets within the converter station (or substation) boundary. Requirements for each asset would need to be agreed with each of the third-party utility providers.

4.5.65 All drainage for the proposed converter stations (and substation) and construction compounds would be installed at the initial stage of the construction phase to avoid any flooding during construction. Where groundwater is elevated, lining of the attenuation ponds with an impermeable liner may be necessary to mitigate groundwater ingress, and anchoring of the liner may be required to manage buoyancy. Some of the attenuation basins may need to be formed above the ground level and pumped into this due to the anticipated high-water table and flat topography.

4.5.66 The site earth mat would be installed at an early stage, with requirements set out based on the high voltage arrangement, electrical requirements, and local ground conditions of each site. The main earth grid is typically installed 500 mm below ground and is therefore installed at an early stage with earthworks and utility installation. Final earth mat connections would be completed once equipment has been installed on site.

Foundations

4.5.67 Foundation requirements would be location specific and dependent on the geology of the area and function of the foundation. The use of piling could be required due to the settlement criteria of the electrical equipment within high voltage converter stations (and substations).

4.5.68 The installation of foundations would typically be completed in parallel to the utilities and drainage works due to the interfaces. Foundations supporting high voltage equipment may require significant ducting and fixings to be suitable for the function of the high voltage equipment.

4.5.69 Early studies suggest a likely combination of ground improvement works and piling would be required, with the majority of structures requiring piled foundations. Ground improvement may provide a suitable solution across wider areas of the platform as noted in **Paragraph 4.5.62.**

Construction and installation of the Walpole converter stations

4.5.70 Once the above works have been fully completed, erection of the converter halls and supporting buildings could begin. Buildings typically comprise of steel frames, craned into place, fixed and clad with composite materials.

4.5.71 The materials and cladding used in converter station (and substation) environments are typically simplistic, utilising greys and greens to blend into the surroundings. Exact specifications vary depending on location and stakeholder engagement. The infrastructure that would be required for the Walpole converter stations is outlined in **Section 4.4** above. To summarise, the platform dimension for each converter station would be approximately 350 m x 250 m, comprising an area of approximately 8.8 ha and housing specialised electrical equipment. The height of the tallest buildings would be up to 30 m, excluding the need for additional platform raising to allow for flood risk protection and surface water drainage. Additional space would be required for landscaping, drainage and access requirements.

River Nene Temporary Quay

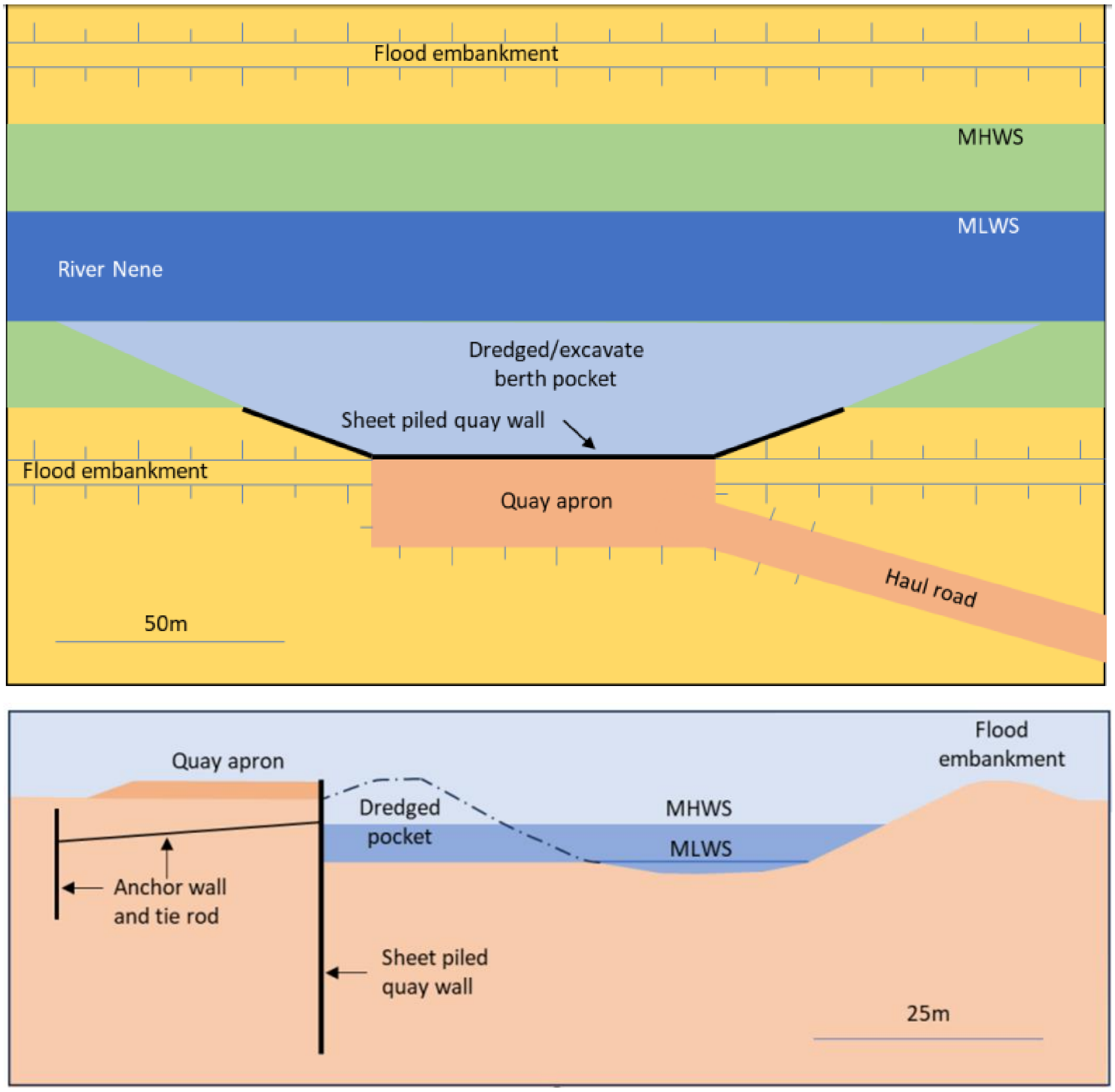
4.5.72 There is an opportunity to use the River Nene to receive the transformer unit needed for the converter stations and other construction materials. The transformer unit and construction materials would be delivered to an existing port (which will be identified at detailed design stage if this option is taken forward) along the River Nene and stockpiled within the draft Order Limits. From the port, there are two methods by which materials could be transported to the Indicative zone for converter stations i.e., by HGVs utilising existing highways and new access roads, or by barges to a newly developed temporary quay along the River Nene. From the temporary quay, materials would be transported to the Indicative zone for converter stations by utilising the HVDC underground cables haul road which would already be established. Indicative sizes for the River Nene temporary quay is provided in **Plate 4-5.**

4.5.73 A temporary quay wall would be offset from the river channel to allow barge unloading and transit of coasters. Offsetting the quay wall from the channel would require the existing flood defence line to also be set-back. For the purpose of assessment within this PEIR, it is assumed that the temporary quay would be constructed and removed whilst maintaining the flood protection. The river bank and flood protection would be reinstated when the temporary quay is removed. The temporary quay wall is anticipated to be a tied sheet piled wall with a concrete capping beam.

4.5.74 The alignment of the quay wall would be parallel to the main channel to avoid operational conflicts with other river traffic. Each end of the temporary wall would be angled into the existing river bank to limit turbulence with associated areas of scour and deposition.

4.5.75 A temporary quay apron would be constructed (see **Plate** 4-5**)** and would accommodate a crane or long reach excavator to transfer materials between the barge and the temporary quay. Construction of this would include removal of soft material, construction up to formation with granular fill and creation of a working platform with capping or sub-base graded granular material. This would be a permeable surface and would not require formal drainage. A standing area for construction plant would be provided to contain oil drips in accordance with the standard construction practices.

Plate 4-5: Illustration of a temporary quay



Anderby Creek Landfall

Construction and Installation at the landfall

4.5.76 An area larger than that required for the permanent area of the TJB would be required temporarily during its construction and installation to accommodate temporary construction equipment and storage areas. A description of the offshore elements of the landfall is provided below in **Paragraphs 4.5.165** to **4.5.178**.

4.5.77 A temporary construction compound, which would extend approximately 150 m by 150 m (2.25 ha), would be required to construct the landfall and the TJB. The temporary compound would contain all necessary plant and equipment, plus parking and welfare facilities required. Once installation of the TJB and all construction works is completed the land would be reinstated to pre-existing conditions (but at a higher elevation due to the raised platform); the only infrastructure visible on the surface (on otherwise fully reinstated land), refer to **Plate 4-6** as an example of a TJB raised platform at Triton Knoll) would be the cover of the link box pit.

Plate 4-6: Illustration of a TJB raised platform

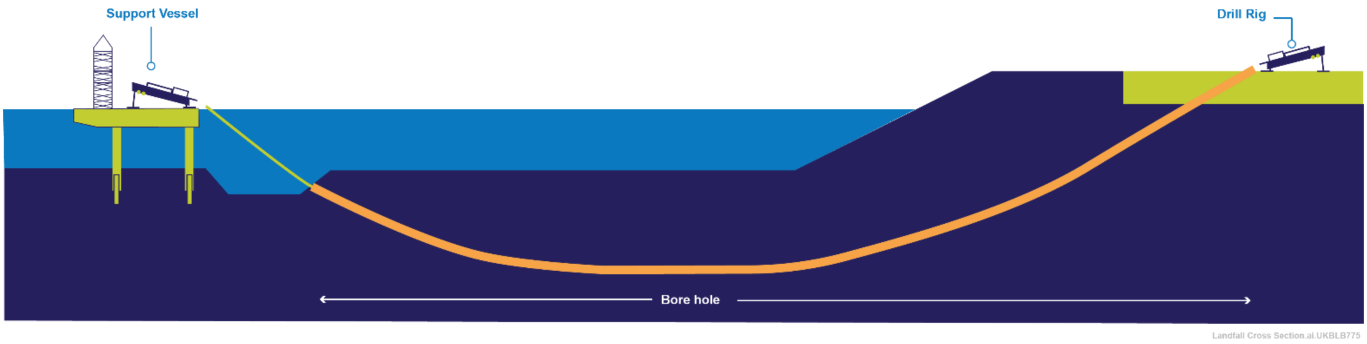
4.5.78 Installation of the DC cables at the landfall between Onshore and Offshore environments would be achieved utilising trenchless methods to minimise disruption and avoid direct impacts to the intertidal zone. The exact trenchless method is subject to further detailed design considering the results of ground investigation; however, the most likely installation technique would be HDD whereby a tunnel is drilled under a constraint (such as a watercourse, environmentally sensitive area or other infrastructure) and a pipeline or cable is pulled through the drilled underground tunnel. Further details of trenchless techniques, including HDD, are provided within the Underground HVDC Cables section below, **Paragraphs 4.5.87** and **Paragraph 4.5.95 - 4.5.101,** respectively.

4.5.79 At the landfall, HDD or similar trenchless technique would be utilised to install a duct for each subsea cable between the TJB, passing beneath the sea defences and the punch-out point in the Offshore environment beyond the MLWS. Four ducts would be installed for both the EGL 3 Project and the EGL 4 Project between the TJB, which is located behind the dune system above the Mean High-Water Spring (MHWS) mark to a point below 0 m Lowest Astronomical Tide (LAT). Further information on the cable configuration is provided in **Paragraph 4.4.64**, and a detailed description of the landfall HDD operation is provided in **Paragraphs 4.5.165** to **4.5.178**. The punch-out point from the HDD would subject to the appointed Contractor(s) final design and dependent on the ground conditions and depth of the cable needed to be achieved to ensure suitable protection, however it is anticipated to be 1.6 km and would exit the seabed between 0 m and 8 m LAT .

4.5.80 The subsea cables would be pulled through the installed ducts and joined to the underground onshore DC cables at the TJB. An indicative cross section of the HDD at the landfall is provided in **Plate 4-7**.

4.5.81 Onshore access to the landfall would likely to be via a temporary access track from the existing road network. Onshore construction activities within the landfall would include compound construction, site mobilisation, site operations, materials deliveries, cable pull-in, site demobilisation and site reinstatement. Anticipated construction vehicles would include HGVs, light goods vehicles (LGVs), vans and cars. AIL movements would be required to allow cable delivery to the landfall.

Plate 4-7: Indicative landfall cross section



Underground HVDC Cables

Construction sequence

4.5.82 The cable installation would likely be following a construction sequence comprising:

1. Site surveys – including ecological, archaeological, UXO, highways;
2. Initial enabling works:
    a. Vegetation clearance/topsoil strip;
    b. Construction of access junctions (bellmouths);
    c. Installation of demarcation fencing and diversion of Public Rights of Way;
3. Establishment of construction compounds including site facilities;
4. Haul road installation, including temporary culverts, bridges, and diversions;
5. Ducted and trenchless crossings in advance of main works;
6. Cable trench installation, including ducts where used, and construction of joint bays;
7. Cable pulling (installation);
8. Cable jointing and terminations;
9. Testing and commissioning; and
10. Decommissioning of all site works. Restoration of the site to the original condition.

4.5.83 Subject to agreement, the Contractor may make the decision to reinstate certain areas of the English Onshore Scheme early. These areas could potentially be handed back to the landowner at this stage.

Construction and Installation of the HVDC Cables

4.5.84 The typical DC working width required for the construction and installation of the DC cables, including for temporary haul roads, soil storage and drainage, would be approximately 76 m in total. This is described in this PEIR as the ‘working width’. The working width may widen at crossing locations, particularly where trenchless crossings (see **Paragraphs 4.5.87** and **Paragraph 4.5.95 - 4.5.101** for further details) would be required. The working width is demarcated by a post and rail fence and would typically comprise:

- storage areas for topsoil and subsoil stripped from the working width;
- drainage measures, such as:
  - installation of drainage filter drains for the capture of water within the working width;
- installation of filter drains/swales to intercept the runoff entering the site from the adjacent ground, as this creates additional polluted waste;
- temporary haul road, typically 7 m in width, for the movement of installation traffic;
- excavation of the cable trench / trenches to a minimum depth of 900 mm (to the cable protective tiles) and approximate width of 1.4 m (for each cable trench);
- storage areas for excavated material in preparation for its return, if suitable;
- security fencing;
- additional space requirements at joint bays and sites of potential engineering difficulty;
- tolerance to adjust the positional location of the cable route corridor and its components to practicably accommodate the unexpected; and
- other mitigation measures as necessary.

4.5.85 In addition to the working width, cable construction and installation would require temporary construction facilities to be established at various locations along the route. This includes temporary access to the working width, drainage and temporary compounds for storage, lay-down and site offices.

4.5.86 The exact methods for cable installation would depend on the final cable route and constraints which are present. The general types of physical constraint identified along the cable route are:

- main rivers, water courses, and ditches;
- major road crossings;
- railway crossings;
- crossings of existing underground utilities (gas/water pipes, telecommunication, electrical cables, etc.); and
- areas of important environmental significance i.e. internationally designated ecological sites.

4.5.87 An overview of typical cable installation techniques and the activities they would involve is outlined below. Further explanation of the cable installation techniques most likely to be utilised by the English Onshore Scheme are also provided under the relevant headings below.

- **Open cut/direct buried**: this is where a trench is excavated, and the underground cables laid directly into a single trench typically 1.4 m wide unless ground conditions or constraints dictate otherwise, as described above. The trench would then be backfilled using a combination of excavated soils and thermally suitable material (such as CBS) and the land reinstated. Further information regarding the measures that would be undertaken to reinstate land and soils is provided in **Volume 1, Part 2, Chapter 11: Agriculture and Soils**. Two trenches are required for the English Onshore Scheme, one for the EGL 3 Project and one for the EGL 4 Project.

- **Open cut/ducted** - This installation method is largely the same as per the process for open cut/direct buried. The main difference is that ducts are laid in the trench, and the underground cables are then pulled through the ducts. This installation method allows for the ducts to be laid, and the majority of the trench reinstated without the underground cables being present. Cable joint bays would need to remain open as they would be utilised to pull the underground cable through the pre-installed ducts and join the sections of underground cables together. Following underground cable installation, the land would be reinstated. Open cut ducted methods will be employed for the majority of the cable route; further details are provided in **Paragraph 4.5.90 - 4.5.94** below**.**
- **Trenchless methods** such as HDD or micro tunnelling/pipejacking: these are used where specific features are encountered, such as main rivers, major roads, railway lines, flood defences or other significant infrastructure, need to be crossed. Where HDD is not technically viable, then a tunnelled (micro tunnelling/pipejacking) solution can be considered. In determining the most appropriate trenchless technique for installing DC cables, NGET would need to ensure the electrical performance of the DC cables is not compromised.
  - HDD involves the use of a drill to bore a route below the ground through which ducts would be pulled and cables installed. For the English Onshore Scheme, HDD is the preferred trenchless installation method and as such further details are provided in **Paragraph 4.5.95 - 4.5.101**, respectively.
  - Micro tunnelling/Pipejacking is a technique for installing underground ducts and uses hydraulic jacks to push specially designed pipes through the ground behind a shield at the same time as excavation is taking place within the shield, cables are then installed in the pipes.
  - Direct Pipe is a more recent method of installing pipelines which combines pipe jacking and HDD technology. A slurry supported micro tunnelling machine is used to drill the hole while installing a steel pipe. From the launch pit, a pipe thruster pushes the pipe and the tunnelling machine into the ground. Pipe sections are welded to previous sections on the surface while being pushed in, therefore the size of the construction site can be kept as small as the length of the pipe sections. A carrier pipe or pipes may be inserted within the steel pipe.
  - E-Power Pipe is an emerging trenchless crossing technology which takes on some of the best aspects of HDD, Direct Pipe and pipe jacking. The method relies on a two-stage process. From a shallow launch shaft, a pilot hole is drilled. This hole is drilled using an Automated Slurry Boring micro-tunnelling machine, which is a closed, full face excavation machine using a hydraulic slurry circuit. This machine is pushed through the ground using temporary steel jacking pipes, which carry the slurry circuit, power supply and data transmission system. Once the pilot hole is drilled, the TBM is removed, and a pull-head is attached to the drill string. A prefabricated pipe that will form the permanent pipeline is attached and pulled back through the borehole. As the pipe is pulled back, the overcut between the pipe and the borehole is backfilled with material. The material injection is pressure and volume controlled, maintaining mechanical support of the borehole during the entire process.

Cable joint bays

4.5.88 Limitations on the maximum length of cable that can be manufactured and delivered to site mean that cable joints would be required at regular intervals along the length of the route, approximately every 800 m to 1.5 km. At these locations, the individual cable lengths would be mechanically joined in oversized trenches known as ‘joint bays’. Joint bay sizes would be determined by the cable joint accessories, the area required for jointing works and the environment in which they are installed. Sizes may vary throughout the route, though typically, this would be approximately 12 m in length and approximately 4 m in width.

4.5.89 Cable joint bays must be clean and dry so temporary covers would be erected at jointing locations, as shown in **Plate 4-8**. Due to the precise nature of engineering employed, cable joint bays could remain open for several weeks to allow for trench and joint bay excavation, cable pulling, jointing and reinstatement.

Plate 4-8: Cable joint bay

Open cut ducted

4.5.90 Where conditions allow DC cables are typically installed using open cut methods. Open cut methods are generally preferred as they enable DC cables to be installed at more technically efficient depths. Open cut methods are also generally more economical and often require a smaller construction footprint than trenchless methods.

4.5.91 Where technically feasible, and unless other environmental and infrastructure features and considerations determine otherwise, the underground cable system would be predominantly open-cut ducted. The cables would be pulled through plastic ducts pre-installed at the required depth below ground. Where direct burial of cables is required, the excavated trench would be left open until the cables are pulled in, this has a greater impact on land owners and exposes the open trench to a greater risk due to bad weather given the extended nature of the open excavation. Due to these risks, a ducted installation would be used with the exception of specific locations on the cable route where direct buried cables may be required (e.g. in close proximity to the converter stations or Walpole B substation or entry to Trenchless Crossings).

4.5.92 For a ducted installation, the cable trench would first be excavated to a minimum depth of 900 m (below the surface of the ground to the top of the cable protective tiles).

However, the depth of the cables would vary, subject to the outcome of soil ALC, agricultural land drainage, engineering and ground investigation surveys. Where justified, cables may be laid deeper.

4.5.93 The width of the cable trench would be approximately 1.4 m (unless physical constraints dictate otherwise). To provide protection to the operatives, trench supports would be installed, or the trench would be battered (sloped) back to eliminate the risk of collapse. Where required, a separation membrane would be placed in the base of the trench and the first layer of thermally suitable cable surround (such as CBS) installed to the prescribed depth/thickness. The plastic ducts would be laid within the trench and surrounded by CBS or similar thermally suitable material surround. The CBS or equivalent material would be covered with protection tiles and the remainder of the excavation would be backfilled with a thermally suitable material (including warning tape) installed 100 mm above the protective tiles. The ground surface would be reinstated to the original condition and level or as agreed with the landowner.

4.5.94 Where specific environmental or infrastructure features preclude the use of open cut methods, use of trenchless methods such as HDD would be used. The depth of installation would be deeper at locations where trenchless installation methods are used.

Trenchless Crossings

4.5.95 Trenchless crossings (such as HDD) would typically be utilised where significant obstacles such as major watercourses, roads, railway lines, flood defences or other utilities need to be crossed, and open cutting is not considered a suitable option.

4.5.96 Where a constraint is required to be crossed using a trenchless method, there are a number of methods that could be employed depending on the ground conditions and detailed design. For the English Onshore Scheme, HDD would be the preferred trenchless installation method. However, the final decision on the implemented technology will be subject to detailed ground investigation and the encountered on-site conditions.

4.5.97 The process of HDD comprises of three main stages: the pilot bore, reaming and finished pipe installation. See **Plate 4-9** for illustration. Firstly, temporary construction compounds would be established at either end of the desired crossing, termed launch and reception areas, to locate the drilling equipment, store materials and undertake pipe stringing.

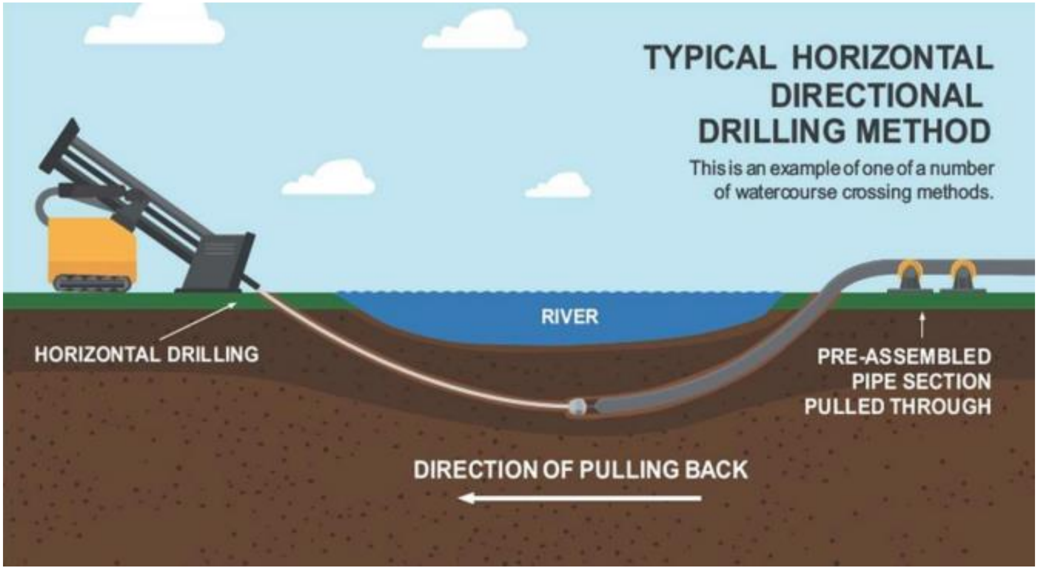
4.5.98 At both sites, a pit would be excavated to provide a smooth entry and exit (approximately 12 degrees) and to aid the collection of fluid returns from the drilling works. Drilling would commence by pushing a cutting head connected to sections of rigid drill pipe on a defined path towards the reception pit. A mechanism of tracking the drill head and controlling the angle at which it progresses would allow the direction to be determined by the operator. A mixture of water and bentonite clay would be continually pumped through the cutting head to assist the removal of cuttings and stabilise the bore. The pilot bore process is complete when the cutting head surfaces at the reception pit location.

4.5.99 A larger diameter cutting tool would then be affixed to the nose of the pilot bore cutting head and pulled in reverse back through the newly excavated pilot bore. The process would be repeated with successively larger reaming tools as required until the desired diameter is achieved. A final pass, known as a ‘swab pass’, would be undertaken using a reamer of larger diameter than the final pipe installation. Throughout the process of reaming, drilling fluid would be continually pumped through, entraining the soil and aiding removal.

4.5.100 The final stage concerns the installation of the finished pipe. In a process known as pipe stringing, sections of pipe, corresponding to the full length of the crossing, are laid out at the reception pit location and welded together. A draw string would be installed within the ducts to later aid the process of cable pulling. Pressure testing and inspection of welds may be undertaken on the final string to ensure watertightness. The pipe string would then be pulled into the bore towards the drill rig to achieve the finished cable duct. Further testing would then be undertaken and finally the bores would either be joined to the remainder of the ducting works or be capped, buried, and re-excavated with future works.

4.5.101 Once the above process has been repeated for each of the cables, the drilling sites would be demobilised, and the ground returned to pre-existing conditions.

Plate 4-9: Typical HDD methodology



Underground HVAC Cables

Construction and Installation of the HVAC Cables

4.5.102 The typical AC working width required for the construction and installation of the AC cables, including for access routes, soil storage and drainage, would be approximately 135 m in total where open-cut installation methods are used and approximately 140 m (at the entry and exit compounds) in total where trenchless installation methods are used. The working width would be demarcated by a post and rail fence and would typically comprise the same measures and activities as required for HVDC cables. Unlike the HVDC cable trench, however, the HVAC cable trench would be approximately 3 m wide.

4.5.103 In addition to the working width, cable construction and installation would require temporary construction facilities to be established at various locations along the route. This includes temporary access to the working width, drainage and temporary compounds for storage, lay-down and site offices.

4.5.104 As with DC cables, there are several different installation methods available for the installation of AC cables. These methods are the open-cut and trenchless methods described in **Paragraph 4.5.87** with AC cables installed in sections and connected at buried cable joint bays. The number of sections and the number, location and dimensions of cable joint bays required, would be determined through consultation feedback, information from surveys and ongoing design studies.

4.5.105 Where technically feasible, and unless other environmental and infrastructure features and considerations determine otherwise, all underground cable installation would be by open-cut ducted methods. However, as with DC cables, where specific environmental or infrastructure features preclude the use of open cut methods, use of trenchless methods such as HDD would be used.

4.5.106 Where open-cut installation methods are used for the AC cables, two trenches would be required for the EGL 3 Project AC Cables and two trenches would be required for the EGL 4 Project AC cables. Each trench would contain three AC cables and (subject to cable system design) would be approximately 3 m wide. Each trench would also accommodate a DTS carrier tube and communications fibre cable.

4.5.107 As with DC cables, the minimum depth coverage would be 900 mm to the cable protective tiles. However, the depth of the cables would vary, subject to the outcome of soil Agricultural Land Classification (ALC), agricultural land drainage, engineering and ground investigation surveys. Where justified, cables may be laid deeper.

4.5.108 For the HVAC cables only, an optical fibre link would be provided along the alignment of the cable installation. This would require regular chambers to be installed along the route for installation, monitoring, and repair. Inspection chambers are installed at regular intervals, usually at approximately 450 m intervals. Made of precast concrete, these chambers would be buried with chamber covers suitable for the anticipated loading for the area.

Proposed 400 kV Walpole B Substation

Construction of the proposed Walpole B Substation

4.5.109 Prior to construction, enabling works and a series of site preparation activities would need to be undertaken to make provision for the actual construction and installation of the Walpole B Substation. These pre-construction/installation works would comprise similar activities as required for the Walpole converter stations, as described in **Paragraphs 4.5.61 - 4.5.69**, respectively. To summarise, for the Walpole B Substation, these activities would comprise the following:

- Vegetation clearance and stripping of topsoil from the proposed permanent site area and any working areas (topsoil would be stored in bunds on site, for reuse);
- Set up of temporary access, construction compounds and temporary drainage (including temporary fencing, laying and compaction of granular material (and asphalt where required, proposed at the construction laydown areas), excavation of drainage attenuation features, installation of pipes);
- Earthworks for construction of permanent site access and platform (including the forming of temporary soil bunds for storing excavated material). Where practicable, temporary and permanent access would be combined.

- Civil engineering works to include permanent fencing, access, drainage and foundations (which may include piling of larger structure and/or equipment that is sensitive to ground settlement);
- Installation of structures (for e.g. gantries);
- Delivery and installation of high voltage equipment (including transformers);
- Building works;
- Overhead line conductor stringing works to install the downleads between terminal towers and gantries;
- Testing of equipment;
- Commissioning/energisation; and
- Reinstatement of working areas, including environmental mitigation.

4.5.110 During construction, temporary diversions of the existing 400 kV 4ZM overhead line route would take place to allow new terminal pylons to be constructed on the existing overhead line alignment, before the overhead line would be moved back onto the new pylons with new conductors installed between the new terminal pylons and the substation gantries to connect into the proposed Walpole B Substation. Two existing pylons will be dismantled as part of this work, along with a short section of the existing overhead line which is no longer required. Furthermore, as part of the works, a proposed new cable sealing end compound would be erected east of the proposed Walpole B Substation containing a further gantry with an associated overhead conductor connection to one of the new terminal pylons. A short section of underground cable, approximately 0.6 km in length, would connect the cable sealing end compound to the substation.

English Offshore Scheme Construction Activities

Pre-installation Activities

4.5.111 Prior to the installation of the subsea cables, certain activities would be undertaken to prepare the route for cable lay.

Pre-installation Survey

4.5.112 Although detailed marine surveys have been undertaken, further surveys may be carried out prior to the start of cable installation. The objectives of these surveys would be:

- to confirm that no new obstructions have appeared on the seabed since the original marine surveys were undertaken;
- to establish the final position for infrastructure crossings;
- to establish a reference seabed level against which the depth of burial of cables can be compared;
- to determine the position of any potential UXO (note clearance is subject to a separate licence process);
- to support the micro-routeing of the cables around any mobile bedforms, archaeological features or sensitive habitats; and

- to provide a pre-installation baseline should it be required for post-construction monitoring purposes.

4.5.113 The pre-installation surveys could involve a range of marine survey techniques including:

- Multi-Beam Echo Sounder (MBES) are used to record water depth, prepare a three dimensional (3D) digital terrain model of the seabed, and to identify relevant bedforms and bathymetry.
- Side Scan Sonar (SSS): maps the seabed surface and is used for identification of sediment types, obstacles lying on the seabed, such as wrecks, debris, UXO, and surface-laid or exposed pipelines and cables that might affect cable installation.
- Sub-Bottom Profiling (SBP): directs a pulse of energy into the seabed. Using reflections from the sub-surface geology it can assess the thickness, stratification, and nature of the seabed sediments.
- Magnetometer: passively detects magnetic anomalies compared to the earth's magnetic field. Such anomalies can be caused by geological faults and buried metallic objects such as UXO, pipelines, cables and archaeological features.
- Geotechnical surveys: consisting of cone penetration tests (CPTs) and vibrocores (VCs) to take measurements and core samples to assess the geotechnical properties of the seabed.
- Drop Down Video or remotely operated vehicle video: (DDV) is a piece of marine survey equipment that typically comprises an underwater camera and lighting on a robust sled or frame which is able to stream live footage to the surface. It has built in depth sensors and lasers to provide a scale to estimate the field of view.
- Diver led surveys for UXO target investigation, utilising handheld clearance tools.
- Grab sampling: Is a technique of grabbing a sample of the seabed for testing e.g., to look at sediment composition and properties or to identify marine flora and fauna or eDNA. Types of grabs include hamon grab, dual van veen grab and shipek.

4.5.114 The pre-installation survey would typically be split into two elements: nearshore (<10 m depth of water) and offshore (>10 m depth of water), each requiring a survey vessel suitable for the different water depths.

4.5.115 An offshore vessel is generally larger and can conduct 24-hour operations. The towed sensors, sensor arrays and equipment are stored on the back deck potentially in dedicated garages and are deployed using a crane or vessel A-frame or through a moon pool in the ship's hull.

4.5.116 A nearshore vessel is generally smaller and due to its reduction in size can be used in shallower water depths. Operations are usually kept to 12 hours (or daylight hours) with the sensors and equipment stored in pallet cases/boxes on the back deck; however, if the size of the vessel allows night working or 24-hour working, operations would still be possible.

4.5.117 The data acquired by both vessels would be to the same or very similar standard.

Unexploded Ordnance (UXO) Identification

4.5.118 A desk-based study and risk assessment for potential UXO across the English Offshore Scheme has been undertaken by Ordtek, which will inform the position and development of the English Offshore Scheme.

4.5.119 Publicly available data, historic maps, aerial photographs and records, internet research and research documents will be used to characterise the types of ordnance likely to be present within the English Offshore Scheme. **Table 4-12** lists the types of ordnance that could be present, within the English Offshore Scheme.

Table 4-12 – Potential UXO types typically found in the southern North Sea

UXO	Net Explosive Quantity (NEQ)
Small arms ammunition	< 50 kg
Land service ammunition	101 kg
High explosive bombs	260 kg
Sea mines	697 kg
Torpedoes	365 kg
Depth charges	272 kg
Missiles / rockets	< 50 kg

4.5.120 The offshore geophysical survey completed in 2024 was designed to detect any significant seabed features and obstacles within the offshore draft Order Limits and will be analysed as part of the initial assessment being carried out by Ordtek.

4.5.121 A more detailed UXO specific pre-construction survey would be conducted using a magnetometer array and side scan sonar array prior to seabed clearance and cable lay, to characterise and investigate any anomalies, that may be UXO, in more detail. These surveys will also be designed to capture archaeological features.

4.5.122 The extent of the UXO survey would be nominally 40 m either side of the proposed cable centreline (80 m total per EGL 3 Project and EGL 4 Project); the route along which the cable would be laid and buried within the offshore draft Order Limits. It would be undertaken using a geophysical survey vessel(s).

4.5.123 The data acquired during the survey would be used to map potential UXO (pUXO) and undertake further micro-routeing of the cable centreline to avoid as many pUXO as possible.

4.5.124 Any pUXO detected during the survey that cannot be avoided by the cable centreline would be further investigated to confirm whether it is UXO, an archaeological feature or debris.

4.5.125 Archaeological pUXO identified as a target for investigation would be surveyed in one of two ways:

- Diver survey using a circular search pattern with handheld magnetometer to identify the position of the target and using a low-pressure water jet and dredge system; and/or
- Remotely Operated Vehicle (ROV) equipped with magnetometer, dredge pump and sonar.

4.5.126 A minimum 5 x 5 m grid would be investigated around each target. Should scrap/debris be identified during the survey e.g., objects with ferrous content, this would be removed to the surface to be disposed of according to the Waste Hierarchy and Waste Regulations (2011) (Ref 4.5). Targets covered by sediment would be exposed. A small pit would generally be excavated, until the target is sufficiently exposed to confirm whether it is UXO. Where debris has been identified and removed, investigations would continue until the entire search grid is complete, in case debris had masked the presence of UXOs.

4.5.127 Any non-explosive debris that cannot be removed to the surface (e.g., for health and safety reasons) would be relocated on the seabed within the offshore draft Order Limits.

4.5.128 A Written Scheme of Investigation (WSI) and Protocol for Archaeological Discoveries (PAD) (**Volume 2, Part 3, Appendix 3.26.A Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries**) would be followed throughout the UXO identification campaign, and a marine archaeologist would be on hand in case any targets have archaeological potential.

4.5.129 UXO clearance would be undertaken following completion of the initial UXO identification survey and once all potential targets have been identified and where avoidance of targets, through micro routing, is not possible. A separate Marine Licence application under the Marine and Coastal Access Act (2009) (Ref 4.6) would be submitted to the Marine Management Organisation (MMO) to permit the clearance activities. UXO clearance activities are excluded from this DCO application, however a high-level assessment has been provided.

Route preparation

4.5.130 Prior to the construction of the English Offshore Scheme, preparation of the seabed would be required to ensure installation equipment can operate efficiently and safely. The following activities may be undertaken within the offshore cable corridor.

Boulder clearance

4.5.131 Geophysical data would be used to inform the requirement for boulder clearance within the offshore cable corridor. Where possible micro-routing around boulders would be undertaken, however, where there are large volumes of boulders present micro-routing may not be feasible and therefore clearance of boulders from the route of the cables would be required to allow the use of burial equipment.

4.5.132 There are a number of methods that may be used for the clearance of boulders. Where there are few boulders to be cleared, a grab could be used to individually target and move boulders away from the centreline of the cables. Boulders would be repositioned within the cable corridor red line boundary away from the final route of the cable.

4.5.133 Where there are high volumes of boulders, a SCAR plough or similar would be used. The plough would push boulders to either side of the centreline, clearing a swathe of up to 20 m wide. Multiple passes may be required to achieve the required clearance.

4.5.134 All clearance activities would be undertaken from a construction support vessel (CSV) or similar.

4.5.135 The worst-case in terms of boulder clearance is assumed to be the use of the SCAR plough as this results in the greatest footprint on the seabed. Up to 54% of the EGL 3 Project and 30% of the EGL 4 Project would be required to be cleared using this method (up to 232 km for EGL 3 and 125 km for EGL 4). A grab tool would be used where feasible, reducing the overall footprint.

4.5.136 The boulder clearance parameters are shown in **Table 4-13**.

Table 4-13 – Boulder Clearance parameters

Parameter (per scheme)	EGL 3 Project	EGL 4 Project
Length of cable requiring boulder clearance using SCAR plough (km)	232 km (estimated from length of boulder fields) in English waters <54%	125 km (estimated from length of boulder fields) in English waters <30%
Width of plough/cleared swathe	15 m swathe cleared	15 m swathe cleared
Total area of seabed disturbed by boulder plough (km^2)	3.48 km^2	1.875 km^2
Depth of seabed disturbed by clearance plough	~10 cm (<2 m if trenching)	~10 cm (<2 m if trenching)

Pre-Lay Grapnel Run (PLGR)

4.5.137 A PLGR would be required to clear any debris from the seabed prior to cable installation to ensure the cable route is clear of snagging risks. The PLGR is a wire with specially designed hooks or grapnels at intervals along its length that is towed behind a vessel, typically a CSV.

4.5.138 The PLGR is designed to capture all types of debris at or just below the surface of the seabed, up to approximately 1 m depth. Debris, such as scrap trawler warps, old cable, ghost fishing gear, caught with the grapnel would be recovered to the vessel for appropriate licenced disposal onshore.

4.5.139 Due to the length of the cable as described above, installation may be undertaken over a number of campaigns. The PLGR may therefore be undertaken in one single phase prior to the first installation campaign or in separate phases prior to each installation campaign to ensure the route is clear of debris. Typically, the PLGR is undertaken a few days prior to cable installation but may be undertaken up to a month prior to cable installation.

4.5.140 PLGR parameters are listed in **Table 4-14**.

Plate 4-10: Typical PLGR arrangement

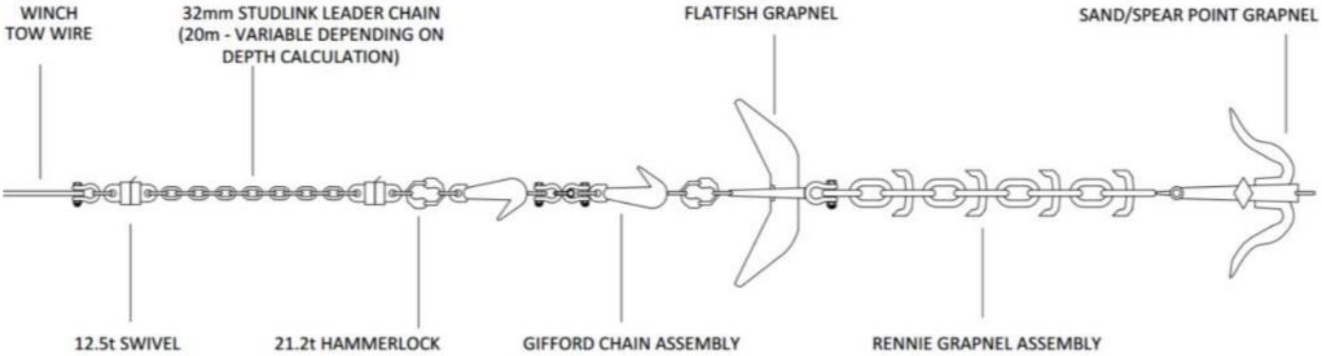


Table 4-14 – PLGR parameters per EGL 3 Project and EGL 4 Project

Parameter (per project)	EGL 3 Project	EGL 4 Project
Length of cable requiring PLGR	100%	100%
Length of cable requiring PLGR (km)	436	425
Width of PLGR clearance corridor (m)	30	30
Total area of seabed disturbed by PLGR (km^2)	13.20	12.75

Trial trenching

4.5.141 Trial trenching, if required to test the capabilities of the trenching tool to meet depth of burial requirements, would be undertaken within the proposed English Offshore Scheme Cable Corridor. The trial trenching would use the same methodology as that proposed for the installation of the cables. During the trial trenching, if cables were to be laid and buried, these would be subsequently removed following the trial. The total length of trial trenching would be up to 5 km. The total area of seabed disturbed by cable trenching would be 75,000 m^2 (0.075 km^2, 7.5 ha) assuming the maximum width of a burial tool would be 15 m.

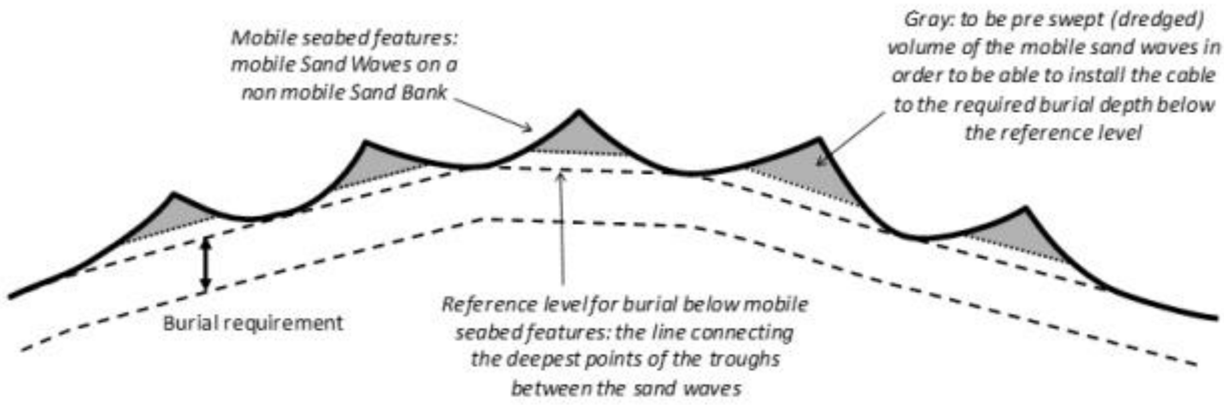
Sand wave clearance and disposal of dredged material

4.5.142 In areas where mega ripples (wave heights <1.5 m) and sand waves (wave heights > 1.5 m) are present along the English Offshore Scheme cable corridor, pre-sweeping may be required prior to cable installation to:

- ensure the burial equipment can operate safely along the cable centreline (i.e., avoiding step slopes); and
- ensure that the burial equipment reaches the required depth of burial, therefore preventing future exposures.

4.5.143 Sand waves can present a major technical challenge for both towed and self-propelled burial equipment. Burial equipment commonly works on long inclines of up to 10-15°. For commonly available machines, the practical limit for burial depth is 3 m. By removing a proportion of the sand wave prior to installation, the burial machine can reach further down and place the cables below the level at which they may be affected by the mobility of the bedform feature (the non-mobile reference level) and can reduce the slope angle, ensuring the burial machine does not topple or tilt over as illustrated in **Plate 4-11.**

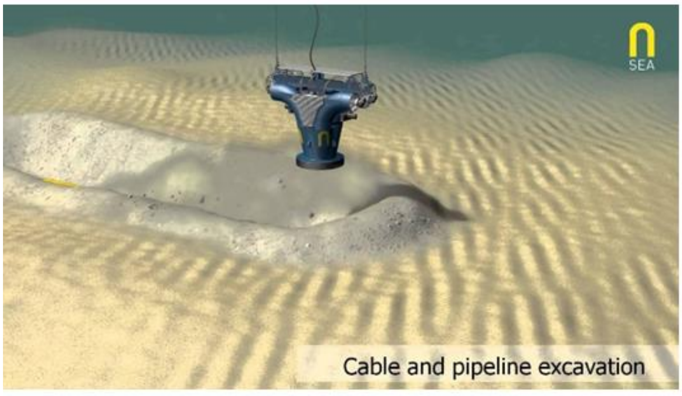
Plate 4-11: Illustration of the process of sand wave pre-sweeping



4.5.144 Pre-sweeping can be undertaken using two different techniques:

- Controlled flow excavator (CFE) - A technique that uses highly pressurised water directed at the seabed to push sediment to either side of a trench, also commonly referred to as a mass flow excavator (MFE). An example is shown **Plate 4-12.** This equipment works best where the sand waves are < 3 m, it also creates a wide footprint and uneven ground, where the sand is pushed aside.
- Trailing suction hopper dredger (TSHD) - A dredging vessel that uses a suction pipe (the trailing drag head) to suck up sediment off the seabed. The sediment is discharged into a compartment (the hopper) on the vessel. An example is shown **Plate 4-12.** The sand can either be retained in the hopper for deposition onshore or deposited back on the seabed by opening the hopper doors. Alternatively it can be side cast as the dredging occurs to allow the sand to settle away from the trench or deposited back to the seabed using the suction pipe in a reverse process to dredging. Compared to the CFE, the TSHD can create a defined trench with a stable flat bottom, typically seabed disturbance is narrower using this technique.

Plate 4-12: Example Controlled Flow Excavator and Trailing Suction Hopper Dredger



4.5.145 The area to be pre-swept would be wide enough for the passage of the burial equipment at the base of the sand wave; typically 10-20 m. Where pre-sweeping is required this would be undertaken up to a few weeks in advance of the cable lay and burial to ensure a cleared path for burial.

4.5.146 If seabed material is recovered to the TSHD and not returned to the seabed it would be disposed of in a licensed disposal area within the English Offshore Scheme cable corridor. The preference would be for the dredged material to be returned to the seabed in the vicinity of the dredged area where practical. The proposed disposal site for the English Offshore Scheme is shown in **Volume 3, Part 1, Figure 4-7**.

4.5.147 The requirements for sand wave clearance would vary along the English Offshore Scheme Cable Corridor. The final determination of depths and locations would be made post consent and would be informed by the cable burial risk assessment and pre-installation surveys, which can be compared to the marine characterisation survey data to determine seabed mobility. However, indicative maximum areas and volumes are presented in **Table 4-15** to support PEIR assessments in **Volume 1, Part 3 English Offshore Scheme**, these will continue to be refined for the ES.

Table 4-15 – Indicative sand wave pre-sweeping parameters

Parameter (per project)	EGL 3 Project	EGL 4 Project
Length of cable requiring pre-sweeping (km)	11.34 km	8.28 km
Maximum clearance width (m)	20	20
Total area of seabed disturbed by pre-sweeping (km^2 / hectares)	226,800 m^2 (0.23 km^2 / 23 ha)	165,600 m^2 (0.17 km^2 / 17 ha)
Maximum volume of sediment disturbed by pre-sweeping (m^3)	138,830.02 m^3	108,280.24 m^3

Preparation for infrastructure crossings

4.5.148 The proposed cable route(s) would cross over several types of third-party infrastructure which have been identified through desktop studies, the marine characterisation survey and direct engagement with the operators and asset owners. A formal crossing agreement will be agreed with each of the infrastructure asset owners prior to making the crossing. This agreement will include the design of the crossing, describing aspects such as crossing angle and vertical separation distance between the third-party asset and the English Offshore Scheme. Where out of service infrastructure is present, agreements will be made to cut and remove sections of this infrastructure to allow unimpeded burial.

4.5.149 At the time of writing, the infrastructure which would be crossed by the English Offshore Scheme includes:

- 7 operational, under construction or planned interconnector or cable reinforcements.
- 9 operational or planned sets of Windfarm export cables (constituting up to 25 cables).

- 7 active telecoms cables and one fibre optic cable.
- 16 active or planned pipelines and 9 not in use or abandoned pipelines.

Active telecommunications cables

4.5.150 The crossing of active telecommunications cables (telecoms cables) by the English Offshore Scheme would comprise a “bridge” over the assets made of either aggregate (rock) or concrete mattresses. This would provide a protective layer and separation between the English Offshore Scheme and the telecoms cable.

4.5.151 Separation could also be achieved by installing a protective material around the English Offshore Scheme (such as Uraduct® or TekDuct). This protective material would be positioned during route preparation by a pre-construction vessel using either a crane or a fall pipe. A secondary layer of rock or mattressing would then be laid over the crossing once the cable is installed. This is described further in **Paragraphs 4.5.204.**

4.5.152 A list of the telecoms cables identified from spatially mapped data sources (e.g., KIS-ORCA and Admiralty charts), as crossing the English Offshore Scheme, is provided in **Volume 1, Part 3, Chapter 25 Other Marine Users**. It is assumed that infrastructure crossings would be required for all seven cables and one third party fibre optic cable.

Export cables from offshore wind farms

4.5.153 The crossings of offshore wind farm export cables would be undertaken in the same manner as the crossing of telecoms cables although, as there may be multiple cables in close proximity, the required rock protection of mattresses may be greater.

4.5.154 There are currently 7 operational or under construction offshore wind farm export cables that would need to be crossed by the English Offshore Scheme and a further 3 offshore wind export cables, that are currently in planning, that may need to be crossed depending on the timing of installation. **Volume 1, Part 3, Chapter 25 Other Marine Users** provides an overview of the offshore wind farm export cables that would require crossing, the number of cables to be crossed and the anticipated position of the crossings. For the purposes of assessment, it has been assumed that all these crossings would be required.

In-service Pipelines

4.5.155 The English Offshore Scheme would need to cross 16 active or planned pipelines, some are buried, and some are surface laid. Where the pipeline is buried, it would use the same methodology as described above for telecoms cables and offshore wind farm export cables, comprising a “bridge” of rock or concrete mattresses.

4.5.156 Where the pipeline is surface laid a crossing bridge would be created using supporting structures to ensure the cable is supported as it crosses the pipeline.

4.5.157 **Volume 1, Part 3, Chapter 25 Other Marine Users** lists all of the in-service pipelines that cross the English Offshore Scheme.

Abandoned or Out of Service Pipelines

4.5.158 Additionally, there are 11 abandoned or out of service pipelines that have been identified that would need to be crossed by the proposed English Offshore Scheme identified from spatially mapped data and the geophysical surveys.

4.5.159 These pipelines are a combination of surface laid and buried. As they have been decommissioned, a crossing structure would be needed for the pipelines. Where these are buried, the construction methodology would be similar to that proposed for In Service cables. Where the pipeline is surface laid, methodology would be the same as that for surface laid in service pipelines.

Out of Service (OOS) Telecommunication cables

4.5.160 There is currently 1 out of service telecoms cable that would need to be crossed by the English Offshore Scheme.

4.5.161 Agreement would be sought from the cable owners to cut the OOS cables where owners can be identified. At the known location of the cable a grapnel would be used to try and retrieve the cable. Should this be unsuccessful, then a de-trenching grapnel would be deployed, which can penetrate the seabed up to 2 m, to retrieve the cable.

4.5.162 Once the OOS cable is retrieved to the vessel, the cable would be cut, and the ends secured with clump weights and returned to the seabed in accordance with guidelines from the International Cable Protection Committee (ICPC) recommendation No 1 (Ref 4.7). The use of clump weights should ensure the risk of fishing gear snagging the cut cable ends is reduced.

4.5.163 The length of cable to be removed would be agreed with the asset owner in advance, but typically a section 100 m long, 50 m either side of the centre line would be removed. This could be extended to 200 m, if identified that it would be beneficial for fishers. For the purposes of assessment, it has been assumed that a maximum of 200 m of OOS cable would be removed.

4.5.164 The clearance of OOS cables would be undertaken by a construction support vessel during the seabed clearance campaign.

Landfall Enabling works and Cable Pull-in

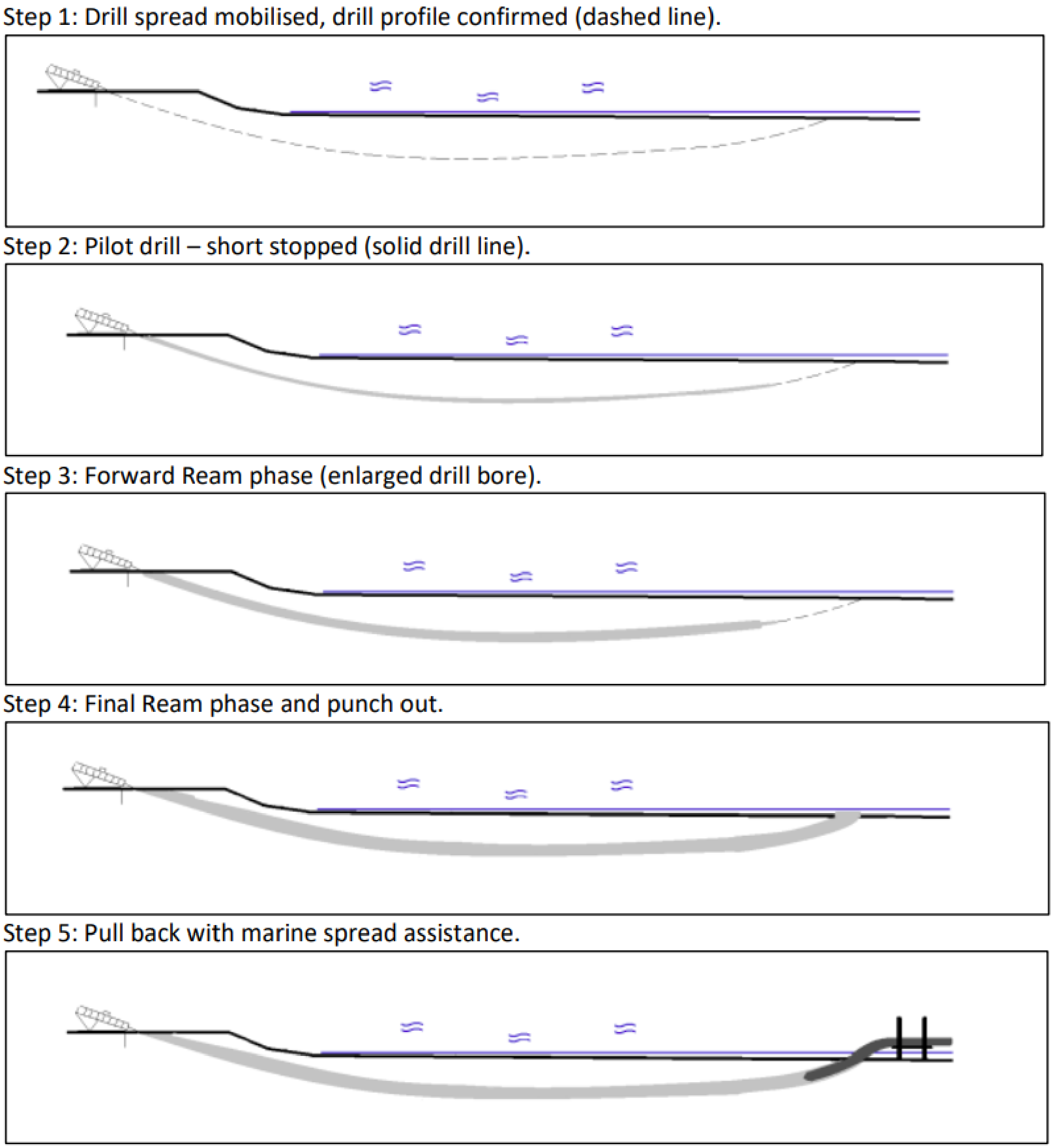
4.5.165 The method for drilling cable ducts from the HDD compound to the offshore exit point is described below. There would be up to two High Density Polyethylene (HDPE) ducts installed per offshore project (so four in total for the English Offshore Scheme), exiting in the nearshore (between 0 m and 8 m LAT). Depending on the final design and depth of the ducts, there would be a 25 m separation between adjacent drill HDD exit points, and a separation of no less than 50 m between the EGL 3 Project and EGL 4 Project.

4.5.166 The HDD entry point would be located onshore and directed out to sea, to avoid disturbance of the Site of Special Scientific Interest (SSSI) and coastal cliffs and beach. The HDD would reach 25 m at its maximum depth. For each borehole, a pilot hole would be drilled and then widened to the full diameter required. The primary HDD activity that interacts with the offshore environment is where the HDD breaks through the sediment (or punches out) onto the seabed. During the HDD punch out, drilling fluid and cuttings would be released from the bore on to the seabed. The HDD works would broadly involve the following activities:

- Mobilisation and aligning the HDD Rig;
- Pilot hole drilling;
- Forward Reaming;
- Excavation of HDD pits (if required);

- Punch Out;
- Installation of ducts;
- Demobilisation;
- Re-excavating the HDD pits (if required); and
- Pulling of cables.

Plate 4-13: Indicative over of the HDD process



Note: Alternatively step 5 may involve push through from onshore

4.5.167 The drilling fluids that would be used for the HDD are likely to be a modified bentonite, a biodegradable drilling fluid additive, a modified natural cellulosic polymer, soda ash (sodium carbonate) and a natural biodegradable polymer which does not contain synthetic polymers, and a solidification reagent (or similar). All products used would be certified as being environmentally friendly. Bentonite is classified by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) (scientific advisors to DESNZ) as posing little or no risk to the marine environment.

4.5.168 The volume of drilling fluid and cuttings lost during punch out would be minimised by several factors, including the boreholes having been drilled to their maximum diameter prior to punch out and the continuous removal of drilling fluid and cuttings prior to punch out. Lower drilling fluid pumping rates would also be used during punch out to minimise the loss of drilling fluid. It is estimated that approximately 110 m^3 of drilling fluid would be released into the marine environment per duct.

4.5.169 An excavated exit pit may be required at the HDD exit points to clear unconsolidated sediment layers that may jam HDD equipment during punch out or prevent duct installation once the boreholes have been drilled. This excavation would be undertaken by either a backhoe excavator (barge mounted) or a controlled flow excavator. Up to two exit pits may be required per project measuring up to 75 m x 15 m each. Sediments would be side cast next to the pits for later backfilling. Exit pits would then be refilled with a combination of manual infilling (backhoe excavator) and natural backfilling. Exit pits would remain open until the cable pull in. Ducts laid in the bottom of the exit pits may be weighted to the seabed using clump weights or rock bags.

4.5.170 Should an exit pit not be required, the drill and duct would exit directly onto the seabed. Once installed, the ducts may still require to be weighted using clump weights, rock bags or temporarily buried.

4.5.171 Upon completion of borehole drilling, HDPE ducts would be installed in each borehole (four in total for both the EGL 3 Project and EGL 4 Project). These may be pulled through from either onshore or offshore or pushed through from onshore. The method requiring the most offshore activity is a pulled installation from onshore. This would require a completed HDPE duct to be floated to the HDD exit point and pulled through the borehole to the HDD entry point in the onshore JTB. Floating the HDPE ducts would involve several vessels and tugs.

4.5.172 A jack-up barge, spud barge or multi-cat would be on site at the HDD exit for a period of 2-4 months for each of the EGL 3 and EGL 4 Projects. This is to support the installation of the HDPE ducts as they are pushed or pulled through the boreholes. The vessels would be equipped with cranes, winches and dive support facilities. Other vessels used at this time may include a guard vessel, crew transfer vessels, a diver support vessel and tugs.

4.5.173 Depending on the construction programme and any seasonal sensitivities at the landfall, there may be a break in works between the HDD finalisation and the cable pull-in. The offshore end of the cable ducts would be “wet stored” for this period by fitting a temporary flange to stop water ingress. This would be either a blanking plate (flat plate) or marine bell mouth (not to be confused with onshore bellmouth junction relating to highways infrastructure) with blanking plate to cover. A bell mouth in this context, is a cone type structure, as illustrated in **Plate 4-14**. It would support the cable as it is pulled into the duct to ensure that the cable does not snag on sharp duct edges or bend too far. The duct ends would then be stabilised as described above.

4.5.174 To prepare for the cable pull-in, any deposits would be fitted with lifting rings, which divers would fit a chain from the surface deck crane. If the ducts have been buried into the seabed, they would be exposed using a barge mounted excavator, hydraulic dredge pump or controlled flow excavator. Once the bell mouth or flange is exposed, temporary bags of sand, rock or grout could be placed underneath the bell mouth to keep it raised off the seabed and prevent egress of sediment into the bell mouth during works.

Plate 4-14: Example of a marine bell mouth

4.5.175 At the start of cable pull-in, a messenger wire would be fed through each HDPE duct from the HDD compound. The messenger wire would be attached to a winch within the HDD compound. The cable lay vessel or shallow water barge would approach the English Landfall position at approximately the 10 m water depth contour. The cable end would be transferred to a multi-cat or construction support vessel and the cable end sailed to the messenger wire at the HDD duct exit. Floats would be installed along the cables to keep them from sinking to the seabed. Workboats would be positioned along the length of the floating cable, always ensuring the steady positioning of the cable.

4.5.176 The onshore winch would start to pull the cable through the duct. Divers would remove the floats as the cable approaches the duct, allowing the cable to sink into and be pulled through the duct. Floats may either be allowed to wash to the beach in a controlled manner for retrieval or would be picked up by a support boat.

4.5.177 A cofferdam will not be used for the landfall enabling works.

4.5.178 This activity would be repeated for each cable to be installed, however, as set out in **Section 4.5**, cables for the EGL 3 Project and EGL 4 Project may not be installed at the same time.

HDD Frac-out

4.5.179 Frac-out is the term for an unintentional or inadvertent loss of drilling fluid during the drilling of the boreholes. This occurs when a fracture in the underlying geology is encountered and drilling fluid finds an alternative path to the intended route, returning to the drill entry point for re-use and recycling. Drilling fluid can either be lost in the geological formation or can emerge at the surface. When released on an intertidal or sub-tidal surface, drilling fluid is rapidly diluted, dispersed and break down in the marine environment.

4.5.180 Due to the geology in this area, Glacial Till overlaying Chalk, the drill would likely avoid the chalk layer, therefore minimising the likelihood of a frac-out. The components of the drilling fluid, including bentonite, are not hazardous to the marine environment (i.e., it is biodegradable, does not bioaccumulate and is non-toxic) and if released at the surface in the intertidal or sub-tidal area would not have any adverse effect on water quality or the environment. Construction Contractors would be required to ensure that chemicals used in the marine environment are selected from the CEFAS Offshore Chemical Notification Scheme (Ref 4.8).

4.5.181 The amount of drilling fluid used in a drill is closely monitored and therefore most frac-outs are of small quantities. However, if there were to be a large release, this could be visible as a plume in the marine environment for a short period (typically the length of the tidal cycle over which the release is occurring). Once drilling fluid is in contact with sea water, Natrium Chloride molecules (which are present in salt sea water) would react with the clay particles and polymers of the bentonite. The particulates in bentonite flocculate on contact with seawater. Immediately after this flocculation, the bentonite particle shrinks and becomes a flat platelet (de-flocculation). The seawater would discolour at the outbreak, but the particles would be mixed by tidal and wave driven currents and dilute over time and with distance from the outbreak so that any discolouration would be localised. Once the drilling fluid is diluted, the clay and polymer molecules would be separated from the freshwater component of the drilling fluid and would be broken down into such small particles they would no longer be visible by human eye. Dilution would continue during the following 1 to 2 tidal cycles until the discolouration disappears.

4.5.182 Measures to manage any such spills will be detailed in the Marine Pollution Contingency Plan.

Cable installation

Cable laying

4.5.183 Following completion of the preparation activities, the cable would then be transported to the site ready for cable laying. When the cable lay vessel (CLV) arrives on site the cable would be transported via cable engines from the carousels on the deck to the over-boarding point at the back of the ship. Under tension, the cable would be guided over the back into the water. It would either be laid directly on the seabed for later burial or would be directed into a burial tool for burial into the seabed.

4.5.184 There are three possible configurations for cable installation:

- **Pre-cut trenching** – A pre-cut trenching vessel would tow a plough along the seabed creating a V-shaped trench. A separate CLV would follow, laying the cables directly into the trench. It would generally be followed by another construction support vessel towing a back-fill plough which would push the spoil heaps into the trench, covering the cables. Alternatively, the trench would be left to naturally backfill or be filled using external cable protection.

- **Simultaneous lay and burial** – This technique would simultaneously create a trench excavation and lay the cable into the trench at the same time. The CLV may tow the burial equipment, or it would be deployed by another vessel following close behind, creating effectively a single large spread. The cables would be fed into the burial equipment directly from above and the cables would be buried as the spread progresses along the route.
- **Post-lay burial** – The CLV would lay the cables on the seabed and a post-lay burial vessel would follow later to bury the cables. As the post-lay burial is a stand-alone operation, the post-lay burial vessel may operate with a longer separation distance from the CLV, so there would be two operations separated physically by distance and in time.

4.5.185 During cable installation a safety zone would be in place around construction vessels; typically 500 m in radius to allow safe manoeuvring of the installation vessel. This would be extended to cover an anchor spread if one is used. Depending on the burial tool used, the vessels would be moving at speeds of 50 to 1,000 m per hour during cable lay and burial. The cable laying operations can generally continue in weather conditions up to force 7 winds and wave heights of up to 3 m. Operations would continue until the total cable length within that cable section has been installed.

4.5.186 If the weather is more severe, and the vessels can no longer remain on station, there would be two options:

- The cable lay vessel would continue to slowly lay the cable onto the seabed, against the wind. After riding out the storm, the length of the cable laid during the storm would be retrieved from the seabed and cable lay operations started again from the point of suspension.
- If the weather is too severe, it might be necessary for the cable lay vessel to cut the cable and leave the site until it is safe to return. This would be considered as a last resort. On return, the vessel would retrieve the end of the cable, make a joint and then continue the laying operation.

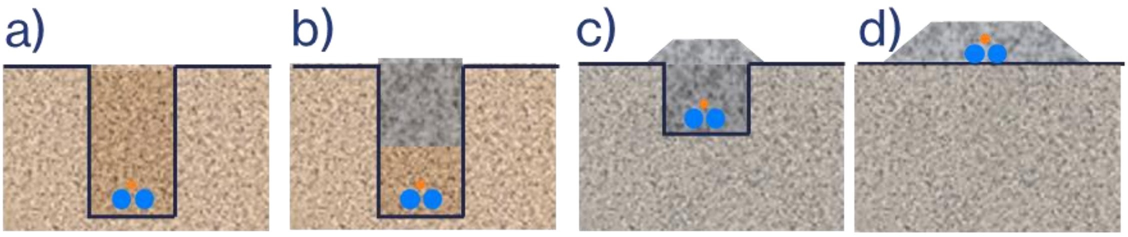
4.5.187 Cable lay and burial operations typically operate 24-hours a day to maximise the vessel and equipment time, and minimise disruption to shipping channels, fishing grounds or any other sensitive areas.

Burial depths

4.5.188 Burial in the seabed is recognised as the best protection method for marine HVDC cables. However, ground conditions may not always allow full cable burial to the depth necessary to protect from external risks. The cable would be buried below the seabed wherever possible, with a target burial depth defined post-consent in a pre-construction Cable Burial Risk Assessment (CBRA) and Burial Assessment Study undertaken by the cable installation contractor. The minimum and maximum cable burial depth would vary along the offshore scheme, depending on numerous factors such as soil type, presence/absence of sub-cropping or outcropping rock, shipping and fishing activity and the type of burial tool utilised.

4.5.189 Information on seabed conditions provided by the 2024 geophysical and geotechnical surveys, has indicated ground conditions along the proposed English Offshore Scheme as well as the depth of water which would limit the burial tools that can be used, and full burial may not be possible along the entire route. **Plate 4-15** presents the various cable burial and protection scenarios that may be encountered along the proposed English Offshore Scheme.

Plate 4-15: Cable burial and protection scenarios



a) Target depth of burial achieved - full burial in sediment.
b) Target depth of burial achieved - insufficient natural backfill, cable protection required to seabed level.
c) Target depth of burial not achieved - additional cable protection required above seabed level to achieve adequate protection.
d) Cables surface laid - protection provided fully by external measures.

4.5.190 The design envelope of the English Offshore Scheme is provided in **Table 4-16** below and is based on information from the outline Cable Burial Risk Assessment. At this stage in the Projects development, no burial tools, as outlined in the section below, can be ruled out.

Table 4-16 – Indicative design envelope for cable burial (unless stated to be indicative)

Parameter	EGL 3 Project	EGL 4 Project
Length of Cable (km)	436 km	425 km
Indicative Length of route where cable burial in seabed can be achieved (km)	~253 km	~297 km
Indicative burial depth (m)	2.25 m max	6 m max (due to extremely low strength clays)
Footprint of cable installation equipment (m)	15 m	15 m
Indicative area of seabed disturbed by cable installation (m^2)	3,795,000 m^2	4,455,000 m^2

Parameter	EGL 3 Project	EGL 4 Project
Indicative area of seabed disturbed by cable installation (km^2)	3,795 km^2	4,455 km^2

Burial tools

4.5.191 There are a range of burial tools and techniques that could be used to bury the English Offshore Scheme. The selection of the tool would be based on numerous factors including the seabed geology and mobility, burial depth to be achieved, the installation contractor selected, proximity to existing infrastructure and environmental sensitivities and mitigation defined during the assessment process.

4.5.192 For all burial techniques, machine function would be controlled from the surface vessel via an umbilical cable. In shallow water, divers may be used to assist e.g., load cable into the machine.

4.5.193 The nature of the seabed, the target burial depth and the tool selection would influence how successful the first attempt at burying the cable is. Additional passes (i.e., where the burial equipment makes a number of attempts at burying the cable to get it deeper each time) would be made where the target burial depth is not achieved on the first attempt.

4.5.194 The following sub-sections describe the burial tools that could be used.

Cable plough

4.5.195 Cable ploughs are used in non-cohesive soils such as loose coarse sand to fine dense sand and cohesive soils such as clay through to rock. They are either towed behind the cable lay vessel to simultaneously lay and bury the cables or towed by a separate vessel to bury the cables post-lay.

4.5.196 The cable plough would be positioned on the seabed with the cable fed into the front of the burial machine. The cable would be guided through the machine to a plough ‘share’ to emerge in the trench the share leaves as it passes through the seabed. Soil displaced by the share is pushed to either side of the trench. The displaced soil may be simultaneously pushed by the plough back into the trench to cover the cables; pushed into the trench by a separate back-fill plough; or left in place to naturally back-fill the trench via natural seabed sediment movement.

4.5.197 The action of the plough has a greater seabed footprint of disturbance (in comparison to other techniques such as jet trenching).

Plate 4-16: Example of a typical cable plough

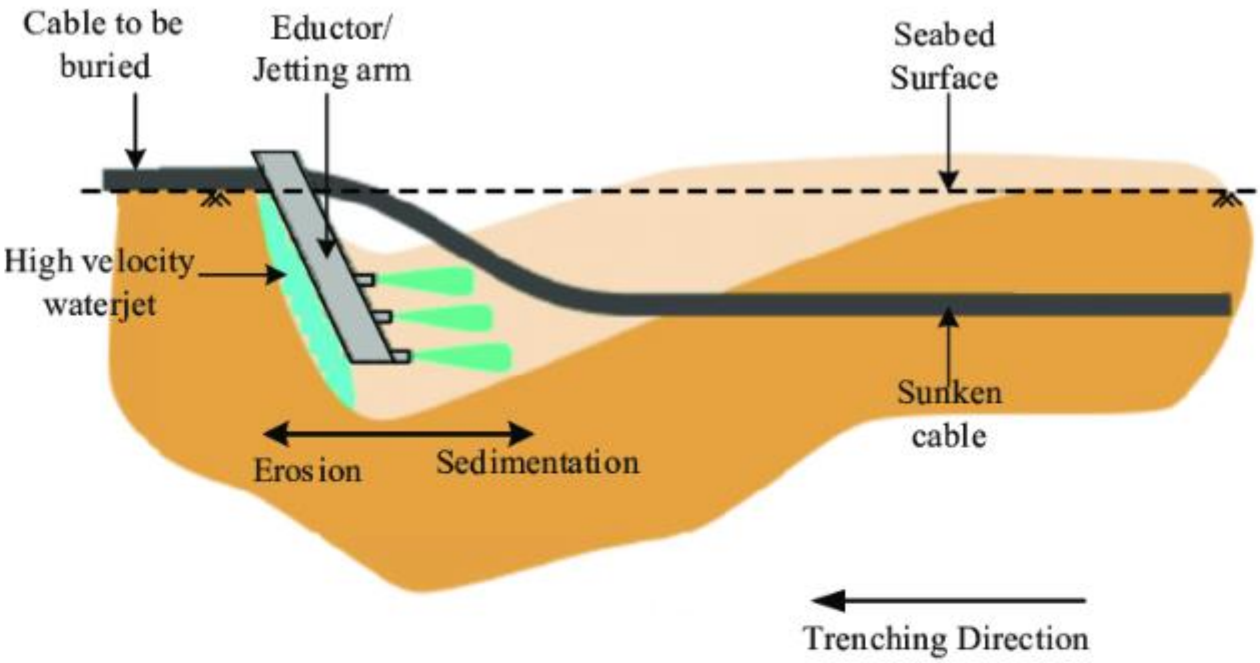
Source: KIS-ORCA (Ref 4.9)

Jet trenching and / or vertical injector

4.5.198 These burial tools are tracked or Remotely Operated Vehicle (ROV) fitted with jetting swords. Most jet trenchers are self-propelled ROVs, although some can be towed from the cable lay vessel. The trencher would be lowered to the seabed above pre-laid cables. High pressure water is pushed through jetting swords into the seabed on either side of the cable, to fluidise the sediment. Lowering mechanisms allow the swords to be lowered into the seabed to the required burial depth, usually with a transition to the target depth of burial. The pre-laid cables sink through the fluidised soil to the bottom of the trench. The seabed sediments naturally re-form and back-fill the trench covering the cables. If the required depth of burial is not achieved, several passes can be made.

4.5.199 Jet trenchers operate in unconsolidated sediments (sand, silt) and can achieve burial depths of up to 3 m. Vertical injectors operate using a similar principle to jet trenchers, but can achieve greater burial depths down to 10 m.

Plate 4-17: Schematic of typical jet trenching method



Source: Arcadis (2024) (Ref 4.10)

Cutting

4.5.200 Cutting is used on hard clay, cemented sand, sandstone and other types of rock. It would be used to either create a pre-cut trench into which the cables would be laid, or post-lay. The burial machine is usually a tracked vehicle that uses chain saws or wheels armed with tungsten carbon steel to cut a defined trench. Soil from the trench is ejected by the cutting action to either side of the trench. This action may be augmented by eductors that suck cut spoil out of the trench and deposit it on either side. The open trench would be backfilled or left to refill naturally.

4.5.201 The operation is slower than other burial methods and typically requires more frequent maintenance stops.

Controlled Flow Excavation (CFE)

4.5.202 CFE is a technique that uses highly pressurised water directed at the seabed to push sediment to either side of a trench. Also commonly referred to as mass flow excavator (MFE), this technique can also be used for the pre-sweeping of sand waves.

4.5.203 The CFE is operated and directly connected to the installation vessel and is suspended over the seabed unlike the previous methods noted above which are on the seabed.

External cable protection

4.5.204 External cable protection may be required in various areas along the English Offshore Scheme. Areas that require protection would include:

- infrastructure crossings; and
- areas where depth of burial cannot be achieved.

4.5.205 A preliminary review of the 2024 geophysical and geotechnical data has provided an indication of potential areas along the offshore draft Order Limits where external cable protection may be required. The Outline Cable Burial Risk Assessment sets out the routeing and burial risk considerations at this point in time and provides a starting point for the pre-construction CBRA that would be submitted in line with the anticipated deemed Marine Licence conditions. The pre-construction CBRA will take into consideration, the environmental measures, the final recommended target burial depths, the capabilities of the actual burial tools to be used, any contractual requirements such as the number of passes each burial tool is required to make to reach burial depth, as well as any new information on ground conditions.

4.5.206 Cable protection would be required at up to 66 infrastructure crossings, this cannot be avoided and is discussed in the following sections.

4.5.207 The design parameters for cable protection are listed in **Table 4-17**.

Table 4-17 – Maximum design parameters for Cable Protection (excluding Infrastructure crossings) (unless stated to be indicative)

Parameter	EGL 3 Project	EGL 4 Project
Indicative Length of Cable requiring cable protection (excluding infrastructure crossing) (%)	20 % due to geology	26 % due to geology
Indicative Length of Cable requiring cable protection (excluding infrastructure crossings) (km)	85 km	110 km
Maximum width of cable protection on seabed (m)	10 m	10 m
Maximum height of cable protection berm (m)	1.5 m	1.5 m
Maximum area of seabed covered by cable protection (m^2)	60,000 m^2 (crossings) + 855,000 m^2 (risk of burial not being achieved due to geology) English waters = 915,000 m^2	66,000 m^2 (crossings) + 1,069,000 m^2 (risk of burial not being achieved due to geology) English waters = 1,135,000 m^2
Maximum volume of cable protection (m^3) (including infrastructure crossings)	905,000 m^3	1,120,000 m^3

Rock Placement

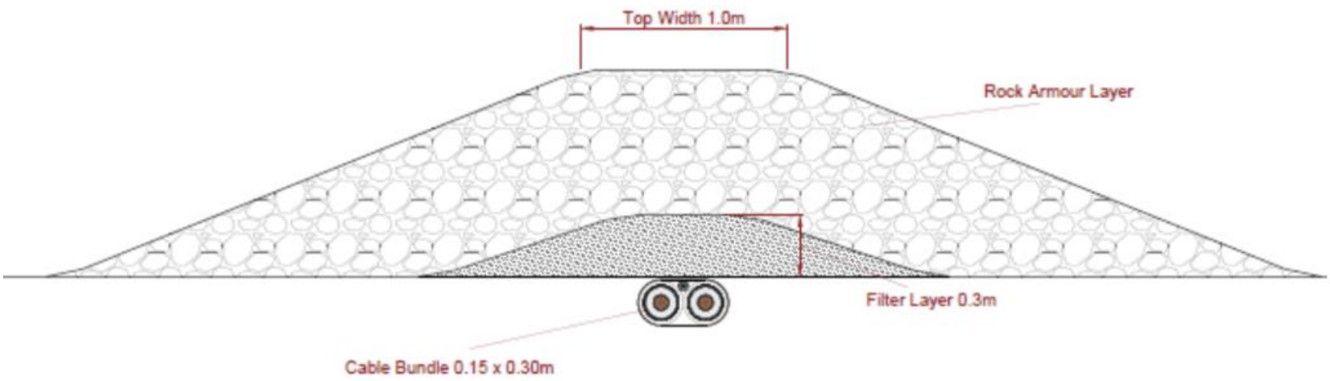
4.5.208 Rock placement is used to protect subsea cables by covering the cable with a continuous berm of graded rock which would be profiled. The berm is typically made up of two layers, a filter layer and then a layer of armour.

4.5.209 The filter layer is made of smaller particle size rock which is laid first to provide a stable layer for the armour layer, which comprises larger sized rock. The outer armour layer is designed to provide protection from external threats such as fishing gear or anchors as well as withstanding the metocean conditions.

4.5.210 Typically, the rock used would be an inert material such as granite to prevent the chances of non-native species being introduced to the area. The size of the berms would depend on the location of the berm and seabed conditions and would be individually designed as indicatively shown in **Plate 4-18.**

4.5.211 The berm is typically constructed using a fall pipe vessel which would place rock over the cable in a targeted manner.

Plate 4-18: Example schematic of a rock berm



Concrete mattresses

4.5.212 A concrete mattress comprises of matrices of interlinked concrete which are connected with rope and wire. They are installed using a crane from a construction support or diving vessel, which would lower the mattress into position over the cable.

4.5.213 Concrete mattresses are typically 6 m in length and 3 m wide and provide a strong protective cover to prevent potential snagging of fishing gear or anchors. They are not as protective as rock berms and it is possible for the mats to be caught and dragged by anchors or moved by strong currents, so they cannot be used in all locations. Multiple mattresses can be laid to provide larger area of coverage. For infrastructure crossings, mattresses are used in combination with rock protection.

4.5.214 There are various companies in the market that are investigating alternative designs for concrete mattresses to make them more nature inclusive. Concrete blocks are designed with complex surface structures and textures to encourage marine life to colonise them once installed. The concrete may also include chemical additives which promote the growth of encrusting organisms such as oysters and barnacles.

Flow dissipation devices

4.5.215 The purpose of a flow dissipation device is to reduce the velocity of water passing over, encouraging sediment to drop out of suspension and accrete. They are often used to protect structures from erosion. The most commonly used device is a fronded system/mat which can be either used on its own or attached to a concrete mattress. The system comprises of UV polypropylene fronds secured to a polyester webbing. Once laid, they resemble seaweed which interrupts and reduces the velocity of the local currents. The drop in velocity allows the sediment to drop out of suspension and build up on the mats to form a natural embankment on and around the mat.

4.5.216 Fronded mats are suitable to be used in areas where the seabed is primarily sand, as they are designed to capture sediment as it moved over the mattress, they would not be appropriate on a rocky seabed environment. The mats can be custom made but are typically 5 m in length and 2.5 m wide, with the fronds being up to 1.25 m in length.

4.5.217 As technologies develop, there are opportunities for fronded mats to be made of non-plastic products.

Protective coverings, claddings or pipes

4.5.218 There are several varieties of protective coverings for subsea cables currently on the market such as Uraduct® or TekDuct, which are polyurethane half tubes and used to enclose the cable bundle. They can include a ballast should the cable system need to be weighted down further.

4.5.219 There are also cast iron and concrete versions of the half pipe which can also be used. This type of protection is typically used in combination with another type of protection such as rock placement. However, it can be used as a standalone method for short lengths of cables.

Rock, gravel/sand bags

4.5.220 Rock bags consist of various sized rocks (or sand and/or gravel) within a rope or wire netting bag, although there are new products coming on to the market whereby the bags are made from specially developed basalt fabric. They would be installed using a crane from a construction vessel placing them over the cable in the correct position.

Sand backfill

4.5.221 Sand sourced from the seabed adjacent to the cable trench may also be used to backfill the trench. A fall pipe or FP vessel would be used to gather and place the sand within the trench. The fall pipe system enables the controlled installation of backfill materials without excessive misplacement, which is crucial for maintaining the integrity of the cable installation.

Nature Inclusive design

4.5.222 Wherever possible and appropriate, opportunities to incorporate nature inclusive design solutions into the cable protection will be considered. Nature inclusive design incorporates measures that are integrated into or added to the design of cable protection to increase suitable habitat for native species (or communities). This could include designing the cable protection to encourage growth of benthic fauna to increase biodiversity.

Cable jointing

4.5.223 Cable lay vessels are limited in the length of cable they can carry in a single load (typically 5,000 to 10,000 tonnes). For the cable system design, this equates to cable lengths in a bundled configuration of 80 – 100 km. Sections of offshore cables would be connected by a cable joint. The cable system would therefore require up to 10 joints within the English Offshore Scheme due to its length.

4.5.224 At the cable joint position, the end of the installed cable would be temporarily left on the seabed whilst the cable lay vessel returns to port to pick up a new cable length. A ground wire would be attached to the cable end to enable retrieval when the cable lay vessel returns. The cable end may be temporarily buried into the seabed, marked with a buoy and/or guarded by a guard vessel whilst the cable lay vessel is offsite.

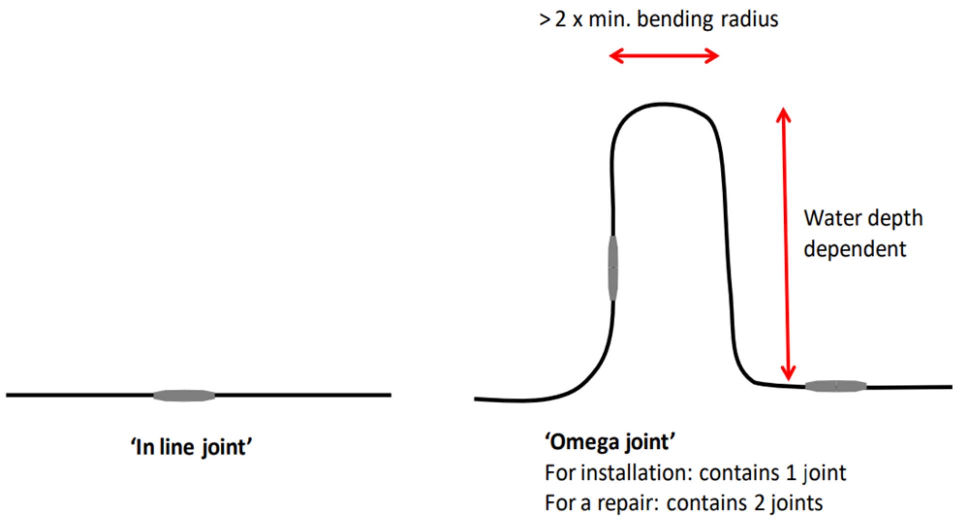
4.5.225 The cable joint would be made on board the cable lay vessel and would take up to two weeks per joint location. During this time, the cable lay vessel would likely anchor to maintain position. Once the cable joint has been made, the cable lay vessel would continue to lay the new cable section.

4.5.226 In-line joints would be made where cable laying can be continued after the cable end has been picked up. Where the cable is laid towards the cable end, or where a repair is required in an existing cable, an omega joint is made, as illustrated in **Plate 4-19**. In this scenario, both cable ends would be bought on board the cable lay vessel to make the joint. The process requires extra cable, approximately equal to twice the depth of water to allow for the transition of each cable from the seabed to the surface to make the joint. When the cable is returned to the seabed the additional cable would be laid on the seabed to one side of the centreline in a loop.

4.5.227 For both types of joint, the joint and cables would be buried (as the preference) or protected by external cable protection.

4.5.228 It is assumed that the seabed footprint for cable jointing is within the design envelope for seabed preparation and cable installation described in **Paragraphs 4.5.111** to **4.5.203.** Cable Operations and Maintenance (O&M) requirements are described in **Paragraphs 4.6.2** to **4.6.12.**

Plate 4-19: Indicative illustration of subsea cable joints



Infrastructure crossings

4.5.229 The works that would be undertaken to prepare the seabed for infrastructure crossings are described in **Paragraphs 4.5.204** to **4.5.222** . This would involve installing a protective layer between the existing infrastructure and the English Offshore Scheme.

4.5.230 An exclusion zone either side of the existing infrastructure would be agreed as part of the crossing agreement. The burial tool would transition out of the soil before reaching the exclusion boundary, and the English Offshore Scheme would be surface laid over the infrastructure ‘bridge’ created during the seabed preparation works. A minimum vertical separation between the existing infrastructure and the English Offshore Scheme, typically 300 mm, would be agreed with the asset owners, and the crossing engineered to achieve the agreed vertical separation. Burial (as applicable) would continue after cable lay progresses outside of the burial exclusion zone on the opposite side of the crossed infrastructure.

4.5.231 External cable protection would then be laid over the English Offshore Scheme along the surface laid cable (including the zones where the English Offshore Scheme transited out and into the soil). **Plate 4-18** illustrates a typical crossing berm.

4.5.232 The physical crossing designs for each infrastructure crossing would vary according to, among other things, the size, type, location and burial state of the crossed asset, and the exclusion zone. However, the crossings would not exceed the maximum design parameters presented in **Table 4-18.**

4.5.233 If the English Offshore Scheme is exposed for any period e.g., between cable lay and deposition of external cable protection, a guard vessel would be deployed.

Table 4-18 – Maximum design parameters for infrastructure crossings

Parameter	EGL 3 Project	EGL 4 Project
Total number of crossings required	60	61
Typical length of crossing (m)	100 m (at some locations crossings may be combined due to proximity of infrastructure)	100 m (at some locations crossings may be combined due to proximity of infrastructure)
Total length of cable crossings (m)	6,000 m	6,600 m
Maximum width of crossing (m)	10 m	10 m
Maximum height of rock berm (m)	2 m	2 m
Total area of seabed covered by cable crossings (m^2)	60,000 m^2	66,000 m^2
Total area of seabed covered by cable crossings (km^2)	0.06 km^2	0.066 km^2

Cable wet storage

4.5.234 It may be necessary to temporarily store sections of the cable on the seabed prior to installation. Sections would be placed on the seabed within the draft Order Limits and its location communicated to mariners through a Notice to Mariners.

Construction Installation Vessels

4.5.235 A range of different vessels would be required during construction of the English Offshore Scheme. The use of specific vessels such as the Cable Lay Vessel (CLV) or a Cable Lay Barge (CLB) would be confirmed once the installation contract has been awarded (post consent).

4.5.236 Details of vessels deployed on similar cable installation projects to the English Offshore Scheme have been used to inform the description of representative vessels. It is expected that the following types of vessels would be used; descriptions of each are provided in the subsequent sections:

- Cable lay vessel;
- Cable lay barge;
- Anchor handling tug;
- Jack-up barge;
- Guard vessel;
- Construction and dive support vessels; and
- Rock placement vessels.

Cable Lay Vessel (CLV):

4.5.237 The CLV is a specialist ship designed specifically to carry and handle long lengths of heavy power cables. The CLV would be equipped with a dynamic positioning (DP) system, which enables the vessels to be held very accurately in position despite the effects of adverse weather. The shallowest depth in which the cable ship can operate would depend on the vessel used, but is typically around 10 m lowest astronomical tide (LAT), although some vessels can operate in much shallower depths.

4.5.238 The cable would be loaded onto powered turntables (carousels) on the back of the CLV at the cable production factory. The cable would be transported in this manner to prevent any twists of kinks in the cable.

Cable Lay Barge (CLB):

4.5.239 A CLB may be required at the proposed Landfall. These types of vessels typically operate in water depths less than 10 m LAT. These shallow water operations are generally conducted upon flat top pontoon barges. These barges are fitted out with the necessary cable storage and working equipment.

4.5.240 Typically, a CLB uses anchors (up to 8 in total) to hold position covering an area of between 500 m and 1,000 m radius from the vessel, alternatively the CLB may use spud legs which can be jacked up and down allowing the barge to tether to the seabed if required.

4.5.241 The CLB typically is assisted by a team of other vessels and possibly divers depending on the cable laying technique being used. The small vessels are used to move anchors, monitor traffic and guard the vessel spread.

Anchor Handling tug

4.5.242 Dedicated anchor handling tugs may be used to support the CLB. They can move the anchors to allow the barge to propel itself within the proposed Offshore draft Order Limits. These specialised vessels are typically 30 m in length and have the ability to work in the shallower depths of the nearshore area. Jack-up/anchored barge or vessel/multi-cat

4.5.243 A jack-up barge is a platform that generally has four to eight legs which can be adjusted for the sea conditions. These types of vessels may be used at the trenchless technique punch-out point to support the drilling and pull-in of the cables.

4.5.244 The jack-up barge does not have its own propulsion system, so it is towed into position by a tug.

Guard vessel

4.5.245 Guard vessels are used to ensure the safety of mariners operating in the vicinity of construction and maintenance activities associated with the cable. They may be required to accompany the CLV or CLB, particularly in areas of high-frequency shipping. The guard vessel or other construction support vessels maintain surveillance around the CLV/CLB to monitor traffic and would notify other vessels to keep away from the installation spread to avoid the potential threat of collision.

4.5.246 Guard vessels are also used to protect areas of exposed cables prior to burial or deposit of external cable protection. A guard vessel may also be used to warn fishing vessels from areas of the route that are temporarily unprotected during the gap between cable lay and burial or the installation of external cable protection, to avoid any snagging of fishing gear.

4.5.247 Guard vessels are typically quite small, preferably locally sourced and crewed to the project location to ensure that they are familiar with areas they are guarding. They are frequently fishing vessels who are unable to fish their normal grounds due to the construction works.

Construction support vessels (CSVs)

4.5.248 There are several other types of support vessels which would be used during the construction of the English Offshore Scheme. These are likely to include dive support vessels (DSV), crew transfer vessels, general construction vessels (CSV) and small rigid inflatable boats. The DSVs and CSVs would vary in size depending on the type of activity they would be required to do and the working conditions. They may also undertake several different roles on a project, such as inspections for UXO or archaeology, PLGR, anchor handling or the placement of mattresses at crossing locations.

Rock placement vessels

4.5.249 Vessels used for rock placement are highly specialised. They comprise of a large hopper to transport the rock and a mechanism for the deployment of the rock at the correct location. This can use the following techniques:

- side dumping where rock is pushed or tipped over the side of the vessel;
- split hopper where the hopper separates to allow the rock to fall straight through the vessel on to the seabed below; and

- flexible fall pipe where a retractable chute is used to accurately control a flow of rocks over the cable on the seabed.

4.5.250 The use of the fall pipe is the most accurate technique but can only be used in waters over 10 m in depth.

Indicative vessel movements

4.5.251 A condition of the deemed Marine Licence could be for the construction Contractor to confirm the number and types of vessels to be used during all phases of construction. **Table 4-19** provides an indication of the types of vessels to be used during construction based on experience on other projects. Vessels would typically transit in a linear manner along the proposed English Offshore Scheme. However, their port of origins are unknown at this stage and will not be known until an installation contractor has been appointed.

Table 4-19 – Indicative vessel requirements for the English Offshore Scheme

Construction activity	Indicative vessel requirements per EGL 3 Project and EGL 4 Project for the English Offshore Scheme
Preconstruction survey	2 x survey vessel
UXO identification	2 x CSV
Boulder clearance	1 x CSV
Sand wave pre-sweeping	1 x TSHD
Crossing preparation	1 x CSV 1 x rock placement vessel
PLGR	1 x CSV
landfall enabling works	1 x JUB / multicat 1 x tug 1 x crew transfer vessel 4 x small workboats
Cable lay and Burial	1 x CLV 1 x CSV 2 x tug / anchor handler 10 x guard vessel 1 x rock placement vessel

4.6 Operation and maintenance

English Onshore Scheme

4.6.1 Routine inspection and periodic maintenance and repair of the English Onshore Scheme would be required during its operational lifetime and access point details will be subject to further design and will be assessed in the ES. The routing inspection would identify any damage or deterioration of the components or becoming life-expired and requiring replacement. Typical maintenance procedures are summarised in **Table 4-20.**

Table 4-20 – Indicative Maintenance Procedures

Scheme Element	Example Maintenance Works
Underground DC and AC onshore cables	Activity along the proposed DC and AC onshore cable routes would generally be limited to non-intrusive inspections and cable repairs. The latter would only be required in the unlikely event of a cable fault. Where a fault does occur the location of the fault would be identified, and the faulty section of cable replaced. The activities involved in cable repair would be like those outlined above for installation, albeit over a much smaller section.
Converter stations	The converter stations would be operated by a small team that visits the site weekly and otherwise as and when required. During maintenance (planned and unplanned), the number of personnel present on site would increase with the number of staff proportionate to the nature of the maintenance works being undertaken. Visual inspections of equipment within substations to ensure smooth and efficient working. Servicing of equipment, such as cleaning, adjustment and lubrication. Repair and replacement of equipment which is faulty.
Walpole B Substation	There would be no permanent personnel working at the Walpole B Substation. During maintenance (planned and unplanned), the number of personnel present on site would be proportionate to the nature of the maintenance works being undertaken. Visual inspections of equipment within the substation to ensure smooth and efficient working. Servicing of equipment, such as cleaning, adjustment and lubrication. Repair and replacement of equipment which is faulty.
Overhead lines	Minor repairs or modifications may be required from time to time for local earthwire damage, addition of jumper weights, local conductor damage, broken insulator units, damaged or broken spacers, broken or damaged vibration dampers, and damaged or broken anti climbing devices. Refurbishment work would be undertaken typically on one side of the pylon at a time, so that the other side (supporting the other electrical circuit) could be kept ‘live’ or in use. Once all the work has been completed on the first side, the circuit would be re-energised, and the opposite side switched off, so that the work could be carried out on the other side. The refurbishment works would require temporary access

Scheme Element	Example Maintenance Works
	tracks, a small compound and potentially scaffolding to protect roads and other features during the work.

English Offshore Scheme

4.6.2 The English Offshore Scheme would be designed to minimise any maintenance requirements. Following installation, routine maintenance of the HVDC subsea cables is not anticipated, however, the following activities may be periodically required during the operational phase:

- inspection surveys, including geophysical surveys;
- cable repair (if required) (noting that emergency repairs requiring immediate action are exempt and therefore not included in this DCO) and
- reburial, remedial protection or maintenance and reinstatement of external cable protection features.

In-Service Survey Operations

4.6.3 Geophysical surveys would be undertaken periodically to monitor cable burial and the status of external cable protection e.g., remedial or at infrastructure crossings. If results of the as-laid survey show that the English Offshore Scheme is not at the required burial depth or has become exposed, remedial works could be undertaken as described in **Paragraph 4.5.204** to **4.5.222**. Additional surveys may be undertaken after storm events which exceeded the design conditions.

4.6.4 Surveys would use the standard suite of geophysical techniques described in **Paragraph 4.5.113** (i.e., multibeam echosounder, side-scan sonar, sub-bottom profiler, magnetometer etc). Nearshore and offshore survey vessels or an automated underwater vehicle would be used.

Cable Repair

4.6.5 Should a fault be identified by the cable monitoring system, it would be necessary to access the relevant location of the fault and retrieve the cable to the surface for inspection. The damaged section would then be repaired or replaced. The most common reason for a repair of a subsea cable is damage caused by third parties, typically by a vessel anchor strike on a shallow or exposed cable segment.

4.6.6 A cable repair would typically be carried out by a single vessel. For a shallow water repair, in less than 10 m of water, an anchored barge would typically be used. In deeper water, a DP cable vessel would be used. Vessels carrying out cable repair operations are restricted in their ability to manoeuvre and divers and/or ROV would be expected to be used with associated vessels.

4.6.7 The actual operational details and the precise configuration of a repair spread would depend on the type of repair identified. The typical steps would comprise:

- loading of spare cable to the repair vessel;
- survey to locate the damaged cable;
- cable de-burial;

- cable cutting and recovery to the surface;
- splicing in the replacement section of cable; and
- re-deployment of cable onto the seabed and re-burial.

4.6.8 A repair would require the insertion of additional cable and two additional cable joints. The additional cable length may be equal to or greater than approximately three times the depth of the water at the site, depending on how much damage the cable has sustained.

4.6.9 If the repair is of a single cable in a bundled pair, the pair of cables would need to be cut, and both brought to the surface. However, it is possible that both cables might be repaired as a precaution against undetected damage.

4.6.10 The extra length of a repaired cable section means that the repaired cable cannot be returned to its exact previous position and alignment on the seabed. The excess cable would be laid on the seabed in a loop to one side of the original route to form an 'omega' loop, as illustrated in **Plate 4-19.** This new piece of cable would then be buried into the seabed, or external cable protection would be deposited if burial is not feasible due to ground conditions or position.

4.6.11 A cable repair operation would be expected to take between two and six weeks depending on the type and extent of the damage, the burial requirements, and operational constraints such as weather.

4.6.12 The requirement for repair operations during the lifetime of the proposed English Offshore Scheme would depend on the number of faults, location of the faults, and the burial/protection method used for the original installation.

4.7 Emissions

4.7.1 The emissions that may occur during cable installation or operation are:

- electric and magnetic fields.
- heat.
- underwater sound.

English Onshore Scheme

Electric and Magnetic Fields

4.7.2 All equipment that generates, distributes or uses electricity produces Electric and Magnetic Fields (EMFs). Exposure limits for EMFs in the UK are set by the Government on advice from Public Health England, and the electricity industry strictly adheres to these limits. The exposure limits for both DC and AC cables originate from the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines, published in 1994 and 1998 respectively and recently updated in March 2020.

4.7.3 Other onshore emissions associated with traffic, air quality, noise, dust and lighting are outlined within the relevant technical aspect chapters within **Volume 1, Part 2 English Onshore Scheme** of this PEIR.

English Offshore Scheme

Electric and Magnetic Fields

4.7.4 The English Offshore Scheme would use Direct Current (DC) technology which has a frequency of zero hertz (0Hz) and would produce static EMFs.

4.7.5 Electric fields depend on the operating voltage of the equipment producing them and are measured in V/m (Volts per metre). As the proposed English Offshore Scheme cables would be enclosed in a solid metal sheath, which screens the electric fields, they would not produce an external electric field. However, they would produce a magnetic field, which is not screened by the metal sheath, and seawater moves through the magnetic field, a small localised electric field is produced. This is known as an induced electric field.

4.7.6 Magnetic fields depend on the electrical currents flowing, which vary according to the electrical power requirement at any given time and are measured in µT (microtesla). Magnetic fields generated by the operational cables diminish rapidly with distance from the source.

4.7.7 The earth also produces its own DC magnetic field, which in the UK is around 49.9 µT, but this can vary due to geomagnetic material such as ferromagnetic rocks. Given the natural magnetic field, the background induced electric field could range between 5.0 and 65 µV/m in tidal velocities ranging between 0.1 m/s and 1.35 m/s.

4.7.8 The estimated magnetic fields for the English Offshore Scheme have been calculated for two cable configurations: bundled HVDC cables; HVDC cables separated by 15 m and buried to 25 m at landfall. All calculations were performed assuming the current maximum circuit separation and minimum burial depth, and 100% load giving a worst-case scenario. The maximum magnetic field for each design option was calculated at vertical distances of 0 to 20 meters from the seabed, and horizontal drop off along the seabed. A worst-case (minimum) burial depth of 1 m was used for all calculations. The assessment is provided in **Volume 2, Part 1, Appendix 1.4.A Electric and Magnetic Field Assessment.**

Magnetic Compass Deviation

4.7.9 Magnetic compasses, whether traditional magnetic needle designs or alternatives such as fluxgate magnetometers, operate from the Earth’s magnetic field, and are susceptible to any perturbation to the Earth’s magnetic field by other sources.

4.7.10 The Maritime and Coastguard Agency (MCA) in their response for the EGL 3 & 4 Scoping Opinion stated that “*There must be no more than a 3-degree electromagnetic compass deviation for 95% of the cable route and for the remaining 5% of the cable route there must be no more than a 5-degree electromagnetic compass deviation. If the MCA requirement cannot be met, a post installation actual electromagnetic compass deviation survey should be conducted for the cable in areas where compliance has not been achieved*.”

4.7.11 The magnetic fields and compass deviation at the sea’s surface were calculated for the proposed English Offshore Scheme for the same three design scenarios considered by the EMF calculations. The assessments were performed using cable orientation and depth from bathymetry data. The orientation of the cables to north, separation and depth, as well as the current flowing in the cable, will all impact the extent a compass is deviated from the Earth’s magnetic north.

4.7.12 The compass deviation calculations assume that the cable would be buried 1 m below the seabed. The compass deviation calculation results are calculated at the sea surface. In practice, the draft of any vessel will limit the sea depth that applies, and the compass is likely to be situated above the water line, both of which will reduce the compass deviation that will be found in practice.

4.7.13 The calculations, presented in **Volume 2, Part 1, Appendix 1.4.A Electric and Magnetic Field Assessment**, show that:

- When HVDC cables are bundled, the MCA thresholds are not exceeded.
- Within 300 m of the shoreline where the HVDC cables are separated into individual ducts, compass deviation would be > 5-degrees.

Heat

4.7.14 As well as EMF, cables generate heat as a by-product of transmitting electricity. The generated heat has the potential to raise the temperature of the seabed in proximity to the cables and consequently, alter the surrounding habitat, potentially resulting in impacts to benthic and fish species. The heat losses from the cables are related to the physical and thermal properties of the cables. A number of scenarios were modelled to evaluate the thermal performance of the cables, including directly buried in a bundle to differing depths and contained within a duct at the landfall at various depths. The results presented in **Volume 2, Part 1, Appendix 1.4.B EGL 3 Heat Calculations** and **Volume 2, Part 1, Appendix 1.4.C EGL 4 Heat Calculations,** show that for cables operating at full power, temperature would be raised in the immediate vicinity of cables but reduces within increasing distance. The heat would be highly dependent on the depth of burial and the thermal resistance of the surrounding seabed. Temperature is likely to fluctuate as the cables would be unlikely to be operating at maximum capacity all the time or for extended periods of time (months/years).

Underwater Noise

4.7.15 The predominant noise generating activities during the installation and operations of the proposed English Offshore Scheme would be from:

- Geophysical survey equipment (e.g., side scan sonar, multi-beam echosounder, sub-bottom profiler and magnetometer);
- Cable trenching (vessel and equipment noise);
- Placement of external cable protection (vessel, equipment and rock placement noise);
- Investigation and clearance of potential UXO (note clearance is subject to a separate Marine Licence); and
- Movement of vessels.

4.7.16 UXO clearance is being consented via separate Marine Licence and is therefore not assessed in detail, a high-level assessment is provided only to ensure a holistic view of the whole project.

4.7.17 The above activities include both impulsive and non-impulsive (continuous) anthropogenic sound sources.

- Impulsive sounds include pulses generated during geophysical surveys, which can be characterised by short duration pulses, broad bandwidth and have rapid rise and decay period with high peak pressures.
- Non-impulsive sounds include the continuous sounds from vessel movements, which can be characterised by low level sounds spread over a longer period of time that do not have a rapid rise and decay times or high peak pressures.

4.7.18 Underwater modelling has been undertaken for the English Offshore Scheme with results included in **Volume 2, Part 3, Appendix 3.22.A Underwater Noise Technical Assessment**.

4.8 Decommissioning and demolition

Introduction

4.8.1 NPS EN-1 (Ref 4.2) Paragraph 4.3.5 states that the ES should cover the decommissioning of a project. Decommissioning of electricity networks is not specifically covered in NPS EN-5 (Ref 4.4) although Paragraph 2.1.4 recognises that generally, nationally significant electricity networks are likely to have an ongoing function, but will be subject to maintenance, reinforcement works and for assets to be replaced when they come to the end of their lifespan.

4.8.2 There are currently no specific plans to decommission the Projects. It is expected that the transmission of electricity would continue for as long as there is a business case for doing so and that any decommissioning activity would occur decades into the future. To date, relatively few transmission projects have been decommissioned since the main expansion of such infrastructure in the 1950s and 1960s.

4.8.3 If the English Onshore Scheme, or any part of it, were to be decommissioned, a written scheme of decommissioning would be submitted for approval by the relevant planning authorities. The decommissioning works would follow NGET processes at the time for assessing and avoiding or reducing any environmental impacts and risks. Potential effects from works required for decommissioning would be separately assessed at the time of decommissioning. Further description is provided below regarding the works that could take place should the Projects be decommissioned.

Converter Stations

4.8.4 The anticipated operational life of the proposed Converter Stations would be a minimum of approximately 40 years. It is likely that during this period refurbishment and plant replacement would extend the life of the proposed Converter Stations. If decommissioning is required, the scale and nature of activities would use similar methods as those required to install the assets. The main components would be dismantled and removed for recycling wherever possible.

Walpole B Substation

4.8.5 Typically, the above ground features of the Walpole B Substation would be removed (unless otherwise agreed). Any above ground buildings would be demolished and taken off site for suitable disposal along with any other above ground features such as electrical equipment. Any temporary access tracks and working areas required would be removed and the site reinstated to an appropriate end use.

HVAC and HVDC Underground Cables

4.8.6 Dependent on the requirements at the time, the redundant cables could either be left in-situ, or all or parts of the cable could be removed for recycling. Where this is not possible, removed cables would be disposed of in accordance with the relevant waste disposal regulations at the time of decommissioning. If decommissioning is required, it is expected that it would use similar methods as those required to install the assets.

Landfall

4.8.7 The expected minimum operational life of the proposed landfall infrastructure is 40 years, with replacement only expected to occur upon the failing of specific assets.

4.8.8 The below ground transition joint bay providing onshore to offshore cable interface may be left in place as well as the ducts installed to bring the cables onshore. As a result, it is expected that there would be similar methods to remove these components as those used to install the asset.

Overhead Line

4.8.9 Sections of overhead line which connect into the Walpole B Substation would be removed. Fittings such as dampers and spacers would be removed from the conductors. The conductors would be cut into manageable lengths or would be winched onto drums in a reverse process to that described for construction. The conductor, fittings and insulator assemblies would be removed from the pylons and lowered to the ground.

4.8.10 Each pylon would most likely be dismantled by crane, with sections cut and lowered to the ground for further dismantling and removal from site. Depending on the access and space available, it may be possible to cut the pylon legs and then pull the pylon to the ground using a tractor. The pylon could be cut into sections on the ground. Unless there was a compelling need for removal of all the foundations, these would be removed to approximately 1.5 m deep, sufficient for safe agricultural use of the land and subsoil and topsoil reinstated. All waste would be removed from site and recycled in line with waste disposal regulations at the time.

Offshore Cable

4.8.11 The minimum design life of the Projects subsea cables is 40 years, although with repairs, some cable systems last upwards of 60 years. The English Offshore Scheme will require a Licence or Lease from The Crown Estate. An Initial Decommissioning Plan (IDP) will be written once the final route and construction methodology is chosen. This is a legal requirement necessary to secure The Crown Estate Licence. The IDP will form the basis of the Final Decommissioning Plan which would be developed in consultation with The Crown Estate and in line with the following decommissioning principles:

- The measures and methods for any decommissioning would comply with any legal obligations which would apply to the decommissioning of the English Offshore Scheme when it takes place;
- All sections of the cables within 12 NM would be removed except for any section or sections which are preferable to leave in situ having regard to the principles below;
  - that the measures and methods for any decommissioning are the best for, or minimise the risks to:

    - the safety of surface or subsurface navigation;
    - other uses of the sea;
    - the marine environment including living resources; and/or; and
    - health and safety.
- The seabed would be restored, as reasonably as possible and to the extent reasonably practicable, to the condition that it was in before the cable was installed.

4.8.12 The IDP is periodically reviewed and updated in line with the applicable guidance and regulations at the time of writing.

4.8.13 The full environmental impact of works required to decommission the Projects would be assessed at the time of decommissioning. Removal of the subsea cable is a similar process to the installation of the cable, but in reverse. The environmental impact can therefore not be fully assessed until the environmental conditions at the time of decommissioning are established.

Environmental Effects of Decommissioning

4.8.14 It is anticipated that rather than the Projects be decommissioned, parts would be replaced to extend the operational life. As such, the operational assessments in the PEIR have been undertaken under the assumption that the Projects will continue to operate in perpetuity. For the English Onshore Scheme in particular, the environmental impact of decommissioning cannot be fully assessed until the environmental conditions at the time of decommissioning are established. It is not anticipated that impacts from decommissioning would be any greater than impacts from the construction phase.

4.8.15 Acknowledging the complexities of completing a detailed assessment for decommissioning works up to 40 years in the future for the English Onshore Scheme and given that there are no current plans to decommission the Projects, an assessment of effects associated with decommissioning is not presented in **Volume 1, Part 2 English Onshore Scheme** and **Part 4** of this PEIR. Instead **Table 4-21** below summarises the assessment of the likely significant effects associated with decommissioning for each environmental aspect based on existing information. **Table 4-21** assumes that standard good practice measures would be implemented during decommissioning activities, as these would be typical measures employed on large NGET contracts. **Table 4-21** does not consider changes to the baseline environment, outside of those noted within the future baseline section of **Volume 1, Part 2, Chapters 6 – 16** and **Volume 1, Part 4, Chapter 27 - 28**, as there could be a number of scenarios that could occur. However, it is noted that the baseline environment could change and would be assessed at the time of decommissioning.

4.8.16 Given the level of information available regarding the approach to decommissioning for the English Offshore Scheme, reasonable assumptions with regards to likely environmental impacts at the time of decommissioning can be made. As such, **Volume 1, Part 3, English Offshore Scheme** has considered impacts associated with decommissioning within the technical aspect chapters.

Table 4-21 – Preliminary summary of decommissioning effects

Aspect	Summary Assessment
Part 2, English Onshore Scheme	
Chapter 6 Biodiversity	The footprint of any decommissioning works is likely to be the same, or smaller, than the ground disturbed during construction of the English Onshore Scheme and the effects are anticipated to be no worse than those identified during construction. There could be effects to protected species and habitats at the time of decommissioning. However, these are likely to be managed through standard good practice measures and/or the measures set out in relevant consents or European Protected Species (EPS) licences required at the time, as informed by update baseline ecological surveys and assessment. Therefore, significant effects to biodiversity during decommissioning are predicted to the same (or less) than those identified by the construction stage assessment.
Chapter 7 Cultural Heritage	The footprint of any decommissioning works is likely to be smaller than the ground disturbed during construction of the English Onshore Scheme. As the ground within this area would already have been disturbed during construction, it is unlikely that archaeological remains would be present. Therefore, there are unlikely to be any significant effects to buried archaeology during decommissioning. There could be impacts on the setting of heritage assets during decommissioning (namely the Grade I listed Church of St Mary (NHLE 1077676) and its separate bell tower (NHLE 1171875), the Grade II listed buildings of Ingleborough Mill (NHLE 1077675), Shepherds Cottage (NHLE 1264180), Faulkner House (NHLE 1237331), but these would be the same as the construction effects, only for a shorter duration. Removal of the Walpole B Substation would remove all impacts to the Medieval Moated site (MNF2207).
Chapter 8 Landscape and Visual Amenity	The footprint of any decommissioning works is likely to be the same, or smaller, than the ground disturbed during construction of the English Onshore Scheme and the effects are anticipated to be no worse than those identified during construction. The removal of above ground infrastructure to foundation level including the converter stations, Walpole B Substation and overhead lines could have beneficial effects on views and the landscape character of the area during decommissioning works, however these are unlikely to be significant. Significant effects to landscape and visual amenity during decommissioning are therefore predicted to be the same (or less) than those identified by the construction stage assessment.
Chapter 9 Water Environment	The footprint of any decommissioning works is likely to be the same, or smaller, than the ground disturbed during construction of the English Onshore Scheme and the effects are anticipated to be no worse than those identified during construction. There could be short-term temporary effects to watercourses (e.g. pollution risks) and on the land drainage regime during

Aspect	Summary Assessment
	decommissioning. However, these effects would be expected to be managed by standard good practice measures applied at the time. Therefore, no likely significant effects to the water environment during decommissioning are anticipated.
Chapter 10 Geology and Hydrogeology	The removal of the above ground infrastructure to foundation level is not likely to have significant effects on the geology. The removal of underground cables and associated underground infrastructure if conducted in a similar manner to the installation is unlikely to have significant effects on the geology. Leaving underground cables in situ in part or entirely is unlikely to have significant effects on the geology. There is the potential for short-term temporary effects to hydrogeology (e.g. pollution risks from contaminated land) during decommissioning. However, these effects would be managed by standard good practice measures applied at the time. Therefore, there are unlikely to be any significant effects to the geology and hydrogeology during decommissioning.
Chapter 11 Agriculture and Soils	The footprint of any decommissioning works is likely to be the same, or smaller, than that required for the construction of the English Onshore Scheme and the effects are anticipated to be no worse than those identified during construction. There could be temporary loss of agricultural land, including best and most versatile (BMV) land, temporary disruption to agricultural operations and temporary impacts on soil function. However, all land would be reinstated to its pre-decommissioning condition and as such there are unlikely to be any significant effects to agriculture and soils during decommissioning.
Chapter 12 Traffic and Transport	The decommissioning works would generate traffic associated with the construction vehicles required to transport materials off site and associated staff vehicles. The decommissioning works are likely to involve a similar, or smaller, workforce than during construction as the works could be phased and managed. Therefore, significant effects to traffic and transport during decommissioning are predicted to be the same (or less) than those identified by the construction stage assessment.
Chapter 13 Noise and Vibration	The decommissioning of the English Onshore Scheme, including demolition of the converter stations, and excavation and removal of underground cabling has the potential to generate short-term, localised noise and vibration impacts. However, it is unlikely that these noise and vibration impacts would be materially different to those identified during the construction phase. Furthermore, given that decommissioning is expected to occur at least 40 years in the future, advancements in vehicle and machinery technology are likely to reduce noise and vibration generation. Where noise and vibration levels hold the potential to exceed acceptable thresholds, best practicable means (BPM) would be implemented to control these, including measures such as noise barriers and plant specification, to reduce the generated impacts. As such significant effects from noise

Aspect	Summary Assessment
	and vibration during decommissioning are considered unlikely subject to the implementation of these controls.
Chapter 14 Air Quality	There is potential for emissions to air to be generated from vehicle exhaust emissions, Non-Road Mobile Machinery and diesel generators associated with the decommissioning phase of the English Onshore Scheme. However, in the future when decommissioning is likely to take place, emissions from vehicles and generators are predicted to decrease over time due to new technology, increasingly stringent emission regulations and cleaner fuel formulations. Therefore, there are unlikely to be significant effects on air quality associated with vehicle emissions and generators during the decommissioning phase of the English Onshore Scheme. There is also potential for fugitive dust emissions to arise from construction activities. However, these effects would be managed by standard good practice measures applied at the time. Assuming standard good practice measures are implemented, residual effect from all dust generating activities are unlikely to be significant during the decommissioning phase of the English Onshore Scheme.
Chapter 15 Socio-economics, Recreation and Tourism	The footprint of any decommissioning works is likely to be the same, or smaller than during construction of the English Onshore Scheme and the effects are anticipated to be no worse than those identified during construction. There is the potential for short-term, temporary effects on amenity for residents, recreational users of PRoW, tourist and community facilities, associated with air quality and dust, noise and vibration, and visual impacts. In line with the above assessments however, these are anticipated to be not significant during decommissioning, and therefore any perceptible adverse impact on residential, recreational, tourist and community receptors are considered to be not significant. These effects are expected to be managed by standard good practice measures applied at the time. Given the works associated with decommissioning are anticipated to be smaller than during construction, any beneficial effects relating to construction employment generation are also anticipated to be short term, temporary, and minor. It is not considered that temporary accommodation for construction employees will be required, due to the scale, duration, and short term nature of the decommissioning works. Therefore, no likely significant effects related to Socio-economics, Recreation and Tourism during decommissioning are anticipated.
Chapter 16 Health and Wellbeing	The footprint and nature, and thereby impacts, of any decommissioning works is likely to be the same, or smaller, than that during construction of the English Onshore Scheme and the effects are anticipated to be no worse than those identified during construction for health and wellbeing.

Aspect	Summary Assessment
Part 4, Project Wide	
Chapter 27 Greenhouse Gases	The scale of GHG emissions associated with any future decommissioning works are forecast to be lower than currently assessed for the construction phase. There are no additional activities specific to decommissioning not identified in the construction phase assessment. In practice, items such as marine cables may be left in-situ rather than being recovered. Plant equipment and marine vessels associated with any works are likely to be less carbon intensive due to future fuel switching or use of alternative fuels.
Chapter 28 Cumulative Effects	The combined effects would depend on the potential effects identified from the different aspects at the time. However, it is unlikely that the effects would be different to those identified within individual aspect chapters and therefore there would be no new or different significant effects for the decommissioning phase when compared to construction of the Projects. The cumulative effects assessment would depend on the proposed developments within the vicinity at the time of decommissioning. Therefore, an assessment of cumulative effects is not possible at the current time

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