Royal HaskoningDHV
Enhancing Society Together

VATTENFALL

Norfolk Vanguard Offshore Wind Farm

Design and Access Statement

Applicant: Norfolk Vanguard Limited
Document Reference: 8.3
APFP Regulation: 5(2)(q)

Date: June 2018
Revision: Version 1
Author: Royal HaskoningDHV

Photo: Kentish Flats Offshore Wind Farm

Document Reference: 8.3

June 2018

For and on behalf of Norfolk Vanguard Limited

Approved by: Ruari Lean, Rebecca Sherwood

Signed: [redacted]

Date: 8th June 2018

For and on behalf of Royal HaskoningDHV

Drafted by: Ruth Henderson

Approved by: Jon Allen

Signed: [redacted]

Date: 24th May 2018

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
14/05/18	01D	First draft for Norfolk Vanguard Limited Review	RH	AH	JA
24/05/2018	01F	Final for DCO submission	RH	AH	JA

Table of Contents

Figures

Tables

Plates

Glossary

CWS	Country Wildlife Site
DAS	Design Access Statement
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
GW	Gigawatt
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
NCA	National Character Area
NPSs	National Policy Statements
NSIPs	Nationally Significant Infrastructure Projects
OLEMS	Outline Landscape and Ecological Management Strategy
PRoW	Public Right of Way
SCADA	Supervisory Control and Data Acquisition
SEO	Statement of Environmental Opportunity
SoS	Secretary of State
SUDs	Sustainable Urban Drainage

Terminology

Cable Relay Station	Primarily comprised of an outdoor compound containing reactors (also called inductors, or coils) and switchgear to increase the power transfer capability of the cables under the HVAC technology scenario as considered in the PEIR. This is no longer required for the project as the HVDC technology has been selected.
Indicative mitigation planting	Areas identified for mitigation planting at the onshore project substation and National Grid substation extension.
Jointing pit	Underground structures constructed at regular intervals along the cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	Where the offshore cables come ashore at Happisburgh South.
Landfall compound	Compound at landfall within which Horizontal Directional Drilling (HDD) drilling would take place.
Link boxes	Underground chambers or above ground cabinets next to the cable trench housing low voltage electrical earthing links.
Mobilisation area	Areas approx. 100 x 100m used as access points to the running track for duct installation. Required to store equipment and provide welfare facilities. Located adjacent to the onshore cable route, accessible from local highways network suitable for the delivery of heavy and oversized materials and equipment.
Mobilisation zone	Area within which the mobilisation area will be located.
National Grid new / replacement overhead line tower	New overhead line towers to be installed at the National Grid substation.
National Grid overhead line modifications	The works to be undertaken to complete the necessary modification to the existing 400kV overhead lines
National Grid substation	The permanent footprint of the National Grid substation extension.

extension	
National Grid temporary works area	Land adjacent to the Necton National Grid substation which would be temporarily required during construction of the National Grid substation extension.
Necton National Grid substation	The existing 400kV substation at Necton, which will be the grid connection location for Norfolk Vanguard.
Onshore 400kV cable route	Buried high-voltage cables linking the onshore project substation to the Necton National Grid substation.
Onshore cable corridor	200m wide onshore corridor within which the onshore cable route would be located as submitted for PEIR.
Onshore cable route	The 45m easement which will contain the buried export cables as well as the temporary running track, topsoil storage and excavated material during construction.
Onshore cables	The cables which take the electricity from landfall to the onshore project substation.
Onshore project area	All onshore electrical infrastructure (landfall; onshore cable route, accesses, trenchless crossing technique (e.g. Horizontal Directional Drilling (HDD)) zones and mobilisation areas; onshore project substation and extension to the Necton National Grid substation and overhead line modification).
Onshore project substation	A compound containing electrical equipment to enable connection to the National Grid. The substation will convert the exported power from HVDC to HVAC, to 400kV (grid voltage). This also contains equipment to help maintain stable grid voltage.
The Applicant	Norfolk Vanguard Limited.
The OWF sites	The two distinct offshore wind farm areas, Norfolk Vanguard East and Norfolk Vanguard West.
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure
Transition pit	Underground structures that house the joints between the offshore export cables and the onshore cables within the landfall
Trenchless crossing zone (e.g. HDD)	Temporary areas required for trenchless crossing works.
Workfront	The 150m length of onshore cable route within which duct installation would occur

This page is intentionally blank.

1 INTRODUCTION

1.1 Purpose of the Design and Access Statement

1. The purpose of this Design and Access Statement (DAS) is to provide details of the use, layout, scale and appearance of the Norfolk Vanguard offshore wind farm (the 'project'). The DAS supports the application for a Development Consent Order (DCO) for the project and should be read in conjunction with the DCO and supporting documentation.

2. This application is based on realistic worst case dimensions for the proposed installed infrastructure. The design will continue to be developed post-consent and a detailed design will be submitted for approval in accordance with DCO Requirement 16 and any principles included within this DAS.

3. The project is described in more detail in section 4 of this DAS and in Chapter 5 Project Description of the Environmental Statement (ES).

4. The DAS focuses on demonstrating the design and development of the Norfolk Vanguard permanent above ground infrastructure such as the onshore project substation and National Grid substation extension including overhead line modifications.

5. The DAS explains the principles and concepts that have influenced the form and appearance of the elements of the onshore project area and provides a tool to communicate how the requirements for good design and access provision have been considered, and will be considered for the detailed design of the substation in due course.

6. Information contained in the ES has been used to inform the preparation of this DAS, and reference should be made to the ES for full details of both the offshore and onshore project components and their relationship to the receiving environment, particularly:

    - Chapter 2 Need for the Project;
    - Chapter 3 Policy and Legislative Context; and
    - Chapter 5 Project Description.

2 PLANNING CONTEXT AND GUIDANCE

2.1 National Policy Statements

7. National Policy Statements (NPSs) form primary planning policy documents that are specifically provided for by the Planning Act 2008 to guide decision making on Nationally Significant Infrastructure Project (NSIP) applications. The application for the project will be determined in accordance with relevant NPSs.

8. Further detail on the planning policies associated with the project is found in the Norfolk Vanguard ES, Chapter 3 Policy and Legislative Context.

9. The three NPSs that hold particular relevance for offshore wind and its associated onshore development are:

- Overarching NPS for Energy (EN-1, July 2011) (DECC 2011a);
- NPS for Renewable Energy Infrastructure (EN-3, July 2011) (DECC 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5, July 2011) (DECC 2011c).

2.1.1 Overarching NPS for Energy (EN-1)

10. Existing policies set out within EN-1 make clear the requirements for good design in energy projects. Paragraph 3.7.1 of EN-1 explains that much of the new electricity infrastructure that is needed will be located in places where there is no existing network infrastructure. It acknowledges that this is likely to be the case for many wind farms, or where there may be technical reasons why existing network infrastructure is not suitable for connecting the new generation infrastructure.

2.2 Guidance

11. There is no specific guidance provided for the preparation of design and access statements in relation to NSIPs.

12. This DAS has been prepared in line with The Commission for Architecture and the Built Environment guidelines (CABE, 2007). The bullet points below set out the key parameters set out in the CABE guidelines:

- Use – the purpose of the onshore project substation and how it will fit within the surrounding environment;
- Amount – size and volume of the onshore project substation and its constitute elements;
- Layout – the relationship between the onshore project substation and the surrounding buildings;
- Scale – the physical size and shape of the onshore project substation development;

- Appearance – the physical look of the onshore project substation specifically the design and materials;
- Landscaping – how mitigation proposals will be applied to screen the development from wider views; and
- Access – inclusive of construction and operational traffic and how crossings over roads and watercourses will be achieved.

13. These parameters are discussed in section 6 of this DAS.

3 DESCRIPTION OF THE DEVELOPMENT

3.1 The Project

14. The project comprises two distinct offshore areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) ('the OWF sites'). The offshore wind farm sites are located approximately 47km from their closest point to the Norfolk Coast and would be connected to the shore by offshore export cables from the wind farm to a landfall point at Happisburgh South, Norfolk. From there, onshore cables would transport power over approximately 60km to the onshore project substation at Necton, Norfolk.

15. Once built, Norfolk Vanguard would have a capacity of up to 1800MW. The offshore components include:

- Wind turbines;
- Offshore electrical platforms;
- Accommodation platforms;
- Interconnector cables; and
- Export cables.

16. The onshore components of the project include:

- Landfall;
- Onshore cable route, accesses, trenchless crossing technique (e.g. Horizontal Directional Drilling (HDD)) zones and mobilisation areas;
- Onshore project substation; and
- Extension to the Necton National Grid substation and overhead line modifications.

17. The onshore and offshore project areas are shown on Figure 1 and Figure 2. A full description of the project for offshore and onshore is available in Chapter 5 Project Description of the ES.

18. Given their distance offshore there is not considered to be any visibility of the offshore infrastructure from the coast, and any requirement for a landscape and visual impact assessment has been scoped out of the EIA. As such, this DAS considers the onshore infrastructure only.

19. Table 3.1 provides a list of key onshore parameters and their associated characteristics for the project.

Table 3.1 Indicative onshore project characteristics

Parameter	Characteristic
Landfall	
Landfall	Happisburgh South
Onshore Cable Route	
Export cable route length (km)	60 (approximate)
Number of onshore cable trenches	Up to Four
Number of ducts	Up to six
Jointing Bays	Up to 150
Onshore Project Substation	
Onshore project substation area (m x m)	Up to 250 x 300
Number of substations within compound	One substation (comprised of two convertor halls)
Onshore project substation tallest building (m)	Up to 19 (HVDC converter hall)
Onshore project substation tallest structure (m)	Up to 25 (Lightning protection mast)
Onshore project substation fence height (m)	Up to 3.5
National Grid substation extension	
Grid connection location	Necton National Grid substation
National Grid substation extension area (m x m)	Up to 200 x 150
National Grid substation extension tallest structure (m)	Up to 15 (Outdoor AIS busbar and landing gantries)
Overhead Line Modifications	
Net number of permanent new towers	1
Tallest new tower (m)	Up to 55m

4 SITE SELECTION PROCESS

4.1 Introduction

20. The siting, design and refinement of the project has followed a site selection process, taking account of environmental, physical, technical, commercial and social considerations and opportunities as well as engineering requirements with the aim of identifying sites that will be environmentally acceptable whilst also enabling, in the long-term, benefits of the lowest energy cost to be passed onto the consumer. A multi-disciplinary design team was formed to undertake the site selection process which included a team of specialists comprising engineers and EIA consultants whose expertise were drawn upon throughout the site selection process.

21. The site selection process is shown in Plate 1, and outlined in more detail in Chapter 4 Site Selection and Assessment of Alternatives. Each stage of the site selection process forms part of an iterative design process undertaken to identify the most suitable locations and configuration for project infrastructure. The framework for the site selection process is based upon a set of design principles and engineering requirements.

22. The details of how sensitive site selection has shaped the final project design are also discussed in section 6 of this DAS.

4.2 Consultation

23. Norfolk Vanguard Limited has undertaken pre-application engagement with stakeholders, communities and landowners in order to inform the submitted project design and communicate decisions on refinements (for further information see the Consultation Report (document reference 5.1)). The Scoping Report (Royal HaskoningDHV, 2016) and the Preliminary Environmental Information Report (PEIR) (Norfolk Vanguard Limited, 2017) set out the process for the development of the onshore and offshore elements of the projects showing a series of search areas for the landfall, onshore cable corridor, cable relay station (CRS) locations (no longer required) and onshore project substation locations.

24. The refinements in the project layout and configurations have been communicated to relevant audiences through the informal and formal pre-application stages (20 month period) between scoping in October 2016 and the application, and feedback received has been taken into consideration where possible.

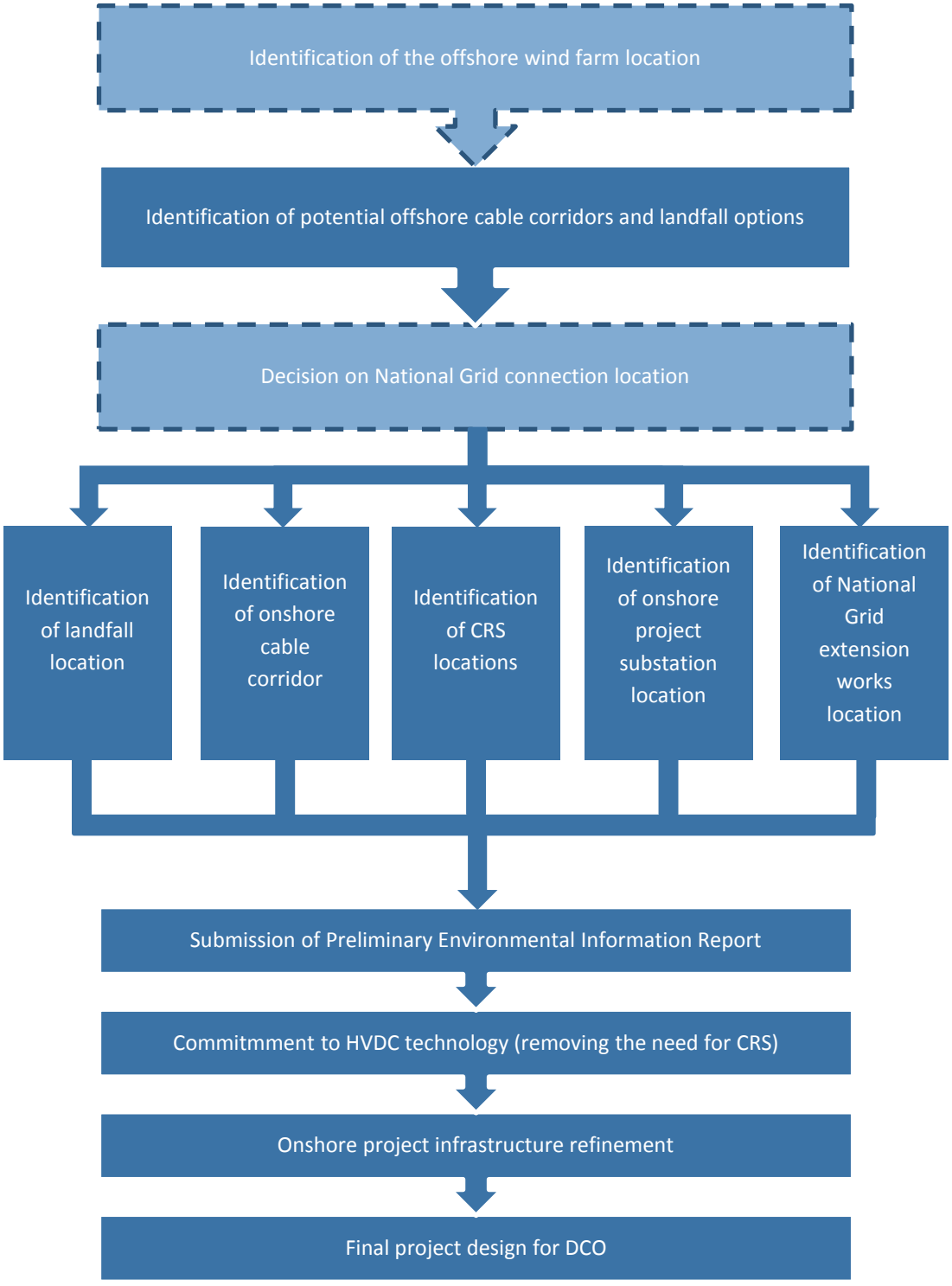


Plate 1 Site selection process[1]

1 Strategic decisions regarding fundamental project locations such as the offshore wind farm location and grid connection point have been made in conjunction with the Crown Estate and National Grid respectively.

5 DESIGN CONSIDERATIONS

5.1 Consideration of Alternatives Influencing the Project Design

25. A number of alternatives have been considered as part of the design decision-making process to date. Assessment of alternatives has been considered from the outset of the project, and were reported within the Scoping Report (Royal HaskoningDHV, 2016) and PEIR (Norfolk Vanguard Limited, 2017), and alternatives have been considered throughout the refinement of the project.

26. As project design is an iterative process, and a multidisciplinary approach, alternatives have been considered incorporating engineering, buildability, cost, environmental, landowner, community, and stakeholder considerations to inform the final design.

27. The early strategic project consideration of alternatives which fed directly into the site selection process, are detailed in Table 5.1.

Table 5.1 Strategic project alternatives considered

Alternatives considered	Decision	Benefit
• Strategic approach to delivering Norfolk Vanguard and Norfolk Boreas • No elements of Norfolk Boreas considered within the design envelope for Norfolk Vanguard	**To take a strategic approach to delivering Norfolk Vanguard and Norfolk Boreas.**	This strategic approach would allow the main civil works for the cable route to be completed in one construction period and in advance of cable delivery, preventing the requirement to reopen the land in order to minimise disruption. Co-location of onshore project substations will keep these developments contained within a localised area and, in so doing, will contain the extent of potential impacts.
• Overhead lines along the ~60km route from landfall to grid connection location • Buried onshore cables within ducts along the ~60km route from landfall to grid connection location	**Buried onshore cables within ducts**	The environmental benefits of this are to minimise visual impacts and to deliver the project within the timeframes set by the UK government in relation to targets on renewable energy and CO_2 reduction.
• Ducts laid in a sectionalised approach to enable cable pull through at a later stage • Open cut and direct lay of onshore cables along the full length of the cable route	**Ducts laid in a sectionalised approach to enable cable pull through at a later stage**	The environmental benefit of this would minimise the amount of land being worked on at any one time and would also minimise the duration of works on any given section of the route.

5.2 Identification of Onshore Project Substation Location

28. In order to identify the most appropriate location to site the onshore project substation, National Grid's Guidelines on Substation Siting and Design (The Horlock Rules) have been taken into consideration. These guidelines document National Grid's best practice for the consideration of relevant constraints associated with the siting of substations. The Horlock Rules have been considered as part of the development of the onshore project substation location and those relevant to design are outlined within Table 5.2.

Table 5.2 Application of Horlock Rules (relevant to design) to onshore project substation

National Grid's Approach to Design of Substations	Norfolk Vanguard onshore project substation considerations
Design	
In the 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, seeking to keep effects to a reasonably practicable minimum.	HVDC technology has been committed to which removes the requirement for a cable relay station. In addition, onshore cable will be buried to avoid introducing new overhead power lines. Overhead line modification is unavoidable as part of the National Grid extension works however, the number of new towers has been minimised by upgrading an existing tower. The net increase in new towers will be one, which will be located in proximity to existing towers to reduce the potential proliferation of energy infrastructure. Realistic worst case dimensions have been proposed for the substation infrastructure, taking into account the largest structure (the converter hall at up to 19m tall).
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.	Permanent footprints for the onshore project substation are based on realistic preliminary layouts. During detailed design, consideration will be given to space-efficient solutions where appropriate. The location of the onshore project substation has avoided direct impacts to public rights of way.
The 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.	A detailed landscape and visual impact assessment has been undertaken to support the application. This process has informed the approach to landscape planting to minimise potential visual impacts. The choice of substation site was driven by the existence of existing woodland, and the proposed landscape planting will reinforce these areas. The presence of access roads, perimeter fencing and ancillary development were taken into account as part of this assessment.
Line Entry	
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	All new cabling between the landfall and the onshore project substation (approximately 60km) will be buried underground to avoid the introduction of new

National Grid's Approach to Design of Substations	Norfolk Vanguard onshore project substation considerations
to avoid a confusing appearance.	overhead lines in an open landscape. Modifications to the existing overhead line structures are required at Necton to accommodate the newly installed infrastructure. The net new number of towers required to accommodate the works is one, and will be in proximity to the existing corner tower (to the north east of the existing Necton National Grid substation) to minimise proliferation of energy infrastructure and additional clutter.
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.	Overhead line modification is unavoidable as part of the National Grid extension works however, the number of new towers has been minimised by upgrading an existing tower. The net increase in new towers will be one, which will be located in proximity to existing towers to reduce the potential proliferation of energy infrastructure.

5.3 Design Principles and Recommendations

29. The final design of the onshore project substation and National Grid substation extension are subject to detailed design post-consent. In order to minimise visual impacts as far as possible, the appropriate building design and materials will be considered, to ensure blending with the local environment and minimisation of impacts as far as possible.

Table 5.3 Design Principles for the onshore project substation and National Grid substation extension.

Principle	Description
1	Continue to engage relevant authorities on detailed design and landscaping proposals as detailed design progresses.
2	Actively seek appropriate building design and materials (e.g. building materials, shape, layout, coloration and finishes).
3	The design of the onshore project substation will be within the parameters set out in Requirement 16 of the DCO, namely: • Buildings must not exceed a height of 19m; • External electrical equipment must not exceed 25m; • The total footprint of each building housing the principal electrical equipment must not exceed 110m by 70m; and • The fenced compound area must not exceed 250m by 300m.
4	The design of the National Grid substation will be within the parameters set out in Requirement 16 of the DCO, namely: • The total number of buildings housing principal electrical equipment must not exceed two; • The total net number of new overhead line towers must not exceed two, and must not exceed a height of 55m; • Buildings and external electrical equipment must not exceed a height of 15m; and • The fenced compound area (excluding accesses) must not exceed 200m by 150m.
5	Landscaping to minimise the visual impacts, and respond to local landscape character and biodiversity will be undertaken and considered with building design and layout of ancillary structures. Delivery of this principle will be guided by implementation of the Outline Landscape and Ecological Management Strategy (OLEMS) (document 8.7).
6	A detailed SUDS drainage strategy will be developed.

6 ONSHORE PROJECT DESIGN

6.1 Introduction

30. There will be no above ground permanent infrastructure associated with the landfall and this is not considered within this DAS. The onshore cable route will be buried underground in ducts); the only potential above ground infrastructure associated with the cable route is the inclusion of link boxes, which are considered within this DAS. Other than link box design, the DAS focuses on the design and development of the Norfolk Vanguard onshore project substation and National Grid substation extension (including overhead line modifications).

31. As set out in section 2.2 the approach within any DAS is to consider the use, amount, layout, scale, appearance, landscaping (where relevant) and access of the permanent above ground infrastructure.

6.2 Link Boxes Design

6.2.1 Use, Amount, Scale, Appearance

32. The onshore cable route will be approximately 60km in length, from the landfall to the onshore project substation at Necton. Sections of cabling would be connected together in jointing bays along the route and link boxes are required in proximity (within 10m) to a subset of jointing pit locations. Link boxes would be the only potential permanent above ground feature associated with the onshore cable route.

33. Link boxes would not be required at all jointing locations and can typically be placed at 5km intervals. The number and placement of the link boxes would be determined as part of the detailed design post-consent.

34. The link boxes, with maximum dimensions 1.5m x 1.5m, per circuit, would either be buried to ground level within an excavated pit, providing access via a secured access panel (refer to Plate 2) or alternatively, above ground link box cabinets (1.2m x 0.8m x 1.8m) may be utilised which are typically sited on a 0.15m deep concrete slab.

35. There is no requirement for permanent lighting at link boxes.

Plate 2 Example below ground link box following reinstatement (Source: Rey Wind Farm, Vattenfall Wind Power Ltd.)

6.2.2 Layout

36. The link boxes would be located at approximately 5km intervals along the onshore cable route.

6.2.3 Access

37. Access to link boxes is only required for periodic testing purposes, which is typically every 5 years. Where possible, the link boxes would be located close to field boundaries and in already accessible locations. No additional formal access is proposed to each link box.

6.3 Onshore Project Substation Design

6.3.1 Use

38. The onshore project substation converts the HVDC electrical power from the Norfolk Vanguard export cables to HVAC which is the appropriate voltage required for connection to the National Grid system. Filtering, switchgear and associated protection and control equipment is also located at the onshore project substation to comply with the technical requirements of the National Grid and allow safe operation of the Norfolk Vanguard connection.

6.3.2 Amount, Scale

39. The onshore project substation will consist of up to two converter stations, each having a power transfer capability of between 800MW and 1000MW. As such, the onshore project substation will consist of:

- 2x converter buildings - housing DC filter equipment and power electronics to convert HVDC to HVAC power for connection to National Grid;
- 2x outdoor HVAC compounds – each compound will contain one or more 400kV transformers, plus HVAC filters, busbars and cable sealing ends;
- Control building – housing SCADA and protection equipment;
- Access roads – for operation and maintenance access to equipment; and
- Associated connections between equipment via overhead busbar and cabling, including buried earthing system.

40. The largest equipment within the onshore project substation will be the converter halls which will not exceed a height of 19m, all other equipment will not exceed a height of 13m. The tallest structure at the onshore project substation site will be the lightning protection masts at a height of 25m. The total land requirement for the onshore project substation to the perimeter fence is 250m x 300m.

41. Permanent palisade fencing will be installed around the onshore project substation compound up to a height of 2.4m.

42. The final appearance of the onshore project substation is subject to detailed design post consent. For the purposes of the DAS, indicative maximum parameters (as set out in Table 5.4 and DCO Requirement 16) have been provided with reference to a Rochdale Envelope approach in terms of realistic worst case design parameters.

6.3.3 Layout and Appearance

43. In addition to the main converter halls, the onshore project substation compound would contain electrical equipment including power transformers, switchgear, harmonic filters, cables, lightning protection masts, control buildings, communications masts, backup generators, access, fencing and other associated equipment, structures or buildings. The onshore project substation would have a compact layout, with the majority of equipment contained in agricultural style buildings.

44. The onshore project substation would be enclosed by a fence surrounding the external equipment outlined above. Other infrastructure and equipment will be included within the compound such as interconnecting cables, access tracks, hard standing, car parking, water tanks, communications mast, diesel generators and welfare facilities.

45. The onshore project substation would be connected to the existing Necton National Grid substation by means of HVAC underground cables.

46. An indication of the typical appearance and layout of a HVDC substation is shown on Plate 1.

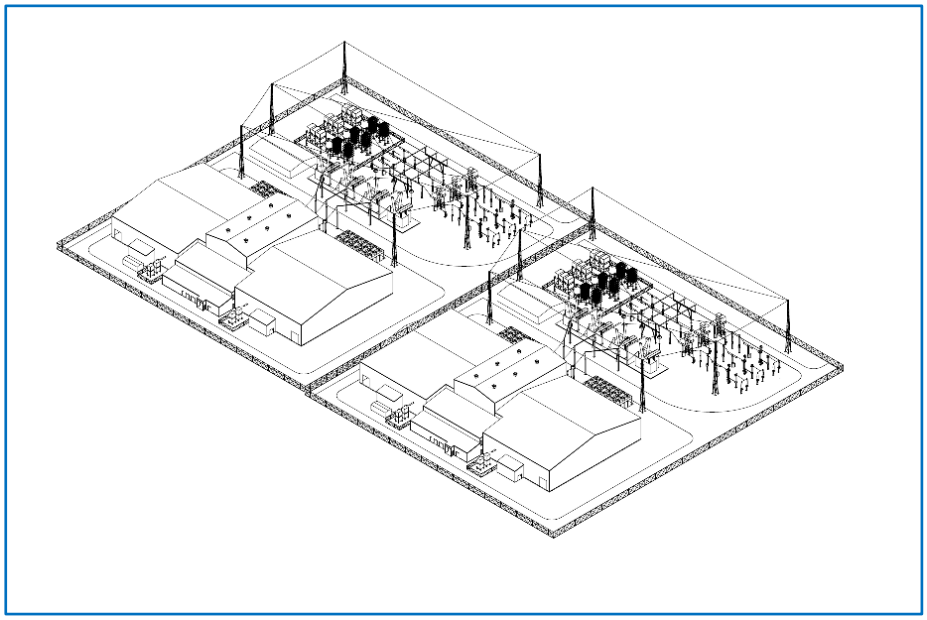


Plate 61 Indicative onshore project substation layout – HVDC

6.3.4 Access

47. The onshore project substation will be accessed from the A47. Three access options have been considered:

- Access A: Existing Necton National Grid Substation access utilising a U-turn strategy at Dereham to remove right turn access off the A47;
- Access A1: Upgrading the existing Necton National Grid Substation access to a Design Manual for Roads and Bridges (DMRB) compliant access; and
- Access B: Construction of a new DMRB compliant access opposite 'Spicers Corner' junction.

48. Further consultation with highway stakeholders will be undertaken post-consent to finalise the onshore project substation access strategy.

49. During operation, the onshore project substation would not be manned, however access would be required periodically for routine maintenance activities, estimated at an average of one visit per week.

6.3.5 Lighting

50. Normal operating conditions would not require lighting at the onshore project substation, although low level movement detecting security lighting may be utilised for health and safety purposes. Temporary lighting during working hours will be provided during maintenance activities only.

6.4 National Grid Substation Extension and Overhead Line Modifications

6.4.1 Use, Amount, Layout, Scale and Appearance

51. The existing Necton National Grid substation would require an extension to accommodate the Norfolk Vanguard connection points. The National Grid substation extension would need to accommodate circuit breakers and associated busbar structures which allow connection onto the existing 400kV overhead line for generation to be transmitted onto the wider National Grid system.

52. The National Grid substation outdoor busbar will be extended in a westerly direction to a total length of 200m, with seven new AIS bays installed along the busbar extension for Norfolk Vanguard. The substation extension will be similar in appearance to the existing National Grid substation at Necton as it is in simply an extension to the existing busbar and AIS bays.

53. During operation, the Necton National Grid substation would not normally be illuminated. However, lighting would be used when conducting inspection and maintenance activities (during working hours only).

54. In addition to the existing Necton National Grid substation itself, modifications to the existing overhead line structures adjacent to the substation would be required to provide a double turn-in arrangement[2].

55. Two new overhead line towers will be required in proximity to the existing corner tower (to the north east of the existing Necton National Grid substation) with a maximum height of 55m. The existing corner tower will be demolished such that the net new number of towers will be one.

6.4.2 Access

56. The existing Necton National Grid substation has an existing access from the A47. This would continue to be used during operation. However, this access may be

[2] Each overhead line tower carries two 400kV circuits. In this arrangement, both circuits are turned into the substation busbar structure.

subject to some upgrades associated with the onshore project substation – see section 6.3.4.

57. The National Grid substation extension and overhead line modification would not be manned; maintenance of the substation would be undertaken approximately every three years. Visual checks would be undertaken on a monthly inspection visit to the site.

6.5 Onshore project substation and National Grid Substation Extension Landscaping

58. The onshore project substation site benefits from some substantial existing hedgerows and woodland blocks within the local area. These would provide mitigation of landscape and visual effects from the outset and can be strengthened during the early phases of the proposed project to ensure robust screening. The extent of mitigation planting incorporated into the design is presented on Figure 3 and Figure 4 and mostly comprises indigenous woodland species and would be located around the onshore project substation and along the southern edge of the National Grid substation extension. Owing to the dimensions of the onshore project substation site, the National Grid substation extension, and the associated mobilisation areas construction activities would be required to level existing contours. The earthworks required for the cut and fill to create the level platform would produce surplus soil which would be used to form subtle earthwork bunds of up to 2m along the western side of the onshore project substation. This would help to give an incremental increase to the overall height of screening along this sensitive boundary which is not constrained by planting restrictions associated with underground cables.

59. The mitigation planting would be designed to comprise a mix of faster growing 'nurse' species and slower growing 'core' species. The core species would comprise a mix of preferred native, canopy species that would outlive the nurse species and characterise the woodland structure over the longer term. It is anticipated that 5m to 7m growth would take 20 years and the nurse species would have reached approximately 7.25m to 9.75m (assuming planting height of 1m) after 25 years. The nurse species would be sufficiently fast growing to provide substantial screening of the onshore project substation after 20 years.

60. The proposed landscaping is described in more detail in the OLEMS (document 8.7), with regard to the re-establishment of hedgerows and tree planting. The landscaping works will be designed in detail post-consent in accordance with DCO Requirement 18.

7 SUMMARY

61. This DAS forms part of the suite of documents submitted as part of the DCO application for the project, and sets out the various principles, concepts and considerations incorporated into the design of the onshore electrical transmission works.

62. The design of the project is part of an ongoing process in which Norfolk Vanguard Limited is committed to optimising the quality of the design. The design-development process has been informed by consultation particularly in relation to site selection, design evolution and accessibility considerations.

63. Although indicative at this stage, the design for the onshore project substation and National Grid substation extension will set out to achieve a high standard of design whilst at the same time balancing the operational requirements of the facility with the character and appearance of the existing environment.

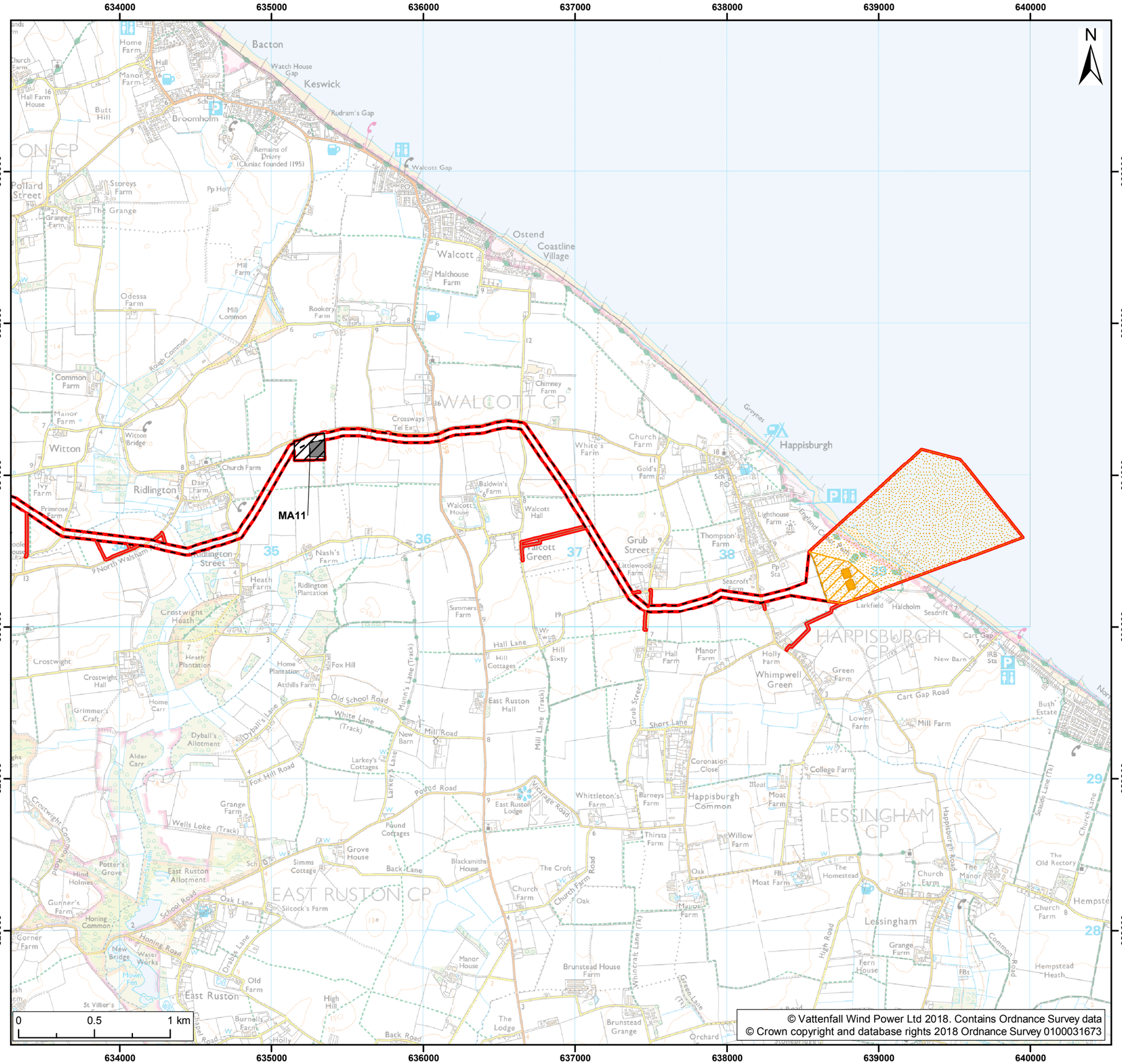
64. There will be no requirement for public access to the onshore project station or National Grid substation extension, and appropriate security measures will be installed to prevent unauthorised access to the onshore electrical transmission works once operational.

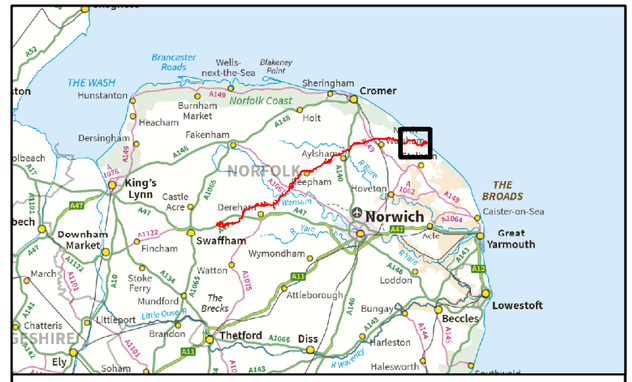
65. Integration of the building into the local landscape will be further assisted by detailed landscape design including planting using a selection of appropriate indigenous species to increase site biodiversity.

8 REFERENCES

CABE (2007) Design and Access Statements: How to write, read and use them. Online, available at: http://webarchive.nationalarchives.gov.uk/20110118111019/http://www.cabe.org.uk/files/design-and-access-statements.pdf . Accessed 14/05/2018.
Department of Energy and Climate Change (DECC) (2011a). National Policy Statement for Energy (EN-1) July 2011, DECC Publications.
Department of Energy and Climate Change (DECC) (2011b). National Policy Statement for Electricity Networks Infrastructure (EN-5) July 2011, DECC Publications.
Department of Energy and Climate Change (DECC) (2011c). National Policy Statement for Renewable Energy Infrastructure (EN-3) July 2011, DECC Publications.
Norfolk Vanguard Limited (2017). Norfolk Vanguard Preliminary Environmental Information Report
The Planning Inspectorate (2012) Advice note nine: Rochdale Envelope. Online, available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2011/02/Advice-note-9.-Rochdale-envelope-web.pdf accessed 14/05/2018.
Royal HaskoningDHV (2016). Norfolk Vanguard Scoping Report

9 FIGURES





Legend:

- Norfolk Vanguard onshore red line boundary

Landfall

- Landfall zone
- Landfall compound zone
- Indicative landfall compound

Onshore cable route

- Onshore cable route
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 1 of 9)

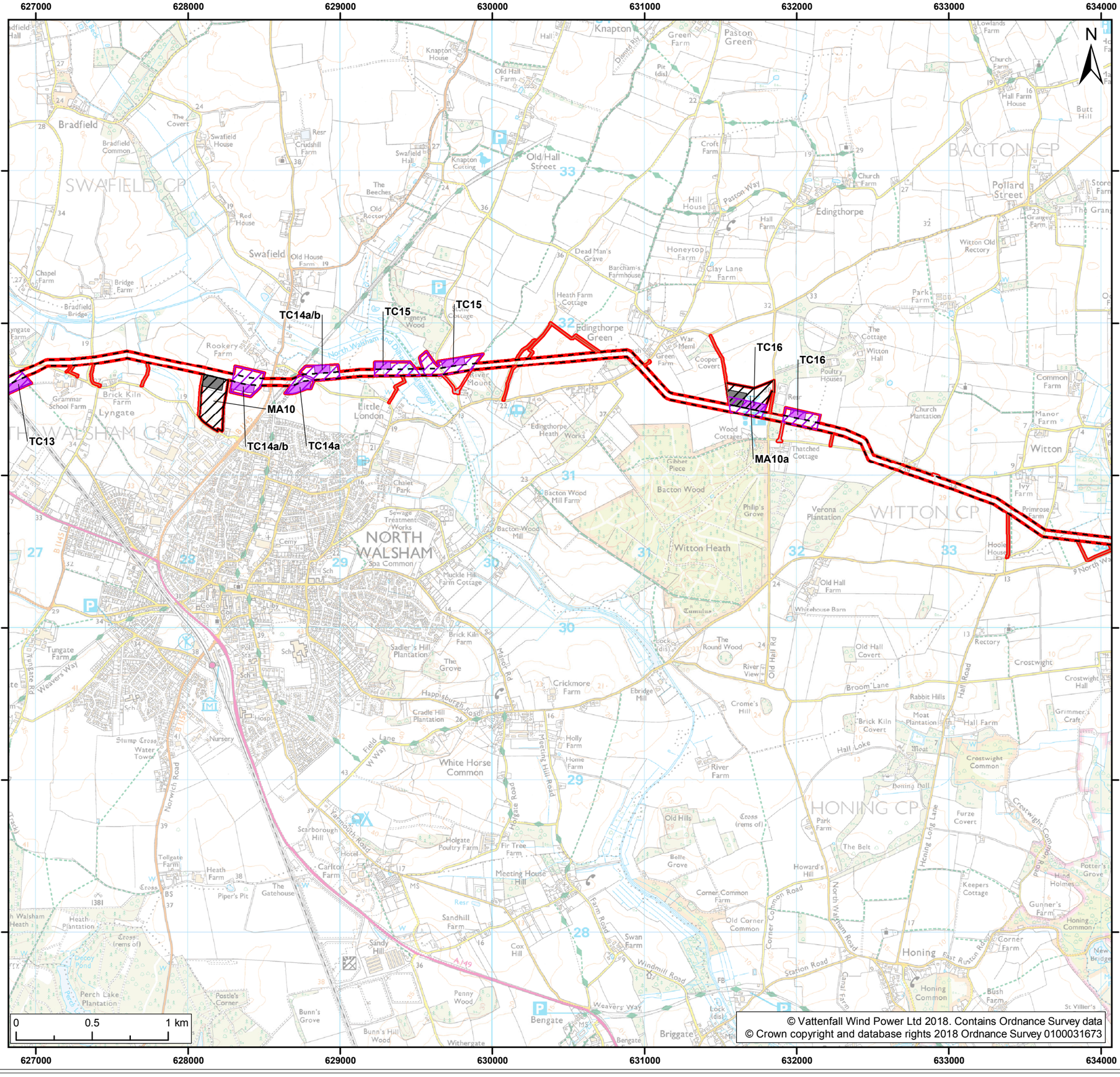
Figure: 1 | Drawing No: PB4476-006-010-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together



Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 2 of 9)

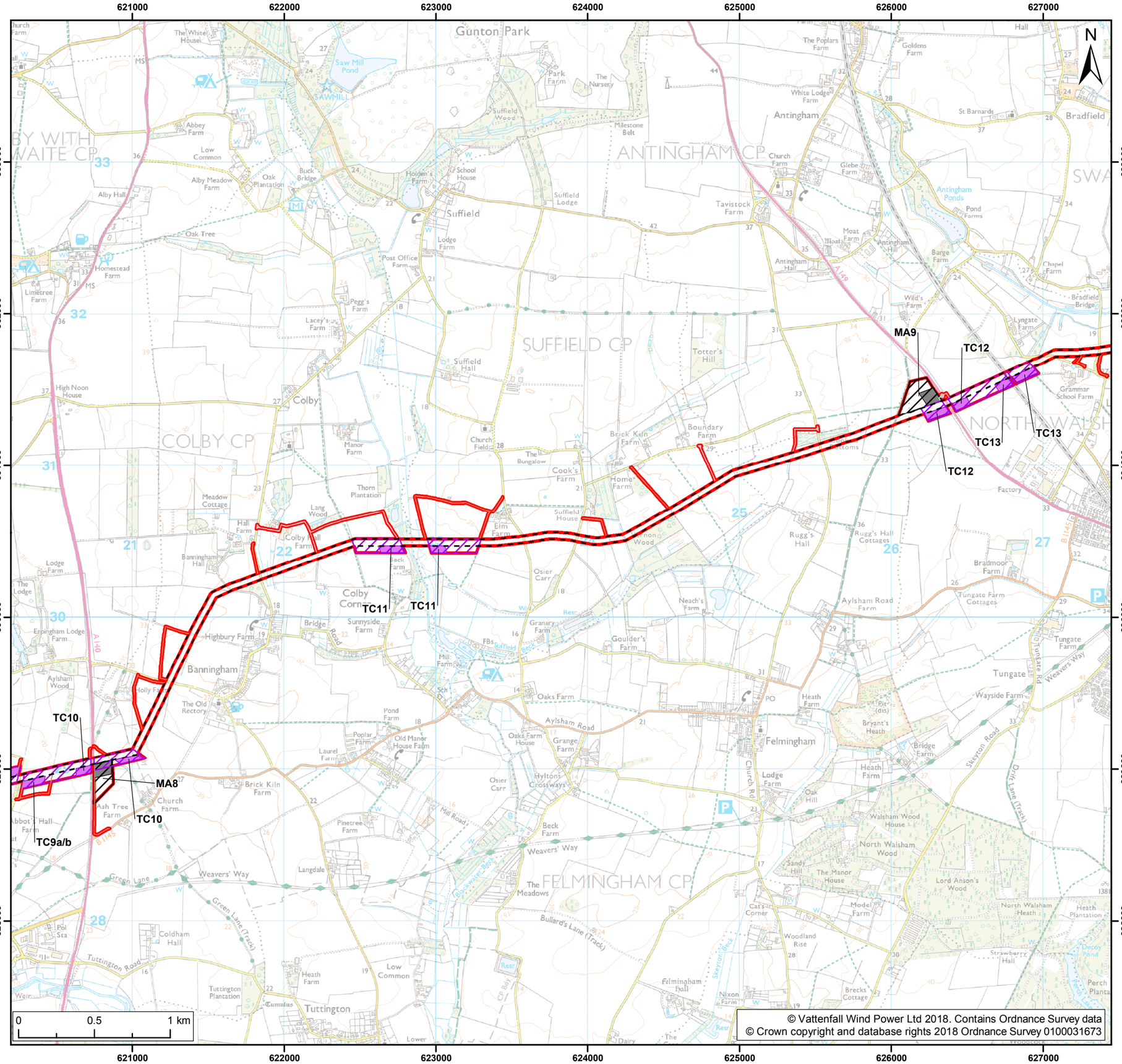
Figure: 1 | Drawing No: PB4476-006-010-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together



Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 3 of 9)

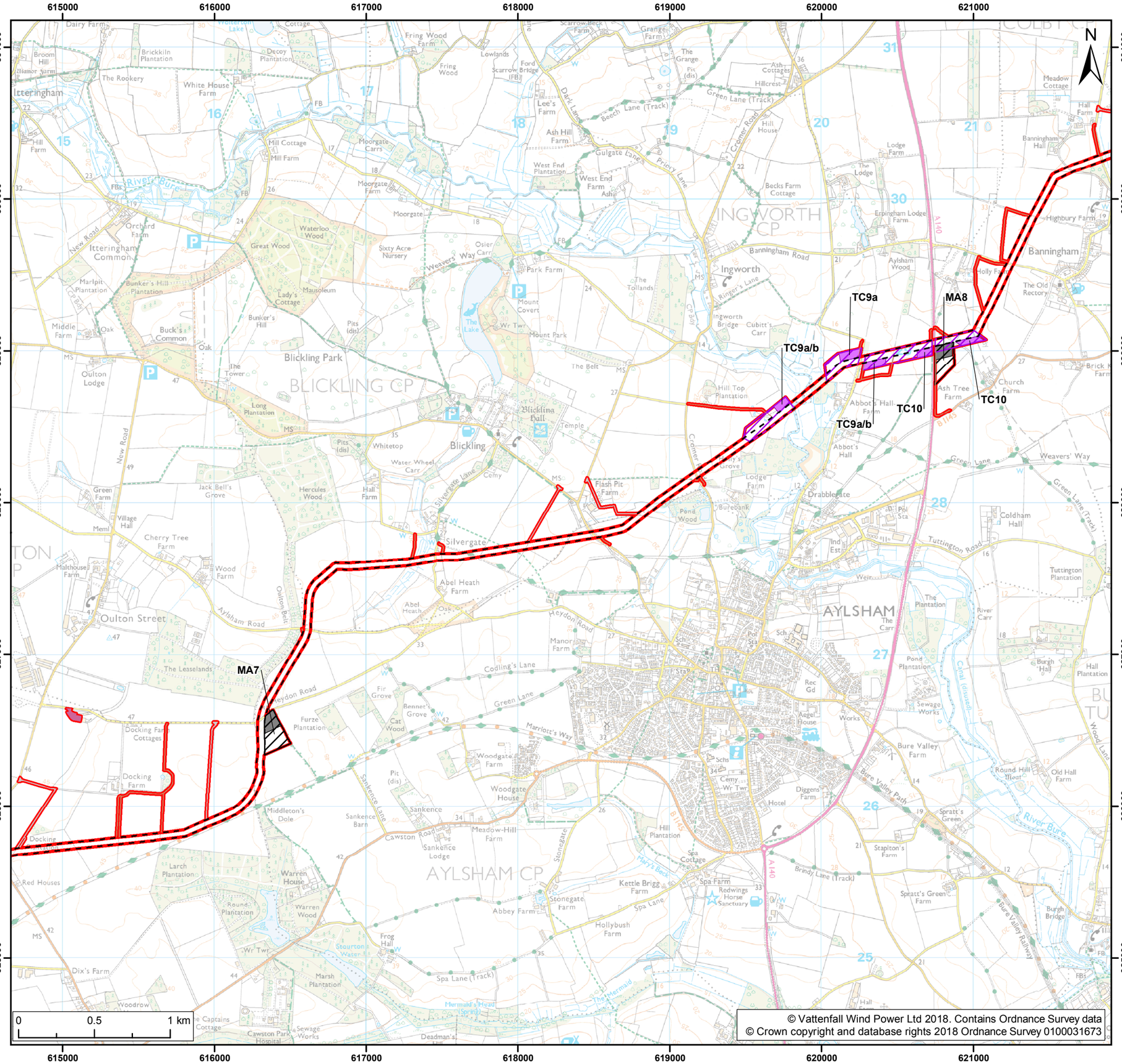
Figure: 1 | Drawing No: PB4476-006-010-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together



Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound
- Cable logistics area

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 4 of 9)

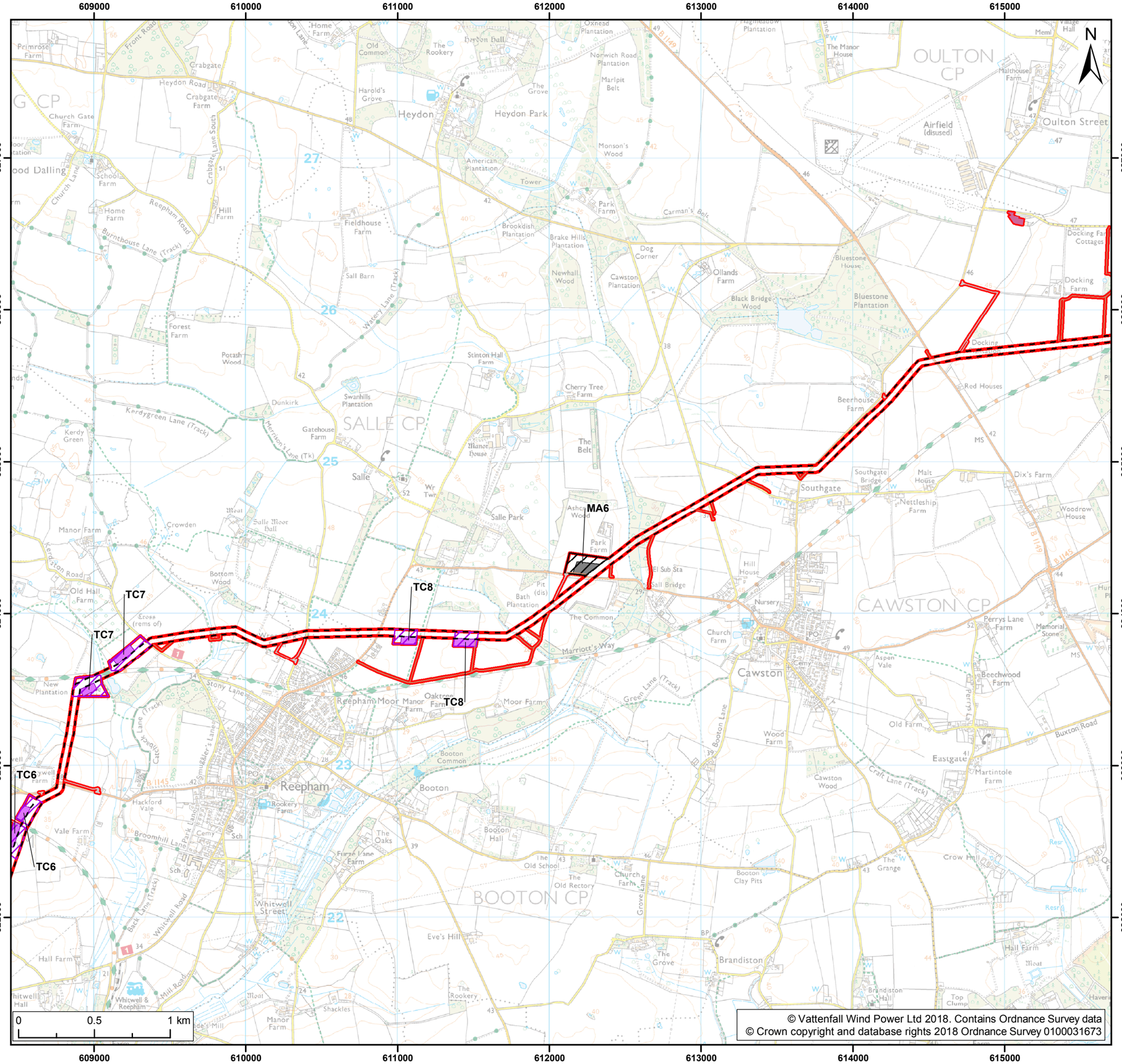
Figure: 1 | Drawing No: PB4476-006-010-001

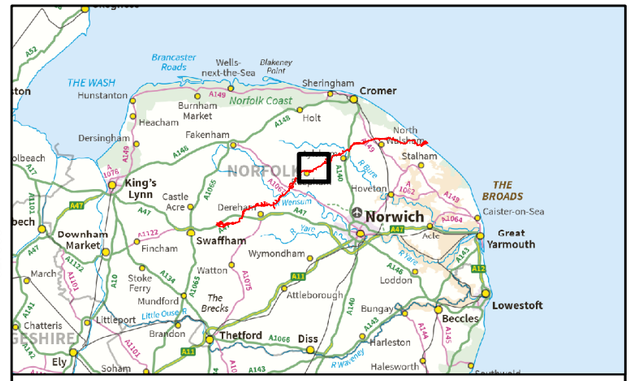
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together





Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound
- Cable logistics area

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 5 of 9)

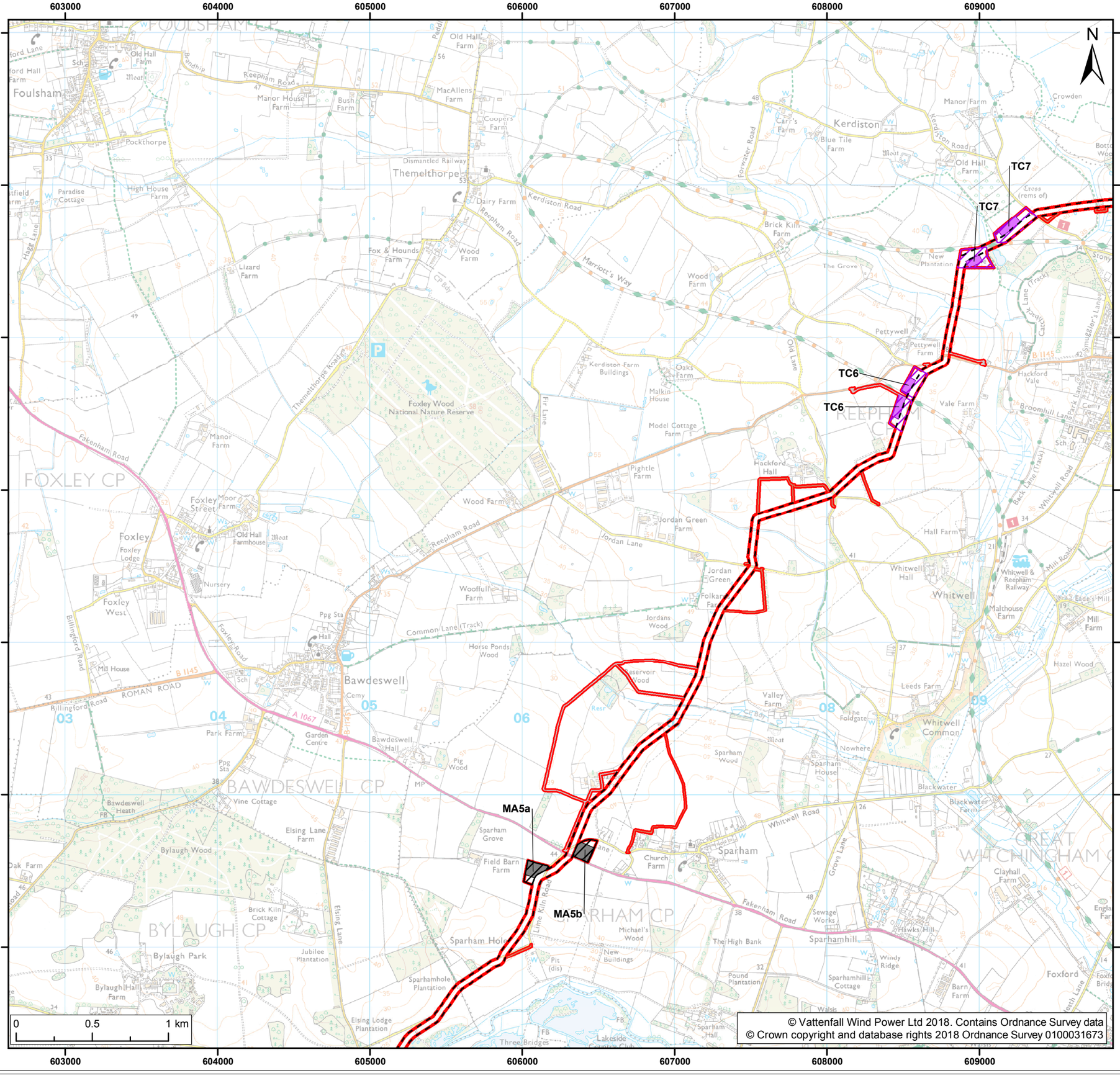
Figure: 1 | Drawing No: PB4476-006-010-001

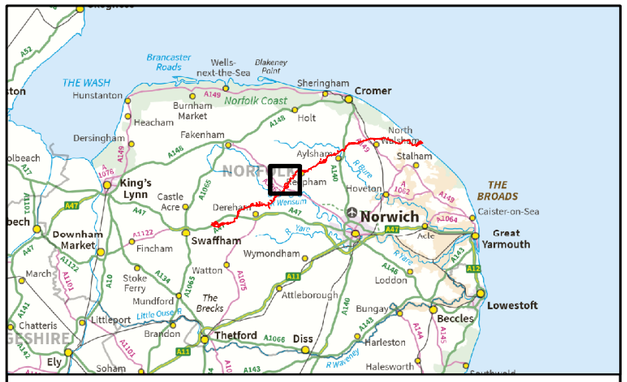
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together





Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 6 of 9)

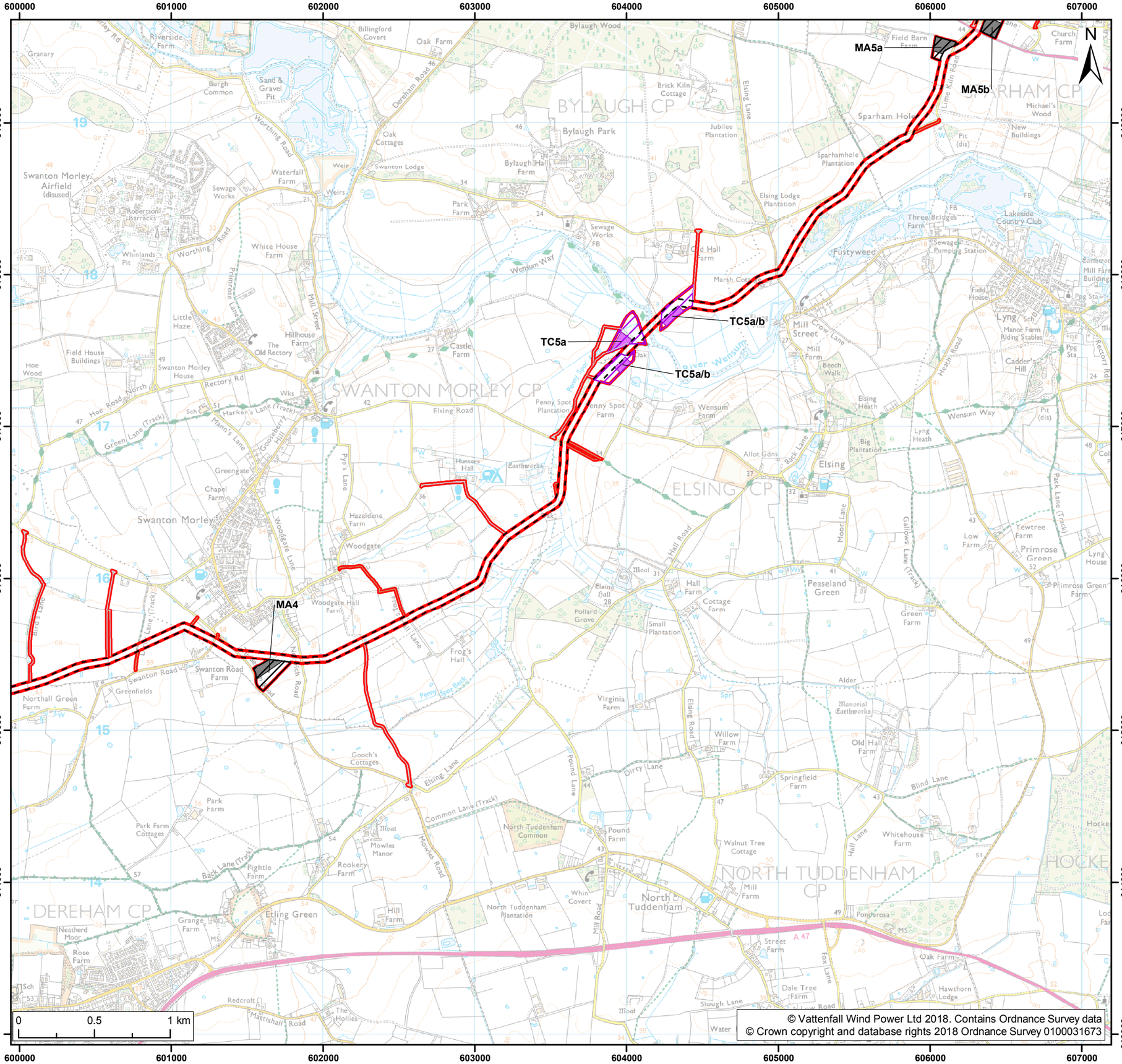
Figure: 1 | Drawing No: PB4476-006-010-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together



Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 7 of 9)

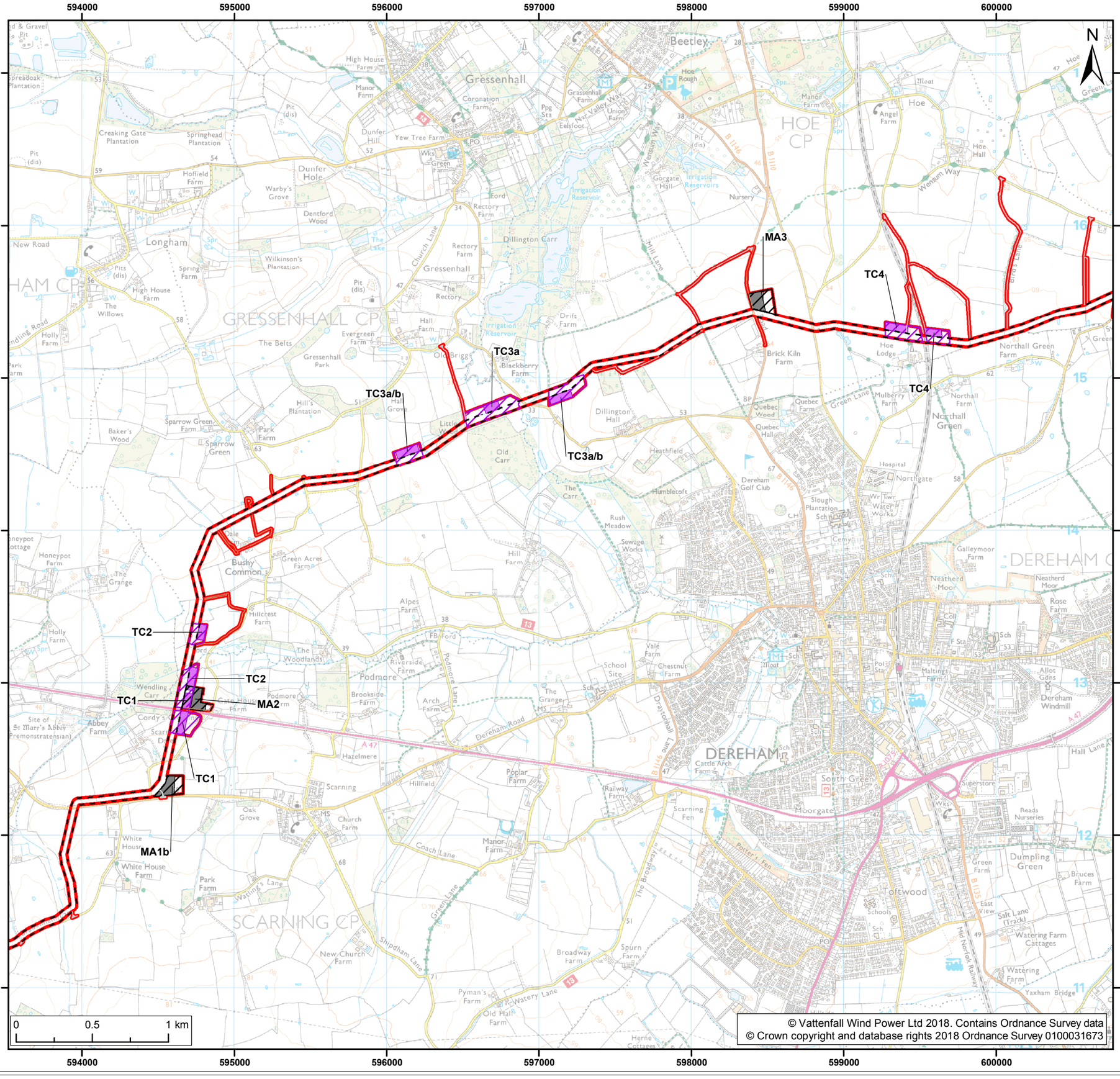
Figure: 1 | Drawing No: PB4476-006-010-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together



Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 8 of 9)

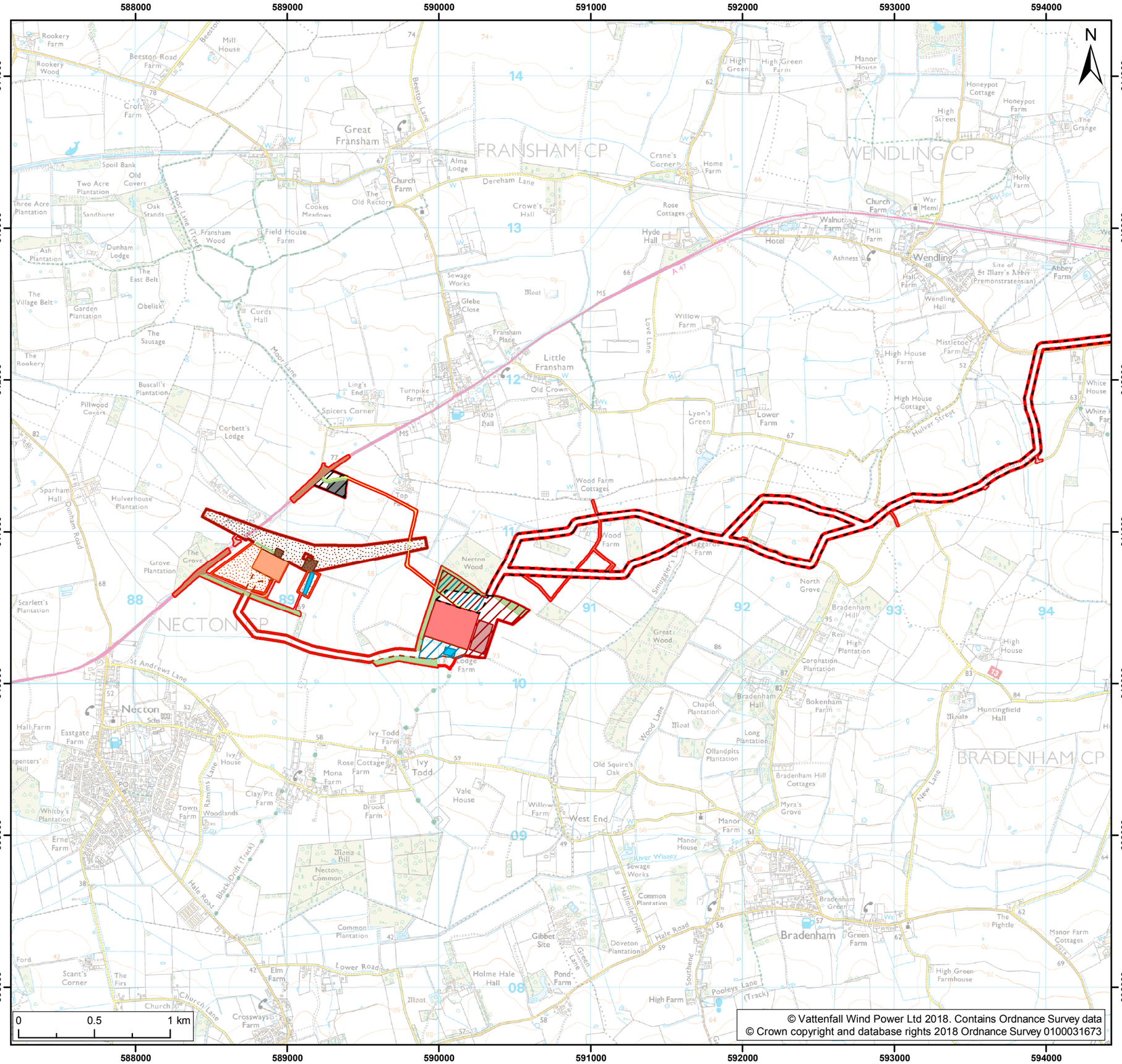
Figure: 1 | Drawing No: PB4476-006-010-001

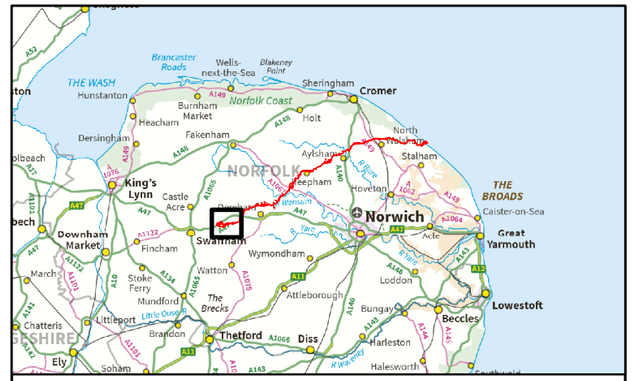
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together





Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Onshore 400kv cable route
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Permanent access
- Construction access
- Operation access

Onshore project substation

- Onshore project substation
- Onshore project substation temporary construction compound zone
- Indicative onshore project substation temporary construction compound

National Grid

- National Grid substation extension
- National Grid new / replacement overhead line tower
- National Grid temporary works
- Overhead line temporary works

Mitigation areas

- Attenuation pond zone
- Indicative attenuation pond
- Indicative mitigation planting

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Onshore project area
(map 9 of 9)

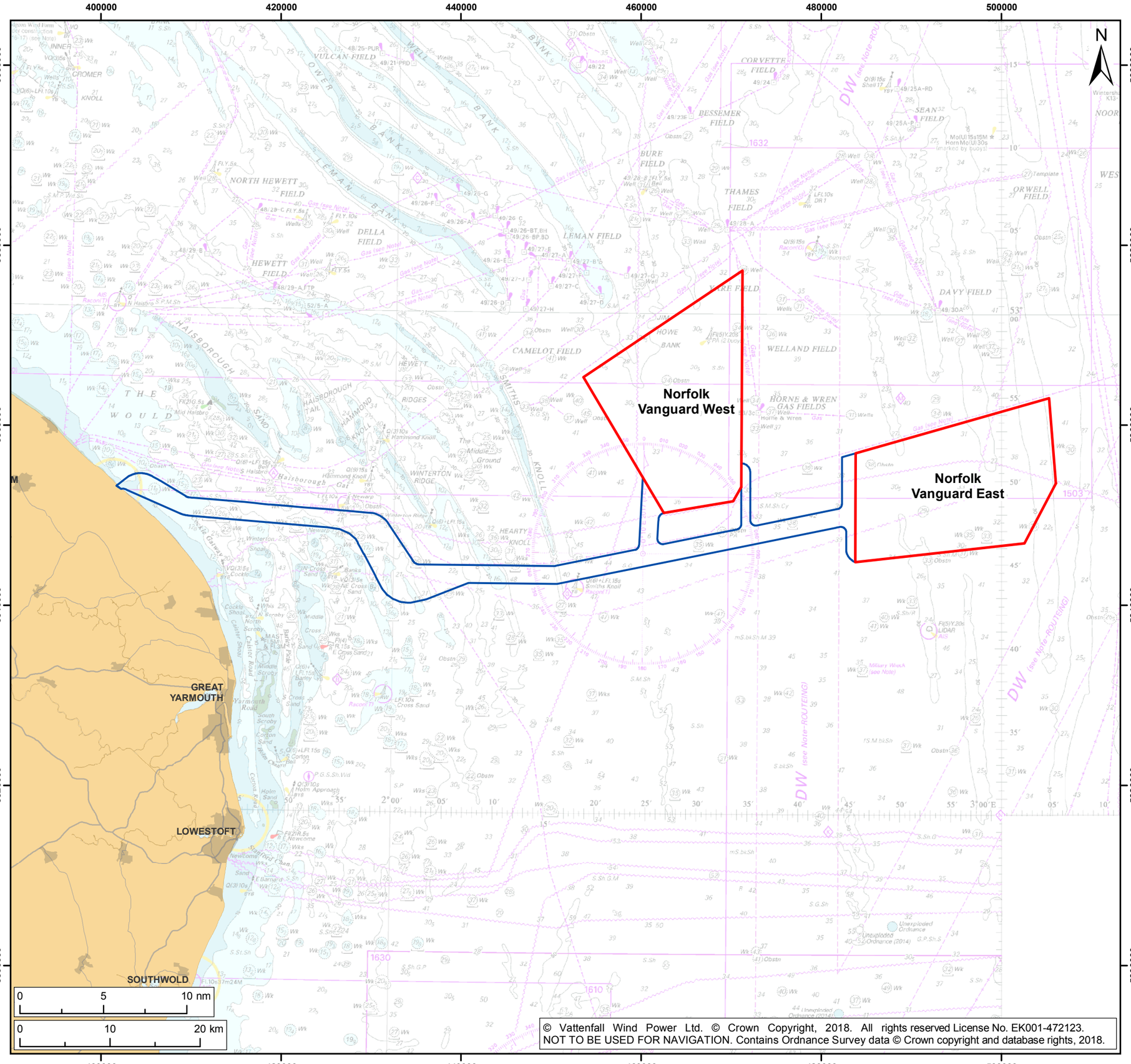
Figure:	Drawing No:
1	PB4476-006-010-001

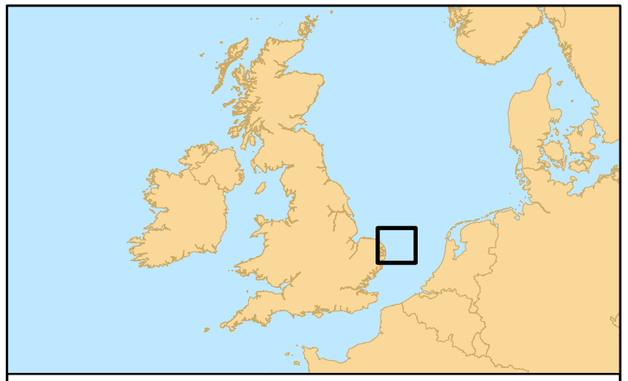
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together





Legend:

- Norfolk Vanguard
- Offshore cable corridor

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title: Offshore project area

Figure: 2 | Drawing No: PB4476-006-010-002

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	14/05/2018	LB	GK	A3	1:425,000

Co-ordinate system: ETRS 1989 UTM Zone 31N **EPSG:** 25831

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together

589500 589750 590000 590250 590500

310750 310500 310250 310000

N

Drain
Issues
Drain
Necton Wood
Drain
Existing Woodland
Species Rich Grassland
Planted Post Construction
Existing hedgerow removal to be
limited to 20m within the 45m shown
and reinstated after duct installation
2m Existing Hedge
7m Core Woodland Mix
7m Nurse Woodland Mix
Earth Bund up to 2m
Understory Planting
7m Nurse Woodland Mix
7m Core Woodland Mix
2m Existing Hedge
Species Rich Grassland
Planted Post Construction
Pond
Track
Drain
SUDS
69.8m
Drain
Lodge Farm
72.8m
Track
3m Species Rich Grassland
10m Nurse Woodland Mix
10m Core Woodland Mix
Existing Woodland
66.8m
Pond
57.6m
Drain

0 100 200 m

Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Onshore 400kv cable route

Onshore project substation

- Onshore project substation

Existing vegetation

- Existing woodland
- Existing hedgerow

Proposed mitigation area

- Proposed core woodland
- Proposed nurse woodland
- Proposed understorey planting
- Proposed species rich grassland
- Indicative attenuation pond
- Proposed hedgerow

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Indicative Mitigation Planting Onshore Project Substation – Norfolk Vanguard

Figure: 3 | Drawing No: PB4476-006-010-003

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	15/05/2018	LB	GK	A3	1:4,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together

589750 590000 590250 590500

310750 310500 310250 310000

N

Issues

Drain

Necton Wood

Drain

Pond

Track

Drain

SUDS

69.8m

Drain

Lodge Farm

72.8m

Track

Species Rich Grassland

7m Nurse Woodland Mix

7m Core Woodland Mix

Pond

Proposed Hedge

10m Core Woodland Mix

10m Nurse Woodland Mix

66.8m

Pond

57.6m

Track

Drain

Pond

0 100 200 m

Legend:

- Norfolk Vanguard onshore red line boundary

Onshore cable route

- Onshore cable route
- Onshore 400kv cable route

Onshore project substation

- Onshore project substation
- Norfolk Boreas onshore project substation

Existing vegetation

- Existing woodland
- Existing hedgerow

Proposed mitigation area

- Proposed core woodland
- Proposed nurse woodland
- Proposed understorey planting
- Proposed species rich grassland
- Indicative attenuation pond
- Proposed hedgerow
- Replacement hedge (in areas of removal)

Project:	Report:
Norfolk Vanguard	Design and Access Statement

Title:

Indicative Mitigation Planting Onshore Project Substation – Norfolk Vanguard and Norfolk Boreas

Figure: 4 Drawing No: PB4476-006-010-004

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	15/05/2018	LB	GK	A3	1:4,000

Co-ordinate system: British National Grid **EPSG:** 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together