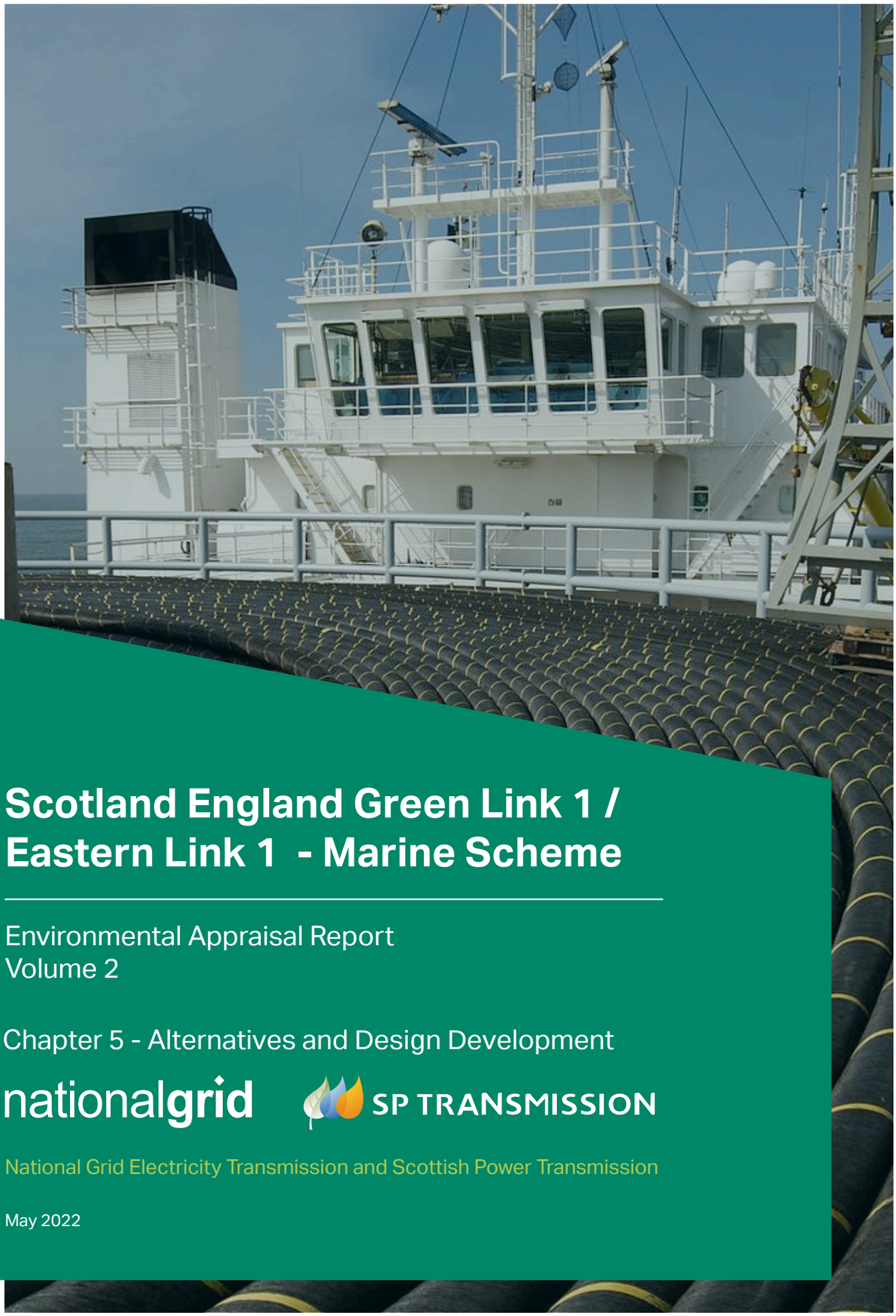


# Scotland England Green Link 1 / Eastern Link 1 - Marine Scheme

Environmental Appraisal Report
Volume 2

Chapter 5 - Alternatives and Design Development

nationalgrid SP TRANSMISSION

National Grid Electricity Transmission and Scottish Power Transmission

May 2022

## Prepared for:

National Grid Electricity Transmission and
Scottish Power Transmission

## Prepared by:

AECOM Limited
Aldgate Tower, 2 Leman Street
London, E1 8FA
United Kingdom

T: +44 20 7061 7000
aecom.com

In association with:

Xodus Group (Shipping and Navigation);

Wessex Archaeology (Marine Archaeology); and

Brown and May Marine Ltd (Commercial Fisheries)

# Table of Contents



# Figures



# Tables

# 5. Alternatives and Design Development

## 5.1 Introduction

This chapter describes the evolution of the design of the Marine Scheme, including the reasoning for the selection of HVDC technology for the cable system. The chapter also describes the alternatives considered to reach a solution that balances the need for a technically feasible and economically viable route whilst limiting the disturbance to people, existing marine users and the environment. The chapter goes on to explain the rationale for selection of the Project Design Envelope (PDE) (Chapter 2: Project Description).

The “Need for the Project” has been discussed in Chapter 1: Introduction, where the context of Government net-zero targets, North Sea developments, as well as north to south electricity transfer requirements are explained. The primary objective of the Project is to reinforce the electricity network and increase transmission capacity across the B6 boundary between southern Scotland and northern England before 2030.

The development of the Marine Scheme has included the identification and assessment of potential landfall locations along the east coast of Scotland and northern England. The approach to the identification of the marine installation corridor connecting the two landfall locations has been informed by strategic optioneering as well routeing and siting. The Transmission Owners (TOs) National Grid Electricity Transmission (NGET) and Scottish Power Transmission (SPT) are the holders of electricity transmission licences and are subject to a number of statutory duties which they have had regard to in developing the Project.

The Marine Scheme proposes use of High Voltage Direct Current (HVDC) technology because it is more effective at transmitting high electricity capacity over longer distances with lower energy losses than an equivalent High Voltage Alternating Current (HVAC) system. Additionally, a HVDC technology system provides a greater degree of control over the magnitude and the direction of power flow, eliminating the requirement for synchronisation between the electricity systems at either end of the link. This will be converted to HVAC through the converter stations which form part of the English Onshore Scheme and Scottish Offshore Scheme.

## 5.2 Strategic Alternatives

### 5.2.1 The Do-Nothing Scenario

The ‘do-nothing’ scenario considers a scenario in which the Project is not developed.

In such a scenario, transmission system reinforcement between Scotland and England, to increase the capability of the electricity transmission network and to accommodate the transfer of renewable and low carbon energy, is not realised. This would not achieve the primary objective of the Project.

Electricity flow between the north and south of the UK is forecast to increase at all levels across transmission and distribution because of increasing generation capacity, largely from Scottish offshore wind farms, connecting to the electricity network. In a ‘do-nothing’ scenario this forecasted growth will put pressure on the existing network, which may result in a requirement for constraining action by the TOs to restrict power flows and ensure equipment capacities are not exceeded. The cost of constraint actions would be passed on to consumers. The TOs predict that the ‘do-nothing’ scenario will result in sub-optimal operation of the network in the long-term.

In this scenario, any contribution that the Project might have made towards UK targets of becoming net-zero in all greenhouse gases by 2050 for England and Wales, and 2045 for Scotland, would not be realised. Wider benefits of increased electricity transmission network capability contributing to energy, security, sustainability and affordability would also not be realised.

### 5.2.2 The Do-Something Scenario

Investment in network reinforcements, as proposed under the 'do-something' scenario, will contribute towards the additional required capability across network boundaries in Scotland and Northern England. This will meet the primary objective of the Project.

Consideration has been given to the alternative electricity transmission infrastructure design options for delivering this connection between Scotland and Northern England, including:

- Selection of the most appropriate electricity transmission technology;
- Identification of connection points to Scottish and English electricity transmission systems;
- Selection of the proposed converter station sites;
- Selection of the proposed underground cable routes; and
- Selection of the proposed subsea cable corridor through Scottish and English waters.

A subsea HVDC link between Torness and Hawthorn Pit, known as the Eastern Link, was given a 'proceed' signal in the first Network Options Appraisal (NOA), published in 2015/16. The NOA 2018/2019 recommended the development of two HVDC reinforcements between the east coasts of Scotland and England, known as Scotland to England Green Link 1 (SEGL1) or Eastern Link 1 (EL1), the other as SEGL2 or EL2. It has continued to appear in each yearly NOA Report and is included in the most recent NOA 2021/22, published in January 2022, along with the SEGL2/EL2 project. Therefore, the Do-Something scenario was taken forward by the TOs.

## 5.3 Approach to Corridor Selection and Design

### 5.3.1 Overview of Approach

The approach used to identify and assess both the potential landfall sites and the marine installation corridor options followed an iterative and integrated process, which allowed the identification and consideration of technical, socio-economic, environmental and cost constraints. The aim was to identify sites and route options which best balance these factors; this used a staged appraisal process in accordance with National Grid's 'Approach to Options Appraisal' (National Grid, 2012).

The options appraisal for the Marine Scheme was carried out in three main phases:

- **Phase 1**: Strategic Options Appraisal (SOA). This stage comprised of a desktop study to review consenting and environmental constraints, without site visits or stakeholder engagement, with the objective of presenting Strategic Options. The Strategic Options comprised of feasible cable corridors in the onshore and offshore study areas providing seven route options (of which four related to SEGL1 / EL1), with 33 sub-routes (of which 19 related to SEGL1 / EL1) (East Coast Connection - Strategic Options Appraisal (RPS, 2019)), supported by other previous documents;
- **Phase 2**: Marine Route Optioneering. The Marine Route Refinement and Selection Study was completed in March 2020 comprising of a high-level assessment of the six offshore options taken forward from Phase 1 (of which three related to SEGL1 / EL1), including 33 sub-routes, of which 19 related to SEGL1 / EL1 (Eastern Link - Phase 2 Marine Route Refinement & Selection (RPS, 2020)); and
- **Phase 3**: Marine Survey Corridor Development and Selection. The Marine Survey Corridor Development and Selection Study was completed in May 2020; which built upon Phases 1 and 2, incorporating the use of high-resolution bathymetry data, and optimising the route in accordance with high-level principles and the DNV Recommended Practice for Subsea Power Cables in Shallow Water, concluding with a suitable survey route corridor. (Eastern Link – Phase 3 Marine Survey Corridor Development and Selection (RSK, 2020)).

Specific studies were also undertaken to further refine the landfall location selection, including:

- Identification of landfall options in Torness (Wardell Armstrong, 2013) and Hawthorn Pit (RPS, 2020);
- Onshore route assessment and potential AC underground cables in Torness to Hawthorn Pit English Onshore Routeing Optioneering Report (Wood, 2020); and

- Eastern Link – Torness Project Options Appraisal Report (RSK, 2021).

## 5.4 Phase 1 - Strategic Options Appraisal

A technical feasibility study of route options completed as part of the 2018 / 2019 NOA identified seven strategic route options to connect the two HVDC reinforcement projects into the existing grid network (Figure 5-2). Six connection points were considered for the route options, two in the north (Scotland) and four in the south (England) from which six strategic marine route options, and one strategic onshore route option were derived. These were taken forward to the Strategic Options Appraisal (Phase 1) and are summarised in Table 5-1 and shown in Figure 5-2.

The 'start' point for SEGL1 / EL1 was assumed to be at Torness in Scotland, due to the proximity of the transmission network to the coast and its connectivity to the existing 400KV system. Options 2, 4, 6 and 7, highlighted in green in Table 5-1, were therefore taken forward for further appraisal for SEGL1 / EL1. Options 1, 3 and 5 relate to the appraisal of options for SEGL2 / EL2, and so are not discussed further in this chapter.

**Table 5-1: Strategic Marine Route Options Considered During Phase 1**

| Option | Sub-routes | Connection Point | | Type |
|---|---|---|---|---|
| | | North | South | |
| 1 | 1 | Peterhead | Hawthorn Pit | HVDC Onshore / offshore |
| | 1x | | | |
| **2** | **2** | **Torness** | **Hawthorn Pit** | **HVDC Onshore / offshore** |
| | **2x** | | | |
| 3 | 3a-d | Peterhead | Drax | HVDC Onshore / offshore |
| | 3x | | | |
| | 3y | | | |
| **4** | **4a-d** | **Torness** | **Drax** | **HVDC Onshore / offshore** |
| | **4x** | | | |
| 5 | 5a-e | Peterhead | Cottam | HVDC Onshore / offshore |
| | 5x | | | |
| **6** | **6a-k** | **Torness** | **Cottam** | **HVDC Onshore / offshore** |
| | **6x** | | | |
| **7** | **n/a** | **Torness** | **Lackenby** | **HVAC Onshore** |

In England, no suitable connection point was identified close to the coast, with the most suitable identified at Hawthorn Pit substation, which is located approximately 7 km inland. Connections at the Drax and Cottam substations were also considered, as was an entirely onshore route option with connection at Lackenby.

The potential onshore route (Option 7 in Table 5-1), as well as the onshore connections from the English landfall to the substations were appraised in accordance with National Grid's Approach to Options Appraisal (National Grid, 2012) with four main topics examined as part of the routeing study namely, network capability and technical considerations, environmental and socio-economic impacts, programme and cost implications, and boundary transfer capability. A route corridor of 2 km (1 km either side of a centreline) was used to allow for adjustments where possible during further route development. Constraints were classed as 'Hard' or 'Soft' constraints based on a series of definitions.

Hard constraints were those where the level of consenting, installation, legal and / or physical and operational risks were significant enough to warrant their avoidance entirely. These included such constraints as oil and gas infrastructure, safety zones, offshore windfarms, shipping, dredging locations, military danger / practice areas, shellfish and fish farms.

Soft constraints were ranked either Major, Medium or Minor, with Major constraints to be avoided if possible, Medium constraints to be avoided at the initial stage but can be considered if routeing around is not possible, and Minor constraints requiring no avoidance. The categorisations of these rankings comprised:

- **Major**: considered to be of major significance due to their legal, financial and physical implications for the project that can cause serious delays, extra cost and other risks;
- **Medium**: considered to be of medium significance and which will have limited legal, financial and physical implications for the project. These constraints are expected to be manageable but can be expected to require some efforts to deal with; and
- **Minor**: considered to be of minor importance and which have only limited legal, financial and physical implications for the project. These constraints are easy to manage and are expected to be possible deal with on a routine level.

This information was captured in a detailed Geographic Information System (GIS), colour coding each category and allowing the constraints to viewed across the geographic area and overlap between constraint layers to be identified.

The outcomes of this Strategic Options Appraisal (Phase 1) report are summarised below.

## 5.4.1 HVDC Onshore / Offshore Strategic Marine Route Options

The 19 sub-routes associated with SEGL1 / EL1 Options 2, 4 and 6 were each appraised. A summary of the outcomes of these appraisals is presented below.

### 5.4.1.1 Torness to Hawthorn Pit (Option 2)

Option 2 avoided most of the high number of environmental constraints on the east coast of the UK, which are mainly Marine Conservation Zones (MCZs), Site of Special Scientific Interest (SSSIs) and Special Areas of Conservation (SACs) (classed as Soft-Major constraints) as well as the Hard nearshore constraints.

Two sub-routes were appraised, route 2 and route 2x. Route 2 was 43 km longer than the route 2x. There were interactions identified with one wind farm export corridor for both options, five Soft-Major interactions for route 2 and 10 Soft-Major interactions for route 2x.

### 5.4.1.2 Torness to Drax (Option 4)

The routeing decisions for the northerly half of Option 4 were similar to those for the Torness to Hawthorn Pit connection as to whether the route should accommodate the extensive Hard nearshore environmental constraints.

Five sub-routes were appraised, route 4a-d, and 4x. There were few differentiating numbers of Hard or Soft-Major interactions and so the route length was the main consideration.

### 5.4.1.3 Torness to Cottam (Option 6)

Option 6 was the most challenging of route development options. The locality to the coast and increased density of both Hard and Soft constraints towards the southern connection points means that 12 offshore sub-route options were developed, Option 6a-k and 6x.

Consistent with Options 2 and 4, the principal constraints in the northern part of the route were the environmental designations, with routeing options nearshore, centre corridor or offshore so to avoid significant consenting risks. Option 6x reduced the connection length routeing through this nearshore coastal region. The shortest route created third party asset crossings within environmental designations which would increase the potential of identifying likely significant effects during the environmental assessment and pose a consenting risk.

For the southern end of the connection route, it was necessary to route through the area just east of the Humber Estuary. There are significant pipeline assets just to the north, followed by densely packed Soft-Major constraints in and around the estuary, as well as Hard constraints and significant crossings with current export cable corridors, harbour and anchorage areas and a shipping and traffic separation scheme. In order to route to the west of these third-party assets and avoid environmental designations,

further additional crossings were generated. The routeing to the east of the third-party assets reduced the crossings and route length.

There were a large number (between seven and 14) of Hard constraints associated with Option 6, as well as four to six wind farm export corridors and four to seven Soft-Major interactions.

## 5.4.2 HVAC Onshore Strategic Route Option

### 5.4.2.1 Torness to Lackenby (Option 7)

A previous, high level review of the proposed Torness to Lackenby HVAC OHL route was undertaken by Hyder Consulting (Hyder) in 2014. The Strategic Options Appraisal (Phase 1) report reviewed this previous appraisal to ensure the opportunities, constraints and conclusions identified remained current and valid.

Stage 1 and 2 of the Hyder study identified that there are several environmental constraints of high sensitivity within the Hyder Study Area (Figure 5-2) including Flodden Battlefield and Monument, the Northumberland National Park and the North York Moors National Park. Other environmental constraints of medium sensitivity identified include regional and local landscape designations, urban population areas and associated Green Belt, the setting to Hadrian's Wall World Heritage Site and existing wind farm developments. Several national and major development proposals were also identified, with the majority concentrated within the Newcastle upon Tyne and South Shields area.

Prior to commencing Phase 2, the TOs decided that Option 7 Torness to Lackenby HVAC Onshore route was not feasible and it was discounted from the routeing process. This is because it would have had greater potential for environmental impact only to deliver a similar amount of additional network capability.

### 5.4.2.2 Torness Landfall (Scotland)

A previous land and site study, undertaken in 2013 by Wardell Armstrong, identified several possible landfalls located both to the north and south of Torness power station. Five potential landfall locations were considered and are shown in Figure 5-1, including two which were considered viable. The landfall options within the offshore routeing 'fan' shape are labelled as: Torness North (TN) 1, 2 and 3; and Torness South (TS) 1 and 2, relative to the Torness power station. Landfalls in the north of the study area noted a likely need to cross a planned Scottish offshore wind farm export cable (Wardell Armstrong, 2013). This work was not repeated as part of this Strategic Options Appraisal (Stage 1) study but was used to define the Torness connection point and landfall options. The new substation was to be located south of the Torness power station, but at this point there was uncertainty over where the new converter station would be located (further appraisal work was undertaken to site the converter station, refer to Section 5.5.2).

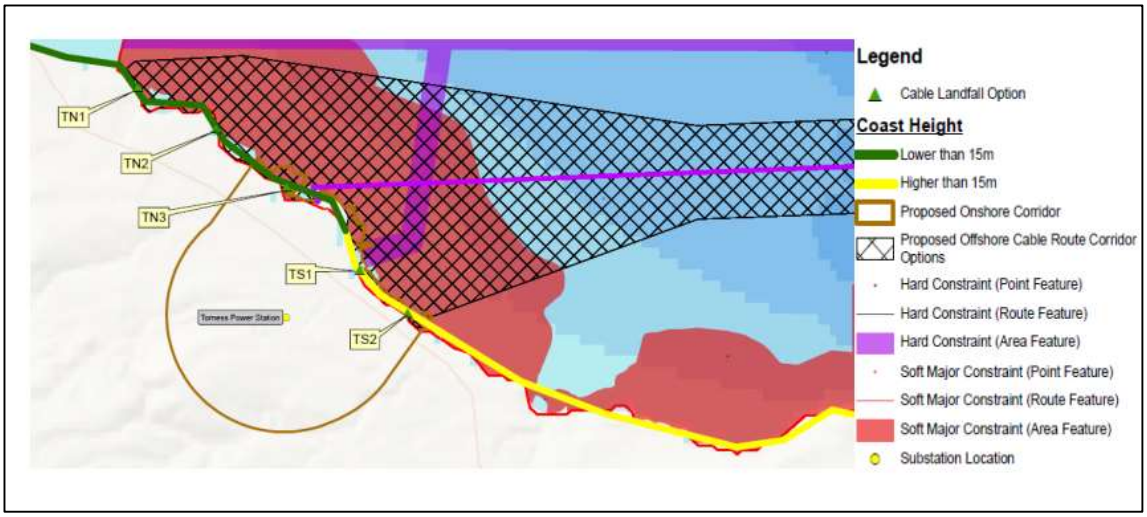
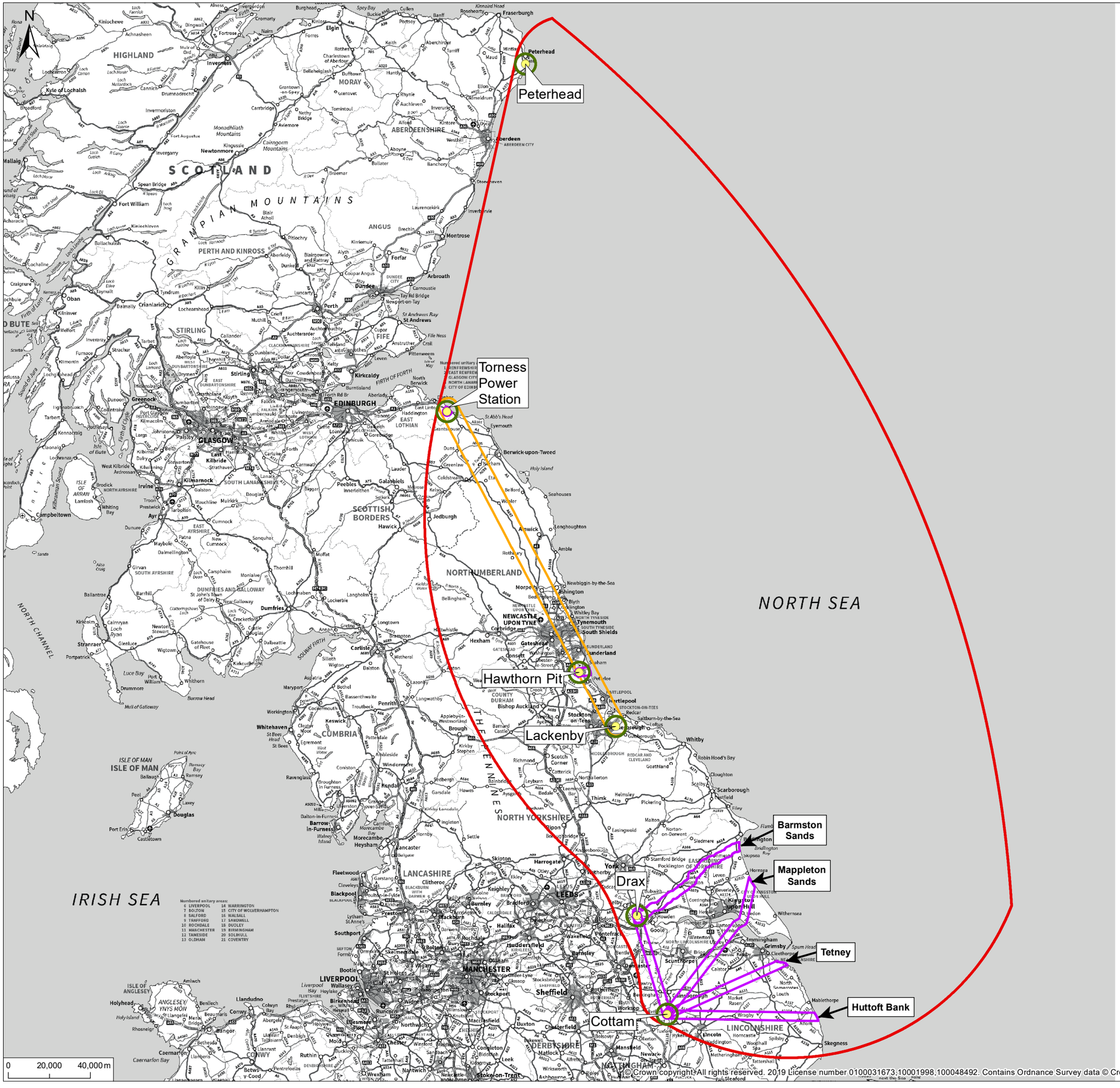



**Figure 5-1: Torness Sub-station and Onshore and Offshore landfall route snapshot (Source: RPS, 2019)**






Notes
1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.

## Legend

- Study area
- Substation location
- 5km buffer from substation location
- 5km wide corridor
- Hyder study area

| Rev | Description | By | CB | Date |
|---|---|---|---|---|
| | | | | |
| | | | | |

MAKING COMPLEX EASY

20 Western Avenue, Milton Park, Abingdon, Oxfordshire, OX14 4SH
T: +44(0)1235 821 888 E: rpsox@rpsgroup.com

Client: National Grid

Project: East Coast Connection Study

Title: Overview map

| Status | Drawn By | PM/Checked By |
|---|---|---|
| FINAL | MS | MB |
| **Project Number** | **Scale @ A3** | **Date Created** |
| EOR0741 | 1:1,900,000 | MAY 2019 |

Figure Number: **EOR0741-200**

Rev: -

rpsgroup.com



O:\11166 East Coast Connection\Tech\Drawings\11166-0024-04.mxd

The Strategic Options Appraisal (Phase 1) (RPS, 2019) comprised a fixed 'start' point on the network in Scotland at Torness in East Lothian, which was identified by TO Scottish Power Transmission (SPT). It is planned that ahead of the completion of SEGL1 / EL 1, a new 400 kV substation will be constructed in the Torness area, known as Branxton 400 kV substation. This substation will become a key node on the main interconnected transmission system. Its connectivity to the existing 400 kV system, and location close to the east coast, means that it will become a collector substation for offshore wind in the Firth of Forth and further offshore as well as providing the connection point for the SEGL1 / EL Project.

### 5.4.2.3 English Landfall Options

The Strategic Options Appraisal (RPS, 2019) identified a number of alternative 'end' points at substations on the network in England, in an area from Blyth in Northumberland as far south as Middlesbrough, both on the coast and inland. The objective of the strategic options appraisal was to identify a preferred Strategic Proposal which would best meet the need case by providing additional network capability when it is needed while also taking account of TO statutory and licence obligations.

These 'end' points comprised of three existing NGET substations: Hawthorn Pit Substation, Drax Substation and Cottam Substation.

The process of identifying feasible landfall areas took into account:

- situations where the connection point is already at the coast;
- ensuring the landfall is as close to site as possible;
- avoidance of steep changes in relief from the transition joint bay to the beach (requirement to be >15m); and
- where a landfall option has already been established from previous study reports.

For connection points inland, which included Drax and Cottam substations, the possible routes to landfall also had to take into account onshore route corridors, which may dictate landfall options, and were established using the methods of:

- following existing corridors;
- identifying the shortest route; and
- utilising similar landfall location for similar projects.

A key consideration was the coastal height, as large cliffs would present a substantial constraint to making landfall.

#### *Hawthorn Pit Landfall*

The Hawthorn Pit grid connection point is approximately 7 km inland, and the coastal height is greater than 15 m above sea level at the potential landfall location.

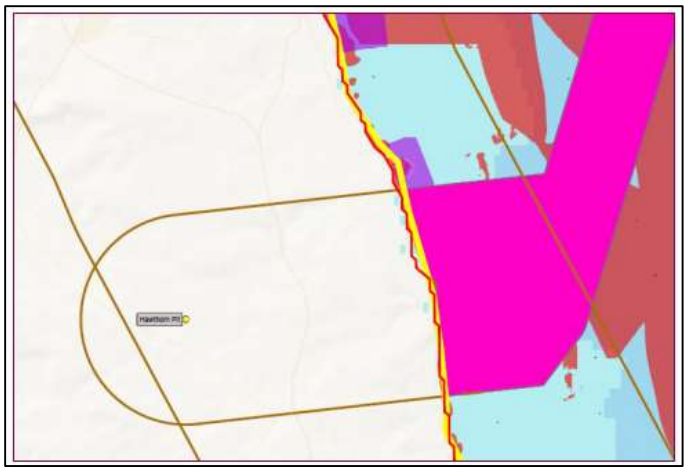


**Figure 5-3: Hawthorn Pit Onshore and Offshore landfall route alignment snapshot (Source: RPS, 2019)**

#### *Drax Landfall*

An onshore route to the potential coastal landfall from the Drax substation was identified at over 70 km utilising the former White Rose Carbon Capture and Storage (CCS) onshore pipeline route, which was never used. The route meets the coast at Barmston Sands, East Yorkshire, where coastal height is less than 15 m.

#### *Cottam Landfall*

A potential landfall location at Mappleton Sands was considered for onward connection to the grid at Cottam substation following an onshore route in excess of 80 km. The potential landfall identified was at one of the few areas below 15 m on the Holderness Coast.

#### 5.4.2.4 Preferred Landfall

Hawthorn Pit substation was identified as the preferred 'end' point because it provides a strong point on the network to connect into and has the benefit of being relatively close to the coast when compared to the other options, which reduces the length of onshore cable routes. Hawthorn Pit substation also benefits from land around the existing substation on which to locate a new substation and converter station.

### 5.4.3 Phase 1 Conclusion

The Phase 1 Strategic Options Report (RPS, 2019) provided a desktop study of the consenting and environmental constraints with the objective of presenting Strategic Options with feasible cable corridors in the onshore and offshore study areas and each of the requested connection options were provided with a high-level feasible route or routes. All of the offshore options were taken forward to Phase 2. However, the seventh, the onshore option of Torness to Lackenby, was discounted and not taken forward.

## 5.5 Phase 2 - Marine Route Optioneering

### 5.5.1 Marine Route Refinement & Selection

Phase 2 involved the development of a Marine Route Refinement & Selection report, which was completed in March 2020 (RPS, 2020) to further develop the route options from the Phase 1 (RPS, 2019) scope of work. A route refinement exercise was undertaken, reducing the 2 km wide route corridor to a 1 km wide route corridor, to avoid or minimise the constraints for each sub-route option. In some cases, sub-routes were refined outside the original 2 km route corridor to avoid larger constrained areas. A review of the Phase 1 dataset was initially undertaken to identify datasets that could be updated with more contemporary datasets. Additional datasets that were not included at Phase 1 were also identified.

As part of the Phase 2 study, a more detailed analysis of the technical, socio-economic and environmental constraints analysis was undertaken to identify a preferred sub-route for each of the six strategic marine route options (see Figure 5-4). The study took into consideration several routeing and engineering principles which were defined as environmental and social constraints (presenting a risk to gaining consent), and technical constraints (presenting a physical obstruction to the development of the route). They were used during the refinement of each route, being scored on a scale of 0-5. The Phase 2 report concluded with a preferred sub-route recommendation for each of the six strategic marine route options. These were used to inform stakeholder engagement and formed the basis of the planned seabed survey of up to two of these routes, preferred sub-route options, which was further developed in Phase 3 (see Section 5.7 below).

.

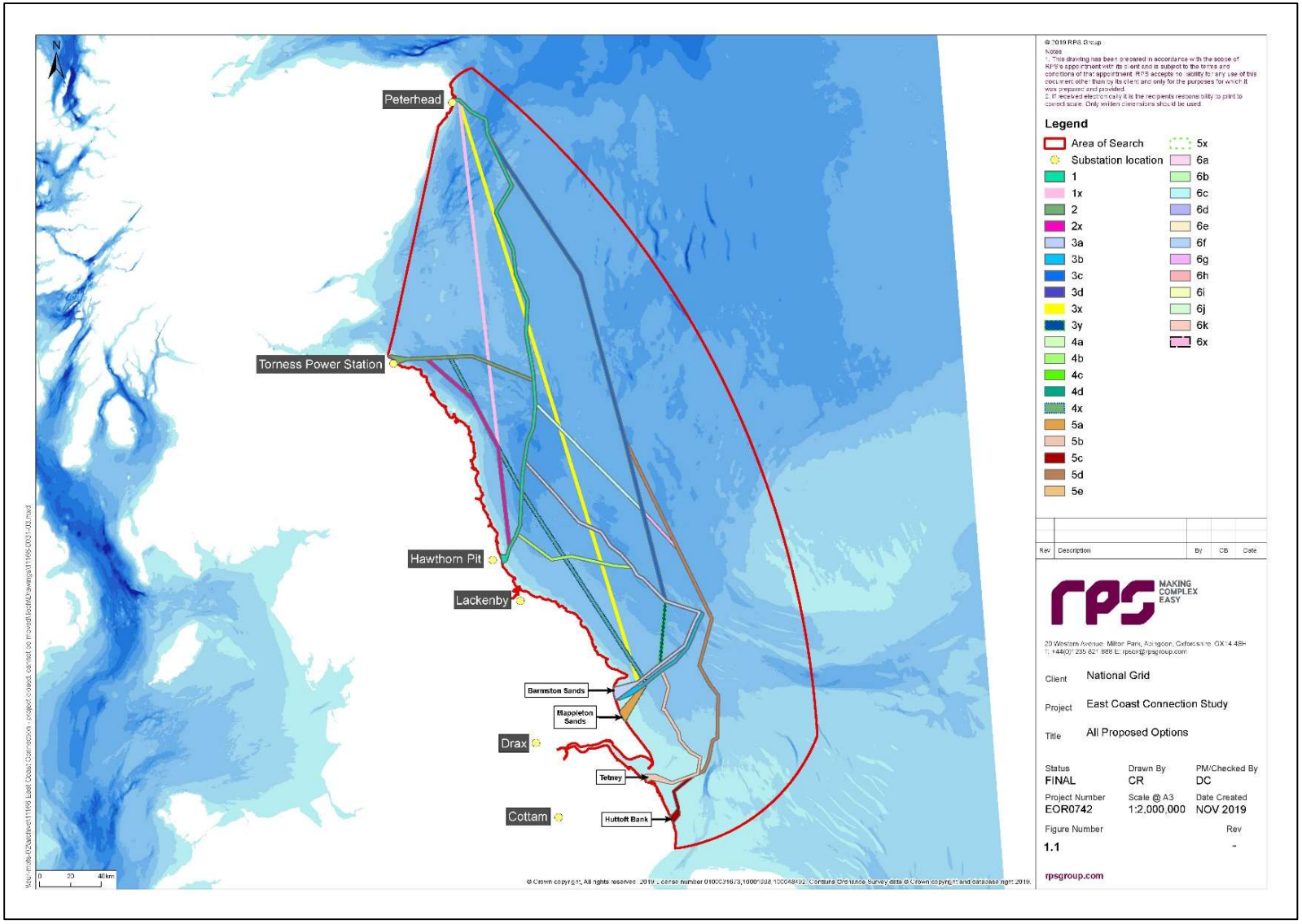



**Figure 5-4: Map showing the six potential offshore routes (1-6) and their sub-route options (Source: RPS, 2020)**

## 5.5.2 Landfall study

The Phase 2 report (RPS, 2020) included an environmental and socio-economic, and technical constraints analysis and refinement of each landfall location at the Mean High Water Spring (MHWS) mark as per the landfall route corridors identified as part of Phase 1 (see Figure 5-1 and Figure 5-3). The route corridors near to each landfall were extended out into a 'fan' shape from the 2 km route corridor to allow flexibility in identifying a suitable location as shown in Figure 5-5.

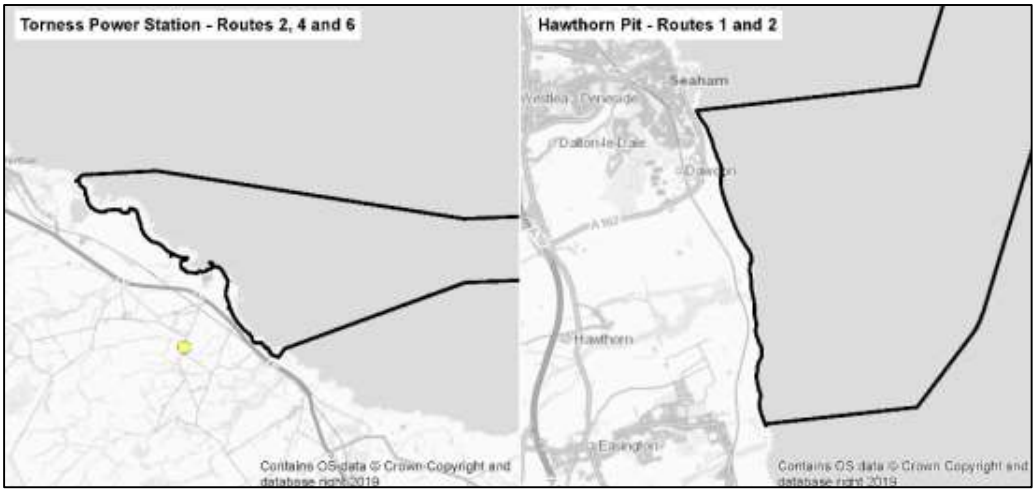



**Figure 5-5: Landfall area of search for Torness and Hawthorn Pit connection points (Source: RPS, 2020)**

***Hawthorn Pit landfall***

Building on the Phase 2 Strategic Options Appraisal work of suitable 'end' point substations on the network in England, an assessment of both the onshore and offshore sections of the Hawthorn Pit landfall location was undertaken that considered the consenting, technical and engineering constraints. A Hawthorn Pit Offshore Landfall Route Assessment was produced in April 2020 prior to Phase 3 (RPS, 2020). The purpose of this was to undertake a detailed review and assessment of the environmental, social and physical constraints for the offshore sections of the Hawthorn landfall location.

The constraints assessment concluded with the identification of five potential offshore landfall route options A-E; these were identified in areas of least constraint which included avoidance (where possible) of sewage outfalls, dredge disposal areas, wrecks, the Seaham Harbour Authority Area, reefs within intertidal and subtidal areas, and marine designated sites.

All offshore landfall route options were constrained in some part by intertidal and subtidal reef, wrecks, or vegetated cliffs designated as a SAC and SSSI. Offshore landfall route option A was also constrained by a designated bathing water, SPA and subtidal sewage treatment infrastructure.

This report concluded that although all five offshore landfall route options have similar levels of constraint, Options C and D were recommended as the preferred option due to the slightly lower level of constraints identified along the route and the shorter total route length. However, all identified landfall locations considered were marginal in terms of their level of constraint. Data from the marine surveys allowed for micro-routeing to avoid sewage treatment outfall infrastructure and reef habitat. It was identified that Horizontal Directional Drilling (HDD) would be used to avoid designated vegetated cliff features and intertidal reef habitat. Taking these further refinements into account it was concluded that route options A, B and E could be considered an acceptable landfall location. there were no differentiating factors and all options presented acceptable landfall locations.

## 5.5.3 Phase 2 Conclusion

Phase 2 concluded with a recommendation relating to each sub-route identified at Phase 1. As the route options A, B and E (Figure 5-6) were all considered acceptable landfall locations for English landfall route options, further optioneering and appraisal work was undertaken at Phase 3 to determine a preferred landfall point (see Section 5.7).

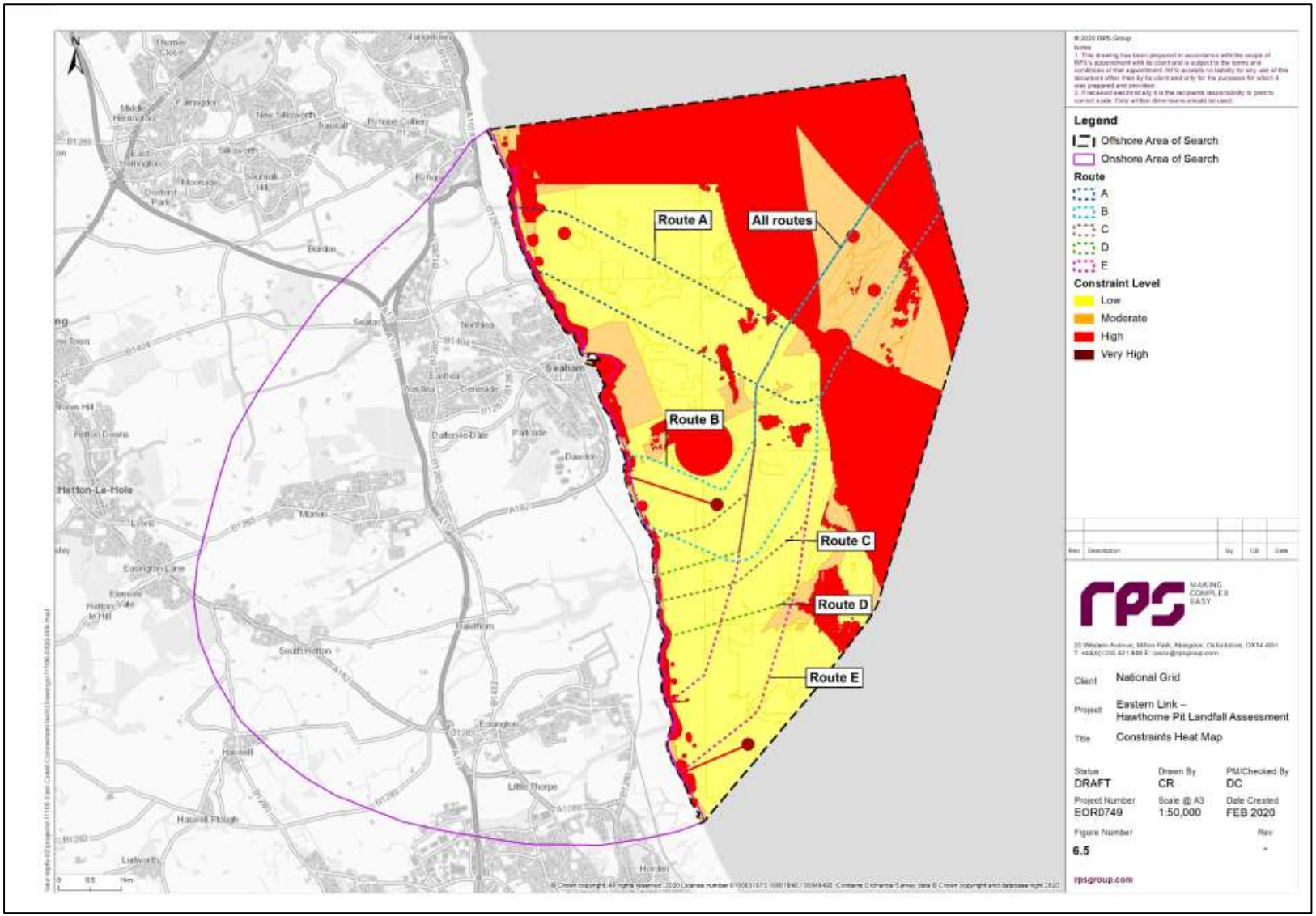



**Figure 5-6: Proposed offshore landfall locations A, B, C, D and E with heat mapping of technical and E&S constraints (Source: RPS, 2020).**

## 5.6 Phase 3 - Marine Survey Corridor Development and Selection

The Eastern Link – Phase 3 Marine Survey Corridor Development and Selection report (RSK, 2020) built upon the Phase 1 and 2 reports and looked in greater detail at the preferred Phase 2 routes for Torness to Hawthorn Pit, includingd consideration of available high-resolution bathymetry data.

Phase 3 sought to further develop proposed installation corridors to optimise routeing in accordance with the following high level principles (DNV-GL, 2021):

- minimise total cable length;
- minimise interaction with environmentally sensitive areas[1];
- seek to avoid areas of migrating sediments - where this is not possible, optimise routeing to minimise possible future cable exposure;
- seek to avoid obstacles (e.g. boulder areas, rock outcrop/subcrop, pockmarks, plough marks, wrecks, paleo-landscapes, debris areas, potential free-span areas, potential unexploded ordnance (UXO));
- seek to avoid unstable/steep slopes;
- cross in-service pipelines and cables as near to 90˚ as possible, but in any event not less 60˚ or more than 120˚ (unless Crossing Agreements state otherwise); and
- minimise anchoring/navigation restrictions.

### 5.6.1 Torness to Hawthorn Pit Marine Survey Corridor

The proposed marine survey corridor between Torness and Hawthorn Pit was established as part of the Phase 3 work. It extended approximately 176 km from a Scottish landfall near Torness power station and the area south of Thorntonloch to an English landfall north of Seaham (Figure 5-4), which is approximately 7 km from Hawthorn Pit 400 kV substation. The survey corridor was set at approximately 500 m wide for most of its length, so to provide sufficient opportunity for micro-routeing, and fell entirely within the 12 Nautical Miles (NM) UK territorial seas. The corridor had varying water depths, with depths greater than 30 m over the majority of its length and with shallower depths limited to the nearshore landfall sites.

The main characteristics of the marine survey corridor (Figure 5-7), as reported in the Phase 3 - Marine Survey Corridor Development and Selection (RSK, 2020), are described below.

#### 5.6.1.1 Scottish Landfall (KP 0)

The proposed Torness landfall was to be located on the cliffs south of Thorntonloch beach installation between MHWS and MLWS and undertaken using HDD. The HDD direction and exit point were selected to avoid the offshore reefs, with drill conduit breakout point(s) in soft sediment and sandy seabed.

#### 5.6.1.2 KP 0 to KP 176

The marine survey corridor (referred to as the marine installation corridor in the Environmental Appraisal Report (EAR)) was designed to avoid, as far as possible, areas of rock/hard substrate visible in the bathymetry data, which may be categorised as Annex 1 – Reef Habitat, and to minimise interactions with designated and protected marine areas. The route avoided the Northumberland Coast SACs and had minimal interaction with the Northumberland Marine SPA (6.4 km in length). Whilst the marine survey corridor extends for 26 km within the Farnes East MCZ the corridor was specifically designed to minimise potential interaction with the specific qualifying features of this designation, specifically rock outcrops and sediment habitats.

[1] *A constraint which presents an obstruction to gaining consent for the development of the route, such as the route crossing through an area which is designated for benthic features, areas of high fishing activity or areas of high fish spawning activity. These constraint types are typically legal, social or environmental barriers to development (RPS, 2020)*

The Outer Firth of Forth and St Andrews Bay Complex SPA was designated in December 2020, after Phase 3 was completed. The marine survey corridor extends for 17.2 km within this SPA, which is designated for 21 seabird and waterbird species, including both breeding and overwintering species.

The Phase 3 report (RSK, 2020) indicated that the survey corridor was relatively unconstrained from man-made factors with one infrastructure crossing identified, these being the two cables of the North Sea Link Interconnector at approximately KP128. The corridor was also designed to avoid known spoil grounds, extraction areas, harbour limits and military training areas. All charted and known wrecks were also avoided.

The Phase 3 report (RSK, 2020) indicated that the marine survey corridor '*has generally a low fishing intensity with the exception of areas of muddy sands between KP10-KP30 and KP120-KP165*' […]. However, through subsequent consultation with local fisheries undertaken by Brown & May Marine Ltd in late 2021, extensive fishing activities exists in the vicinity of the Farne Islands, principally potting, but the majority of these activities are inshore of the selected marine installation corridor.

To avoid Annex 1 reefs to the west and east, the north east corner of the Northumberland Marine SPA is intersected by the marine survey corridor for a distance of 6.4 km.

A number of designations including Northumberland Marine SPA, Berwickshire and North Northumberland SPA and the Farnes East MCZ coalesce in the area to the east of the Farne Islands. Careful routeing consideration was given to this area and the resulting 26 km interaction with the Farnes East MCZ and 17.2 km interaction with the Outer Firth of Forth and St Andrews Bay Complex SPA allows other designated areas (Berwickshire and North Northumberland Coast SAC and Berwick to St Mary's MCZ) to be completely avoided. Alternative routeing to avoid all designations was considered infeasible as it would have required an additional estimated 40 km of cable routeing with all the associated impacts both from a cost, an environmental and installation standpoint.

The Farnes East MCZ is principally designated for Annex 1 rock habitat. The 26 km interaction with this MCZ is principally in mud, sand and gravel. The receptors within the other designated sites (Berwickshire and North Northumberland Coast SAC and Berwick to St Mary's MCZ) would have been potentially more sensitive to effects of the Marine Scheme.

The identified marine survey corridor nearshore route option took advantage of shallower bathymetry. In addition, available evidence indicates that subcropping and outcropping rock is far less extensive than indicated by the British Geological Survey (BGS) data and can be substantially avoided. It was stated that if burial is not achieved (or is deemed unachievable after surveys) the probable cause would be either sub/outcropping rock or the presence of boulders. The limited use of rock placement, if required, would therefore be in areas already characterised by the presence of rock/boulders.

#### 5.6.1.3 English Landfall (KP 176)

The final 8-10 km of the corridor on approach to the proposed Hawthorn Pit landfall at Thorntonloch Beach at Seaham sought to avoid obvious rock outcrops as far as practicable, but there remained the potential for areas of rock to be affected. The proposed Hawthorn Pit landfall is located approximately 2 km north of Seaham. The HDD was thought to require the use of a field west from the Seaham Hall Beach car park, to a sub-tidal location approximately 300 m seawards from the cliff base.

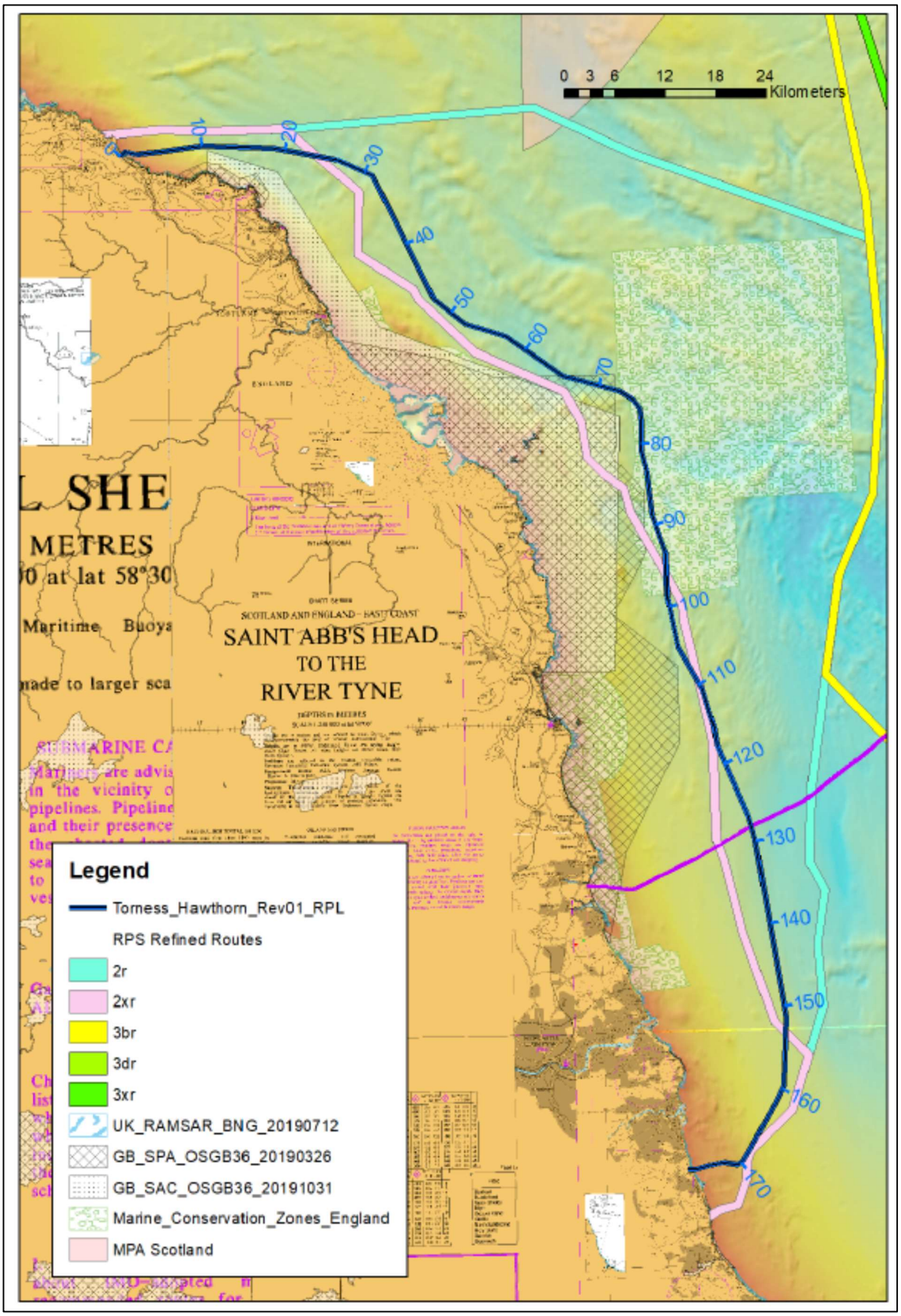



**Figure 5-7: Proposed survey route (blue) and other sub-routes considered in previous phases Source: (RSK, 2020)**

### 5.6.2 Phase 3 Conclusion

The Phase 3 report (RSK, 2020) concluded with the establishment of a proposed marine survey corridor between the Torness and Hawthorn Pit landfalls.

## 5.7 Torness to Hawthorn Pit, English Onshore Routeing Optioneering Report

The Torness to Hawthorn Pit, English Onshore Routeing Optioneering Report (Wood, 2020) was produced after Phases 2 and 3. Part of the purpose of this report was to consider the suitability of the coastline within the study area to accommodate a landfall site. This study considered:

- The suitability of ground conditions;
- Site accessibility; and
- Potential drill and/or trench profiles to install the cable.

The study undertaken by Wood (2020) identified nine potential landfall areas and applied a RAG (red / amber / green) analysis to reflect the number of constraints in each landfall area, with red being the most constrained areas and green the least as shown in Figure 5-8. The study area was initially based on a landfall zone located approximately 5 km inland from Mean Low Water Spring (MLWS). It had to provide sufficient opportunity to locate landfall infrastructure.

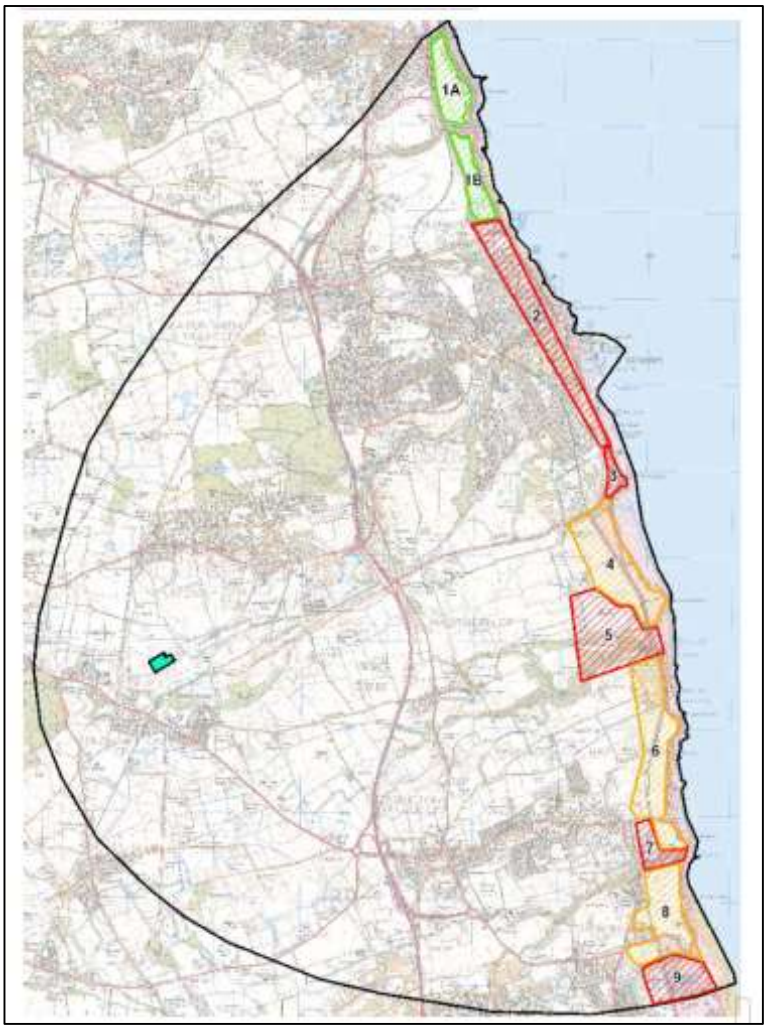



**Figure 5-8: Potential landfall areas within the Study Area (Source: Wood, 2020)**

Landfall areas 2, 3, 5, 7 and 9 were deemed unfeasible due to space constraints, designations and mining operations in the area. The remaining landfall areas 1A and 1B (green), 4, 6 and 8 (amber) were taken forward for further appraisal.

The cable landfall location was appraised using National Grid's Option Appraisal Guidance (2012) with consideration of known terrestrial constraints, mapped for the terrestrial cable route options (Wood, 2020). The landfall areas were appraised in terms of environmental, planning, socio-economic, engineering and technical constraints.

Landfall area 4 was more constrained than landfall areas 1A and 1B, due to greater cliff height and poor access onto the east side of the railway, as well as proximity to landscape and nature conservation designations. Landfall areas 6 and 8 were discounted as most of the sites fall within either a landscape or nature conservation designation, the cliff heights in this area were greater than 50m, and extensive former mining operations were present. Access to the site would require routeing traffic through the village of Easington Colliery and via residential roads and possibly farm tracks. Access across the east side of the railway would also be difficult as no suitable road access currently exists. Locating the drill site on the west side of the railway would therefore require a longer drill length. Additionally, for landfall area 8, routeing the cable west from the landfall area towards Hawthorn Pit Substation would be constrained by the presence of ancient woodland, built development in Horden, and the presence of Horden Hall, a Grade II* listed building.

Landfall area 1A was less preferable to 1B, as consent has been granted for a mixed-use development on the western side of the B1827, close to the northern part of landfall area 1A, which would have constrained any cable routes inland from this area. Landfall area (1B) was deemed to be the least constrained in terms of HDD installation methods with the lowest cliff heights. It had good road access and was less constrained by the location of the Durham Coastal Railway compared with other landfall areas. It also had fewer geotechnical risks when compared to the other landfall areas which were all located near former mine workings. It also maximised the distance to the Northumbria Coast Ramsar and SPA designation. Although closer to internationally important ecological designations (Northumbria Coast Ramsar and SPA designation) it was the anticipated that measures can be taken to mitigate effects on these designations and the overwintering bird species for which they are designated. Other landfall areas had a greater proportion of land falling within designated nature conservations sites and were considered more likely to directly affect these receptors.

Following the review of all the key constraints, landfall area 1B was taken forward as the emerging preferred landfall area. Although landfall area 1A would be closest to the Northumbria Coast Ramsar and SPA designation, locating the drill site at the southern end of Landfall Area 1B would maximise the distance to these designations. Locating the construction site here would also help reduce visual effects on the outskirts of Seaham as woodland north of the beach car park would screen views as well as reduce marine effects as the extent of Annex 1 reef habitat is less in this area. This part of the landfall had the lowest cliff heights as well as good access from the B1287.

## 5.8 Eastern Link – Torness Project Options Appraisal Report

Building on the Phase 2 Strategic Options Appraisal work of suitable 'start' point substations on the network in Scotland, an options appraisal was undertaken by RSK in 2021. This appraised feasible options for the location of the converter station, substation and landfall options. Eight landfall options were appraised: Whitesands Bay; Barns Ness North; Barns Ness; Skateraw Harbour; Thorntonloch; Inlet near Thorntonloch; Cove Harbour; and Pease Bay.

Consideration was given to nearshore geology and nearshore cable crossings including proposed cable crossings associated with Neart na Gaoithe Offshore Wind Farm and Berwick Bank Wind Farm cabling. Based on the comparative analysis between environmental, technical and cost, the landfalls were shortlisted to either Thorntonloch or the Inlet near Thorntonloch, as the other options were located within SSSIs and there was the potential for underlying bedrock offshore. Further engineering studies focussed on the marine cable route identified a preference for the landfall at a point between the two shortlisted landfall locations and so a landfall at southern Thorntonloch was taken forward.

## 5.9 Consultation and Stakeholder Engagement

The preferred Marine Scheme comprised:

- a ‘start’ point at a landfall site at Torness;
- an ‘end’ point at a landfall to the north of Seaham; and
- approximately 176 km of subsea HVDC cable, comprising 37.5 km in Scottish waters and 138.5 km in English waters.

Stakeholders, including, Durham County Council, Sunderland City Council, Natural England, Historic England, and the Environment Agency in England, and East Lothian Council, Scottish Natural Heritage, Historic Environment Scotland and Scottish Environmental Protection Agency in Scotland, were consulted with on the preferred Marine Scheme (and the Onshore Schemes elements), as appropriate. This engagement started in 2019.

Marine based stakeholders including the Maritime and Coastguard Agency, The Crown Estate and Crown Estate Scotland, Trinity House, Inshore Fisheries and Conservation Authorities, Inshore Fisheries Groups and National Federation of Fishermen’s Organisations and Scottish Fishermen’s Federation were consulted on the preferred marine cable route and landfalls.

For further information on the comments received, refer to Table 6-1 in Chapter 6: Consultation and Stakeholder Engagement.

Following feedback from the statutory consultees, the preferred option was further developed and was the subject of public consultation on the proposed option in Summer 2021.

## 5.10 Summary

In identifying the Marine Scheme, the TOs have given consideration to a range of alternatives at both a strategic and project-specific level and has included considerations of alternative landfalls and cable route corridors. In appraising these alternatives, the TOs have undertaken a series of specialist studies considering technical, environmental and economic factors as well as undertaken consultation with statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public.

The results of these specialist studies and feedback received from consultation have informed decision making. Through consideration of alternatives, the TOs have established a preferred Marine Scheme which is considered to best balance technical, environmental and economic factors with feedback received from consultation.

The preferred Marine Scheme consequently comprises a ‘start’ point at a landfall site at Torness and an ‘end’ point at a landfall to the north of Seaham with approximately 176 km of subsea HVDC cable, comprising 37.5 km in Scottish waters and 138.5 km in English waters, between the two landfalls. The full description of the Marine Scheme is detailed in Chapter 2: Project Description. This proposed development meets the primary objective of the Project.

## 5.11 References

DNV-GL (2021). DNV-RP-0360 Subsea power cables in shallow water. Available at: https://www.dnv.com/energy/standards-guidelines/dnv-rp-0360-subsea-power-cables-in-shallow-water.html

Hyder (2014). National Grid Eastern Link Onshore Feasibility Study. High Level Review of Route Options and Potential AC Underground Cables.

MMT (2012) Integrated Geophysical and Geotechnical Report, Anglo-Scottish Eastern HVDC Link, Marine Survey, Peterhead-Seaham, June – July 2012.

National Grid (2021). Future Energy Scenarios. Available at: https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021

National Grid (2021) Electricity Ten Year Statement. Available at: https://www.nationalgrideso.com/research-publications/etys

National Grid ESO (2022). Network Options Appraisal. Available at: https://www.nationalgrideso.com/research-publications/network-options-assessment-noa

National Grid (2012). Our approach to Options Appraisal. Available at: https://www.nationalgrid.com/uk/electricity-transmission/document/96531/download

RPS (2019). Eastern Link – Phase 1 Environmental Strategic Options Appraisal.

RPS (2020). Eastern Link – Phase 2 Marine Route Refinement & Selection.

RPS (2020). Hawthorn Pit Offshore Landfall Route Assessment – Options Assessment Report.

RSK (2020). Eastern Link – Phase 3 Marine Survey Corridor Development and Selection.

RSK (2021). Eastern Link – Torness Project Options Appraisal Report. Available at: https://www.spenergynetworks.co.uk/userfiles/file/Eastern_Link_Options_Appraisal_Report.pdf

Wardell Armstrong (2013). Eastern HVDC Link – Onshore Options: Strategic Environmental Assessment.

Wood (2020). National Grid Eastern Link - Torness to Hawthorn Pit – English Onshore Routeing Optioneering Report.