AENC-NG-CNS-REP-0202

Norwich to Tilbury

Volume 7: Other Documents

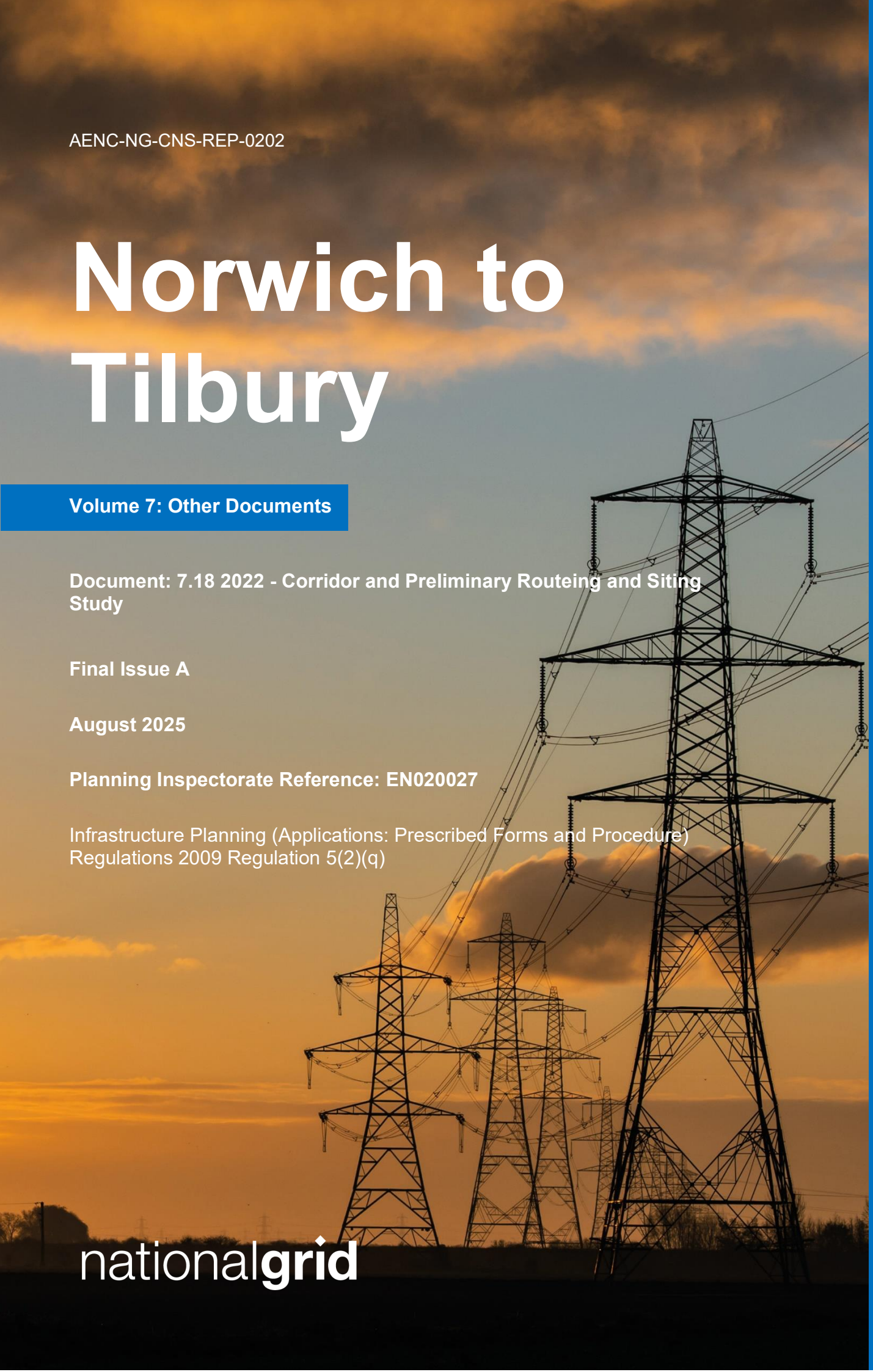
Document: 7.18 2022 - Corridor and Preliminary Routeing and Siting Study

Final Issue A

August 2025

Planning Inspectorate Reference: EN020027

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(q)

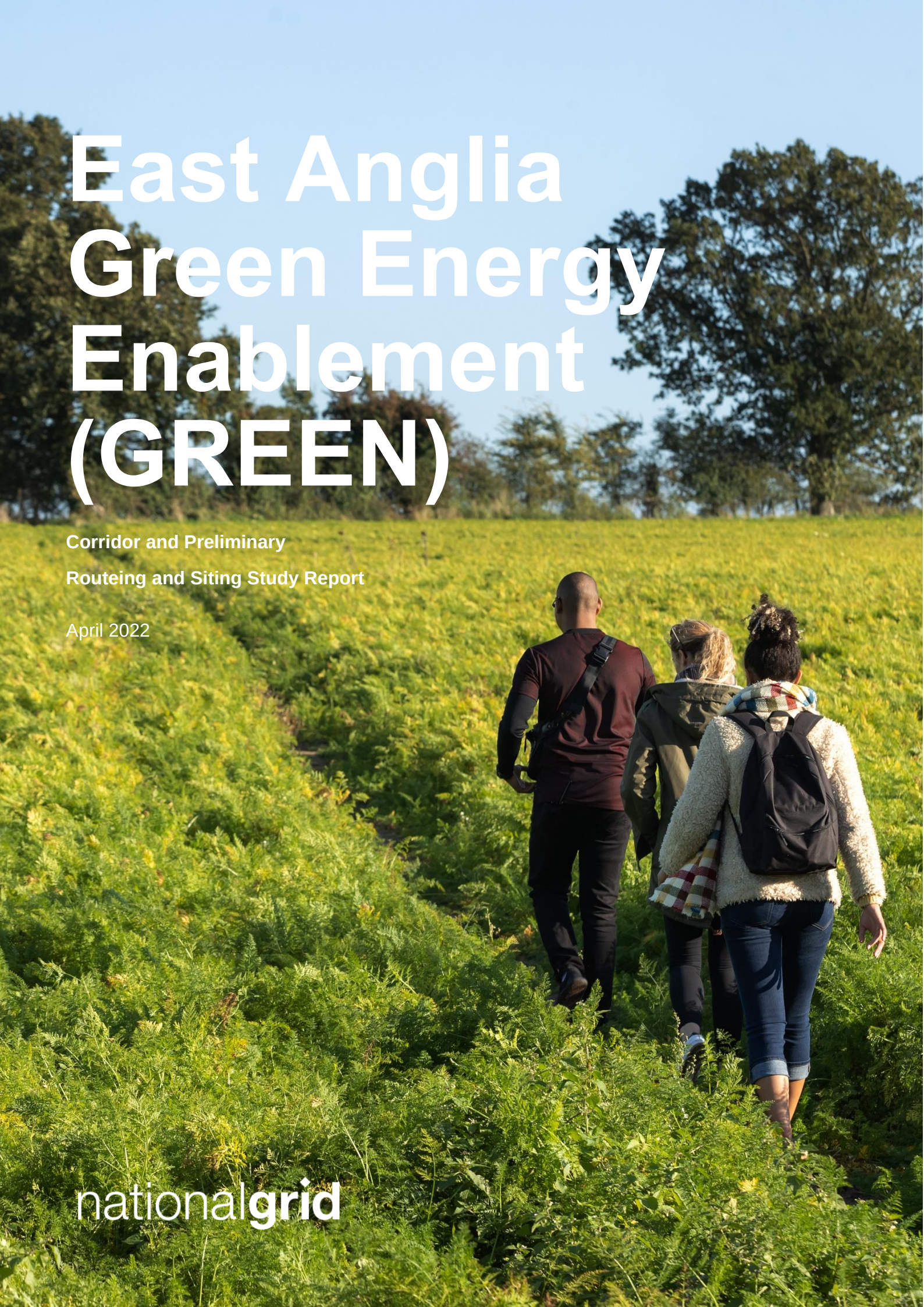


nationalgrid

East Anglia Green Energy Enablement (GREEN)

Corridor and Preliminary Routeing and Siting Study Report

April 2022



nationalgrid

Contents

Executive summary

This report is the Corridor and Preliminary Routeing and Siting Study which has been undertaken to define the broad location of the East Anglia GREEN project – the Project. The study focused on the routeing of new transmission infrastructure, and siting of a new substation, in three geographical sections:

- Norwich, in Norfolk, to Bramford, in Suffolk;
- Bramford to a new East Anglia Connection Node substation (EAC) on the Tendring peninsula; and
- the EAC to Tilbury, in Essex.

The Norwich Main substation to Bramford substation section is referred to as the North East Anglia (NEA) connection. The remaining section from Bramford substation to the EAC, and from the EAC to Tilbury substation, forms the South East Anglia (SEA) connection. The study also considers the siting of the new EAC.

The Project is being developed by National Grid Electricity Transmission (NGET) and comprises a major reinforcement of the electricity transmission system to facilitate the transfer of power from the East Anglia region to the rest of the Main Interconnected Transmission System (MITS) thereby enabling the connection of offshore wind generation and bidirectional transfer.

The Project is expected to include the construction of new infrastructure consisting of one new substation, overhead lines, underground cables and multiple cable sealing end compounds (CSEC), as well as upgrade works to existing infrastructure.

This report considers options for the broad locations for the proposed transmission infrastructure, both overhead line routes and associated underground cabling, and sites for additional high voltage infrastructure and the new proposed EAC substation. The preferred options presented may be subject to modification following stakeholder engagement, public consultation, further design development and survey work.

1. Introduction

1.1 Overview and Purpose

1.1.1 National Grid owns the high-voltage electricity transmission network in England and Wales. They are responsible for making sure electricity is transported safely and efficiently from where it's produced to where it's needed.

1.1.2 The Electricity System Operator is a legally separate business, balancing supply and demand to ensure homes and businesses in Great Britain have the electricity they need 24/7. National Grid also owns and operates the gas national transmission system in Great Britain, ensuring gas is transported safely and efficiently from where it's produced to the places it's consumed, balancing supply and demand day-to-day.

1.1.3 National Grid's transmission system in England and Wales consists of approximately 7,200km of overhead lines and a further 700km of underground cabling, operating at 400kV and 275kV. 400kV lines are at the higher voltage giving them a higher power carrying capability, while 275kV lines generally represent the older parts of the network which were established prior to the 400kV transmission system. The overhead lines and cables connect around 340 substations to form a highly interconnected network. The substations provide points of connection for around 80 power stations and for connections to the local distribution networks, which operate at voltages from 132kV down to 240V (at which voltage, the power is distributed to domestic consumers). The distribution networks are owned by Distribution Network Operators (DNOs), including UK Power Networks (UKPN) in East Anglia.

1.1.4 The East Anglia Green Energy Enablement (GREEN) Project (the 'Project') is being developed by National Grid Electricity Transmission plc (National Grid) and comprises a reinforcement of the electricity transmission system in the East of England. The project will facilitate the transfer of power from the East Anglia region to the rest of the Main Interconnected Transmission System (MITS) thereby enabling the connection of offshore wind generation and bidirectional transfer.

1.1.5 The Project is expected to include the development of new 400kV electricity transmission infrastructure including overhead lines, underground cables, a substation and associated modification works to existing transmission and distribution infrastructure.

1.1.6 This report is the Corridor Preliminary Routeing and Siting Study (CPRSS), which has been undertaken to identify the broad locations for the required infrastructure.

1.1.7 The CPRSS is focussed on the routeing of new electricity transmission infrastructure (presumed to be overhead line unless otherwise defined) and the siting of a new substation in three geographical sections:

- Norwich, in Norfolk, to Bramford, in Suffolk;
- Bramford to a new East Anglia Connection Node substation (EAC) on the Tendring Peninsula; and
- the EAC to Tilbury, in Essex.

1.1.8 The Norwich substation to Bramford substation section is referred to as the North East Anglia (NEA) connection. The remaining section from Bramford substation to the EAC, and from the EAC to Tilbury substation, forms the South East Anglia (SEA) connection. The study also considers the siting of the new EAC.

1.1.9 A description of the proposed Project infrastructure within the scope of this CPRSS is set out in **Chapter 2**.

1.1.10 This report sets out the routeing and siting activities undertaken to date, including the identification, refinement and assessment of options for route corridors and provides National Grid's preferred options for the broad location of new infrastructure to meet the Project need, resulting in a preliminary route in the form of a corridor and connection location, both with graduated swathes. (Graduated swathes are areas within the corridor or zone within which Project infrastructure is considered more or less likely to be located. They are graphically represented by the use of a graduated swathe to emphasise their preliminary nature). Further detailed routeing and siting development work will follow public consultation, stakeholder engagement and surveys, and the broad location of the preferred options may be subject to modification.

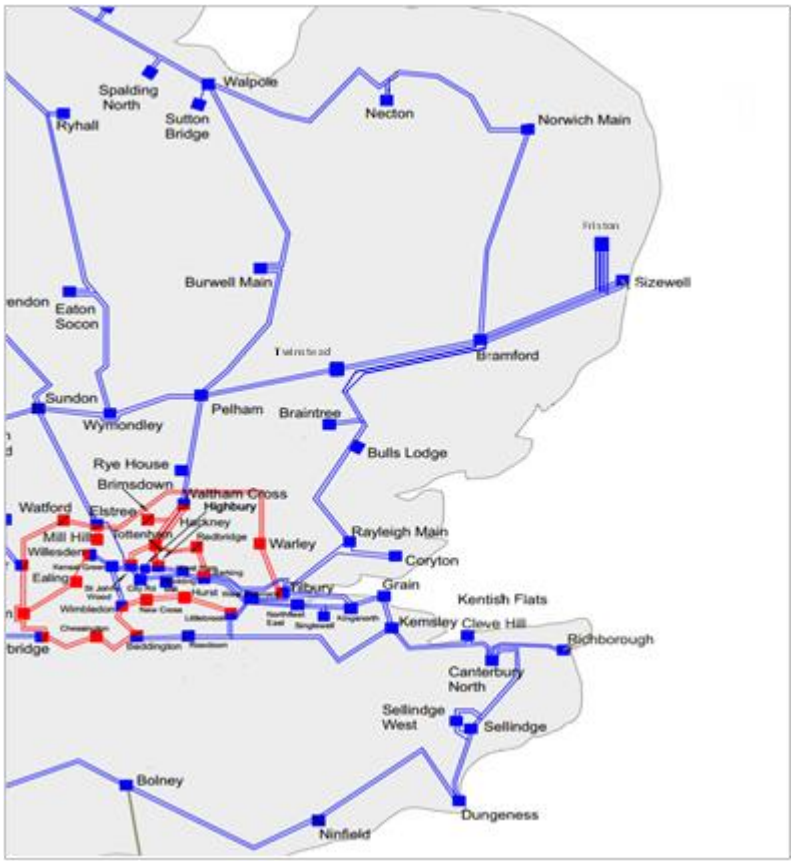
1.2 Identification of the need for network reinforcement

1.2.1 New connections for new offshore wind and nuclear power generation projects and for interconnectors are expected into East Anglia by 2035. These are being constructed or expected into substations at Necton, Norwich Main, Bramford, Friston and Sizewell. Additionally, agreements are in place with two offshore wind farm projects on the basis of their connection into a new East Anglia Connection Node substation (EAC). National Grid has a duty to facilitate new connections and maintain a safe National Transmission System (NTS) and has considered the capability of the existing network to support such connections. This assessment considered various published Future Energy Scenarios[1] (a range of scenarios which seek to address the uncertainty that exists over such an extended planning horizon) to consider network capability relative to the expected connection requirements.

1.2.2 National Grid Electricity System Operator (ESO) concluded that the existing high voltage electricity network in East Anglia does not have the capability needed to reliably and securely transport all the energy that will be connected while meeting the National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS). In particular, the standard requires that the NTS continues to operate under the conditions of the loss of a double circuit route. The current network arrangements (including for planned upgrades to existing circuits and the proposed Bramford to Twinstead area reinforcement and of which a diagrammatic illustration is shown below) are not sufficient to meet this standard for the levels of power flow that will be required with the likelihood that the existing circuits will be overloaded and may fail.

[1] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-documents-archive

Figure 1.1 – Anticipated Baseline Network Configuration



1.2.3 As a result, and to meet its duties, National Grid needs to reinforce the electricity network to allow power to be imported to, and exported from, East Anglia and to provide additional capability to allow power flows into and out of the south-east area to connect with areas of demand and interconnectors to Europe.

Overall approach

1.2.4 NGET has undertaken a Strategic Options Appraisal which establishes the project need case in more detail and identifies a preferred strategic proposal to meet requirement of multiple regional projects. The project has multiple potential start, intermediate and end points. These options were narrowed down by initial assessment of the general composition of a number of potential reinforcement strategies and identified the best performing of those. Alternative strategic options for delivering that preferred reinforcement solution were then developed and appraised to identify the preferred strategic proposal.

1.2.5 The Strategic Options Report will be subject to backcheck and periodic update to respond to new information or to increase accessibility going forwards.

1.3 Identifying the Preferred strategic proposal for EAG

Defining Strategic Options

1.3.1 Conceptually there are numerous alternatives through which the necessary reinforcements could theoretically be achieved comprising a range of different technologies and a multitude of connection points on the existing NTS. It is neither

necessary or efficient to subject all of these alternatives to detailed assessment and some initial filtering was applied using professional judgements to sensibly reduce the number of options taken through for appraisal whilst ensuring the analysis is comprehensive. We initially considered which alternative connection technologies should be considered and then applied these to a representative suite of alternative reinforcement solutions.

Alternative Technologies

1.3.2 There are number of different forms of connection and types of technologies which can be used to provide new transmission circuits. These technologies have different features which affect how, when and where they can/should be used and are reviewed below:

1.3.3 **Offshore connections.** In the marine environment DC cables are preferred over AC cables for transmission circuits due to: the engineering complexities associated with laying multiple AC cables to achieve similar ratings; the lower DC system costs over longer distances; and reduced environmental effects from fewer cables. A number of established and deliverable techniques can be used to install the cables. For example, ploughing/trenching etc. Other existing cables and pipelines would need protecting where the new cables cross. Convertor stations are required at each end of the cable to integrate with the AC based NETS. In the context of the required reinforcement from East Anglia, offshore connections provide an element that could potentially be used in combination with other technologies for some strategic alternatives. Conceptually connections can be made from either the Necton / Norwich area or Sizewell area down to locations such as Grain or Tilbury to connect into London or into Kent such as Richborough to connect with interconnectors. Marine DC options are included within options taken forward to appraisal.

1.3.4 **Onshore Connections.** A number of technology options to reinforce the network using onshore technology have been considered.

1.3.5 ***Increasing operating voltage*.** The highest operating voltage on the British transmission system is 400kV. The Electricity Safety, Quality and Continuity Regulations 2002, the SQSS and the System Operator Transmission Owner Code allow operating voltages up to a maximum of 400kV only. Operating at higher voltages (550V or 800kV) would require the replacement of all affected routes. Not only is it likely that a new pylon design would be needed along with appropriate new transformer substations at each point of connection with the existing NTS, this approach is deemed high risk due to the need to amend government Regulation and various Industry Codes and Standards. This would have the potential to substantially impact programme and cost. More directly, whilst increasing power flows it does not achieve the uplift in capability necessary and reinforcement will still be required when compared against marginal benefit it provides over 400kV. On this basis increases above 400kV are not considered further as part of strategic options.

1.3.6 Some parts of the London NTS network operate at 275kV and increases to 400kV may offer some advantage and were included as part of some options.

1.3.7 ***AC overhead lines*** are an established technology and offer a simple and cost-effective design. They are necessarily large scale structures that can be widely-visible in the landscape but are accepted in relevant national planning policy in most circumstances and meet National Grid's statutory duties to develop the network in an economic and efficient manner. For the purposes of strategic comparison adoption of standard steel lattice pylons is assumed.

1.3.8 ***AC underground cable.*** Alternatives to provide connections using wholly underground AC cable were considered but not taken forward to strategic option stage. The alternatives of OHL or cable bring different effects and costs. Relevant National Planning Policy identifies the acceptability of OHL in normal circumstances, and, with AC cable options being at substantially greater cost, their use is informed by the presence of other factors. For example, any route through National Parks and AONBs would be likely to conflict with relevant national policy statements and National Grid's statutory duties. We assume the use of AC underground cable through AONB's and National Parks but with the majority outside such designated areas expected to be justified as OHL. Further consideration of more localised mitigation (which may involve the use of cables for parts of connections as one of a number of techniques) will occur as part of detailed route studies. The use of tunnels as containment for cable options may be appropriate for some locations (e.g. crossing under estuaries) but is also a function of routeing and considered at route development stage.

1.3.9 ***Alternative overhead AC tower types*** (standard lattice, low height lattice and T-pylon) have not been considered as alternative strategic options but will be considered as appropriate at routeing and siting stages where the different potential effects associated with tower heights and form will be considered in the context of local effects and as part of a balanced decision making process.

1.3.10 ***HVDC onshore overhead line*** has been considered at strategic option stage as part of a combination solution. In general, whilst these may provide a further tower type and scale to consider at routeing, it would require the considerable additional cost of converter stations (with associated land take and environmental effects) at each end of the connection section with limited benefit compared with AC OHL options. So, whilst generally not considered an economic solution, HVDC OHL has been included as an option within one of the entirely onshore options to test this evidence.

1.3.11 ***HVDC onshore cables*** have advantages over AC cables having significantly less land take, and therefore somewhat lower environmental impact. They also require a lower number of construction traffic movements and don't need mid-point or end-point reactors, unlike AC cables. However, the costs and effects of the associated converter stations also need to be considered and over shorter circuit lengths become particularly significant in the overall balance. So, whilst generally not considered an economic solution we included HVDC cable as an element in some of the options to test this evidence.

1.3.12 ***Gas Insulated Line***. GIL's provide an alternative to AC cable. Whilst they may potentially provide an alternative to AC cable, they have significantly greater climate change potential due to the SF6 gas that they normally contain. Additionally, GIL is not proven for long distance circuits such as those forming reinforcement elements that have been considered as part of the regional solution appraisals. On this basis GIL has not been considered at strategic option stage but may be an appropriate consideration at detailed routeing in some limited circumstances.

1.3.13 In conclusion, in terms of connection technologies for consideration at strategic option stage, only the following are taken forward: AC OHL (with cable in AONB / National Parks); HVDC marine cable, HVDC onshore cable; and, uprating existing Transmission infrastructure to 400kV if it is present but at lower voltages. These technologies are considered within a number of alternative reinforcement solutions.

Geographic scope of strategic options

1.3.14 It is pertinent to note that in the context of the existing network configuration and capability and the complexity of system operating conditions (wind based generation, interconnector flows, London demand etc) no single reinforcement element achieves the necessary increase set out in section 1.2. It is not just a case for example of connecting A to B, the requirement needs for example the connection of A to C, D to F and C to B. We therefore identified, through the use of professional judgement, combinations of reinforcement elements into reinforcement strategies.

1.3.15 We also applied sensible professional judgement to reduce theoretical combinations of potential reinforcements (reinforcement solutions) to a reasonable number for appraisal. This removes those that are obviously inferior without the need for unnecessary detailed study. For example, in theory, a new connection or reinforcement of an existing connection could be made to a geographically distant and less constrained part of the NTS. Where such a new connection requires new infrastructure extending for a distance substantially beyond the sections of the NTS nearest to the area of reinforcement, they can be expected to represent an inefficient development through requiring longer connections with greater environmental effects and at greater cost and they were not taken forward. Such examples also ignore some of the inherent capability and flexibility of power flows to move around the network.

1.3.16 Similarly, we also considered the need for knock-on reinforcements and, where for example two options ultimately moved power to the same point but where one required a longer cumulative reinforcement, took forward the shorter connection.

1.3.17 In general terms the geographical scope was therefore restricted to the area of East Anglia and the south east that encompasses the nearest parts of the NTS that would facilitate a connection between the northern parts of East Anglia, South Coast Interconnectors and the demand area formed by London. As will be apparent in later sections, options exist to make such connections around the west of London through to the East, so the geographic scope is nonetheless extensive.

1.3.18 It is evident, given the layout of the NTS and location of existing substations (notwithstanding the potential to construct new substations on the existing NTS) that even defining a geographic scope retains the potential for a large number of variations on a strategic theme to be developed where reinforcement could be via many combinations of location. For example, a reinforcement via the west of London could encompass many combinations of substations such as Amersham, Iver, West Weybridge, Watford etc. In general, these potential combinations can be expected to deliver broadly similar reinforcement uplift and therefore we progressed only a limited number of combinations as strategic options. Should one of these emerge as a preferred option then a combination of back-check and detailed strategic proposal development work will ensure review of these potential variations to the main strategic proposal.

Reinforcement Options

1.3.19 Applying the above filtering for technology and geographic scope, we identified connection reinforcement solutions that could be used to provide the necessary reinforcement.

1.3.20 The reinforcements identified for appraisal fall into three main themes. These are geographic themes, noting that some of the different elements making up a complete

reinforcement solution in each theme may appear in multiple themes and may include geographically dispersed elements.

- Eastern - that transports power from the north of East Anglia into the south-east England area connecting with existing substations such as Tilbury and Grain.
- Northern - creating additional capacity by connecting into the north of the existing London area network and then into the south-east England area connecting with existing substations such as Wymondley, Pelham, Waltham Cross.
- Western - creating additional capacity by transporting power westward around London and down into the south-east England area connecting with existing substations such as East Claydon, West Weybridge along with additional reinforcement to the south of London.

1.3.21 A total of 23 options (3 for west, 5 for north and 15 for east) were identified supporting these reinforcement themes that aimed to provide a solution with longer term goals of supporting the system's capacity into the 2030s. These were appraised, considering combinations of start, end and intermediate connection points and encompassing onshore and offshore connection elements. **Table 1.1** below lists the options, the reinforcement elements making up the option, and summarises the technology components that were included within each option and overall capital cost (based on standardised costings providing a consistent basis for comparison between different technology options at this strategic stage – this is discussed in section 4) for the option. All options assume the BTNO Bramford to Twinstead area reinforcement and reconductoring (to increase capacity between Norwich and Bramford) are completed.

1.3.22 The five options below illustrate (in terms of the geographical and technical scope of all options) those retained following the technical benefit and deliverability filtering process. Collectively the options test combinations of onshore AC OHL, onshore HVDC OHL, onshore HVDC cable and offshore HVDC and some uprating to 400kV:

- Option East 14 - two new offshore HVDC links and one new onshore buried cable HVDC link that provide capacity directly between East Anglia and the south-east. This tests a whole cable and predominantly offshore option against options such as E13 where the onshore cable element is delivered by AC OHL as well as other options such as E7 with a greater onshore component.
- Option East 7 - a single offshore HVDC link between central East Anglia and the south-east supported by new AC overhead line circuits between the north of the East Anglia area and the Thames Estuary following the east coast and connecting to a new East Anglia Connection substation.
- Option East 3 - new onshore circuits (AC OHL and HVDC buried cable) from north of East Anglia directly to the Thames Estuary supported by new offshore circuits from the central East Anglia area to the Thames Estuary following the east coast and connecting to the new East Anglia Connection substation. This and E2 include onshore HVDC cable as alternatives to E1 which is entirely AC OHL
- Option North 2 - a single new offshore HVDC link between the central East Anglia area to the south-east supported by new circuits from the north of the East Anglia area to the existing 400kV circuits around London. New circuits and upgrades of the existing 275kV and 400kV network are required to allow power to be transferred around London and to Thames Estuary area. A separate connection to be established to the new East Anglia Connection substation.

- Option West 3 - new circuits extending from the north of East Anglia area to the west of London and new circuits between the existing London 400kV ring and the existing 400kV circuits on the south coast. This option is supported by new circuits from the central East Anglia area to the Thames Estuary following the east coast and connecting to the new East Anglia Connection substation. In the West 3 option we tested onshore HVDC OHL (this had the longest single connection section where DC OHL may have most benefit) against AC OHL in the other west options.
- The full list is as follows:

Table 1.1 – Reinforcement solution options assessed

Option reference	Code	Reinforcement Elements	Technology
West 1 Capex £2,395.25m	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	NWNC	Necton - Wymondley	AC OHL (Onshore)
	IBNC	Iver - WestWeybridge - Bolney	AC OHL (Onshore)
West 2 Capex £2,719.68m As West 1 but with additional connectivity to interconnectors	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	NWNC	Necton - Wymondley	AC OHL (Onshore)
	IBNC	Iver - WestWeybridge - Bolney	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
West 3 Capex £3,605.06m	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	NCDC	Norwich - East Claydon	HVDC OHL(Onshore)
	IBNC	Iver - WestWeybridge - Bolney	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
North 1 Capex £ 2,369.33 m	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NWNC	Necton - Wymondley	AC OHL (Onshore)
North 2 Capex £2,488.94 m As North 1 plus some uprating to increase capacity	WTUP	Waltham Cross - Tilbury	Uprate Existing Circuits
	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	HENC	Wymondley - Waltham Cross	AC OHL (Onshore)
	NWNC	Necton - Wymondley	AC OHL (Onshore)
North 3 Capex £ 2,369.27 m As North 1 with onshore alternative to SCD1	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	SCN1	Sellindge - Longfield Tee	AC OHL (Onshore)
	NWNC	Necton - Wymondley	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
North 4 Capex £ 1,815.46 m As North 3 with variant to onshore alternative to SCD1	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	CAKE	Canterbury - Kemsley	AC OHL (Onshore)
	NWNC	Necton - Wymondley	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
North 5 Capex £2,459.27 m Enhancement to North 1 to increase export capacity from EC5 and into SC1.5	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	NPNC	Necton - Pelham	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 1 Capex £ 1,865 m	AENC	Norwich - Bramford	AC OHL (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	SCN1	Sellindge - Longfield Tee	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)

East 2 Capex £ 2,589.64 m Similar to East 1 but with HVDC from Substations at north of East Anglia	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	SCN1	Sellindge - Longfield Tee	AC OHL (Onshore)
	NTDC	Necton - Tilbury	HVDC Cable (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 3 Capex £ 2,035.84 m Similar to East 2 but with variant to SCN1 connection	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	NTDC	Necton - Tilbury	HVDC Cable (Onshore)
	CAKE	Canterbury - Kemsley	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 4 Capex £ 2,215.68 m Similar to East 2 but with variant To SCN1 and CAKE connections	AENC	Norwich - Bramford	AC OHL (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	IBNC	Iver - WestWeybridge - Bolney	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 5 Capex £1,311.46 m Similar to East 3 but as assumed OHL option for connection from Substations at north of East Anglia	AENC	Norwich - Bramford	AC OHL (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	CAKE	Canterbury - Kemsley	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 6 Capex £ 1,865.33 m Similar to East 2 but with Offshore cable to achieve Connectivity with SC1.5	AENC	Norwich - Bramford	AC OHL (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
East 7 Capex £ 2,189.75 m As East 6 with enhanced export capacity from EC5	AENC	Norwich - Bramford	AC OHL (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 8 Capex £ 2,914.12 m Similar to East 7 utilisng HVDC for connection from Substations at north of East Anglia	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NTDC	Necton - Tilbury	HVDC Cable (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 9 Capex £ 3,046.34 m Variant to East 7 but with offshore cable for connection from substations at north of East Anglia	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NGDC	Norwich - Grain	HVDC Cable (Offshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 10 Capex £ 3,490.99 m As East 8 but with increased HVDC capacity by onshore HVDC OHL	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NTDC	Necton - Tilbury	HVDC OHL (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 11 Capex £ 3,911.70 m As East 8 but with increased HVDC capacity by onshore HVDC cable	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NTDC	Necton - Tilbury	HVDC Cable (Onshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 12 Capex £ 3,851.72m	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NGDC	Norwich - Grain	HVDC Cable (Offshore)

As East 9 with emphasis on offshore cables and reduced onshore infrastructure	ATNC	Bramford - Tilbury	AC OHL (Onshore)
East 13 Capex £ 4,176.14 m Variant to East 11 with increased offshore component	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	NGDC	Norwich - Grain	HVDC Cable (Offshore)
	ATNC	Bramford - Tilbury	AC OHL (Onshore)
	TENC	Tilbury - Grain	AC OHL (Onshore)
East 14 Capex £3,514.47 m HVDC only option	SCD1	Richborough - Sizewell	HVDC Cable (Offshore)
	SCD3	Bacton - Sellindge	HVDC Cable (Offshore)
	NTDC	Necton - Tilbury	HVDC Cable (Onshore)
East 15 Capex £ 2,189.75 m As East 7 with adjusted delivery date for ATNC	AENC	Norwich – Bramford	AC OHL (Onshore)
	ATNC	Bramford – Tilbury	AC OHL (Onshore)
	SCD1	Richborough – Sizewell	HVDC Cable (Offshore)
	TENC	Tilbury – Grain	AC OHL (Onshore)

Environmental Appraisal

1.3.23 For each of these options we undertook an appraisal of deliverability, considered the system benefit that the reinforcement provided, considered environmental and socio-economic factors and considered the cost benefit analysis completed by the ESO. In completing this work, it is recognised that some aspects, for example such as effects on residential amenity, on heritage assets or on priority habitats, are more appropriately evaluated at the next stage of routeing and siting. Some topics may require the gathering of a large evidence base and development of detailed routeing, mitigation or construction methods. All strategic options are affected to some degree by such factors and therefore likely to give rise to some requirement for back-checking at future stages.

1.3.24 Whilst the Outer Thames Estuary SPA is likely to be unavoidable impacts could be potentially managed through timing and construction practice. Likewise, the Southern North Sea SAC is designated for harbour porpoise (*Phocoena phocoena*) and it is expected that any potential effects could be managed through timing and construction practices. Margate and Long Sands SAC has more potential for effects due to the potential for permanent habitat loss associated with cable crossings and protection however this site is judged to be avoidable. The two offshore MCZs are both avoidable when considered in isolation. Intertidal designations include Thanet Coast SAC and Sandwich Bay SAC, Orfordness – Shingle Street SAC and Minsmere-Walberswick SAC are all unlikely to be avoidable but it is considered that through appropriate routeing and mitigation a likely significant effect is avoidable. Thanet Coast SPA and Sandwich Bay SPA is designated for both over wintering and breeding bird populations therefore the timing of cable installation is likely to impose restrictions on construction but is judged not to preclude marine options.

1.3.25 Additional considerations, but not considered as barriers to a marine option include:

- Parts of the marine environment contain highly mobile sediments in areas of known shipping channels. Careful attention would be required to ensure cable integrity is maintained without any protection measures affecting shipping. Much depends on routeing which is also influenced by landfall. Overall it does not preclude marine options.

- Shipping and fishing. The primary marine users include shipping and navigation and fishing, with the most significant Port area being the Port of London Authority (PLA). However, the Port of Ramsgate, is also present and the dredged channel for the Port of Felixstowe extends into this study area. The main shipping channels into the Port of London include Princes, Black and Borrow Deep which converge into the Yantlet Channel that extends up the inner Thames. Due to the shallow and mobile nature of the seabed within the Thames Estuary a number of these channels are dredged to facilitate access for the larger vessels along with channels into both Ramsgate and Felixstowe. As above effects depends on routeing, protection methods and selection of landfall. Whilst flagging challenges these are not judged to preclude marine options.
- Marine infrastructure (e.g. windfarms, cables and pipelines). Some may be avoidable by routeing but others not. In general there are well established means to successfully address such constraints and these are not judged to preclude marine options.

1.3.26 For onshore connections we considered whether environmental and socio-economic constraints with the potential to materially affect strategic options were present. The vast majority are relatively localised in their geographic scope and not materially relevant at strategic level given the potential for routeing and siting to address potential effects. but overall consider that none are extensive enough to materially influence strategic option selection. For example whilst some relatively extensive areas of built development are present (Ipswich, Colchester etc) they can be avoided.

1.3.27 Much of the nature conservation interest onshore has close association with the extensive marine sites and comprises a number of protected estuaries, rivers and lake within the study area including amongst others: Essex Estuaries SAC; Blackwater Estuary SPA; Crouch & Roach Estuaries SPA; Abberton Reservoir SPA; Hamford Water SPA; and Stour and Orwell Estuaries. Later sections of this document discuss these designated areas in more detail. In most instances these sites would not be directly impacted as any crossings of rivers or estuaries would most likely be undertaken using trenchless techniques. However, associated species could be indirectly impacted through noise and visual disturbance. Whilst these aspects tend to weigh against onshore coastal options the strategic options all have potential to adopt routes that are more inland where any effects would be avoided. The greatest area and density of inland sites is the Thetford Breckland sites, which include both SAC and SPA designations and potentially affect options leading away from Necton. Again, however, routeing options to avoid the effects are available and these are not therefore considered to be determining factors.

1.3.28 Some more extensive areas of national landscape designations are also present. These include the Norfolk Broads National Park and several Areas of Outstanding Natural Beauty (AONB) including: Dedham Vale; Suffolk Coast and Heaths; Surrey Hills; and Kent Downs amongst others. At a strategic level we considered the relative location of these in combination with the potential to adopt alternative technology to OHL meant that none presented a barrier to development or indicated an option should not be progressed.

1.3.29 In respect of the onshore historic environment, listed buildings (including grade 1) are present across the whole region albeit in varying densities albeit generally concentrated away from the lower lying wetland/ marsh areas. This is even more pronounced on the strategic options running to the south west of the Necton substation where development of all types, including listed buildings, reduces substantially within the Bedford Levels,

with only the historic cathedral city of Ely rising out from the surrounding fens. There are historical military 'stop lines' present where the density of anti-invasion remains (pillboxes, gun batteries etc) increases. The coast of Kent is especially rich in such military remains as shown by the number of sites recorded by the Defence of Britain Project within the county. Overall historic environment was not a main differentiator with attention expected to be required for all options at routeing and siting stage to appropriately respond to potential effects.

Cost Benefit Analysis

1.3.30 Using the estimated costs, small changes in the in-service dates for different elements dates, and boundary capabilities achieved by each option, the Electricity System Operator (NGESO) was able to carry out an independent cost benefit analysis on these reinforcement strategies. This analysis assessed the benefit that would be delivered by each reinforcement strategy against each of the four Future Energy Scenarios described in the 2020 versions of the Future Energy Scenarios. The scenarios are: Steady Progression (SP) - slowest credible decarbonisation; System Transformation (ST) – Hydrogen for heating; Consumer Transformation (CT) – Electrified heating; and, Leading the Way (LW) – Fastest credible decarbonisation. Of these only SP does not meet Net Zero by 2050. The EAG project will be periodically checked against any future FES scenarios where substantive change in scenario occurs.

1.3.31 An approach was taken to minimise cost exposure for the consumer. The approach determines the best performing option under each scenario then defines that as the "no regret" solution for that scenario. The "regret" cost for all other options is defined as the amount of value that would be lost for the consumer. For example, if under a given scenario an option delivered £100m less value than the best performing option it would be said to have a regret cost of £100m under that scenario.

1.3.32 The value delivered by an investment is the balance between the constraint saving achieved through increased boundary capability delivered and the capital cost of the reinforcements required to provide that additional capability. Therefore, the best performing option in terms of constraint savings may not be the best option for consumers if the cost of that option is very high. Other options that provide less additional capability, but do so at a lower cost, can ultimately be the most economic option for the consumer.

1.3.33 **Table 1.2** below presents the 'net regret costs' (ordered with the best performing, i.e. with the lowest worst regret cost, shown first and poorest performing shown last in the table) for each of the four Future Energy Scenarios (FES) for each of the reinforcement solutions appraised.

Table 1.2 – Least Worst Regret analysis results for reinforcement strategies appraised

Reinforcement Solution Option	Net Regret Cost by FES (£m)				Worst Regret Cost (£m) *ordered by least-worst regret*
	CT	LW	SP	ST	
East 7	36	143	51	0	**143**
North 5	233	340	248	197	**340**
East 3	296	556	0	355	**556**
East 15	499	664	96	504	**664**
East 6	0	0	711	155	**711**
East 8*	819	914	710	606	**914**
East 9*	863	995	737	692	**995**

East 2	746	1,000	422	803	**1,000**
East 14	923	960	1,126	730	**1,126**
North 2	804	789	1,314	709	**1,314**
East 10	1,237	1,330	1,111	1,028	**1,330**
North 1	687	654	1,376	664	**1,376**
East 11	1,549	1,642	1,423	1,340	**1,642**
West 3	1,477	1,660	1,428	1,374	**1,660**
East 13	1,691	1,820	1,549	1,524	**1,820**
East 12	1,715	1,749	2,315	1,685	**2,315**
West 2	1,413	1,430	2,951	1,646	**2,951**
North 4	1,458	1,228	3,705	1,718	**3,705**
West 1	1,487	1,421	3,978	1,908	**3,978**
North 3	1,909	1,678	4,151	2,165	**4,151**
East 4	2,159	1,812	5,083	2,453	**5,083**
East 5	2,179	1,661	6,515	2,645	**6,515**
East 1	2,633	2,114	6,961	3,096	**6,961**

* Due to a formatting error in the original publication, East 7 and East 8 have been renumbered to East 8 and East 9.

1.3.34 The results showed that West options (1, 2 and 3) all perform relatively poorly in terms of least regret cost appearing in the bottom half of performance, poorer performing than a number of East and North options. Option East 7 includes the sub option East 6 (which only excludes the Tilbury Grain element as the last element delivered), so whilst option East 6 appears to perform best under two scenarios this performance is only differentiated from option East 7 once the Tilbury Grain element is delivered. It is further noted that the East 6 option performs much less well in regret cost under one of the other scenarios.

1.3.35 The estimated capital cost for Option E7 is approximately £270m lower than the 2nd best option in least regret terms (North 5) but £150m higher than the capital cost of the 3rd best option in least regret terms (East 3). Options East 7 and North 5 achieve the same boundary capabilities. In purely capital cost terms, it is noted that the lowest capital cost option (East 5) performs poorly relative to other options in terms of regret cost. Of the next lowest capital cost options (North 4, East 1 and East 6 within the range £1,815m to £1,865m) the best performing in regret cost terms is East 6 which as noted is a partial implementation of East 7.

Conclusion

1.3.36 Taking all factors into account (environmental, deliverability, socio-economics, CBA and overall regret costs etc), the balanced conclusion across the range of scenarios, was that the highest overall consumer value and thus preferred reinforcement solution was provided by Option East 7. This preferred solution (referred to as the Strategic Proposal) combines offshore and onshore connections with three distinct elements: an offshore reinforcement between the south coast and East Anglia (whilst subject to separate study this is initially identified as between Sizewell and Richborough and referred to as the SEALink project); onshore reinforcement between Tilbury and Grain; and onshore reinforcement between Norwich and Tilbury. The remainder of this section focuses only on the onshore reinforcement between Norwich and Tilbury and is referred to as the East Anglia GREEN project (EAG). The other elements described above are

being progressed as separate schemes due to the general geographic separation of potential effects.

Refining the East Anglia Green - Norwich to Tilbury Connection

1.3.37 There are additional Influences that lead to the routeing of this reinforcement being potentially from, and via, a number of locations on the NTS and via a new East Anglia Connection (EAC) node substation. These relate to a proposed new connection node for additional customers as well as National Grid's recognition of the interconnectivity of the network and some interchangeability between certain locations.

1.3.38 The EAC node emerged as the outcome of discussions between the windfarm customers and the ESO. NGET undertook further work to combine the CBA drivers for increased boundary capability with customer connections and established the benefit of connecting via a new EAC substation on the Norwich to Tilbury reinforcement from a Clacton area landing point. The outcome of combining drivers for the new customer connection substation and ATNC projects will result in reduced total infrastructure requirements and reduced total overall costs when compared with developing the investments separately.

1.3.39 National Grid is also mindful of the relatively proximity of Norwich to another substation at Necton and that routeing of the connection to Tilbury could be via the Twinstead Tee or Bramford areas (to provide necessary network connectivity). Later stages of refinement and development of the detail of the strategic proposal therefore considered either Necton or Norwich as connection start points and Twinstead Tee area or Bramford as intermediate locations on the connection to the EAC node.

Developing the detail of the Strategic Proposal

1.3.40 The appraisal of strategic options considered the various ways to achieve the EAG project connections through a combination of different start, end and intermediate locations and the strategic options for connecting between them and concluded:

- **The use of onshore technology.** The potential for an offshore connection was considered as part of the process of defining the preferred reinforcement solution and it forms one of the elements of the preferred strategic proposal (the SEAlink project). Specifically, options East 9, 12 and 13 all considered Norwich to Grain via offshore HVDC (with inevitably some onshore infrastructure to get from Norwich to the coast) but concluded that the options were poorer performing on the basis of capability and poorer in cost benefit least regret terms. Note that Grain and Tilbury are in close proximity and for the purposes of strategic evaluation for offshore cable connections from East Anglia are essentially interchangeable as end points. Given this earlier evaluation of offshore cable connections, the use of offshore technology for the specific EAG reinforcement was not considered further in respect of the connection between Norwich or Necton and Tilbury, with an assumption made that onshore technology will be adopted.
- **The use of AC OHL technology except where mitigation is justified.** As discussed above the use of entirely AC cable solutions were considered but not progressed through to appraisal. Additionally, some of the reinforcement solutions considered the use of HVDC cable for certain onshore connections (e.g. East 2, 3 and 11) and also considered HVDC OHL (e.g East 10, but these were found to perform less well. It is also notable that relevant National Policy Statements support initial consideration of overhead lines as an acceptable technology with the use of

underground cables in certain designated areas. The use of AC OHL has therefore been taken as the start basis for the EAG project though it is noted that certain sections of some potential routeing options would require the use of AC cable where: crossings of existing 400kV OHL may be required; where routed through AONB or National Parks; and where potential effects may justify consideration of cable technology as mitigation.

- **Necton or Norwich.** There are opportunities to successfully achieve a new 400kV connection between either Norwich Main or Necton and either Twinstead or Bramford. The area of potential connections features a series of ancient woodlands, geological sites, areas of regionally rare habitats and protected species, areas of best and most versatile land and heritage assets (including to the north of Norwich Main the Venta Icenorum: Roman town and associated prehistoric, Anglo-Saxon, and medieval remains which may have implications for siting of a substation extension and routeing of line entries). Connection areas are generally flat, albeit with some limited topographical variation for river valleys which are also associated with Flood Zones which require crossing for all options, with no particular option offering clear advantage for routeing to benefit from landform screening. Overall whilst all of the constraints can be avoided through routeing when considered in isolation, the constraints south of Necton may be slightly more difficult to address through routeing and feature a number of designated sites closer to Necton at Breckland (including a complex of SPA/SAC/SSSI sites, and nationally scarce and exceptionally rich communities of invertebrate species and important populations of protected bird species), as well as heritage designations that may be harder to avoid. Overall however, there is no indication that identified constraints are extensive enough to mean that one or other alternative is not achievable. Connection distances to Twinstead are comparable from either Necton or Norwich Main however Norwich Main provides a starting location that gives the shortest route length to Bramford (60km compared with 75km). Shorter route lengths are generally associated with lower levels of environmental effects and in general terms are more compliant with relevant policy guidance, With connections to both Twinstead and Bramford potentially requiring some use of cable mitigation (including to potentially respond to the Stour Valley Project Area for connections to Twinstead and potentially to respond to cumulative visual effects on the route to Bramford), the shorter length of the overall connection to Bramford can be expected to be at lower capital and lifetime cost. For connections to either Twinstead or Bramford, the use of Norwich Main as the start point provides the potential opportunity (subject to detailed routeing consideration) for construction of a larger proportion of the reinforcement in close parallel to existing OHL infrastructure though as all options are considered capable of being successfully routed to avoid significant effects this is not a determinative factor. In considering whether the connection should start at the substation at Necton or the substation at Norwich Main, National Grid's appraisal concluded that Norwich Main provides the preferred start point as the use of Necton generally results in longer connections, increases the potential for environmental effects, and therefore is less compliant with the Holford Rules.
- **Bramford or Twinstead Tee area.** EAG requires a connection to the NTS in the Bramford or Twinstead Tee area for system integrity reasons. The Twinstead Tee are is where the double circuit heading west from Bramford spllits with one circuit continuing west and one to the south. There are similar constraints to the routeing of new connections from the north to both the existing Bramford substation or to a new substation to be located in the Twinstead Tee area with both potentially requiring some use of 400kV cable as mitigation. For clarity the new Grid Supply

Point substation being established as part of the BTNO reinforcement in the Twinstead area is to provide a connection to the 132kV DNO network and is not appropriate technically or in the right location for the 400kV interconnectivity required hence the need for a new 400kV substation if the connection were made in the Twinstead Tee area. In terms of whether to route via Twinstead Tee or Bramford for a connection through to Tilbury via the EAC node, the appraisal concluded that a route via Twinstead Tee areawould be longer and requires a new substation to be constructed (rather than an extension to the substation at Bramford). The option via Twinstead Tee area would be at higher capital cost, and with a similar potential for additional mitigation to be required (including by cable to respond to landscape effects) compared with a route via Bramford. Overall greater Holford Rule compliance is achieved with a connection via Bramford.

- **Norwich to Bramford Connection**. Based on the above we conclude that the preferred alternative is a Norwich to Bramford connection and considered this to be feasible by overhead line and capable of securing consent with normal routeing and siting practice adopted.
- **EAC Node (general siting)**. As discussed above, including the customer connection works as part of the ATNC reinforcements will have a net reduction in overall costs when compared with delivering separately via Felixstowe as a standalone substation. Routeing and siting benefits arising from the adoption of a connection node closer to Clacton or one closer to Felixstowe were also investigated given the locations of the connecting windfarm proposals (North Falls and Five Estuaries) with potential landing points extending from Clacton-on-Sea in the south through to sites north of Felixstowe. Siting of substations and onward routeing for Felixstowe area landing points is substantially more challenging due to the presence of the Suffolk Coast & Heaths AONB through which connection cables are likely to be laid and which makes siting the EAC node more challenging (if the node is to be located outside the AONB and its immediate setting to be compliant with Horlock siting rules) and likely to be focussed on areas in a relatively narrow corridor along or to the north-east side of the A14. Onward connection from a Felixstowe landing point and such a location for an EAC node would require a new double circuit connection to be routed either to the north or south of Ipswich. Routeing to the north has potential (subject to EAC node siting) to pass through or close to the Suffolk Coast & Heaths AONB and place the new reinforcement in some locations in a corridor alongside two existing OHL's connecting from Sizewell. Avoiding the AONB or potentially adopting undergrounding at this point is also considered to be limited due to extent of urban development. Routes to the south of Ipswich would also cross parts of the Suffolk Coast & Heaths AONB and also require a crossing of the River Orwell, potentially with a requirement for a tunnel given the width of the estuary around likely crossing points. Both north and south connection routes would require a further connection to be made into Bramford substation in addition to the connections from Norwich and to Tilbury that form part of the preferred strategic reinforcement strategy potentially exacerbating cumulative effects requiring further mitigation. In contrast the use of a Clacton landing point supports a node location on the less constrained Tendring Peninsula. Onward 400kV connections could be configured as a spur connecting to Bramford substation, as a spur to the existing or reinforced NTS or integrated as part of the reinforcement from Bramford to Tilbury. Connecting as a spur may not provide the necessary security of supply necessitating further reinforcement with a connection to Bramford and also a connection to the existing or reinforced NTS. Integrating the node connection with the reinforcement to Tilbury, would achieve two points of connection from the EAC

node with a single substation and provide onward connections to Bramford and to Tilbury (i.e. it doesn't require this connection and a spur). It is likely to be achievable with node locations available to support connection reinforcements to the west and east of Colchester. Whilst in all cases (see discussion below re alternative OHL option around the AONB) the route south from Bramford would have to pass through the Dedham Vale AONB (and is expected to necessitate the use of 400kV cable through the AONB), onward connections from the EAC node to Tilbury are available that avoid AONBs albeit some options route in proximity to Special Protection Areas to the south and east of Colchester though options to avoid these are available. For clarity the route south from Bramford through the Dedham Vale is common to Felixstowe or Clacton landing points and for Felixstowe landing points would be in addition to connections through the Suffolk Coasts and Heaths AONB. Overall the appraisal concluded that options associated with Clacton landing points and EAC nodes in Tendring District are preferred. These locations, in combination with the required onshore connections from the node to the NTS, are more compliant with Holford and Horlock routeing and siting guidance, in particular by offering greater potential to avoid and minimise effects on AONBs than would be the case with Felixstowe landing points.

- **Bramford to EAC node connection through or around Dedham Vale AONB.** In view of the location of the AONB to the south of Bramford and its importance in policy terms, we also considered whether the connection to the EAC Node was best achieved by connection through the Dedham Vale AONB (assumed to be via buried cable within the AONB) or around the AONB (via a third connection between Bramford and via the Twinstead Tee area). A route around the AONB would be around twice the length of the more direct alignment and whilst likely to be capable of being predominantly progressed as OHL may require a similar length of cable to cross the Stour Valley Project Area (SVPA) (an area continuing from the AONB further upstream on the Stour Valley) (assuming the use of cable as proposed to be adopted by the Bramford to Twinstead reinforcement) as required to cross the AONB via a more direct alignment. Over and above the landscape constraints both direct or options to route around the AONB have the potential to interact with properties, habitats including woodland, heritage assets and a range of other constraints. Both are nonetheless considered deliverable options subject to normal routeing and siting practices. The route around does however become more constrained should a connection from the EAC node to Tilbury also route to the west of Colchester (due to the presence of SPA areas for eastern options). Taken together we concluded that the option routeing through the AONB, utilising cable through the AONB and overhead line outside the AONB, is more compliant with the Holford rules and would not incur the environmental effects of a third connection between Bramford and the Twinstead Tee area. In view of the sensitivity of the AONB, the consideration of routeing through or around the AONB was subsequently back-checked as part of the detailed routeing and siting process as discussed later in this report and was confirmed as the preferred option.
- **EAC Node to Tilbury Connection.** This part of the reinforcement requirement features a network of estuarine and marsh sites along the eastern boundary with many associated with Special Conservation Area (SAC) and Special Protection Area (SPS) designations. There are also scattered sites of ecological interest across the rest of the study area. Sites within this study area are considered to be avoidable when considered in isolation noting that the SAC / SPA designations suggest more inland routes are likely to be more favourable. The land in this likely connection routeing area is relatively flat with Flood Zone concentrated around the river network

and Thames Estuary including the existing Tilbury Substation within Flood Zone 3 (with extension into the flood zone requiring an exemption test). The area is not constrained by any national landscape designations however much of the Study Area comprises constraints to OHL with numerous settlements and scattered properties. A number of high value designated assets are present including scheduled monuments, Registered Parks and Gardens, and listed buildings. These are distributed throughout the study area, although the majority of listed buildings are focused on settlements. Parks and Gardens scheduled monuments are also distributed throughout the study area, although there is a large concentration of scheduled monuments to the south of Colchester, and two scheduled monuments flank the existing Tilbury power station. Two extensive Parks and Gardens (Weald Park and Thorndon Hall) also occupy a large area of land near Brentwood. Known BMV land is relatively extensive with Grade 1 BMV land more likely to be located in the east. Grade 3 agricultural land (noting however that grade 3 land is split into 3a and 3b with only 3a constituting BMV land) is the most prominent land type classification. All route options would unavoidably cross a number of linear infrastructure features (roads, railway lines etc). Interaction with a number of golf course appears likely on most route options given that they often occupy open areas between settlements. Overall it is considered feasible to develop a suitable route for a new 400kV overhead line in this area with normal routeing and siting practice potentially via routes either to the east (subject to being able to address SPA related effects) or west of Colchester. Whilst not without its challenges the nature of constraints seems unlikely to justify the alternative effects or additional costs associated with alternative technologies such as 400kV cable.

Conclusion on the preferred strategic proposal for EAG

1.3.41 In conclusion, an appraisal of strategic options concluded that the East Anglia GREEN project is to comprise onshore reinforcement by a new 400kV double-circuit of ~60km between Norwich Main and Bramford substations and a new 400kV double circuit of ~120km between Bramford and Tilbury substations via a new East Anglia Connection (EAC) Node substation to be located in Tendring District. Most of these reinforcements are expected to comprise steel lattice pylon supported overhead lines, but with the use of underground cable through the Dedham Vale AONB. Whilst not identified at this early stage, there is expected to be a need for associated works at substations and elsewhere to connect the reinforcements to the existing network and to ensure the safe construction and operation of the reinforcement. Adoption of mitigation measures may also be required and will be identified following more detailed environmental assessment at a later stage (including potential cumulative effects) identified during detailed routeing and siting.

2. Summary of the Project

2.1.1 This Chapter (paragraphs 2.2.1 to 2.5.1) summarises the key components of the Project. The technology to be used for each of the components is described in accordance with the initial technology assumptions set out in National Grid's Approach to Consenting and the existing EN-5 NPS which states that the "*Government does not believe that development of overhead lines is generally incompatible in principle with developers' statutory duty under section 9 of the Electricity Act to have regard to amenity and to mitigate impacts"*. Outside particularly sensitive locations, it is assumed that connections will be made via overhead line supported by steel lattice pylons and that within nationally designated landscapes, such as Areas of Outstanding Natural Beauty[2,3], connections will be made via underground cable. These initial technology options are in accordance with existing and emerging National Policy and National Grid's Stakeholder, Community and Amenity Policy. Should the appraisal of options indicate that different technologies may need to be employed, these will be identified in accordance with the relevant policy and regulatory context within which the routeing and siting was undertaken, as detailed in Section 3.1, and National Grid's mitigation hierarchy as set out in Section 3.2.

2.2 Norwich to Bramford

2.2.1 A new 400kV double-circuit overhead line between Norwich Main substation, located to the south of Norwich in Norfolk, and Bramford substation, located to the west of Ipswich in Suffolk. The straight-line distance between the two substations is 57.8km. An existing National Grid 400kV overhead line (the 4YM route) runs on a north – south alignment between the two substations, a distance of approximately 62km. Works are required at both Norwich Main and Bramford substations to facilitate connection of the new double circuit overhead line which would include additional line end gantries and substation bays.

2.3 Bramford to East Anglia Connection Substation

2.3.1 A new 400kV double-circuit, connection between Bramford substation and the new EAC substation. The straight-line distance between the two substations is likely to be between approximately 18km and 30km, depending upon the location selected for the

[2] The existing National Policy Statement for Electricity Networks Infrastructure (EN-5) (July 2011) states at paragraph 2.8.9 that consent should only be refused for "*overhead line proposals in favour of an underground or sub-sea line if it is satisfied that the benefits from the non-overhead line alternative will clearly outweigh any extra economic, social and environmental impacts and the technical difficulties are surmountable. In this context it should consider: the landscape in which the proposed line will be set, (in particular, the impact on residential areas, and those of natural beauty or historic importance such as National Parks, AONBs and the Broads)".*

[3] The Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (September 2021) states at paragraph 2.11.13 that *"Although it is the government's position that overhead lines should be the strong starting presumption for electricity networks developments in general, this presumption is reversed when proposed developments will cross part of a nationally designated landscape (i.e. National Park, Broads, or Area of Outstanding Natural Beauty). In these areas, and where harm to the landscape cannot feasibly be avoided by mitigation or re-routing, the strong starting presumption will be that the developer should underground the relevant Section of the line*".

EAC. The connection may pass through the Dedham Vale Area of Outstanding Natural Beauty (AONB) and/or the Suffolk Coast and Heaths AONB. The connection is expected to comprise:

- Sections of 400kV overhead line outside AONBs.
- If the connection passes through an AONB, a section or sections of 400kV underground cable and associated cable sealing end compounds[4](CSECs).

2.4 East Anglia Connection Substation

2.4.1 A new 400kV substation on the Tendring peninsula. Site search was based on the EAC substation requiring an area of approximately 18ha. Customer substations are likely to require areas between approximately 10ha and 15ha, either co-located with, or located near to, the EAC.

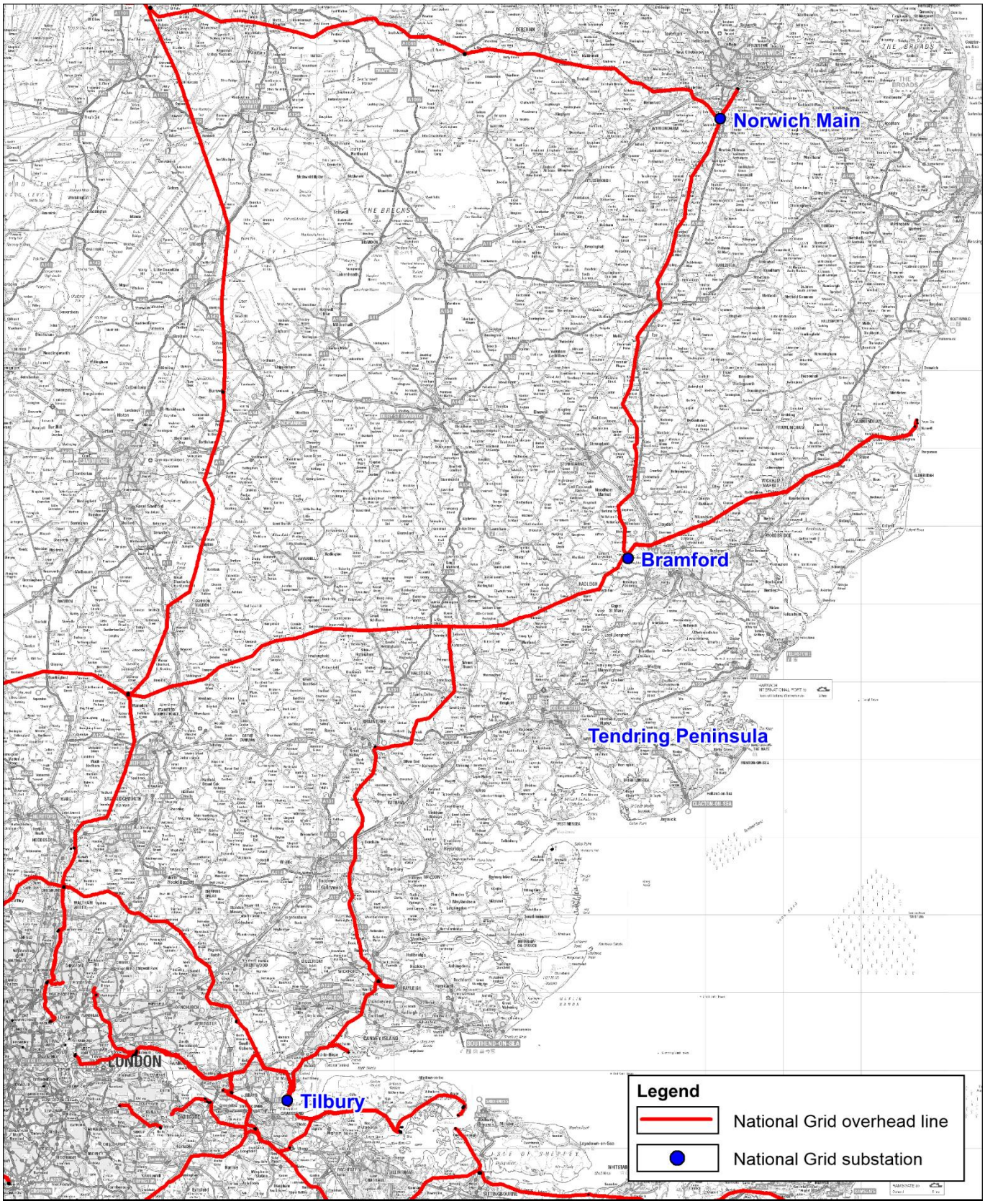
2.5 East Anglia Connection Substation to Tilbury

2.5.1 A new 400kV double-circuit overhead line between the proposed EAC substation and National Grid's existing 400kV Tilbury substation. The straight-line distance between the two substations is likely to be approximately 70km, depending upon the location selected for the EAC. Works at Tilbury will depend on the technology used to enter the site and the components used within the site but will require additional substation bays being created.

2.5.2 The locations of Norwich Main, Bramford and Tilbury substations and of the Tendring peninsula are shown on **Figure 2.1**.

[4] compounds that contain electrical infrastructure which facilitate the transition between an overhead line and underground cables. The presumption to underground in designated landscapes is based on National Grid's Approach to Consenting, detailed in Chapter 3, paragraph 3.1.2 to 3.1.20).

Figure 2.1 –Project Connection Points



2.6 Structure of this Report

The report is structured as follows:

- Chapter 3: Approach to Routeing and Siting: sets out the process used to identify, appraise and select options, following National Grid Guidance and in line with relevant policy.
- Chapter 4: Norwich to Bramford Options Appraisal: presents the options appraisal process and the preferred option for the Norwich to Bramford section of the Project.
- Chapter 5: Bramford to EAC Options Appraisal: presents the options appraisal process and the preferred option for the Bramford to EAC section of the Project.
- Chapter 6: EAC Options Appraisal: presents the options appraisal process and the preferred option for the EAC location.
- Chapter 7: EAC to Tilbury Options Appraisal: presents the options appraisal process and the preferred option for the EAC to Tilbury section of the Project.
- Chapter 8: Conclusions and Next Steps: provides the conclusions of the CPRSS and outlines the next steps in the East Anglia Energy Enablement (GREEN) Project.

3. Approach to Routeing and Siting

3.1 Overview of National Grid's Statutory Duties, Policy, and Approach to Consenting

National Grid Statutory Duties (Electricity Act 1989)

3.1.1 National Grid has duties placed upon it by the Electricity Act 1989 ('the Electricity Act') and operates under the terms of its transmission licence. Those duties and terms of particular relevance to the development of the proposed connection described in this report are set out below. In the instances that National Grid is developing new infrastructure, it is required to have regard to these following statutory duties under the Electricity Act.:

- Electricity Act 1989 – Schedule 9 (preservation of amenity including: taking into account impacts upon communities. Landscape, visual amenity, cultural heritage and ecological resources).
- Section 38 and Schedule 9 of the Electricity Act 1989 state that:
  "*(1) In formulating any relevant proposals, a licence holder or a person authorised by exemption to generate, distribute, supply or participate in the transmission of electricity:*
  (a) shall have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and
  (b) shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects."

3.1.2 Further to these, relevant statutory obligations outwith the Electricity Act have been given due regard, and are cited where relevant to the outcomes presented.

National Policy Statements (NPS) – EN1 (Overarching National Policy Statement for Energy) and EN5 (Electricity Networks Infrastructure)

3.1.3 The regulatory context within which the routeing and siting for electricity infrastructure networks is undertaken is set out in National Policy EN-1 and EN-5. Taken together they provide the primary basis for decisions on applications for electricity networks infrastructure which are classified as Nationally Significant Infrastructure Projects.

3.1.4 The commentary provided below is based on the extant NPS. Whilst drafts of updated NPS have been consulted upon in late 2021 and are emerging policy which include reference to the Horlock Rules, the current versions remain the relevant policy basis. (For the avoidance of doubt the Horlock Rules are not referred to in the existing NPS). There is no indication that changes to the NPS are expected to undermine the policy summary set out below, but this will be kept under review.

3.1.5 As set out in footnotes to this chapter, the draft NPS confirm that the Holford Rules and Horlock Rules should be embodied in proposals for new overhead lines and their associated infrastructure.

Overarching National Policy Statement for Energy – EN1

3.1.6 EN-1 sets out the need for new nationally significant infrastructure which includes meeting energy security and carbon reduction strategies, the need for more electricity capacity to support increased supply from renewables and the need to meet future increases in electricity demand.

3.1.7 EN-1 sets out the impacts and means of mitigation that are anticipated to arise most frequently from energy developments. This CPRSS considers the potential effects and consequent mitigation required for the following topics: Biodiversity; the Historic Environment, Landscape and Visual Amenity (Landscape and Visual) and Socio-economics. Topics such as air quality, soils and geology, and water[5] were scoped out on the basis that at this phase of the Project with the topics above already applied, that these topic areas would not have a significant effect on the determination of the preferred route for the connection or substation siting.

3.1.8 EN-1 explains that in terms of:

- Biodiversity – applicants should show how the project has taken advantage of opportunities to conserve and enhance biodiversity interests.
- Historic Environment – there is a desirability to sustaining and where appropriate enhancing the significance of heritage assets, their setting and the positive contribution they can make to communities. EN-1 also makes clear that substantial harm to or loss of designated assets of the highest significance, including scheduled monuments; registered battlefields; grade I and II* listed buildings; grade I and II* registered parks and gardens; and world heritage sites, should be wholly exceptional.
- Landscape and Visual – projects need to be designed carefully, taking account of the potential impact on the landscape. Having regard to siting, operational and other relevant constraints the aim should be to minimise harm to the landscape, providing reasonable mitigation where possible and appropriate. EN-1 confirms that National Parks, the Broads and AONBs have been confirmed by the Government as having the highest status of protection in relation to landscape and scenic beauty. It makes clear that development consent in these areas can be granted in exceptional circumstances. In such instances, the development should be demonstrated to be in the public interest and consideration of such applications should include an assessment of:
  - the need for the development, including in terms of national considerations, and the impact of consenting or not consenting it upon the local economy;
  - the cost of, and scope for, developing elsewhere outside the designated area or meeting the need for it in some other way, taking account a consideration of alternatives; and

[5] Although detailed option appraisal was not conducted for water at this stage, the location of flood zones and watercourses were considered as part of the suite of baseline constraints on route and substation positioning, and the implications for effects therein.

- any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.

- Socio-economics – applicants should identify the impacts of new energy infrastructure and potential mitigation measures.

Overarching National Policy Statement for Energy – EN5

3.1.9 EN-5 sets out the factors influencing site/route selection and the impacts and other matters which are specific to electricity networks infrastructure. In summary, it states that:

- Biodiversity – particular consideration should be given to the effects on large birds, including feeding and hunting grounds, migration corridors and breeding grounds.

- Landscape and Visual – – Paragraph 2.8.2 of EN-5 states that "*The Government does not believe that development of overhead lines is generally incompatible in principle with developers' statutory duty under section 9 of the Electricity Act to have regard to amenity and to mitigate impacts*. *In practice new above ground electricity lines, whether supported by lattice steel towers/pylons or wooden poles, can give rise to adverse landscape and visual impacts, dependent upon their scale, siting, degree of screening and the nature of the landscape and local environment through which they are routed. For the most part these impacts can be mitigated, however at particularly sensitive locations the potential adverse landscape and visual impacts of an overhead line proposal may make it unacceptable in planning terms, taking account of the specific local environment and context. New substations, sealing end compounds and other above ground installations that form connection, switching and voltage transformation points on the electricity networks can also give rise to landscape and visual impacts".* EN-5 also makes clear that the Holford Rules should be followed by developers when designing their proposals. Paragraph 2.8.8 states that "*Paragraph 3.7.10 of EN-1 sets out the need for new electricity lines of 132kV and above, including overhead lines. Although Government expects that fulfilling this need through the development of overhead lines will often be appropriate, it recognises that there will be cases where this is not so. Where there are serious concerns about the potential adverse landscape and visual effects of a proposed overhead line, the IPC will have to balance these against other relevant factors, including the need for the proposed infrastructure, the availability and cost of alternative sites and routes and methods of installation (including undergrounding)"*[6].

The Holford and Horlock Rules

3.1.10 National Grid employs two sets of rules/guidelines for the routeing and siting of new energy transmission infrastructure:

- The Holford Rules, which provide guidelines for the routeing of high voltage overhead transmission lines; and,

[6] The Draft National Policy Statement for Electricity Networks Infrastructure EN-5 NPS states that *"Although it is the government's position that overhead lines should be the strong starting presumption for electricity networks developments in general, this presumption is reversed when proposed developments will cross part of a nationally designated landscape (i.e. National Park, Broads, or Area of Outstanding Natural Beauty). In these areas, and where harm to the landscape cannot feasibly be avoided by mitigation or re-routing, the strong starting presumption will be that the developer should underground the relevant Section of the line".*

- the Horlock Rules, which provide the approach to and guidelines for, the design and siting of substations (in addition to cable sealing end compounds and line entries)[7].

3.1.11 When considering new electricity infrastructure, National Grid have regard to the degree to which options comply or deviate from these rules.

3.1.12 Paragraph 2.8.7 of the existing NPS EN-5[8] makes clear "*that the Holford Rules, and any updates, form the basis for the approach to routeing new overhead lines"*. The Holford Rules state that routeing of high voltage overhead transmission lines should where possible, in summary:

- Avoid areas of the highest amenity value and smaller areas of high amenity value.
- choose the most direct line with no sharp changes in direction;
- be positioned against tree and hill backgrounds as far as possible;
- prefer moderately open valleys with woods;
- be kept as far as possible from smaller lines, converging routes and other poles, masts, wires and vales to avoid a concentration or 'wirescape'; and
- approach urban areas through industrial zones, where they exist; and when residential and recreational land intervenes between the approach line and the substation, carefully compare costs of undergrounding, for lines other than those of the highest voltage.

3.1.13 The Horlock Rules[9] state that:

- In the development of system options including new substations consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements, against the consequential environmental effects, in order to avoid as far as possible adverse effects;
- siting of substations, sealing end compounds and line entries should seek to avoid areas of the highest amenity, cultural or scientific value by the overall planning of the system connections and areas of local amenity value, important existing habitats and landscape features should be protected as far as reasonably practicable;
- siting of substations, extensions and associated proposals should take advantage of the screening provided by landform and existing features and the potential use of site layout and levels;
- proposals should keep visual, noise and other environmental effects to a minimum;
- land use effects of the proposal should be considered when planning the siting of substations or extensions;

[7] The Draft National Policy Statement for Electricity Networks Infrastructure EN-5 NPS has incorporated the Horlock Rules. At paragraph 2.11.11 it states "*The Horlock Rules – guidelines for the design and siting of substations – were established by National Grid in 2009 in pursuance of its duties under Schedule 9 of the Electricity Act 1989. These principles should be embodied in Applicants' proposals for the infrastructure associated with new overhead lines"*.

[8] The Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (September 2021) in paragraph 2.11.9 confirms that the Holford Rules "should be embodied in developers' proposals for new overhead lines.

[9] The Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (September 2021) in paragraph 2.11.11 confirms that the Horlock Rules "should be embodied in Applicants' proposals for the infrastructure associated with new overhead lines".

- design of new substations or line entries, early consideration should be given to the options available for terminal towers, equipment, buildings and ancillary development appropriate to individual locations;
- space should be used effectively to limit the area required for development consistent with appropriate mitigation measures and to minimise the adverse effects on existing land use and rights of way, whilst also having regard to future extension of the substation;
- design of access roads, perimeter fencing, earth shaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings;
- in open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance; and,
- the inter-relationship between towers and substation structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable the exposure of terminal towers on prominent ridges should be minimised by siting towers against a background of trees rather than open skylines.

National Planning Policy Framework (NPPF)

3.1.14 Paragraph 5 of NPPF states that the "*Framework does not contain specific policies for nationally significant infrastructure projects. These are determined in accordance with the decision making framework in the Planning Act 2008 (as amended) and relevant NPSs for major infrastructure, as well as any other matters that are relevant (which may include the National Planning Policy Framework)".*

National Grid's Approach to Consenting

3.1.15 National Grid's Approach to Consenting[10] (hereinafter referred to as 'The Approach') outlines the project development process for major infrastructure projects, from initial inception to consent and construction. The Approach is divided into a number of phases, which can be combined if appropriate to the needs of a project:

- Strategic Proposal;
- Options Identification & Selection;
- Defined Proposal & Statutory Consultation;
- Assessment & Land Rights;
- Application, Examination & Decision; and
- Construction.

[10] https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/planning-and-development

Figure 3.1 – The phases in National Grid's Approach to consenting.

3.1.16 This CPRSS has been undertaken as part of the Options Identification & Selection phase of the Project. For the Project, the activities identified in the Approach as being required for this phase will be broken down into the following five stages:

- Stage 1: Options Identification;
- Stage 2: Options Appraisal;
- Stage 3: Options Selection;
- Stage 4: Development of preliminary route alignments or substation sites; and
- Stage 5: Non-statutory consultation with stakeholders regarding the preferred option or options.

3.1.17 This CPRSS sets out the findings of the first four stages of the Options Identification & Selection phase for the EAG project and is expected to inform subsequent non-statutory consultation.

3.1.18 At Stage 1, options to deliver the Strategic Proposal[11] are identified based on the parameters set out in the Strategic Proposal (i.e. the need for 400kV connections between the substations at Norwich Main and Bramford, between Bramford and the EAC and between the EAC and Tilbury substation) and a standard set of assumptions regarding the technology to be used (as described in paragraph 2.1.1. The options involve little detailed engineering design, but include high-level mitigation, such as routeing to avoid designated sites and other large-scale constraints.

3.1.19 In Stage 2, all identified options (corridors and substation sites) are subject to Options Appraisal in accordance with National Grid's Approach to Consenting (which incorporates National Grid's Approach to Options Appraisal[12]). National Grid's guidance provides a thorough and consistent framework to inform the appraisal of project options and decision making. Its aim is to ensure that decisions regarding the route, location or technology of a project are based on a full understanding of the technical, socio-economic, environmental and cost implications of each option. It also enables National Grid to document in a transparent manner the information on which judgements have been based.

[11] The Strategic Proposal is defined by the Strategic Options Report, summarised in Section 1.3.

[12] https://www.nationalgrid.com/uk/electricity-transmission/document/96531/download

3.1.20 In Stage 3, once all identified options have been appraised, the option or options that best meet National Grid statutory duties and obligations are selected as the preferred option or options.

3.1.21 At Stage 4, engineering subject matter experts and environmental specialists and planners undertake an analysis of each preferred route corridor option and the preferred substation siting search zone, to identify areas within the corridor or zone within which Project infrastructure is considered more or less likely to be located. This analysis is based on the information available at this time and may be subject to change as more information becomes available and the views of stakeholders are taken into account. As such, they are graphically represented by the use of a graduated swathe to emphasise their preliminary nature. (Graduated swathes are areas within the corridor or zone within which Project infrastructure is considered more or less likely to be located. They are graphically represented by the use of a graduated swathe to emphasise their preliminary nature).

3.1.22 The preferred option or options, together with their graduated swathes, are then consulted upon as soon as possible with stakeholders and the public as part of Stage 5 of this process. The early feedback received helps shape the further development of the project design.

3.1.23 The methodologies employed by this study for Stages 1 to 4 are described in Section 3.2, below. The findings of the non-statutory consultation to be undertaken as Stage 5 of this process will be reported in a consultation feedback summary.

3.2 Options Identification and Selection Process

3.2.1 The methodologies employed for the first four stages of the options identification and selection process are described below.

Stage 1: Options Identification

Overview

3.2.2 The identification of corridor and substation siting area options consists of the following activities:

- Definition of the study area;
- constraints and opportunities mapping; and
- identification and refinement of options.

3.2.3 Whilst these activities are broadly sequential, the process is an iterative one. For example, some high-level constraints mapping is likely to be required to inform the definition of the Study Area and additional constraints may be identified whilst refining options. The approach to each activity is described below.

Definition of the study area

3.2.4 The Project Study Area is the area within which infrastructure required for the Project may be located. The Study Area is informed by:

- the connection points identified in the Strategic Proposal;

- the distribution of extensive areas of the highest amenity value or environmental constraint for example, National Parks, Areas of Outstanding Natural Beauty or internationally designated ecological sites);
- the nature of the physical and human geography for example, the presence of features such as chains of hills, estuaries or major settlements that may represent a natural boundary to the Study Area or dictate a need for the area to extend to support routes around such features; and
- consideration of the likely balance of environmental impact between direct and indirect routes.

3.2.5 Based on these factors, the Study Area must extend to encompass the area within which a project design is likely to be located which satisfies the statutory duties and obligations of National Grid and meets the Project objectives, but should not extend to include areas unlikely to yield such a design.

3.2.6 Given the large geographical extent of the Project, distinct, but interrelated, Study Areas have been defined for each of its four components. The factors that have influenced the definition of these study areas are set out in:

- Chapter 4 for the Norwich to Bramford Study Area;
- Chapter 5 for the Bramford to EAC Study Area;
- Chapter 6 for the EAC Study Area; and
- Chapter 7 for the EAC to Tilbury Study Area;

Constraints and opportunities mapping

3.2.7 To identify connection options which best satisfy the statutory duties and obligations of National Grid and meet the Project objectives identified in the Strategic Proposal, it is necessary to understand the distribution of environmental and technical constraints (push factors) and opportunities (pull factors) within the Study Area. As part of this process, geographical information system (GIS) web mapping was developed comprising available environmental, socio-economic and technical data within the Study Area.

3.2.8 Features representing potential constraints to development were categorised as either ‘seek to avoid’ or ‘seek to minimise’ in order to, respectively, either avoid or minimise effects whilst achieving the Project objectives. Features were categorised based on the level of constraint that the relevant internal project team subject matter expert considered them to represent on the basis of professional judgement and relevant environmental legislation, policy and best practice. As the same feature may represent a different level of constraint to the routeing of an overhead line or underground cable, compared with the siting of a substation, features were categorised separately for the different types of development. For example, potential inundation by flooding is a far more important consideration for substation siting than it is for overhead line or underground cable routeing as it could result in a substation ceasing to function, whilst a line or cable would be likely to function as normal in most circumstances. As a result, Flood Zones 2 and 3 are categorised as ‘seek to avoid’ in relation to substations, whilst Flood Zone 3 is categorised as ‘seek to minimise’ and Flood Zone 2 is not considered in relation to overhead lines and underground cables. Buffers were also included for some environmental constraints, where it was considered that potentially significant indirect effects could occur from beyond the asset itself, for example effects on the setting of a

listed building, in order to avoid or minimise that effect. The extent of the buffers was based upon the professional judgement of the relevant internal project team subject matter expert against relevant environmental legislation, policy and best practice. The constraints mapped in relation to overhead line and underground routeing are listed in **Table 3.1**, those for substation siting in **Table 3.2**.

Table 3.1 – Routeing Constraints

Sub-topic	Constraint Name	Seek to Avoid/ Seek to Minimise	Buffer
Ecology	Ancient Woodland (AW)	Seek to avoid	
Ecology	National Nature Reserves	Seek to avoid	
Ecology	Ramsar	Seek to avoid	
Ecology	Special Area of Conservation (SAC)	Seek to avoid	
Ecology	Special Protection Area (SPA)	Seek to avoid	
Ecology	Site of Special Scientific Interest (SSSI)	Seek to avoid	
Ecology	Local Nature Reserves (LNR)	Seek to minimise	
Historic Environment	Battlefields	Seek to avoid	
Historic Environment	Scheduled Monuments	Seek to avoid	
Historic Environment	Conservation Areas	Seek to minimise	
Historic Environment	Listed Buildings	Seek to avoid	Seek to avoid 50m Seek to minimise 50m to 100m
Landscape & Visual	AONB	Seek to avoid	
Landscape & Visual	Heritage Coast	Seek to avoid	
Landscape & Visual	National Parks	Seek to avoid	
Landscape & Visual	Parks and Gardens	Seek to avoid	

Sub-topic	Constraint Name	Seek to Avoid/ Seek to Minimise	Buffer
Landscape & Visual	Residential Properties	Seek to avoid	Seek to avoid 30m Seek to minimise 30m to 50m
Planning	Proposed development subject to the Development Consent Order process (DCO)	Seek to minimise	
Planning	Greenbelt	Seek to minimise	
Technical	Built-up Areas	Seek to avoid	Seek to avoid 30m Seek to minimise 30m to 50m
Technical	Flood zone 3	Seek to minimise	
Technical	Permitted Waste/ Reg Landfill	Seek to minimise	
Technical	Statutory Main Rivers	Seek to minimise	Seek to minimise 20m

Table 3.2 – Substation Siting Constraints

Sub-topic	Constraint Name	Seek to Avoid/ Seek to Minimise	Buffer
Ecology	Ancient Woodland	Seek to avoid	
Ecology	National Nature Reserves	Seek to avoid	
Ecology	Ramsar	Seek to avoid	
Ecology	RSPB reserves	Seek to avoid	
Ecology	SAC	Seek to avoid	
Ecology	SPA	Seek to avoid	
Ecology	SSSI	Seek to avoid	
Ecology	Local Nature Reserves	Seek to minimise	
Ecology	National Forest Inventory Woodland	Seek to minimise	
Ecology	Priority Habitat Inventory	Seek to minimise	

Sub-topic	Constraint Name	Seek to Avoid/ Seek to Minimise	Buffer
Historic Environment	Scheduled Monuments	Seek to avoid	
Historic Environment	Battlefields	Seek to minimise	
Historic Environment	Conservation Areas	Seek to minimise	
Historic Environment	Listed Buildings	Seek to avoid	Seek to avoid 50m Seek to minimise 50m to 100m
Landscape & Visual	AONB	Seek to avoid	Seek to avoid 1000m
Landscape & Visual	Heritage Coast	Seek to avoid	
Landscape & Visual	National Parks	Seek to avoid	
Landscape & Visual	Parks and Gardens	Seek to avoid	
Landscape & Visual	Residential Properties	Seek to avoid	Seek to avoid 30m Seek to minimise 30m to 50m
Planning	Agricultural Land Quality 1,2 or 3)	Seek to minimise	
Planning	Countryside and Rights of Way Act 2000 (CRoW) category 15	Seek to minimise	
Planning	CRoW category 16	Seek to minimise	
Planning	CRoW category 4 Common Land	Seek to minimise	
Planning	CRoW category 4 Open Country	Seek to minimise	
Planning	DCOs	Seek to minimise	
Planning	Greenbelt	Seek to minimise	
Technical	Major roads	Seek to avoid	Seek to avoid 5m
Technical	Minor roads	Seek to avoid	Seek to avoid 2m
Technical	Built-up Areas	Seek to avoid	Seek to avoid 30m

Sub-topic	Constraint Name	Seek to Avoid/ Seek to Minimise	Buffer
			Seek to minimise 30m to 50m
Technical	Flood zone 2	Seek to avoid	
Technical	Flood zone 3	Seek to avoid	
Technical	Risk of Flooding from Surface Water	Seek to avoid	
Technical	Statutory Main Rivers	Seek to avoid	Seek to avoid 50m
Technical	Water Framework Directive (WFD) ALL	Seek to avoid	Seek to avoid 50m
Technical	Historic Landfill	Seek to minimise	
Technical	Permitted Waste/ Reg Landfill	Seek to minimise	

3.2.9 As well as potential constraints to development, the mapping exercise also identified features that might offer potential opportunities and therefore promote the inclusion of certain areas within corridors or sites.

3.2.10 In relation to corridor options for overhead lines, the principal opportunities were:

- the potential to route parallel in close proximity to existing 400kV overhead lines, and thus restrict the geographic extent of environmental effects associated with such infrastructure; and
- the potential to provide mitigation through the rationalisation of existing 132kV overhead lines, and thus reduce the level of environmental effects arising from electricity transmission and distribution infrastructure.

3.2.11 The EAC substation requires an area of approximately 18ha. Whilst customer substations are likely to require areas between approximately 10ha and 15ha, either co-located with, or located near to, the EAC. In addition to these essential requirements in terms of area, factors identified as being potentially beneficial to siting area options for the EAC substation included:

- appropriate topography;
- the availability of existing screening elements and the potential to introduce additional screening elements;
- proximity to major roads, to minimise the extent of required new access roads;
- proximity to existing 132kV infrastructure (as it provides for potential parallel routeing to reduce the geographical extent of effects and potentially for rationalisation of existing connections); and
- proximity to the points at which corridor options from Bramford and corridor options to Tilbury might be likely to enter or leave the EAC substation Study Area and, hence, potentially reduce the length of connection required.

3.2.12 The manner in which the identified constraints and opportunities were employed to identify corridors and substation site areas is described in the paragraphs immediately below.

Identification and refinement of options

3.2.13 The identification of initial route corridors and substation site areas is led by environmental considerations to ensure that all identified options seek to minimise environmental impacts as far as possible.

3.2.14 As a first step, the project team environmental subject matter experts review the constraints and opportunities within the Study Area to set Study Area-specific parameters. These parameters were used to focus initial GIS-based investigation upon the areas considered most likely to yield environmentally preferrable options, as well as to ensure that multiple options are considered. For example, within the Bramford to EAC Study Area, parameters were set to ensure that the initial GIS-based investigation considered options that avoided, as well as those that passed through, AONBs. These parameters are important to ensure that areas of potential opportunity are subject to thorough investigation as well as those that present constraints.

3.2.15 Once parameters have been set, GIS is used initially to identify corridors or areas that may offer the most direct routes through the least constrained areas. These preliminary corridors or areas are then reviewed by the project team environmental subject matter experts, who employ professional judgement to park, refine or identify wholly new options.

3.2.16 The options identified are then subject to review by project team engineering subject matter experts, who use their professional judgement to park, refine or expand options. Recommendations for expansion or refinement are reviewed and implemented by the environmental team to ensure that changes are made in a manner consistent with environmental considerations.

3.2.17 In relation to connection routeing, it should be noted that where complex, overlapping permutations of options are identified (e.g. in relation to the connections between Bramford substation and the EAC substation and between the EAC substation and Tilbury), it has been necessary to identify discrete parts of corridors so that all areas can be appraised without duplication. These discrete parts of corridors are termed “sections”. Following Options Appraisal, the corridor sections are combined in various permutations to form end-to-end corridor “options”. In the less complex situation pertaining to the connection between Norwich Main substation and Bramford substation, it was possible to identify end-to-end corridor options without a significant degree of overlap. In this instance, sections were identified later in order to make specific parts of the corridor options easier to identify.

3.2.18 In order that the corridor options for each component of the Project may be identified without confusion, each option has been given a prefix as follows:

- Norwich to Bramford options have the prefix “NB” e.g. Option NB1;
- Bramford to EAC options have the prefix “BE” e.g. Option BE1; and
- EAC to Tilbury options have the prefix “ET” e.g. Option ET1.

3.2.19 The potential route corridor options or sections and the substation site areas identified by this process are referred to as initial options and are taken forward to Options Appraisal.

Stage 2: Options Appraisal

Overview

3.2.20 Options Appraisal is a structured process by which the environmental, socio-economic, technical and cost implications of initial options are identified, reported and compared. Options Appraisal may be employed during all phases of The Approach prior to an application for development consent. At the Options Identification and Selection phase, the purpose of Options Appraisal is:

- Comparing route corridors / sites to inform the selection of a preferred route corridor / site; and
- As appropriate, back-checking and review of the performance of the preferred route corridor or site against the anticipated performance of the preferred strategic option if there have been material changes to any of the determining factors (environmental, socio-economic, technical and cost) that resulted in its selection.

3.2.21 A detailed overview of the Options Appraisal process is set out in the National Grid document 'Approach to Consenting'. This guidance (and its precursor 'Our Approach to Options Appraisal', 2012) note that the key differentiating points should be included in narrative form in the Route Corridor Study (or equivalent).

3.2.22 This section sets out:

- The topics and sub-topics included in the appraisal; and
- the methodology used for Options Appraisal for this Project.

3.2.23 The process of comparison and selection of options is described under Stage 3: Options Selection.

Appraisal Topics

3.2.24 The topics and sub-topics that can be used to inform Options Appraisal are shown in **Table 3.3**.

Table 3.3 – Option Appraisal Topics

Topic:	Environmental	Socio-economic	Technical	Cost
Sub-topics:	Landscape and Visual	Local Economic Impact	Technical Complexity	Capital cost
	Ecology	Aviation and Defence	Construction/project delivery issues (including programme, resource waste H&S including CDM issues)	Lifetime cost
	Historic environment	Traffic and Transport (only considered for the EAC	Suitability of technology	

Topic:	Environmental	Socio-economic	Technical	Cost
		Substation Siting)		
	Water		Network capacity	
	Local air quality		Network efficiencies/benefits (including energy efficiency)	
	Soils and Geology			
	Planning (including future development proposals)			

3.2.25 In line with the guidance, whilst all topics/sub-topics should be carefully considered for inclusion in Options Appraisal, only the sub-topics that are critical by having a bearing on the choice of option require inclusion in Options Appraisal. Experience and lessons learnt from previous projects should be drawn upon in determining only those that are sufficiently significant to inform decision-making. For example, where there are no features within the Study Area related to a certain sub-topic, or where all options would have a similar effect on a sub-topic (and therefore would not be a distinguishing factor between options and as such would have no bearing on the appraisal), these sub-topics should be scoped out of the Options Appraisal (noting however, that they would still be considered in the Environmental Statement).

3.2.26 As the Cost and Technical topics do not refer to receptors, but to inherent features of the project, they are not subject to the same approach to scoping.

3.2.27 Each of the corridor and siting area options were subject to options appraisal, with input from project team environmental and technical specialists in:

- Landscape and Visual;
- Ecology;
- Historic Environment;
- Planning;
- Socio-economics;
- Technical; and
- Cost.

3.2.28 The substation siting areas also received input from project team specialists in Traffic and Transport.

3.2.29 Topics such as air quality, soils and geology, and water[13] were scoped out of the Options Appraisal process on the basis that at this phase of the Project with the

[13] Although detailed option appraisal was not conducted for water at this stage, the location of flood zones and watercourses were considered as part of the suite of baseline constraints on route and substation positioning, and the implications for effects therein.

constraints above already applied, that these topic areas would not have a significant effect on the determination of the preferred route for the connection or substation siting.

Approach to Appraisal

3.2.30 The Approach notes that at the Options Identification and Selection phase, Options Appraisal should be largely desk based. However, the Options Appraisal for this Project has also been informed by limited field observations undertaken by specialists from the Landscape and Visual and Technical topics. These observations have provided additional information to inform the Options Appraisal, which, in conjunction with that drawn from the desk-based studies, has provided an evidence-base appropriate to inform this phase of the Project. As the Project progresses to subsequent phases of more detailed design and assessment, additional surveys and analysis will add further information to the evidence base, which will be used to back-check the findings of this study.

3.2.31 For each relevant topic and where applicable, sub-topic, the appraisal considers the nature of identified receptors; receptor value and sensitivity to the Project; how a receptor may be affected by the Project; and whether such effects could be avoided or mitigated. Mitigation is considered in accordance with National Grid's mitigation hierarchy. The mitigation hierarchy is sequential, meaning that measures are not considered unless measures that precede them in the hierarchy have been considered first and deemed to be inadequate. The sequence in which measures should be considered is as follows:

- Careful routeing;
- landscape mitigation planting;
- different lattice pylon design / conductor configuration;
- alternative pylon design (low height or T-pylon);
- reduction of 'wirescape' through distribution network rationalisation / undergrounding;
- reduction of 'wirescape' through transmission network rationalisation; and
- alternative technology (gas insulated lines, undergrounding).

3.2.32 Once mitigation measures have been considered, a judgement is made as to whether the residual effects on a receptor would be positive, neutral or negative. The findings of the appraisal under each of the sub-topics is summarised in an Options Appraisal Summary Table (OAST).

Stage 3: Options Selection

3.2.33 Following the appraisal of each individual option, challenge and review workshops took place for each of the four components of the Project to analyse and discuss the outputs of the Options Appraisal and, where applicable, park non-preferred options and shortlist options to be taken forward to the next stage, decision workshops. The initial filtering workshops identified if any additional information was required and what subsequent work needed to be undertaken prior to the subsequent decision workshops. They also identified opportunities for additional hybrid corridors to be developed and back-checked, to be considered alongside the original options at the decision workshops.

3.2.34 Decision workshops then took place for each of the four components of the Project to agree preferred corridors and a preferred substation siting zone. The decision workshops considered the issues associated with each option in relation to all the topics and sub-topics appraised to identify a provisional preferred option.

3.2.35 In line with the Approach, in selecting a preferred option, and aligned with policy and principles of the Holford and Horlock Rules, decision-makers had regard to the following guiding principles:

- Using or adapting existing infrastructure (for example, up-rating or extending existing infrastructure or taking down and rationalising Distribution Network Operator (DNO) lines in exchange for new high voltage lines) will generally be of benefit / advantage compared with creating new infrastructure.
- Shorter routes will generally be of benefit/advantage compared with longer routes, as smaller scale infrastructure projects are generally likely to have lower environmental, safety, sustainability and cost implications (for comparable technology options).
- Financially less-expensive options, both in terms of capital and lifetime cost, will generally be of benefit/advantage, as these support National Grid's statutory duty to develop and maintain an *"efficient, co-ordinated and economical"* network.
- Options which avoid or minimise and mitigate impacts on environmental or socio-economic constraints will generally be of benefit/advantage compared with those which have likely significant residual effects, as less environmentally or socially damaging routes support National Grid's statutory duty (under Section 9 of the Electricity Act 1989), to *"have regard to the desirability of preserving amenity"* and will more readily achieve consent.

Stage 4: Development of Graduated Swathe for the Preferred Corridor and Graduated Siting Areas

3.2.36 Following agreement of the preferred corridor options and substation siting zone option, the project team considered the locations available for a connection within the preferred corridors and the preferred substation siting zone. These preliminary designs are indicative only and may be subject to substantial revision as the consenting process continues and more information becomes available. The preliminary designs are therefore indicative of where development is considered more likely to occur within a preferred corridor or zone, but do not rule out development within other parts of the corridor or zone if necessary, or indeed outside those corridors, based on feedback received, the findings of surveys and subsequent design response. As such, preliminary alignments and substation sites are indicated graphically using a graduated swathe, with areas considered more likely to be developed shown as a darker colour than areas considered less likely.

3.3 Technology Options

Overhead lines

3.3.1 National Grid's starting assumption for new transmission is the use of overhead lines. This is supported by existing and emerging government policy NPS EN-5 as described earlier in this report.

3.3.2 National Grid typically use steel lattice pylons to support overhead lines. The size, height and spacing of pylons are determined by safety, topographical, operational and environmental consideration. A typical 400kV pylon is 45-50m tall (Figure 3.2).

3.3.3 A typical National Grid overhead line route will involve the use of three main types of pylon. They are as follows:

- Suspension pylons – these support the conductor on straight stretches of line. Conductors are suspended by a vertical insulator string
- Angle pylons – these occur at points where the route changes direction. Conductors are attached by horizontal insulator strings. To accommodate forces produced by the change in direction, these pylons are bulkier than suspension pylons.
- Terminal pylons – these pylons are of greater bulk in order to ensure stability. They occur at the end of overhead lines where they connect with substations or underground cables

3.3.4 The main impact of overhead lines is generally considered to be visual, with effects on landscape and views.

Figure 3.2 – 400kV Steel Lattice Angle Pylon

Underground cables

3.3.5 National Grid may use underground cables in sensitive areas, such as National Parks, to reduce visual impact.

3.3.6 Ordinarily trenches are dug to accommodate each cable. A large cable swathe (Figure 3.3 and Figure 3.4) is normally required which can be 65m in width depending on the number of circuits and size of conductor to be installed. Joint bays are necessary at intervals of approximately 500–1,000m to allow for the jointing of the individual sections of cable. In these areas a widening of the easement corridor may be required for the arrangement of joints.

3.3.7 The works required to bury a cable are likely to affect archaeology, vegetation and wildlife along the construction corridor.

3.3.8 A sealing end compound is needed where a section of cable is terminated and the circuit continues on to an overhead line (Figure 3.5). These sealing end compounds are generally around 30m x 80m for a 400kV circuit, and house the support structures for the cable terminations/sealing ends, post insulators, earth switches and a terminal tower. These enable the transition from cable conductor to the overhead line conductor.

Figure 3.3 – 400kV underground cable swathes

Figure 3.4 – 400kV underground cable swathes

Figure 3.5 – 400kV Cable Sealing End Platform

4. Norwich to Bramford Options Appraisal

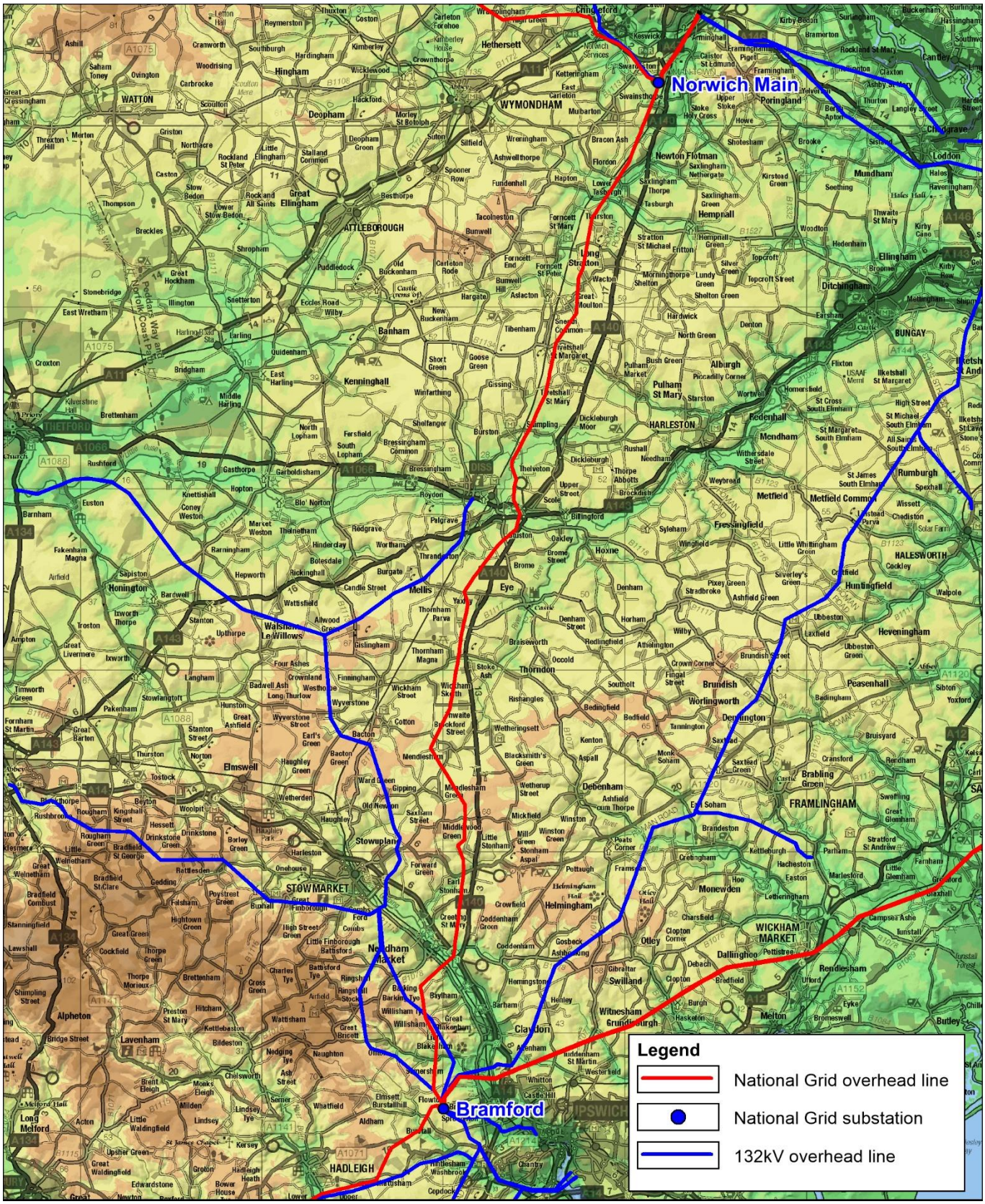
4.1 Stage 1: Options Identification - the Study Area

4.1.1 The Strategic Proposal identifies a 400kV double circuit connection between Norwich Main substation, to the south of Norwich, in Norfolk, and Bramford substation, to the west of Ipswich, in Suffolk. In line with paragraph 2.8.2 of the existing NPS EN-5[14], the Project assumption is that this connection should be made via overhead line supported by steel-lattice pylons.

4.1.2 The Norwich to Bramford Study Area is shown on **Figure 4.1**.

[14] Paragraph 2.8.2 of EN-5 states *"Government does not believe that development of overhead lines is generally incompatible in principle with developers' statutory duty under section 9 of the Electricity Act to have regard to amenity and to mitigate impacts"*

Figure 4.1 – Norwich to Bramford Study Area



4.1.3 The Study Area is bounded by the existing Norwich Main Substation in the north and the existing Bramford Substation in the south. The straight-line distance between the two substations is 57.8km. An existing National Grid 400kV overhead line (the 4YM route) runs on a north – south alignment between the two substations with a length of approximately 62km.

4.1.4 Internationally designated areas of nature conservation, in the form of the Breckland Special Area of Conservation (SAC) and Special Protection Area (SPA), are located approximately 15.5km to the west of the 4YM route at their nearest point. To the east, the Broads National Park extends to within 14.5km of the 4YM route in the north. These areas of the highest amenity value are excluded from the Study Area and form the western and eastern boundaries. The Suffolk Coast and Heaths AONB is within approximately 15.5km to the south. The landform of the Study Area is largely comprised of a low plateau, which is incised by several river valleys. The largest of these valleys are those of the River Tas in the north, the River Waveney in the centre and the River Gipping in the south. Ground elevations within the valley floors are generally between 10m and 25m AOD, whilst the most elevated areas within the Study Area are in the region of 55m to 65m AOD. The north/south alignment of the required connection largely runs against the 'grain' of the landscape, with plateaux and valleys generally being on an east/west alignment. As a result, there is little opportunity for options within the Study Area to be routed within moderately open valleys as recommended by Holford Rule 5.

4.1.5 The majority of the northern part of the Study Area is located within Norfolk, where central and some eastern parts fall within South Norfolk District and western parts within Breckland District. Norwich City lies on the periphery of the Study Area to the north. The remainder of the Study Area is located within Suffolk, where Mid Suffolk District occupies the centre, with East Suffolk District to the east, West Suffolk District on the western periphery and Babergh District and Ipswich Borough to the south.

4.1.6 The location of Norwich Main Substation to the south of Norwich and of Bramford substation to the north-west of Ipswich results in the two largest settlements in East Anglia being peripheral to the Study Area, though a connection to Bramford could pass in relatively close proximity to the north-western outskirts of Ipswich. Other main settlements within the Study Area include Wymondham in the north-west; Diss and Harleston in the Waveney Valley; Stowmarket, Needham Market and Claydon in the south; and Wickham Market and Framlington in the south-east. Settlement is densest in the valleys of the Rivers Waveney and Gipping and is relatively evenly distributed across the rest of the Study Area, with few areas of sparse settlement.

4.1.7 The major roads within the Study Area are the A140, which runs parallel and to the east of most of the length of the 4YM route; the A143, which is located within the Waveney Valley to the east of Diss before bearing south-west; the A1066 within the Waveney Valley to the west of Diss; the A11, which runs south-west from Norwich; the A146, which runs south-east from Norwich; and the A14, which runs north-west from Ipswich and is located within the Gipping Valley. With regard to railways, the line between Norwich and Ipswich runs parallel and to the west of the 4YM route for much of its length; the lines from Norwich to Lowestoft and Thetford traverse the north-eastern and north-western parts of the Study Area respectively; the line between Stowmarket and Bury St. Edmunds traverses the south-western part of the Study Area; and the line from Ipswich to Lowestoft lies on the eastern periphery of the Study Area.

4.1.8 Existing electricity transmission and distribution infrastructure of 132kV and above is more common within the southern half of the Study Area than in the north. There is a

necessary convergence of overhead lines at both Norwich Main and, particularly, Bramford Substations. At Bramford, the 4YM route from the north converges with the 4ZX and 4ZW parallel 400kV overhead line that form the connection to Sizewell to the east and the 4YL route, which approaches from the south-west. If consented, the new Bramford to Twinstead 400kV overhead line will also approach from the south-west when constructed. Five 132kV overhead lines also converge at Bramford, with some employing underground cables on approach to the substation. At Norwich Main, the 4YM route from the south converges with the parallel PHC and PGG routes from the north-east and the 4VV route and a 132kV overhead line from the west.

4.2 Stage 1: Options Identification – Constraints and Opportunities

4.2.1 Following the definition of the Study Area, constraints were mapped and categorised in accordance with the parameters set out in Table 3.1 and Table 3.2. Within the Study Area there are no areas of the highest constraint that are extensive enough to exclude any part of the Study Area from further consideration. Similarly, whilst the distribution of constraints is slightly denser in the north and south of the Study Area and within the valley of the River Waveney in the centre, there is no pronounced geographic pattern of constraint across the Study Area and, hence, no compelling reason to focus on some parts of the Study Area over others on the basis of the distribution of environmental receptors.

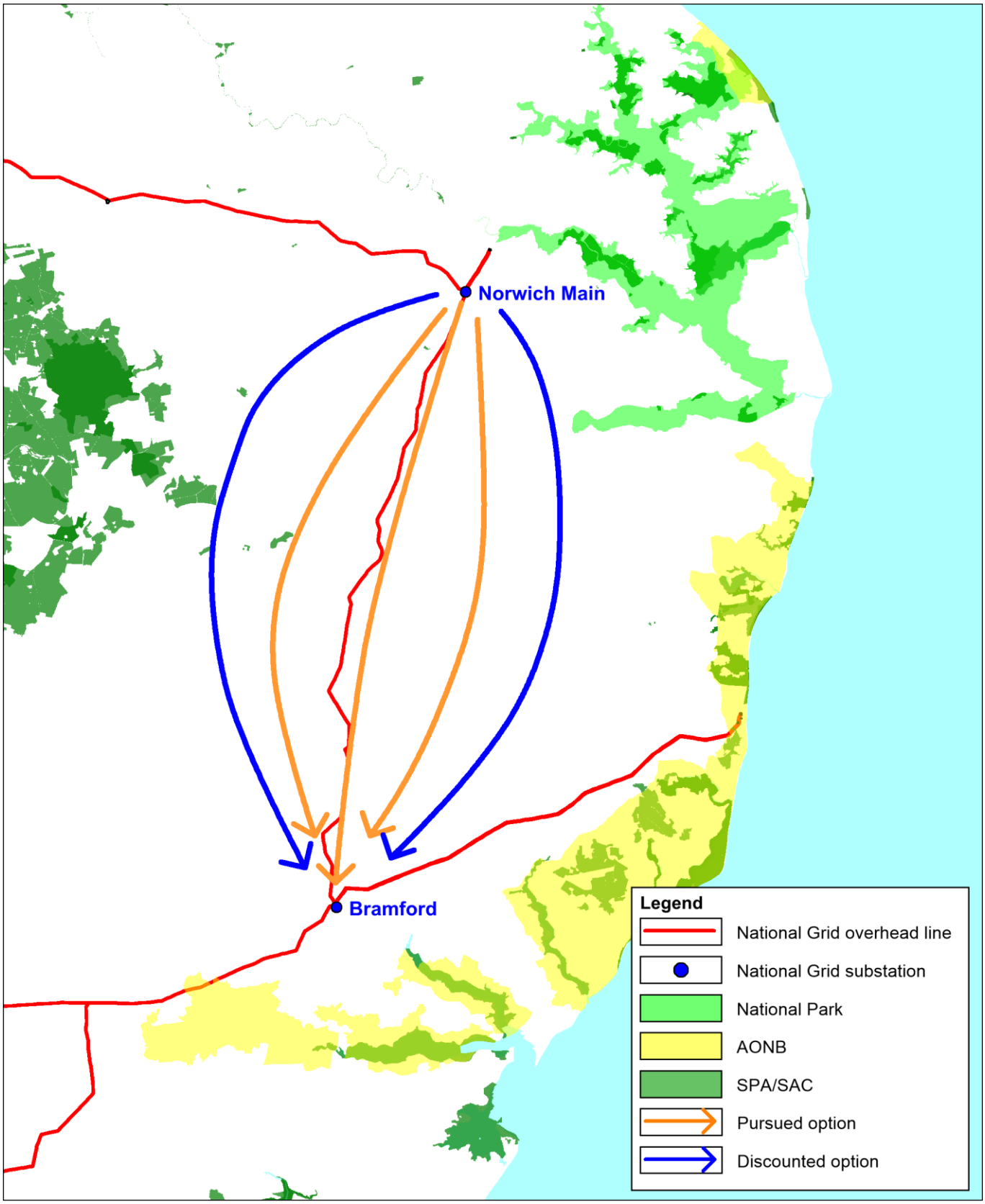
4.2.2 The primary opportunity identified at this stage, was in relation to the existing 400kV overhead line between Norwich and Bramford (the 4YM route) and the potential that this might afford for limiting the extent of the area affected by transmission lines through routeing parallel to and in close proximity to it, referred to as a close-parallel route.

4.2.3 In general terms, a close-parallel route may have the potential to reduce the level of environmental effects associated with a proposal. This may be particularly relevant in circumstances where it may provide an opportunity to use the space made available by the removal of an existing close-parallel lower voltage connection, as in the case of the proposed Bramford to Twinstead reinforcement, or where the close-parallel circuits are constructed at the same time, such as occurred for the Sizewell to Bramford connection. Whilst neither of these circumstances apply to the Norwich to Bramford connection, a close-parallel connection may still have the potential to reduce environmental effects by limiting the number of receptors affected by both the existing and proposed connections, albeit that the level of effect sustained by these receptors may be cumulatively greater.

4.2.4 Whilst the efficacy of close-paralleling in reducing environmental effects would be strongly influenced by local factors (e.g. topography, settlement pattern, woodland cover etc.), the optimum level of benefit is likely to result from lines that, as stated in Holford Rule 6, are planned with pylon types, spans and conductors forming a coherent appearance. In most circumstances, this is likely to be more achievable the closer the lines are to each other, as local conditions would be likely to be similar for both lines. The minimum distance between close-parallel lines is defined by technical and safety constraints and would typically be 80m (noting that the lines between Sizewell and Bramford are only 50m apart at many points with the closer positioning possible because they were constructed at the same time). The maximum distance at which the benefits of close-paralleling might be achieved is not defined and will be highly dependent upon local factors and, whilst not precisely defined, is considered to be unlikely to be more than 200m in most circumstances.

4.2.5 Consideration was therefore given to a range of potential corridor options across the full width of the Study Area. The length of connection associated with routeing in different parts of the Study Area ranges from approximately 61km to 65km, for corridors located within 6km of the 4YM route, to approximately 75km for any potential corridors located toward the edge of the Study Area. The 4YM route is approximately 62km long. On this basis, the parameters of the preliminary stage, GIS-based corridor identification exercise were set at a maximum of 7km to the east and west of the 4YM route so as not to identify routes that would deviate excessively from the recommendation of Holford Rule 3 to, other things being equal, choose the most direct line. The internal project team landscape and visual subject matter experts therefore considered that whilst preliminary corridor options that, in accordance with Holford Rule 6, would allow sufficient separation to limit the effects on properties and features between the corridors and the 4YM route, might be identified at distances considerably less than 7km from the 4YM route, the preliminary corridor identification exercise should consider potential options up to 7km away in order to maximise the number of potential options identified. Figure 4.2, below, shows the pursued and discounted areas in schematic form.

Figure 4.2 – Norwich to Bramford Parameters for Preliminary Corridor Option Identification



4.3 Stage 1: Options Identification – Corridor Identification and Refinement

Identification and Refinement of Preliminary Options

4.3.1 The preliminary corridor identification exercise identified four potential corridor options (shown on **Figure 4.3**) balancing directness of route and the avoidance of constraints. This balance resulted in a corridor largely located between approximately 2.5km and 5km to the west of the 4YM route (referred to as Option NB1, blue route), corridors located between 80m and approximately 1km to both the west and the east of the 4YM route (referred to as Option NB2, green route and Option NB3, pink route, respectively), and a corridor largely located between approximately 4km and 7km to the east of the 4YM route (referred to as Option NB4, yellow route).

4.3.2 These four preliminary corridors were then subject to a back-check review and further refinement by both environmental and technical specialists. This process resulted in the removal of some parts of corridors, primarily due to the presence of engineering constraints, and the extension of corridors to allow for routes to avoid constraints, as well as provide opportunities for a connection to switch between corridors. In places, the corridors in close proximity to the existing 4YM route (Options NB2 and NB3) were extended to include the existing route, to facilitate further opportunities to achieve a close-parallel route.

4.3.3 As described in more detail below, this process concluded that a connection via a complete end-to-end close-parallel route was not available to either the east or the west of the 4YM route (i.e. within either or both of Options NB2 or NB3) and that no end-to-end connection was available at all to the east (i.e. within Option NB3). Option NB3 was therefore discounted as a viable stand-alone option, though parts of it were retained to enable further consideration of options that might include partial close-paralleling of the 4YM route in combination with other corridors.

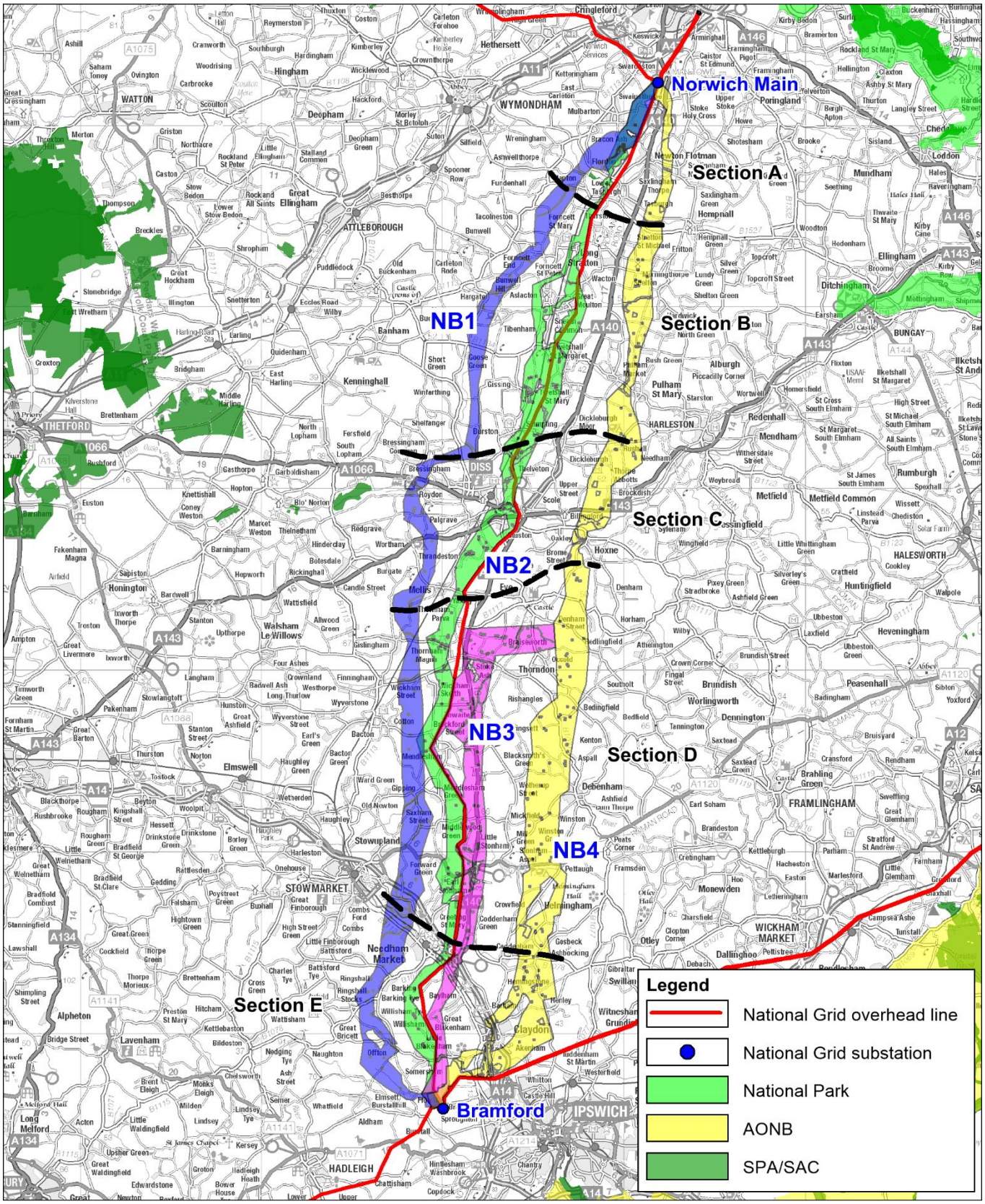
Options taken forward for appraisal

4.3.4 As a result of the options identification and refinement process described above, the following four options were taken forward to Options Appraisal:

- Option NB1, blue route - a corridor largely located between approximately 2.5km and 5km to the west of the 4YM route;
- Option NB2, green route – a corridor located between 80m and approximately 1km to the west of the 4YM route;
- Option NB3, pink route – two discontinuous corridors located between 80m and approximately 1km to the east of the 4YM route; and
- Option NB4, yellow route - a corridor largely located between approximately 4km and 7km to the east of the 4YM route.

4.3.5 The four initial options are shown on **Figure 4.3**.

Figure 4.3 – Norwich to Bramford initial options taken to Options Appraisal



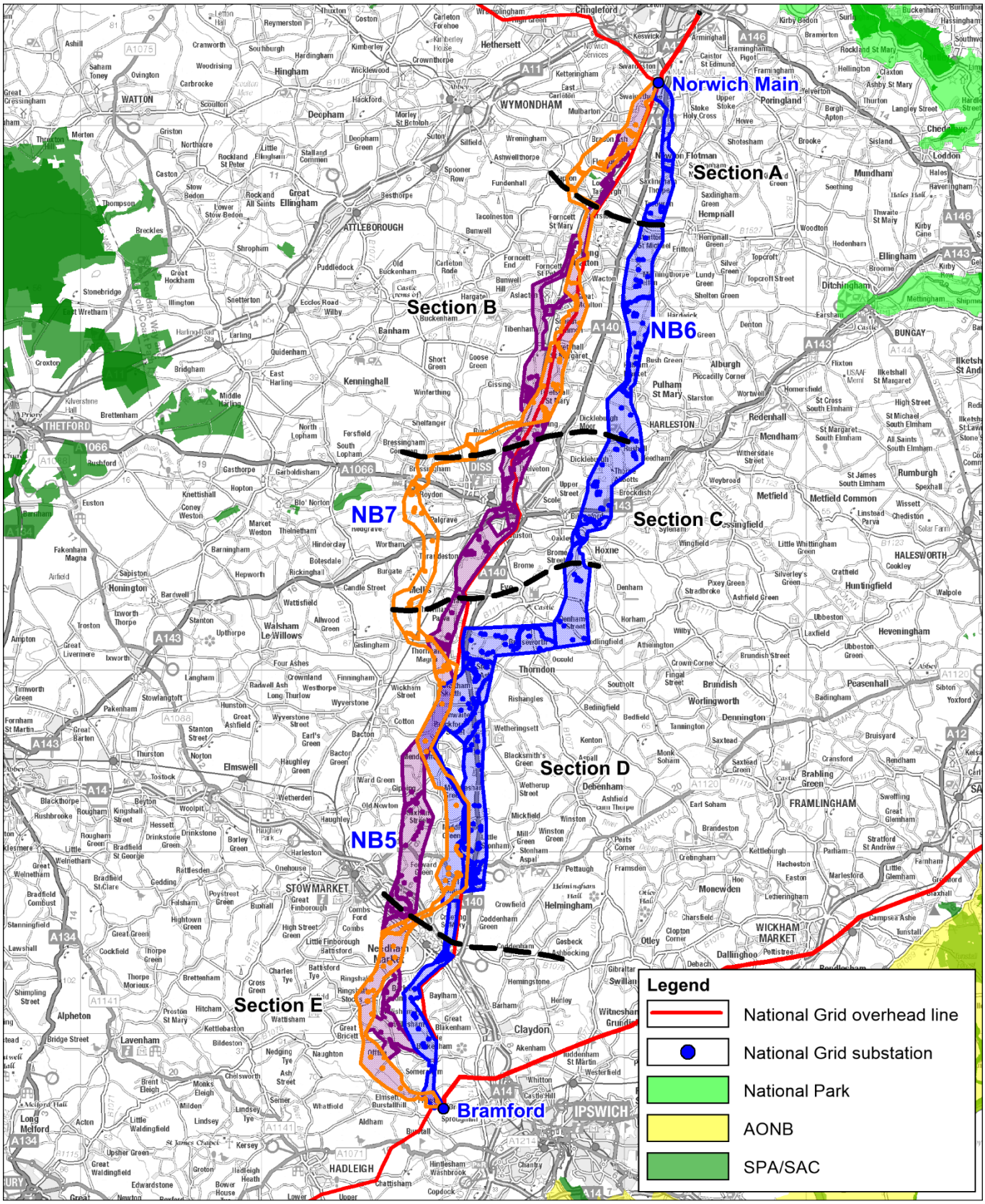
4.3.6 Following the appraisal of these four options (and as detailed in the Option Appraisal Tables in Appendix A), a challenge and review workshop took place to analyse and discuss the outputs of the Options Appraisal, park non-preferred options, and shortlist options to be taken forward to the decision workshop. The initial filtering workshops identified if any additional information was required, and what subsequent work needed to be undertaken prior to the subsequent decision workshops. They also identified opportunities for additional hybrid corridors to be developed and back-checked, to be considered alongside the original options at the decision workshops.

4.3.7 The filtering workshop identified the following three additional hybrid options to be subject to Options Appraisal prior to the decision workshop:

- Option NB5 – a corridor consisting of the northern part of Option NB2, green route, and the southern part of Option NB1, blue route;
- Option NB6 - a corridor consisting of the northern part of Option NB4, yellow route, a section of Option NB3, pink route, and the southern part of Option NB2, green route; and
- Option NB7 - a corridor consisting of the northernmost, central and southernmost parts of Option NB1, blue route with linking sections to Option NB2, green route, between those sections.

4.3.8 The filtering workshop also recommended that the remaining northern part of Option NB3, pink route, be combined with Option NB2, green route. As a result, Option NB3 is not considered as a stand-alone option in the Options Appraisal described in Section 4.4 and as detailed in Appendix A. The three additional hybrid options were taken forward to options appraisal and are shown on **Figure 4.4**.

Figure 4.4 – Norwich to Bramford additional options taken to Options Appraisal



Options not taken forward for appraisal

4.3.9 Options that would entail an excessive length of connection, as described in section 4.2 and shown in blue on **Figure 4.2**, would result in greater environmental and socio-economic effects and would substantially increase the costs of the connection. As such, they would not offer any environmental or socio-economic benefits over a more direct connection and would not be compatible with National Grid's statutory duties under the Electricity Act to be economic and efficient. These options were therefore discounted from further detailed consideration.

4.3.10 In addition to options that would entail an excessive length of connection, the process of identification and refinement of corridors also carefully considered the potential for an end-to-end close-parallel option to the 4YM route.

Consideration of Close Paralleling

4.3.11 In attempting to identify viable close-parallel route corridors for appraisal, National Grid took into consideration the following criteria and assumptions in addition to the considerations set out in **Chapter 3**:

- A corridor of approximately 100m either side of the existing 4YM route would facilitate a 'parallel' alignment allowing for an 80m centreline to centreline separation between new and existing overhead lines. This 80m represents a typical separation required to allow for asset construction and operation in line with design, security of supply and safety parameters. Closer positioning may be possible in some areas but is inherently associated with increased construction complexity and increased construction risks.
- Alignments that alternate between west and east of the existing 4YM route could be acceptable, with various solutions possible to maintain electrical system integrity. However, each switch of the positioning of the new alignment would increase the engineering complexity - likely to require additional angle pylons, temporary works and system outages to facilitate construction.
- Localised diversion of short sections of the existing alignment, typically of 2 to 4 existing pylons and associated spans, in order to avoid potential constraints would be possible to maintain close parallel alignment but each diversion would be expected to require additional angle pylons, temporary works and system outages.

4.3.12 National Grid has concluded that due to project-specific circumstances, a close-parallel arrangement to the existing 4YM route between Norwich Main and Bramford does not provide an appropriate end-to-end solution for the reinforcement. National Grid therefore discounted an end-to-end close-parallel option from the appraisal, noting that corridor options with the potential for parallel arrangements in certain sections were taken forward. The reasons for this decision are set out under the headings below.

Substantial Engineering Construction risks

4.3.13 National Grid undertakes appropriate ground investigation prior to all invasive construction works. Whilst there are engineering risks with all potential corridors, ahead of such detailed site investigations, to achieve a close parallel option these are increased in several locations. For example:

- To the north of Station Road / Flordon Road, in the vicinity of Flordon and Newton Flotman, the existing overhead line passes between residential properties to obliquely cross the railway before continuing to the south-west alongside commercial

property and with residential property to both sides. A parallel overhead line could potentially be positioned on the west from Norwich Main substation but would then need to be positioned to the east after crossing the railway before transitioning to the west again to the south of Flordon. Achieving such an arrangement presents a series of engineering challenges and risks: requiring diversion of the existing connection; has restricted limits of deviation for the construction of around ten pylons over an approximately 2km to 3km section, limiting the ability to respond to as yet unknown services and ground conditions; and increases construction complexity and system outage requirements. The resulting design would add several angles of deviation into what is otherwise a predominantly straight alignment, and thus be less compliant with Holford Rule 3 and appears likely to unavoidably oversail at least one commercial property. An alternative design response would be to install this section of the second alignment as underground cable, possibly by Horizontal Directional Drilling (HDD) or similar, or trenching, between CSECs. Whilst addressing some constraints, this would result in other environmental effects and would be less consistent with National Grid's statutory duties due to substantial additional cost (in the order of £25m compared with other corridor options taken forward).

- At the A14 crossing near Needham Market, a close parallel arrangement is substantially constrained by a combination of residential properties, the Beacon Hill Service Area, the geometry of the adjacent roundabout and associated slip roads as well as the River Gipping and various adjacent waterbodies. Whilst a parallel alignment to the eastern side of the 4YM route may be possible the identified constraints substantially increase engineering risks by restricting pylon positioning flexibility. As above, a cable solution may be possible but brings its own challenges and additional costs which, compared with other corridor options taken forward, would be less compliant with National Grid's statutory duties.

Multiple diversions to avoid, or substantially reduce proximity to or oversailing of residential and commercial properties

4.3.14 Whilst close-paralleling of the 4YM route would be possible for much of the existing alignment there are a substantial number of locations where the proximity of existing residential and commercial property would require diversion of the existing line to create space for a new parallel line, or require the new line to be constructed on the west (moving from the east) or east (moving from the west). Typically, these diversions would require restrictions on construction flexibility increasing risk and requiring the addition of at least six angle pylons to divert both the new and existing lines, leading to reduced Holford Rule 3 compliance compared with other options taken forward to appraisal. Whilst some of these changes maintain property separation there are a number of locations where this would not be possible and as such there would be reduced compliance with the Holford Supplementary Notes on residential amenity. Some examples from along the potential corridor include:

- North of Wacton, east of Brome and east of Thornham Magna – At each location between 4 and 8 additional angle pylons are likely to be required for the diversion in otherwise generally straight alignments to achieve a parallel route between residential property that constrains the available space.
- Between Mellis and Yaxley – Diversion to realign new and existing lines with approximately 6 angle pylons to achieve appropriate separation from properties, or reduced number of angle pylons but reduced separation to property and possible oversail of garden.

- West of Tharston and south of Mendlesham - Switch of new line from west to east requiring between 4 to 6 additional angle pylons to avoid residential property oversail.
- Earl Stoneham / Creeting St. Mary – Insufficient space for parallel alignment at All Saints Road likely to require new line to divert to west with a number of residential and commercial properties between new and existing line.
- South of Burston and west of Lower Somersham – Likely that at both locations overhead lines would need to pass to either side of residential / commercial property due to restrictions on space for new parallel alignment.

Additional environmental effects and reduced compliance with Holford Rule 2 (smaller areas of higher amenity value)

4.3.15 The existing 4YM alignment was routed to substantially avoid constraints, but routes in relatively close proximity to several features that would therefore constrain any second parallel alignment routed in close proximity to it. This includes a number of woodlands, reducing compliance with Holford Rule 2 unless additional angle pylons were used to divert around such features, thereby making an alignment less direct and reducing compliance with Holford Rule 3. A new route not restricted by the need to close-parallel an existing alignment has greater potential to increase compliance with the Holford Rules.

4.3.16 Additional socio-economic effects may also be associated with a close-parallel option. The potential for a close-parallel alignment is particularly constrained at Sturston Golf Club, where the presence of the extensive urban areas of Diss, to the west, and Scole, to the east, and residential ribbon development along adjacent roads, restricts corridor options. Some socio-economic effects on Sturston Golf Club may therefore be unavoidable with a close-parallel solution.

Cost & Programme

4.3.17 There are capital cost implications associated with a close-parallel option, particularly as a result of the additional permanent diversions to the 4YM route and multiple temporary diversion required to facilitate the construction of the close parallel solution. Without detailed study, the exact cost of diversions can only be indicatively estimated. Simpler diversions are estimated to add approximately £300,000 per diversion, with more complex diversions (e.g. around Flordon and at the A14 crossing and at Sturston) being several times this. With around 15 diversions estimated as a minimum, if achieved entirely by overhead line, the additional costs of an end-to-end close-parallel solution are estimated to be in the order of an extra £5m to £10m. As set out above there are some locations where an underground cable solution may be the only way to address constraints, further adding to the additional costs of a close-parallel option.

4.3.18 The project needs to connect the proposed low carbon energy generation sources by 2030. There are risks to this programme from the need for multiple outages (i.e. the disconnection of the particular circuits to allow safe working) necessary to safely construct the diversions. Whilst there is the potential for a number of diversions to be constructed under a single outage, it is likely that the level of outages needed to safely construct and connect an end-to-end close-parallel connection would lead to an extension of programme, or at least substantially increase the risks to programme, with the potential to incur very significant constraints costs to curtail supply within system capacity.

Conclusion regarding the viability of an end-to-end close-parallel option

4.3.19 Taken together, the consequences and effects described above would mean that any end-to-end close-parallel corridor option would perform poorly relative to other options, including those options incorporating more limited sections of parallel routeing. Further detailed evaluation would not resolve these fundamental issues and, on this basis, a full end-to-end close-parallel option was discounted from further detailed consideration and appraisal. The potential for specific sections of close-parallel alignment to form part of the Project are nonetheless considered as part of the appraisal of certain options where the end-to-end connection is formed in combination with sections that are not close-parallel.

4.4 Stage 2: Options Appraisal

4.4.1 The Options Appraisal Summary Tables for the Norwich to Bramford part of the Project are set out in detail in **Appendix A**.

4.5 Stage 3: Norwich to Bramford Options Selection

Overview

4.5.1 As outlined in section 4.2 above, workshops were held to consider the effects of the options identified on receptors in the Study Area. Project team representatives from technical disciplines of engineering and costs attended the workshops alongside those from the environmental team to ensure the discussions were balanced and considered all constraints. Each option was considered in turn, with each environmental and technical topic's key constraints being noted as the workshop progressed.

4.5.2 The workshops concluded that Option NB1 was the preferred option for Norwich to Bramford because, in summary:

- The options identification and refinement exercise undertaken at Stage 2 had demonstrated that no end-to-end close-parallel option was available;
- options that seek to achieve some degree of close-paralleling (Options NB2, NB4, NB5, NB6 and NB7) do so at the expense of additional changes of direction, increased system and engineering complexity and additional cost;
- where options need to deviate from close-paralleling of the 4YM route (Options NB2, NB5 and NB7), there is substantially greater potential that these options would not achieve sufficient separation from the 4YM route to limit the effects on properties and features between the lines;
- the southern section of the option that seeks to approach Bramford from the east (Option NB4) is subject to engineering constraints to such a degree that it is considered undeliverable without complex engineering designs at additional cost; and
- all other viable options are considered to be likely to result in greater levels of adverse environmental impact.

4.5.3 It recognised that there are a number of constraints that are expected to require further consideration, consultation, and potential mitigation to ensure that effects arising from Option NB1 are avoided or reduced. Whilst Habitats Regulations Assessment (HRA) is likely to be required in relation to the Norfolk Valley Fens SAC, there is a high degree of

confidence that effects would be limited and could be managed through best practice standard design measures.

4.5.4 A comparison of the performance of options against the appraisal criteria is summarised under the headings below.

Environmental performance of options corridors

4.5.5 For Ecology and Biodiversity, Option NB1 was considered to perform less well than the other options due to its relative proximity to Norfolk Valley Fens SAC (also Flordon Common SSSI). A potential pathway for effects (a hydrological link) with the SAC is present and introduces the potential for Likely Significant effects (LSEs), and thus, the requirement for HRA. However, it is considered that such potential LSEs would be minimised through embedded design measures (pylon positioning), as well as best practice pathway control measures to stop or minimise indirect effects downstream on the SAC to a level that would not result in LSEs. In that circumstance, it is expected that a No Significant Effects Report (NSER) would suffice.

4.5.6 From a Historic Environment perspective, whilst there would be effects on multiple listed buildings in each corridor, these effects were not considered to be sufficiently dissimilar between the corridors to act as a differentiator in identification of a preferred corridor. In terms of effects on conservation areas, whilst Options NB1, NB2, NB5, NB6 and NB7 would result in a new overhead line route close to conservation areas, only one corridor (Option NB4) would directly affect a Conservation Area (at Shotesham through the estate park land of the Grade I listed The Hall and associated listed buildings). This was assessed to be a factor that differentiated it from the other Options. In terms of scheduled monuments, only Option NB4 affected these designations and thus, was assessed as a further differentiating factor.

4.5.7 With regard to Landscape and Visual, from a Landscape perspective, it is considered that landscape character is not generally a differentiating feature across the Norwich to Bramford Study Area. This conclusion was informed by a high-level appraisal of the likely sensitivity of Landscape Character Types across the Study Area, to the introduction of 400kV overhead lines, drawing upon a consideration of landform, scale, distribution of woodland and settlement pattern, in relation to the preferences expressed by the Holford Rules. The exception to this was in regard to the Rural River Valleys Landscape Character Type identified in the South Norfolk Landscape Assessment, subject to protection via Policy DM4.5 of the South Norfolk Local Plan, and which is considered to be potentially highly sensitive to the proposed infrastructure. Except for Option 1, this locally protected Landscape Character Type is affected by all options which pass through Landscape Character Area A1 (Tas Rural River Valley) to the south of Flordon. Option NB1 avoids this designation as the corridor is routed further to the west. This is determinative in decision making about which corridor to take forward, albeit only to a marginal degree.

4.5.8 What is more significant as a differentiator from a Visual perspective is that where Options NB2, NB5 and NB7 need to deviate from close-paralleling of the 4YM route, there is substantially greater potential that these options would not achieve sufficient separation from the 4YM route to limit the effects on properties and features between the lines. For example, excluding the inevitable proximity of all options to existing lines in the vicinity of Norwich Main and Bramford, Option NB7 would diverge from the 4YM route at Low Tharston, near Burston, near Thornton Magna and to the east of Creeting St. Mary, whereas Option NB1 would approach close proximity to the 4YM route only in

the area to the west of Mendlesham. Elsewhere, the distribution of visual receptors is relatively uniform in relation to all options and does not represent a differentiating factor.

4.5.9 As a result, Options NB1 and NB4 are preferred from a Landscape and Visual perspective, with Option NB1 being slightly more preferred on the basis it avoids the locally protected landscape.

4.5.10 From a Socio-economic perspective, Option NB1 performed marginally better than the other options as it avoids golf courses and maximises distances to care homes and primary schools. However, these differences between the corridors were considered to be marginal and as such socio-economics was not considered to be determinative in decision making about which corridor to take forward.

Engineering, system and cost performance of options

4.5.11 From a Technical perspective, Option NB1 is preferred to the other options as it had positive effects on network benefits/efficiencies as a result of not requiring additional apparatus at substations and was considered the least complex. By comparison Options NB2, NB5, NB6 and NB7 required major mitigation from a complexity and construction/delivery perspective, and Option NB4 was considered undeliverable without complex engineering designs at additional cost and therefore were not taken forward on complexity and construction grounds. In terms of Network benefits/efficiencies Option NB2 and NB4 required major mitigation and Options NB5, NB6 and NB7 required minor mitigation.

4.5.12 Option NB1 was also considered to be less complex from an engineering perspective as it required less mitigation than the other options in the form of undergrounding.

4.5.13 From a Technical perspective, Option NB1 was considered the preferred end to end solution. Compared to the alternative options, Option NB1 has fewer constraining areas and an overall greater level of flexibility for the routeing of an overhead line. Despite the presence of sporadic concentrations of residential properties, routeing was largely unconstrained with reduced construction/delivery engineering complexity.

4.5.14 In comparison, Option NB2 sees multiple significantly constrained areas within the corridor which not only reduce, but in some instances provide no flexibility for the routing of an overhead line whilst also increasing construction/delivery engineering complexity. This includes: a narrow corridor, electrified railway crossing and proximity to residential properties at Flordon; the crossing of Stuston Golf Course at Stuston; a narrow corridor and proximity to a high concentration of residential properties at Earl Stoneham; and the A14 dual carriageway, associated Service Area, watercourse and waterbodies, electrified railway and industrial area at Darmsden. The proximity to Norfolk Gliding Club (Tibenham) directly adjacent to corridor Option NB2 was also deemed to create additional routing risk (potentially limiting the position of structures) and as such the engineering complexity.

4.5.15 The northern sections of Option NB4 are relatively unconstrained from a technical perspective, except for requiring a section of underground cable on approach to Norwich Main Substation to cross the existing 4YM overhead line. Option NB4 contains multiple reduced-to-no flexibility areas for routeing. This significantly increases construction/delivery & engineering complexity, particularly in the southern section of Option NB4 between Claydon and Bramford, with specific relation to the A14 dual carriageway, the River Gipping and associated watercourses/waterbodies, edge of settlement residential and industrial areas, existing 220kV underground cables positioned in one viable gap between other constraints, Suffolk Water Park, existing

distribution network operator assets and proposed plan allocations and planning application developments. Additionally, upon approach to Bramford Substation and section of underground cable would be required to cross the existing 4YM OHL. From an engineering and technical perspective, this section of Option NB4 was deemed to be undeliverable without complex engineering designs at additional cost.

4.5.16 Option NB5 in sections shares similar technical constraints to Option NB2 at Flordon and Stuston. Whilst Option NB5 was deemed to perform better than Option NB2 in regard to entries into Bramford Substation, the aforementioned constraints make Option NB5 significantly more constrained than Option NB1 and therefore less preferable from a technical perspective.

4.5.17 Option NB6 includes constrained areas with limited to no routeing flexibility and increased construction/delivery complexity at Darmsden and Earl Stoneham as described in Option NB2 and NB4. Additionally, the underground cable required out of Norwich Main Substation to cross the existing 4YM overhead line as well as the need to cross the 4YM overhead line via underground cable again between Mendlesham and Needham Market, make Option NB6 considerably more technically complex when compared to Option NB1 and as such is less preferable.

4.5.18 From an engineering and technical perspective, Option NB7 sees challenging routeing throughout with multiple areas comprising no flexibility. Increased construction/delivery & engineering complexity and a number of system outages would be required to facilitate the four locations that the proposed new parallel overhead line would need to swap from one side of the existing 4YM overhead line to the other. Extensive additional engineering works (including temporary diversions) would be required to facilitate this option, largely negating the benefits of a close parallel alignment which would only be achieved for a portion of the entire route, particularly due to the need to deviate away from close parallel due to the aforementioned constraints at Flordon, Stuston, Earl Stoneham and Darmsden.

4.5.19 Costs have been developed by National Grid's inhouse cost estimating team (EHUB) using consistent assumptions including that: new substations are AIS; route lengths are based on a route produced from a desktop exercise that is representative of the likely constraints to routeing; the costs of applying normal industry 'best practice' mitigation measures during construction and operation are inherent within the cost base used. Costs can therefore be compared on a consistent basis noting that they could be higher or lower, but consistent in relative terms.

4.5.20 Option NB1 was the least cost. It has anticipated capital costs of £157million. By comparison anticipated capital costs for Options NB2 to NB7 ranged from £169 million to £313 million. Option NB1 is therefore preferred from a cost perspective.

Policy performance of options

4.5.21 All options have been considered against national and local policy and assessed against the Holford Rules. National and local policy considerations were not considered to materially differentiate between the options.

4.5.22 At the route corridor stage of appraisal, there are no clear and significant differentiators between the options based on the Holford Rules, as all the options have been designed with due consideration of the Rules, and as far as possible to avoid areas of environmental constraint.

4.5.23 At this stage of appraisal, Holford Rule 1 and 4 are not considered to help differentiate between the options. All corridors avoid the major areas of highest amenity value (Holford Rule 1) and it is considered that alignments in all corridors could be defined to comply with Holford Rule 4.

4.5.24 The consideration of alternative pylon designs (Supplementary Note 3 to the Holford Rules) follows later in the mitigation hierarchy and can be considered once an alignment has been established and an assessment undertaken to establish whether alternative pylon designs are needed.

4.5.25 With the exception of Option NB4, all options avoid smaller areas of high amenity value or scientific interest (Holford Rule 2). Option NB4 would directly affect Shotesham Conservation Area and contains scheduled monuments within the corridor south east of Eye.

4.5.26 Options NB1 and NB4 offer the potential for more direct alignments and fewer changes in direction (Holford Rule 3). Compliance with this rule is not considered to be so varied that it becomes a differentiating factor in its own right, but the higher potential for deviation to avoid constraints in Options NB2, NB5, NB6 and NB7 does contribute to differentiation.

4.5.27 All options avoid ancient woodlands (Holford Rule 5). However, Options NB2 and NB5 contain more areas of woodland than the other options. Notwithstanding this, alignments would be routed to avoid woodland and further work is required as part of the detailed routeing process to develop an alignment to comply with this rule as far as possible.

4.5.28 Options NB2, NB5 and NB7 have the potential to result in a concentration of wirescape due to the intervisibility with existing 400kV and 132kV high voltage lines (Holford Rule 6). We note in relation to options NB2, NB5 and NB7 there is substantially greater potential for alignments that would not achieve sufficient separation from existing lines to limit the effects on properties and features between the lines. As a result, Holford Rule 6 is assessed to be a differentiating factor with Option NB1 and NB4 assessed to be the most compliant with this rule.

4.5.29 Given the location of Norwich Main substation to the south of Norwich and Bramford substation to the west of Ipswich, only options which approach Bramford substation from the east (i.e. Option NB4), have the potential to be in close proximity to either of the two largest settlements within the Study Area and therefore have the potential to approach urban areas through industrial zones (Holford Rule 7). As a result, Rule 7 is only applicable to Option NB4, with which it complies. All other smaller settlements within the Study Area are considered to be avoidable.

4.5.30 All of the Options have been designed to avoid routeing close to residential areas as far as possible (Supplementary Note 1) and the distribution of residential settlement throughout the options is not considered to be a differentiating factor in its own right. However, options that entail the convergence or divergence of corridors with the existing 4YM route at multiple points (excluding at Norwich Main and Bramford as these are common to all options) have greater potential to result in higher levels of effect on general residential amenity. The convergence or divergence of corridors with the 4YM route at multiple points arises in relation to corridors that sought, but do not achieve, a consistent end-to-end close-parallel alignment (Options NB2, NB5 and NB7). As a result, Options NB1 and NB4, which do not do this, are assessed to be more compliant with this rule.

4.5.31 All of the options pass through areas allocated for mineral extraction (primarily west and south of the Norwich main substation). As this minerals designation is common to all options it is not considered to be a differentiator in the selection of a preferred corridor.

4.5.32 The avoidance of the locally protected Landscape Character Area A1 (Rural River Valley)), south of Norwich, achieved by Option NB1 is assessed to weigh marginally in its favour and results in it being more preferred in relation to Supplementary Note 2 compared to the other options.

4.5.33 An end-to-end close parallel alignment for the NEA is not achievable. The cohesion and synchronicity of infrastructure and pylons in a logical visual appearance was assessed as not possible. Option NB2 attempts to get closer to the principle of close paralleling but it is a much narrower corridor with multiple changes in direction, which would result in more angle pylons. Option NB7 sought to achieve a greater degree of close paralleling, but was parked on the basis it did not deliver any differentiating landscape and environmental benefits, it has the potential to result in greater visual effects at the points at which it deviates from close-parallel, and the costs were higher, due to the route and challenges associated with construction and programme. As such, both Options NB2 and NB7 were parked.

4.5.34 Option NB4, is predominantly not preferred from an engineering perspective due to multiple constraints to construction in the south in the vicinity of the A14 crossing, and whilst possible to be overcome, the identified constraints substantially increase engineering risks. It also would directly affect Shotesham Conservation Area which is contrary to Holford Rule 2

Conclusion to Norwich to Bramford Options Selection

4.5.35 Overall, whilst there were some differences between the corridors from a socio-economics perspective, a decision about which option to take forward as the preferred corridor in NEA was principally driven by the differences between ecology, landscape, historic environment, technical and cost factors. Option NB1 has the potential for effects on an SAC, which Options NB2, NB4, NB5 and NB6 do not. However, it is considered that these effects could be minimised through the implementation of standard mitigation measures so that significant effects do not arise. Option NB1 avoids the potential for residential properties to be surrounded in close proximity by overhead lines to a greater extent than the other options and thus reduces the potential of unacceptable levels of effect upon general residential amenity. As such, effects would be difficult to mitigate with standard measures, this weighs considerably in favour of Option NB1. Option NB1 also avoids a locally protected landscape that other options do not, though this in itself would not be a major differentiating factor. Option NB1 was also preferred from an historic environment perspective, particularly compared to Option NB4 which directly affected a Conservation Area (at Shotesham through the estate park land of the Grade I listed ‘The Hall’ and associated listed buildings).

4.5.36 From a Technical perspective, Option NB1 is preferred as it has fewer constraining areas and an overall greater level of flexibility for the routeing of an overhead line with reduced construction/delivery & engineering complexity than Options NB2, NB5, NB6 and NB7.

4.5.37 From a cost perspective, Option NB1 was the least cost. It has anticipated capital costs of £157 million. By comparison anticipated capital costs for Options NB2 to NB7 ranged from £169 million to £313 million. Option NB1 is therefore preferred from a cost perspective.

4.6 Stage 4: Development of Graduated Swathe

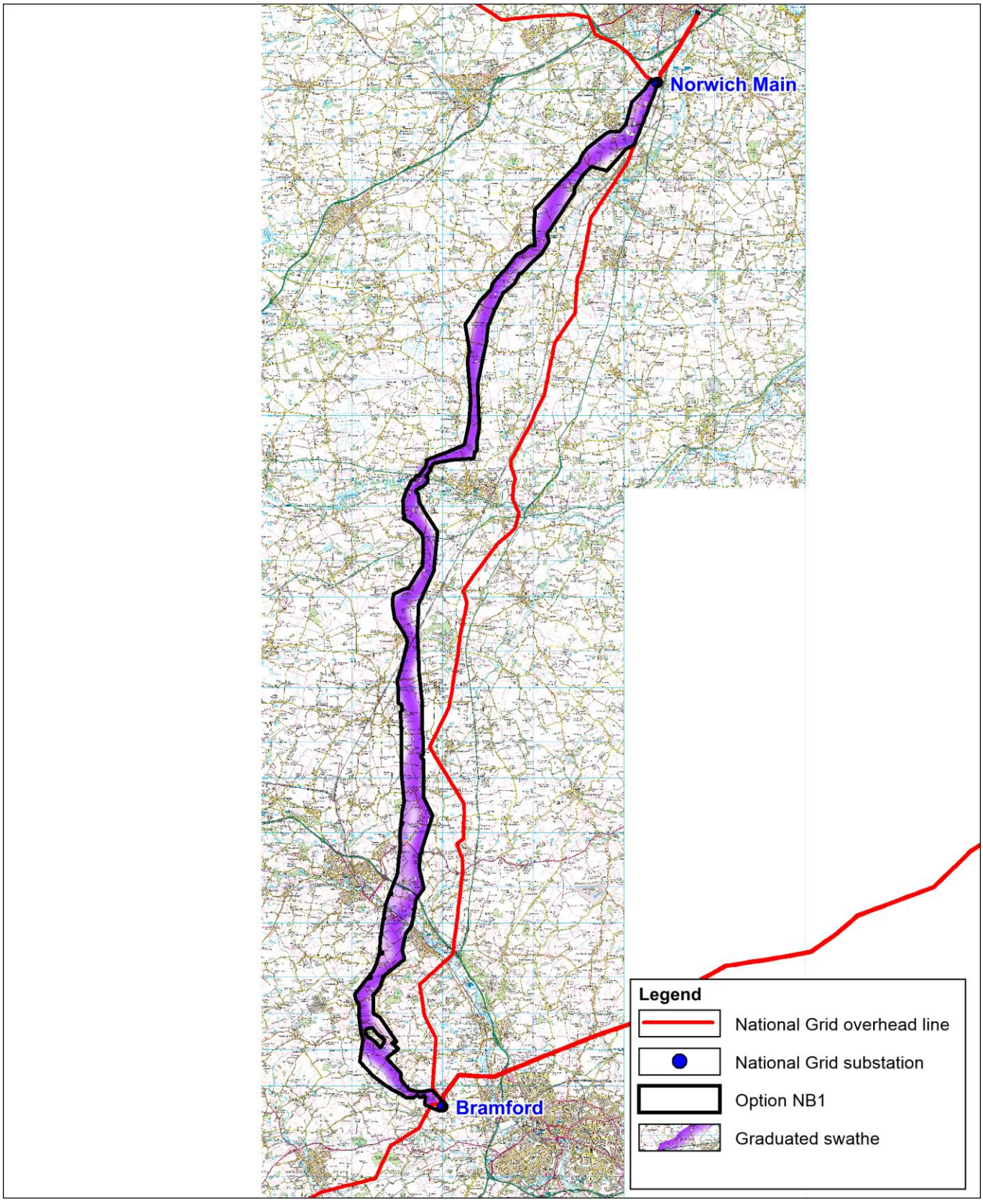
4.6.1 Following the identification of Option NB1 as the Preferred Option, an analysis of potential routeing within the corridor was undertaken by engineering subject matter experts and reviewed by environment subject matter experts. The analysis identified areas within the Preferred Option corridor within which Project infrastructure is considered more or less likely to be located. The analysis was informed by the same desk-based studies and limited field observations that informed the options appraisal and its findings should therefore be considered provisional, indicative and subject to revision as more detailed information becomes available. Notwithstanding their provisional nature, it is considered that the areas identified provide a reasonable indication of where development is more or less likely to take place within the Preferred Option corridor and that this information will be helpful in assisting stakeholders to understand the Project proposals during the non-statutory consultation to be undertaken as Stage 5 of this phase of National Grid's development process.

4.6.2 In order to communicate the findings of the analysis to stakeholders in a manner that does not imply an inappropriate level of certainty, the areas within the Preferred Option corridor that may host the route alignment are indicated by means of different densities of shading, referred to as a graduated swathe. The graduated swathe uses darker tones to indicate areas in which development is considered to be more likely and lighter tones to indicate where it is considered less likely. The absence of any shading within the Preferred Option corridor indicates that development in these areas is considered unlikely, albeit remains possible if other areas are ruled out by new information. Areas of the Preferred Option corridor that the analysis identified as having very little potential to host a route alignment have been removed.

4.6.3 In some places, the analysis identified that a potential route alignment may pass in close proximity to, or sometimes cross the boundary of the Preferred Option corridor and that a small extension to the corridor would be required. All such instances were reviewed by environment subject matter experts to ensure that they would not result in any adverse environmental effects that had not been considered in the options appraisal and the Preferred Option corridor was expanded in a small number of locations as a result.

4.6.4 The revised Preferred Option corridor and the graduated swathe are shown **on Figure 4.5**.

Figure 4.5 – Norwich to Bramford Graduated Swathe



5. Bramford to East Anglia Connection Substation Options Appraisal

5.1 Stage 1: Options Identification – the Study Area

5.1.1 The Strategic Proposal identifies a 400kV double circuit connection between Bramford substation, to the west of Ipswich, in Suffolk and a new EAC substation required to facilitate the connection of offshore windfarm proposals with the electricity transmission system. In line with the existing NPS EN-5 and National Grid's Approach, the Project assumption is that sections of this connection outside National Parks or AONBs should be made via overhead line supported by steel-lattice pylons and that any sections within such nationally designated landscapes should be made via underground cable.

5.1.2 The Bramford to EAC Study Area is shown on **Figure 5.1**.

Figure 5.1 – Bramford to EAC Study Area

5.1.3 The Study Area is bounded to the north by the existing Bramford Substation and to the south and east by the location of the nearest of the potential EAC substation siting zones (as discussed in section 6 below). The routeing of the connection and the siting of the EAC occurred as an iterative and co-ordinated process but presented for clarity in sections 5 for connection and 6 for EAC siting. In order to allow the consideration of options that might wholly avoid passing through either the Dedham Vale AONB or the Suffolk Coast and Heaths AONB, the Study Area extends as far as Sudbury in the west and Ipswich in the east. The straight-line distance between Bramford substation and the nearest EAC siting search zone is approximately 17km.

5.1.4 With regard to areas of the highest amenity value, both the Dedham Vale AONB and the more westerly parts of the Suffolk Coast and Heaths AONB fall within the Study Area. Whilst Holford Rule 1 states that connections should "*Avoid altogether, if possible, the major areas of highest amenity value, by so planning the general route of the first line in the first place, even if the total mileage is somewhat increased in consequence*", it was considered that the length of connection associated with options that avoid these AONBs would be so great, that options through the AONBs should still be considered in spite of their sensitivity. Consequently, the Dedham Vale AONB and the more westerly parts of the Suffolk Coast and Heaths AONB are therefore included in the Study Area.

5.1.5 Similarly, whilst extensive internationally designated areas of nature conservation that are peripheral to the Study Area are excluded (i.e. Hamford Water SPA, to the south of Harwich, and the Colne Estuary SPA and Essex Estuaries SAC, along the south-western side of the Tendring peninsula), the Stour and Orwell Estuaries SPA, which extends from the east to the centre of the Study Area, is included in order to allow consideration of the most direct potential options.

5.1.6 The landform of the Study Area is dominated by the valley of the River Stour, which bisects the Study Area on an east/ west alignment. Ground elevations within the valley floor range from a little above sea-level to approximately 20m AOD. To the north of the Stour Valley, the landform comprises a relatively low plateau, which is incised by smaller valleys associated with tributaries of the River Stour. Maximum ground elevation in this area reaches approximately 80m in the vicinity of Milden, but the majority of the plateau is located between approximately 50m and 70m AOD. To the south of the Stour Valley, the landform of the Study Area largely consists of a low plateau, which is incised by tributaries of the Stour to the north, by tributaries of the Colne to the south-west and by the Holland River in the east. Ground elevations within the valley floors range between just above sea-level and 10 m AOD, whilst the most elevated areas within southern part of the Study Area are in the region of 30 m to 40 m AOD. The nationally designated status of most of the Stour Valley and the relatively narrow nature of many of the smaller valleys limits the opportunity for options within the Study Area to be routed within moderately open valleys as recommended by Holford Rule 5.

5.1.7 The majority of the northern part of the Study Area is located within Babergh District, in Suffolk, and most of the southern part of the Study Area lies within Tendring District and Colchester Borough, in Essex. The more westerly parts of the Study Area are located within Braintree District, in Essex. Within the Study Area, the River Stour forms the boundary between Essex and Suffolk.

5.1.8 Settlement across the Study Area is dominated by the large towns of Ipswich, on its north-eastern periphery, and Colchester, to the south. The towns of Sudbury and Clacton are peripheral to the north-west and south-east respectively. A relatively dense

pattern of settlement extends north-eastwards from Colchester as far as Manningtree and the boundary of the Dedham Vale AONB. Elsewhere, settlement is restricted to smaller towns and villages, many of which are located within valleys or along the coast of the Tendring Peninsula. Settlement is sparsest within some of the inland parts of the Tendring peninsula.

5.1.9 The major roads within the Study Area are the A12, which traverses the Study Area from the north-east to the south-west, the A120, which traverses the Study Area from east to west, and the A133, which runs down the centre of the Tendring peninsula, linking Clacton-on-Sea to the A120. The larger settlements across the Study Area are linked by a network of B roads and smaller settlements are served by a network of minor roads. The railway network within the Study Area radiates from Colchester, with lines to Sudbury in the north-west, Ipswich in the north-east, Harwich in the east, Clacton-on-Sea and Walton-on-the-Naze in the south-east and Chelmsford to the south west.

5.1.10 NTS infrastructure within the Study Area is concentrated in the north, where several overhead lines radiate from Bramford substation. Of these lines, the 4YM route to Norwich Main and the parallel 4ZX and 4ZW routes to Sizewell are located to the north of Bramford substation and do not influence routeing options to the EAC. The 4YL route is located to the west of Bramford, from where it crosses the Study Area on a broadly west-south-west alignment. In the west of the Study Area, the 4YLA route connects with the 4YL route near Twinstead, from where it traverses the Study Area on a north/ south alignment to the Colne Valley and then leaves the Study Area on a south-west/ north-east alignment towards Braintree. Whilst not yet consented or constructed, and itself subject to consultation and ongoing design work, the proposed Bramford – Twinstead New 400kV Double Circuit (BTNO) overhead line between Bramford and Twinstead, would be located to the immediate south of the 4YL route and is considered to form part of the baseline conditions.

5.1.11 Overhead lines that form part of the electricity distribution network, operating at 132kV, which have the potential to affect the routeing of the Bramford to EAC connection, include two lines located to the south-east of Bramford, which serve Ipswich, and two lines located on a broadly south-south-west, north-north-east alignment between Ipswich and the Manningtree area. The more westerly of these lines terminates at a 132kV substation near Little Bromley, to the south of Lawford on the Tendring peninsula. Three other 132kV overhead lines also converge upon this substation, including a relatively short line to the north-east, toward Manningtree, a line to the south-west, that skirts the south-eastern edge of Colchester, and one that traverses the Tendring peninsula from north-west to south-east, where it terminates at the 132kV substation at Holland Road, near Clacton. The existing 132kV overhead line to the immediate south of the 4YL route is assumed to have been substantially removed and a new Grid Supply Point installed at Twinstead as part of the development of the BTNO connection.

5.2 Stage 1: Options Identification – Constraints and Opportunities

5.2.1 Following the definition of the Study Area, constraints were mapped and categorised in accordance with the parameters set out in **Table 3.1**.

5.2.2 In terms of environmental receptors, options for routeing within the Study Area are heavily influenced by the presence of the Dedham Vale AONB and, to a lesser extent,

the Suffolk Coast and Heaths AONB. The Dedham Vale AONB falls wholly within the Study Area, extending for approximately 18km from Manningtree and Cattawade, near the mouth of the River Stour, in the east, to the vicinity of Wormingford and Bures in the west. It therefore straddles the most direct line from Bramford to the nearest EAC siting search zone. Given that National Grid's Approach, and hence the Project assumptions, presume that any connection through a nationally designated landscape, such as an AONB, would be made via underground cable, it was decided that relatively direct options passing through the AONB should be identified. In addition to providing the most direct options, any such options would also allow the potentially advantageous aspects of undergrounding, i.e. minimisation of long-term landscape and visual effects, to be weighed against the adverse effects arising from the construction period.

5.2.3 To the east, the Dedham Vale AONB is separated from the Suffolk Coast and Heaths AONB by an irregular corridor, generally less than 1km wide, that contains the settlements of East Bergholt, Brantham, Cattawade and Manningtree. The westernmost part of the Stour and Orwell Estuaries SPA extends for approximately 2km into the eastern part of the Dedham Vale AONB. The highly constrained nature of the area to the east of the Dedham Vale AONB led to the discounting of identification of options that would pass to the east of the Dedham Vale AONB, as, notwithstanding the additional engineering constraints associated with having to cross the Stour Estuary, any such route would have to pass through the Suffolk Coast and Heaths AONB as well as the Stour and Orwell Estuaries SPA and would therefore be unlikely to offer any environmental benefit.

5.2.4 To the west of the Dedham Vale AONB, an extensive section of the valley of the River Stour is defined as the Stour Valley Project Area. The Stour Valley Project Area is included in the Dedham Vale AONB Management Plan, but does not form part of the AONB. The definition of the Stour Valley Project Area recognises the westward continuity of aspects of the landscape of the AONB and the value that is placed upon them. However, there are no nationally designated landscapes or internationally designated areas of nature conservation present to the west of the Dedham Vale AONB and, in the absence of areas of the highest amenity value, it was decided that the potential for this area to host a connection option that avoided the AONB should be subject to further investigation.

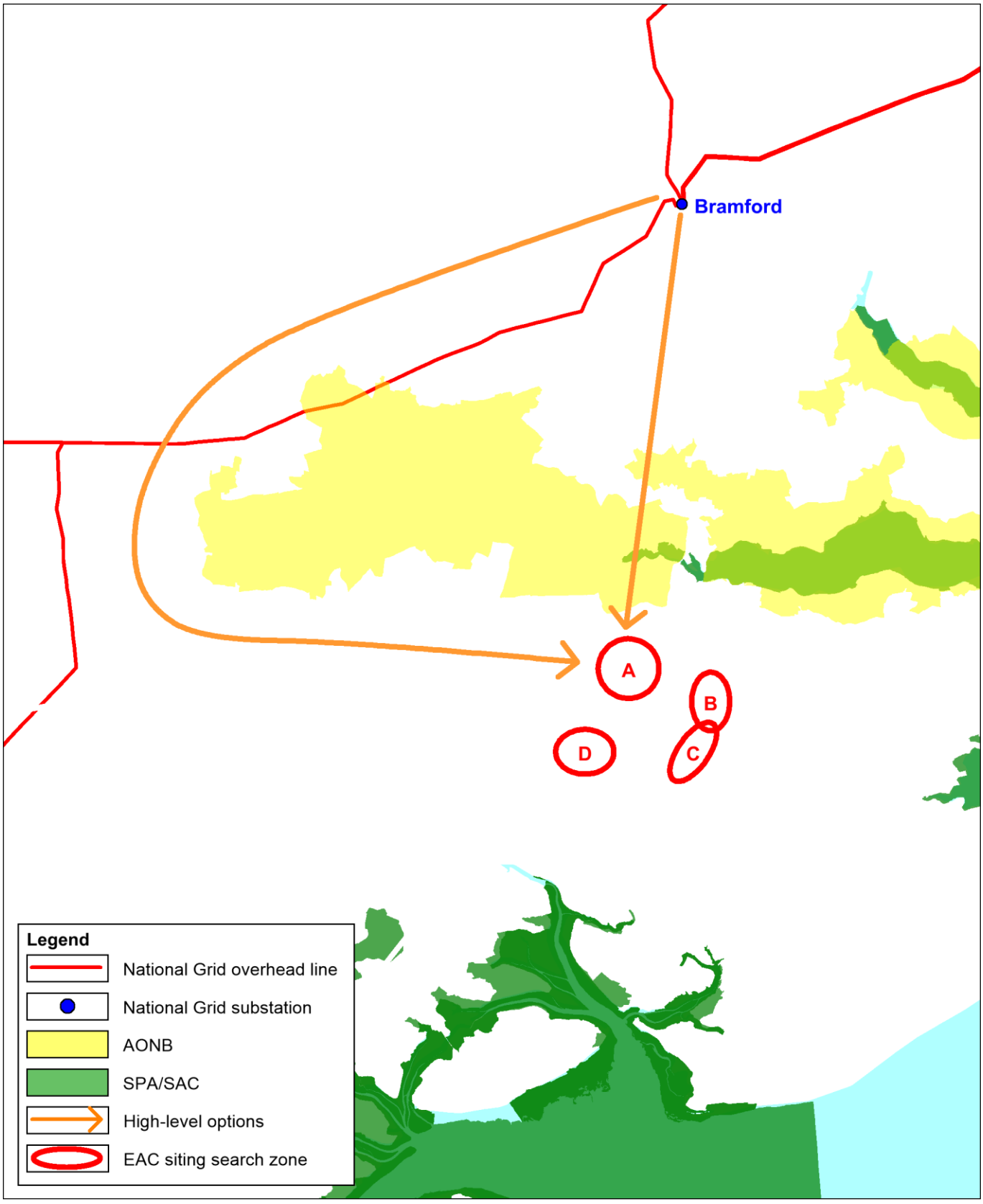
5.2.5 Once it was decided to consider options to the west of the Dedham Vale AONB, it was recognised that a further opportunity to minimise environmental effects may be available if options could be identified that enabled the routing of all or part of the new connection in close-parallel with the existing 4YL route between Bramford and Twinstead. Given that the options appraisal undertaken for the proposed BTNO route had identified close-paralleling with the 4YL route as the preferred option for that connection, this opportunity was also taken forward for further consideration. This opportunity was considered to relate only to potential options to the north of the 4YL route, as options to the south would also need to be located to the south of the proposed BTNO route and could not therefore avoid passing through a substantial section of the AONB. To the north of the 4YL route, a corridor option with the potential to achieve consistent close-paralleling whilst passing through a short section of the AONB, might be identified if it was considered that it could deliver the benefits of close paralleling outside the AONB, and be adequately mitigated through undergrounding within the AONB. In this regard, the potential length of connection within the AONB, and hence the level of temporary adverse effects potentially sustained by the AONB, was considered to be the differentiating factor between potential options to the north or south of the 4YL route. No other options included in the appraisal undertaken for the proposed BTNO route were

considered to offer potential environmental benefits that would justify the longer length of connection associated with them.

5.2.6 The output of the constraints mapping exercise also highlighted the highly constrained nature of the area between the Dedham Vale AONB and Colchester. The area is relatively densely settled, with numerous small settlements and a high level of ribbon development along the roads radiating out from Colchester. Constraints are also present in the form of an extensive scheduled monument to the south of Ardleigh, the presence of Ardleigh Reservoir and adjacent mineral extraction site, a large solar farm at Langham Moor and the requirement to cross major roads and a railway.

5.2.7 Consideration was therefore given to a range of potential corridor options across the full width of the Study Area. The length of connection associated with routeing in different parts of the Study Area ranges from approximately 18km to 21km, for corridors passing through the Dedham Vale AONB on a north/ south alignment, to in the region of between 45km and 50km for corridors passing to the west of the Dedham Vale AONB. The parameters of the preliminary, GIS-based corridor identification exercise included direct options, through the Dedham Vale AONB, and indirect options, to the west of the Dedham Vale AONB. Options passing east of Manningtree were excluded on the basis that these would have to pass through the Suffolk Coast and Heaths AONB as well as the Stour and Orwell Estuaries SPA and the Stour Estuary. Options seeking to allow routeing in close parallel to the south of the 4YL route were excluded on the basis that these would entail considerably increased length of connection, but could not avoid passing through a substantial section of the Dedham Vale AONB. **Figure 5.2**, below, shows the pursued and discounted areas in schematic form.

Figure 5.2 – Bramford to EAC Parameters for Preliminary Corridor Option Identification



5.3 Stage 1: Options Identification – Corridor Identification and Refinement

Identification and Refinement of Preliminary Options

5.3.1 The preliminary corridor identification exercise identified four potential corridor options balancing directness of route (notwithstanding that the parameters of the exercise included the identification of options that pass to the west of the Dedham Vale AONB) and the avoidance of constraints. Corridor options were composed of sections, so that those common to more than one option could be appraised without duplication. Sections also reflect the potential interaction of corridor options between Bramford and the EAC and those between the EAC and Tilbury, described in Section 7. The sections are shown on **Figure 5.3**.

5.3.2 The identified corridor options were:

- Option BE1 - A relatively direct corridor passing through the Dedham Vale AONB (Section A);
- Option BE2 - A relatively direct corridor passing through a more easterly part of the Dedham Vale AONB and through the westernmost part of the Suffolk Coast and Heaths AONB (northern part of Section A, Section B and the southern part of Section A);
- Option BE3 - A corridor passing to the west of the Dedham Vale AONB and seeking to allow routeing in close-parallel with the 4YL route (Section C, Section E and Section F); and
- Option BE4 - A corridor passing to the west of the Dedham Vale AONB and seeking to maximise distance from the northern part of the AONB (Section D, Section E and Section F).

5.3.3 These four preliminary corridor options were subject to initial review and refinement by environmental specialists and to an iterative process of refinement by both environmental and technical specialists. This process of refinement resulted in the removal of some parts of corridors, primarily due to the presence of engineering constraints, and the extension of corridors to provide alternative routes to avoid constraints.

5.3.4 A key finding of this process was that a close-parallel route to the north of the 4YL route would only be likely to be achievable for a relatively short part of the route. This finding mirrors that of the Options Appraisal undertaken for the proposed BTNO route, which concluded that a close-parallel route to the south of the 4YL route would be preferrable.

Options taken forward for appraisal

5.3.5 As a result of the options identification and refinement process, the same four options described above were taken forward to options appraisal.

5.3.6 Following the initial appraisal of these options, a challenge and review workshop took place to analyse and discuss the outputs and park non-preferred options, and shortlist those to be taken forward to the decision workshop. The filtering workshop also identified where any additional information was required, as well as subsequent work to be undertaken prior to the decision workshops. It also identified opportunities for

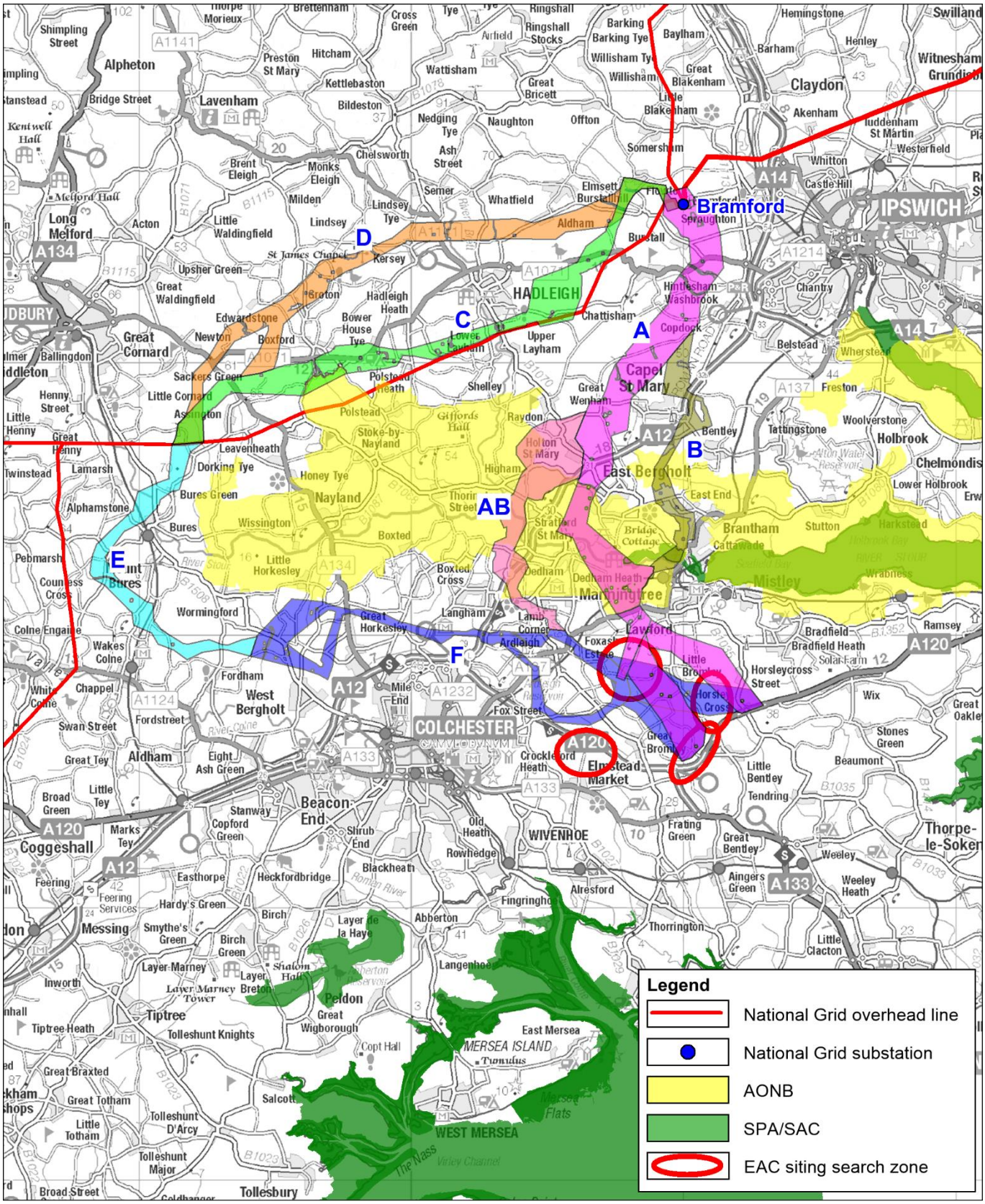
additional or hybrid corridors to be developed and back-checked to be considered at the decision workshop.

5.3.7 The filtering workshop identified the following additional hybrid option to be subject to Options Appraisal prior to the decision workshop:

- Option BE5 - A relatively direct corridor passing through a more westerly part of the Dedham Vale AONB achieving greater separation from sensitive ecology receptors and from areas of particular focus for AONB visitors (northern part of Section A, Section AB and the eastern part of Section F).

5.3.8 The four initial options and the additional hybrid option were taken forward to options appraisal and are shown on **Figure 5.3**.

Figure 5.3 – Bramford to EAC options taken to Options Appraisal



Options not taken forward for appraisal

5.3.9 All identified options were taken forward for appraisal.

5.4 Stage 2: Options Appraisal

5.4.1 The Options Appraisal Summary Tables for the Bramford to the East Anglia Connection part of the Project are set out in detail in **Appendix B**.

5.5 Stage 3: Bramford to EAC Options Selection

Overview

5.5.1 As outlined in section 5.2, a filtering workshop was held to consider the effects of the options identified on receptors in the Study Area. Project team representatives from technical disciplines of engineering and costs attended the workshops alongside those from the environmental team to ensure the discussions were comprehensive and considered all constraints. Each option was considered in turn, with each technical topic's key constraints being noted as the workshop progressed.

5.5.2 The workshop concluded that Option BE5 (consisting of the northern part of Section A, Section AB and the eastern part of Section F) was the preferred option for Bramford to the East Anglia Connection substation. However, it recognised that there are a number of constraints that are expected to require further consideration and potential mitigation to ensure that effects are avoided or reduced.

Environmental performance of options corridors

5.5.3 From a Biodiversity and Ecology perspective, Options BE1 and BE2 were considered to perform more poorly than other options due to the potential for negative effects (LSEs) on the Stour and Orwell Estuaries SPA and supporting Cattawade Marshes SSSI (which forms part of the SPA). For Option BE5, whilst the northern part of the corridor is the same as Option BE1, the central part (Section AB) is routed further to the west in the AONB compared to equivalent parts of Options BE1 and BE2 (the central part of Section A and Section B, respectively). As a result, due to its increased distance from the SPA and SSSI, Option BE5 is assessed to have lower potential to affect these designations via potential pathways for effects (e.g hydrological link) and thus trigger the requirement for Habitat Regulations Assessment (HRA). Any potential effects would be minimised through design measures (pylon positioning), as well as best practice pathway control measures to stop or minimise indirect effects downstream. Overall, western options (Options BE3 and BE4) are preferred from a Biodiversity and Ecology perspective as they would not be likely to result in LSEs on these designations.

5.5.4 From a Historic Environment perspective, whilst there would be effects on the setting of multiple listed buildings in each corridor option, these effects are not sufficiently different between each corridor option to differentiate one as a preferred option. In terms of effects on Conservation areas, Options BE1, BE3 and BE4 (Sections A, C and E, respectively) would pass directly through the edges of conservation areas (in Section A – Dedham and Lawford, in Section C – Boxford, in Section E Bures St Mary) as they could not be avoided in routeing due to the presence of other constraints/infrastructure. This this was assessed to be a factor that differentiated these corridors from the other corridor options. None of the corridors include scheduled monuments. However, the southern arm of Section F abuts Pitchbury Ramparts and would result in effects on the setting of this historic feature. This is an important consideration against the identification of any option utilising the southern arm of Section F (potentially Options BE3 and BE4) as the preferred option. National Grid's approach to minimising the

effects of overhead line infrastructure in AONBs, includes the use of undergrounding. As such, this would apply to Options BE1, BE2 and BE5, and, depending on the alignment of the connection, it could also be needed in Option BE3. Whilst such undergrounding would lead to a change to the setting of heritage assets during construction, these effects would be of limited duration and largely reversible in the longer term. This is a factor that is assessed to weigh in favour of these options.

5.5.5 From a Landscape and Visual perspective, Option BE4 avoids passing through the Dedham Vale AONB. Whilst the use of undergrounding in AONBs would not lead to long term negative effects post construction, the avoidance of even temporary disturbance effects of such areas of the highest amenity value is still an important consideration. However, corridor options that pass through the Dedham Vale AONB using underground cables (Options BE1 and BE5) and the Dedham Vale AONB and the Suffolk Heath AONB (Option BE2) would entail a length of connection between approximately 19km and 22km, whilst corridors that avoid passing through any AONBs (Option BE4) would entail a connection length of approximately 49km. In general terms, there is a reduction in environmental effects and cumulative effects likely to be associated with a reduced connection length. Option BE4 does not pass through any AONBs, however, it may still result in adverse effects on AONB setting, notably within the locally designated parts of the Stour Valley Project Area. No Landscape or Visual advantages are considered to be associated with Option BE3, as this would entail both a longer length of connection and would pass either through, or in extremely close proximity to, the Dedham Vale AONB. Thus, there is a strong preference in landscape and visual terms for a more direct connection via underground cable through an AONB. Of these corridor options, Option BE5 is preferred to Options BE1 and BE2 due to its greater distance from particularly highly valued parts of the Dedham Vale AONB. Further work needs to be undertaken to identify the most appropriate locations for CSEC sites to facilitate the start and end points of the underground section.

5.5.6 From a Socio-economic perspective, whilst greater effects on socio-economic receptors were identified for Option BE1 (including National Trust - Dedham Hall Farm and a solar farm), Option BE4 (Dove Barn Wedding Venue) and Options BE3, BE4 and BE5 (solar farms), the differences between the options were assessed to be marginal. However, Option BE5 achieves greater separation from areas of particular focus for AONB visitors and as such is preferred from a socio-economics perspective.

Engineering, system and cost performance of options

5.5.7 From a Technical perspective, all options performed similarly. However, routeing via the most westerly option through the Dedham Vale AONB utilising Option BE5 is preferred. However, it is acknowledged that the mitigation of the 4YL overhead line, the requirement of 10-13km of underground cable including multiple Horizontal Directional Drills (HDD) to overcome the River Stour, Black Brook and the A12 dual carriageway and the need for additional infrastructure to facilitate this technology, is considered more complex than the alternative Options BE3, and BE4, overhead line options. Despite this, the benefits of a much shorter route length, the temporary nature of the works in the AONB and the constraints present for overhead line routeing in Options BE3 and BE4 outweigh the increased technical nature of this option.

5.5.8 Option BE3, whilst considered less technically complex than Option BE5, still requires the use of a section of underground cable to cross the proposed BTNO and the existing 4YL overhead lines. Additionally, the proximity of the route to Dedham Vale AONB may also require the use of a substantial underground cable section, negating many of the

benefits of this option. Multiple significantly constrained areas within the corridor option not only reduce, but in some instances provide no flexibility for the routing of an overhead line whilst also increasing construction/delivery & engineering complexity. This is largely in relation to narrow sections of corridor and proximity to residential properties and other physical constraints at Layham, Boxford, Lamarsh Lane and multiple (in Section F) between Great Horksley and Ardleigh (The Causeway, Straight Road, the A12 dual carriageway and Dedham Road crossings). Additionally, there is only space for one new overhead line in the constrained part of Section F between Great Horksley and Dedham Road north of Ardleigh, which if utilised as a preferred corridor option between Bramford to the EAC Substation, would then prevent its utilisation as the preferred corridor option from the EAC Substation to Tilbury Substation.

5.5.9 Option BE4, shares many of the constraints as Option BE3, except for the potential underground cable section close to the Dedham Vale AONB and the constrained areas at Layham and Boxford making it preferable to Option BE3. The constraints involved with the utilisation of Section F are a reflection of those above.

5.5.10 Options BE1 and BE2, are the alternative options for routeing through the Dedham Vale and Suffolk & Coast Heaths AONBs. These options would include overhead line sections to the north and south of the AONBs, but underground cable through the AONBs and some minor to moderately long sections of HDD. From an engineering perspective, these options are similar in terms of technical complexity as the preferred Option BE5. However, in terms of construction complexity these options were both deemed to have sections of challenging routeing with reduced flexibility at areas of significant constraint. Such areas include the scattered residential properties, farm complexes, the A12 and various ancient woodland blocks present within both options. Option BE2 requires a longer stretch of underground cable than Option BE1 and must also include a longer HDD crossing of the two River Stour crossings at the location the river meets the associated estuary. Of the two, Option BE1 was technically preferred over Option BE2 as it required a slightly shorter underground cable length and included the need for shorter HDD sections.

5.5.11 Costs have been developed by National Grid's inhouse cost estimating team (EHUB) using consistent assumptions including that: new substations are AIS; route lengths are based on a route produced from a desktop exercise that is representative of the likely constraints to routeing; the costs of applying normal industry 'best practice' mitigation measures during construction and operation are inherent within the cost base used. Costs can therefore be compared on a consistent basis noting that they could be higher or lower, but consistent in relative terms.

5.5.12 A connection through the AONB (Option BE1, BE2 and BE5) would range from £222 million (this includes an assumption of undergrounding to pass the existing and proposed Bramford to Twinstead lines) to £265 million (this includes an assumption of undergrounding from 1km either side of and through the AONB).

5.5.13 A connection around the AONB (Options BE3 and BE4) would range from £258 million to £261 million.

5.5.14 In light of this a comparison between the most costly option that routes around and avoids the AONB (£261 million) would cost similar to the most costly connection through the AONB (£265 million).

5.5.15 Overall, all options are within a fairly narrow cost range of £222 million to £265 million.

Policy performance of option corridors

5.5.16 All options have been considered against national and local policy and assessed against the Holford Rules. National and local policy considerations were not considered to materially differentiate between the options.

5.5.17 At the route corridor stage of appraisal, it is difficult to identify significant differentiators between the corridors based on the Holford Rules, as all the options have been designed with due consideration of the Rules, and as far as possible to avoid areas of environmental constraint.

5.5.18 It is considered possible for all overhead line routes to choose tree and hill backgrounds when crossing ridges (Holford Rule 4) and as such this rule is not considered to be a differentiating factor. However, further work is required as part of the detailed routeing process to refine an alignment to comply with this rule as best as possible. In addition, whilst Section F (which forms part of Options BE3, BE4 and BE5) passes the northeast of Colchester, is close to areas of industrial activity (Holford Rule 7) including quarries, business and commercial units, it is not considered to be a differentiating factor that favours this section over the other sections as Holford Rule 7 applies only to routes into urban areas. The consideration of alternative pylon designs (Supplementary Note 3 to the Holford Rules) follows later in the mitigation hierarchy and will be considered if appropriate once an alignment has been established and an assessment undertaken to establish whether alternative pylon designs are needed.

5.5.19 All corridor options, have the potential to result in a concentration of wirescape due to the intervisibility with the existing 400kV and 132kV overhead lines that are present in the landscape (Holford Rule 6). As this is common to all corridors, compliance with Holford Rule 6 is not assessed to be a differentiating factor.

5.5.20 All corridors have been designed to avoid routeing close to residential areas as far as possible (Supplementary Note 1) and the distribution of residential settlement throughout is not considered to be a differentiating factor in its own right. The corridors all pass through areas either allocated for minerals extraction or waste sites. As these county designations (Supplementary Note 3) are common they are not considered to be a differentiator in the selection of a preferred corridor.

5.5.21 Options BE3 and BE4 pass through locally designated parts of the Stour Valley Project Area (Supplementary Note 2). Whilst not afforded the same level of protection as an AONB, the Stour Valley Project Area is covered by the Dedham Vale AONB Management Plan, which considers it to be a ‘valued landscape’ in terms of the NPPF. Whilst, this is not considered to be a major differentiating factor, it, together with the increased length of connection and potential for adverse effects on the setting of the Dedham Vale AONB, results in a preference for Options BE1, BE2 and BE5.

5.5.22 Option BE4 avoids major areas of highest amenity value (Holford Rule 1). However, Options BE1, BE3 and BE5 pass through the Dedham Vale AONB, and Option BE2 passes through the Dedham Vale AONB and the Suffolk Coast and Heaths AONB. However, Option BE4 is considerably longer than Options BE1, BE2 and BE5, which would use underground cables to pass through the AONBs on relatively direct routes. It is assessed that the underground cables within the AONB will mitigate the landscape and visual impacts on the designation to the extent that these routes could be considered to be potentially acceptable.

5.5.23 With the exception of Option BE3, which contains (though does not route through) the Hintlesham Great Wood SSSI, all options avoid smaller areas of high amenity value or

scientific interest (Holford Rule 2). Options BE1, BE3 and BE4 would directly pass through the edges of conservation areas so, when considering this factor in isolation, they are assessed to be more constrained than other options in respect of Holford Rule 2. However, the corridors are wide enough to allow the identification of alignments that avoid the conservation areas. As a result, Holford Rule 2 is assessed to be a differentiating factor with Options BE2 and BE5 assessed to be the most compliant with this rule

5.5.24 Options BE1, BE2 and BE5 are the most direct (Holford Rule 3) compared to Options BE3 and BE4 which have been specifically designed to route around and avoid the AONB (albeit it is acknowledged that part of Corridor C does pass through the edge of the AONB south of Boxford). As a result, Options BE3 and BE4 are considerably longer and less direct and due to their proximity to the AONB would still have the potential to lead to impacts on AONB setting. The application of Holford Rule 3 is therefore assessed to be a differentiating factor, with Options BE1, BE2 and BE5 assessed to be the most compliant with this rule. Further work is expected to be needed to identify locations for angle pylons, terminal pylons and CSECs (Note to Holford Rule 3).

5.5.25 With the exception of Option BE3, which contains (though does not route through) Hintlesham Great Wood, all other options have been specifically designed to avoid ancient woodlands (Holford Rule 5). Whilst Options BE3, BE4 and BE5 do contain more areas of woodland than the other options, the corridors are considered to be of sufficient width to allow the identification of alignments which would avoid such woodland. However, further work is required as part of the detailed routeing process to refine an alignment to comply with this rule as far as possible.

Conclusion to Bramford to EAC Options Selection

5.5.26 Overall, a decision about which option to take forward in this area of the Project is principally driven by whether the connection should pass through the AONB or avoid it. From a Landscape and Visual perspective, whilst undergrounding through the AONB would have a temporary effect on the landscape it would facilitate a more direct route – approximately half the length compared to a route that avoids the AONB. Specifically, the environmental effects of underground cabling are largely short-term and associated with the construction period, whereas those associated with overhead lines are largely long-term. As a result, there would be a reduction in the environmental effects and cumulative effects likely to be associated with a connection of less than half the length of the alternative route passing around the AONB noting also that a route which avoids the AONB may still have adverse effects upon its setting. Of the routes that pass through the AONB, Option BE5, which uses the northern part of Section A, Section AB (the section through the AONB) and the eastern part of Section F, is preferred compared to Options BE1 and BE2. This is due to its greater separation from particularly highly valued parts of the Dedham Vale AONB.

5.5.27 From a historic environment perspective Option BE5 is preferred as it avoids passing through any conservation areas unlike Options BE3 and BE4 that seek to avoid the AONB. (Section A does contain the edge of the Dedham Conservation Area at its central part, but this would be entirely avoided by using Section AB to achieve a connection, as in the preferred Option BE5).

5.5.28 Whilst more westerly options are preferred from a Biodiversity and Ecology perspective, Option BE5 is assessed to have the least potential of those that pass through the AONB to have potential for effects resulting in LSEs on the designations of the Orwell Estuaries SPA and Cattawade Marshes SSSI (part of the above SPA).

5.5.29 From a Socio-economic perspective Option BE5 is preferred as it achieves greater separation from areas of particular focus for AONB visitors. In terms of planning, it is considered that whilst a connection that passes through the AONB would be in conflict with Holford Rule 1, the use of undergrounding through this designation would minimise long term residual effects on this designation.

5.5.30 From a technical perspective, all options performed similarly and therefore this was not a differentiating factor.

5.5.31 A connection that avoids the AONB, has a similar cost to the most costly option through the AONB using underground cables. The preferred option costs £240 million which is in the middle of the range of costs for all options.

5.5.32 In conclusion, the combination of using undergrounding and a more direct corridor to achieve a connection, supports Option BE5 being taken forward as the preferred option for the Bramford to East Anglia Connection substation section of the project.

5.6 Stage 4: Development of Graduated Swathe

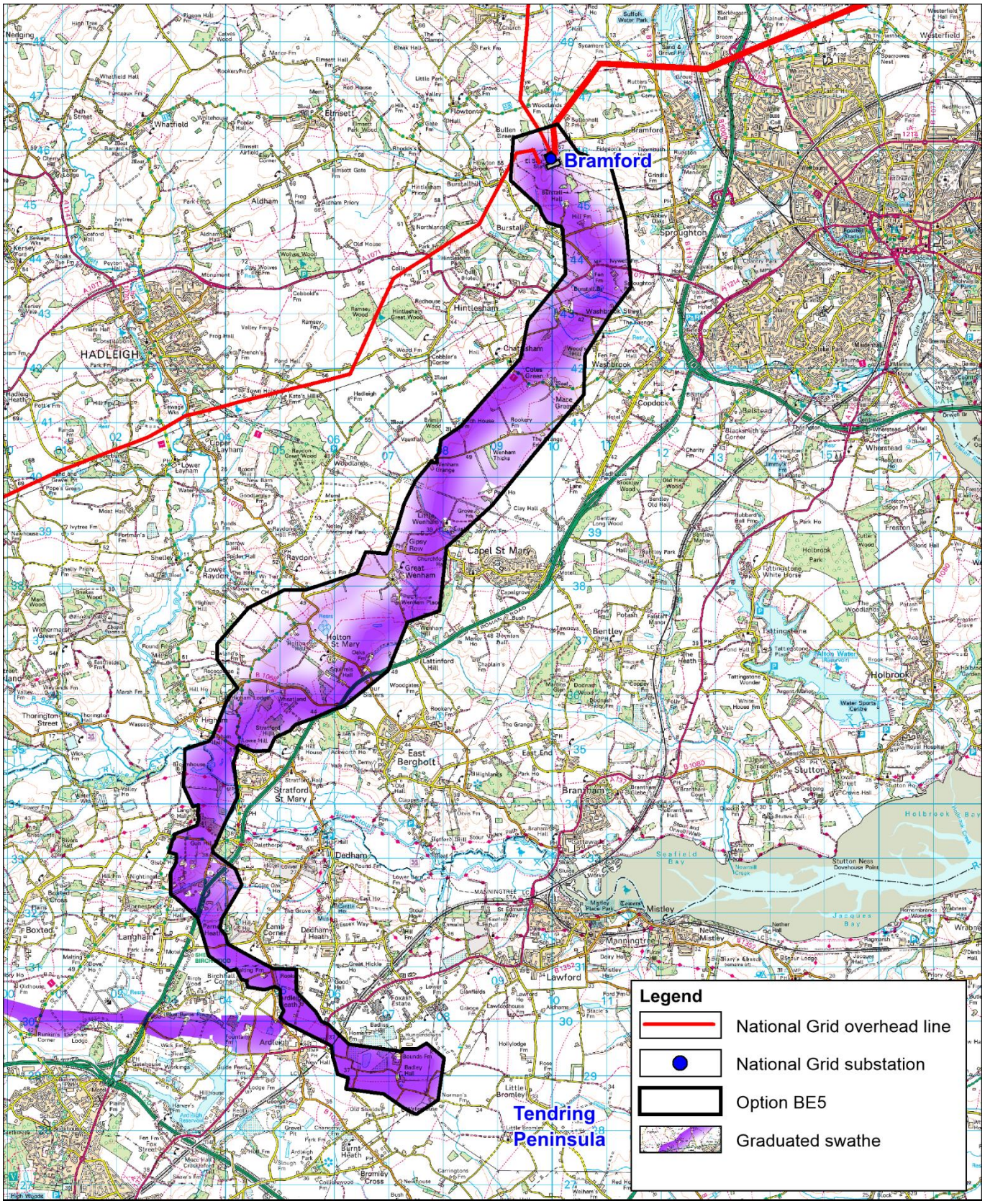
5.6.1 Following the identification of Option BE5 as the Preferred Option, an analysis of potential routeing within the corridor was undertaken by engineering subject matter experts and reviewed by environment subject matter experts. The analysis identified areas within the Preferred Option corridor within which Project infrastructure is considered more or less likely to be located. The analysis was informed by the same desk-based studies and limited field observations that informed the options appraisal and its findings should therefore be considered provisional, indicative and subject to revision as more detailed information becomes available. Notwithstanding their provisional nature, it is considered that the areas identified provide a reasonable indication of where development is more or less likely to take place within the Preferred Option corridor and that this information will be helpful in assisting stakeholders to understand the Project proposals during the non-statutory consultation to be undertaken as Stage 5 of this phase of National Grid's development process.

5.6.2 To communicate the findings of the analysis to stakeholders in a manner that does not imply an inappropriate level of certainty, the areas within the Preferred Option corridor that may host the route alignment are indicated by means of different densities of shading, referred to as a graduated swathe. The graduated swathe uses darker tones to indicate areas in which development is considered to be more likely and lighter tones to indicate where it is considered less likely. The absence of any shading within the Preferred Option corridor indicates that development in these areas is considered unlikely, but possible. Areas of the Preferred Option corridor that the analysis identified as having very little potential to host a route alignment have been removed,

5.6.3 In some places, the analysis identified that a potential route alignment may pass in close proximity to, or sometimes cross the boundary of the Preferred Option corridor and that a small extension to the corridor would be required. All such instances were reviewed by environment subject matter experts to ensure that they would not result in any adverse environmental effects that had not been considered in the options appraisal and the Preferred Option corridor was expanded in a small number of locations as a result.

5.6.4 The revised Preferred Option corridor and the graduated swathe are shown on **Figure 5.4**.

Figure 5.4 – Bramford to EAC Graduated Swathe



6. East Anglia Connection Substation Study Options Appraisal

6.1 Stage 1: Options Identification - the Study Area

6.1.1 The Strategic Proposal identifies a new 400kV substation to facilitate the connection of offshore windfarm proposals to the NTS. In view of the locations of the connecting windfarm proposals (North Falls and Five Estuaries), potential landing points on and north of the Tendring peninsula, extending from Clacton-on-Sea in the south through to sites north of Felixstowe, were considered as strategic options. As described in Section 1.3, the SOR concluded that options associated with Clacton landing points and EAC locations in on the Tendring peninsula are preferred.

6.1.2 The EAC Study Area is shown on **Figure 6.1**.

Figure 6.1 – EAC Study Area

6.1.3 The area within which the substation may be located is restricted to the Tendring peninsula. The Study Area is bounded by Colchester to the west, the Dedham Vale and Suffolk Coast and Heaths AONBs to the north, the River Colne to the south-west and the coast to the south and east. Extensive internationally designated areas of nature conservation in the form of the Hamford Water SPA on the east coast and the Colne Estuary SPA and Essex Estuaries SAC to the south-west are excluded from the Study Area.

6.1.4 The landform of the Study Area largely consists of a low plateau, which is incised by tributaries of the Stour to the north, by tributaries of the Colne to the south-west and by the Holland River in its central part. These valleys are often relatively narrow and steep-sided, limiting their potential to host a substation. Ground elevations within the valley floors range between just above sea-level and 10 m AOD, whilst the most elevated areas within the Study Area are in the region of 30 m to 40 m AOD.

6.1.5 The Study Area is wholly located within Essex. The vast majority of the Study Area lies within Tendring District, with Colchester Borough on its western periphery.

6.1.6 The density of settlement across the Study Area varies considerably, with the periphery of the Study Area generally being more densely settled than the centre. Settlement is densest in the west, where linear development between settlements on the outskirts of Colchester has resulted in the coalescence of previously separate settlements, and on the coast, where little of the coastline remains undeveloped. The settlement of Manningtree, Lawford, Mistley and Bradfield are present to the north and those of Wivenhoe, Arlesford and Brightlingsea in the south-west. The central plateau of the peninsula is more sparsely settled, with Great Bentley and Elmstead Market representing the largest settlements.

6.1.7 The major roads within the Study Area are the A120, which traverses the northern part of the Study Area between Colchester and Harwich, and the A133, which runs down the centre of the peninsula, linking Clacton-on-Sea to the A120. The larger settlements on the peninsula are linked by a network of B roads and smaller settlements are served by a network of, often single-track, minor roads. The railway line between Colchester and Clacton-on-Sea and Frinton-on-Sea traverses the southern part of the Study Area, whilst that between Colchester and Harwich is present on the northern periphery.

6.1.8 National Grid has no electricity transmission infrastructure in the Study Area however there are four 132kV electricity distribution overhead lines which converge on the 132kV substation near Little Bromley, to the south of Lawford. One of these overhead lines traverses the peninsula from north-west to south-east, where it terminates at the 132kV substation at Holland Road.

6.2 Stage 1: Options Identification – Constraints and Opportunities

6.2.1 Following the definition of the Study Area, constraints were mapped and categorised in accordance with the parameters set out in **Table 3.2**.

6.2.2 The EAC substation requires an area of approximately 18ha, whilst customer substations are likely to require areas between approximately 10ha and 15ha. Customer substations must be either co-located with or located near to the EAC in order to minimise the length of additional cable required. For this we have assumed a maximum distance of 1km. Once the constraints were mapped, GIS was used to identify potentially unconstrained contiguous areas of at least 24ha i.e. areas at least 25%

larger than the EAC area requirement in order to allow for areas that might be identified by the GIS as contiguous, but which might be unsuitable for use due to their shape. The areas identified by this exercise were considered as areas of potential opportunity.

6.2.3 The constraints and opportunity mapping exercise demonstrated that, whilst the peripheral parts of the Study Area tend to be relatively highly constrained, whether by settlement, coastal or estuarine ecological designations, or by the AONBs to the north, areas of potential opportunity are relatively widespread in the interior of the Tendring peninsula and numerous areas of potential opportunity considerably in excess of 24ha were identified.

6.2.4 It will be apparent that sites closer to the coast may necessitate relatively longer sections of parallel overhead line connections, whereas locations nearer to these potential entry and/or exit points would entail a shorter length of 400kV overhead line. It is considered that, kilometre for kilometre, a lower level of environmental impact is likely to be associated with the underground cables required to link the windfarm connection landfall points to the EAC than with the two overhead 400kV lines required to connect the EAC to Bramford and Tilbury. On this basis, potential siting zones that would entail a shorter length of connection were considered more likely to yield a preferred zone. As a result, and to focus the identification of potential candidate areas for siting search zones in those areas most likely to yield a preferred zone, consideration was given to the following additional factors:

- Opportunities to limit the length of 400kV overhead line required to achieve the required connections;
- opportunities to mitigate environmental effects associated with the 400kV overhead line connections through the rationalisation or removal of 132kV overhead lines; and
- proximity to the A and B road networks.

6.2.5 Opportunities to limit the length of 400kV overhead line required to achieve the connections to the EAC were considered in two ways. Firstly, as the process of identifying potential EAC siting search areas was undertaken concurrently with the identification of potential corridor options both from Bramford and to Tilbury, consideration was given to the likely points at which the emerging corridors might enter and exit the EAC Study Area.

6.2.6 Secondly, the identified areas of potential opportunity extend for approximately 15km from areas in the vicinity of the 132kV substation near Little Bromley, in the north-west of the peninsula, to the vicinity of the 132kV substation at Holland Road, in the south-east. On the basis that it is considered that, kilometre for kilometre, a lower level of environmental impact is likely to be associated with the underground cables for the windfarm connections than with the two overhead 400kV lines required to connect the EAC to Bramford and Tilbury, preference was given to locations that would require no more than half of the total length of connection on the Tendring peninsula to be made by 400kV overhead line i.e. locations that are closer to the 132kV substation near Little Bromley than to the 132kV substation at Holland Road.

6.2.7 Opportunities to mitigate environmental effects associated with the 400kV overhead line connections through the rationalisation or removal of 132kV overhead lines are considered to be most likely in relation to the 132kV overhead line that traverses the peninsula from the 132kV substation near Little Bromley, in the north-west, to the 132kV substation at Holland Road, in the south-east. It is considered that the undergrounding

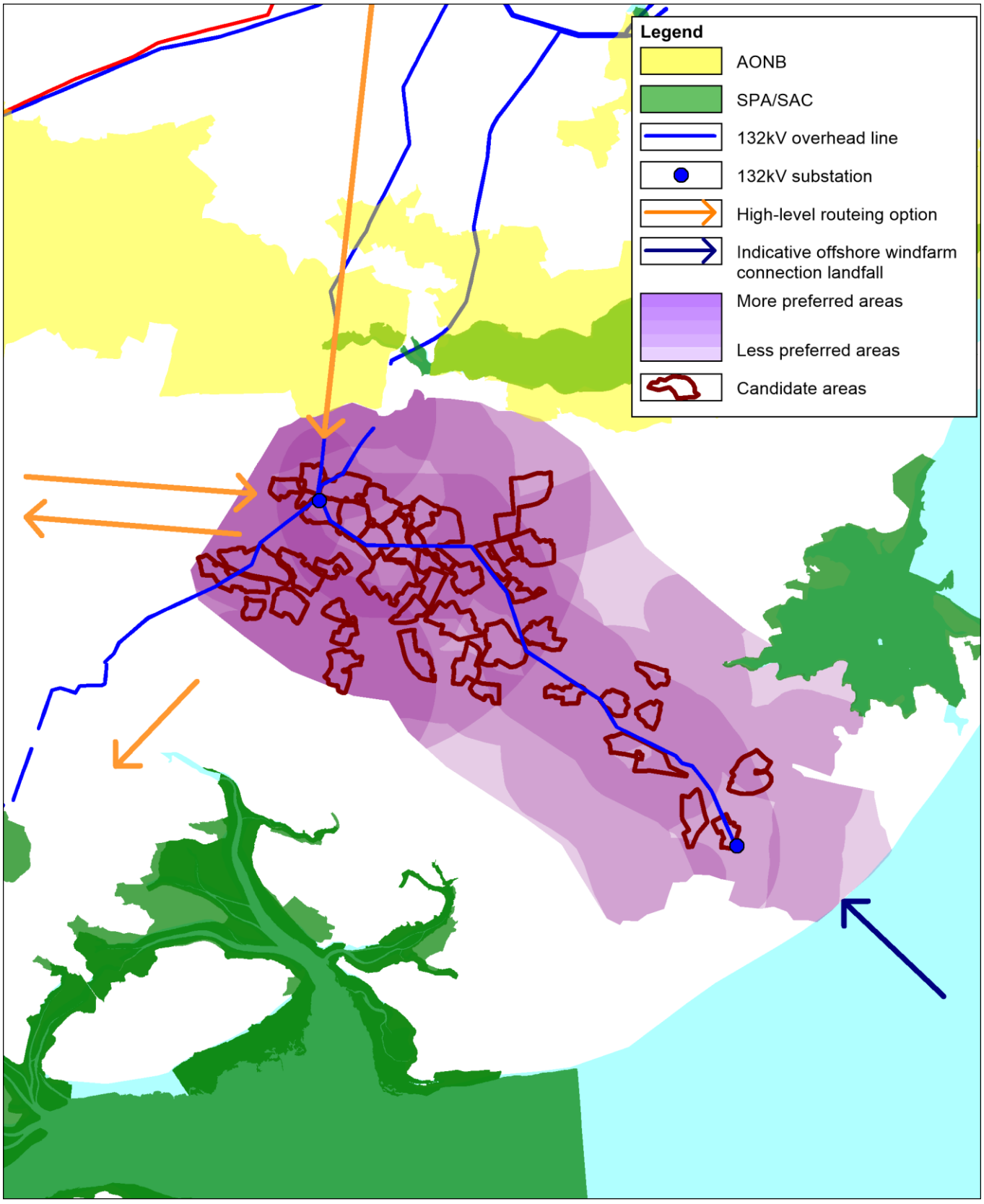
or removal of this line[15] could provide a meaningful reduction in the levels of effect likely to arise from the introduction of the 400kV overhead lines only for receptors located within 2km of the line to be removed. The distance of 2km was chosen as from a landscape and visual perspective it is considered that the incremental effect of the existing 132kV overhead line would not cause effects associated with the new 400kV overline to become significant above this distance. Preference was therefore given to locations within 2km of this 132kV overhead line.

6.2.8 With regard to proximity to the A and B road networks, it is noted that the construction of the EAC would require numerous heavy goods vehicle movements, including some for abnormal indivisible loads. Preference was therefore given to locations within 1km of the A or B road networks to limit environmental effects that may arise from any road improvements or new roads required to accommodate such movements.

6.2.9 It is important to note that the above factors were used as a guide to indicate where potentially preferable substation siting search zones might be located and that they were not applied as absolute requirements for a potential zone to be identified. Consideration was therefore given to a range of potential substation siting zones across the full width of the Tendring peninsula. **Figure 6.2**, below, shows potential candidate areas in relation to the preferred areas of search, where darker areas are more preferred and lighter ones less so.

[15] The 132kV line would need to be replaced by buried cables for any section taken down, or the new 400kV lines could supply an expanded substation at Holland Road if the whole 132kV line was removed.

Figure 6.2 –EAC Parameters for Preliminary Siting Zone Identification



6.3 Stage 1: Options Identification – EAC Siting Search Zone Identification and Refinement

6.3.1 The preliminary EAC siting search zone identification exercise identified a long-list of 45 relatively unconstrained contiguous candidate areas of at least 24ha with the potential to benefit from at least one of the opportunities described in Section 6.2. Whilst the majority of these areas were located in the north-western half of the Tendring peninsula, areas were also identified as far south-east as Holland Road. Initial, high-level analysis was conducted by environment subject matter experts to gauge the likely level of environmental sensitivity likely to be associated with each area. This analysis took account of factors including:

- The scope for mitigation;
- the broad nature of adjacent roads;
- the availability of existing screening elements;
- the proximity of adjacent residential properties or, if applicable, listed buildings;
- public rights of way and cycle routes; and
- the presence of any potentially valuable landscape elements.

6.3.2 In addition to the above, consideration was given to the likely length of 400kV overhead lines within the EAC study area required to connect to each area to the potential corridor sections to Bramford and Tilbury substations, described in **Chapters 5** and **7**. This included consideration of the shortest potential length of connection, the average length of all potential connections and (as a result of a back-check exercise undertaken after preferred corridor options had been provisionally been identified), the potential length of connection to the preferred corridor options. Consideration was also given to the potential length of underground cable required to connect to the windfarm landing area, based upon emerging information from the windfarm customers. Given that it is considered that, kilometre for kilometre, a lower level of environmental impact is likely to be associated with the underground cables for the windfarm connections than with the two overhead 400kV lines required to connect the EAC to Bramford and Tilbury, greater weight was given to the length of the 400kV overhead lines. As a result of this analysis, 19 candidate areas were identified as potentially being the least environmentally sensitive and were included on a short-list of candidate areas.

6.3.3 The areas included on the short-list were subject to further analysis regarding their potential to accommodate the EAC substation and windfarm substation infrastructure. This analysis considered whether all infrastructure could be co-located within one area, or whether areas within close proximity to each other (approximately 1km) could combine to accommodate all infrastructure. As a result of this analysis, nine areas, grouped into four zones were taken forward to Options Appraisal.

Initial Options taken forward for appraisal

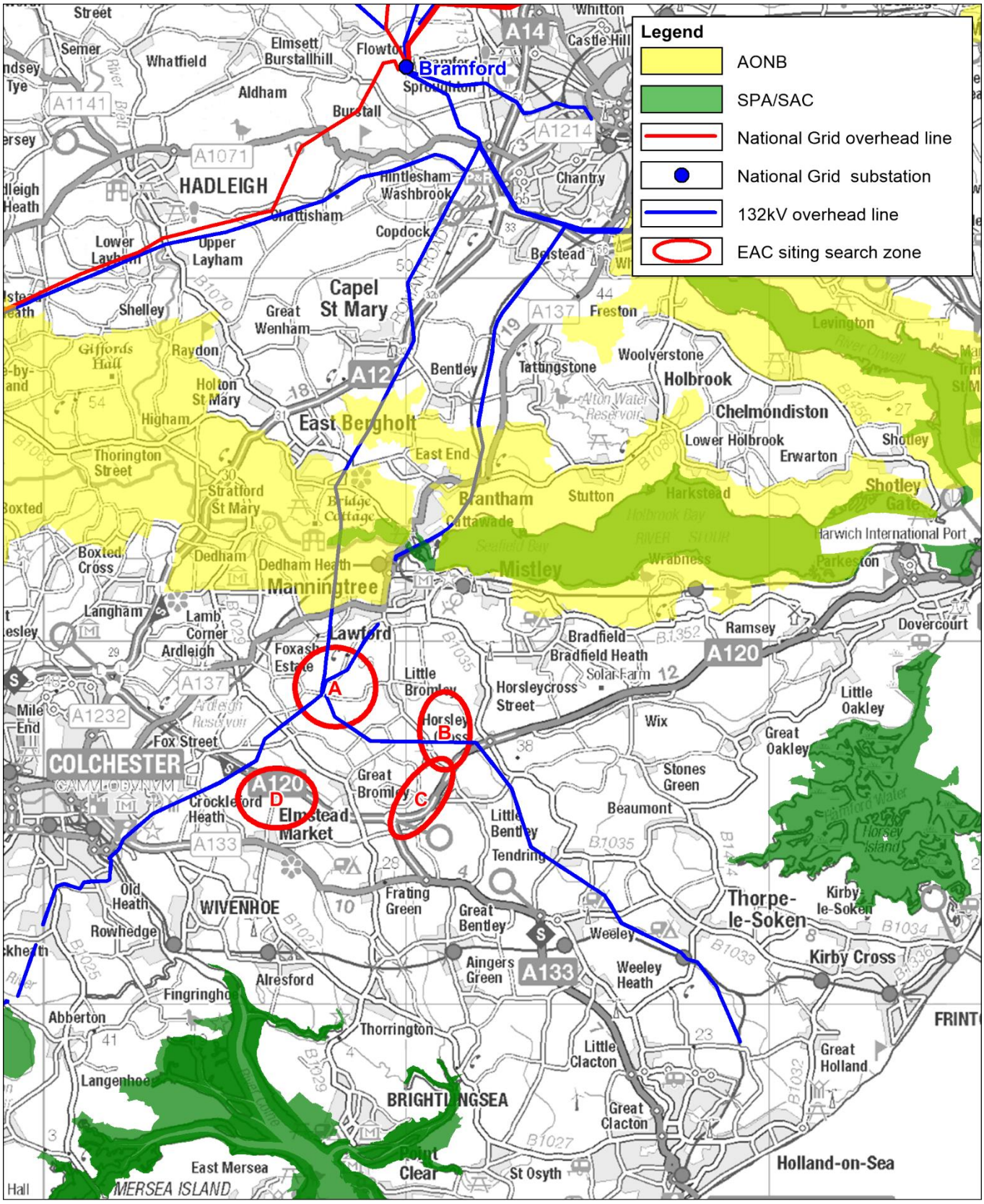
6.3.4 As a result of the options identification and refinement process described above, the following four options were taken forward to Options Appraisal:

- Zone A – an extensive zone including three individual areas centred on the 132kV substation near Little Bromley in the north-west of the peninsula;

- Zone B – a zone consisting of a single large area to the north-west of the A120 between Bentley Road and Horsley Cross;
- Zone C – a zone consisting of two areas to the immediate north-west of the A120 and to the immediate north-east of the junction of the A120 with the A133 near Hare Green;
- Zone D – a zone consisting of three areas to the immediate south of the A120 to the north of Elmstead Market;

6.3.5 The four options taken forward to options appraisal are shown on **Figure 6.3**.

Figure 6.3 – EAC options taken to Options Appraisal



Options not taken forward for appraisal

6.3.6 Twenty six of the long-list of 45 candidate areas were not taken forward to options appraisal because the initial, high-level analysis found them to be likely to be more environmentally constrained than the other 19 areas on the long-list. Of these 19 areas, ten were found to either have limited potential to potential to accommodate the EAC substation and windfarm substation infrastructure or not to offer advantages over areas that performed better in the high-level environmental analysis. Thirty six candidate areas were therefore not taken forward to options appraisal.

6.4 Stage 2: Options Appraisal

6.4.1 The Options Appraisal Summary Tables for the East Anglia Connection study part of the Project are set out in detail in **Appendix C**.

6.5 Stage 3: East Anglia Connection Options Selection

Overview

6.5.1 The identification of a suitable substation siting zone and the identification of suitable 400kV overhead line route corridors to the substation are interdependent as the preferred options for each element must perform well against selection criteria when considered in combination. As such, the development of substation siting zone options for the EAC was undertaken in parallel with the development of route corridor options for the connections between Bramford and the EAC and between the EAC and Tilbury. Options appraisal of the four EAC substation siting zone options was undertaken prior to the identification of preferred route corridor options for either of the two 400kV overhead line connections so that the emerging understanding of the likely performance of route corridor options and substation siting zone options could inform the identification of preferred options for all the elements.

6.5.2 The appraisal of the substation siting zone options therefore considered the likely impacts associated with all of the relevant sections of route corridor (i.e. Sections A and F from Bramford and Sections F, H and N to Tilbury). The preferred substation siting zone option was identified following the identification of Option BE5 as the preferred option for the connection between Bramford and the EAC (as described in Chapter 4) and the identification of Option ET1 as the preferred option for the connection between the EAC and Tilbury (as described in Chapter 7), thus ensuring that the impacts of both substation and 400kV overhead lines were taken into account in decision-making. Decision-making was informed by contributions from technical disciplines of engineering and costs and those from the environmental team to ensure that all constraints were considered.

6.5.3 A comparison of the performance of options against the appraisal criteria is summarised under the headings below.

Environmental performance of substation siting zone options

6.5.4 From an Ecology and Biodiversity perspective in relation to the siting of the substation, all the Zones were considered comparable when applying standard best practice mitigation measures. With regard to the 400kV overhead lines, all corridors were

assessed as neutral, and could support a route alignment, subject to appropriate and localised mitigation hierarchy mitigation and habitat reinstatement.

6.5.5 From a Historic Environment perspective in relation to the siting of the substation, whilst there would be potential effects on the setting of multiple listed buildings in each zone, if Zone D was taken forward it would require significant work to avoid a negative effect. This is particularly the case for Area 8 as there are clear views from the south front of Elmstead Hall (a Grade II* Listed Building), into this area and it is likely that significant adverse effects as a result of change to setting could not be avoided. This was considered to be determinative in decision making about which zone to take forward. With regard to the 400kV overhead lines, the exit corridor from Zone D would also likely give rise to significant adverse effects on the Grade II* listed Elmstead Hall which would be difficult to mitigate. All other zones performed similarly when considering the effects on the historic environment, subject to careful design of routeing. When considering customer underground cable connections, whilst more inland zones would result in greater effects on archaeology, the difference between the length of customer connection required for each zone was a small proportion of the overall length and therefore was not considered to be a differentiating factor.

6.5.6 From a Landscape and Visual perspective, Zone C was considered the most suitable zone when considering the substation infrastructure in isolation from the 400kV and customer connections. This was due to the ample scope for mitigation within the zone, relatively low numbers of adjacent residences and a low potential for the loss of valued landscape elements. The north/central part of Zone A, which has a relatively high incidence of existing screening, and the eastern part of Zone D also performed well in this regard. With regard to Zone A, other parts of the zone were assessed to be acceptable with screening, albeit noting that this may take time to establish. Zone B was considered the least preferred zone from a landscape and visual perspective due to its visually open nature and relative lack of existing screening elements.

6.5.7 Depending upon their length, the two 400kV overhead lines required to connect the EAC to Bramford and to Tilbury substations are likely to have the potential to give rise to greater landscape and visual effects than the substation itself and considerable weight was therefore given to the length of 400kV overhead line likely to be associated with each zone. The customer connections to the EAC will be made via underground cable and are considered to have far less potential to result in significant landscape and visual effects than the 400kV overhead lines. The customer connections were therefore given less weight. As all four of the potential substation siting zones are relatively remote from the likely customer connection landfall point, the difference between the length of customer connection required for each zone was a small proportion of the overall length and not considered to be a differentiating factor.

6.5.8 At options appraisal, consideration was given to the length of connection required to connect the EAC to all of the relevant sections of route corridor (i.e. Sections A and F from Bramford and Sections F, H and N to Tilbury). This exercise found that Zones A and D were likely to require the least length of connection when considered in relation to all scenarios, with Zone A performing well because of its proximity to Sections A and F, and Zone D because of its proximity to Sections H and N.

6.5.9 The identification of Option BE5 as the preferred option for the connection between Bramford and the EAC (as described in Chapter 4) and the identification of Option ET1 as the preferred option for the connection between the EAC and Tilbury (as described in Chapter 7), both of which utilise Section F, resulted in a strong preference for Zone A in relation to landscape and visual considerations. This was because the north/central

part of Zone A performed well in relation to substation infrastructure and would require a substantially shorter length of 400kV overhead line to connect to the preferred route corridor options than any of the other zones. While Zone C and the eastern part of Zone D also performed well in relation to substation infrastructure, the development of these zones would entail both 400kV overlines to be approximately 5km longer for Zone C than for Zone A and approximately 4km longer for Zone D. The addition of between approximately 8km and 10km in total length of 400kV overhead lines would entail the introduction of many more pylons into the landscape and would be highly likely to result in significant adverse landscape and visual effects being experienced by a greater number of receptors and across a greater geographical area.

6.5.10 From a Socio-economic perspective, all zones were assessed to have a neutral effect on socio-economic receptors in relation to both the siting of the substation and the 400kV overhead lines.

Engineering, system and cost performance of substation siting zone options

6.5.11 From a Technical perspective Zones A and B performed similarly. From a Transport perspective, Zone D performed the worst as it had no existing road connectivity from the A120 and as such would require access via residential areas or extensive upgrades to the existing bridge over the A120 to make it suitable to support abnormal invisible loads. Zone C performed better than Zone A and B due to it being directly adjacent to the A120 with existing bellmouth access in place, enabling good access into the site. By comparison, Zone A is not as accessible as Zone C. However, it was assessed that access to Zone A could be resolved in an acceptable manner that will reduce impacts on local residents.

6.5.12 Costs have been developed by National Grid's inhouse cost estimating team (EHUB) using consistent assumptions including that: new substations are AIS; route lengths are based on a route produced from a desktop exercise that is representative of the likely constraints to routeing; the costs of applying normal industry 'best practice' mitigation measures during construction and operation are inherent within the cost base used. Costs can therefore be compared on a consistent basis noting that they could be higher or lower, but consistent in relative terms. In relation to substations, the cost of substation infrastructure (i.e. excluding 400kV connections) would not be materially different between zones and is therefore not considered to act as a differentiator.

6.5.13 In relation to the preferred route corridor options between Bramford and the EAC (Option BE5) and between the EAC and Tilbury (Option ET1), both of which utilise Section F, Zone A would require the shortest length of connection and is considered as the baseline costing scenario. The costs for connecting to the other zones are based upon the additional length of connection that each would require.

6.5.14 A substation is preferred at a location where the extent of overhead line connections is reduced. A substation at Zone C would necessitate around an additional 10km of double circuit overhead line (5km towards Bramford and 5 km towards Tilbury) to reach it compared with a substation at Zone A. This would result in an additional cost in the order of £20million if Zone C was selected. The costs would also increase if Zones B or D were taken forward as the preferred location for a substation, with costs of an additional £16million for Zone B and also £16million at Zone D.

Policy performance of substation siting zone options

6.5.15 All zones have been considered against national and local policy and assessed against the Horlock Rules. In addition, the overhead line connection to and from these zones is assessed against the Holford Rules.

6.5.16 National and local policy considerations were not considered to materially differentiate between the zones.

6.5.17 From a Horlock Rules perspective all zones performed similarly. All zones would result in the loss of Grade 1, 2 and 3 agricultural land Best and Most Versatile (BMV) and as such this was not considered to be a differentiating factor in selecting a substation site.

6.5.18 From a Holford Rules perspective, at the route corridor stage of appraisal, it is difficult to identify significant differentiators between the overhead line corridors based on the Holford Rules, as all the options have been designed with due consideration of the Rules, and as far as possible to avoid areas of environmental constraint. Notwithstanding this, an assessment against the Holford Rules has been undertaken and it is assessed that Zone A would result in the most direct (and therefore shortest) amount of overhead line in the landscape (Holford Rule 3) compared to the other Zones. As a result, an assessment against the Holford Rules favoured Zone A compared to the other zones.

Conclusion to East Anglia Connection Substation Selection

6.5.19 Overall, a decision about which zone to take forward as the Preferred Option was driven by the differences between landscape, technical engineering challenges and cost. Zone A would also result in shorter length of overhead line which would mean fewer pylons and thus fewer effects compared to Zones B to D. This was assessed to be a differentiating factor between the zones as it avoided introducing further additional overhead lines into the landscape.

6.5.20 Whilst Zone A as a whole was considered less preferable from a Landscape and Visual perspective compared to Zone C when considering the substation in isolation, when account is taken of the 400kV overhead lines, Zone A would require the shortest length of connection and is the preferred zone for the East Anglia Connection substation site. The cost for a substation at Zone A would be between approximately £16 million and £20 million less than that for a substation at any of the other zones.

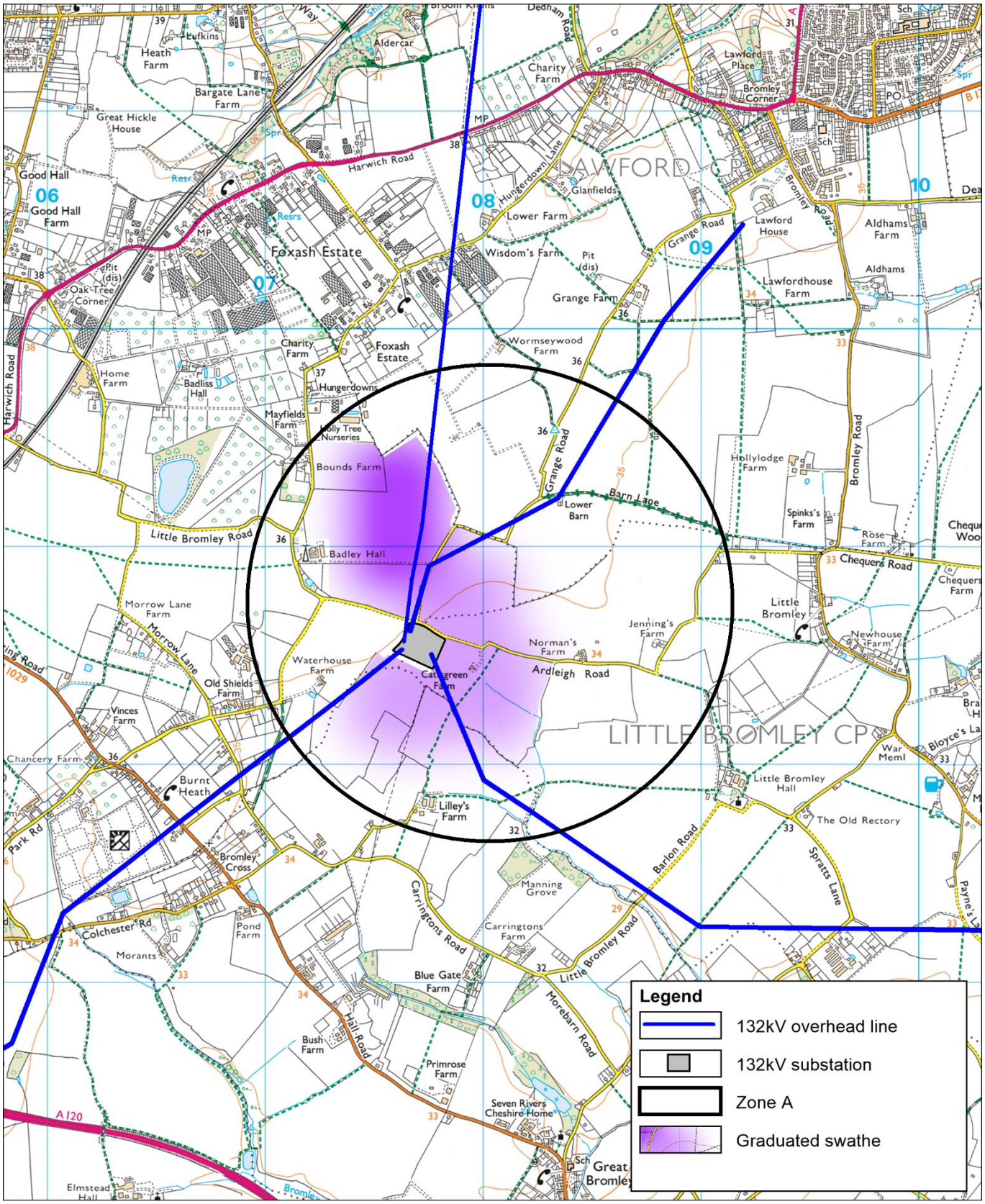
6.6 Stage 4: Development of Graduated Swathe

6.6.1 Following the identification of Zone A as the Preferred Option, an analysis of potential substation layouts within the zone was undertaken by engineering subject matter experts and reviewed by environment subject matter experts. The analysis identified areas in the Preferred Option zone within which Project infrastructure is considered more or less likely to be located. The analysis was informed by the same desk-based studies and limited field observations that informed the options appraisal and its findings should therefore be considered provisional, indicative and subject to revision as more detailed information becomes available. Notwithstanding their provisional nature, it is considered that the areas identified provide a reasonable indication of where development is more or less likely to take place within the Preferred Option zone and that this information will be helpful in assisting stakeholders to understand the Project proposals during the non-statutory consultation to be undertaken as Stage 5 of this phase of National Grid's development process.

6.6.2 In order to communicate the findings of the analysis to stakeholders in a manner that does not imply an inappropriate level of certainty, the areas within the Preferred Option zone that may host the substation infrastructure are indicated by means of different densities of shading, referred to as a graduated swathe. The graduated swathe uses darker tones to indicate areas in which development is considered to be more likely and lighter tones to indicate where it is considered less likely. The absence of any shading within the Preferred Option zone indicates that development in these areas is considered unlikely, but possible. Areas of the Preferred Option zone that the analysis identified as having very little potential to host substation infrastructure have been removed,

6.6.3 The Preferred Option zone and the graduated swathe are shown on **Figure 6.4.**

Figure 6.4 –EAC Substation Graduated Swathe



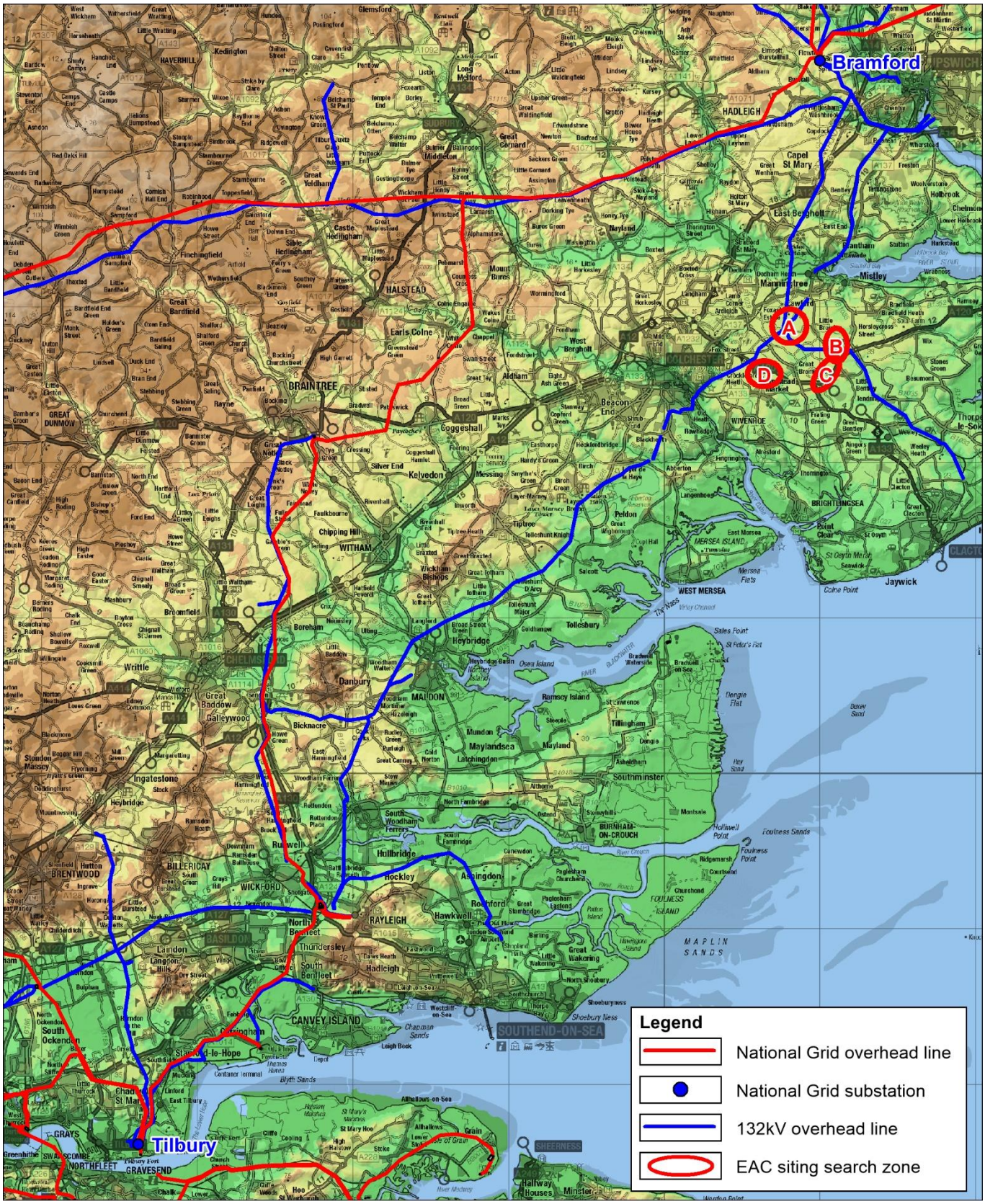
7. East Anglia Connection Substation to Tilbury Options Appraisal

7.1 Stage 1: Options Identification - the Study Area

7.1.1 The Strategic Proposal identifies a 400kV double circuit connection between the new EAC substation on the Tendring peninsula, in Essex and Tilbury substation near the River Thames at Gravesend Reach. In line with the existing NPS EN-5, and in the absence of national landscape designations, the Project working assumption is that this connection should be made via overhead line supported by steel-lattice pylons.

7.1.2 The EAC to Tilbury Study Area is shown on **Figure 7.1**.

Figure 7.1 – EAC to Tilbury Study Area



7.1.3 The Study Area is bounded to the north by the southern boundary of the Dedham Vale AONB, by the coast to the east and by the River Thames to the south. In the south, the Study Area extends as far west as Brentwood, while in the centre and north, it extends to Braintree and Halstead, beyond which it is considered unlikely that a preferred option would be located due to the increased length of connection required when alternative shorter and more direct options are available and appear viable subject to normal routeing development work. The Dengie and Rochford peninsulas are excluded from the Study Area as any potential routes through these areas would entail substantial deviation. The straight-line distance between EAC substation siting search zones and Tilbury substation is approximately 68km.

7.1.4 No areas of the highest amenity value are present within the Study Area but as noted above the Dedham Vale AONB is located to the immediate north of the Study Area.

7.1.5 Extensive internationally designated areas of nature conservation are present along the coast and estuaries adjacent to and within the east of the Study Area. Most of these (i.e. the Colne Estuary SPA, Blackwater Estuary SPA, Crouch and Roach SPA, Benfleet and Southend Marshes SPA, Thames Estuary & Marshes SPA and Essex Estuaries SAC) are peripheral to the Study Area, but their more westerly edges are included in order to allow consideration of the most direct potential routeing options. Abberton Reservoir SPA falls wholly within the Study Area (it is surrounded) and is included for the same reason. Species dependant on these designated areas may forage, roost or migrate (on a daily and/or seasonal basis) on non-designated habitats surrounding the designations or further inland.

7.1.6 The landform of the Study Area is strongly influenced by the estuaries and valleys of the Rivers Colne, Blackwater and Thames and their tributaries. Ground elevations within the valley floors range from approximately 5m to 25m AOD. The majority of these valleys cross the Study Area on a broadly south-east/ north-west alignment, which limits the opportunity for a connection between the EAC, in the north-east of the Study Area, and Tilbury, in the south-west, to be routed within moderately open valleys as recommended by Holford Rule 5. However, some such opportunities may be afforded by the more complex system of valleys associated with parts of the Rivers Chelmer and Blackwater and their tributaries. Ground elevations generally increase gradually from the coastal plain to the south-east to the more elevated areas to the north-west. Ground elevations on the coastal plain range from a little above sea-level to approximately 20m AOD, whilst the highest elevations along the western edge of the Study Area are generally in the region of 70m to 90m AOD. There are a small number of isolated hills and ridges that form the exception to this rule, including the ridge running north-east from Wickham Bishops and the hill at Danbury, which reaches a maximum elevation of 112m AOD.

7.1.7 The Study Area is located wholly within Essex, including all or part of the districts of Basildon, Braintree, Brentwood, Castle Point, Chelmsford, Colchester, Maldon, Rochford and Tendring, and the unitary authority of Thurrock.

7.1.8 Settlement in the north and centre of the Study Area is dominated by the city of Chelmsford and the large towns of Colchester, Braintree, Witham and Maldon. Beyond the larger settlements, the Study Area displays a relatively dense pattern of smaller towns and large villages, with only the coastal plain between Maldon and Colchester being relatively sparsely settled. Settlement is notably denser in the south of the Study Area, with extensive ribbon and infill development between the major towns of Basildon, Billericay, Wickford, Thundersley/South Benfleet and Stanford-le-Hope. In this part of

the Study Area, the area between Brentwood and Billericay and to the west of Basildon is relatively less densely settled.

7.1.9 The major roads within the Study Area are the A12, which traverses the Study Area from the north-east to the south-west, the A120, which traverses the northern part of the Study Area from east to west, the A131 and A130, which traverse the Study Area from north to south, and the A127 and A13 which traverse the Study Area from east to west in the south. In addition to the major roads, the Study Area is served by a relatively dense network of smaller A and B roads, with this network being notably denser in the south. Similarly, the railway network within the Study Area is also densest in the south, where all the larger settlements, and many of the smaller ones, are linked by lines radiating out from London, to the south-east. In the centre and north of the Study Area, railways are restricted to the line between Chelmsford and Colchester and its spurs to Braintree and Sudbury.

7.1.10 NTS infrastructure within the Study Area consists of the 4YLA route between Twinstead and Braintree, the 4VB route between Braintree and Rayleigh substation, the ZJ route between Rayleigh and Tilbury, and the YYJ and ZB routes, both of which enter Tilbury substation from the north-west. Whilst disconnected, the ZT route, between Rayleigh and the decommissioned nuclear power station at Bradwell, is still present in the landscape to the north and north-west of Rayleigh. With regard to 132kV distribution network overhead lines, there are two that run broadly parallel to the ZJ and 4 VB routes, one that runs between the 132kV substation at Little Bromley to the north-east and Rayleigh in the south, one between Rayleigh and Warley substations in the south, and another that runs on a north/ south alignment between Brentwood and Tilbury.

7.2 Stage 1: Options Identification – Constraints and Opportunities

7.2.1 Following the definition of the Study Area, constraints were mapped and categorised in accordance with the parameters set out in **Table 3.1.**

7.2.2 The most influential environmental constraints to options for routeing within the Study Area include residential settlement, national and international areas designated for nature conservation in respect of which National Grid has statutory duties and heritage assets including extensive scheduled monuments to the south of Colchester. Whilst the Dedham Vale AONB is located to the immediate north of the Study Area, no areas of the highest amenity value are present within it.

7.2.3 In the north of the Study Area, the town of Colchester is located to the immediate west of the EAC siting search zones identified on the Tendring peninsula and presents a major constraint to corridor options seeking to host routes toward Tilbury, to the south-west. The most direct connection would involve routeing to the south-east of Colchester and across the coastal plain toward Maldon and, in accordance with Holford Rule 3, it was decided that the options identification exercise should seek to exploit this opportunity. However, given the potentially constrained nature of the area to the south-east of Colchester, due to areas designated for nature conservation and the need to cross a tidal section of the River Colne, it was decided that additional options, seeking to route to the north of Colchester, should also be identified. To the south of Colchester, there is a potential opportunity to mitigate the environmental impact of a new connection on the relatively direct, more easterly route toward Tilbury through the removal of the 132kV overhead line between Colchester and Rayleigh, though this line is itself in close proximity to Abberton Reservoir SPA. Further west, the presence of the

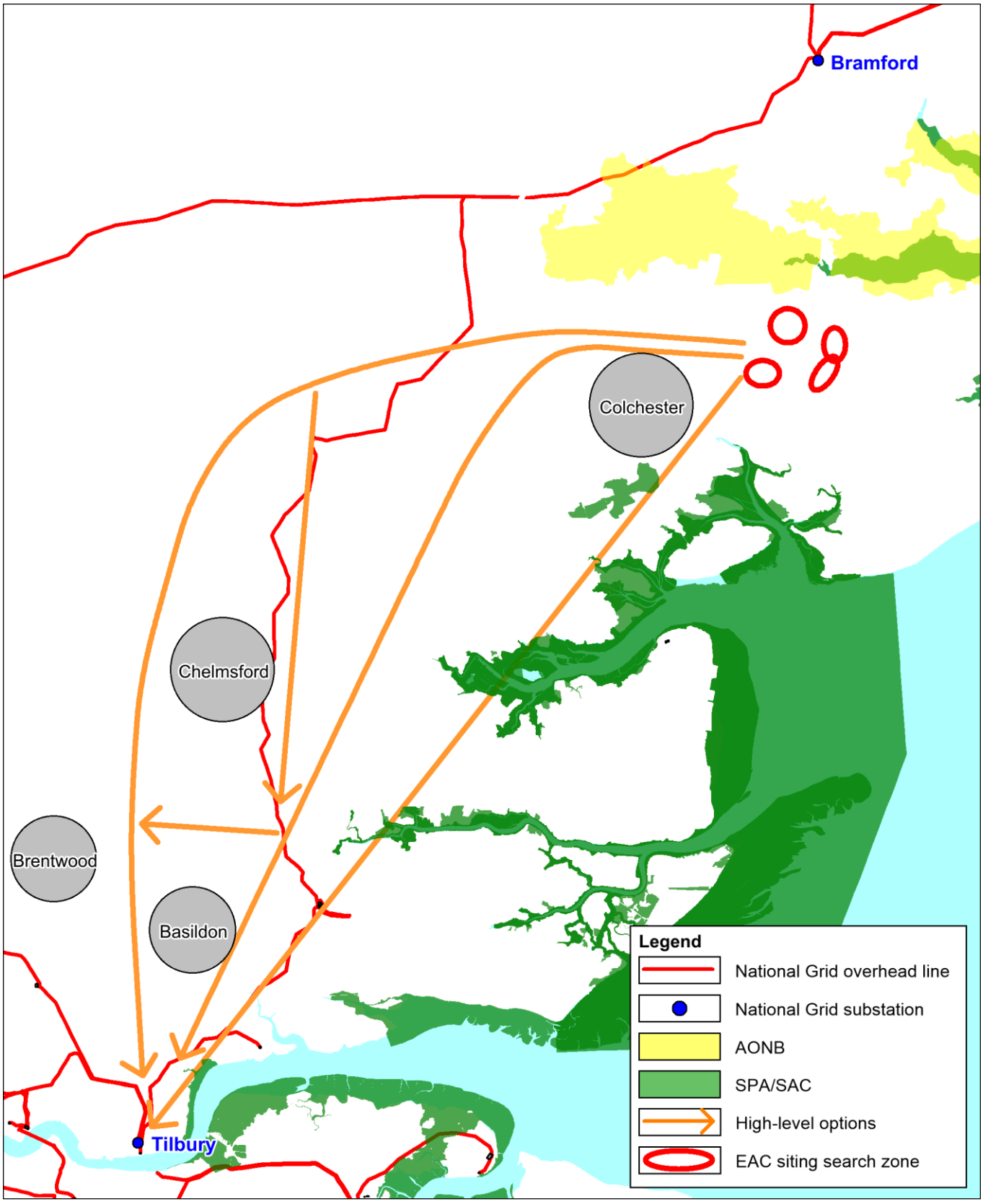
400kV 4VB route and adjacent 132kV overhead line between Braintree and Rayleigh, may offer an opportunity for the new connection to close parallel the 4VB route and an opportunity for mitigation through the removal of the 132kV line in relation to the southward extension of potential options that routed to the north of Colchester. It was decided that, if possible, option corridors should be identified in relation to both of these potential opportunities.

7.2.4 In the central part of the Study Area opportunities for routeing southwards are constrained by the city of Chelmsford in the west, Maldon in the east, and elevated ground and settlement of Danbury in the centre. It was therefore decided that additional options to the west of Chelmsford should be identified if possible.

7.2.5 The southern part of the Study Area is highly constrained by settlement. In the east, the gaps between the settlements of Basildon/ Wickford and Thundersley/ South Benfleet are relatively narrow. The presence of Rayleigh substation and its associated 400kV and 132kV overhead lines in this area may add engineering complexity, but the ZJ route to the south of Rayleigh may also offer a potential opportunity for mitigation through close-paralleling. The area to the west of Basildon and the relatively large gap between the settlements of Brentwood and Billericay are notably less constrained than those to the east and so the potential for option corridors were investigated to both the east and west of Basildon. Because of the potentially highly constrained nature of options to the east of Basildon, the potential for at least one option should be identified to allow more easterly options to cross westwards south of Colchester was also investigated.

7.2.6 Consideration was therefore given to a range of potential corridor options across the full width of the Study Area. The length of connection associated with routeing in different parts of the study area ranges from between approximately 73km to 84km, for corridors passing to the south-east of Colchester and routed towards Tilbury via Maldon and Rayleigh, to between approximately 77km and 90km for corridors passing to the north of Colchester. On this basis, the parameters of the preliminary, GIS-based corridor identification exercise were set to include options passing to the south-east and north of Colchester, easterly options via Maldon and Rayleigh, westerly options to both the east and west of Chelmsford and options to switch from east to west. **Figure 7.2**, below, shows the pursued areas in schematic form and also shows route options from Bramford to illustrate the potential for interactions.

Figure 7.2 –EAC to Tilbury Parameters for Preliminary Corridor Option Identification



7.3 Stage 1: Options Identification – Corridor Identification and Refinement

Identification and Refinement of Preliminary Options

7.3.1 The preliminary corridor identification exercise identified twelve corridor option sections on the basis of a balance between directness of route (notwithstanding that the parameters of the exercise included the identification of options that pass to the north of Colchester and the west of Chelmsford) and the avoidance of constraints. Corridor option sections were defined to allow them to be combined in multiple permutations to provide a range of corridor options. This approach enabled sections common to more than one option to be appraised without duplication. Sections also reflect the potential interaction of corridor options between the EAC and Tilbury, and those between Bramford and the EAC described in Section 4.

7.3.2 The identified corridor sections are set out below noting, for the avoidance of doubt, that the letters "I" and "O" were not used as they may be misidentified as numbers and lead to potential misunderstanding:

- Section F – a section routeing north of Colchester and to the north of Ardleigh Reservoir;
- Section G – a short section required to link Section F to Sections J or K;
- Section H – a section routeing north of Colchester and to the south of Ardleigh Reservoir;
- Section J – a short section required to link Section G to Section M, or Section H to Sections K or M;
- Section K – an extensive section that allows the sections routed to the north of Colchester (Sections F & G and Sections H & J) to continue southward via an inland route, to the west of Chelmsford;
- Section L – a section that allows the sections routed to the north of Colchester that link to Section K, to continue southward via an inland route, to the east of Chelmsford;
- Section M - a section that allows the sections routed to the north of Colchester, that link to Section J, to continue southward to join the more easterly routes in the vicinity of Maldon;
- Section N – a section routeing to the south-east of Colchester and continuing southward across the coastal plain toward Maldon;
- Section P – a relatively short section to the west of Maldon that links Section N or M, to the north, with Sections Q or S, to the south;
- Section Q – a section on a broadly east/ west alignment that allows sections routed to the south-east of Colchester (Sections N and P) to continue southward via an inland route to the west of Billericay and Basildon (Section R);
- Section R – an extensive section with the potential to link all sections, other than Section S, to Tilbury via an inland route to the west of Billericay and Basildon; and
- Section S - an extensive section with the potential to link all sections, that link to Section P from the north, to Tilbury via Rayleigh, to the east of Basildon.

7.3.3 These preliminary corridor sections were subject to an iterative process of review and refinement by both environmental and technical specialists. This process of refinement resulted in the removal of some parts of corridors, primarily due to the presence of engineering constraints, and the extension of corridors to provide alternative routes to avoid constraints. Additions to the sections included:

- The extension of Section S southward towards South Woodham Ferrers to allow the investigation of opportunities that may arise from the decommissioning of the ZT route;
- the extension of Section S southward and eastwards towards Canvey Island to avoid a potentially constrained crossing of Vange Creek in close proximity to the ZJ route and adjacent 132kV overhead line;
- the addition of an eastern branch of Section R to allow routeing through less constrained areas to the west of Little Burstead; and
- a westward expansion of Section K to enable a more gradual change of direction to the west of Writtle.
- Two additional sections south of Colchester:
  - Section T North – a section that allows a link from Section N east of Colchester to continue southwards via an inland route either on Sections M or K.
  - Section T South – a more southerly section south of Colchester that allows a link from Section M to K to continue southward via a more inland route.

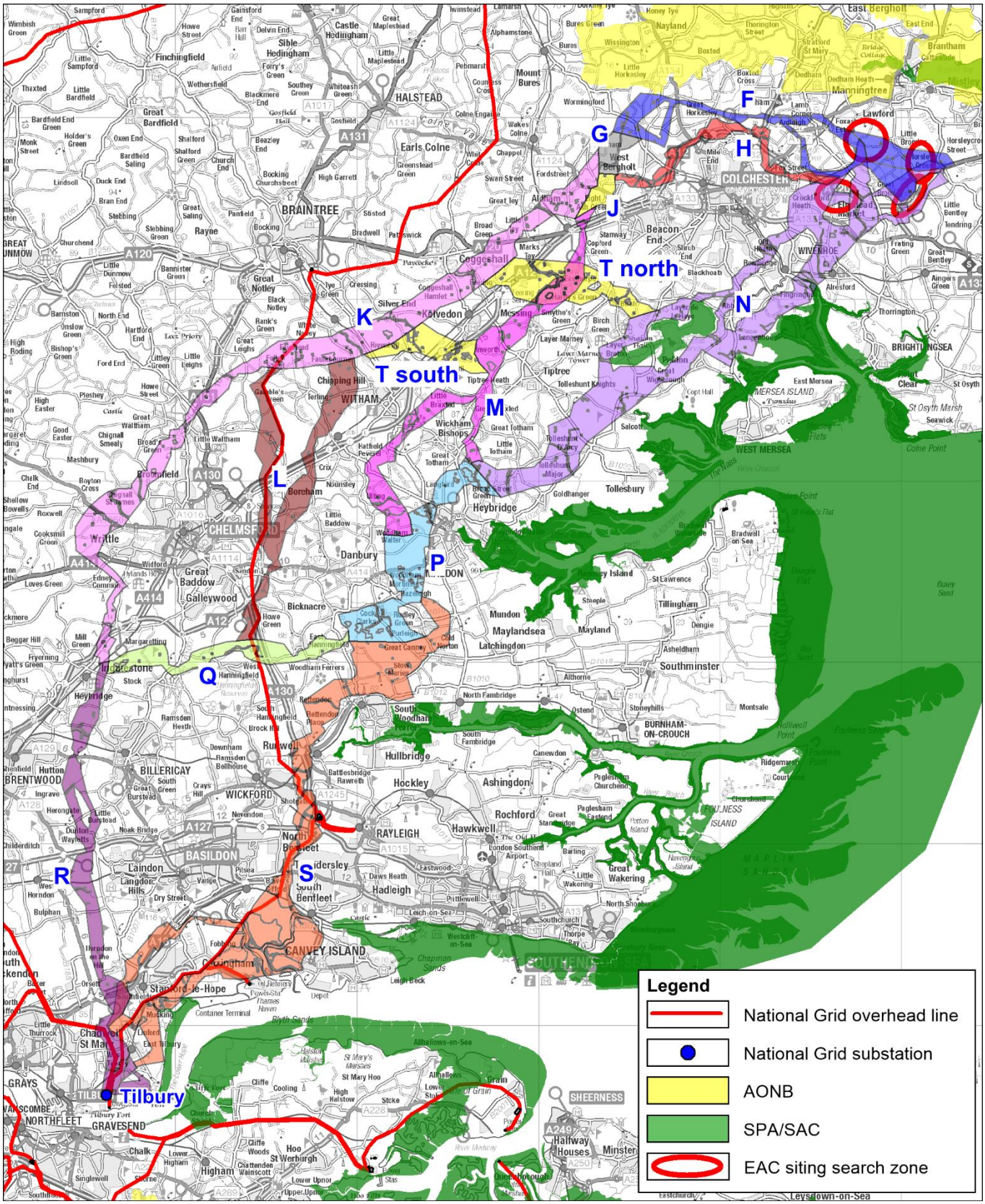
Options taken forward for appraisal

7.3.4 All fourteen of the corridor sections described above, were taken forward to options appraisal. The fourteen corridor option sections are shown on **Figure 7.3**.

Options not taken forward for appraisal

7.3.5 All identified corridor sections were taken forward for appraisal.

Figure 7.3 –EAC to Tilbury corridor sections taken to Options Appraisal



7.4 Stage 2: Options Appraisal

7.4.1 The Options Appraisal Summary Tables for the EAC to Tilbury part of the Project are set out in detail in **Appendix D**.

7.5 Stage 3: East Anglia Connection Substation to Tilbury Options Selection

Overview

7.5.1 Following the appraisal of all corridor sections, a challenge and review workshop took place to analyse and discuss the outputs of the options appraisal, park non-preferred sections and identify combinations of sections to be taken forward as corridor options to the decision workshop.

7.5.2 The filtering workshop did not identify any corridor sections as non-feasible.

7.5.3 The filtering workshop identified the following permutations of sections as potentially viable corridor options between the EAC and Tilbury:

- Option ET1 - An option routeing to the north of Colchester and to the west of Chelmsford, consisting of either Section F and G, or Sections H and J, plus Sections K and R;
- Option ET2 - an option routeing to the south-east of Colchester and via Maldon and Rayleigh, consisting of Sections N, P & S;
- Option ET3 - an option routeing to the north of Colchester and via Maldon and Rayleigh, consisting of either Sections F, G and J, or Sections H and J, plus Sections M, P and S;
- Option ET4 - an option routeing to the north of Colchester and via Maldon and to the west of Basildon, consisting of either Sections F, G and J, or Sections H and J, plus Sections M, P, Q and R;
- Option ET5 - an option routeing to the north of Colchester and to the east of Chelmsford, consisting of either Section F and G, or Sections H and J, plus Sections K, L, Q and R; and
- Option ET6 - an option routeing to the east of Colchester and south of Colchester consisting of either Sections N and T North, or Sections N, T North, M and T South, plus Sections K and R

7.5.4 As outlined in section 7.2, a decision workshop was held to consider the effects of the options identified on receptors in the study area. Project team representatives from technical disciplines of engineering and costs attended the workshops alongside those from the environmental and planning team to ensure the discussions were comprehensive and considered all constraints. Each option was considered in turn, with each technical topic's key constraints being noted as the workshop progressed.

7.5.5 The workshop concluded that Option ET1 (Sections F, G, K and R) was the preferred combination for the East Anglia Connection substation to Tilbury Option. However, it recognised that there are a number of constraints that are expected to require further consideration and potential mitigation to ensure that effects are avoided or reduced.

Environmental performance of options corridors

7.5.6 From a Biodiversity and Ecology perspective, corridor options composed of sections furthest from the coast (Sections F, G, H, J, K and R) are preferred from the EAC substation to Tilbury. These corridor options are not likely to result in adverse effects on the integrity of internationally designated sites, or at the very least present significantly less risk in respect of Likely Significant Effects (LSEs) on the integrity of the international and supporting nationally designated sites. The relevant sites are listed below:

- Section N (Colne Estuary SPA, Colne Estuary Ramsar, Colne Estuary SSSI, Blackwater Estuary SPA, Blackwater Estuary Ramsar, Blackwater Estuary SSSI, Essex Estuaries Special Area of Conservation, Abberton Reservoir SPA, Abberton Reservoir Ramsar and Abberton Reservoir SSSI);
- Section P (Blackwater Estuary SPA, Blackwater Estuary Ramsar, Blackwater Estuary SSSI, Essex Estuaries SAC Essex Estuaries (and component SSSIs); and
- Section S (Crouch and Roach Estuaries SPA, Crouch and Roach Estuaries Ramsar, Crouch and Roach Estuaries SSSI, Benfleet and Southend marshes SPA, Benfleet and Southend Marshes Ramsar (and component SSSIs), Thames Estuary and Marshes SPA, Thames Estuary and Marshes Ramsar (and component SSSIs), Outer Thames Estuary SPA, Outer Thames Ramsar , SAC Essex Estuaries SAC and Blackwater Estuary SPA, Blackwater Estuary Ramsar , Blackwater Estuary SSSI and Pitsea Marsh, Langdon, Vange & Fobbing Marshes, Holehaven Creek Mucking Flats and Marshes SSSIs).

7.5.7 These designated sites (which include highly mobile qualifying interest features) and functionally linked habitats, are sufficiently close to the corridor options east of Colchester and which are close to the coast, to mean that direct or indirect effects would result in LSEs on the integrity of the designated sites. In addition, these corridor options cross potential connectivity pathways to the designated sites (e.g. River Blackwater) which would be likely to result in LSEs and with potential for Adverse effects on Site Integrity (AEoSI) of the designated sites, during both construction and operation of the transmission connection.

7.5.8 This potential long term operational effect arises from the potential collision of those species with overhead lines (the earthwire is typically of most concern in 400kV overhead line connections due to its lower visibility). The employment of alternative technology such as undergrounding in the ZOI is a potential mitigation, but in itself, may result in LSEs or AEoSIs.

7.5.9 Before an eastern coastal route could be preferred, all of these areas would have to be subject to extensive survey and assessment work to fully understand flight-lines, movements and functionally linked habitats both in and extending into the vicinity of the designations. A multiyear survey and assessment programme would be required to provide robust and irrefutable evidence beyond all reasonable scientific doubt to be able to demonstrate no AEoSI with or without mitigation measures (including the employment of alternative technology such as undergrounding). Any mitigation would require detailed survey data and assessment to justify its suitability and efficacy to ensure no AEoSI for the designated sites. At this stage in the appraisal process, there is a high level of uncertainty as to the magnitude and effectiveness of any additional

mitigation to remove such potential AEoSI. All of this work would be subject to consultation and agreement with Natural England. The views of Natural England will be obtained through non-statutory consultation but for the purposes of this report and the conclusions drawn, it is considered likely that Natural England would support the appraisal findings in respect of the preference for the corridor sections furthest from the coastal designations.

7.5.10 In that respect it should be noted that the extent of LSEs will not be determined by assessment of the effect of the project on one designated site alone, but in combination with related or supporting designations; this is exemplified by the Blackwater Estuary and Abberton Reservoir, which are likely to have a considerable level of exchange of birds between them (a functional relationship that is not fully understood at this stage of appraisal), including species that are known to be vulnerable to risk of overhead line collision. This has the potential to apply to some or all of the other designations along the coastal corridor options. Thus, it confers further significant complexity in terms of both approach to survey and assessment, and thus the evidential burden on the project in terms of the quality and amount of the survey data required to rule out AEoSI beyond all reasonable scientific doubt (in consultation with Natural England as noted above).

7.5.11 If survey and assessment work were to indicate that LSEs would be likely to result from the development of a connection corridor close to or linked to coastal areas there would be a requirement for an Appropriate Assessment (AA) to be undertaken in respect of the project. The current expert view is that AEoSI are likely to be the result of an eastern coastal connection from EAC substation to Tilbury. If that is the case and AEoSI cannot be ruled out, then under an AA of that eastern coastal option, if alternatives are available that do not result AEoSI to the identified designated sites, they should be taken forward in preference to the eastern coastal option. It is the view of the relevant experts that those options further inland are likely to result in no AEoSI or at the very least a lower risk of significance of AEoSI to the designated sites. On that basis from the view of ecology and biodiversity the eastern options close to the coast are not preferred over the inland options to the west, as part of the route connection option from the EAC substation to Tilbury. This conclusion will be tested with Natural England through non-statutory consultation on the preferred route option identified in this report with back-checking on the preferred route alignment as necessary.

7.5.12 It is acknowledged that section R would fall within close proximity to the Thames Estuary and Marshes SPA (and Ramsar site) with the potential for LSEs. However, due to the orientation of section R, which approaches the coast from inland rather than running parallel to the coast, it is not in such close proximity to the designations. It is therefore likely to have less adverse effects than of section S, the only alternative to link to Tilbury Substation. Therefore, whilst there is potential for some LSEs to occur, the weight of probability is that any AEoSI are potentially more capable of being adequately negated through mitigation measures. Should AEoSI remain, it would be necessary to demonstrate no better alternative (section S does not provide this) and Imperative Reasons of Overriding Public Interest (IROPI), and clear and demonstrably sufficient levels of compensatory measures to demonstrate the maintenance of overall coherence of the designated site affected, would be required. Section R thus provides the preferable alternative to section S, which is adjacent to the designated sites and the expert assessment is that the latter is more likely to result in AEoSI.

7.5.13 Option ET1 (composed of either Section F and G, or Sections H and J, plus Sections K and R) was therefore considered the preferred option from a Biodiversity and Ecology perspective.

7.5.14 From a Historic Environment perspective, there would be effects on multiple listed buildings in all of the sections including on Grade I and Grade II* buildings. However, a comparison of the magnitude of change on individual listed buildings would vary significantly with detailed routeing within corridor options. As a result, the effects on listed buildings were not considered to be sufficiently dissimilar between the corridor options to act as a differentiator in identification of a preferred option. In terms of effects on conservation areas, Section P would directly pass through the Chelmer and Blackwater Navigation Conservation Area and Section S contains the Stow Maries World War One Aerodrome Conservation Area (albeit it is assessed that sufficient space for alignments within Section S to avoid direct effects on this particular Conservation Area should be possible). In both instances, this was assessed to be a factor that differentiated it from the other corridors. In terms of scheduled monuments, the southern branch of Section F passes very close to the scheduled hill fort at Pitchbury Ramparts. This is a differentiator between the branches of Section F and, as a result, there is a distinct preference for the northern branch of Section F at the east end of this section to maximise the separation from the scheduled monument. Section H would have less effect on the Pitchbury Ramparts Scheduled Monument due to having a greater separation distance compared to Section F. Overall, whilst effects to the historic environment would occur in the inland corridors, it is considered that with mitigation Option ET1 (composed of either Section F and G, or Sections H and J, plus Sections K and R) should be capable of achieving consent.

7.5.15 From a Landscape and Visual perspective, all sections connecting at the EAC (Sections F, H and N) and both sections connecting at Tilbury (Sections R and S) have the potential to give rise to significant cumulative adverse effects on landscape character and/or visual amenity in combination with other electricity transmission or distribution infrastructure at these points. However, as these effects would be common to all corridor options, they are not considered to provide differentiation. Non-cumulative significant adverse effects on landscape character are considered likely only in relation to Section N, within Option ET2, as it traverses the open and relatively undeveloped coastal plain between Colchester and Maldon. With regard to areas of the highest amenity value, the western part of Section F, within Options ET1, ET3, ET4 and ET5, may have the potential to give rise to significant adverse effects on the Dedham Vale AONB in the vicinity of Little Horkesley. However, the relatively elevated and wooded nature of the nearest part of the AONB in this vicinity may limit the susceptibility of the AONB in this area. The potential for significant adverse visual effects is relatively evenly distributed across most corridors, with the exception of Section S, within Options ET2 and ET3, where the dense pattern of settlement and narrow width of areas between settlements, particularly between the settlements of Basildon/ Wickford and Thundersley/ South Benfleet, could result in such effects being experienced by large numbers of people and may not be able to be mitigated.

7.5.16 Sections G, K and R, within Options ET1 and ET5, provide the preferred route between Colchester and Tilbury in Landscape and Visual terms. Whilst these corridors would link to the EAC via Section F, and Section F has the potential to give rise to significant adverse effects in relation to the Dedham Vale AONB, it is considered that it would be possible for such effects to be mitigated and the combination of Sections F, G, K and R is the preferred combination from a Landscape and Visual perspective. Of the two options that utilise this combination of sections, preference from a landscape and visual perspective is given to Option ET1, which is routed to the west of Chelmsford wholly via Section K, over Option ET5, which is routed to the east of Chelmsford via Sections K, L and Q. This is as a result of the greater potential for visual effects associated with Sections L and Q due to interaction with existing 400kV and 132kV overhead lines to

the east of Chelmsford and to the additional relatively sharp changes of direction required to utilise these sections. Option ET1 was therefore the preferred option from a landscape and visual perspective.

7.5.17 From a Socio-economic perspective, Sections N, Q and R have the potential to have negative effects on golf courses. Notwithstanding this, it is assessed that with detailed routeing within the section effects could be minimised. As a result, the effects on socio-economic receptors were not considered to be determinative in decision making about which corridor to take forward.

Engineering, system and cost performance of options

7.5.18 From a technical perspective Sections N, P, S (the more coastal sections within Options ET2 and ET3) and Section M (a central corridor within Options ET3, ET4 and ET6) had greater technical complexity and construction and delivery issues. This included extensive interactions with 132kV and 400kV overhead lines, multiple pinch points, the need for several sections of undergrounding, river crossings (including HDD) and potentially highly restricted periods for construction in order to avoid disturbance effects to the species associated with the designated sites. In addition, routeing to the east of Chelmsford in Section L would involve a greater number of technical complexities due to interactions with District Network Operator and National Grid assets. This was a factor that was assessed to weigh in favour of other corridors.

7.5.19 From a Technical perspective, corridor Option ET1, composed of Sections F, G, K, R, is regarded as the preferred option (noting the constraints for corridor F are covered in Section 5), despite some localised areas of constraints and reduced flexibility, predominantly associated with narrow parts of Section F due to residential properties, listed buildings and farm complexes. The crossing of the A12 in Section F also reduces routing flexibility whilst increasing construction/delivery & engineering complexity, Section K contains multiple constrained or narrow corridor sections which reduce flexibility; however, it is largely considered open with good routeing options for an overhead line. The crossing of the Dunston Hills Family Golf Centre in Section R also reduces route flexibility whilst increasing construction/delivery & engineering complexity. Despite the construction complexity related to the significant constrained areas or narrow corridor sections in Section F at the A12 crossing and Dunston Hill family Golf Centre in Section R, overall technical construction/delivery & engineering complexity of this option were reduced in comparison to options which utilised Section S. In comparison to ET1 all corridor options were found to contain similar significantly constrained and technically complex areas. Overall, Option ET1 (Sections F, G, K and R), experiences a proportionally lower number of major constraints and minimises technical complexity when compared to other options.

7.5.20 Within Option ET1, the alternative potential combination of sections to the north of Colchester via sections H and J was characterised by multiple significant constraints in section H. This included, to the west of the corridor at the A12/A1232 intersection, the existing road infrastructure, Ardleigh Reservoir, a hotel and commercial premisses; in the central part of the corridor, Colchester Park and Ride, a service station, Northern Gateway Sports Park, a hotel, the A12 dual carriageway, Colchester United Football Club, and various residential and commercial properties; and finally in a section of the corridor deemed unfeasible, where the A12 crosses the A134 (Nayland Road) due to a residential housing development which is under construction. Section J is also significantly constrained by the settlements of Fordham and Lexden Heath thus restricting routeing possibilities significantly. For these reasons, the utilisation of

sections H and J north of Colchester were deemed undeliverable without complex engineering designs at additional cost in comparison to the preferred option of utilising sections F and G.

7.5.21 Corridor Option ET2 (Sections N, P and S,), requires multiple crossings of the existing 4VB, ZT (discontinued), ZJ & ZJA overhead lines which greatly increases construction/delivery complexity (system outages and programme risk) as well potentially adding multiple sections of underground cable at additional cost. In Section N, within Options ET2 and ET6, the River Colne is to be crossed likely via HDD and adjacent underground cable section, again further increasing the construction/delivery complexity. Section N routes through extensive areas of Ministry of Defence (MoD) training land, potentially restricting access for line construction and maintenance. The entry to Section P from N, within Option ET2, is constrained by ancient woodland narrowing the corridor such that there is no routing flexibility. Furthermore, the extent of the urban areas both north and south of Rayleigh Substation (Section S, within Options ET2 and ET3), create areas of reduced-to-no flexibility and further technical complexity in relation to multiple existing overhead line assets, major road and railway crossings, therefore Options ET2 and ET3 were deemed to be undeliverable without complex engineering designs at additional cost (the re-use of the discontinued ZT overhead line was identified as a potential opportunity for a short length of Section S, however the benefits of such solution were negated by the level of technical routeing constraints and construction/delivery complexity noted to deliver this solution and noted elsewhere in the Options). In summary the necessity to cross the River Colne via HDD and the concentration of existing overhead line assets, large dual carriageway intersections, railways, and urban fringe residential areas and industrial sites resulted in extremely constrained routing flexibility and increased construction/delivery & engineering complexity that could be avoided by routing via the inland options. Potential restrictions on construction programme in respect of sensitive biodiversity designated site interests, may further make Options ET2, ET3 and ET6 undeliverable prior to customer connection dates.

7.5.22 The northern sections of Option ET3 (Sections F, G, J, M, P and S, (noting the constraints for corridor F are covered in Section 5) shares identical constraints to those previously discussed in Option ET1. Whilst Sections M and P are largely free from significant constraint, they do introduce additional constrained areas including Benton Hall Golf Course where flexibility is limited. The constrained areas in Section S (as discussed previously) are similar for this option. Therefore, whilst not as constrained as Option ET2, the concentration of existing overhead line assets, large dual carriageway intersections, railways, and urban fringe residential areas and industrial sites resulted in constrained routing flexibility and increased construction/delivery complexity that could be avoided by routing via the further inland options.

7.5.23 For Option ET4 (Sections F, G, J, M, P, Q and R) many of the constraints identified are similar to the relevant corridor sections as described above. Routeing via Sections Q and R avoids the most significant technical constraints posed by Section S, and as such is preferred over Options ET2 and ET3. A large golf course occupies much of Section Q, however with the implementation of additional angles of deviation oversailing this area is likely to be avoidable. The constraints of Section R are identical to those previously mentioned above. In summary from a technical perspective Option ET4 performed similarly to Option ET1. However, Option ET1 was slightly shorter and required fewer distribution network operator asset crossings, and thus, it is preferred.

7.5.24 Option ET5 (Sections F, G, K, L, Q and R) shares identical constraints to those previously mentioned, with the exception of Section L. The use of Section L provided an

opportunity to close-parallel the existing 4VB overhead line. However, it was found to introduce additional routing and technical construction/delivery complexity due to the requirement for multiple crossings of the 4VB overhead line in constrained areas and the mitigation of an existing 132kV overhead line which parallels the 4VB overhead line for the western leg of the corridor. The crossing of the 4VB and 132kV overhead lines at the A12 / A130 is more constrained and as such more technically challenging than the possibilities for crossing these assets in Section K, thus Option ET5 was less favourable than ET1.

7.5.25 Costs have been developed by National Grid's inhouse cost estimating team (EHUB) using consistent assumptions including that: new substations are AIS; route lengths are based on a route produced from a desktop exercise that is representative of the likely constraints to routeing; the costs of applying normal industry 'best practice' mitigation measures during construction and operation are inherent within the cost base used. Costs can therefore be compared on a consistent basis noting that they could be higher or lower, but consistent in relative terms.

7.5.26 A coastal connection, Option ET2, has an estimated capital cost of £ £460 million which would be £107 million more expensive than the most inland option, Option ET1, comprising Sections F, G, K and R, at £353 million. Despite their similar lengths, the reason for the higher cost of Option ET2 compared to Option ET1, is that ET2 requires 6km of underground cabling compared to ET1 which requires 3km of underground cabling. A connection using more central corridors would range from £385 million at the higher end (for Option ET3) to £354 million (for Option ET5). The less expensive cost of a more inland connection compared to a coastal connection was a factor that was assessed to weigh in favour of Option ET1, using Sections F, G, K and R.

7.5.27 The least cost Option is ET5 at £354 million. However, for the technical reasons and environmental reasons (set out above), Option ET1 is preferred compared to the least costly connection option of Option ET5.

Policy performance of options

7.5.28 All options have been considered against national and local policy.

7.5.29 Sections K, Q, R and S pass through areas of Green Belt. The Green Belt extends from London in the west, to the coast in the east, and to Chelmsford in the north. On the basis that any corridor option seeking to achieve a connection through to Tilbury would have to pass through the Green Belt it is not assessed to be a differentiating factor between the options. There are already existing 132kV and 400kV overhead lines in the Green Belt and National Grid consider that energy infrastructure is not inappropriate development in the Green Belt.

7.5.30 Section R also passes through an area allocated for residential development, referred to in the Brentwood Emerging Local Plan as the Dunton Hills Garden Village. This area, to the west of Basildon, has two existing overhead lines passing directly across it and as a result it is considered that high voltage overhead lines have not been seen as a barrier to development coming forward on this site. This allocation is therefore not considered to be a differentiating factor between the options.

7.5.31 At the route corridor stage of appraisal, there are few readily identifiable significant differentiators between the corridors based on the Holford Rules, as all the options have been designed with due consideration of the Rules, and as far as possible to avoid areas of environmental constraint.

7.5.32 At this stage of appraisal, Holford Rule 1 and 4 are not considered to help differentiate between the options. All corridors avoid the major areas of highest amenity value (Holford Rule 1) and it is considered that alignments in all corridors could be defined to choose tree and hill backgrounds (Holford Rule 4). All the corridor combinations to achieve a connection from the EAC to Tilbury are comparable in distance. As a result, an assessment of the options against Holford Rule 3 is not considered to result in a differentiator in deciding which option to take forward. Sections K, L, N, P, R, S, have the potential to result in a concentration of wirescape due to the intervisibility with existing 400kV and 132kV high voltage lines (Holford Rule 6). However, this is common to all options and as a result it is not considered to be a differentiating factor. The corridor options have been designed to approach urban areas through industrial zones where they exist in compliance with Holford Rule 7. All of the options pass through areas allocated for mineral extraction and/or waste sites which are classed as designations of County value in relation to Supplementary Note 2. As these designations are common to all options it is not considered to be a differentiator in the selection of a preferred option. Whilst Sections K, M, N, P, Q, T North, T South, contain ancient woodland, it is considered that that the sections contain ample space to ensure that these woodlands are avoided as part of the detailed routeing process, thus ensuring compliance with Holford Rule 5.

7.5.33 All of the options have been designed to avoid routeing close to residential areas as far as possible (Supplementary Note 1). However, the dense pattern of settlement and narrow width of areas between settlements in proximity to Section S, within Options ET2 and ET3, particularly between the settlements of Basildon/ Wickford and Thundersley/ South Benfleet, could result in visual effects being experienced by large numbers of people and may not be able to be mitigated. As such, Options ET2 and ET3 are less compliant with Supplementary Note 1 than the other options.

7.5.34 With the exception of Sections P and S (in relation to conservation areas) and Sections N and S (in relation to international and nationally designated sites) all options avoid areas of high amenity value (Holford Rule 2). As a result, options that utilise Sections N, P and S (Options ET2, ET3 and ET6) are less compliant with Holford Rule 2 than the other options.

7.5.35 The consideration of alternative pylon designs (Supplementary Note 3 to the Holford Rules) follows later in the mitigation hierarchy and can be considered once an alignment has been established and an assessment undertaken to establish whether alternative pylon designs are needed.

Conclusion to East Anglia Connection Substation to Tilbury Options Selection

7.5.36 Overall, a decision about which option to take forward in this area of the Project is principally driven by whether to take a coastal route or a more inland route. A coastal route has greater potential to result in LSES and potentially AEoSI on the range of international and national designations present, including SPAs and Ramsar sites, SACs and SSSIs. There is consequently a high risk that a coastal connection would necessitate the requirement for Habitat Regulations Assessment process to be undertaken due to potential for effects on listed species or the sites. This requires that if alternatives are available that do not result in LSEs or AEoSI (or alternative with AEoSI that are more likely to be adequately negated via mitigation), they should be taken forward in preference, which in this case are those options further inland which are likely to result in lower risk to designated and listed features of the international sites.

7.5.37 In addition, the coastal Section P would pass through the Chelmer and Blackwater Navigation Conservation Area, which cannot be avoided by routeing, due to the east / west extent of its coverage, resulting in a negative effect on the historic environment. Other corridors either avoid conservation areas or have sufficient space for alignments within a corridor to avoid conservation areas.

7.5.38 From a Technical perspective, Option ET1 was deemed to be the preferred option for the routeing of an overhead line. This was largely due to fewer constraints in Section K when compared to Section N, and upon entry into Tilbury via Section R when compared to Section S. The other options utilising Sections M, P, L and Q, whilst similar were less favourable than using Sections K and R alone as they provided no tangible benefits and in some instances additions of construction/delivery and engineering complexity. Section R was deemed favourable to Section S as the latter would necessitate complex engineering designs which would lead to significant programme risk and at additional cost. Option ET1 is considered technically preferable. Option ET2, utilising Sections N, P and S is not preferred.

7.5.39 When comparing more inland connections, Option ET1 is preferred over corridors using central connecting sections (Sections M, L, Q and T, within Options ET3, ET4, ET5 and ET6) on the basis of fewer effects on Biodiversity and Ecology and fewer Technical complexities compared to routeing east of Chelmsford in Sections L and Q.

7.5.40 A more inland connection is also preferred on the basis it is £107 million less than a coastal route (£353 million for Option ET1 compared to £460 million for Option ET2). Option ET1 is marginally more expensive than the least cost inland option (Option ET5) with the difference in cost being £1million and for the reasons set out above Option ET1 is preferred on environmental and technical grounds compared to the other options.

7.5.41 Overall, therefore, the preferred connection for the East Anglia Connection substation to Tilbury section is Option ET1, a combination of Sections F, G, K and R. The capital cost for Option ET1 would be £353 million.

7.6 Stage 4: Development of Graduated Swathe

7.6.1 Following the identification of Option ET1 as the Preferred Option, an analysis of potential routeing within the corridor was undertaken by engineering subject matter experts and reviewed by environment subject matter experts. The analysis identified areas within the Preferred Option corridor within which Project infrastructure is considered more or less likely to be located. The analysis was informed by the same desk-based studies and limited field observations that informed the options appraisal and its findings should therefore be considered provisional, indicative and subject to revision as more detailed information becomes available. Notwithstanding their provisional nature, it is considered that the areas identified provide a reasonable indication of where development is more or less likely to take place within the Preferred Option corridor and that this information will be helpful in assisting stakeholders to understand the Project proposals during the non-statutory consultation to be undertaken as Stage 5 of this phase of National Grid's development process.

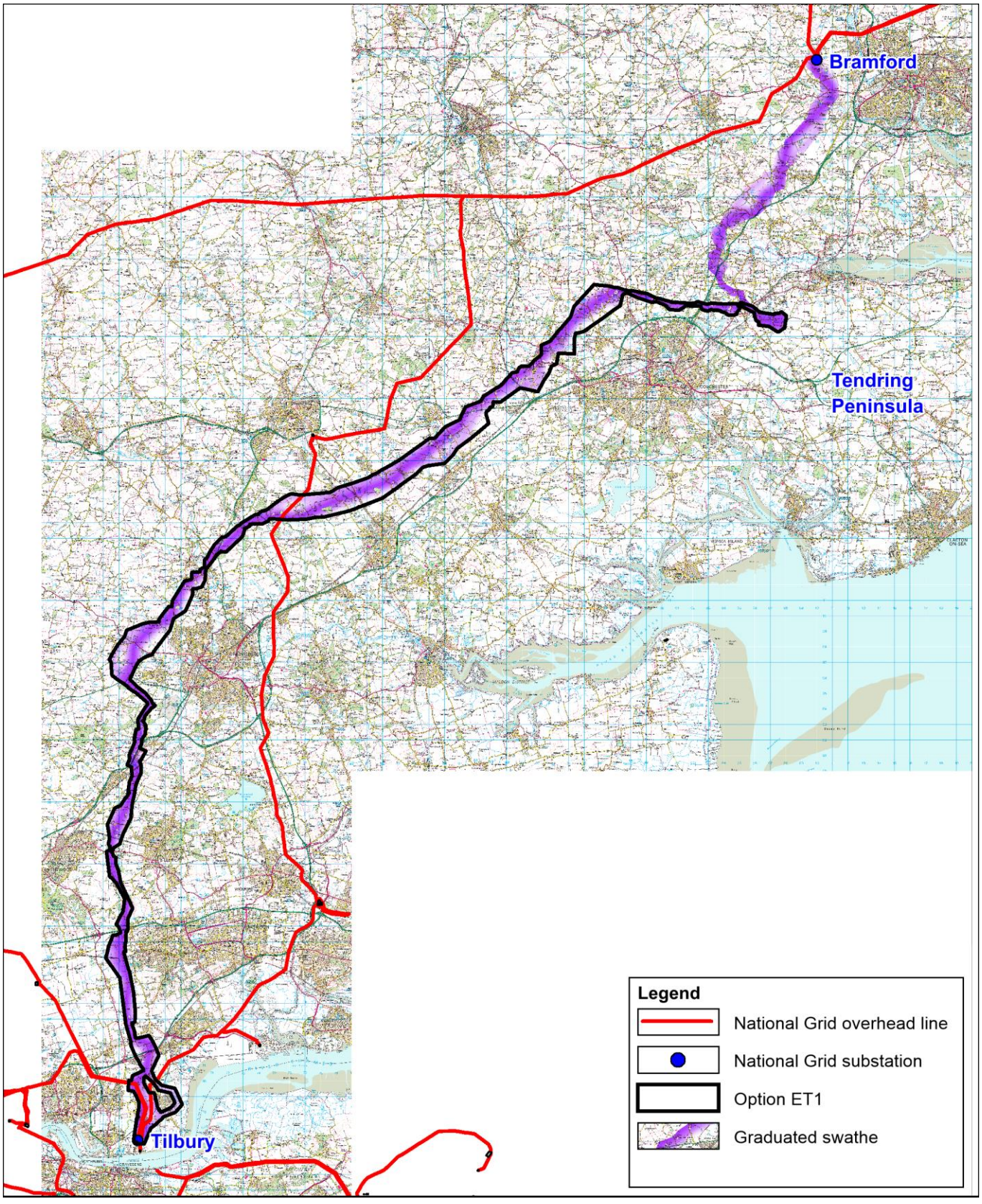
7.6.2 In order to communicate the findings of the analysis to stakeholders in a manner that does not imply an inappropriate level of certainty, the areas within the Preferred Option corridor that may host the route alignment are indicated by means of different densities of shading, referred to as a graduated swathe. The graduated swathe uses darker tones to indicate areas in which development is considered to be more likely and lighter tones to indicate where it is considered less likely. The absence of any shading within

the Preferred Option corridor indicates that development in these areas is considered unlikely, but possible. Areas of the Preferred Option corridor that the analysis identified as having very little potential to host a route alignment have been removed,

7.6.3 In some places, the analysis identified that a potential route alignment may pass in close proximity to, or sometimes cross the boundary of the Preferred Option corridor and that a small extension to the corridor would be required. All such instances were reviewed by environment subject matter experts to ensure that they would not result in any adverse environmental effects that had not been considered in the options appraisal and the Preferred Option corridor was expanded in a small number of locations as a result.

7.6.4 The revised Preferred Option corridor and the graduated swathe are shown on **Figure 7.4**.

Figure 7.4 – EAC to Tilbury Graduated Swathe



8. Conclusion and Next Steps

8.1 Conclusion

8.1.1 A detailed Options Identification, Options Appraisal and Options Selection process has been conducted as described in **Chapter 3,** which has identified the preferred options.

8.1.2 For the **Norwich to Bramford** component of the Project, seven corridors were assessed. It was concluded that **Option NB1 is the preferred option** to be taken forward for the following reasons. It minimises the potential for residential properties to be surrounded in close proximity by overhead lines to a greater extent than the other viable options, and thus reduces the likelihood of unacceptable levels of effect upon general residential amenity. It was preferred from an historic environment perspective, particularly compared to Option NB4 which directly affected a conservation area (at Shotesham through the estate park land of the Grade I listed Hall and associated listed buildings). It was also preferred from a Technical perspective compared with the remaining deliverable options (Option NB4 was not deliverable without complex engineering designs and additional cost) as it resulted in positive network benefits and efficiencies and was the least complex technically. From a cost perspective, Option NB1 was the least cost at £158 million compared to anticipated costs for Options NB2 to NB7 ranging from £169 million to £313 million.

8.1.1 For the **Bramford to East Anglia Connection Substation** component, seven corridor sections resulting in five permutations of potentially viable corridor connections, were assessed. A key factor in deciding which corridor to take forward was driven by whether the connection should pass through the AONB or avoid it. It was assessed that whilst undergrounding through the AONB would have an effect on the landscape, it would facilitate a more direct route. This could be approximately half the length of a route that avoids the Dedham Vale AONB. Moreover, a route that avoids the AONB may still have adverse effects upon its setting. It was concluded that **Option BE5 is the preferred option** due to its greater distance from particularly highly valued parts of the Dedham Vale AONB, less potential for adverse effects on the historic environment and as it is located further from the internationally designated sites and dependant listed features associated with the coast. From a cost perspective, all options are within a fairly narrow cost range of £222 million to £265 million. The preferred connection using underground cables through the AONB would cost £240 million compared to routing around the AONB using overhead lines which would range from £258 million to £261 million.

8.1.2 For the **East Anglia Connection Substation** component, four zones were shortlisted and assessed. A decision about which zone to take forward as the preferred zone, was driven by the differences between landscape, technical engineering challenges and cost. Zone A would also result in shorter length of overhead line which would mean fewer pylons and thus fewer effects compared to Zones B to D. This was assessed to be a differentiating factor between the zones as it avoided introducing further additional overhead lines into the landscape. **It was concluded that Zone A is the preferred option.**

8.1.3 For the **East Anglia Connection Substation to Tilbury** component, 14 corridor sections were assessed, resulting in six permutations of potentially viable corridor

options. A key consideration in deciding which option was preferred was whether a coastal route or a more inland route should be preferred. A coastal route would result in the identification of LSEs on international designated nature conservation sites, including SPAs, / Ramsar sites, SACs and potential effects on listed features of a variety of associated and component SSSIs. Due to the presence of LSEs, such a coastal connection would need to be considered in the light of the Habitat Regulations Assessment process, which, with the presence of LSEs, would require Appropriate Assessment. If AEoSI cannot be ruled out, then if alternatives are available that do not result in LSEs or with lesser AEoSI (or alternatives with AEoSI that are more likely to be adequately negated via mitigation), they should be taken forward in preference. In this case it is those options further inland which are likely to result in lower risk of AEoSI to the European sites. A more inland connection was preferred on historic environment grounds as it either avoided conservation areas, which Section P could not achieve due to the need to pass through the Chelmer and Blackwater Navigation Conservation Area or had sufficient space for alignments within a corridor to avoid conservation areas. **It was concluded that Option ET1 is the preferred option** due to it greater distance from the coast and less potential for adverse effects on the historic environment. It is also preferred on costs grounds as a more inland connection would be £107 million less than a connection on the coast.

8.2 Next Steps

8.2.1 The findings of this work provide the options and sites that are to be briefed within non-statutory public consultation and engagement with key stakeholders, including landowners. The feedback from non-statutory consultation along with information from field surveys and other design work is expected to be used to further inform the development of the design of the Project for Statutory Consultation and thereafter DCO Submission.

8.2.2 This feedback is in addition to a process of back-check and review in the pre-application stages to ensure that when new information comes forward (be it related to policy, technological developments, environmental or other relevant matters) its effect on the robustness of decision making is evaluated.

The detailed connection design will be subject to Environmental Impact Assessment (EIA) and further public consultation and design review prior to submission of applications for a Development Consent Order.

National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom

Registered in England and Wales
No. 4031152
nationalgrid.com