Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Environmental Statement Volume 3

Chapter 1: Project Description (Onshore)

June 2018, Revision A

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Volume 3

Chapter 1: Project Description - Onshore

June 2018

Drafted By:	GoBe Consultants Ltd
Approved By:	Helen Jameson
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Vattenfall Wind Power Ltd

First Floor

1 Tudor Street

London

EC4Y 0AH

T +44 207 451 1150

www.vattenfall.co.uk

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1 PROJECT DESCRIPTION (ONSHORE)

1.1 Introduction

1.1.1 This chapter of the Environmental Statement (ES) describes the onshore elements of the proposed Thanet Extension Offshore Wind Farm (Thanet Extension). It provides a description of the onshore project design envelope (i.e. the Rochdale Envelope) and the proposed methods of construction, Operations and Maintenance (O&M) and decommissioning of the onshore aspects of the proposed development. A description of each of the component parts is provided below.

1.1.2 Where there is clear physical crossover in the offshore and onshore study areas, such as the intertidal area of landfall at Pegwell Bay, a description is provided in this chapter of the works above Mean High Water Springs (MHWS) with a brief description of the seaward 'offshore' works provided for completeness. Full details of the offshore components of Thanet Extension are provided in Volume 2, Chapter 1: Project Description (Offshore) (Document ref: 6.2.1).

1.1.3 The data required to identify and assess the likely significant effects of the project upon the environment are provided in this chapter. Where measures to reduce or avoid adverse environmental effects are built-in to the project design, these are also described.

1.1.4 At this stage in the Thanet Extension development process, the project description is indicative and the 'envelope' has been designed to include flexibility to accommodate further project refinement during detailed design, post-consent. This chapter therefore sets out a series of Options and parameters for which maximum values are shown. The maximum values constitute the worst-case scenario in relation to Thanet Extension.

1.2 Design (Rochdale) Envelope Approach

1.2.1 The use of the design envelope approach has been recognised in the Overarching National Policy Statement (NPS) for Energy (NPS EN-1)[1] and the NPS for Renewable Energy Infrastructure (NPS EN-3)[2]. This approach has been used in the majority of Offshore Wind Farm (OWF) applications.

1.2.2 In the case of OWF, NPS EN-3 (paragraph 2.6.42) recognises that:

"Owing to the complex nature of offshore wind farm development, many of the details of a proposed scheme may be unknown to the applicant at the time of the application, possibly including:

- *Precise location and configuration of development;*
- *Cable type and cable route; and*
- *Exact locations of offshore and/ or onshore substations."*

1.2.3 NPS EN-3 continues:

"The Secretary of State should accept that wind farm operators are unlikely to know precisely which turbines will be procured for the site until sometime after any consent has been granted. Where some details have not been included in the application to the Secretary of State, the applicant should explain which elements of the scheme have yet to be finalised, and the reasons. Therefore, some flexibility may be required in the consent. Where this is sought and the precise details are not known, then the applicant should assess the effects the project could have to ensure that the project as it may be constructed has been properly assessed (the Rochdale [Design] Envelope)". (DECC, 2011b)."

1.2.4 NPS EN-3 also states that:

"The 'Rochdale [Design] Envelope' is a series of maximum extents of a project for which the significant effects are established. The detailed design of the project can then vary within this 'envelope' without rendering the ES [Environmental Statement] inadequate".

1.2.5 The design envelope approach is widely recognised and is consistent with The Planning Inspectorate (PINS) Advice Note Nine: Rochdale Envelope (PINS, 2012) which states that:

"The 'Rochdale Envelope' is an acknowledged way of dealing with an application comprising EIA development where details of a project have not been resolved at the time when the application is submitted".

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47856/1940-nps-renewable-energy-en3.pdf

1.2.6 Throughout the Scoping Report submitted for consultation in December 2016, the Preliminary Environmental Information Report (PEIR) submitted for formal consultation in November 2017 and this subsequent EIA, the design envelope approach has been taken to allow meaningful assessments of Thanet Extension to proceed, whilst still allowing reasonable flexibility for future project design decisions.

1.3 Thanet Extension Boundary

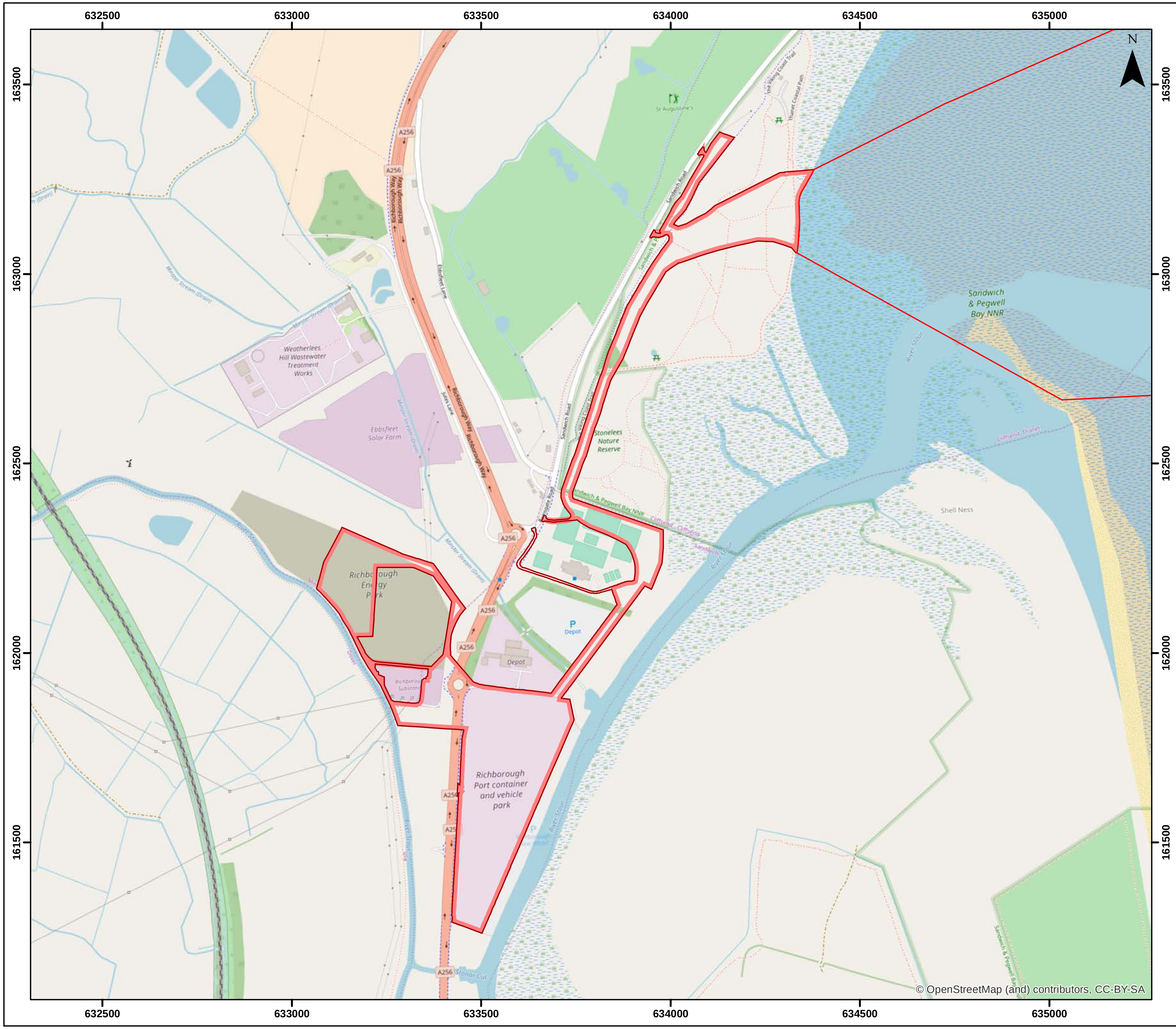
1.3.1 The onshore boundary of Thanet Extension is shown in Figure 1.1. The onshore development boundary encompasses:

- A landfall which comprises the interface between the offshore export cable corridor and the onshore infrastructure. There are three options considered for the landfall;
- The Thanet Extension onshore export cable corridor. This is where the permanent onshore electrical infrastructure will be located;
- The onshore substation; and
- Onward links to the National Grid.

1.3.2 Figure 1.2 to Figure 1.4 show the three options for the landfall and cable works within the Pegwell Bay Country Park. Figure 1.5 to Figure 1.7 show the remaining cable route, which will be the same, regardless of the landfall option taken forward.

1.3.3 In summary the three options comprise:

- Option 1: Use of Horizontal Directional Drilling from the Pegwell Bay Country Park to the Intertidal mudflats;
- Option 2: A seaward extension of the existing sea wall to allow the export cables to interface from burial within the intertidal mudflat and saltmarsh to a surface laid berm within the Pegwell Bay Country Park; and
- Option 3: Open trenching through the existing sea wall and Pegwell Bay Country Park.



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THANET EXTENSION OFFSHORE WIND FARM

Figure 1.1

Location of the Onshore Thanet Extension Boundary

Legend

- Offshore Red Line Boundary
- Onshore Red Line Boundary

Datum: OSGB 1936
Projection: BNG

1:10,000 0 0.25 0.5 km

Drg No	Fig1.1_OnRLBLoc		
Rev	0.1	Date	25/05/2018
By	RM	Layout	N/A

Figure 1.1

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THANET EXTENSION OFFSHORE WIND FARM

Figure 1.2

Onshore Cable Route: Landfall Option 1 (1 of 4)

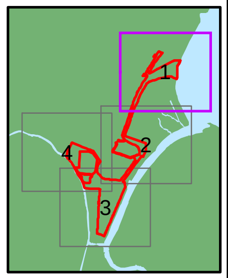
Legend

- Onshore Red Line Boundary
- Offshore Red Line Boundary

Onshore Infrastructure (Indicative locations)

- Construction and laydown area
- Possible access
- HDD exit pits
- Landfall Area 350 m from seawall
- Temporary work area for HDD
- Transition pit cofferdam extent
- Cable corridor
- Transition Pit -12 x 22 m

Datum: OSGB 1936
Projection: BNG



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Drg No	Fig1.2_OnRLBOp1		
Rev	0.1	Date	25/05/2018
By	RM	Layout	N/A

Figure 1.2

THANET EXTENSION OFFSHORE WIND FARM

Figure 1.3

Onshore Cable Route: Landfall Option 2 (1 of 4)

Legend

- Onshore Red Line Boundary
- Offshore Red Line Boundary

Onshore Infrastructure (Indicative

- Construction and laydown area
- Possible access
- Rock armour replacement area
- Temporary works area trenching
- Sea defence extension possible area
- Sea defence extension possible cofferdam extent
- Landfall Area 350 m from seawall
- KWT Crossing 5 x 54 m
- Cable corridor
- Subsea Cable Installation Area - 19
- Transition Pit Area -12 x 46
- Transition Pit -12 x 22 m

Datum: OSGB 1936
Projection: BNG

1:3,500 — 0, 0.09, 0.18 km

Drg No	Fig1.3_OnRLBOp2			Figure 1.3
Rev	0.1	Date	25/05/2018	
By	RM	Layout	N/A	

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THANET EXTENSION OFFSHORE WIND FARM

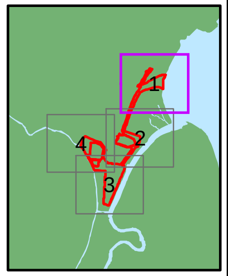
Figure 1.4

Onshore Cable Route: Landfall Option 3 (1 of 4)

Legend

- Onshore Red Line Boundary
- Offshore Red Line Boundary
- Onshore Infrastructure (Indicative
- Construction and laydown area
- Possible access
- Temporary works area trenching
- Sea defence extension possible area
- Sea defence extension possible cofferdam extent
- Landfall Area 350 m from seawall
- Transition pit cofferdam extent
- Cable corridor
- Subsea Cable Installation Area - 19
- Transition Pit -12 x 22 m

Datum: OSGB 1936
Projection: BNG



1:3,500 | 0 | 0.09 | 0.18 km

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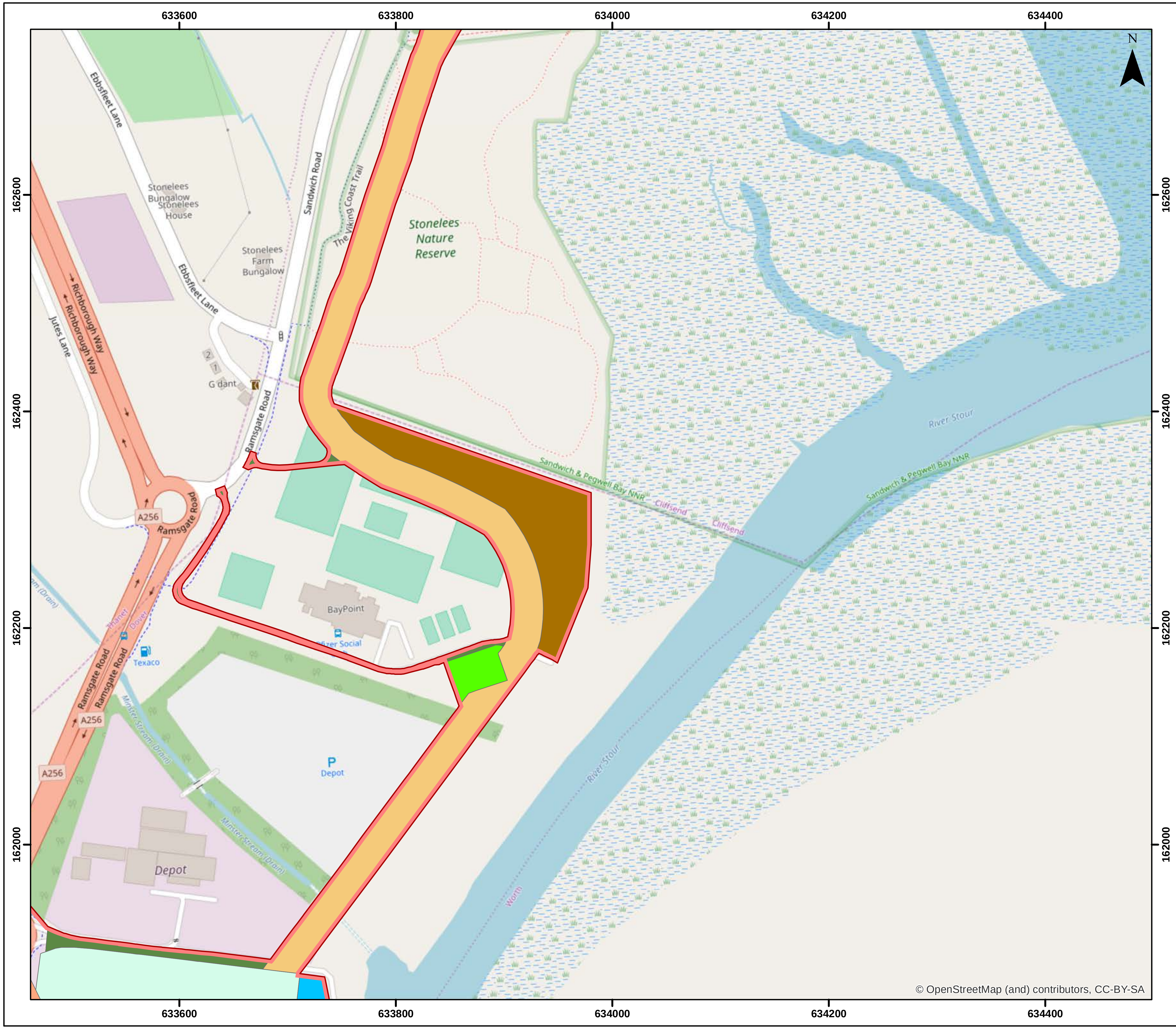
By	RM	Layout	N/A	



THANET EXTENSION OFFSHORE WIND FARM

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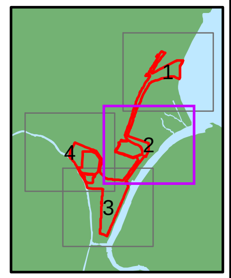
Figure 1.5

Onshore Cable Route: (2 of 4).

Legend

- Onshore Red Line Boundary
- Onshore Infrastructure (Indicative locations)
- Construction and laydown area
- Possible access
- Substation landscape area
- Temporary works area
- Onshore Substation Area
- Cable corridor

Datum: OSGB 1936
Projection: BNG



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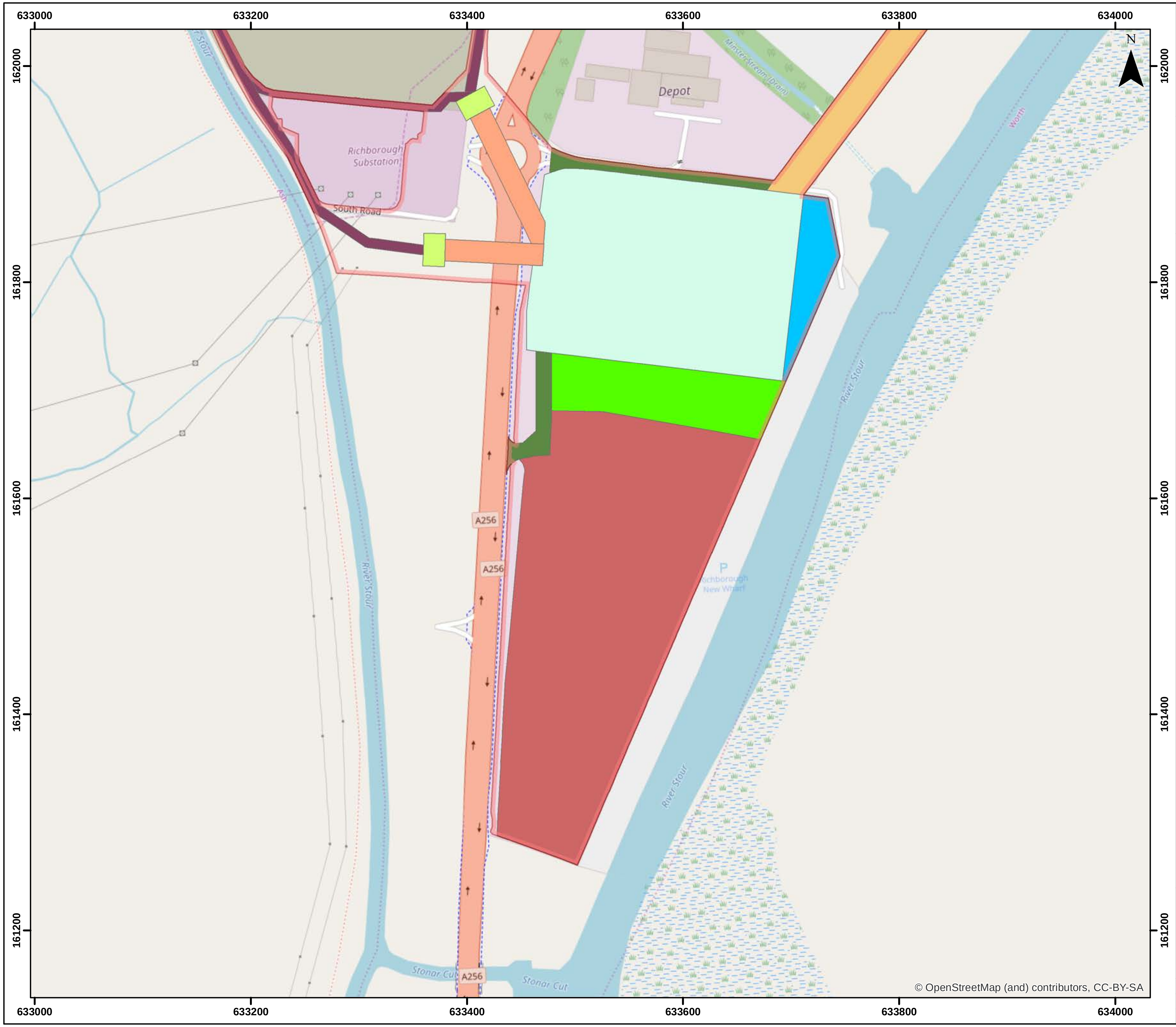
Rev	0.1	Date	07/06/2018	
By	RM	Layout	N/A	



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THANET EXTENSION OFFSHORE WIND FARM

Figure 1.6

Onshore Cable Route: (3 of 4).

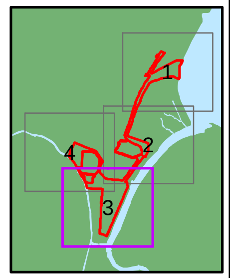
Legend

- Onshore Red Line Boundary

Onshore Infrastructure (Indicative locations)

- Construction and laydown area
- Possible access
- Substation landscape area
- Tenant relocation area
- Cable corridor
- HDD crossing of A256 - 20 m
- Reception pit for HDD 30 m x 20 m
- Onshore Substation Area
- Cable route

Datum: OSGB 1936
Projection: BNG



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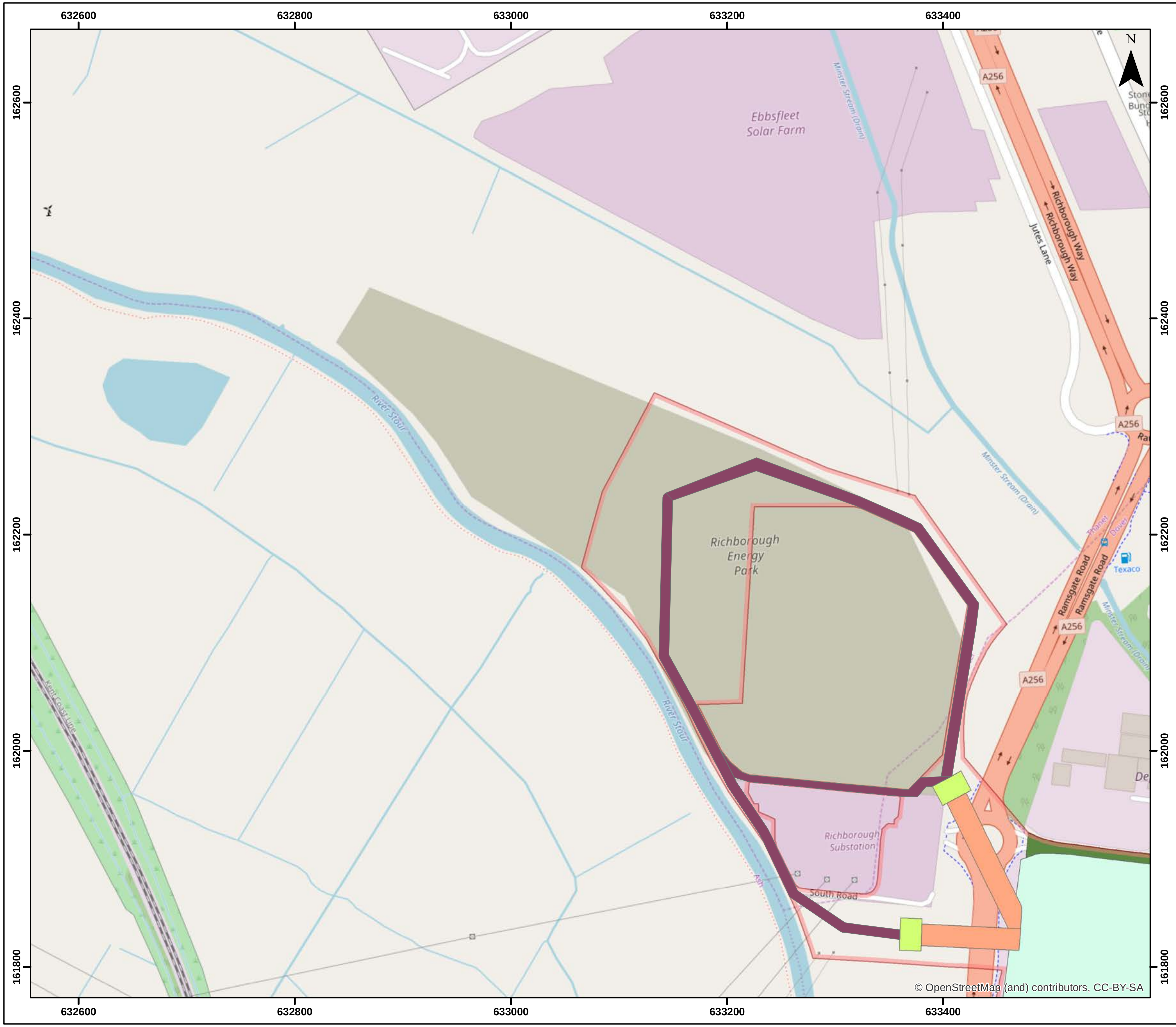
Rev	0.1	Date	06/06/2018	
By	RM	Layout	N/A	



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THANET EXTENSION OFFSHORE WIND FARM

Figure 1.7

Onshore Cable Route: (4 of 4)

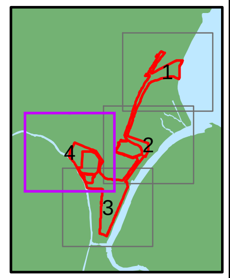
Legend

- Onshore Red Line Boundary
- HDD crossing of A256 - 20 m wide
- Reception pit for HDD 30 m x 20 m
- Cable route

Onshore Infrastructure (Indicative locations)

- Possible access
- Onshore Substation Area

Datum: OSGB 1936
Projection: BNG



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Drg No	Fig1.7_OnRLB4		
Rev	0.1	Date	06/06/2018
By	RM	Layout	N/A

Figure 1.7

1.4 Project Overview

1.4.1 Thanet Extension will comprise of wind turbines (with a maximum generating capacity of up to 340 MW) and all infrastructure required to transmit the power generated by the turbines to the National Grid network at the grid connection location at Richborough Energy Park (REP). It will also comprise any onshore and offshore infrastructure required to operate and maintain the wind farm and associated infrastructure, up to the cable interface point at the National Grid network; no works are proposed on National Grid infrastructure as part of this application.

1.4.2 There are two possible export cable system configurations from the offshore site to the onshore substation:

- 4 cable circuits connected from the Wind Turbine Generators (WTGs) directly to the onshore substation from the offshore site all the way to landfall and then to the onshore substation at Richborough Port at the array cable voltage (expected to be 66 kV) where the power will be transformed to 400 kV before being fed into the National Grid system at REP; or
- An Offshore Substation (OSS) collecting the power from array cables and transforming the 66 kV array cable voltage to up to 220 kV and feeding the power back to the onshore substation via two export cable circuits where the power will be transformed up to 400 kV before being fed into the National Grid system at REP.

1.4.3 The transmission voltage will be up to 220 kV, with a maximum of four export cables circuits.

1.4.4 The offshore export cables will be buried for the majority of the export cable route from the WTGs to the landfall site in Pegwell Bay.

1.4.5 The onshore export cables will be buried for the majority of the onshore cable route. In the Pegwell Bay Country Park (hereafter referred to as 'the Country Park', cables will either be laid in an artificial berm above ground in the case of Option 2 or trenched (buried) in the case of Options 1 and 3. The onshore parts of the proposed Thanet Extension development are likely to also include:

- Cable landfall, where the offshore cables are brought ashore;
- Up to four Transition Joint Bays (TJBs) connecting the offshore cables to the onshore cables;
- Up to four onshore export cable circuits (up to 220 kV);
- One onshore substation at Richborough Port; and
- Up to two interconnecting cable circuits for the grid connection from the onshore substation to National Grid Electricity Transmission's (NGET) existing substation at REP, comprising of one duct per cable and installed under the A256 by Horizontal Directional Drilling (HDD). The final section of these cables will be trenched.

1.4.6 The onshore cable corridor will be approximately 2.6 km in length.

1.5 Onshore construction

Landfall

1.5.1 The landfall denotes the location where the offshore cables are brought ashore and jointed to the onshore cables within TJBs. The landfall location for the Thanet Extension offshore export cables is proposed to be Pegwell Bay, Kent, just to the north-west of the River Stour.

1.5.2 Open trenching using excavators will be required within the intertidal area up to the saltmarsh area between the main offshore cable installation and the landfall area, mainly due to shallow water depth or proximity to other infrastructure and the saltmarsh. This is of particular relevance for landfall Option 1 (paragraph 1.5.11 *et seq.*) in order the install the offshore cables into the seaward HDD pits. The maximum of up to four export cables would need to be installed by open trenching, covering a distance of up to 2 km per cable circuit (8 km total), in four trenches up to 10 m wide and 3 m deep. Material excavated from these trenches would be positioned to the side of the trench and backfilled once the cable has been installed.

1.5.3 The Country Park, at approximately 1.5 m above the saltmarsh, is located on a historic landfill. Due to the potential release of contamination, the suitability of drilling or trenching (such as in landfall Options 1 and 3) within this land will need to be informed by further Site Investigation (SI) works, and specific techniques or mitigation would need to be designed in order to appropriately manage the potentially contaminated land. There are also uncertainties about unstable geologies and how effective any measures put in place to prevent breakouts of contaminants would be. According to local records:

- The landfill was land-raised with approximately one million cubic metres of household and inert waste. The last input to the landfill was in 1972;
- The major components of the landfill gas are methane and carbon dioxide, with landfill refuse considered to be a principal ground gas source; and
- It is likely that the landfill was constructed using the dilute and disperse principles and it is understood that no liner is present preventing leachate from migrating into the underlying groundwater.

1.5.4 Until the SI works described above are undertaken, it cannot be assumed that any disturbance to the potentially contaminated land within the Country Park is possible, and therefore a number of options are being taken forward to the Application, assessed in this ES, that will be refined in the detailed design phase.

1.5.5 For the three landfall options presented below, there are a number of associated common works and parameters, which are described in Table 1.1 below.

Table 1.1: Maximum design envelope for works common to all landfall options

Parameter	Maximum design envelope
Maximum TJB size (m^2)	48
Maximum no. of TJBs required	4
Maximum construction space required for TJB temporary construction area (m^2)	192
Temporary access route track width (m)	6
Temporary access route track length (m)	Up to 350

1.5.6 Given the conditions at landfall, the following three Options have been scoped into the assessment. For all three options, the TJBs are located within the Country Park, up to 350 m from the existing sea wall, within the 'Potential Zone for Transition Pit' area identified in Figure 1.2 to Figure 1.4. Options 1 and 3 assume that the outcomes of SI works indicate that trenching and/or HDD are possible within the historic landfill. A description of the three landfall options is given below:

1.5.7 **Option 1:** Locate the TJBs below ground within the Country Park and cross the sea wall by Horizontal Directional Drilling (HDD). This Option requires a larger onshore temporary works area to house the HDD rig and associated equipment but does not require excavation and reinstatement of the sea wall. Under this Option HDD would be undertaken from land to sea, with an initial bore undertaken prior to a wider drill profile and installation of ducts to house the cables. The HDD ducts would be installed from the TJB location, out to a punch-out location at least 100 m seaward of the sea wall. As a result of the uncertainty associated with the contents of the landfill there may be a need to control the HDD works in order to prevent the introduction of a pathway for the contaminants present. Whilst the detailed design will be subject to the outcomes of the SI works, and any additional SI works that may be required post-consent, there are a number of methods that could be applied to control the release of contaminants from the landfill. This may include excavating down through the landfill and lining it with plastic or other material (depending on depth), or installation of casing through the first section of the HDD bore (within the initial landfill area) to seal it (disposing of the excavated material appropriately) before continuing the bore out to the punch out/receptor pit in clean ground.

1.5.8 **Option 2**: Locate the TJBs above ground within the Country Park. This requires installation of a temporary cofferdam within the upper intertidal/saltmarsh area before extending the existing sea wall. The cables would be trenched through the upper intertidal area to the seawall extension. The seawall extension is required to allow for the vertical transition from buried offshore cables to the above ground TJBs and onward surface laid onshore cables. This would ensure that the works do not expose any of the landfill. For the purposes of assessment it is assumed that the temporary cofferdam will be installed using percussive piling and will take a duration of 16 days, assuming active piling for 70% of the 12 hour working day (noting construction works between 0700 and 1900 6 days per week). After construction of the seawall extension and installation of the cables the cofferdam would be removed, and the seawall extension reinstated.

1.5.9 **Option 3:** Locate the TJBs below ground within the Country Park before trenching the remainder of the route. As with Option 2 this requires installation of a temporary cofferdam before excavating through from the upper intertidal, through the existing sea wall. For this Option the cofferdam is required to ensure no release of contaminants from the landfill into the marine environment. The offshore cables would be trenched from the intertidal area through this cofferdam and seawall area onshore into the TJB area. The cofferdam would be removed, and the seawall reinstated.

1.5.10 More detailed descriptions of the three landfall options are described below, and a description of the TJBs themselves is provided in paragraph 1.5.23 *et seq.*

Option 1

1.5.11 Compared to the other two Options, Option 1 will negate the need to interact with the sea wall and the saltmarsh present within the upper intertidal, as cables will be installed underneath the sea wall via ducts installed connecting the TJBs to offshore punch-out locations within the intertidal, at least 100 m seaward of the existing sea wall. Option 1 assumes that the outcome of future SI works indicate that HDD within the Country Park is possible and does not present an unacceptable risk of contamination release. There are a number of potential methods for passing through the landfill material using HDD. The most suitable method will depend on the nature of the landfill material. The method will need to ensure that the passage of the route through the landfill is sealed to avoid leakage of leachate into or along the HDD. Examples of such methods are:

- Drilled casing, in which the HDD pilot hole is drilled into the underlying superficial deposits below the landfill. Steel casing pipe is then inserted around the drill pipe until it is embedded in the underlying material, forming a seal against leachate entering the HDD;
- Top-driven casing, in which the pipe casing is rammed into the ground, causing it to fill with landfill material/ soil. This material is periodically cleaned from the casing until it reaches inert underlying deposits or bedrock, and the pipe forms a seal against leachate;
- Downhole hammered casing, which is similar to top-driven casing, but the hammer is mounted inside the casing;
- Open excavation using sheet piles, where a pit would be excavated in the landfill, secured using sheet piles driven into underlying superficial deposits which reduces the flow of leachate into the pit. The HDD is then bored into the side of this pit and once complete, the pit can be backfilled with inert material, and could be lined to reduce the risk of leachate reaching the HDD; and
- Open excavation using trench boxes, which is similar to using sheet piles described above, but trench boxes are used instead. This would represent a faster method more suited to the conditions but would be less effective at preventing ingress of leachate. This method would therefore be used to excavate, line and backfill a pit, so that HDD can be drilled through afterwards.

1.5.12 A temporary working area of 60 x 50 m will contain the HDD apparatus, and four ducts will be installed by HDD from the TJB locations, under the sea wall, to exit into four 20 x 20 m offshore containment areas in order to contain the water-based drilling mud (usually inert clay-based Bentonite). A common methodology that may be employed is the creation of a temporary mud lagoon will be installed in the landward drilling entry pit which will use a closed-circuit mud management system where the mud is constantly pumped out of the pit for processing. At the exit pit containment area, which may be excavated or surface based, some bentonite will collect in the exit pit and subsequently removed. Whilst the drilling mud will be water-based and will comprise an inert clay material (Bentonite), this approach will ensure that impacts to surrounding intertidal receptors will be kept to a minimum.

1.5.13 Following the installation of the HDD ducts, the offshore cables will be pulled through into the onshore TJBs. The TJBs would be installed below ground and, subject to the findings of the SI works, the onward cable trenched for the remainder of the onshore route. The layout for landfall Option 1 is shown in plan in Figure 1.8 and in profile in Figure 1.9.

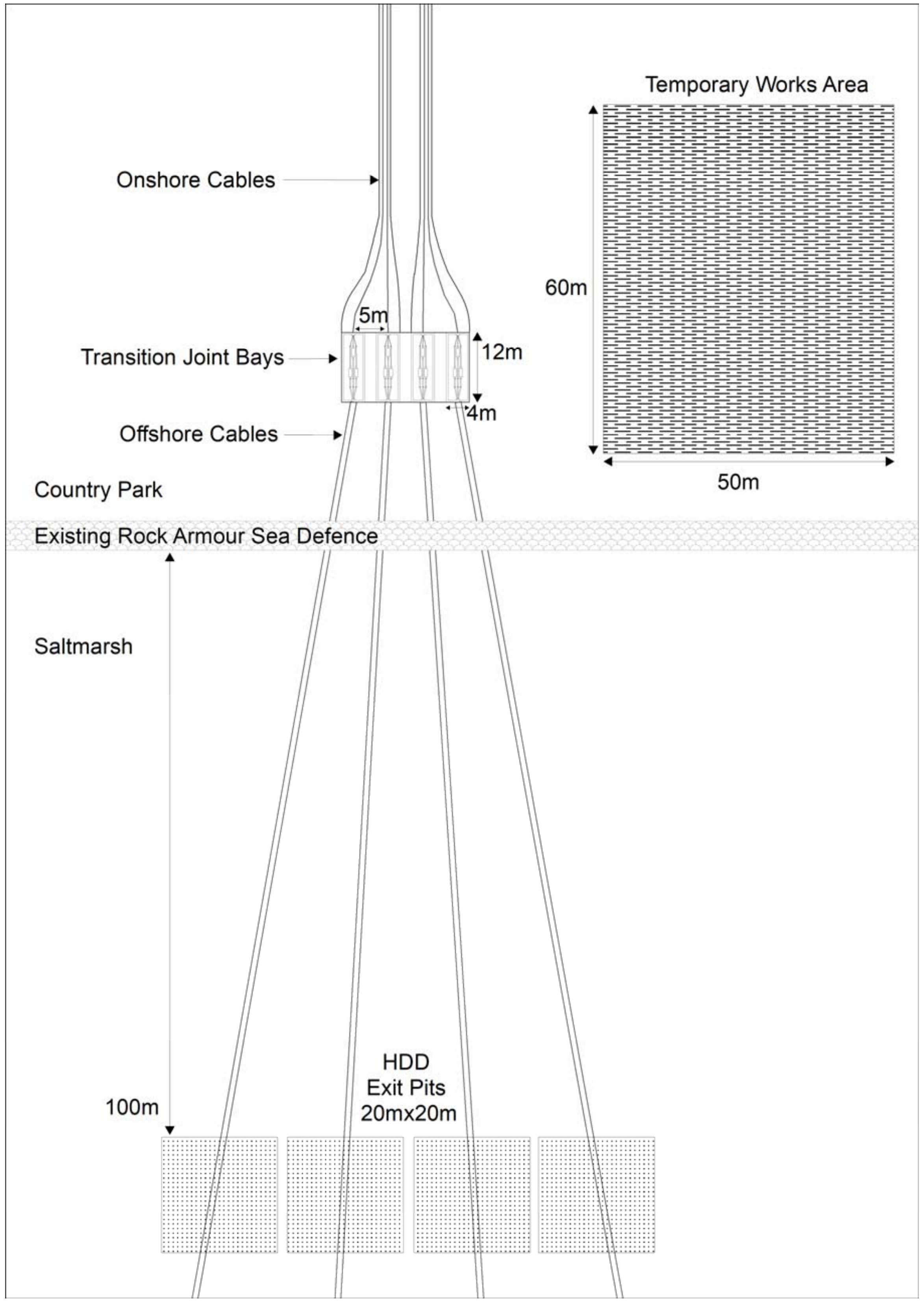

Figure 1.8: Indicative Option 1 landfall layout (plan view).

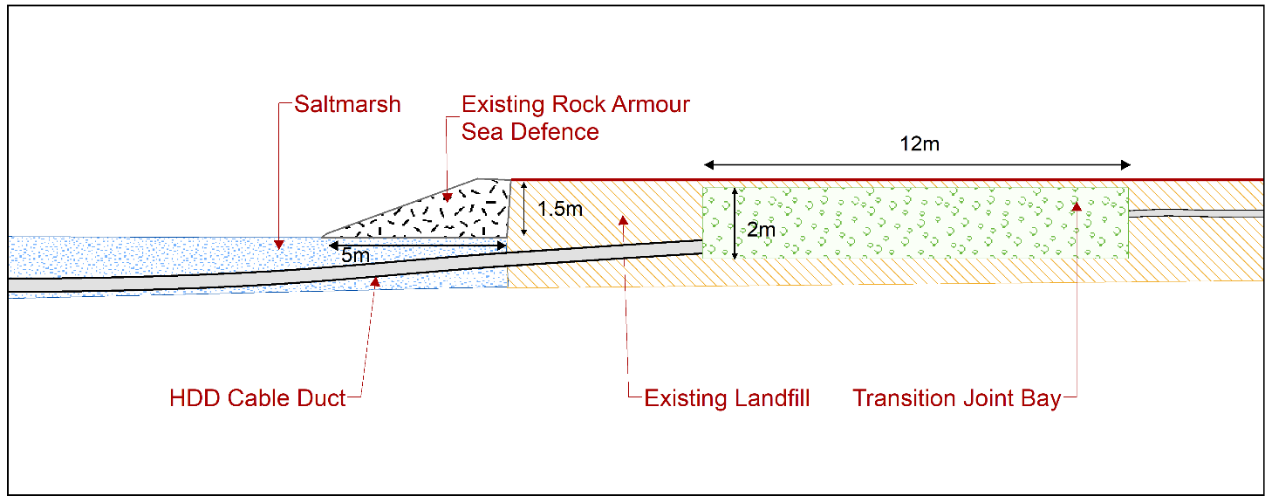

Figure 1.9: Indicative Option 1 landfall profile.

Option 2

1.5.14 Option 2 involves raising the vertical profile of the offshore cables so that the TJBs and onshore cables can be built above ground in the event that SI works indicate HDD and/or burial is not possible in the historic landfill site. In order to raise the offshore cables to the above ground level without affecting the landfill or exceeding the minimum bending radius of the cables, whilst still having the offshore cables buried below ground in the intertidal, an extension to the sea wall would be required (illustrated in Figure 1.12).

1.5.15 Prior to works commencing a temporary cofferdam would be installed at the seaward interface of the landfall works to act as a barrier to tidal inundation, and as a preventative barrier for the release of any contaminants associated with the landfill area. The cofferdam will be installed in such a way as to permit open trenching from the intertidal area to the sea wall extension, allowing a dry working area below the high-water mark on the saltmarsh in the area east of the Country Park. This cofferdam would be a maximum of 25 m seaward by 165 m wide and would be constructed of sheet piles.

1.5.16 After installation of the cofferdam area the existing sea wall would be excavated, and the profile of the land raised to create a seaward extension of the seawall. The offshore cables would be laid within trenches from the intertidal to the seawall before then being laid in a surface laid bund up to the interface with the surface laid TJBs. The extension of the sea wall would be built seaward by up to 18.5 m, at a maximum width of 155 m. The extended sea defence would result in a permanent take of 1,400 m^2 within the saltmarsh.

1.5.17 For this Option, the TJBs would be built above ground to avoid interaction with the historic landfill material, in a bund of up to 2.3 m high, and up to 45 m wide. From here to the edge of the Country Park and the start of Stonelees Nature Reserve, cables would be installed in an above-ground berm which would be at a reduced height of 1.2 m and a width of 15.3 m assuming a 1:5 gradient. Increased gradients will be employed as agreed with the relevant authorities at footpath locations to ensure continued access during the operational phase.

1.5.18 Option 2 is illustrated in plan in Figure 1.11 and in profile in Figure 1.12. An example of the type of sheet piling that would be used for the intertidal cofferdam is shown in Figure 1.10.

Figure 1.10: Example of an intertidal cofferdam installed using sheet piles.

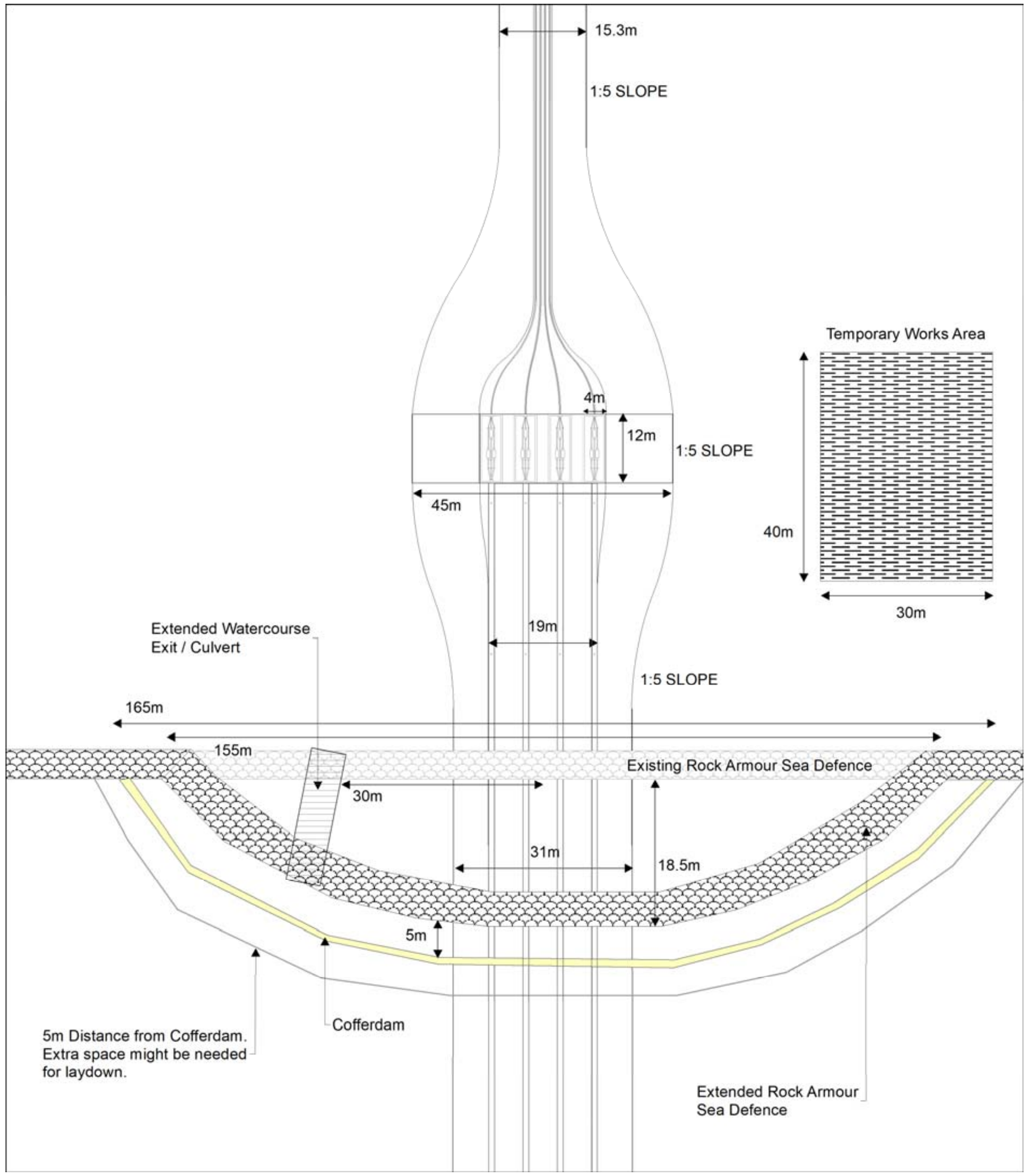

Figure 1.11: Indicative Option 2 landfall layout (plan view).

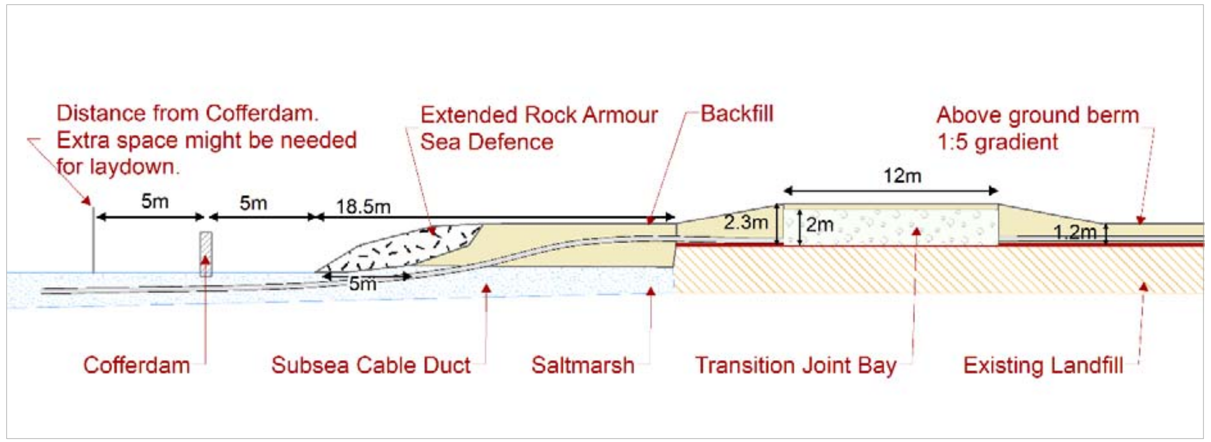

Figure 1.12: Indicative Option 2 landfall profile.

Option 3

1.5.19 Similar to Option 1, Option 3 is subject to a positive outcome of SI works indicating that excavation of ground within the historic landfill is acceptable but assumes that due to subsurface geology and risk to a successful HDD campaign a trench is required instead. As with Option 2, Option 3 requires the installation of a temporary cofferdam, for the same reasons identified in Option 2, namely containment of contaminants and protection against tidal inundation, followed by temporary removal of the sea wall. Offshore cables would then be installed by open trenching from the intertidal zone, through the cofferdam and up to the TJBs. The TJBs would also be installed below ground, as with Option 1. Cables would be buried and the sea wall reinstated to its pre-construction condition, and as there is no need to raise the vertical profile of the cables, there is no requirement for amendments or extension.

1.5.20 Option 3 is illustrated in plan in Figure 1.13 and in profile in Figure 1.14.

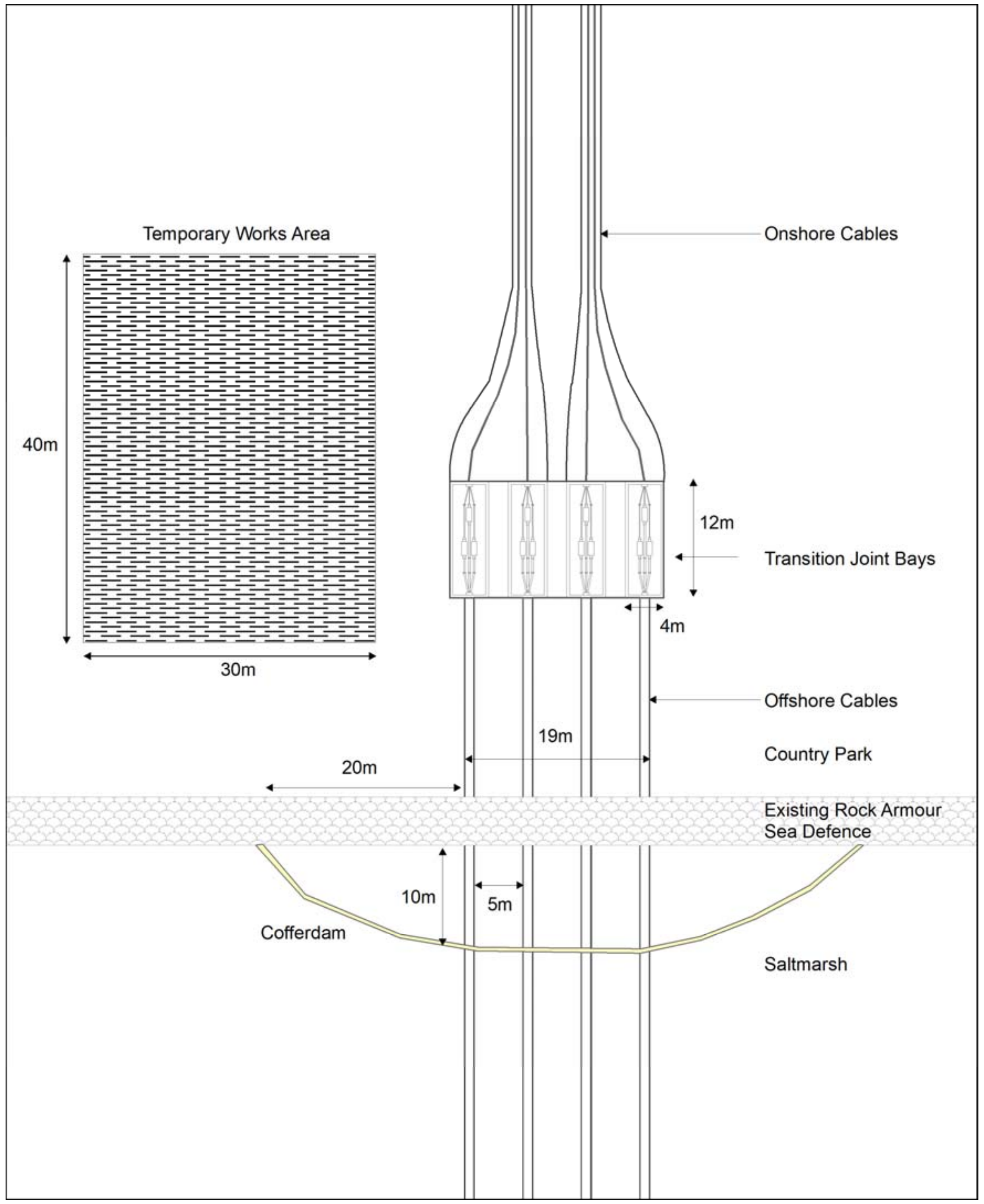

Figure 1.13: Indicative Option 3 landfall layout (in plan).

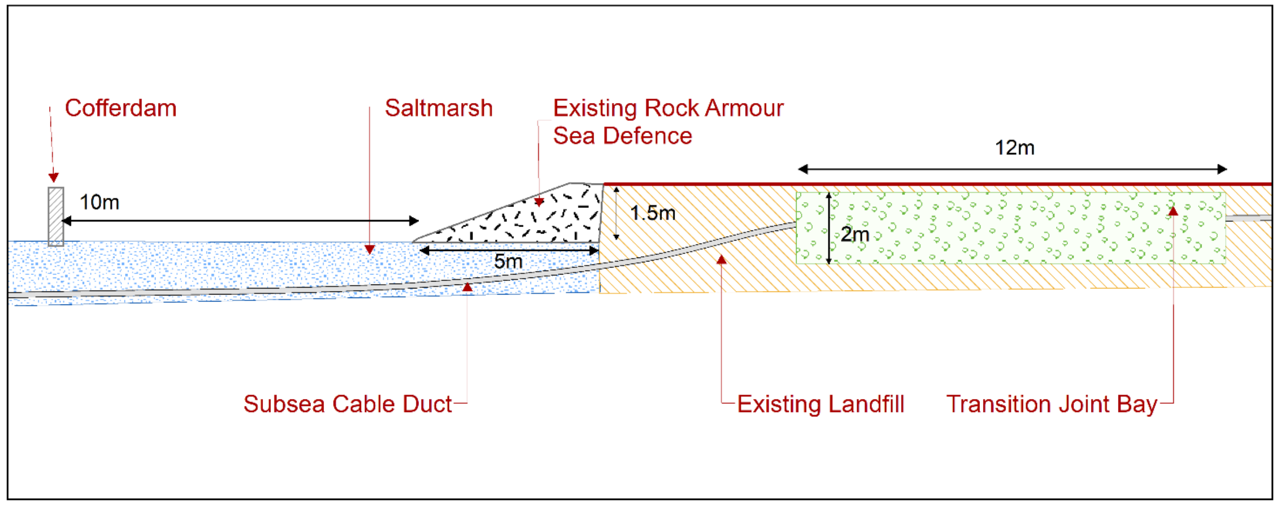

Figure 1.14: Indicative Option 3 landfall profile.

1.5.21 The installation period for the temporary cofferdam required for Options 2 and 3, will be a maximum of 33 days, assuming 12-hour working and a maximum of 70% active piling during this period.

Landfall design parameters

1.5.22 Parameters for all three landfall options are summarised in Table 1.2 below.

Table 1.2: Design envelope for the three landfall options

Parameter	Maximum design envelope		
	Option 1	Option 2	Option 3
Temporary works area (m)	60 x 50	30 x 40	30 x 40
Berm height of TJBs (m)	N/A	2.3	N/A
Berm height of onshore cable route within Country Park (m)	N/A	1.2	N/A
Average berm width of onshore cable route within Country Park (m) (subject to variation at footpath locations)	N/A	15.3	N/A
Intertidal and shallow sub-tidal works configuration	Open trenching of four cables, with a 5 m separation between cables		
Length (assuming approximately north-south alignment) of cofferdam (m)	N/A	165	165
Seaward width of temporary cofferdam area (m)	N/A	25	25
Length (assuming approximately north-south alignment) of sea wall extension (m)	N/A	155	N/A
Seaward extension of permanent sea wall (m)	N/A	18.5	N/A
Maximum excavated material for TJBs (m^3)	1408	N/A	1408

Transition Joint Bays

1.5.23 The TJBs are required to join the offshore cables to the onshore cables. They need to provide a stable, clean and safe working environment for this activity. It is also desirable that they are protected from the action of the sea and located in a relatively dry area. Normally, they are located immediately behind the beach area such that offshore export cables are not installed on land over any significant distance. This is to minimise the pulling tension on the submarine cable once it has been brought onto land. Since the risk of mechanical damage to onshore cables is lower than that for offshore cables, and as such require less armouring, the onshore sections utilise single core, unarmoured cable that is more flexible to install and more easily transportable.

1.5.24 It is assumed that each circuit will require a TJB of no greater than 48 m^2 in area, and a maximum of four circuits would be required, assuming 4 m width by 12 m length by 2.5 m depth. Each TJB would be constructed of a concrete base with concrete and/ or wooden walls and roof. It is also assumed that each circuit will require one TJB, meaning that a maximum of four TJBs will be required. The TJBs are typically backfilled with a suitable material such as Cement Bound Sand (CBS). An example of a single TJB is shown in Figure 1.15. The design envelope for the TJBs is shown in Table 1.3. These values are representative of the landfall options identified in paragraph 1.5.6.

1.5.25 Depending on the final design, TJBs may be constructed to accommodate two or more circuits, rather than one TJB per circuit, however the total area and parameters will not exceed that stated for four individual TJBs (i.e. two TJBs, each double the size of a single-circuit TJB described above).

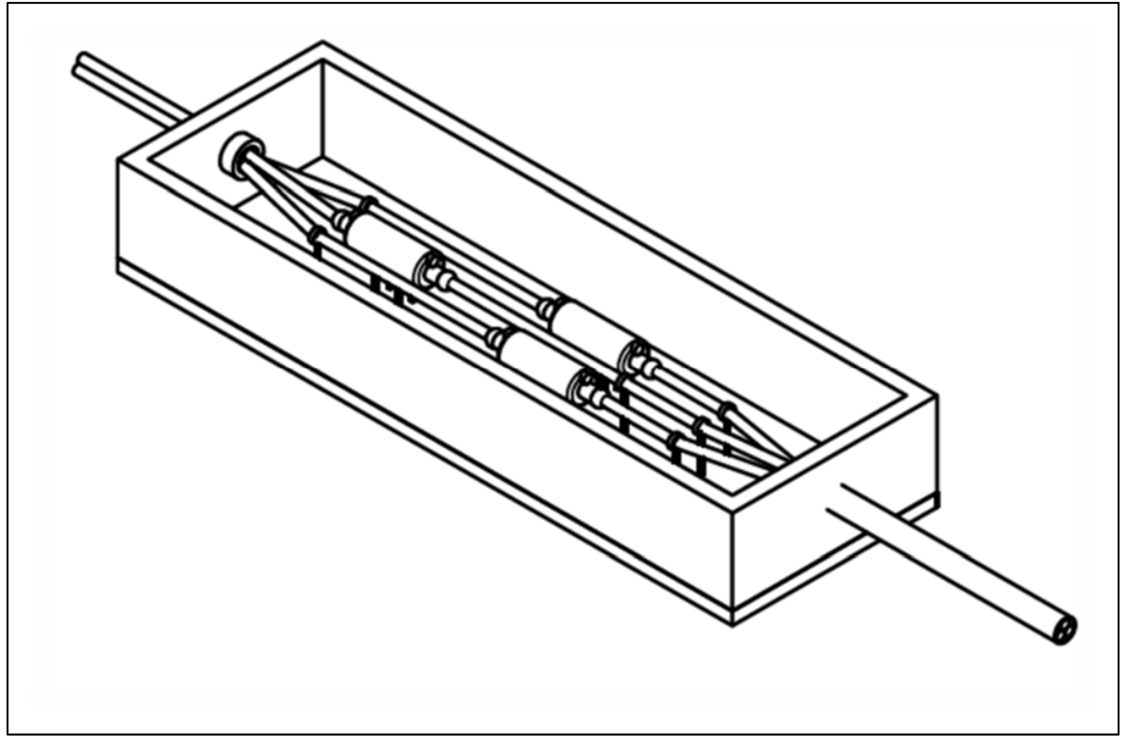

Figure 1.15: Indicative TJB.

1.5.26 For each landfall option there are certain common works that would be anticipated:

- Access to the potential zone for the TJBs; and
- A temporary works area will be retained until cable pulling operations and jointing of the offshore and onshore cables have been completed, at which time the site of the temporary works area will be fully reinstated.

1.5.27 As described previously, in the case of Options 1 and 3, the TJBs would be constructed below ground level, and built above ground in the case of Option 2. Details of the options for TJBs are described below.

Landfall options 1 and 3

1.5.28 Options 1 and 3 require the TJBs to be installed below ground within the Country Park. The TJBs would be installed in pits to a depth of 2 m, requiring up to 1,408 m^3 of material to be excavated. As illustrated in Figure 1.2 to Figure 1.4, the TJBs could be installed anywhere within the 'Potential Zone for Transition Pit' up to 350 m landward from the sea wall.

Option 2

1.5.29 In the case of Option 2, the TJBs would be built above ground within the Country Park, anywhere up to 350 m from the existing sea wall, on top of the historic landfill, whilst avoiding hard constraints.

1.5.30 The TJBs would therefore be installed in a berm up to 2.3 m high, to a maximum width of 45 m, assuming the edges of the berm are retained with a 1:5 gradient.

TJB design parameters

1.5.31 The maximum design envelope for the TJBs is described in Table 1.3 below.

Table 1.3: Design envelope for the TJBs

Parameter	Maximum design envelope		
	Option 1	Option 2	Option 3
Temporary works area (m)	50 x 60	30 x 40	
TJB size (per pit) (m^2)	48		
Max number of TJBs required	4		
Maximum height of TJB (m)	N/A	2.3	N/A

Onshore cable route

1.5.32 The main onshore cable shall operate at a voltage of up to 220 kV and connects the landfall to the onshore substation at Richborough Port where the voltage is transformed up to 400 kV. The main cable route, combined with the 400 kV cable route connecting the onshore substation to the NGET connection point at Richborough Energy Park, will have a combined length of approximately 2.6 km.

1.5.33 An HVAC (High Voltage Alternating Current) export cable solution has been chosen for Thanet Extension. HVDC (High Voltage Direct Current) infrastructure has been discounted due to the relatively short export cable length (approximately 32.5 km in total offshore and onshore), and the installed capacity of the project. At this distance, HVAC is a more efficient solution both in terms of minimising electrical losses and in minimising the size and amount of infrastructure required. Over a sufficient length, the losses associated with conversion to and from HVAC are outweighed by the reduced losses from the HVDC transmission cables. The Thanet Extension export cable however, is significantly shorter, and the export capacity significantly low enough to make the chosen option economic and efficient. Thanet Extension will use export cable voltages of between 66 kV and 220 kV. Whilst 66 kV may be strictly classed as MVAC (Medium Voltage Alternating Current), for the purposes of this ES, al export voltages are referred to as HVAC.

1.5.34 Up to four HVAC circuits will be required to transmit the power from the TJBs to the onshore substation. Each cable circuit will consist of three onshore power cables as well as up to two fibre optic cables.

1.5.35 For the Option 1 and Option 3 landfall options, cable will be buried below ground along the entire cable route, although these options are subject to SI works confirming this is possible within the historic landfill of the Country Park. These are described further in paragraphs 1.5.39 *et seq.*

1.5.36 For the Option 2 onward cable route, cables will be surface laid within the Country Park, covered by a 1.2 m high berm (as illustrated in Figure 1.17) for the primary cable, and a slightly larger berm where jointing bays are required (as illustrated in Figure 1.17) until the cable route reaches the Stonelees Nature Reserve. From here, all cables will be buried and there is no further distinction between the three Options.

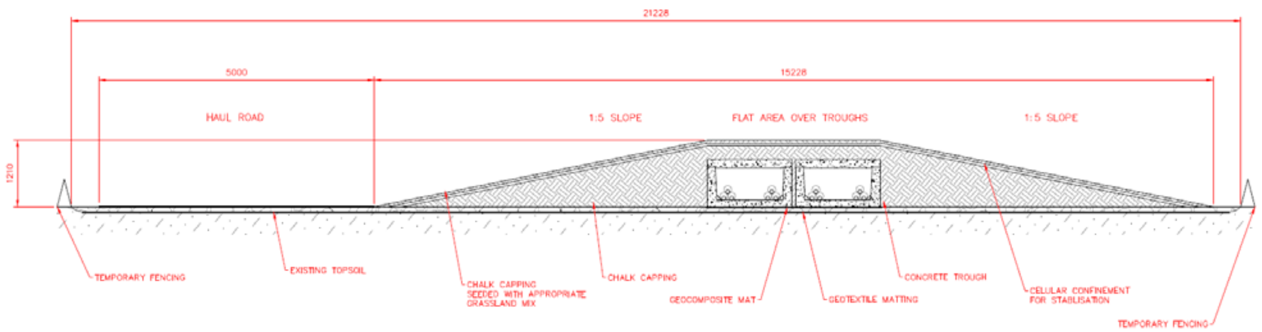

Figure 1.16: Cables installed within a 1.2 m high berm in the Country Park.

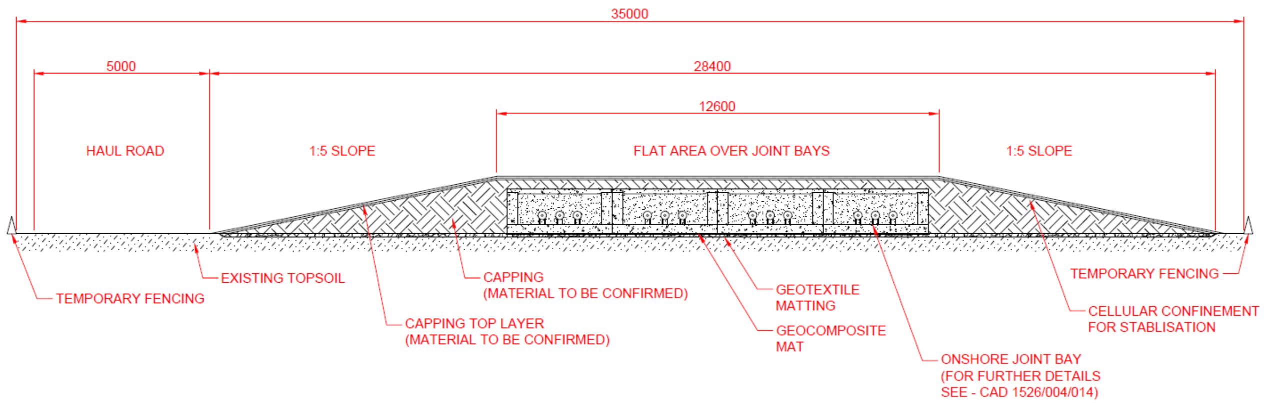

Figure 1.17: Cable Joint Bay installed in a 1.2 m high berm in the Country Park.

1.5.37 The berm will comprise a base layer of geotextile topped with the concrete trough in which the cables will be installed. The trough will be covered over with a capping layer and made into a berm. As noted previously the slopes of the berm will be a 1:5 gradient potentially comprising a capping layer (potentially constructed out of chalk) across the sloped section and flatter top section. The capping layer may then be seeded or left to self-seed in line with a Landscape and Ecological Mitigation Plan (LEMP) (Document Ref: 8.7) which will be defined in consultation with the relevant authorities.

1.5.38 The design envelope for the above ground cable route is detailed in Table 1.4.

Table 1.4: Design envelope for the above ground export cable corridor (Option 2) within the Country Park

Parameter	Maximum design envelope
Number of cable circuits	4
Number of cables	12 (+ 8 fibre optic cables)
Cable voltage (kV)	220 kV
Cable diameter (mm)	150
Cable type	XLPE (cross-linked polyethylene) or EPR (ethylene propylene rubber) electrical cables, plus fibre optics
Temporary construction width (m)	34
Berm width (m) (berm/cable joint bay)	15 – 28
Berm height (m)	1.2

1.5.39 For Options 1 and 3 within the Country Park, and all Options from the edge of the Country Park/Stonelees Nature Reserve cables will be installed by open trenching to the substation at Richborough Port. Cables will be installed in 4 x 1 m trenches, each up to 1.5 m deep (Figure 1.18).

1.5.40 The design envelope for the onshore cable route is detailed in Table 1.5.

Table 1.5: Design envelope for the onshore export cable corridor beyond the Country Park

Parameter	Maximum design envelope
Number of cable circuits/trench	4
Number of cables	12 (+ 8 fibre optic cables)
Cable voltage (kV)	up to 220 kV
Cable diameter (mm)	150
Cable type	XLPE (cross-linked polyethylene) or EPR (ethylene propylene rubber) electrical cables, plus fibre optics
Temporary construction width (m)	30
Trench width (m) per circuit	1
Burial depth (m) (to top of cable)	1.2
Trench depth (m) (to bottom of trench)	1.5

1.5.41 In summary the overall lengths of cable to be installed within each of the primary land areas (Country Park, Stonelees Nature Reserve etc) are presented within Table 1.6:

Table 1.6: Approximate lengths of cable infrastructure within primary sections of onshore cable route

Area	Length (m)
Length of onshore cable route through Country Park (m)	725
Length of onshore cable route through SSSI (m)	350
Length of onshore cable route through Baypoint Club (m)	450
Length of onshore cable route through BCA site (m)	300

Trenching, soil storage and cable installation

1.5.42 The main cable installation method outside the Country Park will be through the use of open-cut trenching with High Density Polyethylene (HDPE) ducts installed, the trench backfilled and cables pulled though the pre-laid ducts.

1.5.43 The cable circuits will be installed in a trefoil (cables bunded together in a triangular shape) or flat (cables laid formation, depending on detailed cable system design, with horizontal separation between circuits of up to 3 m (Figure 1.18) to ensure thermal separation. This figure also illustrates the haul road/ running tack and soil storage arrangements.

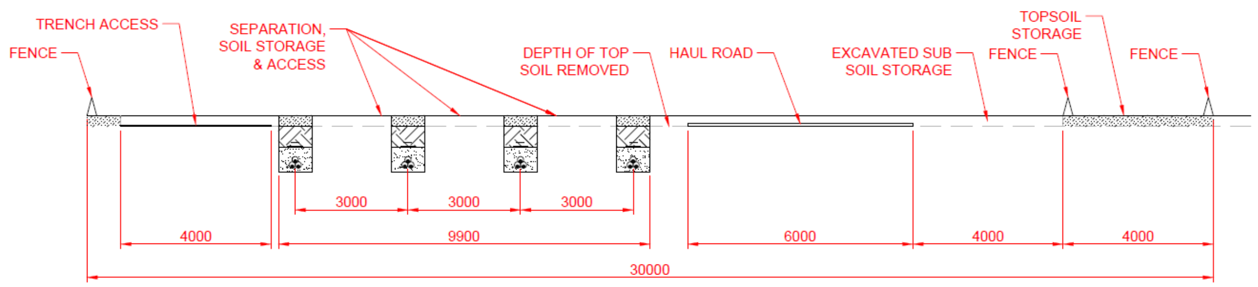

Figure 1.18: Indicative installation configuration.

1.5.44 Where the cable route crosses transport routes, waterways or underground services the standard open-cut trenching installation technique may not be suitable. Further details of crossing methodologies are provided in paragraphs 1.5.65 *et seq*.

1.5.45 The profile of the soil will be carefully maintained during the storage process. The cable trenches will then be excavated, typically utilising tracked excavators. The excavated subsoil will be stored separately from the topsoil, capped and the profile of the soil maintained during the storage process. Soil may be stored immediately adjacent to the trench or stored elsewhere within the development boundary at temporary construction and laydown areas. In shorter cable sections, it may be possible to backfill trenches immediately. Within the Stonelees Nature Reserve, the preference is to maintain soil structure, and backfill as soon as possible.

1.5.46 The trenches may require shoring with wooden battens or other edge protection to enhance integrity and mitigate trench collapse risks. This requirement will be dependent on appropriate risk assessments considering the soil and prevailing weather conditions.

1.5.47 A pre-construction drainage plan will be developed and implemented to minimise water within the trench and ensure ongoing drainage of surrounding land. Where water enters the trenches during installation, this will be pumped via settling tanks or ponds to remove sediment, before being discharged into local ditches or drains via temporary interceptor drains.

1.5.48 The base of the trench will be prepared by laying a backfill material such as CBS. A duct for each cable and separate ducts for a fibre optic bundle will be laid on the base fill material and backfilled with material such as CBS to a certain covering depth. This approach ensures a consistent homogeneous medium for the dissipation of heat generated by the cables during generation. The backfill will be covered with high voltage cable warning tiles with integrated warning tape and the trench backfilled with subsoil material excavated from the trench. The stored topsoil will be replaced upon the backfilled subsoil to reinstate the trench to pre-construction condition, so far as reasonably possible.

1.5.49 Cables will be pulled and installed through the installed ducts later in the construction programme. This approach allows the civil works (such as road, path and waterway crossings etc.) to be completed in advance of cable delivery.

1.5.50 Cable pulling does not require the trenches to be reopened, however access to and from the jointing pits along the running track will be required to facilitate the works which may limit the level of reinstatement immediately after trenching activities, dependant on alternative access availability. If the period between duct installation and cable installation is significant, alternative access and reinstatement arrangements may be agreed with landowners as appropriate to minimise long-term impact. Activities such as cable pulling are likely to require temporary works areas alongside the cable route.

1.5.51 Cable drums will be delivered by Heavy Duty Vehicle (HDV) to temporary works areas for storage where necessary, then transported to the open joint pit locations (vehicle movements are described in Paragraph 1.5.100 *et seq.)*. The cable drum will be located adjacent to the joint pit on a temporary hard standing. A winch at the next joint bay will be attached to the cable with a pilot wire, and the cable will be pulled off the drum from one joint pit to another, through the buried ducts. Cable jointing can be conducted once both lengths of cable that terminate within it have been installed.

Running Track

1.5.52 The running track provides safe access for construction vehicles along the cable corridor, from mobilisation areas to cable installation sites. The running track could be up to 6 m wide and extend the full length of the cable route. A separation of 2 m is maintained from the edge of the running track and the cable trench for safety and to maintain trench stability.

1.5.53 Following topsoil stripping, the running track will be formed of protective matting, temporary metal road or permeable hardcore aggregate dependant on the ground conditions, vehicle requirements and any necessary protection for underground services. Monitoring of the subsoil will be conducted to minimise long-term damage in consultation with relevant stakeholders and higher-grade protection will be applied if deemed necessary.

1.5.54 At drain crossings, the running track may be installed over a pre-installed culvert pipe to allow continued access to the cable route. The pipe may be installed in the drain bed so as to avoid upstream impoundment and will be sized to accommodate reasonable worst-case water volumes and flows. These culverts may remain in place for up to two years.

1.5.55 The running track will be required to remain cleared for the duration of the trenching activities to allow access along the cable route. Following construction completion, the running track will be removed, and the topsoil reinstated although rights will be retained to access the running tracks location should repairs of the cables be required through the lifetime of the project.

Joint Pits

1.5.56 Joint pits will be required along the cable route to allow cable pulling and jointing of two sections of cable. One joint pit will be required approximately every 800 m of cable (to be determined by detailed design), resulting in a maximum of four joint pits per cable (up to 16 in total for a maximum of four cable circuits), in addition to the TJBs at landfall and cable termination at the substation. The joint pits will be of a similar design and installed in a similar approach to the TJBs and will be up to 10 m long by 3 m wide by 1.5 m deep.

1.5.57 All excavation and reinstatement activities for the joint pits will be conducted as per the cable trenching activities.

Link Boxes

1.5.58 Link boxes are required for a HVAC connection arrangement, typically in close proximity (within 10 m) to jointing locations. The purpose of the link boxes is to eliminate or reduce induced voltages and circulating currents within the cables which may otherwise cause reduced transmission capacity and additional heating. The HVAC cable sheath phases are cross bonded and transposed to minimise circulating currents and maximise cable ratings. This is achieved at regular intervals along the cable routes and will be housed within link boxes.

1.5.59 The link boxes may also provide access to sheath test sites, accommodate Sheath Voltage Limiters (SVL), and allow fibre optic jointing and/ or house signal boosting equipment as required. Link boxes may not be required at all joint locations and can typically be placed at every second or third jointing location, although they may be required at every jointing location. These link boxes are likely to be installed below ground, except within the Country Park, where, though technically still ‘below ground’, they would be installed within the 1.2 m high berm. These would require manholes for ease of inspection. The number and placement of the link boxes will be determined as part of the detailed design.

1.5.60 The link boxes will require periodic access by technicians for inspection and testing. Where possible, the link boxes will be located close to field boundaries and in accessible locations with the exact location to be determined during detailed design phases.

1.5.61 The link box, with dimensions 1.5 x 1.5 m, per circuit, will be buried with a secured access panel located at ground level.

Construction and laydown areas

1.5.62 During construction of the onshore substation, temporary works areas will be established to support the works. The temporary works areas will be formed of hard standing with appropriate access to allow the delivery and storage of large and heavy materials and assets, such as power transformers.

1.5.63 The main laydown area for the landfall and cable installation will be located adjacent to the Country Park (Figure 1.2 to Figure 1.4) and may accommodate welfare facilities, car parking and storage areas for the purposes of enabling the construction works. Water, sewerage and electricity services will be required at the site and supplied either via mains connection or mobile supplies such as bowsers, septic tanks and generators. When construction shifts to the onshore substation, the main laydown area will be location adjacent to the substation area, illustrated in Figure 1.6.

1.5.64 An additional temporary works area is illustrated in Figure 1.5 and will be primarily used during the cable installation to accommodate equipment and materials used in the construction, as well as an additional area for soil storage if necessary.

Crossings: Hedgerows and vegetation

1.5.65 There are no hedgerows that require clearance along the Thanet Extension onshore cable route. There are two lines of trees or scrub that will require clearance, located at the interface between Stonelees and the Bay Point Club, and the interface between the Bay Point Club and the British Car Auctions Compound south of the Bay Point Club. In these areas the width of the cable easement will be reduced to the running track and cable trenches only to minimise the amount of tree removal. Tree and scrub removal will be conducted before the nesting season discourage nesting birds and, where necessary, precautionary measures will be taken during felling of any trees having low bat roost potential. Areas may be replanted with plant types matching the existing as part of reinstatement works, with hedge plants such as quickthorn and blackthorn planted directly above the cables where a hedge is necessary either for screening purposes or to indicate a field boundary. This is described in the LEMP (Document Ref: 8.7)

Crossings: other infrastructure and underground services

1.5.66 Information on the type and location of underground services will be collected and verified as part of the pre-construction activities. Where these services are identified, manual trench excavation will be employed within 1 m (or the stipulated distance requirement of the asset owner if applicable) of these locations to uncover the services in a controlled and safe manner. To date, there are two electrical underground cables, and two BT telecommunications cables that may require crossing.

1.5.67 The exposed services will be supported as necessary to prevent damage and the cable ducts installed at a suitable depth above or below the asset. Crossing of the services will be made at a perpendicular angle where practicable to do so to minimise crossing length.

1.5.68 The works will be conducted within the cable easement with no additional land requirements. The running track may require reinforcement in these locations to minimise the risk to services damage. Soil storage and re-instatement of the trench will be conducted in line with the main cable route installation.

Crossings: Traffic Management

1.5.69 The final route for the purposes of this ES and development consent application have been chosen to minimise interaction with roads however there is a need to cross an access road adjacent to the substation location, and a public right of way and other paths within the Country Park.

1.5.70 Temporary crossings of the cable easement may be installed to allow public access to continue during the construction works, particularly where the running track is required to remain in service. In other areas paths or public rights of way may be temporarily diverted. The crossings will be managed to allow safe operation.

1.5.71 Only one major road crossing is required, the A256, which will be crossed by HDD as described in paragraph 1.5.79.

Crossings: Watercourses

1.5.72 Where small scale drainage ditches, are to be crossed, temporary damming and culverting of the drainage ditch may be employed. A single drainage ditch requires crossing to allow construction traffic to access/egress the construction/laydown area within the Country Park adjacent to Sandwich Road. The drainage ditch runs alongside Sandwich Road, and adjoins the Minster Stream, which runs into the River Stour between the Bay Point Club and the substation location at Richborough Port. The drainage ditch at the vehicle crossing location appears to rarely have a distinct flow of water and as such temporary crossings are considered to be straightforward and of low risk. The crossing of the Minster Stream will be necessary for the cables and may require works in the form of a culvert.

1.5.73 The drainage ditch will be dammed at either side of the access track using sandbags or straw bales and ditching clay with water flow pumped or piped across the dammed section during periods of waterflow within the ditch. Reinstatement of the trench is conducted to the pre-construction depth of the watercourse and the dams removed. Alternatively, ducts will be installed to ensure the installed cables do not impede the flow of drainage waters.

1.5.74 For the crossing of the Minster Stream the works will be conducted within the cable easement with no additional land requirements. The Minster Stream is currently culverted at this location however it may be necessary to undertake works to remove and replace the existing culvert if it is not considered robust enough to be subject to the necessary cable installation works.

1.5.75 Crossing of the Minster Stream would be further defined in the detailed design stage post-consent in liaison with the relevant authorities.

Crossings: Trenchless crossing

1.5.76 Trenchless installation methods such as HDD, micro-tunnelling or auger boring may be employed where open-cut trenching is not suitable due to the nature of the feature being crossed. Trenchless installation is proposed to be employed across the A256 to minimise the impact to this main road.

1.5.77 With trenchless methods, the depth at which the ducts are installed depends on the topology and geology at the crossing site as well as the infrastructure to be avoided and length of the crossing.

1.5.78 Where trenchless crossing activities are to be conducted, a temporary works area will be required to store equipment, facilities etc. The dimensions of the temporary works areas will be fully determined by site-specific constraints in the detailed-design stage.

1.5.79 The crossing of the A256 will require a single HDD ducts to be installed under the highway. A temporary works area of approximately 20 x 30 m will be excavated on the eastward side of the road. From here, cables will be installed by open trenching to REP. This is further described in paragraph 1.5.99.

Onshore substation

1.5.80 One onshore substation (HVAC) will be required for Thanet Extension. It will be sited within Richborough Port as close to the REP as reasonably possible (having regard to various matters such as technical requirements and the area needed for the electrical infrastructure) to facilitate ease of connection with the National Grid.

1.5.81 The HVAC substation transforms the wind farm export voltage (up to a maximum of 220 kV) to the National Grid 400 kV transmission voltage. Filtering and reactive compensation equipment may be located at the HVAC substation to ensure that the wind farm complies with the technical requirements to connect to the National Grid. The HVAC substation also accommodates switchgear and associated protection and control equipment to allow safe operation of the wind farm connection. A security fence will surround the area which, subject to relevant guidance is anticipated to be a palisade fence with an electric pulse fence 1 m above the palisade fence line, to a total of 3.4 m high.

1.5.82 The HVAC onshore substation will likely consist of:

- 4 x three phase reactors – to provide additional reactive power compensation to the wind farm connection;
- 4 x Static Synchronous Compensators (STATCOM), Static Var Compensator (SVC) or equivalent – to provide variable reactive power to meet NGET technical connection requirements;
- 2 x transformers – to increase export HVAC voltage (up to a maximum of 220 kV) up to the National Grid transmission voltage of 400 kV;
- 4 x harmonic filters – to meet power quality connection requirements; each filter will comprise capacitors, reactors and resistors together with interconnecting conductors;
- Control building – housing the main switchboard, SCADA and protection equipment;
- Access roads – approximately 6 m wide for O&M access to equipment;
- Associated connections between equipment via overhead busbar and cabling, including buried earthing system; and
- Ancillary infrastructure such as a car park and welfare facilities.

1.5.83 The onshore substation will either utilise an Air Insulated Switchgear (AIS), which uses air for insulation, or a Gas Insulated Switchgear (GIS), which uses sulphur hexafluoride gas for insulation. Installation for a GIS substation are generally smaller than their AIS counterparts, typically taking up a 35% smaller footprint than an equivalent AIS substation, potentially also reducing the construction time. Another advantage of GIS substations is that they typically require less maintenance as all the interior elements are sealed and insulated. GIS systems do, however, have a higher upfront cost, but may have a lower lifetime cost than equivalent AIS systems.

1.5.84 The largest equipment within the onshore substation will be the substation building, with a maximum height of 14 m above existing ground level. All other equipment (e.g. transformers, switchgear) will not exceed a height of 12.5 m above existing ground level. The total land requirement for the HVAC onshore substation to the perimeter fence is 41,000 m^2, as well as a 20,000 m^2 temporary construction area.

1.5.85 An overview of the maximum design envelope for the onshore substation is provided in Table 1.7 below. The worst-case assumptions for the areas required are defined on the basis of an AIS design, with the final decision on technology being subject to detailed design. Indicative layouts and building specifications for the substation building are shown in Figure 1.19 and Figure 1.20.

Table 1.7: Design envelope for the onshore substation

Parameter	Maximum design envelope
Permanent operational area (m^2)	41,000
Temporary Construction Area (m^2)	20,000
Area of main building (m)	50 x 30
Height of main building (m) above existing ground level	14
Maximum height of transformers and busbars (m) above existing ground level	12.5
Maximum number of piles (CFA)	200
Maximum duration of piling (months)	2

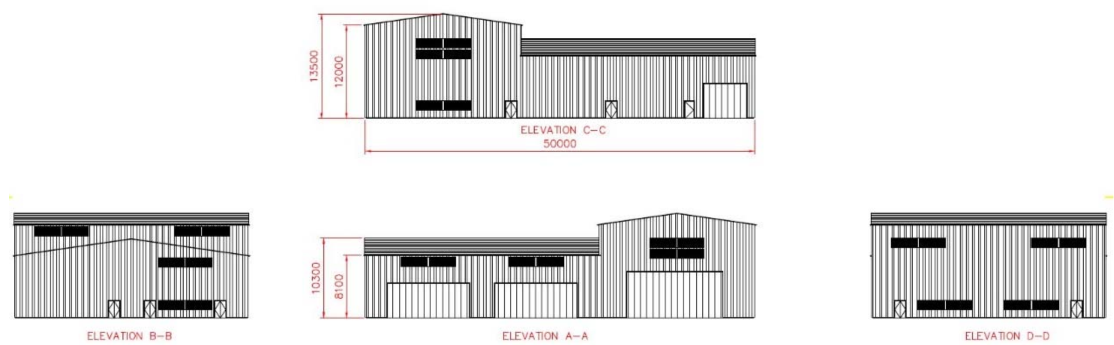

Figure 1.19: Indicative design for substation building (profile view).

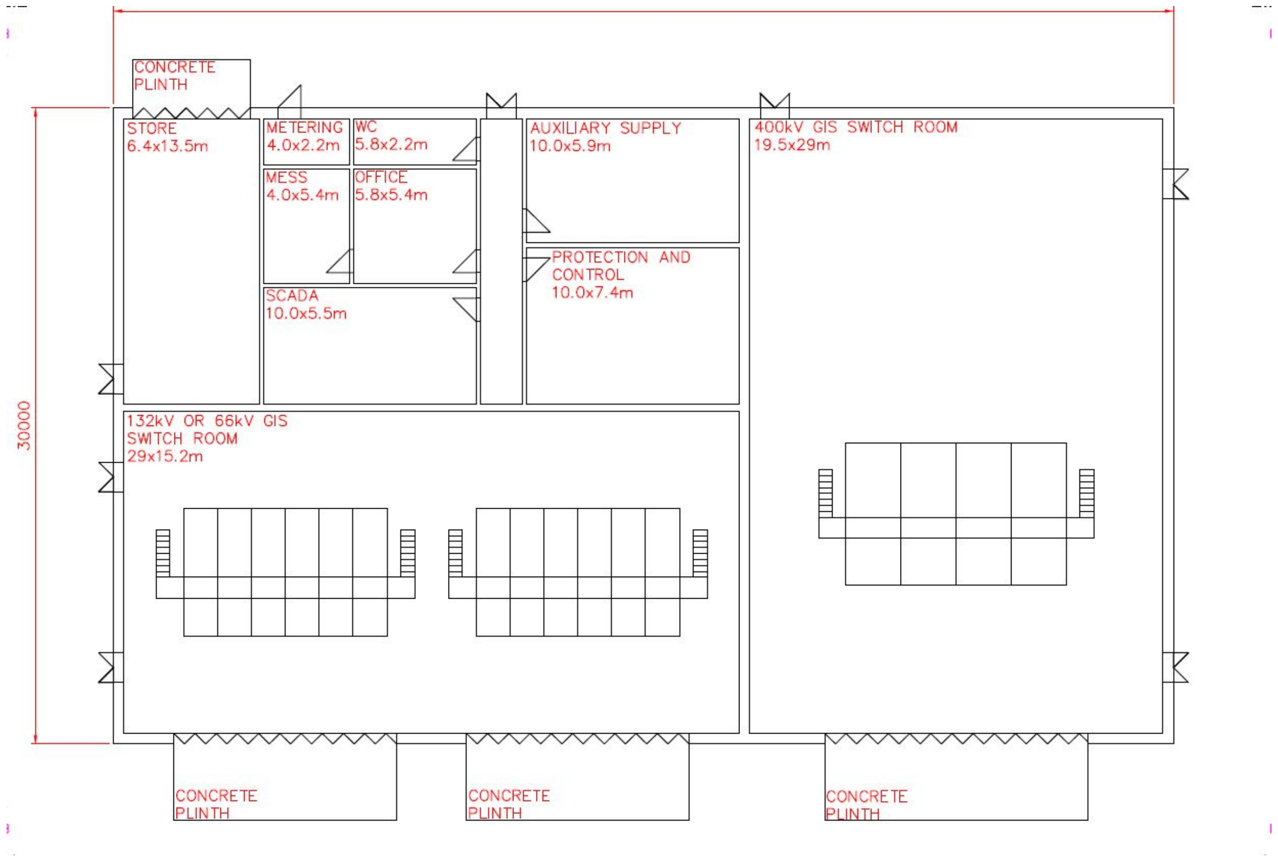

Figure 1.20: Indicative layout of substation building (plan view).

Temporary Construction Area

1.5.86 During construction of the onshore substation, a temporary construction area will be established to support the works. The area will be formed of hard standing with appropriate access to allow the delivery and storage of large and heavy materials and assets, such as power transformers.

1.5.87 The area will be approximately 20,000 m^2 and will accommodate construction management offices, welfare facilities, car parking, workshops and storage areas. Water, sewerage and electricity services will be required at the site and supplied either via mains connection or mobile supplies such as bowsers, septic tanks and generators. This area will also serve for cable installation works.

1.5.88 The location of the onshore substation temporary construction area will be sited next to the onshore substation in close proximity to the cable route with due consideration for avoiding existing watercourses, hedgerows and other known infrastructure/ constraints to minimise impacts.

Pre-construction works

1.5.89 Prior to the construction works beginning, a number of surveys and studies will be undertaken to inform the detailed design including ecological surveys, geotechnical investigations, and mitigation requirements such as landscaping and drainage assessments.

1.5.90 Surface water drainage requirements will be dictated by the final drainage study and will be designed to meet the requirements of the National Planning Policy Framework (NPPF) with run-off limited, where feasible, through the use of infiltration techniques which can be accommodated within the area of development. Foul drainage will be collected through a mains connection to existing local authority sewer system if available or septic tank located within the development boundary. The specific approach will be determined during detailed design with consideration for the availability of mains connection and the number of visiting hours for site attendees during O&M.

1.5.91 Works will also need to be carried out in order to provide replacement land for HMRC to the south of the substation area (Figure 1.6). As requested during Section 42 consultation, it is required that this replacement land be operational prior to the start of any construction works for the substation. The total land area that may require resurfacing is 60,000 m^2.

1.5.92 The onshore substation will be enclosed by a temporary perimeter fence for the duration of the construction period with a permanent fence installed as part of the construction works.

Construction

1.5.93 The site will be stripped and graded as required by the final design. Stripped material will be reused on site where possible as part of bunding and shielding as allowed for in the final design. Any excess material would be disposed of at a licenced disposal site. Excavations and laying of foundations, trenches and drainage will commence after grading is complete.

1.5.94 Foundations for the substation are likely to require Continuous Flight Auger (CFA) piles, with a maximum of 200 piles will be installed over a 2-month period. CFA piling involves excavating a hole using an auger drill, with concrete injected as the drill is removed, allowing a pile to be installed without leaving an open hole. Reinforcements may be added to the wet concrete once the drill is removed.

1.5.95 The specialist electrical equipment will then be delivered to site, installed and commissioned. Due to the size and weight of the transformers' tanks, these deliveries will be classed as Abnormal Indivisible Loads (AILs). Such loads will require specialist delivery methods to be employed and, when on site, offloaded and skidded into position with the use of a mobile gantry crane.

1.5.96 The 400 kV HVAC interconnecting cable from the onshore substation to the NGET substation will be installed in accordance with the main cable laying and installation works.

1.5.97 Construction activities will be conducted six or seven days a week (7 days may be required during specific works, such as at the landfall) during working hours of 0700 - 1900 where practicable, however some discrete locations may require 24-hour working, such as during commissioning. Evening working may be required for specific time critical activities such as transformer oil filling and processing; however, these will be kept to a minimum and will not involve heavy plant. Perimeter and site lighting will be required during the winter months and a lower level of lighting will remain overnight for security purposes.

Commissioning

1.5.98 Some of the commissioning works on the onshore substation site is required to be undertaken simultaneously and retrospectively with the commissioning of individual offshore WTGs. Due to the need to align the final commissioning of the onshore substation with the commissioning of the offshore array, the 6-month commissioning period (Table 1.11) will not take place until 2023, when offshore commissioning is due to take place. This will take place after the heavy construction works at the substation are complete and will mainly be restricted to small indoor electrical works, involving only light vehicles at the transition between the construction and O&M phases.

National Grid connection

1.5.99 The National Grid 400 kV REP substation would accommodate circuit breakers which would constitute the connection point for Thanet Extension to the existing NGET 400 kV transmission system. The circuit breaker would be housed within the existing 400 kV GIS building within the substation compound. It is not anticipated that the project would be required to undertake any extension to the NGET GIS building or substation boundary in order to accommodate Thanet Extension. If NGET are required to carry out alterations or extensions to the REP substation which require planning consent, then the responsibility for these applications is expected to remain with NGET. Up to two 400 kV interconnecting cable circuits from the Thanet Extension onshore substation will be routed underground or laid in troughs to the NGET 400 kV REP substation compound, achieved by HDD as described in paragraph 1.5.76 *et seq.*, with the final section trenched as described in paragraph 1.5.42 *et seq.* Once inside the NGET substation compound, the cables will be terminated into cable sealing ends, which will form the interface to the GIS building. The 400 kV interconnecting cable circuits would each comprise three power cores and up to two fibre-optic cables. A construction width of up to 5 m may be required for the cable route through the existing REP, however the exact working width would be defined by existing site constraints.

Table 1.8: Maximum design envelope for the grid connection works

Parameter	Maximum design envelope
400 kV interconnecting cable circuits	2
Construction width (m)	5
Construction time (months)	3

Traffic and access

1.5.100 Construction traffic will be generated from:

- Construction staff movements;
- Deliveries of equipment, components and materials;
- Waste removal; and
- Any third-party involvement, such as authority inspections.

1.5.101 Construction equipment, plant and materials will be transported to and from the site using HDVs, whilst personnel and light equipment will be transported to and from the site using Light Duty Vehicles (LDVs). There may also be the need for specialist vehicles to bring some plant and large, heavy equipment such as electrical transformers as abnormal loads, although the number of abnormal loads will be limited. The intensity of vehicle movements will vary throughout both the construction period and the working day.

1.5.102 Full details of transport routes will be agreed pre-construction in the Code of Construction Practice (CoCP) and will utilise the local highways network. Further detail on vehicle movements can be found within Volume 3, Chapter 8: Traffic and Transport (Document ref: 6.3.8).

1.5.103 The vehicle movements described in Table 1.9 group the landfall, TJB works, cable installation, substation and NGET grid connection works. The Annual Average Daily Traffic (AADT) numbers are presented in Table 1.10.

Table 1.9: Maximum vehicle movements (per day) during the construction of the onshore components of Thanet Extension

Construction works	Peak two-way HDV trips per day	Peak two-way LDV trips per day
Annual average daily traffic (personnel)	62.2	37.5
Annual average daily traffic (other vehicles)	N/A	24.2
Peak daily traffic	351	84

Table 1.10: Annual Average Daily Traffic (AADT) during construction of the onshore components of Thanet Extension.

AADT	One-way	Two-way
HDVs	76.1	152.2
LDVs	12.7	25.4
Personnel	23.6	47.2
Total	112.4	224.8

Construction plant and equipment

1.5.104 The types of construction plant and equipment that could be used during the onshore construction of Thanet Extension are listed below. This list is not intended to represent an exhaustive list of equipment, rather an indication of the types of plant and equipment that could be used during the construction of Thanet Extension:

- Piling rig for cofferdam sheet pile installation;
- Vibrating compactor;
- Tarmac roller;
- Concrete mixer;
- Cable-pulling winch;
- Angle grinder;
- Pneumatic breaker;
- Tarmac production plant;
- Dump truck;
- Tracked excavator; and
- Lorries.

1.6 Construction Programme

1.6.1 The construction programme for Thanet Extension will be dependent on a number of factors, including:

- The connection dates in the grid connection agreements with NGET (which may be subject to change);
- The date that development consent is awarded; and
- The availability and lead times associated with procuring and installing the project components.

1.6.2 The maximum capacity of Thanet Extension will be 340 MW and this will be transmitted from the Thanet Extension array to the onshore grid connection point at REP in a maximum of four circuits.

1.6.3 Construction periods for each onshore component of Thanet Extension are shown in Table 1.11. It should be noted that the total construction period for the onshore aspects of Thanet Extension cannot be assumed to be the sum of all components as many of the work activities may overlap. Conversely, there may also be periods of inactivity during the total construction period, i.e. should any seasonal constraints be required in the final construction programme. The onshore construction of Thanet Extension is currently anticipated to start in 2020 and take up to a maximum of 30 months. Final commissioning of the onshore substation will be aligned with the commissioning of the offshore WTG array, and will be limited to mainly indoor small works, with associated light vehicle movements.

1.6.4 Other offsite activities include survey reporting and contract tendering processes, which would be carried out pre-construction. Intrusive site investigation surveys (e.g. boreholes) may also be required.

Table 1.11: Construction periods for the onshore components of Thanet Extension

Thanet Extension component	Pre-construction and construction work duration	Indicative construction dates	Works included
Total duration	**30 months**	September 2020 – February 2023 (Note that these dates are indicative and subject to change in the detailed design phase, and seasonal constraints.)	Including pre-construction and construction works. It is important to note that the package-specific durations listed below may overlap, and so the total duration is not simply the sum of these activities. It is also important to note that works may not necessarily be continuous during these periods, and there may be significant gaps within the construction period where works are not occurring, for example during a certain time of year.
Package-specific maximum durations			
Landfall works (including TJBs)	**5 months**	Indicative Q1 2021 – Q3 2021 subject to seasonal constraints.	This covers all associated works including: • Site mobilisation including erection of fencing and welfare and plant delivery; • Earthworks and drainage works; • TJB construction, cable pulling, cable jointing and commissioning; and • Demobilisation, including removal of temporary work area.
Onshore cable circuits	**18 months** (not including cable pulling and jointing)	Q1 2021 – Q2 2022.	This covers all associated works including: • Site mobilisation including erection of fencing and welfare and plant delivery; • Earthworks and drainage works; • Cable duct installation; • Cable pulling, joint bay construction, cable jointing and commissioning; and • Demobilisation and landscaping.
Substation works	**24 months** This is likely to be split into: • 9 months for the civil construction works; • 9 months for mechanical and electrical works. This work would mainly take place inside the substation building, but would involve discrete large scale works such as the installation of transformers; and • 6 months commissioning.	Q3 2020 – Q2 2022 Final commissioning to be completed in-line with offshore commissioning in 2023.	This covers all associated works including: • Site mobilisation including erection of fencing and welfare and plant delivery; • Earthworks and drainage works; • Substation construction; • Commissioning; and • Demobilisation and landscaping.
NGET grid connection works	**3 months**	Q2 2022 – Q3 2022.	This covers all works associated with the installation of the 400 kV connection from the VPWL onshore substation to the grid connection works, including HDD and cable pull, and commissioning. This excludes NGET's own works to facilitate the connection.

1.7 Operation and Maintenance

1.7.1 The operational life of the onshore infrastructure is expected to be up to 40 years but may be extended as the project nears decommissioning as technology and maintenance improves.

1.7.2 The overall O&M strategy will be finalised once the technical specification of Thanet Extension is known, including electrical export option and final project layout.

1.7.3 Maintenance activities can be categorised into two levels: preventative and corrective maintenance. Preventative maintenance is according to scheduled services whereas corrective maintenance covers unexpected repairs, component replacements, retrofit campaigns and breakdowns.

1.7.4 Onshore, the O&M requirements will be largely corrective, accompanied by infrequent on-site inspections of the onshore transmission infrastructure. However, the onshore infrastructure will be consistently monitored remotely, and there may be O&M staff visiting the onshore substation to undertake works on a regular basis (expected to be once per week). The onshore substation will not be manned, and lighting will only be required during O&M activities. Lighting will be required at the NGET connection at REP, although this is assumed to be existing. Periodic access to link boxes and test pits may also be required for inspection, estimated to be annually.

1.7.5 The design envelope for onshore O&M activities is described in Table 1.12 below.

Table 1.12: Maximum design envelope for O&M activities

Parameter	Maximum design envelope
O&M staff visits (per week) (onshore substation)	Approximately 1 visit per week (3 staff per visit)
Maximum O&M personnel required (onshore substation)	4
Vehicle movements	2 HDVs per month (maximum of 24 per year)
Operational noise level (dB(A) at 0.3 m (transformer)	90
Annual O&M visits to NGET REP	Approximately 1 per week.

1.8 Decommissioning

1.8.1 No decision has been made regarding the final decommissioning for the onshore components of Thanet Extension; however, at the end of the operational life of the project, it is likely that onshore cables would be removed from the ducts and recycled, with TJBs capped, sealed and left *in situ*. Where it is preferable to do so and depending on what is the most environmentally acceptable option, cables could be cut and left *in situ*.

1.8.2 The programme for decommissioning is expected to be similar in duration to the construction phase. Any final decommissioning methodology will adhere to industry best practice, rules and regulations at the time of decommissioning. The detailed activities and methodology for decommissioning will be determined later within the project lifetime, but would be expected to include:

- Dismantling and removal of electrical equipment;
- Removal of cabling from site where required (or cutting and leaving *in situ*);
- Removal of any building services equipment;
- Demolition of the buildings and removal of fences; and
- Landscaping and reinstatement of the site.

1.9 References

- Department for Energy and Climate Change (DECC) (2011a), Overarching National Policy Statement for Energy (EN-1) [online]. Available at: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf> [Accessed: May 2017].
- Department for Energy and Climate Change (DECC) (2011b), Overarching National Policy Statement for Renewable Energy Infrastructure (EN-3) [online]. Available at: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47856/1940-nps-renewable-energy-en3.pdf> [Accessed: May 2017].
- The Planning Inspectorate (PINS) (2012), Advice note nine: Rochdale Envelope [online]. Available at: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2013/05/Advice-note-9.-Rochdale-envelope-web.pdf> [Accessed: May 2017].