Rampion 2 Wind Farm

Category 5: Reports

Cable and Grid Connection Statement

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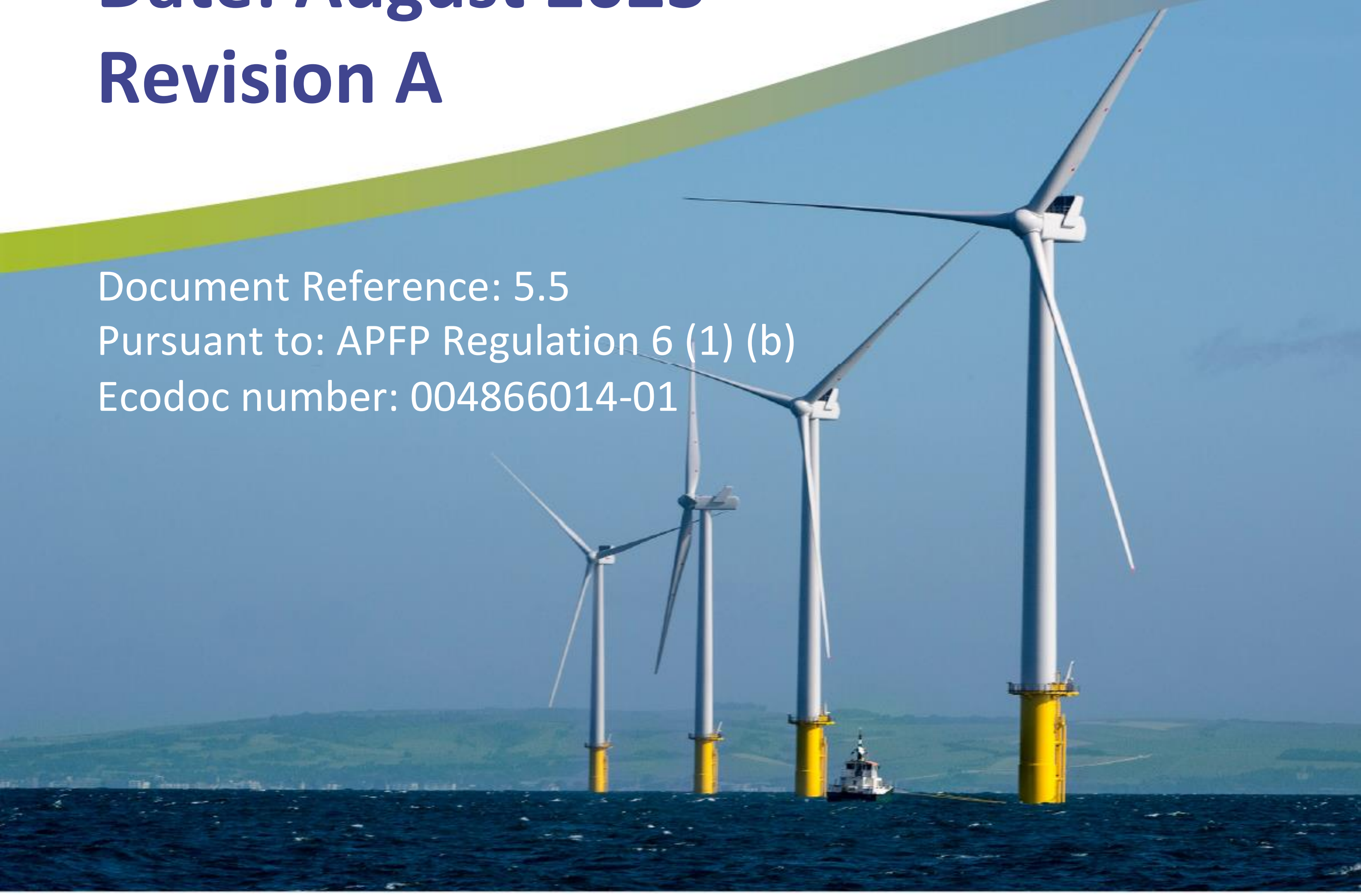

Document revisions

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1. Cable Statement

1.1.1 Regulation 6(1)(b)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (the APFP Regulations) requires the applicant for an offshore generating station to provide 'details of the proposed route and method of installation for any cable' to accompany an application for Development Consent Order (DCO). This document contains these details.

1.2 Cable components of the Proposed Development

1.2.1 The cable components of the Proposed Development are:

- Inter-array cables connecting up to 90 WTG (wind turbine generators) to each other and up to 3 different offshore substations;
- up to four offshore export cables, each in its own trench, to connect to the onshore export cable circuits at the landfall;
- up to two offshore interconnector export cables between the offshore substations;
- up to four onshore export cable circuits, each in its own trench, to connect the landfall to the new onshore substation, proposed near Cowfold, Horsham District; and
- up to two onshore export cable circuits, each in its own trench to connect the onshore substation to an extension to the existing National Grid Bolney substation, Mid Sussex District.

1.3 Description of offshore cables

Array cables

1.3.1 Subsea array cables will connect the (WTGs to each other in strings. The array cable strings will connect the WTGs to the offshore substations. The array cable profile will likely be a three core, armoured cable with copper or aluminium conductors covered in insulation material. The array cables will also contain fibre-optic cores that will be used for protection, control and communications systems. The array cables will be up to 132kV and the length of cable will be dependent on the distance between the WTGs. The total maximum array cable length is expected to be 250km. **Table 1-1** presents the key assessment assumptions for the array cables.

Table 1-1 Maximum array cable assessment assumptions

Assessment assumption	Maximum value
Total array cable length	250km
Array cable depth	1m target depth
Cable diameter	Up to 350mm
Cable trench width	2m
Voltage	Up to 132kV

Interconnector export cables

1.3.2 The Proposed Development may use two offshore interconnector cables to link together the offshore substations in the array area. These interconnector cables also ensure that in the event of one cable failing, the flow of electricity can continue through the other cable(s).

1.3.3 The interconnector cables are likely to be armoured and have three core cables with copper or aluminium conductors and cross-linked polyethylene (XLPE) insulation, with a voltage up to 275kV. The interconnector cables will also contain fibre-optic cores that will be used for protection, control and communications systems. **Table 1-2** provides the assessment assumptions for the offshore interconnector cables.

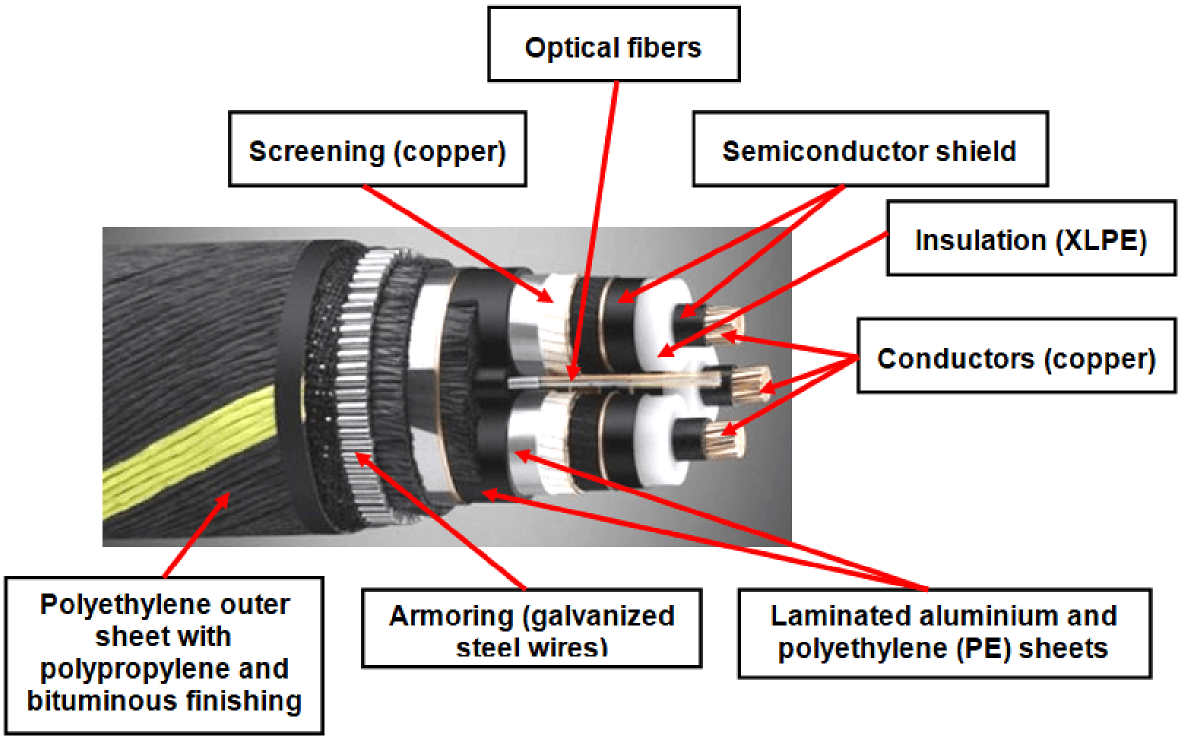
Table 1-2 Maximum offshore interconnector cable assessment assumptions

Assessment assumption	Maximum value
Number of cables	2
Total cable length	40km
Interconnector cable burial depth	1m target depth
Cable diameter	Up to 350mm
Interconnector cable trench width	2m
Voltage	up to 275kV

Export cables

1.3.4 The main export cables will connect the offshore substations to the shore. They are likely to be armoured and have three core cables with copper or aluminium conductors and XLPE insulation, at a voltage up to 275kV. The cross-section of a typical XLPE insulated three copper core export cable is shown in **Graphic 1-1.** The export cables will also contain fibre-optic cores that will be used for protection, control, and communications systems.

Graphic 1-1 Typical cross-sectional details through a three core high voltage export cable



1.3.5 Electricity from the offshore substation(s) will be transmitted via a maximum of four export cables to the transition joint bays located at the landfall near Climping Beach, West Sussex. It is anticipated the export cables will be laid in separate trenches at different times and installed via either ploughing, jetting, trenching, or post-lay burial techniques. The choice of technique will be dependent on ground conditions along the specific export cable routes.

1.3.6 The export cables will be typically buried at a target burial depth of 1.0 to 1.5m below the seabed surface depending on the outcome of the cable burial risk assessment. The exact routing of the export cables within the offshore cable corridor will be determined during the detailed design of the Proposed Development, with consideration of seabed conditions and environmental sensitivities. There are no known third-party cables within the offshore export cable corridor for the Proposed Development. **Table 1-3** provides the assessment assumptions for the offshore export cables.

Table 1-3 Maximum export cable assessment assumptions

Assessment assumption	Maximum value
Export cable	
Export cable rated capacity	Up to 275kV
Number of high voltage alternating current (HVAC) offshore cables	4

Assessment assumption	Maximum value
Export cable trenches	Up to 4
Fibre optic cables	Bundled into export cable
Export cable trench depth	1.0m to 1.5m
Export cable trench width	2m
Export cable corridor	$59km^2$
Number of cable circuits (HVAC)	4
Cable diameter	Up to 350mm
Export cable corridor	
Length of offshore cable corridor, link to shore	17km
Width of offshore cable corridor, link to shore	1.5km
Total length of export cables	**170km**

1.4 Route of offshore cables

1.4.1 There are currently no defined routes for any of the offshore cables as the application is based around a Rochdale envelope. However the Offshore Works Plan (Document Reference 2.2.1) sets out where the cable routing will be designed within.

1.5 Seabed preparation for offshore cables

1.5.1 Following the completion of all preconstruction activities, including satisfying pre-construction statutory consent conditions, engineering, design and procurement and detailed site surveys, seabed preparation is one of the first elements of the offshore construction process for the offshore cables.

1.5.2 Requirements for seabed preparation will vary according to the specific ground conditions and the type of infrastructure being installed. Detailed geophysical surveys will be carried out pre-construction to provide further detail and to clarify the presence of boulders, unexploded ordnance (UXO) and other obstructions on the seabed.

UXO Clearance

1.5.3 Where UXO are identified, the initial process will be to undertake a risk assessment to determine the appropriate action (including avoidance, removal or in situ detonation. Recent advancements in the available methods for UXO clearance, mean that high-order detonation may be avoided. The methods of UXO clearance considered for the Proposed Development may include:

- High-order detonation;
- Low-order detonation (deflagration);
- Removal/relocation; and
- Other less intrusive means of neutralising the UXO.

Boulder clearance

1.5.4 Geophysical surveys will be undertaken within the Offshore Array Area and Offshore Export Cable Corridor and will be used to inform boulder clearance requirements.

1.5.5 Where large volumes of boulders are present, micrositing of cables around these would be onerous and impractical. If left in-situ, these boulders will pose the following risks:

- exposure of cables and/or shallow buried cables, that might lead to the requirement for post-lay cable protection such as rock placement;
- obstruction risk to the cable installation equipment, leading to damage and/or multiple passes and therefore, a delayed cable installation programme (with no guarantee of achieving target burial depth); and
- risk of damage to the cable assets.

1.5.6 Based on current industry experience the following assumptions are made:

- boulders greater than 0.3m in any dimension must be cleared;
- for cables within the Offshore Export Cable Corridor, a corridor of up to 25m per cable (circuit) must be cleared to ensure that all the export cable burial tools being considered can operate in the cleared corridors;
- for cables within the Offshore Array Area, a corridor of up to 25m must be cleared per cable circuit as this width is sufficient for the operation of the cable burial tools under consideration.

1.5.7 There are two key methods of clearing boulders, boulder plough and boulder grab. Where a high density of boulders is seen, the expectation is that a plough will be required to clear the cable installation corridor. Where medium and low densities of boulders are seen, a subsea grab is expected to be employed.

Pre-lay grapnel run

1.5.8 Following the pre-construction route survey and boulder clearance works, a Pre-Lay Grapnel Run (PLGR) and an associated route clearance survey of the final cable route will be undertaken. A vessel will be mobilised with a series of grapnels, chains, recovery winch and survey spread suitable for vessel positioning and data logging. Any items recorded will be recovered onto deck where possible and the results of this survey will be used to determine the need for any further clearance. The PLGR work will take account of and adhere to any archaeological protocols developed for the Proposed Development.

1.5.9 **Table 1-4** provides detail of the maximum assessment assumptions for the seabed preparation works for the Proposed Development associated with the offshore cables. The table identifies the use of both a pre-lay plough and a subsea grab for boulder clearance. Pre-lay ploughs are designed to be pulled along the seabed in areas of high densities of boulders or where large boulders are present. They clear the corridor ready for cable installation and can also have the capability to concurrently form a cable trench. Sub-sea grabs are operated from vessels (e.g., multicat vessels) and are able to pick-up and relocate boulders in areas where low densities of boulders are present.

1.5.10 Until the array layout is finalised, and the associated geophysical data is analysed in detail, it will not be known if sand waves will be affected by the works. Estimates are provided of sand wave clearance quantities for the maximum design scenario for assessment purposes.

Table 1-4 Seabed preparation maximum assessment assumptions

Assessment assumption	Maximum value
Unexploded Ordnance clearance	
Avoidance buffer: Cables Exclusion Zone Radius (from each cable)	40m
Boulder clearance in the Proposed Development array area	
Array cable corridor (all cables) width: pre-lay plough	25m
Export interconnector cable clearance corridor width: pre-lay plough	25m
Clearance corridor width: subsea grab	15m
Total clearance impact area: pre-lay plough for cables	8,800,000m^2
Total clearance impact area: subsea grab for cables	5,280,000m^2
Boulder clearance in the Proposed Development offshore export cable corridor	
Clearance corridor width: pre-lay plough	25m
Clearance corridor width: subsea grab	15m

Assessment assumption	Maximum value
Total clearance impact area: pre-lay plough	1,700,000m^2
Total clearance impact area: subsea grab	1,020,000m^2
Sandwave clearance in the Proposed Development array area[1]	
Sandwave clearance impact width: array and interconnector cables	10m
Length of array cables affected by sandwaves	60km
Sand-wave clearance: total in array area (export cables, array cables, interconnector cables and foundations)	1,375,000m^3

1.6 Offshore cable installation

Overview

1.6.1 Cables will be buried below the seabed, to a target burial depth of 1-1.5m, wherever possible. The installation method and target burial depth will be defined post consent based on a cable burial risk assessment considering ground conditions as well as the potential for impacts upon cables such as from trawling and vessel anchors.

1.6.2 It is anticipated that the offshore cables will be installed via either ploughing, jetting, trenching, or a combination of these techniques, depending on ground conditions along the specific cable route. An example cable installation vessel is shown in **Graphic 1-2**.

[1] Note: no sandwaves are expected on the export cable route.

Graphic 1-2 Example export cable installation vessel (Rampion 1 offshore wind farm)

Ploughing

1.6.3 This method involves a blade, which cuts through the seabed and the cable is laid behind. Ploughs are generally pulled directly by a surface vessel or they can be mounted onto a self-propelled tracked vehicle which runs along the seabed. Cable ploughs are usually deployed in simultaneous 'lay and trench' mode although it is possible to use the plough to cut a trench for the cable to be installed at a later date provided the ground conditions are suitable. When installing the cable in simultaneous lay and trench operation the plough may use cable depressors to push the cable into position at the base of the cut trench; as the plough proceeds the trench is backfilled to provide immediate burial.

1.6.4 Ploughs can be used in seabed geology ranging from very soft mud through to firm clays but, in general, ploughs are not suited to harder substrates such as boulder clay. Some ploughs are fitted with water jet assist options and/or hydraulic chain cutters to work through patches of harder soils. A typical plough design is shown in **Graphic 1-3.**

Graphic 1-3 Typical marine cable installation plough

Jetting

1.6.5 This method involves directing water jets towards the seabed to fluidise and displace the seabed sediment. This forms a typically rectangular trench into which the cable generally settles under its own weight.

1.6.6 The water jets are usually deployed on jetting arms beneath a remotely operated vehicle (ROV) system that can be free-swimming or based on passive skids or active tracks. There are also towed jetting skids available for the installation of cables.

1.6.7 During the formation of the trench the displaced sediment is forced into suspension and settles out at a rate determined by the sediment particle size, density and ambient flow conditions. The jetting process is not intended to displace sediment to an extent that it is totally removed out of the trench; moreover, it requires that the fluidised sediment is available to fall back into the trench for immediate burial through settling. It is only the finer fractions of sediments that are likely to be held in suspension long enough to become prone to dispersal away from the trench as a plume.

1.6.8 A key benefit of a jetting tool is that it can operate close to structures and it is also possible to use jetting tools for remedial burial if required. Typically, there are two methods of water jetting available: 'Seabed Fluidisation' and 'Forward Jetting a Trench'.

1.6.9 Seabed Fluidisation involves first laying the cable on the seabed and afterwards positioning a jetting sledge above the cable. Jets on the sledge flush water beneath the cable fluidising the soil whereby the cable, by its own weight, sinks to the depth set by the operator.

1.6.10 Forward Jetting a Trench uses water jets to jet out a trench ahead of cable lay. The cable can typically be laid into the trench behind the jetting lance. An example of the vessel and equipment used to jet cables into the seabed is shown in **Graphic 1-4** and **Graphic 1-5.**

Graphic 1-4 Example array cable installation vessel (Rampion 1 offshore wind farm)

Graphic 1-5 Typical marine cable jetting seabed fluidiser

Trenching

1.6.11 Trenching involves the excavation of a trench whilst temporarily placing the excavated sediment adjacent to the trench. The cable is then laid, and the displaced sediment used to back-fill the trench, covering the cable. This is most commonly used where the cable must be installed through an area of rock or seabed composed of a more resistant material. Trenching is a difficult, time-consuming and expensive method to use compared to other methods and will only be used in exceptional circumstances.

Cable protection

1.6.12 There is likely to be a requirement for cable protection to be installed around the inter-array cables as they transition from the seabed to enter the WTG via internal or external J-tubes or I-tubes (hollow tubes hung from the foundation that are in the shape of an “J” or “I”). The exact amount of cable protection required on each cable end will depend on the burial depths achieved by the inter-array cable installation and assessment of the scour and movement that could occur during the operating life of the offshore wind farm.

1.6.13 Cable protection will also be required where cable burial depth is not achieved or possible due to ground conditions and at third party cable crossings which may occur on the cable routes. It is estimated that approximately 20% of the array cable may require protection measures.

1.6.14 Following a judicial review challenging the Secretary of State’s decision not to grant development consent to AQUIND in February 2023, the decision was quashed and is now being redetermined. If approved and built, the AQUIND interconnector cable is proposed to cross the western part of the proposed DCO Order Limits. In the eventuality that cable crossings are required for this cable or any other potentially unknown subsea cables / pipelines, then a methodology will be agreed in collaboration with the relevant infrastructure owners.

1.6.15 The exact form of cable protection used will depend upon local ground conditions, hydrodynamic processes and the selected cable protection contractor. However, the final choice will include one or more of the following:

- concrete ‘mattresses’;
- rock placement;
- geotextile bags filled with stone, rock or gravel;
- polyethylene or steel pipe half shells, or sheathes; and / or
- bags of grout, concrete, or another substance that cures hard over time.

1.6.16 If rock placement, or filled bags are used to protect cables, they are typically used to construct a berm on the seabed on top of the cable. The rock placement method of cable protection involves placing rocks of different grade sizes from a fall pipe vessel over the cable. Initially smaller stones are placed over the cable as a covering layer. This provides protection from any impact from larger grade size rocks, which are then placed on top. The rock berm will be up to 1m in height and a maximum of 6m wide.

Installation of array cables

1.6.17 The array cables will typically be buried at a target burial depth of 1m below the seabed surface depending on the outcome of the cable burial risk assessment. The final depth of the cables will be dependent on the seabed geological conditions and the risks to the cable (for example from anchor drag damage). Cable installation may require some form of seabed preparation which may include a Pre-Lay plough, boulder relocation and possibly sandwave clearance.

1.6.18 The array cables will be manufactured at a specialist supplier's factory. The manufactured cables will be spooled from the factory onto cable carousels situated on a transport vessel or directly onto the installation vessel itself, moored at an adjacent quayside. If a transport vessel is used, the cables will be subsequently transpooled onto the installation vessel at a local port before it transits to the Proposed Development site for installation.

1.6.19 It is anticipated that the installation of the array cables will take place over two spring / summer seasons of up to six months each. **Table 1-5** presents the key assessment assumptions for the array cable installation.

Table 1-5 Maximum array cable installation assessment assumptions

Assessment assumption	Maximum value
Array cable installation	
Installation methodology	Plough, trencher or jetter (using pre- or post-lay burial techniques)
Target burial depth	1m
Width of seabed affected by array cable installation	25m
Total seabed disturbance	6,250,000m^2
Burial spoil: ploughing and jetting	500,000m^3
Duration: per array link (hours) – Jetting	Approximately 12hrs
Duration: per array link (hours) – Ploughing	Approximately 30hrs
Duration: total (months)	12 months
Jetting excavation rate – soft soil	300m/hr
Jetting excavation rate – loose soil	125m/hr
Ploughing excavation rate – medium soil	125m/hr
Ploughing excavation rate – hard soil	50m/hr
Rock placement	
Rock protection area	300,000m^2

Assessment assumption	Maximum value
Rock protection volume	175,000m^3
Number of crossings (estimate)	4
Cable/pipe crossings: total impacted area	10,000m^2
Cable/pipe crossings: pre-lay rock berm volume	10,000m^3
Cable/pipe crossings: post-lay rock berm volume	10,000m^3
Height of rock berm	1m
Width of rock berm	6m
Proportion of array cable requiring protection	20%
Replenishment during operations (% of construction total)	25%
Cable rock protection: maximum rock size	0.3m
Vessel requirements	
Number of main laying vessels	3
Number of main burial vessels	3
Number of trenching vessels	2
Number of crew boats or SOVs	6
Number of service vessels for pre-rigging of towers	2
Number of diver vessels	2
Number of vessels for Pre-Lay plough	2
Number of dredging vessels	1
Main laying vessels (total number of return trips)	12
Main burial vessels (total number of return trips)	6

Assessment assumption	Maximum value
Support vessels (total number of return trips)	300

Installation of interconnector cables

1.6.20 Like the installation of array cables, the installation of the interconnector cables is expected to require either ploughing, trenching, jetting, or a combination of these techniques. **Table 1-6** provides the assessment assumptions for the installation of the offshore interconnector cables.

Table 1-6 Maximum offshore interconnector cable installation assessment assumptions

Assessment assumption	Maximum value
Cable protection area	122,000m^2
Cable protection volume	110,500m^3
Installation methodology	Plough, trencher or jetter
Target burial depth	1m
Total seabed disturbance	1,000,000m^2
Burial spoil – jetting	80,000m^3
Burial spoil – ploughing / trenching	80,000m^3
Jetting excavation rate – soft soil	300m/hr
Jetting excavation rate – loose soil	125m/hr
Ploughing excavation rate – medium soil	125m/hr
Ploughing excavation rate – hard soil	50m/hr
Trenching machine excavation rate - soft soil	200m/hr
Trenching machine excavation rate - hard soil	50m/hr

Export cable installation

1.6.21 Similar to the installation of array cables and interconnector cables, the installation of the export cables is likely to involve the burial of the cables below the seabed using ploughing, trenching, or jetting. It is anticipated that a combination of these three methods may be used depending on seabed conditions. No crossings are required along the export cable route. Installation is likely to involve the following activities:

- jet-trenching;
- pre-cut and post-lay ploughing or simultaneous lay and plough;
- mechanical trenching (such as chain or wheel cutting);
- dredging (typically trailing hopper suction dredging (THSD) and backhoe dredging or water injection dredging);
- mass flow excavation;
- rock cutting;
- burial sledge;
- surface laid / self-burying cable; and
- cable installed in pipe / duct.

1.6.22 Duct extensions may be required to enable the landfall HDD ducts to be extended further offshore to facilitate cable installation from an installation vessel situated offshore. These duct extensions will be of a similar diameter to the HDD ducts and installed in their own trench at a similar depth of cover to the export cables. The duct extensions will be backfilled before the arrival of the cable installation vessel.

1.6.23 In shallow water sections of the export cable route, where ground conditions are not suitable to 'ground out' the export cable installation vessel on the seabed, the construction of temporary sand / gravel beds may be required. These beds will allow the vessel to safely 'ground out' before pulling and installing the cables. Following cable installation, these sand/gravel beds will be removed.

1.6.24 The cables will be manufactured at a specialist supplier's factory. The manufactured cables will be spooled from the factory to cable carousels situated on a transport vessel or directly onto the installation vessel itself, moored at the adjacent quayside. If a transport vessel is used, the cables will be subsequently transpooled onto the installation vessel at a local port before it transits to the Proposed Development site for installation.

1.6.25 The maximum total seabed area that may be disturbed by the installation of export cables amounts to approximately 2,015,000m^2. **Table 1-7** provides additional details on installation assessment assumptions for the export cables and vessel requirements.

Table 1-7 Maximum export cable installation assessment assumptions

Assessment assumption	Maximum value
Export cable installation	
Cable protection area	517,000m^2

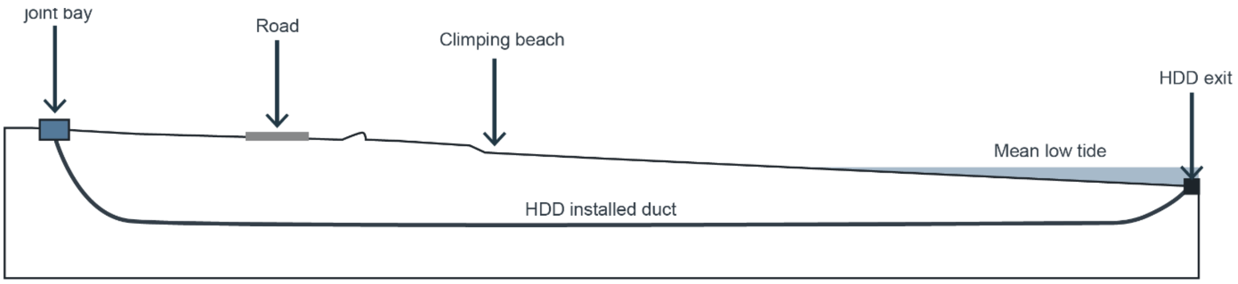
Assessment assumption	Maximum value
Cable protection volume	470,000m^3
Installation methodology	Plough, trencher or jetter
Area of temporary sand/gravel beds for grounding installation vessel	115,000m^2
Volume of temporary sand/gravel beds for grounding installation vessel	57,600m^3
Total seabed disturbance	4,250,000m^2
Burial spoil – jetting	340,000m^3
Burial spoil – ploughing/ trenching	340,000m^3
Duct extensions (total length)	4km total (one duct per cable from HDD exit pit to approximately 1km further offshore)
Duration	6 months
Jetting excavation rate – soft soil	300m/hr
Jetting excavation rate – loose soil	125m/hr
Ploughing excavation rate – medium soil	125m/hr
Ploughing excavation rate – hard soil	50m/hr
Trenching machine excavation rate - soft soil	200m/hr
Trenching machine excavation rate - hard soil	50m/hr
Vessel requirements	
Jack-up area per leg	250m^2
Jack–up number of legs	6
Number of jack-ups per exit pit	2
Number of barge groundings per exit pit	2
Number of main laying vessels	2
Main laying vessels (total number of return trips)	6
Number of trenching machines	2

Assessment assumption	Maximum value
Number of main jointing vessels	2
Main jointing vessels (total number of return trips)	6
Number of main burial vessels	2
Main burial vessels (total number of return trips)	6
Number of multicat-type vessels (for excavating duct extensions)	4
Multicat-type vessels (total number of return trips)	16
Number of spoil barges (for duct extensions)	4
Spoil barges (total number of return trips)	60
Number of support vessels	10
Support vessels (total number of return trips)	60

1.7 Export cable landfall

1.7.1 The offshore export cables will come ashore at landfall between Middleton-on-Sea and Littlehampton at Climping. To reduce the impact of the landfall, a trenchless solution, HDD, is to be used to install ducts that will house the cables under Climping beach. The ducts will run from the Transition Joint Bay (TJB), located in a field behind the beach to an offshore location. TJBs are permanent below ground infrastructure where the offshore and onshore export cables are joined. A schematic diagram to illustrate how the ducts will be installed is shown in **Graphic 1-6**.

Graphic 1-6 Schematic of landfall crossing



1.7.2 The offshore export cables will be pulled ashore through these pre-installed HDD ducts and will interface with the onshore cables at the TJB.

1.7.3 Landfall works include:

- construction of access to the Climping compound;
- construction of the Climping compound;
- HDD works (24 hour working);
- construction of TJBs;
- pull-in of High Density Polyethylene (HDPE) duct from barge;
- pull-in of offshore high voltage cables from vessel;
- transition jointing offshore / onshore cables;
- backfilling of joint bays; and,
- reinstatement works.

1.7.4 Offshore works include:

- excavation of HDD exit area and trench (if required);
- assembly of HDPE duct whilst being pulled through the HDD bore to the landfall;
- laying of additional length of ducting in trench (if required); and,
- capping and burial of HDD duct end.

Access to landfall and associated temporary construction compound

Overview

1.7.5 Main temporary construction access to the landfall will be from the north through an existing road (Ferry Road) connecting into the A259. An existing field access point will be upgraded. A temporary construction access haul road will be constructed along the cable route to a temporary construction HDD compound at landfall. This temporary road will allow movement of personnel and equipment to/from the landfall temporary construction HDD compound. The landfall temporary construction HDD compound and associated temporary construction accesses will be in place from the start of construction through to completion of final cable testing activities. Operational access associated with the area will be retained.

Construction

1.7.6 The landfall temporary construction compound will be located behind Climping beach either approximately 600m or 900m north-east of Atherington. The flexibility in the location is sought to allow for ground investigation to be undertaken to inform the selection of the final location and account for the detailed design of the related offshore works. This compound will be used for the HDD activities, cable pulling and construction of the TJBs.

1.7.7 The landfall temporary construction HDD compound (approximately 100m x 120m) will be set up with required storage for materials and equipment, facilities for personnel, and area for temporary construction activities.

1.7.8 Prior to any construction, survey works and site clearance will be undertaken, this includes geotechnical, topographical, UXO and environmental surveys. The landfall temporary construction HDD compound site will be cleared (topsoil removal etc.) in line with environmental requirements, embedded mitigation measures and the temporary construction access haul road will be prepared.

1.7.9 In the landfall temporary construction HDD compound, up to four HDD pits will be dug to allow the HDD equipment to drill. Exit pits are required offshore and will be excavated by a shallow draft barge. A shallow draft barge such as that illustrated in **Graphic 1-7**, or similar, will be located at the exit point for a period of approximately 10 to 14 days while each HDD is completed, and each duct installed.

1.7.10 The export cable ducts will be installed underneath Climping beach using HDD. The drilling will start from the landfall temporary construction HDD compound for approximately 1km to exit below the mean low water spring tide (MLWS) mark. The location of the HDD exit point and therefore the length of the HDD is to be determined post-consent, following pre-construction surveys, further engineering, and offshore vessel considerations.

Graphic 1-7 Example shallow draft barge

1.7.11 The ducts (with a messenger wire inside) will be pulled through to the landfall temporary construction HDD compound pit from the barge. Once complete the seaward duct end will be capped with the messenger wire inside. A detailed construction plan for the HDD work will be produced for agreement with the regulatory authorities prior to work commencement.

1.7.12 The offshore export cable will be joined to the onshore cable within the TJB. The TJB provides a clean, dry environment where the onshore and offshore cables are jointed, and to protect the joints once completed. Four pits will be dug into the ground and lined with concrete. Once the joint is completed, the TJBs are covered and the land above reinstated. Access will be required during the operation and maintenance phase to link boxes (associated with each TJB).

1.7.13 The export cables will be pulled shoreward through the installed ducts by winching equipment stationed in the landfall temporary construction HDD compound. A cable lay barge will be stationed at the seaward duct end during the cable pulling activities. The seaward duct will be raised onto the vessel. The cable is attached to the messenger wire and pulled through the duct to the TJB. Once the cable reaches the TJB the cable lay vessel will commence the offshore cable lay. Following completion of the offshore and onshore cable installation, the cables will undergo final testing and commissioning.

1.7.14 Individual landfall construction activities (temporary construction HDD compound setup, HDD, TJB construction etc.) have relatively short durations compared with the overall landfall construction window. Due to the landfall works requiring offshore works, the scheduling of the landfall works will allow for flexibility around the offshore schedule and sufficient time for all onshore activities to be performed so as not to delay the offshore works.

Reinstatement

1.7.15 Following successful testing of the cables at the TJB the landfall temporary construction HDD compound and temporary construction access track will be removed. The landfall site will be reinstated to the original condition and handed back to the landowner, this work will include the removal of all equipment and facilities, temporary fencing, haul road and reinstatement of topsoil.

Onshore cable corridor

Introduction

1.7.16 The onshore cable corridor is routed from the landfall at Climping through to a proposed new onshore substation at Oakendene, and then onto the existing National Grid Bolney substation (see Onshore Works Plan, Doc Ref Document Reference: 2.2.2).

1.7.17 The following sections present the maximum design assessment assumptions for the onshore elements of the Proposed Development.

Onshore cable design

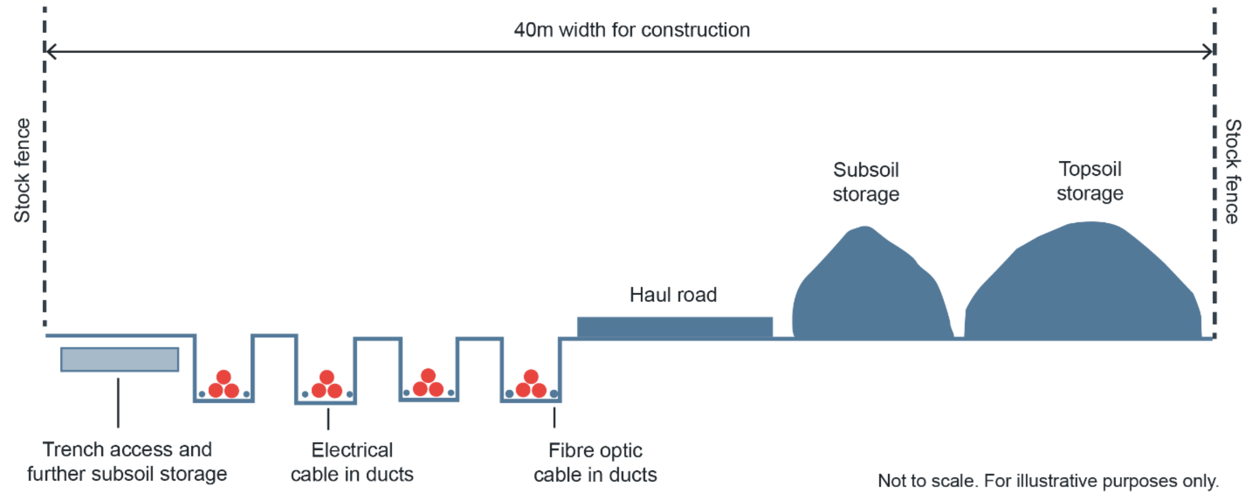
1.7.18 The cable system (up to 275kV) along the onshore cable route will comprise a maximum of 20 buried cables arranged as four cable circuits in separate trenches. These will run along the length of the onshore cable route from the landfall at Climping through to the new onshore substation at Oakendene. Each circuit will contain three Power Cables (HVACs) and two Fibre Optic Cables (FOCs) drawn through pre-installed ducts.

1.7.19 The 400kV cable system between the new onshore substation at Oakendene and the existing National Grid Bolney substation will comprise a maximum of 10 buried cables arranged as two cable circuits in separate trenches. Each circuit will contain three Power Cables and two FOCs drawn through pre-installed ducts.

1.7.20 The standard temporary construction corridor will be up to 40m wide and consist of the trenches, excavated material and a temporary construction haul road. The temporary construction corridor may require widening beyond the standard width in predetermined locations to allow enough space for access / equipment at trenchless crossings and to avoid obstacles. The proposed DCO Order Limits have been defined considering this enlargement at potential locations. Sufficient space to provide temporary drainage infrastructure has also been included in the onshore part of the proposed DCO Order Limits. The standard width is reduced in certain locations for limited lengths as a result of constraints such as watercourses or woodland.

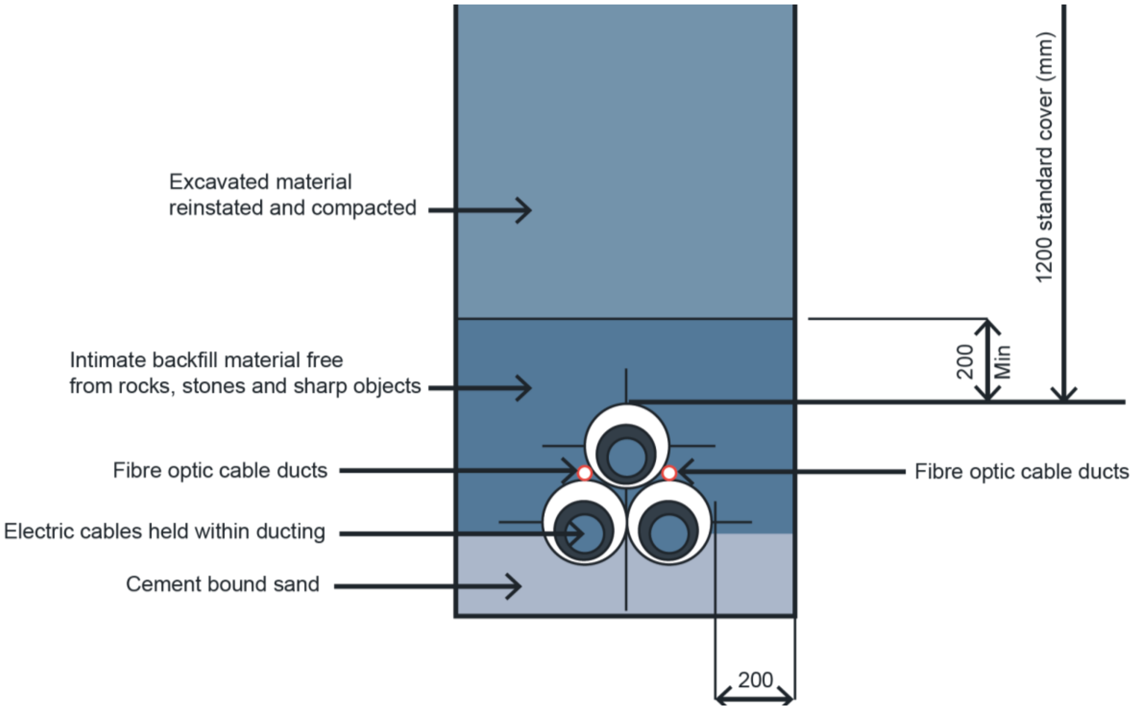
1.7.21 **Graphic 1-8** presents a cross section to illustrate the layout of a temporary construction corridor. The temporary construction corridor is generally routed as straight as possible to reduce overall length and to maximise the distance between JB (see **paragraph 1.7.27**) through lower friction between the cable and the ducts during cable pull.

Graphic 1-8 Temporary construction corridor cross section

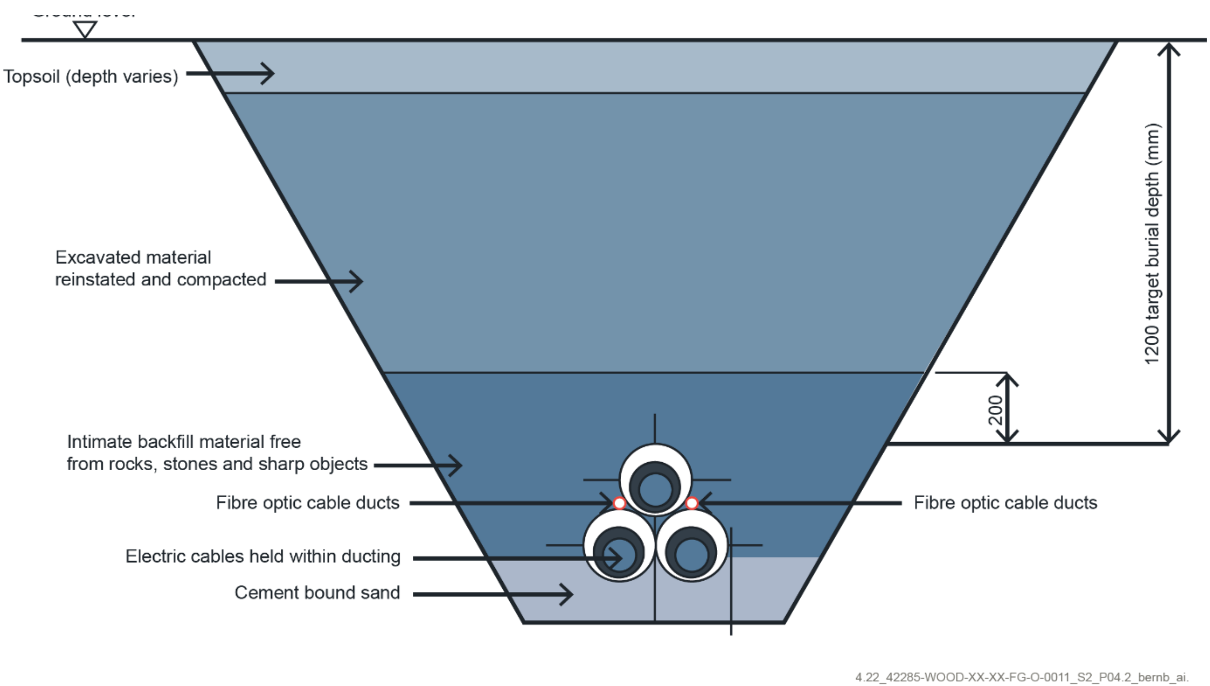


1.7.22 The temporary construction haul road will enable the transportation of plant used for topsoil stripping, subsoil excavation and for delivery of cable duct and cement bound sand (CBS) fill material. This soil will be stored in bunds within the temporary construction corridor, except for works in flood zones where specific soil storage areas have been provided to allow storage outside the floodplain. It is anticipated that a mechanical excavator will be used for these activities. **Graphic 1-9** and **Graphic 1-10** present the proposed trench profiles for hard solid ground and soil.

Graphic 1-9 Trench profile for hard/solid ground



Graphic 1-10 Trench profile for soil



1.7.23 Where required, a layer of stabilised backfill (likely sandy material) will be deposited for the purposes of protection under the cable ducts. The cable ducts will then be positioned in the trenches.

1.7.24 Trenches will be backfilled with the originally excavated material or cement bound sand (CBS) to the layer of the protective tiles/tape (use of CBS is dependent on soil thermal resistivity). Protective cover tiles/tape will be placed on top of the material to prevent the cable from being damaged. The cable protection tiles used will comply with the Energy Networks Association (ENA) Technical Specification 12-23 (ENA TA 12-23). These will typically be made of plastic and will have clear warning of the underlaid cable written on top of the tile. Any surplus material from excavation will be spread across the temporary construction corridor. The topsoil material will be reinstated, and the land returned to its original use.

1.7.25 FOCs will be installed alongside the transmission cables for communication and monitoring purposes as illustrated in **Graphic 1-9** and **Graphic 1-10**. FOCs will be of an all dielectric design. The Power cable is likely to consist of an over sheath, a metallic sheath, a metallic screen, insulation and a conductor. Power cable cores are likely to be made of copper or aluminium with XLPE insulation.

1.7.26 The onshore cable corridor assessment assumptions are provided in **Table 1-8**.

Table 1-8 Maximum onshore cable corridor assessment assumptions

Assessment assumption	Maximum value
Trench width: at base	1.2m
Trench width: at surface	Between 2m and 4m dependant on soil strength. Maximum angle of trench dependant on soil strength. Hard/solid ground: Same as base trench width.
Corridor width: permanent (easement)	Up to 25m[2]
Corridor width: temporary (construction corridor width)	Up to 40m
Corridor area: permanent (easement)	Approximately 985,000m^2 (98.5ha)
Corridor area: temporary (construction corridor width)	Approximately 1,576,000m2 (157.6ha)
Burial depth: minimum	1.2m cover to the top of the duct
Burial depth: maximum (for trenchless crossings)	Approximately 25m
Trench: depth of stabilised backfill	Approximately 0.7m
Onshore cable corridor length	Approximately 38.8km

[2] A typical corridor easement is likely to be 20m, but this may vary according to local conditions. A maximum value of 25m (excluding HDD crossing locations) has been assessed as a reasonable worst case scenario.

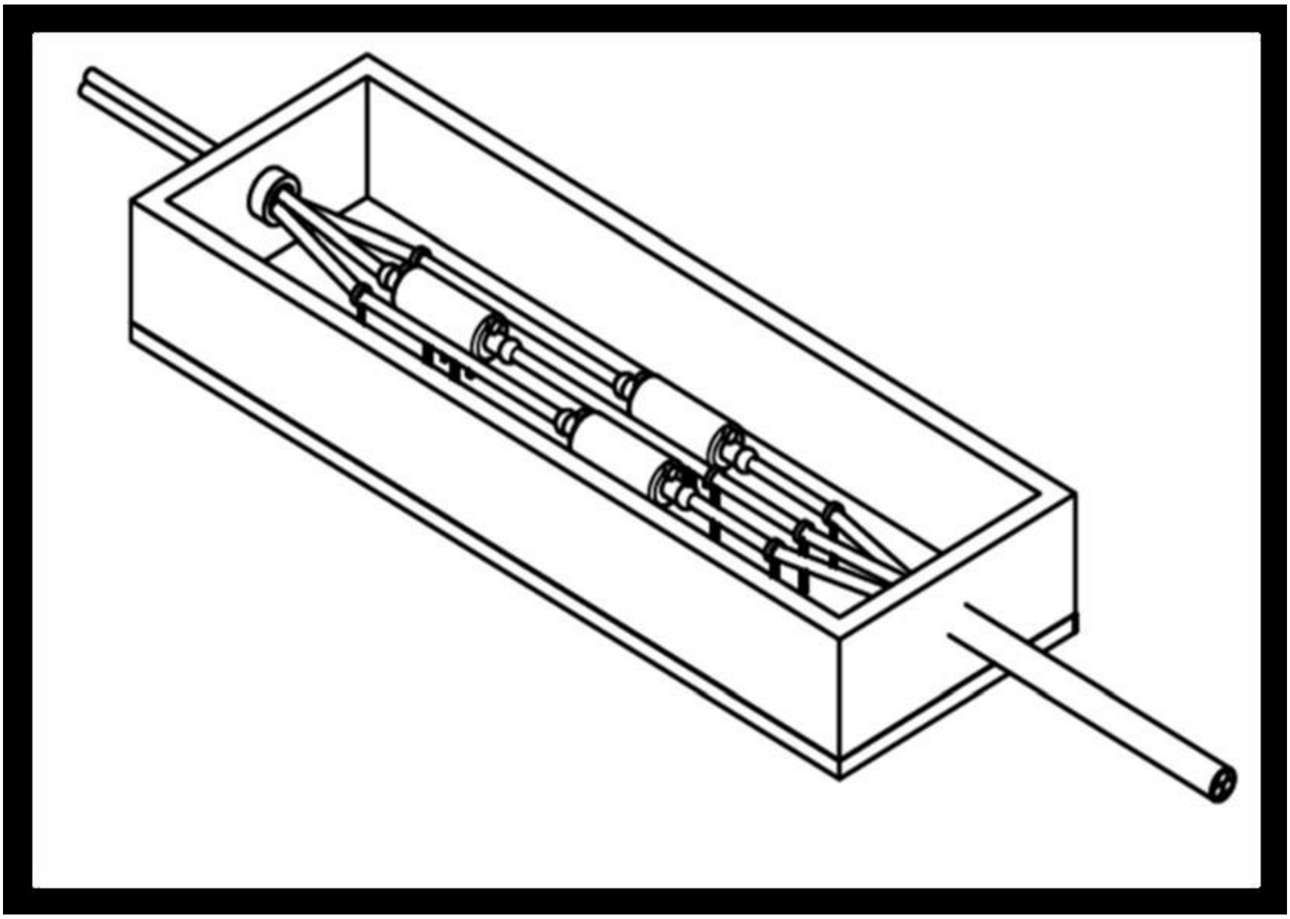
Assessment assumption	Maximum value
Number of cables (including fibre optics)	Up to 20
Number of ducts (including fibre optics)	Up to 20
Number of trenches	Up to 4
Trenchless crossings	27 trenchless crossings which are likely to utilise HDD
HVAC: number of cable circuits	Up to 4
HVAC: number of cables	2 FOCs in each circuit, up to 8 FOCs in total, with up to 12 power cables – maximum 20 individual cables
Voltage	Up to 275kV landfall to Oakendene substation; 400kV from Oakendene substation to the existing National Grid Bolney substation
Diameter of 275Kv cable	Up to 150mm
Diameter of 400kV cable	Up to 160mm
Outside diameter of duct	Up to 250mm
Total installation duration	Up to 36 months
Heavy Goods Vehicle (HGV) construction traffic movements (two-way) across the onshore cable corridor construction programme	Up to 70,468

Joint bays and cable jointing

1.7.27 Along the onshore cable route, joint bays will be constructed to enable cable installation and cable jointing. The joint bays are subsurface structures with an associated subsurface link box and Fibre Optic junction box. These link boxes enable electrical checks and testing to be carried out on the cable system during operation and maintenance.

1.7.28 The locations of the joint bays will be determined during the detailed design phase. Typically, they are located every 750 to 950m however the location depends on factors such as needing to avoid surface features, crossings and bends. Graphic 1-11**Graphic 1-12** presents an illustration of a typical joint bay configuration.

Graphic 1-11 Illustration of a typical joint bay configuration



1.7.29 **Table 1-9** provides maximum design assessment assumptions for joint bays.

Table 1-9 Joint Bay, Link Box and Fibre Optic Cable Junction Box design assessment assumptions

Assessment assumption	Maximum value
Joint Bay (JB)	
Number of JB locations	Up to 66
Number of JBs per location	Up to 4
Max distance between JBs (on one circuit)	1,000m
JB width	4m
JB length	14m
JB area	56m^2
JB depth	Up to 2m

Assessment assumption	Maximum value
JBs – total area	14,784m^2 (1.48ha)
Spoil volume per JB	Up to 118m^3
JBs – total spoil volume	31,152m^3
JB construction duration per location (does not include cable pulling duration)	6 to 8 weeks
Link Box (LBs)	
Number of LBs	264
Max distance between LBs (on one circuit)	1,000m
LB & Fibre Optic Cable Junction Box (FOCJB) dimensions (length & width)	2m x 2m
LB area	4m^2
LB depth	1m
LBs – total area	1,056m^2
Spoil Volume Per LB	4m^3
LBs – total spoil volume	1,056m^3
Fibre Optic Cable Joint Box (FOCJB)	
Number of FOCJBs	264
Maximum distance between FOCJBs (on one circuit)	1,000m
FOCJB dimensions (length & width)	2m x 2m
FOCJB area	4m^2
FOC JB depth	1m
FOCJB total area	1,056m^2
Spoil volume per FOCJB	4m^3
FOC JB total spoil volume	1,056m^3

Cable Clamping

1.7.30 There are some locations along the onshore cable route where the cable circuits will have to travel down some steep slopes. The cable itself is heavy and high mechanical loads can be generated in the cable at the top part of slopes by virtue of the cable wanting to travel down the slope under its own weight. In particular, these high mechanical loads can be subsequently transferred to the nearest adjacent joint and cause it to fail.

1.7.31 To mitigate this, cable clamping will be applied at appropriate locations, typically close to joint bay locations on the side where the downward slope occurs. This will involve the installation of concrete block (approximately $2m^3$ in volume) into an excavated pit below the planned burial depth of the cable. Bolted to the concrete block will be a number of metal cleats, through which each of the three cables per circuit will pass. These cleats will clamp the cables to the concrete block.

1.7.32 Once installed, the ground above these clamping arrangements will be reinstated as per the same specification as the rest of the onshore cable route.

Crossings

1.7.33 There are road, rail, water, footpaths, third party services, and other crossings along the onshore cable route. Each crossing will be individually reviewed / surveyed during detailed design to confirm the crossing methodology employed. Open cut trenching crossing methodology will predominantly be used. This involves the preparation of the crossing (damming / fluming / pumping in the case of water courses) to allow the trenches to be excavated and ducts installed. The crossing area will be reinstated to the original form following the installation of cables. Traffic control measures and diversions will be implemented for open cut trench road crossings.

1.7.34 Similarly, open cut trench footpath crossings such as on the South Downs Way will be temporarily diverted where possible in a safe and controlled manner, with minimal disruption. Whilst there may still be a need for short-term closures, these will be communicated in advance and will be limited to the days where the onshore cable trench is first excavated.

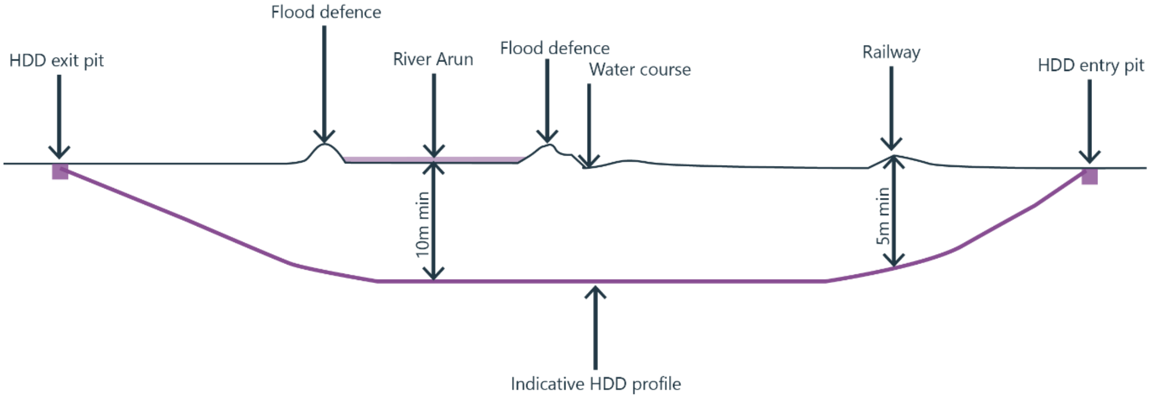
1.7.35 For trenchless crossings, HDD is the likely preferred option based on their reduced complexity and relatively low cost compared to other techniques. The detailed methodology and design of the trenchless crossing will be determined following site investigation and confirmed within stage specific Onshore Construction Method.

1.7.36 Trenchless crossings will be used for main watercourses, railways and roads that form part of the Strategic Highways Network, although if necessary other trenchless methodologies will be considered. The use of HDD methodology is less intrusive than open cut crossings from a crossing interaction, traffic management and environmental perspective, however the equipment used is louder and as it requires 24 hour working, proximity to noise receptors must be considered.

1.7.37 The proposed DCO Order Limits have been widened in areas to accommodate the need for trenchless crossings at defined locations. The compounds for trenchless crossings will be up to 50 x 75mwith the landfall compound up to 120 x 100m.

1.7.38 HDD involves drilling a bore from one location to another under the crossing. Following completion of the bore the duct lengths are strung out and connected in a line of equal length to the crossing and pulled through. Each circuit will have separate HDDs. The configuration and design assumptions of the trenchless crossings will be determined during the detailed design phase and informed by the EIA process. **Graphic 1-12** shows an example of a planned trenchless crossing of the River Arun and the Chichester to Littlehampton railway line using a trenchless crossing of approximately 350m.

Graphic 1-12 Cross section of River Arun and the Chichester to Littlehampton railway line trenchless crossing



Temporary construction access and haul road

1.7.39 Temporary construction access points are required along the onshore cable corridor to allow the transportation of materials, equipment, and personnel to and from the construction sites. These temporary construction access points will allow access to the construction corridor where there will be a temporary construction haul road running along the length of the onshore cable route, except for locations where there are trenchless or road crossings. Key assessment assumptions of the temporary construction access and haul roads are presented in **Table 1-10**.

1.7.40 The use of temporary culverts, flume pipes or bridges may be required where obstacles are encountered along the haul road.

1.7.41 The temporary construction haul road will comprise crushed aggregates and a geotextile membrane where the existing ground is not considered stable enough. It will be used during installation works and construction activities and be removed prior to final reinstatement.

1.7.42 Temporary construction access points are proposed along the onshore cable corridor based on suitability for the Proposed Development requirements, likely environmental and social impacts, highway safety and connection to key road infrastructure. Existing access points and tracks have been utilised where possible.

Table 1-10 Maximum temporary construction access and haul road assessment assumptions

Assessment assumption	Maximum value
Temporary construction haul road width	Up to 6m
Temporary construction haul road width – passing places	8m
Aggregate depth	Approx. 0.3m

Temporary construction compounds

1.7.43 Temporary construction compounds are required for:

- landfall works (see **paragraph 1.7.3**);
- trenchless crossings; and
- logistics; storage of materials and equipment, location of CBS batching plant, also includes welfare facilities and office space as appropriate.

1.7.44 All temporary construction compounds are located within the proposed DCO Order Limits. Temporary construction compounds for trenchless crossings (HDD compounds) typically have an area of 50m x 75m.

1.7.45 Along the onshore cable route five sites have been identified as locations for temporary construction or logistic compounds. Following completion of constructions works, the temporary construction compound facilities will be removed, and each compound site will be returned to its original state. Temporary construction compound details are provided in **Table 1-11.**

Table 1-11 Construction compounds maximum assessment assumptions

Assessment assumption	Maximum value
Number and area of onshore cable corridor main compound areas	Five: • Climping Compound – approximately 61,300m^2 (6.13ha) for the cable installation temporary construction compound. • Washington Compound – approximately 39,100m^2 (3.91ha) for the cable installation temporary construction compound. • Oakendene substation compound – approximately 25,000m^2 (2.5ha) for the

Assessment assumption	Maximum value
	substation temporary construction compound • Oakendene west compound – approximately 50,000m^2 (5ha) for the cable installation temporary construction compound. • Existing National Grid Bolney substation compound – approximately 3,500m^2 for the existing National Grid substation extension temporary construction compound.
Temporary construction compound dimensions (length and width)	Vary depending on the compound
Temporary construction compound use duration per compound	Up to 3 years and 6 months
Trenchless crossing compounds (length and width)	50m x 75m
Trenchless crossing compound at landfall (length and width)	120m x 100m
Trenchless crossing compound construction duration per compound (does not include cable pulling duration)	3 to 4 months

Pre-construction

1.7.46 Pre-construction activities are to secure and prepare all sites and access for the construction activities. These include:

- site clearance,
- demolition,
- pre-planting of landscaping works
- archaeological investigations, which may include intrusive investigations including archaeological trial trenching,
- environmental surveys,
- investigations for the purpose of assessing ground conditions,
- remedial work in respect of any contamination or other adverse ground conditions,
- diversion and laying of services,
- erection of any temporary means of enclosure,

- creation of site accesses; and
- the temporary display of site notices or advertisements.
-

1.7.47 Temporary means of enclosure such as fencing will be used to mark out the onshore cable corridor area. Vegetation will be cleared, where appropriate, from the working width of the onshore cable corridor at the appropriate time of year.

Construction

1.7.48 Construction along the onshore cable corridor will be performed with the commitment to a safe work site and to minimise potential impacts as much as practicable. Generally, where possible construction will take place during daylight hours with a requirement only for local task lighting. The high-level construction sequence is as follows:

- excavate trenches;
- connect ducts and place the ducts in the trenches;
- trenches will be backfilled with an initial layer of fine protective material, overlaid by stockboard and a well-compacted thermally rated indigenous backfill; and
- reinstatement of the topsoil.

1.7.49 In parallel to the above sequence, the joint bays (JBs), Fibre Optic Cable Joint boxes (FOC JB) and link boxes (LBs) will be constructed. This involves:

- excavation and
- associated civil works.

1.7.50 The JBs, FOC JB, and LBs will remain open; ready for cable installation. Following cable installation and testing, they will be backfilled, and the working area reinstated.

1.7.51 Access to all construction sites will be managed throughout the construction phase with suitable supervision provided at access points to the onshore cable route, and temporary construction compounds. Access to all construction sites will be managed by the construction contractor. Where open cut trenching methodology is used for road crossings, traffic management will be in operation.

Cable installation and testing

1.7.52 Following construction of the onshore cable route, with installation of the ducts and JBs, the cables will be installed. Each cable is pulled from one JB to the next (approximately 750 to 950m distance). Testing will be performed to confirm the section of installed cable. This sequence repeats for all cables (HVAC and FOC) and for each circuit along the entire length of the cable route. Once the onshore and offshore cable installation is complete final testing / commissioning will be undertaken. Further details on joint bays are provided in **paragraph 1.7.27.**

Construction lighting regime for the onshore cable and substation

1.7.53 External lighting of the construction site for both the onshore cable and the new onshore substation will be directional. The work will usually be scheduled during daylight hours. If night or 24-hour working is required, such as during trenchless crossing operations, then portable directional task lighting will be deployed.

1.7.54 External lighting of the construction site will be designed and positioned to:

- provide the necessary levels for safe working;
- minimise light spillage and / or light pollution; and
- avoid disturbance to adjoining residents / occupiers of buildings and to wildlife.

1.7.55 At temporary construction compounds and specific locations where night working is required or in poor light conditions during normal working hours, portable lighting units will be used where necessary to ensure safe working and / or site security.

1.7.56 Site or welfare cabins, equipment and lighting will be sited to minimise visual intrusion as far as is consistent with the safe and efficient operation of the work site. Site lighting will be positioned and directed to minimise glare and nuisance to residents, walkers and to minimise distractions or confusion to passing drivers on railways or adjoining public highways. Implementation will comply with the requirements set out in the following standards and guides as far as it is reasonably practicable and applicable to construction works:

- British Standard (BS) *EN 12464-2:2014 Light and lighting. Lighting of work places. Outdoor work places*;
- Institute of Lighting Professionals, (2021). *Guidance Note 1 for the Reduction of Obtrusive Light*;
- Chartered Institute of Building Services Engineers (CIBSE), (2018). *Society of Light and Lighting Guide 1: The Industrial Environment* ; and
- CIBSE Society of Light and Lighting, (2016). Guide 6: *The Exterior Environment* .

1.7.57 When lighting is necessary, appropriate lighting units will be designed to minimise spillage of illumination outside the construction works area into surrounding habitats (e.g. lighting will be directional, task orientated and where possible, fully shielded). This is to minimise the impact of lighting on ecological resources, including nocturnal species. Further details regarding lighting during the construction phase will be developed with the construction contractor.

Rampion 2
WIND FARM