Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited

August 2007

Final Report

9R8482

A COMPANY OF

ROYAL HASKONING

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INTRODUCTION

Scira Offshore Energy Limited

Scira Offshore Energy Limited (Scira) is proposing to construct and operate an offshore wind farm, known as Sheringham Shoal, located off the north Norfolk coast. Scira is a joint venture company formed between Hydro from Norway (50%) and Ecoventures BV from the Netherlands (50%).


Offshore wind turbines

Sheringham Shoal Offshore Wind Farm

In May 2006, Scira made an application for a number of regulatory consents, required to construct and operate the Sheringham Shoal offshore wind farm, to the Department for Business, Enterprise & Regulatory Reform (DBERR) (previously Department of Trade and Industry; DTI), which lead the consent process in association with the Department for Environment, Food and Rural Affairs (Defra). If approval is received, the wind farm will be located approximately 17 to 23km offshore from the north Norfolk coastal town of Sheringham, will have between 63 and 105 wind turbines and will be operational for a period of 40 years.

The application to DBERR covered the wind farm, the interconnecting cables, the sub-sea export cables, a landfall point at Weybourne, and a small element of associated onshore works, consisting of a buried cable connection or 'jointing' pit, a short section of underground cabling and a new switch station building at the Muckleburgh Collection museum in Weybourne (although it should be noted that this building is no longer required).

The wind farm project was subject to an Environmental Impact Assessment (EIA). The findings of the EIA were reported in an Environmental Statement report, which was submitted in support of the wind farm application, and is currently being determined by DBERR.

The Need for Renewable Energy

The central aim of the UK Government's energy policy is to establish a supply of energy that is diverse, sustainable and secure and is offered at competitive prices. Key to this goal is a 60% reduction of CO_2 emissions by 2050. The development of renewable energy plays a key role in the Government's strategy for carbon reduction. In 2000, the Government proposed an initial ten year strategy, which included a target to generate 10% of the UK's electricity from renewable sources by 2010. Revised targets have proposed that 15% of the UK electricity supply should come from renewable sources by 2015, with an aspiration of 20% by 2020.

The Government's targets for renewable energy will help the UK to meet its international obligations, but also obtain greater security of energy supply. The construction of wind farms (both on- and offshore) is expected to be the largest contributor to the renewable energy sector and wind energy will provide the greatest contribution to the 2010 target of all the renewable energy technologies.

The proposed Sheringham Shoal wind farm is expected to produce enough energy to supply over 210,000 homes with renewable energy each year. This would equate to a contribution of up to 1.74% of the total amount of renewable energy required to meet the Governments 15% renewable energy target for 2015. In addition, the wind farm will result in the reduction of approximately 34,400 kilotonnes (kt) of carbon dioxide, 400kt of sulphur dioxide and 120kt of nitrogen oxides over its 40 year lifetime, which would otherwise be released into the atmosphere, if the electricity generated had been produced by a conventional coal-fired power station.

Onshore Grid Connection

In order to feed the electricity generated by the wind farm into the national distribution network, an onshore grid connection will be required between the landfall point at Weybourne and a suitable connection point. An existing electricity substation at Salle, near Cawston, which is owned and operated by EDF Energy (EDFE), has been selected as the preferred connection point by Scira.

The onshore grid connection project consists of two main components:

- An underground cable system between Weybourne and the substation at Salle (approximately 21.3km in length).
- A new substation adjacent to the existing EDFE substation at Salle.

The onshore grid connection project will require planning consent from the two local planning authorities within which the project is located; North Norfolk District Council (NNDC) and Broadland District Council (BDC).

Figure 1 - Overview map

A separate EIA has been carried out for the onshore grid connection project; the results of which have been reported in an Environmental Statement.

This document forms a Non-Technical Summary of the onshore grid connection EIA process. For further details of the findings of the EIA, reference should be made to the full Environmental Statement document. Details of how to view the full Environmental Statement are given at the back of this document.

Further information regarding the Sheringham Shoal Offshore Wind Farm can also be found on Scira's website (www.scira.co.uk).

Figure 1 provides an overview of the entire Sheringham Shoal project, including the location of the offshore wind farm, the export cables and the landfall point at Weybourne (all part of the May 2006 application to DBERR) along with the location of the proposed onshore grid connection, to which this document relates.

REGULATORY REQUIREMENTS AND THE EIA PROCESS

Regulatory Consents and Need for EIA

In order to construct and operate the proposed onshore grid connection, Scira must first apply for and obtain planning permission under the Town and Country Planning (England and Wales) Act 1990 from North Norfolk District Council and Broadland District Council. Planning permission is required for the whole project, including the cable system and the new substation.

The project also needs to be subject to an Environmental Impact Assessment (EIA) in accordance with the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999.

The EIA Process

EIA and the Environmental Statement

EIA is a procedure that must be followed for certain types of development before they can be given development consent. The procedure is a means of drawing together an assessment of a project's likely significant environmental effects. The process takes into account each stage of the development, from the planning of the design, through to construction, operation and eventual decommissioning.

The results of the EIA are documented within an Environmental Statement (ES) report, which contains the following:

- Description of the development proposal, including any alternatives considered.
- Description of the existing environment at the site and its environs.
- Prediction of potential impacts on the existing human, physical and natural environment at the site and assessment of subsequent effects.
- Description of mitigation measures to avoid or reduce such effects.
- Description of monitoring requirements.
- Non-Technical Summary.

The following stages are typically included in an EIA:

- Screening determination of whether a development proposal needs an EIA.
- Scoping determination of the issues to be addressed by the EIA.
- Consultation and public participation.
- Original data collection and surveys where necessary to fill data gaps.
- Impact identification and evaluation.
- Identification of mitigation and residual impacts.
- Identification of monitoring requirements.
- Submission of the ES to the relevant authorities as part of the consents process.
- Liaison and consultation to resolve matters or representations/objections.
- Decision on whether the development proposal should proceed.

The EIA for the onshore grid connection project has been carried out in a number of stages and has been an integral part of the project design.

Site selection and consideration of alternatives

In order to identify the preferred route of the cable system, Scira has progressed a detailed and iterative route identification process, taking into account environmental, technical, financial and risk considerations. This process has been carried out by Scira with the support of a team of environmental and technical specialists. In summary, the process has included:

- Investigations into underground cable system options, rather than new overhead lines, to minimise impacts to the landscape and visual environment.
- Investigation into cable routes across agricultural land as well as routes using the road network.
- Initial studies to identify environmental designations in the area.
- Capture and analysis of aerial photographs to aid the route identification process and avoid environmental features.
- Detailed surveys, studies and assessments to gather information on the existing environment.
- Detailed technical assessments along proposed route option corridors to confirm engineering feasibility.
- Regular and thorough consultation with a range of consultees including public exhibitions.
- Analysis, assessment and route modifications to identify the best-fit preferred route option and any mitigation or monitoring measures which may be required to reduce any potential impacts to an acceptable level.

The identification of a location for Scira's proposed new substation has focused in and around the existing EDFE substation at Salle, near Cawston. The selected site is located immediately adjacent to the south-eastern side of the existing substation and was chosen as the preferred option, based primarily on; space availability; proximity to the substation for grid connection; and landscape and visual impact, as the site is naturally shielded to some degree already by the existing vegetation and topography. The substation and screening has been designed to limit impact on the environment and blend with existing landscape and features already present.

An almost limitless number of route options and combinations are theoretically possible in order to connect the proposed Sheringham Shoal offshore wind farm to the grid, however Scira is confident that the detailed and iterative process which has been adopted has taken due account of all environmental and technical considerations in order to propose the most favourable buried grid connection route and a new substation with minimal impact upon the natural, human and physical environment.

Agricultural fields between Weybourne and Bodham

Scoping and Consultation

As part of the EIA process, a scoping exercise was carried out to identify the main issues that needed to be addressed during the EIA. A scoping opinion was sought from both North Norfolk District Council and Broadland District Council.

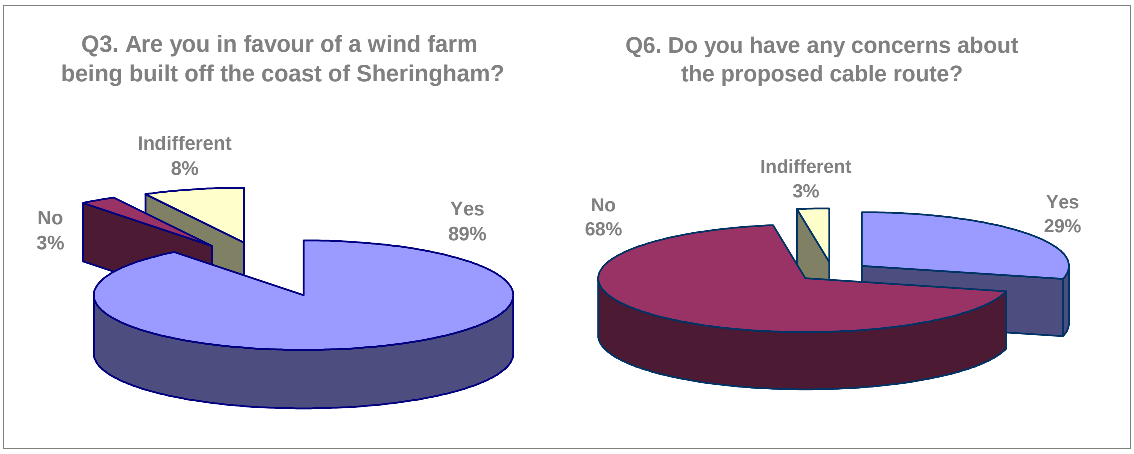
Extensive consultation has been carried out during the scoping stage and throughout the EIA process with statutory and non-statutory bodies, in order to identify key concerns and issues regarding the project. Consultees have included North Norfolk District Council, Broadland District Council, Norfolk County Council, parish councils, the Environment Agency, Natural England, English Heritage, Norfolk Landscape Archaeology, Norfolk Wildlife Trust, the local community, and other local organisations and individuals, including landowners and tenants.

Public exhibition at the Corpusty and Saxthorpe Centre

Consultation was carried out by written correspondence, telephone conversations and meetings. In addition, three public exhibitions were held in Bodham, Saxthorpe / Corpusty and Cawston during October 2006 to ensure that local people were aware of and had the opportunity to be involved in the EIA process.

A total of 114 people attended the public exhibitions, and 38 completed a questionnaire. 89% were in support of the wind farm project as a whole. 68% reported that they had no concerns in relation to the proposed onshore cable connection. 29% of the visitors stated they had concerns about the proposed cable route; however it should be noted that these concerns mainly related to the road-based route option being investigated at the time of the exhibitions, such as issues relating to traffic disruption and possible effects on road-side trees.

Public exhibition questionnaire analysis extract



Original data collection and surveys

A series of detailed surveys, data collection exercises and desk-studies were undertaken as part of the EIA to collect site specific information about the area. These are discussed in detail in the Environmental Statement and included:

- Ecological survey programme to identify important habitats and any protected species; supplemented with ecological data searches to collate any previous records, and a review of any designated nature conservation sites.
- Archaeological desk-based assessments to identify any features of cultural heritage significance such as Scheduled Monuments and Listed Buildings, as well as any previously recorded archaeological finds or features.
- Desk-based assessments and site reconnaissance visits to collate information on the geology, hydrology and hydrology of the area, as well as any data on possible contaminated land.

- Identification of landscape designations; and a landscape and visual character assessment.
- Calculation of traffic movements and vehicle types during construction and operational stages.
- Desk based noise and vibration studies with reference to British Standards and other current relevant guidance.
- Desk based assessments with reference to existing air quality and monitoring data held by North Norfolk District Council, Broadland District Council and the National Air Quality Information Archive (NAQIA).
- Desk-based assessments with reference to local maps and data sources to identify features relating to the local land use and local community, as well as any tourism or recreational features, including a review of any Public Rights of Way in the area.
- Additional site visits to ground truth the findings of various surveys and studies.

Impact identification and evaluation

Impact identification and evaluation was carried out via a number of methods and techniques, including reference to guidelines, research, literature review and consultation. In order to provide a consistent framework for considering and evaluating impacts, significance levels have been assigned to each impact. To assess the significance of an impact, it is necessary to identify the magnitude of the effect and also the sensitivity of the receptor. The resulting significance is a balance of the two. The assigned definitions for assigning significance are set out in the table below.

Terminology for classifying environmental impacts

Impact Significance	Definition
No impact	There is an absence of one or more of the following: impact source, pathway or receptor.
Negligible	The impact is not of concern.
Minor adverse	The impact is undesirable but of limited concern.
Moderate adverse	The impact gives rise to some concern but is likely to be tolerable (depending on the scale and duration).
Major adverse	The impact gives rise to serious concern; it should be considered as severe.
Minor beneficial	The impact is of minor significance but has some environmental benefit.
Moderate beneficial	The impact provides some gain to the environment.
Major beneficial	The impact provides a significant positive gain.

Mitigation, monitoring and residual impacts

Where potentially significant adverse impacts are identified, mitigation measures to avoid, reduce and minimise these impacts are outlined, either as part of the design, or as a measure implemented during construction or operational phases. Good practice measures are also identified in order to minimise the impact of the proposed development further. Scira has agreed to these mitigation measures and they are therefore expressed as commitments. If required, monitoring initiatives have also been identified. The level of significance assigned to an impact is the **residual** impact, following successful implementation of the stated mitigation methods, good construction or operational practice or relevant regulations and guidelines, and is shown in **bold** in each section.

Assessment of cumulative effects

In order to make the connection, EDFE would also need to install additional electrical equipment and extend an existing building within their substation compound. Although this work does not form part of Scira's onshore grid connection application, this work has been discussed in the ES in order to provide the 'whole picture'. In addition, the possibility of any cumulative impacts have been assessed where appropriate.

PROJECT DETAILS

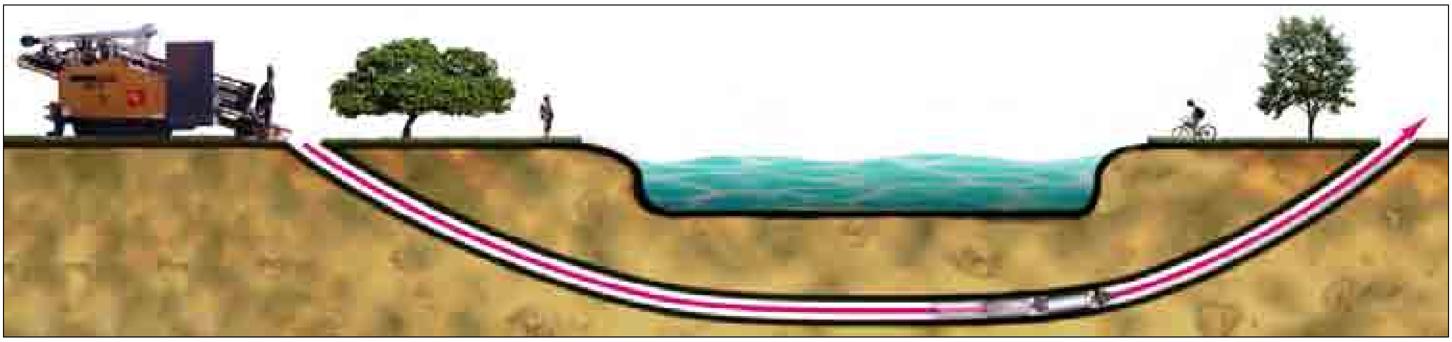
The cable system

The onshore grid connection would consist of an underground 132 kilovolt (kV) cable system, 21.3km in length, between the Muckleburgh Collection museum at Weybourne and the existing substation at Salle, near Cawston. **Figure 2** shows the route of the proposed cable system. The majority of land along the proposed route is cultivated agricultural land separated by hedgerows with occasional trees. The route also crosses the local road network in 21 locations; the North Norfolk Railway (Poppy Line); the River Bure; several areas of woodland and a holiday park (Kelling Heath).

The cable system would comprise of six power cables, installed below ground in plastic pipes or 'ducts'. Fibre-optic cables for communication purposes would also be installed. For the most part of the route, it is proposed that the cables are installed by a method of open-cut trenching. The trenches would need to be approximately 2.2m wide and 1.6m deep.

In four locations, it has been assessed that open trenching would not be appropriate for either environmental or technical reasons (or both). These locations are; Kelling Heath Holiday Park and the Poppy Line Railway; Baconsthorpe Wood; the River Bure; and a woodland to the east of Salle Park, and are also shown on **Figure 2**. In these locations, a technique known as 'directional drilling' will be used to install the cable ducts to avoid or minimise any impact to the surface features. A simplified diagram to illustrate the directional drilling process is given below.

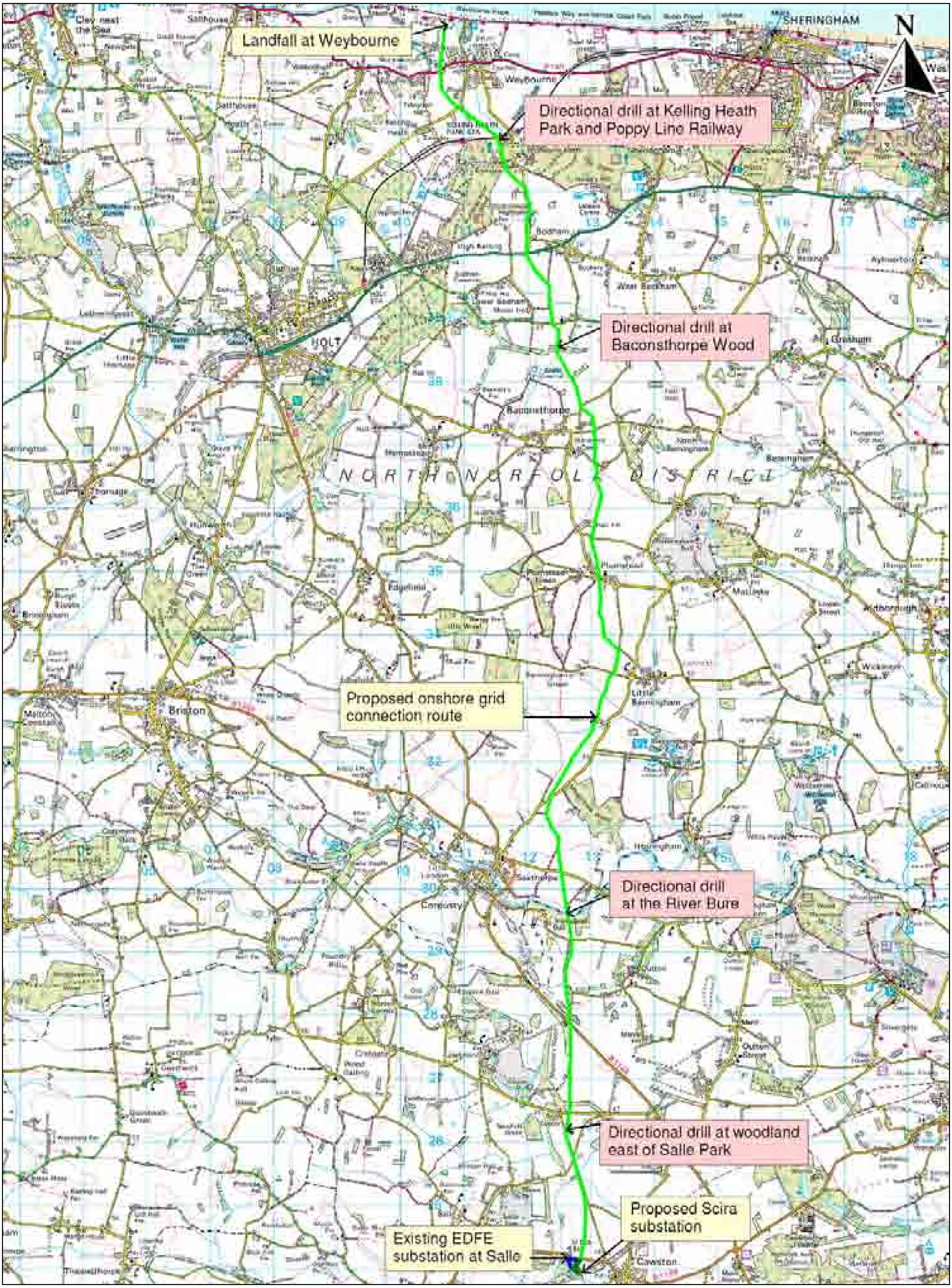
Simplified illustration of directional drilling to cross a surface feature



The cables would be delivered in lengths and would need to be jointed together on site. Where the cables are jointed together, a process known as cross-bonding would also be necessary. The cross-bonding would need to be permanently accessible for maintenance purposes. It is expected that there would need to be 34 cross-bonding locations along the cable route, which would be located at field boundaries. In most cases, it is envisaged that the cross-bonding would be placed in buried pits with a surface manhole; however in certain places, it may be necessary to install an above ground inspection pillar. Pictures of typical cross-bonding pits and pillars are shown below. Following the construction phase, the cable system would be buried and the land reinstated to its former condition.

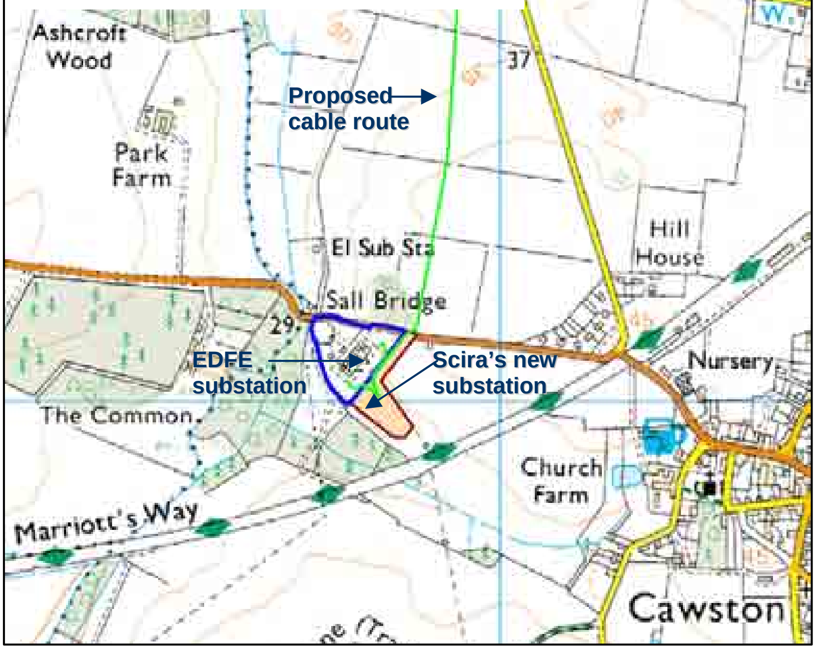
Typical cross-bonding arrangements involve either a buried pit with a manhole or an above ground pillar

Figure 2 – Proposed cable route



The substation

Figure 3 – Proposed substation location



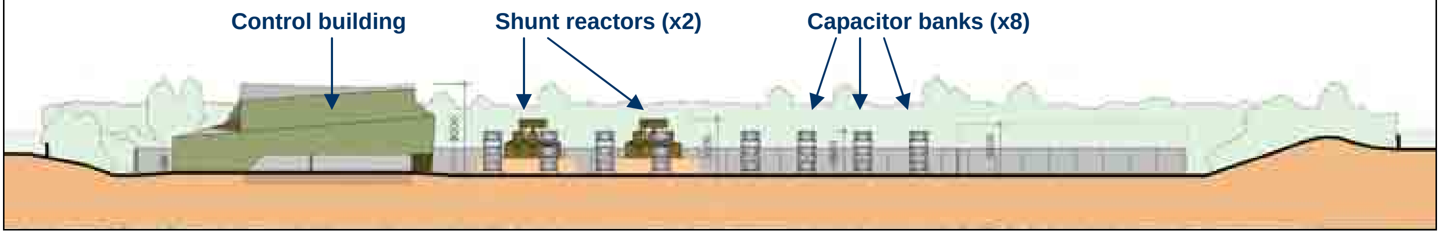
The proposed location for the new substation lies adjacent to the south-east boundary of the existing EDFE Salle substation as shown in **Figure 3**. The site is currently a field under arable cultivation.

Figure 4 shows the south-west elevation of the proposed substation.

Scira's new substation would house indoor and outdoor equipment necessary to connect the offshore wind farm to the electricity grid network and would include:

- A Control Building containing the switch gear and control gear for the wind farm. The dimensions of the building would be 15.4m in width and 27.4m in length. The overall above ground height would be 8.0m with an eave height of approximately 6.5m.
- An Ancillary Building adjacent to the control building would house a workshop, store room, toilet and shower room, mess room and office. The dimensions of the building would be 6.1m width and 16.0m length.
- Two shunt reactors, which would be up to 5m in height.
- Eight three-phase capacitor banks (24 single stacks), each up to 4m in height.
- Space for additional electrical equipment (if required).
- Associated access, hard standings, security fencing and tree planting.

Figure 4 – South-west elevation of the proposed substation



Programme

It is envisaged that the offshore wind farm would be operational during 2011. The construction of the entire cable system is expected to take between 18 months and two years, however construction at each location along the route will be very limited in duration. The construction of the substation is expected to take between 15 and 18 months. The overall time frame for the construction of the onshore grid connection cannot be determined at this stage as it will be dependant upon a number of factors which would be finalised during the detailed design stage following consent.

SUMMARY OF ENVIRONMENTAL IMPACTS

Introduction

The following sections summarise the potential environmental impacts associated with the construction and operation of the onshore grid connection for the Sheringham Shoal Offshore Wind Farm. The following environmental topics have been assessed:

- Nature conservation and ecology.
- Archaeology and cultural heritage.
- Geology, hydrology and hydrogeology.
- Landscape and visual assessment.
- Noise and vibration.
- Air quality and dust.
- Local community, land use, tourism and recreation.

The assessment of effects relating to construction traffic has been carried out as part of the noise and vibration; air quality and dust; and local community, land use, tourism and recreation assessments.

Wood anemones at Baconsthorpe Wood

Nature conservation and ecology

The cable route and substation site have been planned to ensure that there is **no impact** to any international, European, or nationally designated nature conservation sites. All areas of woodland listed on Natural England's Ancient Woodland Inventory and the majority of County Wildlife Sites (CWS) have also been avoided. The route across the Kelling Heath Park and Hundred Acre Woods CWS would be directionally drilled to reduce the potential impact. The construction corridor across Carman's Belt, also a CWS, would be minimised and mitigation incorporated to ensure that the impact to these two county-level sites is reduced to a **negligible** level.

Baconsthorpe Wood, the River Bure, and a woodland east of Salle Park, would also be directionally drilled, therefore **no impact** would occur to these ecologically sensitive locations.

The impact to hedgerow habitats will be **minor adverse** following measures such as using existing gaps for cable crossings, reinstating hedgerows and avoiding individual trees wherever possible. Careful management of watercourse crossings will mean that there would also be **no impact** once reinstatement has taken place. Impacts to grassland habitat would also be **negligible**. The new substation is sited on arable land of low ecological value, therefore there would be **no impact**.

Targeted protected species surveys found that no badgers were present in the area of the proposed works, therefore **no impact** is predicted to this species. Water vole and otter are present at the River Bure; however this location will be directionally drilled meaning there would be **no impact** to these two protected species. Following mitigation, **no impact** is envisaged to breeding birds, great crested newts, bat roost sites, or white clawed crayfish habitats. Following sensitive management of grassland, woodland and wetland habitats during the construction phase, impacts to reptiles or diverse invertebrate assemblages would be **negligible**. Surveys for badger and water vole will be repeated nearer to the time of development to re-confirm the status of the two species.

No impact to any nature conservation sites or features or ecological significance would occur during the operational phase.

Archaeology and cultural heritage

An archaeological desk based assessment found that over 100 archaeological sites listed on the Norfolk Historical Environment Records (NHER) database exist within the survey area, dating from Pre-historic, Iron Age, Roman, Medieval, and WWI and II time periods. These include two Scheduled Monuments, several Listed Buildings, two Registered Parks and Gardens, earthworks, cropmarks and a variety of finds such as pottery remains, coins and jewellery.

The cable route has been designed to avoid known archaeological sites wherever possible, and there is **no impact** on the majority of these sites, including all Listed Buildings and Scheduled Monuments in the area. In some locations it has not been feasible to avoid some archaeological finds or features. In order minimise the potential impact to these sites, Scira will agree and implement a suitable mitigation strategy and recording programme in liaison with Norfolk Landscape Archaeology. The residual impact of the cable route construction on these affected archaeological sites is likely to be **minor adverse**.

No archaeological sites were identified in the area of the proposed substation location. In addition, this area has undergone archaeological study in the past and no finds or features were recorded. The likelihood of encountering previously unrecorded archaeological finds or features at this site has been assessed as **negligible**.

During the operation of the onshore grid connection, there would be no further ground disturbance, therefore there would be **no impact** to archaeology and cultural heritage during operation.

Geology, hydrogeology, hydrology and land quality

The cable route directly crosses 14 watercourses, including one main river (the River Bure) and one watercourse managed by the regional Internal Drainage Board. Both of these two watercourses would be directionally drilled therefore there would be **no impact.** Construction works to cross the remaining 12 watercourses; which comprise of small drainage channels and dry ditches; may cause increased levels of sediment in the water, and higher levels of soil erosion. The implementation of mitigation and good construction practice will ensure that the impact to these small watercourses would be **negligible** during construction.

Historically, the land use along the cable corridor has been agricultural. However, there are several old military sites, quarry sites, pits, and landfill sites in the area which have been identified as possible contaminated land locations.

A 'Conceptual Site Model' has been used to assess the potential environmental risks in relation to the proposed onshore grid connection. The risk assessment has been used to design suitable mitigation measures to reduce these risks. These measures include adhering to Pollution Prevention Guidelines; minimising excavated volume; rapid reinstatement of excavated areas; and undertaking further consultation if any previously unrecorded contamination is found during the works. The residual impacts of the development with respect to geology, hydrogeology, hydrology and land quality were found to be **negligible**. The only exception is the potential impact of directional drilling if unknown contaminated exists, in which case the impacts on controlled waters and construction workers was assessed to be **minor adverse**.

The River Bure

Landscape and visual character

The cable route and substation have been designed with landscape and visual impacts in mind, in order that they cause the least possible negative impacts. An assessment of the landscape of the study area was carried out, through aerial photography, extensive field walking, reference to countryside character assessments, and thorough consultation with local planning and countryside officers.

The main visual and landscape impacts of the cable route would be caused during the construction phase. However, this is only for a short duration, and would follow a management programme. Once installed the majority of the cable would be buried underground, with the exception of cross bonding pits (or pillars, if necessary). Therefore there are **no major impacts** on landscape and visual character associated with the cable system.

Construction of the substation would have a greater visual impact on the local landscape; however this is not a major impact due to its short duration. Once in operation, the key effect would be the change to the views for the travelling public and for the few houses near the substation site. This impact will be reduced by siting the building on lower ground so it is shielded from view, and by planting trees around the building. In addition, these measures will be beneficial by helping to shield the existing substation from the public's view. The overall impact of the completed substation on landscape and visual character has been assessed as **negligible**.

Noise and vibration

The noise and vibration impact of the proposed onshore grid connection project has been assessed with reference to British standards. Impacts were predicted for potentially noise sensitive receptors within a 300m zone either side of the construction area for the cable route and substation. The study showed that approximately 190 residential properties would be affected by noise during the construction period. Unacceptable day time noise levels were predicted to occur for approximately 15 properties; and minor to major adverse impacts were predicted for approximately 124 properties within the 300m zone. Night time activities such as pumping operations are likely to cause unacceptable night time noise levels for all properties within the survey area, and possibly for properties up to 480m away from the route.

To minimise these impacts, best practice working methods will be used, along with the quietest equipment available and, where necessary, the use of physical screening. These methods will ensure that noise levels are reduced such that no more than a **minor adverse impact** occurs. Where this is not possible, a public relations programme will keep the public informed of construction works, so that the subjective perception of noise is reduced to a **minor adverse** significance. Controls on the speed and times of operations and of construction-related traffic will ensure that impacts from these activities are only of **minor adverse** significance. All impacts relating to the construction of the cable system would be of a short-term duration.

The substation location is far enough away from residential properties that after noise reducing measures have been implemented there will be **no adverse impact**. If the substation works coincide with EDFE's expansion works at the existing substation, there may be an increased level of noise impact. After noise reduction measures haves been carried out, this impact will be reduced to a **minor adverse** level.

Air quality and dust

Air quality monitoring has shown that local background concentrations of nitrogen dioxide (NO_2) and fine particles (PM_{10}) would achieve air quality objectives in 2007 and 2010. The development is not expected to cause UK air quality objectives to be exceeded.

All non-road mobile machinery (NRMM) used for the development will comply with current or previous EU Directive Staged Emission Standards. This will help to minimise the impact on air quality through techniques such as the use of ultra low sulphur diesel, fitting all machinery with Diesel Particulate Filters (DPF), and using energy saving methods whilst operating the machinery. The residual impact of NRMM during construction has been assessed as **negligible**.

An air quality assessment found that construction emissions will have a short term moderate adverse impact on sensitive receptors within 200m of the construction corridor. This impact will be reduced by following the Code of Construction Practice techniques to minimise dust emissions. The residual impact on air quality during construction (for sensitive receptors) has been assessed to be of short term, **minor adverse** significance. The construction of the substation is likely to cause a **minor adverse** impact on air quality.

Once the cable route and substation are operational, it has been assessed that there would be **no impact** on local air quality.

Local community, land use, tourism and recreation

The land use in the area of the development is mainly private agricultural land, with a few exceptions including locations where it crosses the Public Highway, Public Rights of Way, the Poppy Line Railway, the River Bure, several woodlands, the Kelling Heath Holiday Park and the Muckleburgh Collection museum. The impact of the cable system to agricultural land will be **negligible**, as the construction work is temporary and land will be fully reinstated to its previous use after construction. The location of the proposed substation is privately owned agricultural land. The construction of the substation will have a **minor adverse impact** on agricultural practices.

The temporary disruption to the local road network will be minimised by mitigation measures such as consultation with the Highways Authority (Norfolk County Council) to ensure suitable diversion routes, and scheduling construction traffic at off-peak times of the day. The resulting impact on the road network will be **minor adverse** during periods of high traffic movement, and **negligible** at other times. Several Public Rights of Way and other public access routes will need to be temporarily closed during the construction phase. The impact on these is assessed to be **negligible**, after mitigation such as public communication and appropriate diversions have been put in place.

Depending on the time of year that construction is carried out, there may be disruption to local tourism. This impact has been minimised by the proposal to directionally drill under features of importance to tourists, such as the Kelling Heath Holiday Park and the Poppy Line railway. The works at Muckleburgh collection museum will take place out of the tourist season meaning there will be **no impact**. If construction at Kelling Heath takes place in the main tourism season, the impact will be **minor adverse**; if it avoids the tourist season the impact will be **negligible**. **No impact** on tourism or recreation is envisaged in relation to the proposed substation construction.

The increase in construction workers using local hotels, restaurants and shops during the construction of the onshore grid connection is likely to have a short-term **minor beneficial impact** on the local economy.

During operation, the cable system will be buried and will have **no impact** on the local community, land use, tourism or recreation. The operation of the substation has also been assessed to have **no impact** during operation.

The Muckleburgh Collection museum in Weybourne

CONCLUSIONS

In order to identify a suitable cable route, Scira has undertaken a detailed programme of surveys, studies and assessments, taking into account environmental, technical, financial and risk considerations. This process has been carried out by Scira with the support of a team of environmental and technical specialists.

An almost limitless number of route options are possible, however Scira is confident that the proposed buried cable route has considered all environmental and technical factors, has minimal impact on the environment and is the most favourable option. The location, layout and design of the proposed substation has been carried out in a way to minimise the effects on the landscape and visual character of the area.

A detailed Environmental Impact Assessment (EIA) has been carried out which has assessed the impact of the proposed grid connection to the natural, physical and man-made environment. The EIA process has also involved consultation with statutory and non-statutory organisations, and the local community throughout. Overall, given the successful implementation of the stated mitigation measures as committed to by Scira, it is predicted that the onshore grid connection project would have no long-term unacceptable impacts.

Following planning consent, an Environmental Action Plan (EAP) will be prepared to ensure that the mitigation measures committed to by Scira as part of the Environmental Statement and best practice are implemented correctly on site and as part of the construction contract.

The project is an essential part of the overall Sheringham Shoal Offshore Wind Farm, and would therefore make a significant contribution to both regional and national renewable energy targets and CO_2 emission reductions.

An operational offshore wind farm

ROYAL HASKONING

FURTHER INFORMATION

Further information on the Sheringham Shoal Offshore Wind Farm can be obtained from Scira's website at www.scira.co.uk.

The full Environmental Statement can be viewed during the statutory consultation period at the following locations:

- North Norfolk District Council, Council Offices, Holt Road, Cromer, Norfolk NR27 9EN.
- Broadland District Council, Council Offices, Thorpe Lodge, 1 Yarmouth Road, Thorpe St. Andrew, Norwich NR7 0DU
- Copies will also be provided to all parish councils along the proposed cable route alignment

Requests for copies of the full Environmental Statement should be made in writing to Royal Haskoning, 4 Dean's Yard, Westminster, London SW1P 3NL, or by email to info@london.royalhaskoning.com (a fee will be applicable which would be confirmed upon application). Additional copies of this Non-Technical Summary can be obtained free of charge from this address. The Non-Technical Summary is also available to download from Scira's website (www.scira.co.uk).

Please note, if you wish to make any comment on the planning applications, these must be made in writing, directly to North Norfolk District Council and Broadland District Council, using the addresses given above, marked 'Planning Administration'.

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 1

INTRODUCTION

1 INTRODUCTION

1.1 Background

Scira Offshore Energy Ltd. is proposing to construct and operate an offshore wind farm, known as Sheringham Shoal, at a site located approximately 17 to 23 kilometres (km) offshore from the coastal town of Sheringham, on the north Norfolk coast. The application for environmental and other consents required for the offshore wind farm is currently being determined by the Department for Business, Enterprise & Regulatory Reform (DBERR) (previously Department of Trade and Industry; DTI).

An onshore grid connection will be required in order to connect the wind farm to the national electricity distribution grid. It is proposed that this would comprise of approximately 21.3km of underground cabling between the coastal of town of Weybourne and an existing substation at Salle, near Cawston. In addition a new substation will be required adjacent to the existing substation, in order to accommodate the additional capacity from the offshore wind farm. The extent of the proposed onshore grid connection, in relation to the proposed Sheringham Shoal offshore wind farm is shown in **Figure 1.1**. An application for planning permission by Scira Offshore Energy Ltd. under the Town and Country Planning (England and Wales) Act 1990 is being made to North Norfolk District Council and Broadland District Council in relation to this onshore grid connection project ("the Project"). The scope of this ES does not cover the offshore wind farm, export cables or the proposed landfall at Weybourne.

The Project is subject to an Environmental Impact Assessment (EIA) in accordance with the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999. EIA is a procedure that must be followed for certain types of development before they can be given development consent. The procedure is a means of drawing together an assessment of a project's likely significant environmental effects, from the planning of the design, through to construction, operation and eventual decommissioning.

On its own the Project would not normally be subject to EIA. This is because in most cases the laying of an underground electrical cable by a Statutory Undertaker after they have obtained an Electricity Generation Licence is considered Permitted Development under the Town and Country Planning (General Permitted Development) Order 1995. In addition, the substation building on its own would not attract the need for EIA. However the onshore grid connection is an essential part of the Sheringham Shoal offshore wind farm, which has been subject to EIA. For this reason, the Project must be seen as part of the wider offshore wind farm proposal and thus EIA is required.

A Scoping Report was prepared setting out the proposed scope of the EIA to be carried out. This was submitted to North Norfolk District Council and Broadland District Council who consulted various consultees and confirmed that the proposed scope of the EIA was satisfactory and attached consultee responses for consideration in the EIA.

This Environmental Statement (ES) is the report that describes the proposed onshore grid connection project and documents the findings and recommendations of the EIA process.

Figure 1.1 Offshore wind farm and onshore grid connection site overview

(DBERR: Department for Business, Enterprise & Regulatory Reform (DBERR) (previously DTI); NNDC: North Norfolk District Council; BDC: Broadland District Council)

1.2 Background to the Project Proponent

1.2.1 Scira Offshore Energy

Scira Offshore Energy Ltd. (hereafter referred to as Scira), is a joint venture company formed between Hydro from Norway and Ecoventures BV from The Netherlands, to develop the Sheringham Shoal Offshore Wind Farm.

Scira considers offshore wind energy as an opportunity, both for society and from a business perspective. Its strategy towards the development of offshore wind farm development combines the following elements:

- Active involvement of society to create and maintain the necessary support for wind energy projects and to find optimal solutions for any problems or damages that may occur.
- Pro-active risk management.
- Balance between innovation and proven technology.

On March 12 2007 Scira was granted a Generation Licence by the Office of Gas and Electricity Markets (Ofgem). Two months later, the Gas and Electricity Markets Authority switched-on Standard Licence Conditions (SLCs) 14 and 15 in the company's electricity generation licence. These modified conditions apply to the compulsory purchase of land and other powers related to cable laying, and give licence holders certain powers and rights enabling them to carry out specific activities.

Further information is available on Scira's website www.scira.co.uk.

1.2.2 Norsk Hydro

Hydro is a Fortune 500 energy and aluminium supplier with 36,000 employees in nearly 40 countries. The company has over 100 years of Norwegian heritage and Hydro believes that business performance and societal needs are inseparable and interdependent.

Hydro is a leading offshore producer of oil and gas, and for the past 40 years has played a major role in the development of the Norwegian petroleum industry. Its world-class project execution skills and expertise in deep waters and rough seas help the company to yield maximum results from its operations in the North Sea and around the world. Hydro is also a pioneer in renewable energy and energy efficient solutions, with a particular focus on wind and hydrogen energy production.

Hydro is in the process of merging it's oil, gas and energy business with the Norwegian oil and gas company Statoil. The merger is expected to take place on 1 October 2007. The merged company has ambitions to become a major player in the renewable industry.

1.2.3 Ecoventures BV

Ecoventures BV is a subsidiary of Econcern BV in The Netherlands. Ecoventures BV focuses on sustainable energy business development and holds participating interests in several initiatives, companies and projects.

Econcern is the holding company of Ecofys, Evelop, Ecostream and Ecoventures. The mission of these European companies is “a sustainable energy supply for everyone”. With over 20 years of experience, the Econcern group delivers unique projects and innovative products and services for a sustainable energy supply. Econcern employs around 300 professionals in The Netherlands, Germany, Belgium, Spain, United Kingdom, Poland and Italy.

1.3 Background to the Sheringham Shoal Offshore Wind Farm

1.3.1 Brief history

In 2003, following the success of the first major round of UK offshore wind farm developments (“Round One”), The Crown Estate, as landowners of the seabed in the UK out to the 12 nautical miles’ territorial limit, and in discussion with the Department of Trade and Industry (DTI; now DBERR), invited developers to bid for site option agreements for the second round of offshore wind farm developments (“Round Two”). Round Two sites were identified in three strategic areas: the North West, Greater Wash, and Thames Estuary.

In December 2003, The Crown Estate offered Scira a lease agreement to develop the Sheringham Shoal site, located within the Greater Wash strategic area. The agreement granted Scira a development option, during which time Scira must obtain the relevant statutory consents. Once these are in place, the agreement can then be converted into a full lease of the seabed for a period of 40 years.

1.3.2 Key features of the offshore project component

The proposed Sheringham Shoal offshore wind farm would be located approximately 17 to 23km offshore from the north Norfolk coastal town of Sheringham, and would consist of between 63 and 105 wind turbines[1]. The maximum height of the turbines would be up to 172m above mean high water springs (MHWS) to blade tip.

The wind farm would be connected via a network of cables which would link at one or two offshore transformer stations located within the wind farm. From these stations, power would be exported via two marine cable circuits, which would make landfall in the vicinity of Weybourne on the north Norfolk coast.

Depending upon the selected wind turbine manufacturer, the individual turbines would have a power rating of between approximately 3.0 and 5.0 MegaWatts (MW). The total maximum power capacity of the wind farm would be approximately 315MW. The wind

[1] The application to DBERR in May 2006 included between 45 and 108 turbines (each between 3-7MW). This potential variance has since been reduced.

farm would have an operational life of 40 years, after which point it would be decommissioned in accordance with an agreed Decommissioning Plan. Due to market constraints it is now envisaged that the planned operational start-up date for the wind farm of 2010 may now be delayed to 2011, unless lead times for turbines turn out to be shorter, in which case it could still be possible to be operational by 2010.

A number of regulatory consents are required for the construction and operation of the offshore wind farm project. In May 2006, Scira applied to the DTI (now DBERR) – who lead the consent process in association with the Department for Environment, Food and Rural Affairs (Defra) – for the following key consents:

- Consent under section 36 of the Electricity Act 1989 to construct and operate the offshore wind power generating station, including all ancillary infrastructure.
- Licence under section 5 of the Food and Environment Protection Act 1985 to deposit materials such as the turbine foundations and the buried cables, on the seabed.
- Consent under section 34 of the Coast Protection Act 1949 in order to make provision for the safety of navigation in relation to the export cables.
- Deemed planning permission under section 90 of the Town and Country Planning Act 1990, sought as part of the section 36 application, for the onshore elements of the works.

The offshore wind farm project was subject to an EIA, as required under the Electricity Works (Environmental Impact Assessment) Regulations 2000, and an ES was submitted in respect of the wind farm application (Scira, 2006).

The application and ES covered the following scope of works: the wind farm itself; the export cables; the landfall point at Weybourne; and associated onshore works, comprising of a jointing pit, approximately 600m of underground cabling and a new switch station building[2] within the Muckleburgh Collection museum at Weybourne. The application is currently being determined by DBERR.

This ES relates to the **onshore grid connection project** (i.e. the “Project”), which is required to connect the wind farm from the first onshore jointing pit at the Muckleburgh Collection museum in Weybourne to the existing electricity distribution grid at Salle, and is subject to a separate consenting process.

Further information relating to the overall wind farm project can be obtained from Scira’s website www.scira.co.uk.

1.4 Onshore Grid Connection Requirement

The Sheringham Shoal Offshore Wind Farm would require a 132kV grid connection between the Muckleburgh Collection museum at Weybourne and the electricity distribution grid. It is proposed that this new connection would link to an existing regional electricity grid substation at Salle, near Cawston, which is owned and operated by the Distribution Network Operator (DNO); Electricite de France Energy (EDFE).

[2] It should be noted that the switch station building is no longer required; refer to Section 3.

It is proposed that this element of the Project would involve a new underground cable connection rather than any new overhead lines. In addition, a new substation would be required in order to accommodate the wind farm connection. It is proposed that Scira's new substation would be located adjacent to the existing EDFE facility at Salle.

Scira has carried out a detailed process of environmental and technical surveys and studies in order to identify the preferred route option for the grid connection. The selection of the preferred route has taken into account environmental, technical, financial and risk factors and is discussed in detail within Section 2: 'Site Selection and Consideration of Alternatives'. Detailed plans showing the proposed route and the location of the proposed substation at Salle are given within Section 3: 'Project Details'.

The onshore grid connection route starts at the Muckleburgh Collection museum, in Weybourne. From hereon, the route of the buried cables heads south-east to cross the Poppyline railway and Kelling Heath/Hundred Acre Woods, and then south in the vicinity of Bodham, Lower Bodham, Baconsthorpe, Plumstead, Little Barningham, Saxthorpe, Oulton and Cawston, before connecting at the Salle substation.

The route is located almost entirely within private agricultural land, with the exception of 21 locations where it crosses the road network; one of these involves the cable being laid within the road carriageway for approximately 92m.

The grid connection would require two circuits, each consisting of three 132kV single core cables installed within individual ducts and buried within an excavated trench, approximately 1.6m in depth. Fibre optic cables; required for the transmittal of information between the wind farm and the substation; would also be installed within ducts buried in the excavated trench.

For the most part of the route, it is proposed that the ducts are installed by a method of open-cut trenching with the cables being pulled through the ducts after the trench is backfilled. The exception to this is in specific locations where open-trenching is not considered the preferred option, and instead a technique known as "directional drilling" is proposed.

The proposed location for the new substation lies adjacent to the south-east boundary of the existing EDFE Salle substation. Scira's new substation would house equipment necessary to connect the offshore wind farm to the electricity grid network and would include a new building to house the metering and switching equipment, an ancillary building, two reactors and a series of capacitors.

In order to make the connection, EDFE would also need to install additional infrastructure within their substation compound. In addition, it has been identified that EDFE would also need to upgrade the existing overhead line between Salle and the Earlham Substation in Norwich. Both these elements would be the subject of a separate planning process and would be progressed by EDFE.

Detailed information and maps of the proposed onshore grid connection are given within Section 3: 'Project Details'.

1.5 Statement of Need

In line with the Kyoto Protocol, signatory states, such as the UK have individual targets for their energy generation from renewable sources. The European Union's overall emission target under the Protocol is a reduction of greenhouse gas emissions to 8% below 1990 levels by the commitment period of 2008 to 2012 (www.berr.gov.uk). At the recent 2007 Spring Summit, EU leaders agreed to a mandatory target of 20% of all the Union's energy to be sourced from renewables by 2020.

In its Climate Change Programme, the UK Government proposed an initial ten year strategy, which included a target to generate 10% of the UK's electricity from renewable sources by 2010. Other targets included reducing greenhouse gas emissions to 12.5% below 1990 levels by 2012 and cutting carbon dioxide (CO_2) emissions to 20% below 1990 levels by 2010.

These initial targets were revised in February 2003 with the Energy White Paper "Our Energy Future – Creating a Low Carbon Economy" (DTI, 2003), which included a goal to reduce CO_2 emissions by 60% by 2050. The Government's strategy for carbon reduction includes a revised target that 15% of the UK electricity supply should come from renewable sources by 2015, with an aspiration of 20% of renewable energy supply by 2020.

The recent Energy White Paper "Meeting the Energy Challenge" (DTI, May 2007) sets out the Government's revised international and domestic energy strategy to cut CO_2 emissions by 60% by about 2050, with real progress by 2020. The 2007 Energy White Paper again states the UK's aspiration of achieving 20% of electricity from renewable energy sources by 2020.

The Government's targets for renewable energy will help the UK to meet its international obligations, but also obtain greater security of energy supply through the promotion of indigenous electricity generation. The construction of both onshore and offshore wind farms is expected to be the largest contributor to the development of the renewable energy sector and wind energy will provide the greatest contribution to the targets of all of the renewable energy technologies.

The Stern Review on the Economics of Climate Change (2006) has highlighted the urgent need for a major increase in renewable energy contributions to the global energy demand. In terms of renewable energy developments, it states:

> "*Renewable energy, and wind power in particular, can be a massive benefit to the prosperity of this country, providing secure, stably-priced energy supplies in the short term. In the future, UK companies could be generating significant export revenues in the emerging technologies of wave and tidal power. In order to achieve these results, however, the Government has to urgently show that the UK is a good place to do renewable business*."

The Sheringham Shoal offshore wind farm would have an installed capacity of 315MW, which is envisaged to equate to the production of around 1.0TeraWatt hours (TWh) of electricity per year[3]. Although domestic energy use only accounts for part of the country's energy needs, it is useful to consider that this would be enough to supply electricity to over 210,000 households[4]. Based on 2001 Census data[5], this equates to 62% of all Norfolk households (including Norwich) or 9.5% of all households within the East of England government region.

The wind farm is expected to be operational by 2011 and will therefore contribute to the UK Government's target of 15% energy supply by renewable energy sources by 2015. This 15% target is expected to require the generation of 57.5TWh per year[6]. Once operational, the proposed wind farm is expected to contribute 1.0TWh per year, or 1.74% of the total amount of energy required to meet the target.

In addition, the proposed wind farm would help the UK move towards its goals by reducing emissions of CO_2 by approximately 34,400 kilotonnes (kt) over its 40 year lifetime[7]. Furthermore, the proposed installation will reduce the emissions of other air quality pollutants by approximately 400kt of SO_2 and 120kt of NO_X over its 40 year lifetime.

The reader should refer to Section 5: 'Policy and Planning Guidance' for further details on regional energy policies and targets.

1.6 Report Structure

The Environmental Statement is structured as follows:

- Non-Technical Summary.
- Section 1 introduces the project.
- Section 2 sets out the process by which the proposed onshore grid connection has been selected and the assessment of alternatives considered.
- Section 3 provides a detailed account of the project details including information related to the construction, operation and decommissioning of the onshore grid connection.
- Section 4 provides a background to the legislative context and the EIA process which has been carried out, as well as information on the EIA project team.
- Section 5 gives an account of the relevant national, regional and local policy and planning guidance.

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[3] Electricity production estimated from an energy assessment including a review of the site specific wind resource (Garrad Hassan, 2006).
[4] Calculation based on an average UK household energy consumption of 4,700KWh, based upon Digest of UK Energy Statistics 2005, cited by BWEA www.bwea.com/edu/calcs/html.
[5] National Statistics Online, 2001 Census Data (www.statistics.gov.uk).
[6] Based upon total projected electricity generation for 2015 of 365TWh; estimate based on a prediction favourable to coal, contained within the Energy Review 'The Energy Challenge', Annex C (DTI, 2006).
[7] All CO_2, SO_2 and NO_x calculations based on avoided emissions from coal powered plants (www.bwea.com.edu/calcs.html).
NB. 1 kilotonne (kt) = 1,000 tonnes (t).

- Sections 6 to 12 are topic based, whereby each section describes a separate environmental parameter. Details on the assessment methodology, existing environment, impacts during construction and operation are presented as well as any necessary mitigation and monitoring proposals.
- Section 13 summarises the main findings of the EIA.

A series of Appendices contain supporting technical or site specific survey information, in addition to a summary of the consultation carried out during the EIA.

1.7 References

Department of Trade and Industry 2003
Energy White Paper 2003: Our Energy Future – Creating a Low Carbon Economy

Department of Trade and Industry 2007
Energy White Paper 2007: Meeting the Energy Challenge

Hassan, G 2006
Document Review of the Wind Resource and Energy Assessment of the Sheringham Shoal Wind Farm

Scira Offshore Energy Ltd. 2006
Sheringham Shoal Offshore Wind Farm Environmental Statement

Stern, Sir Nicolas 2006
Stern Review Report on the Economics of Climate Change
Report to the Prime Minister and the Chancellor of the Exchequer on the Economics of Climate Change

www.bwea.com.edu/calcs.html [Accessed 16/06/07]

www.dti.gov.uk [Accessed 16/06/07] (now at www.berr.gov.uk)

www.statistics.gov.uk [Accessed 16/06/07]

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SECTION 2

SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

2 SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

2.1 Introduction

This section outlines the process which Scira has adopted to identify and refine the proposed onshore grid connection cable route and substation.

The cable route identification and planning process has followed a staged approach in order to build-up information to identify and refine the preferred route option, with consideration to environmental, technical, financial and risk factors. The EIA has considered route options utilising both the carriageway of the existing road network as well as off-road routes, mainly within land under arable cultivation.

This process has been carried out by Scira with the support of a team of environmental and technical specialists. The iterative process has included the elements listed below. These are given in the approximate timeline order in which they were undertaken, however several of the tasks were either run concurrently with one another, or were ongoing throughout the whole process.

- Key project design decisions, including the decision to install the grid connection underground (rather than any new overhead lines) and to investigate both road and 'off-road' cable route options.
- Initial Cable Route Identification Studies to look at the grid system, environmental and technical constraints and opportunities over an extensive area to identify key issues and broad route option possibilities.
- Initial site visits and consultations with key stakeholders.
- Aerial photography - a project specific flight to obtain high resolution aerial photography of the area which produced valuable information for the detailed analysis.
- Review and analysis of existing environmental information (desk-based) – including review of available data on protected species, 'route-critical' archaeological data and potential issues relating to contaminated land.
- Amalgamation and assessment of data to identify the most feasible road-based route as well as the identification of a corridor of agricultural land for further investigation for potential off-road routes.
- Discussions with landowners, tenants and agents within the private land identified for possible off-road route options (ongoing).
- Scoping and further consultation with key consultees.
- Detailed site surveys, studies and assessments as part of the EIA process.
- Involvement of the local community – public exhibitions and consultation.
- Modification of routes within agricultural land based on identified environmental and technical constraints.
- Identification of existing significant utilities such as gas mains.
- Specific site visits and consultations in relation to trees along the carriageway.

- Detailed site visits to confirm the engineering feasibility of identified road and off-road route options.
- Written EIA consultation to an extensive list of stakeholders and meetings as required.
- Final route modifications and selection of preferred option.

At the initial stage of the process, a concentration of environmental and technical constraints, located in an east-west ‘ridge’ across the countryside, was identified between Weybourne and Bodham. A specific section of this ES section is therefore devoted to this area in order to explain the selection of the preferred route in this particular locality and the other alternatives considered.

In terms of the grid connection at the Salle substation, the site selection process identified three possible locations in and around the existing substation facility. Once the preferred site was selected, the design of the proposed extension works also followed a staged-approach in order to minimise the landscape and visual impact and other environmental impacts, wherever possible. The process is discussed separately below.

A brief account of the site selection process for the Sheringham Shoal offshore wind farm site, export cable and landfall, as well as the selection of the Salle substation as the preferred grid connection point, are also provided for context.

2.2 Site Selection of Offshore Components

The scope of this ES does not cover the offshore wind farm, export cables or the proposed landfall at Weybourne, which were covered in a previous ES document submitted to the DTI (now DBERR) in May 2006 (Scira, 2006). Nevertheless, the process by which these locations were identified is briefly described for historical context, as they play a key determining factor in the routing of the proposed onshore grid connection.

The proposed Sheringham Shoal offshore wind farm is one of 15 of The Crown Estate’s Round Two sites, which are located in three strategic areas: the North West, the Greater Wash, and the Thames Estuary. Each of the three areas was the subject of a Strategic Environmental Assessment (SEA) (BMT Cordah, 2003).

The proposed wind farm site is located within the Greater Wash strategic area. The site was located and designed taking into account a combination of factors including: the wind resource; potential visual impact; impact on birds; shipping intensity; presence of aggregate or disposal sites, oil and gas platforms; Ministry of Defence practice and exercise areas; existing cables or pipelines; and nature conservation sites (both existing and potential sites).

The general Weybourne area was identified as a suitable location for the proposed landfall to minimise the distance between the wind farm and the shore, in order to reduce energy losses and cable length costs, as well as disturbance to the sea-bed. The actual location of the proposed landfall at the Muckleburgh Collection museum was identified following an assessment of environmental and technical constraints. The chosen position was selected to utilise a 'gap' in an otherwise near-continuous stretch of constraints along the coastline, which includes nature conservation (and geological) designations, significant built-up areas, existing pipeline landfalls, and steep cliff features.

The proposed location of the wind farm, export cables and landfall location are shown in Figure 1.1 of Section 1: 'Introduction'.

The project also considered alternative routes for the export cable and landfall through the Wash, in order to connect to an alternative substation at Walpole, which is discussed further within Section 2.3: 'Site Selection of Grid Connection Location', below.

2.3 Site Selection of Grid Connection Location

As part of a series of grid studies, Sinclair Knight Merz (SKM) was commissioned by Scira to carry out an assessment of options for grid connection (late 2005/early 2006). Connection to the following existing facilities was assessed:

- National Grid Transco's (NGT) Walpole 400kV substation.
- NGT's Norwich Main 400 kV substation.
- EDFE's 132kV system using the Norwich Main – Norwich Trowse circuits.
- EDFE's 132 kV network in the vicinity of the Salle. An existing overhead 132kV connection is located between Salle and a facility at Earlham (Norwich).

A key factor in the selection of the preferred grid connection point was to minimise the overall length of the grid connection wherever possible, both for the subsea and onshore cable circuits. Increased length of connection results in the following:

- Increases in energy losses resulting in reduced renewable energy production and emission savings.
- Increased construction programme, leading to increased period of disruption.
- Increased environmental issues, relating to magnitude of impact and number of constraints.
- Increases in financial cost, including supply of cable (and other materials), construction and reinstatement.

Following discussions with EDFE, it was reported that some refurbishment to the existing overhead line between Salle and Earlham was anticipated at an unspecified point. Detailed analysis of the network capacity determined that the replacement of some of the existing conductors (cables) along the overhead line would yield sufficient additional capacity in order to accommodate the Sheringham Shoal offshore wind farm at Salle substation near Cawston.

The analysis of options to install a new underground grid connection directly between Weybourne and the Norwich substations identified that there was likely to be increased environmental and technical issues in comparison to connecting directly to Salle. This is primarily due to the increase in length of connection (i.e. an additional 26km approximately), as well as specific environmental and physical constraints located between Weybourne and Norwich. Constraints include an increase in the built-up nature of the area (including Norwich and two trunk roads), railway crossings, and the River Wensum, which is a designated Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

Connection to NGT's facility at Walpole was also discounted, again due to an increase in subsea and onshore cable route length, as well as specific environmental issues in relation to the international and national nature conservation designations located within the Wash.

Following detailed consideration of the results, Scira selected Salle as the preferred connection point.

2.4 Cable Route Design Constraints

2.4.1 Type of cable system

The onshore grid connection between Weybourne and Salle lies within a sensitive landscape. A large portion of the northern part of the onshore grid connection area is designated as part of the Norfolk Coast Area of Outstanding Natural Beauty (AONB). In addition, much of the remaining area is identified as being of local landscape importance. Several large Conservation Areas and Registered Parks and Gardens are also present.

The standard arrangement for 132kV circuits ordinarily involves above-ground electric lines supported on steel towers ('pylons'). Although there are numerous pole-mounted 11kV overhead electricity lines in the general area, there are very few pylon-mounted electricity distribution lines except towards the southern area, around the Salle substation. For this reason, Scira decided at an early stage of the onshore grid connection project, that in order to minimise impacts on the landscape, no new overhead lines would be proposed. The onshore grid connection project has therefore focused on underground route options.

2.4.2 System design constraints

The design of the cable route system is discussed in detail within Section 3: 'Project Details', however for the purposes of route identification and planning, several design parameters were key to the decision-making process.

As previously mentioned, a key consideration in the design of the cable route was to minimise the overall length wherever feasible, in order to minimise energy losses, duration of construction, disruption, costs and environmental impacts. This was balanced with the need to minimise impact to specific environmental constraints; take into consideration existing land-use practices and avoid physical "obstacles" along the route.

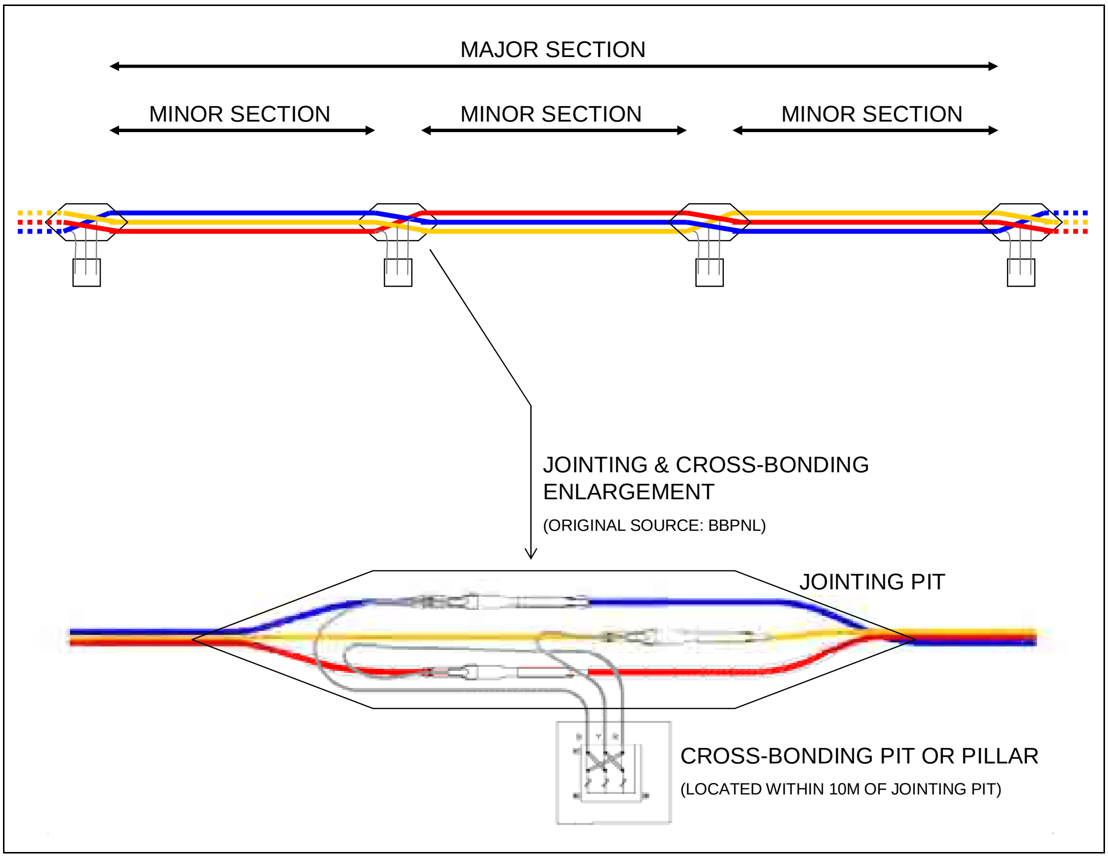
The final selection of the cable material and diameter to be installed would be subject to optimisation during the detailed engineering stage, following award of the cable installation contract. Although the precise measurements are not known at this stage, the types of cables to be installed would have a cross sectional area of up to 1,600mm^2 and an overall cable diameter of approximately 100mm. The maximum length of individual cable sections which can be delivered to site is limited by the size and weight of the cables selected, and the type of drum used for delivery.

The sections of cable would need to be jointed together on site, with the connection point enclosed in a protected sheath and buried within a 'jointing pit' beneath the surface. The number of joints in the system are minimised wherever possible by maximising the length of the individual sections of cables.

Each circuit of three cables would be laid in an arrangement of 'major' sections consisting of three shorter 'minor' sections, as illustrated in **Figure 2.1**. If these minor sections are not similar in length, then this can induce voltages in the protective sheath of the jointing pit. To limit this, cables need to be laid in specific lengths, where each group of three minor sections are similar in length, with the variance between them minimised.

In addition, at each of the jointing pits, a process of cross-bonding is required. The cross-bonding needs to occur within 10m of the joint and requires permanent access for maintenance. The cross-bonding is therefore installed within an inspection pit or pillar, which would be the only visible feature of the buried cable system, once reinstatement has occurred.

Figure 2.1 Simplified arrangement of major and minor sections (one circuit)



In order to minimise restrictions to future agricultural (or other) uses of the land, it is preferable to locate these cross-bonding pits or pillars at existing field boundaries (and ideally road crossings) wherever possible. Careful route planning has been necessary to reconcile the conflicting requirements of cable lengths with the positioning of cross bonding equipment on field boundaries.

Other design parameters which have had a bearing on the proposed route include:

- Due to the size of the cables and likely installation method, it is preferable to minimise the radii of any bends along the route. Where this is unavoidable, it is preferable to locate the bend at a cable joint position.
- To limit disruption to agricultural practices during the construction phase, the route has been designed to track along the edges of field boundaries wherever feasible (keeping an appropriate distance to avoid impacts to tree roots and hedgerows) in order to minimise any unworkably small or inaccessible sections of field and in consideration of other technical, environmental and financial factors. Tracking the route along field boundaries also has the benefit of increasing the number of opportunities for suitable cross-bonding locations.

2.5 Cable Route Identification Process

2.5.1 Initial cable route identification studies

Initial assumptions regarding the use of road corridors

Scira commissioned several desk-based studies in late 2005/early 2006 to identify the following: design parameters for consideration, including trench and working area requirements; environmental and technical constraints and opportunities; and broad cable route options or corridors. These studies were carried out by SKM, Freedom Group / Cambridge Landscape Architects (CLA) and Royal Haskoning. At this stage, the option to connect to either Norwich Main or Norwich Trowse substations was still a consideration, therefore the studies included options to connect between Weybourne and Salle; Salle to Norwich; and direct between Weybourne to Norwich. The study area within which possible routes were looked at is shown as **Figure 2.2**.

As already discussed, it was since identified that connection could be achieved at Salle. Therefore, the account of the decision-making process hereon refers only to the new grid connection required between Weybourne and Salle.

At an early stage in the process, Scira decided to investigate route options utilising both the carriageway of the existing road network and also options within open countryside/agricultural land (i.e. ‘off-road’ routes). It was envisaged at an early stage that the two different types of route would have entirely different characteristics as well as advantages/disadvantages.

For road routes, on the assumption that the onshore grid connection could be installed entirely within the road surface, it was expected that the time required to obtain any necessary (pre-construction) agreements would be significantly reduced. It was also considered that in some instances, presuming there was sufficient space, that the potential environmental impact, relating mainly to habitat loss and disturbance would be

Figure 2.2 Extent of area assessed for possible cable route options during the initial cable route identification studies between Weybourne and Norwich

minimised. However it was expected that the installation of a buried cable system within the carriageway would lead to significantly more disruption to the local road network users, as well as a significantly longer construction period. The likelihood of encountering existing buried services was also expected to be more frequent with a road-based route.

For routes utilising open countryside or agricultural land, it was known that a wider working corridor would be necessary, which could potentially result in higher levels of disturbance and the potential loss of habitat. It was also envisaged that off-road routes may need to cross a greater number of environmental and technical obstacles. In terms of advantages, the duration of construction would be significantly reduced, along with disruption to the human environment (by minimising impact to the local road network). Due to the method of installation (i.e. below ground), it was also expected that off-road routes would generate significant lower levels of waste material and would require fewer deliveries of material to site.

Technical constraints of road routes

Part of the initial cable route identification studies involved identifying the main technical parameters that would need to be taken into account during the design of the cable route. This included an outline of the likely trench width and working area requirements for both road and off-road options (discussed in detail in Section 3: 'Project Details').

It was initially assessed, for the purposes of road-routes only, that the width of the road would determine the construction process and the need for road closures. For roads less than 7.2m in width it was concluded that the installation of the cables would likely to require the complete closure of the road during the construction phase. For roads greater than 7.2m in width, it was assessed that it would be possible to install the trench on one side of the carriageway, whilst maintaining one-way traffic.

Site visits were carried out to review the characteristics of the roads in the general area. The visits revealed that in the area between Weybourne and Salle, roads were generally narrow (3-5m in width), and would therefore require full road closures. Most of the roads are bound by hedgerows and road-side trees. Verges capable of being wide enough to accommodate the cable trench are almost entirely absent.

Due to the characteristics of the network of minor roads, it was identified that any road closures would not entail significant diversions. For this reason, it was assessed at an early stage that the routing of the cable along narrow, minor roads (requiring complete closure with diversions along nearby alternative routes) would be preferable to routing the cable along the few larger roads in the area, which would require one-way traffic management and increased disruption during construction.

Environmental constraints

A desk-based study was also carried out to identify significant environmental opportunities and constraints. The initial study utilised information available in the public domain and existing site knowledge only. Key environmental interests and features which were likely to constrain route selection were identified, for example, nature conservation designations and features of archaeological significance, as well as social and physical elements such as main settlements and tourist attractions. The presence of physically constraining features such as road, river and railway crossings were also factored into the process.

The type of environmental data gathered during the initial study is listed in **Table 2.1**.

Table 2.1 Subjects and types of environmental data gathered during initial studies

Nature Conservation and Ecology

- Ramsar sites
- Special Protection Areas (SPA)
- Special Areas for Conservation (SAC)
- Sites of Special Scientific Interest (SSSI)
- National Nature Reserves (NNR)
- Local Nature Reserves (LNR)
- Ancient Woodland Inventory (AWI)
- County Wildlife Sites (CWS)
- National Inventory of Woodland and Trees (NIWT)
- Other features of ecological significance (e.g. woodlands, grassland, heathland, wetland habitats)

Geology and Geomorphology

- Solid & drift geology maps
- Soil types

Hydrology, including Flood Risk

- Key watercourses
- Other surface water features
- Environment Agency flood mapping

Physical Engineering Constraints

- Potential constraints relating to river, rail, road crossings, existing overhead lines.

Archaeology and Cultural Heritage

- Scheduled Monuments
- Registered Parks and Gardens
- Historic Battlefields
- World Heritage Sites
- Conservation Areas

Landscape

- Areas of Outstanding Natural Beauty (AONB)
- National Parks
- Local Plan local landscape designations

Land Use, Ownership, Recreation and Tourism

- Defra Provisional Agricultural Land Classification (ALC)
- Environmentally Sensitive Areas (ESA)
- National Trust properties/sites
- Settlements patterns (including agricultural field scales)
- Public Rights of Way
- Identification of features of recreational/tourism interest (e.g. car parks, golf courses, museums, caravan sites, camp sites, etc.)

Environmental constraints identified were prioritised into “route critical” and “non-route critical” for the purposes of route planning. The following features were identified as “route critical” and were avoided throughout the process wherever possible:

- Ramsar sites.
- Special Protection Areas (SPA).
- Special Areas of Conservation (SAC).
- Sites of Special Scientific Interest (SSSI).
- National Nature Reserves (NNR)*.
- Local Nature Reserves (LNR)*.
- Ancient Woodland Inventory (AWI).

- County Wildlife Sites (CWS).
- National Inventory of Woodland and Trees (NIWT).
- Scheduled Monuments.
- Registered Parks and Gardens.
- Historic Battlefields*.
- World Heritage Sites*.

  * None in immediate study area.

It was assessed that other features such as the Norfolk Coast AONB, local landscape designations and Conservation Areas, would not be considered route-critical, because:

- The areas covered by these designations are extensive and could not feasibly be avoided during route planning.
- Following construction and reinstatement, the proposed grid connection would be predominantly underground; therefore the potential impact to these landscape designations and features was unlikely to be significant.

Summary

The outcome of the above process was the identification of several road-route options, as well as possible corridors for off-road options, which were based on a solid understanding of the major technical and environmental constraints associated with this project. These constraints are outlined in **Table 2.2**.

Table 2.2 Summary of initial constraints identified

Feature	Constraint or assumption	Implication
Grid Connection Location	Minimise the length of grid connection for both subsea and onshore cable circuits.	The preferred grid connection point was identified as the Salle substation.
Cable Route	The study area lies within an area of landscape significance, which includes the Norfolk Coast AONB, areas of local landscape importance and Registered Parks and Gardens.	The cable route should be underground rather than overhead.
	Minimisation of overall length.	Shortest cable route would be preferred.
	The weakest link of the cable system is likely to be where the cables are jointed together.	The number of joints should be minimised by maximising cable lengths.
	If the 'minor' sections of the cable lengths are not similar in length, then this may induce voltages in the protective sheath of the 'jointing pit'	Route design needs to consider that cables need to be laid in specific lengths.

Feature	Constraint or assumption	Implication
	As the cross-bonding pits or pillars will be the only above-ground element of the cable route, it is preferable to locate these at existing field boundaries.	To maintain suitable cable lengths, this has required careful route planning in order to locate cross-bonding at suitable locations.
	Cables are large and have limited bending radii.	It is preferable to minimise the radii of any bends along the route.
	The route could disturb agricultural activities during the construction phase.	The route has been designed to track along the edges of field boundaries where feasible.
Road Route Constraints	For roads less than 7.2m in width, the installation of the cables would require the complete closure of the road during the construction phase.	The routing of the cable along narrow, minor roads (requiring complete closure with diversions along nearby alternative routes) would be preferable to routing the cable along the few larger roads.
Environmental Constraints	Route-critical constraints were identified and avoided wherever possible.	These included: • Ramsar sites • Special Protection Areas (SPA) • Special Areas of Conservation (SAC) • Sites of Special Scientific Interest (SSSI) • Ancient Woodland Inventory (AWI) • County Wildlife Sites (CWS) • National Inventory of Woodland and Trees (NIWT) • Scheduled Monuments • Registered Parks and Gardens

2.5.2 Initial meetings with key stakeholders

At an early stage in the process, a meeting was held with the Norfolk County Council Highway Authority to discuss the Project, specifically the feasibility of installing the grid connection within the Highway and any additional design considerations and route preferences. Meetings were also arranged with officers from Broadland District Council and North Norfolk District Council planning department and Natural England during May and June 2006 in order to inform them of the project and to gain initial responses to feed into the route design process. The scope of the EIA was also discussed informally.

Meetings were held with South Norfolk Council and the Highways Agency relating to the possible requirement for a new grid connection between Salle and Norwich. As discussed, this element of the Project is no longer necessary, as there is an existing overhead connection from Salle to Norwich which has the capacity to accommodate electricity produced by the wind farm, on the basis of some planned upgrades.

The outcome of the meetings confirmed the processes which would need to be carried out as well as specific areas which would need to be considered during the EIA process. Details of all consultations carried out are summarised in **Appendix 4.2**.

2.5.3 EIA Scoping process

A formal request for a Scoping Opinion, accompanied by a Scoping Report (Royal Haskoning, 2006), was made to both North Norfolk District Council and Broadland District Council on 19 July 2006, under the EIA Regulations 1999. The Scoping Report was distributed within both District Councils, to the Planning, Countryside and Environmental Protection Officers, as well as to Norfolk County Council (including Highways, Countryside and Public Rights of Way Officers and Norfolk Landscape Archaeology), Natural England, the Environment Agency and the Norfolk Wildlife Trust.

The Scoping study identified a possible road-based route, as well as a corridor suitable for off-road route options, which was under further investigation, and was reported within the Scoping Report. These are shown on **Figure 2.3**.

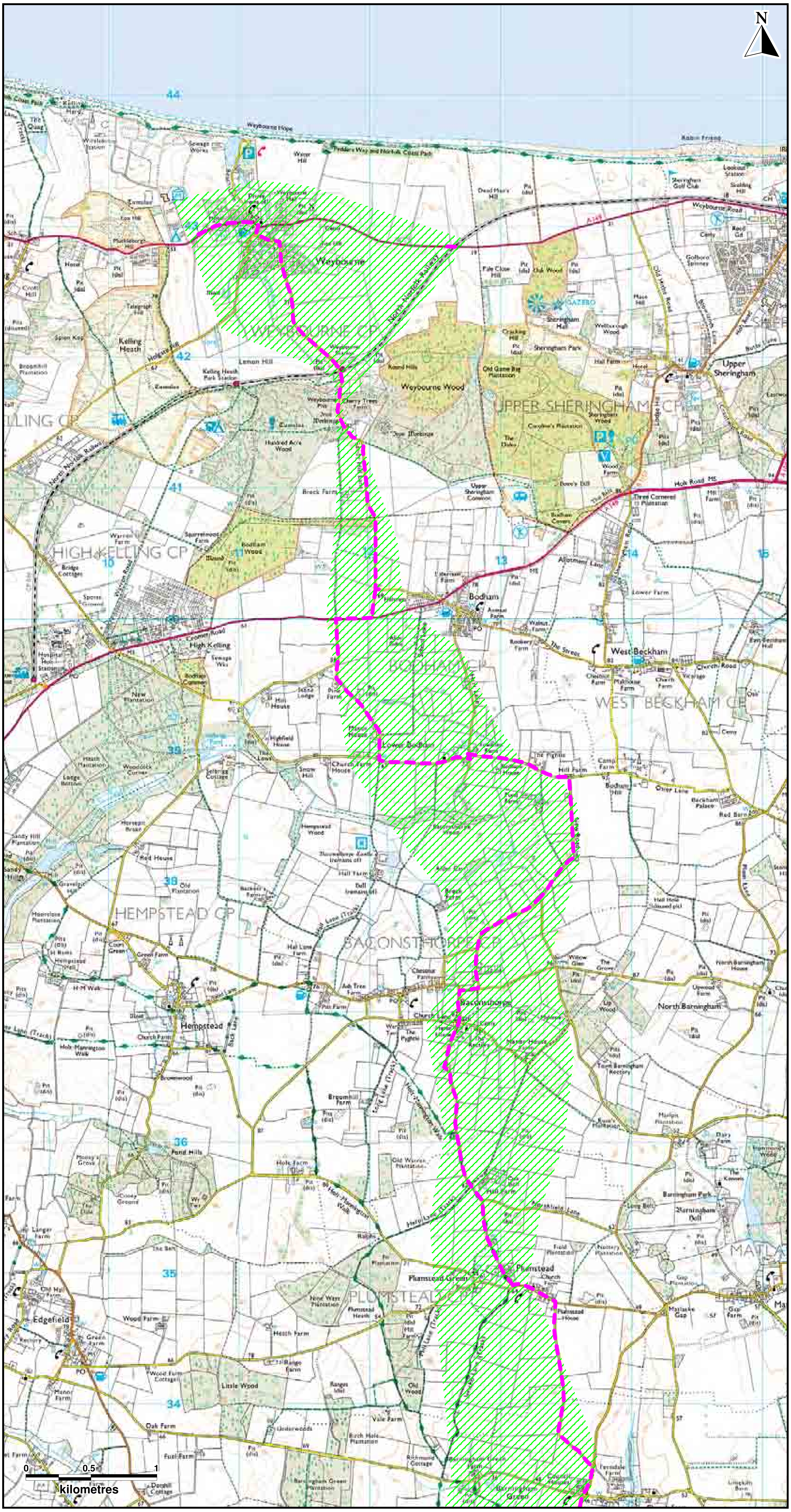
The proposed road-route was outlined as the most feasible road-based option based on the consideration of the following objectives:

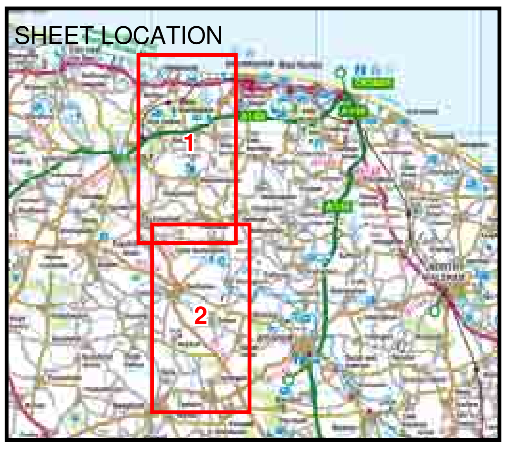
- To minimise the distance of the overall cable route.
- To primarily utilise narrow roads with suitable diversions in order to limit disruption to more important (i.e. wider) parts of the road network.
- To minimise the number of settlements through which the route will pass.
- To locate a route that would allow suitable route options through adjacent agricultural land, should agreement be obtained from landowners and this be identified as the preferred option.
- To identify a technically and environmentally feasible route across the area of constraints between Weybourne and Bodham.
- To avoid the majority of environmental route-critical designations.

The “arable” corridor was designed to be linked with the possible road-based route, so that the final preferred route would allow for a combination of road and off-road sections, should that prove to be the best option. The interlinking of the road and off-road routes was also considered at this stage in the Project due to the possibility that agreement to install the cable across private land may not be obtained from all landowners. Retaining the off-road route relatively close to the road network also has obvious advantages in relation to construction access.

At this point, an exercise to identify landowners, tenants and other occupiers in the area of the road route and arable corridor commenced, with the aim of obtaining access for surveys and also to initiate discussions regarding possible wayleave and easement agreements.

A Scoping Opinion was received from North Norfolk District Council (NNDC) on 31 August 2006. Broadland District Council (BDC) also provided a list of comments as discussed in Section 4: ‘Legislative Context and the EIA Process’. The Scoping Report and NNDC Scoping Opinion are provided as **Appendix 2.1** and **Appendix 2.2** respectively.





LEGEND:

Road route under consideration at the Scoping stage

Off-road areas under consideration at the Scoping stage

Title:
SCOPING STAGE CABLE ROUTE STATUS

SHEET 1 OF 2

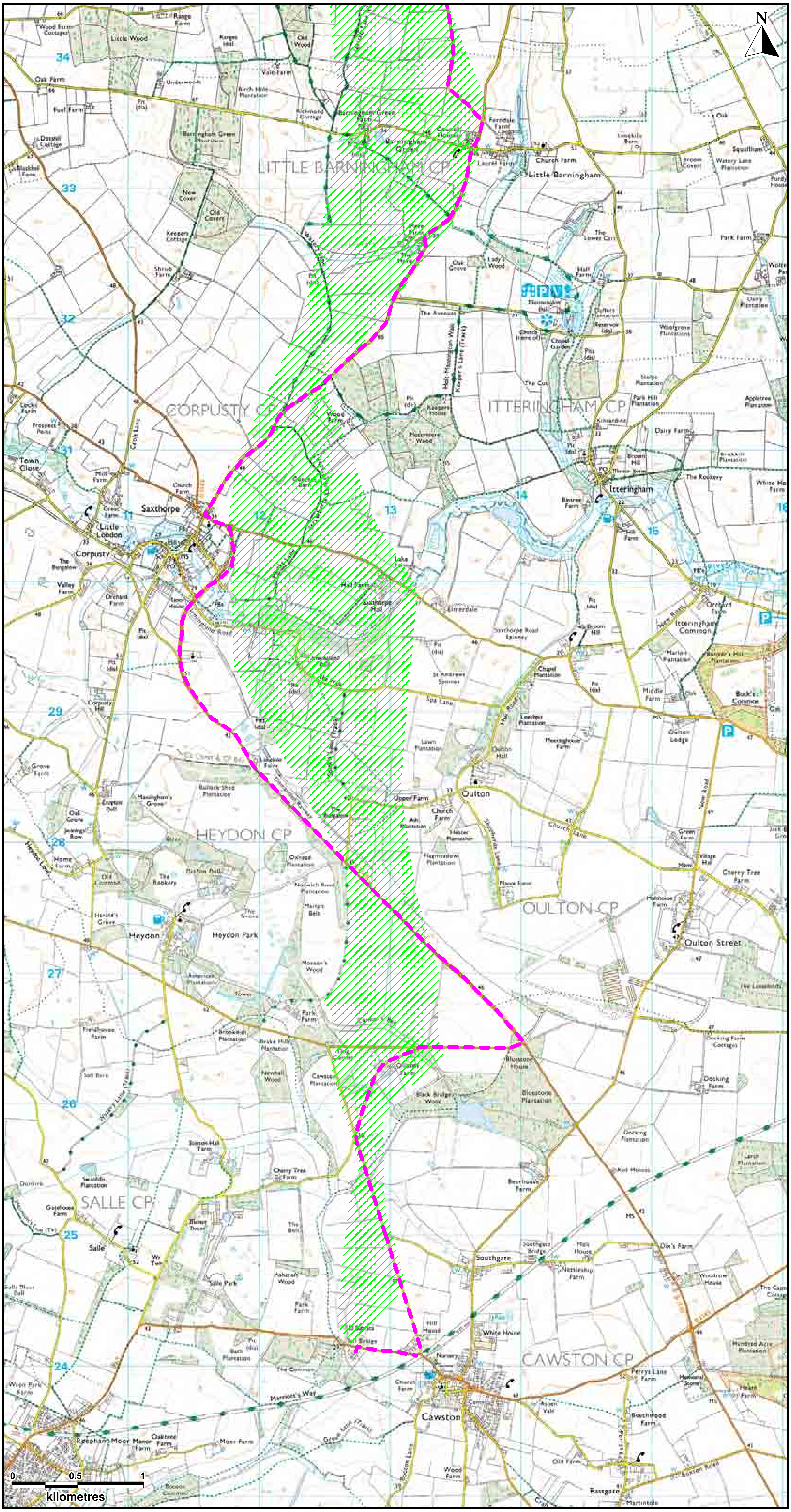
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 2.3 (1 of 2)

ROYAL HASKONING



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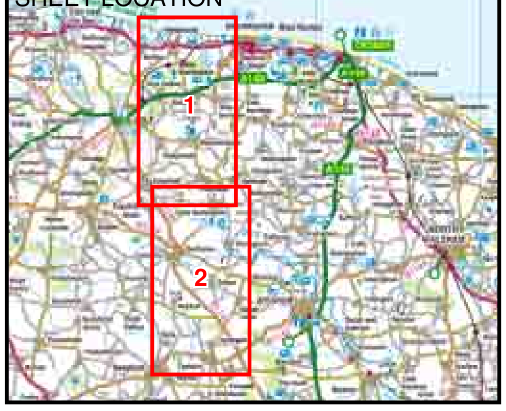


LEGEND:

- Road route under consideration at the Scoping stage
- Off-road areas under consideration at the Scoping stage

Title:
SCOPING STAGE CABLE ROUTE STATUS

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

Scale:
NTS

Figure:
FIGURE 2.3 (2 of 2)

ROYAL HASKONING

2.5.4 Additional environmental data collection

In order to further refine the identified road route and arable corridor, a further stage of potentially route-critical environmental desk-based studies were carried out at the end of July 2006, which included:

- A review of available protected species data within the route corridors.
- A rapid assessment of the Norfolk Historic Environment Record (NHER) to locate sites of archaeological significance (including Listed Buildings).
- The provision of an Envirocheck report to locate areas of potentially contaminated land and other sites/features of geological/hydrological significance.
- Due to reports of high-pressure underground springs to the south of Weybourne, a desk-based study was carried out into the history and characteristics of the springs.

The results of these studies were incorporated into the ongoing design of possible routes within the arable ‘corridor’ already identified (shown on **Figure 2.3**).

2.5.5 Acquisition and analysis of detailed aerial photography

The area of the proposed grid connection was the subject of a project-specific flight in order to capture high-resolution aerial photography (AP) in June 2006. The geo-referenced AP was overlain with digital Ordnance Survey (OS) mapping so that the results could be used for detailed route identification and refinement processes. The following features, which are not usually identifiable on OS data but visible on AP, were mapped:

- Individual trees within the area of the road-route in order to highlight areas with potential constraints.
- Possible existing access points along the road-route and locations for turning heads and minor compounds/drop-off points (if needed).
- Individual trees within fields and field boundaries in order to micro-site arable route crossing points to minimise impact.
- Gaps in hedgerow to minimise habitat loss during arable route boundary crossings.
- New field boundaries.
- New or extended buildings.
- Habitats within which route avoidance may be preferable, for example areas of potentially diverse grassland, scrub, woodland (not already shown on OS) and marshy or damp areas.
- Possible crop-marks, which may have potential archaeological interest.
- Overhead lines (11kV and 33kV), where visible.
- Recent utility installations, e.g. the routes of recent gas main installations are still visible ‘on-the-ground’.

The mapped data were used to narrow-down possible arable route corridors, which aimed to avoid potentially sensitive features as shown on AP, as well as features and areas previously identified during the desk-based assessments discussed previously.

These arable route corridors were then subject to further site based investigations, consultations and assessment, as discussed further below.

Site surveys were carried out during later stages to ground-truth and assess the routes. These surveys revealed that the route options generally met little or no environmental or technical 'resistance', due to the micro-planning which had already been completed with reference to the AP. For this reason, the need to alter the route corridors has been fairly limited throughout the later stages of the process. Where route modifications have been necessary, this has also been undertaken with reference to the AP.

The information obtained from the AP has been retained in a series of digitally geo-referenced "traced feature" plans for future reference.

Figure 2.4 illustrates the modified off-road route corridors which were refined and assessed in more detail for possible off-road route options, along with the possible off-road route and road-routes which were refined and subject to full EIA consultation in April/May 2007.

2.5.6 EIA surveys, studies and assessments

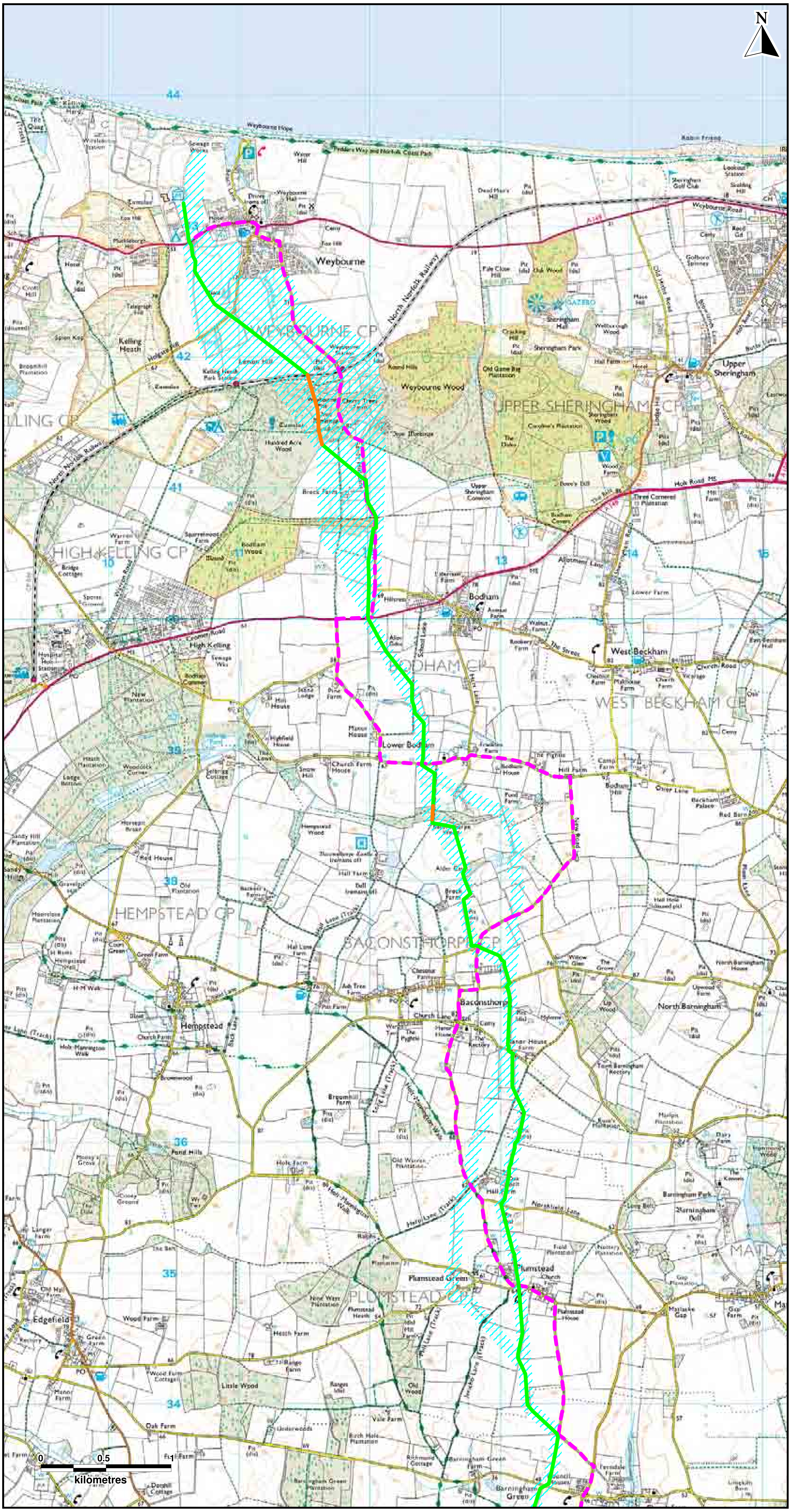
Following the identification of the feasible road and arable route corridors, detailed ecological surveys were carried out during July, August and September 2006, in order to survey the habitats and species present during the optimum ecological period. Specific surveys for great crested newts were also carried out during spring 2007, along with other additional ecological surveys which were required to supplement the initial survey.

Detailed Archaeological Desk-Based Assessments (ADBA) were also undertaken for both the road and arable routes between July and November 2006.

The information obtained from these surveys and studies was incorporated into the ongoing route design, as necessary.

All the EIA surveys, studies and assessments required adhered to the agreed scope of the EIA and were ongoing during the period of initial route identification and selection of the final preferred route.

Detailed assessment methodologies, descriptions of the existing environment, impacts during construction and operation are presented in this ES along with any necessary mitigation for each of the topic based assessments (Sections 6 – 12).



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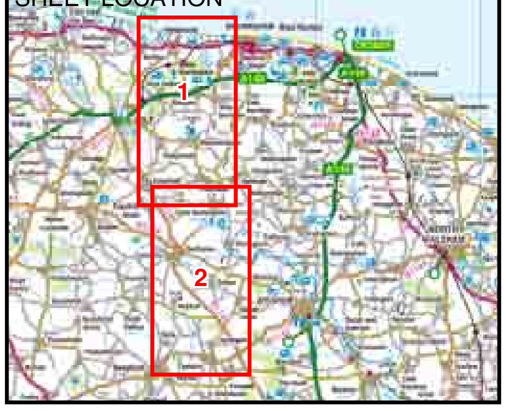


LEGEND:

Off-road corridor

Refined off-road corridor within which off-road routes were investigated further

Routes under consideration at time of EIA consultation stage (April 2007)

Road-based route

Off-road based route

Directional drill sections

Title:
ROUTE MODIFICATIONS DURING EIA PROCESS

SHEET 1 OF 2

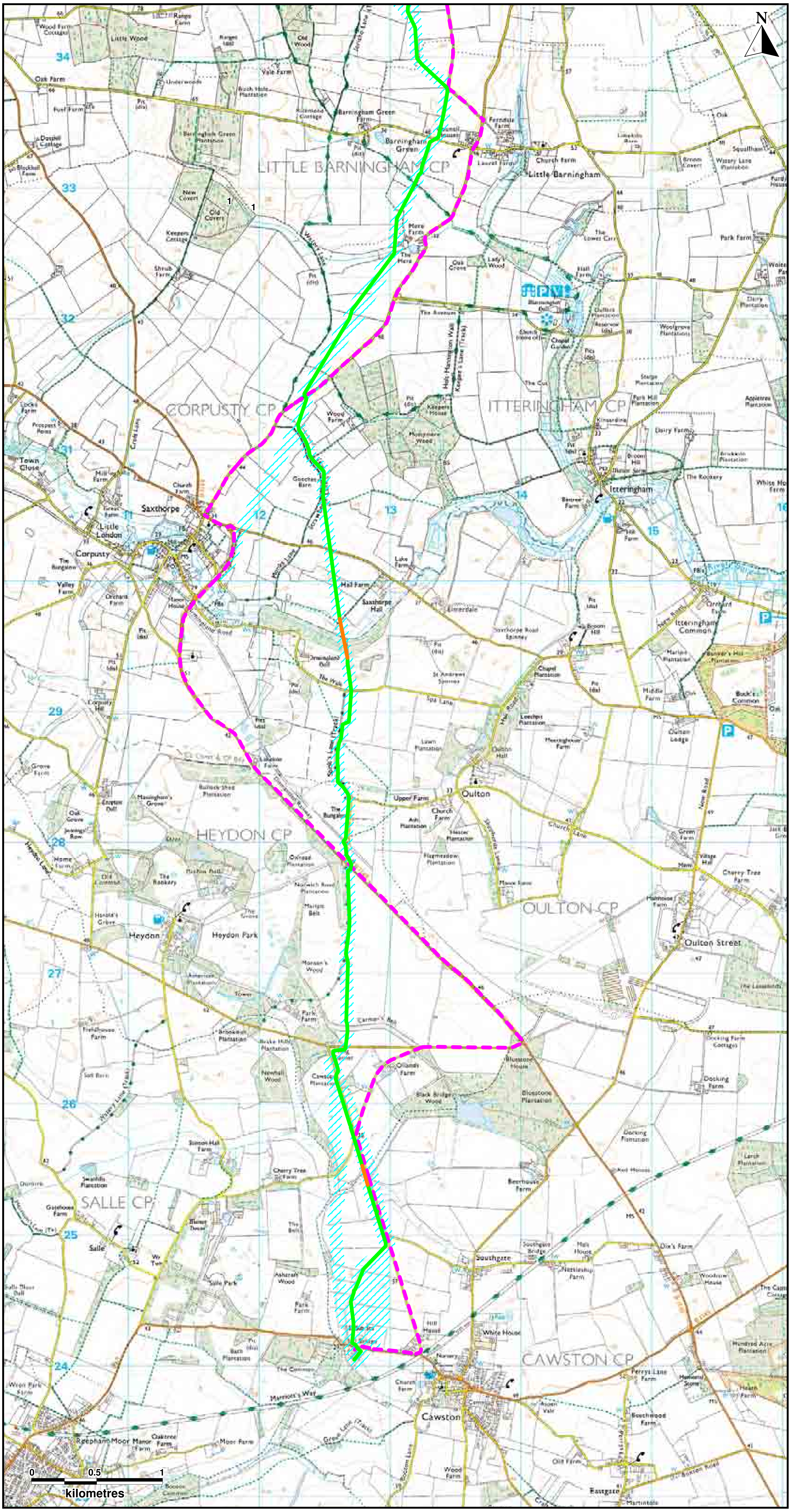
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

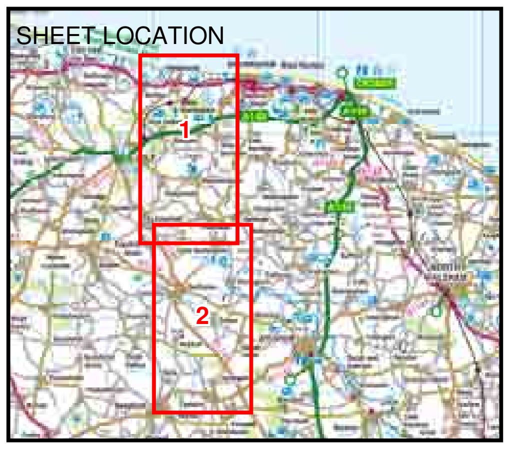
Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 2.4 (1 of 2)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Off-road corridor

Refined off-road corridor within which off-road routes were investigated further

Routes under consideration at time of EIA consultation stage (April 2007)

Road-based route

Off-road based route

Directional drill sections

Title:
ROUTES MODIFICATIONS DURING EIA PROCESS

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 2.4 (2 of 2)

ROYAL HASKONING

2.5.7 EIA consultation

Consultation has been ongoing in order to feed into the route identification process. This has included:

- Meetings with Norfolk County Council (April 2006 and June 2006) as well as written communications throughout the process.
- Meetings and written communication with North Norfolk District Council and Broadland District Council at appropriate points throughout the EIA process, including specific site-meetings with countryside/aboricultural officers with respect to assessing possible impacts to road-side trees (refer to Section 2.5.8).
- A meeting with Natural England to discuss the project and agree upon the scope of ecological survey required during the EIA (June 2006).
- The issue of a Scoping Report to key consultees (July 2006).
- Initial written correspondence to all parish councils along the route alignment (August 2006).
- Public exhibitions at Bodham, Corpusty/Saxthorpe and Cawston, promoted through a widespread issue of invitations and local advertising (October 2006).
- The issue of EIA consultation documents (Royal Haskoning, 2007) and requests for feedback (April to May 2007).
- Specific consultation with English Heritage, Norfolk Landscape Archaeology, Natural England, Norfolk Wildlife Trust and Environment Agency as required in respect of specific issues identified during process.

The purpose of carrying out consultation at each stage of the project was to keep consultees well-informed and also to feed information, issues or concerns into the route planning process. A summary of all consultation responses is given as **Appendix 4.2**.

2.5.8 Identification of highway trees

In general terms, the network of rural roads within the area, including those along which the identified road route follows, are typically narrow, and bound by hedgerows with frequent mature trees (predominantly oaks), adjacent to the carriageway. Verges are also generally narrow and often steeply embanked.

It was recognised at an early stage, that due to the presence of mature road-side trees, the width of the carriageway and the width of the trench to be excavated, that there was the potential for the installation of the proposed grid connection, within the carriageway, to impact adversely upon tree roots.

The protection of trees is a material consideration for the determination of planning applications. The planning consideration of tree protection measures has recently been made more rigorous by the release of British Standard 5837:2005 ‘Trees in relation to construction – Recommendations’, which requires applicants for planning permission to adopt a systematic approach to the assessment of impact on trees (landscape, ecology and arboricultural value) and the avoidance of excavation within defined distances from the centre of trees. The protection of Highway trees is also dealt with by the recommendations contained within the National Joint Utilities Group document NJUG10 'Guidance for the planning, installation and maintenance of utility services in proximity to trees', which constrains conventional open excavations within the canopy spread of trees (distances similar to the dimensional criteria in BS 5837:2005).

Site visits were carried out to identify areas along the possible road-route where Highway trees could impact upon the feasibility of the route option. Numerous areas along the route were identified as being problematic. Site visits were also carried out with countryside or aboricultural officers from both NNDC and BDC in order to make an initial assessment of the likely impact to roadside trees.

In summary, it was assessed that the requirements of NJUG10 and BS583:2005 to avoid open-trenching within the defined distances from the tree could not be achieved. However, a rapid assessment of the actual likely impact to trees along the route identified that due to the characteristics of the trees in question, the likely growing pattern of roots within the surface in relation to verges and adjacent land, and the likely occurrence of previous works having already severed roots, that in the majority of cases, where NJUG10 and BS5837 could not be technically complied with, the actual impact to trees was generally likely to be minor. In several locations, however it was identified that there was a high probably that the trenching would result in significant severance of tree roots, which could potentially lead to some die-back at a later date and/or the instability of the tree, which would then need to be felled to protect Highway safety. The likelihood of this potential impact being considered as unacceptable to the District Councils was considered to present a risk to the Project.

Due to the sheer number of trees which could potentially be affected and the operational constraints arising from the available width of working space, it was also assessed that the use of non-open cut trenching methods would not be feasible, and could not be contained within the confines of the carriageway without negatively impacting upon adjacent verges and hedgerows.

2.5.9 Engineering and environmental feasibility surveys

Further site visits were carried out at both the possible road and arable route options during March and April 2007, in order to confirm the engineering feasibility of the outlined routes and to ground-truth the environmental impact of the two routes, with reference to the previous surveys, studies and assessments carried out. For the road route in particular, this included specific consideration of the amount of space available for the working area.

The proposed line of the road route was surveyed by bicycle on 22 and 23 March 2007. A walkover survey of the refined arable route was carried out on 11, 12 and 13 April 2007. Several minor arable route modifications were identified where appropriate.

2.5.10 Specific route planning between Weybourne and Bodham

Between Weybourne and Bodham, a concentration of environmental and technical constraints was identified during the initial feasibility studies. These constraints are formed by an east-west "ridge" of woodland, heath-land and parkland habitats, with various designations and features, which are constrained further by the built-up areas of Sheringham to the east and Holt to the west. Specific constraints in this area include:

- Kelling Heath Site of Special Scientific Interest (SSSI).
- County Wildlife Sites (CWS) at The Hangs; Kelling Heath and Hundred Acre Woods and Sheringham Park.
- Several blocks of woodland listed on Natural England's inventory of Ancient Woodland.
- The Grade II* Sheringham Hall Registered Park and Garden.
- A large Conservation Area in the area of Sheringham Park.
- Generally steep terrain.
- The Poppy Line railway between Sheringham and Holt.
- Numerous archaeological features.
- High levels of tourism.

In consideration of all these factors, two initial route options through the ridge were identified in the area near Weybourne Station, in order to take advantage of a natural narrowing of the band of constraints as follows:

a. A road-route through Weybourne, up Sandy Hill Lane towards Weybourne Station, towards Bodham.
b. An off-road based route through agricultural fields to the west of Weybourne, with a directionally drilled section to cross the railway and Kelling Heath / Hundred Acre Woods without any surface disturbance, and then open-cut trenching south towards Bodham.

These two route options are shown in **Figure 2.4**. Although the two options avoid impacting directly upon the majority of environmental designations in the area, technical and potential environmental impacts were identified in relation to both options, including:

a. The road route was not considered to be entirely feasible due to an unsuitable bridge over the railway. The feasibility of open-trenching up the road within the wooded area was also questionable, along with potential impacts to roadside trees at the southern end of the wood and disruption impact to residents within Weybourne, along Sandy Hill Lane and the Kelling Holiday Park; located within Kelling Heath / Hundred Acre Woods.
b. Several drawbacks in relation to the off-road route were also identified, primarily in relation to the possible directionally drilled section, including concentrations of archaeological finds and features, as well as a Scheduled Monument within the woods; reports of underground high-pressure springs in the woodland; the length of the directional drill; and steep terrain along the northern side of the woodland.

Due to the risk associated with both options, further assessment, surveys and modifications to the two route options were carried out, in parallel with new investigations to look at alternative route options in the area.

Alternative options were looked at to the east and west, including the option of utilising the road network through Kelling Heath SSSI, Kelling Village, Holt, Upper Sheringham and West Beckham. It was assessed that these alternatives offered no advantages over the existing route options, and also added a significant distance to the route, which in turn would increase the level of disruption, as well as being routed through built-up areas and other sensitive environmental features.

Based on the lack of suitable alternative route options, it was decided to progress the two initial route options, with modifications, to reduce their environmental impact, as discussed below:

a. It was determined that the preferred road-based route would require a directional drill to the east of Weybourne Station in order to cross the railway without impacting upon the unsuitable bridge. An engineering assessment of the remaining section of road-based route within the wooded ridge to the south of Weybourne station was also carried out, which confirmed that although the process would be very slow and technically difficult, that the route was technically feasible.

b. The preferred off-road route was planned to avoid the area of potentially high-pressure springs, the Scheduled Monument and the majority of previously recorded archaeological finds and features, with the exception of an area of ancient iron-working pits.

In order to provide further information on the feasibility of directional drilling beneath either the railway to the east of the station, or beneath the wooded ridge to the west of the station and Sandy Hill Lane (Kelling Heath Holiday Park), several trial holes were carried out as well as a detailed analysis of the terrain and electrical system schematic design. This concluded that the long drill option across the whole of the ridge within Kelling Heath Holiday Park (included as part of the off-road route), would not be the preferred option due to potential technical constraints relating to the length involved (approximately 575m) and the steep terrain along the northern side of the woodland.

The drilling methodology within the off-road route drill was therefore modified to be carried out in ‘two-hits’, or segments, which would rejoin at the surface at a point in the middle of the route. A wide strip of grass (used as a firebreak) located in the area of the drilling route was identified to be the best location for the drill to surface without resulting in significant impact both to the ecological and landscape value of the woodland and the use of the site by holiday visitors.

Specific consultation was carried out with Norfolk Wildlife Trust to gain feedback on any potential effects to the value of the Kelling Heath Park/Hundred Acre Woods County Wildlife Site (CWS) and with Norfolk Landscape Archaeology in relation to the known areas of archaeology. Their responses confirmed that the revised directional drill design, with open excavation in the firebreak at Kelling Heath Holiday Park, were likely to be insignificant. The responses are summarised in **Appendix 4.2**.

A technical and environmental assessment of both the refined options was carried out. This assessment determined that although both route options were considered to be technically feasible, that the off-road option, with a “two-hit” drill beneath the Kelling Heath Holiday Park was the preferred option for the following reasons:

- The ‘road-route’ would require the complete closure of Sandy Hill Lane for several weeks, which would result in significant levels of disruption and disturbance to residents along Sandy Hill Lane and Weybourne, users of the holiday park, and visitors using the road as a route to the coast and Weybourne.
- If the ‘road-route’ was required to commence at Muckleburgh, it would result in significant disruption within Weybourne, including road closures, and potential impacts to flint retaining walls and Listed Buildings within the settlement area.
- If the ‘road-route’ avoided Weybourne utilising fields north of the Kelling Heath Holiday Park, it would need to cross Spring Beck (which would otherwise not be required).
- The off-road based route is significantly shorter.
- The off-road route drill would result in surface disturbance of the firebreak within the Kelling Heath Park / Hundred Acre Wood CWS however this has been assessed as being of low ecological significance. In addition, the depth of the drill and alignment through the fire break would ensure that there would be no impact to the trees within the woodland (refer to Section 6 ‘Nature Conservation & Ecology’).

The final preferred route between Weybourne and Bodham is shown within Section 3 ‘Project Details’.

2.5.11 Identification of the preferred route

As demonstrated in the above summaries, the results of the various surveys, studies and assessments carried out were analysed in detail to identify the preferred route option for submittal for Town and Country Planning Act (TCPA) consent. The identification of the preferred route has considered a number of environmental, technical, financial and risk factors.

In general terms, the assessments have identified that with the exception of certain locations where site specific features are encountered, that the preferred option is to utilise agricultural land, or ‘off-road’ routes, rather than routes utilising the carriageway of the road network. The reasoning is summarised within **Table 2.3**.

Based on the available data and a solid understanding of the environmental and technical implications of the Project, a preferred grid connection has been identified. Although it is acknowledged that there are countless possible route options which could have been identified, Scira are confident that the route outlined takes into due account a realistic view of all potential impacts. Residual impacts to the natural, physical and human environment are assessed within this ES, along with the identification of suitable mitigation and/or monitoring in order to further reduce potential impacts.

Details of the final proposed route are given within Section 3: ‘Project Details’.

Table 2.3 Generic evaluation of impacts for road and off-road routes

Impact receptor	Road based	Off-road based
Habitats and associated features *(disruption and loss of habitats)*	Although trenching would primarily take place within the road surface, in some situations, the working width required could inevitably have some impact upon road-side verges and hedgerows during construction.	Routes across agricultural land would inevitably require breaches within sections of hedgerows and some watercourses. Route planning has been designed to minimise impact to significant features such as woodland and larger watercourses through the utilisation of directional drilling techniques. Impact to other features is also minimised by route micro-siting to avoid or minimise impact to boundary trees, utilising gaps in hedgerows and reinstatement any disturbed habitats following construction.
Habitats and associated features *(impact to tree roots)*	Some parts of the road route are bound by mature trees. Trenching within the road-surface could potentially impact upon the roots of certain trees along the road, which could result in instability and die-back.	Route planning across agricultural land has had the advantage of being able to micro-plan the proposed route to cross boundaries at appropriate locations to minimise impact to tree roots and take advantages of any gaps in hedgerows for example.
Local community and other road users *(road closures and diversions)*	The majority of the road network consists of narrow roads, which would require full road closures and diversions during the construction phase. Although Scira would endeavour to minimise impacts wherever feasible, there would be some disruption with respect to reduced access and increased journey lengths for the local community, businesses and travelling public.	Although off-road routes would still require road-crossings, these are of significantly lower impact and disruption levels.
Settlements *(disruption to local residents)*	The road route would need to pass through several villages and settlements, which would result in disruption during the construction phase relating to increased noise and dust levels and restricted access.	An advantage of off-road routes is the ability to by-pass settlements to avoid or minimise impact.

Impact receptor	Road based	Off-road based
Services *(impact to buried services)*	Within settlements and to a lesser extent along the road network, there are likely to be concentrations of buried services within the carriageway, which could restrict the feasibility of the road route.	The occurrence of buried services is generally reduced within agricultural land and can be mitigated easily due to greater availability of space.
Construction timing *(longer construction periods)*	Due to restricted working widths available, trench excavation and reinstatement differences, construction of road-routes are significantly longer in duration.	The installation of the grid connection within agricultural land would be significantly faster than within the road surface.
Excavated materials *(increased requirement for off-site disposal of excavated material and associated additional construction traffic)*	Reinstatement of the road-surface and back-filling of the trench is likely to require significantly higher quantities of materials which need to be brought in and taken away from the site, which would ultimately require off-site disposal.	With the exception of the backfill required surrounding the cables, the majority of the trench backfill would utilise the material excavated from the trench, which would significantly reduce the volumes of material requiring transporting to and from the site.

2.6 Scira Substation Location and Design

2.6.1 Identification of preferred location

The selection of the proposed location for the Scira substation at Salle has focused in and around the immediate existing substation site. From an analysis of the land which may be available and suitable for such a feature, three possibilities were identified and investigated:

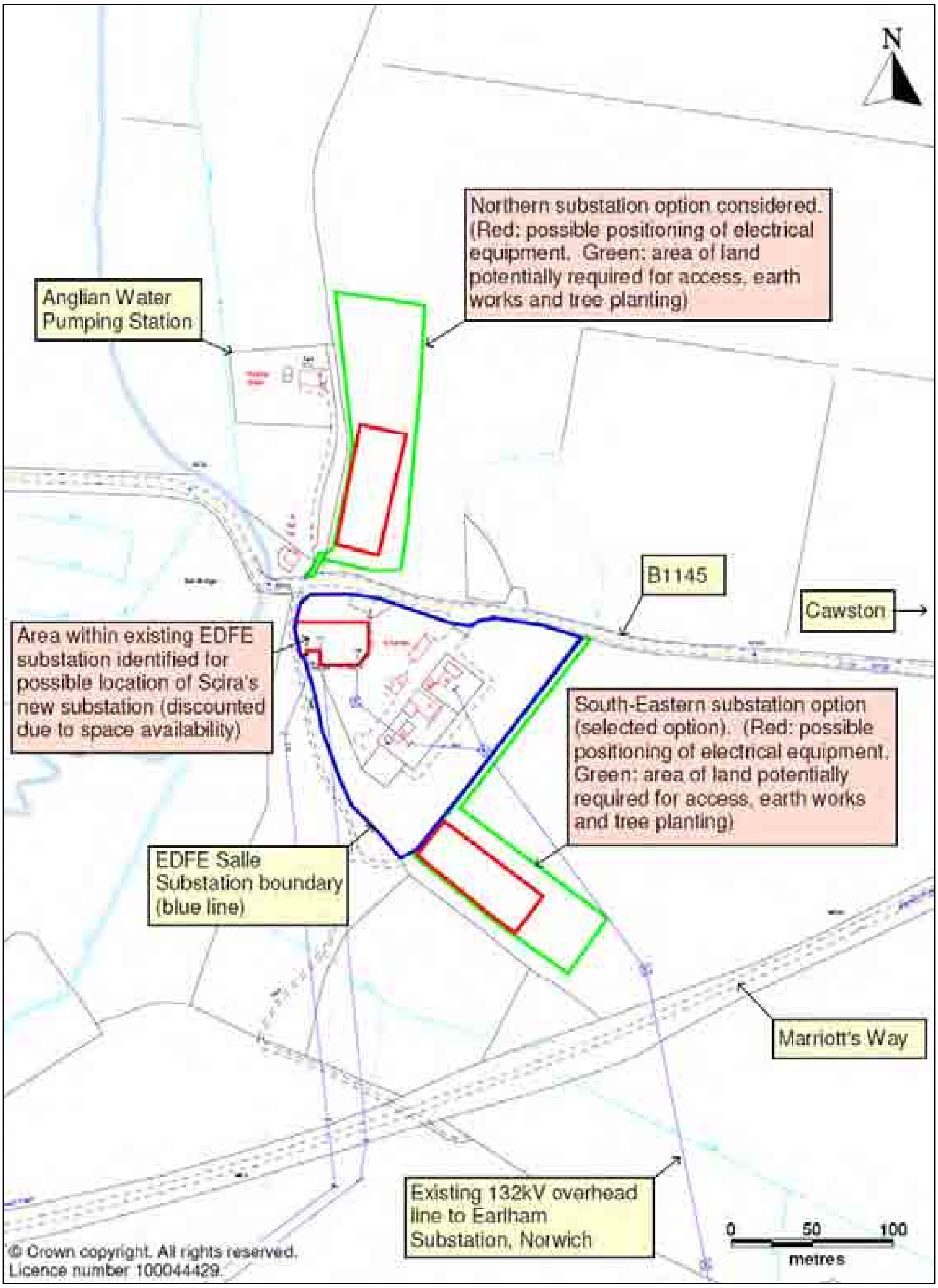
- An area within the existing EDF substation at Salle.
- An area to the north of the B1149 road, opposite the existing substation.
- An area to the south-east of the existing substation.

These potential substation locations are shown on **Figure 2.5**.

Early on in the process, the first option was discounted, as the space available was not sufficient to house the equipment which is likely to be necessary to connect the Sheringham Shoal offshore wind farm to the Salle substation.

Following various site visits, the two possible sites to the north and south-east were identified as potentially suitable. An analysis of all the baseline environmental data available for the area was carried out which determined that neither site had any particular preference over the other, with the exception of potential impacts to the landscape and visual environment.

Figure 2.5 Possible locations identified for Scira's new substation at Salle



The site to the north is located on an elevated slope. Due to the size of the equipment necessary, it would not be possible to shield views from the road below to the new substation. In comparison, it was assessed that the site to the south-east of the site was already well shielded by existing topography and enabled the resultant group of existing and new 'industrial' structures to be kept in a compact group. In addition, a backdrop of woodland (associated with the wooded valley to the south) would be located behind the new substation in key views. Hedgerow vegetation along the southern side of the road would also help to screen the remaining parts of the substation which could be visible from the road.

For these reasons, the south-eastern substation option was selected for further assessment and the next stage of design considerations.

2.6.2 Design considerations

The site selection, site layout and design of Scira's proposed substation at Salle has been an iterative process, of which the consideration of landscape and visual impact has played a key role.

The arrangement of external equipment and buildings, while based on certain optimal relationships in below surface cable connections, also had flexibility in relative positioning and orientation relative to the existing substation. This flexibility was exploited in the site planning process with regard to landscape and visual impact.

The site planning utilised the aerial photography as well as site visits and photographs taken from the public roads and footpaths in the area. A full topographic survey of the existing substation was undertaken to enable a full understanding of the visual, spatial and functional connections between the two facilities.

In summary, the site planning has involved the following measures:

- Grouping the equipment and building group into a tight 'footprint' and locating the building/equipment group at the lowest elevation.
- Locating the site as far as possible from public viewpoints
- Arranging the group to locate the tallest elements closest to existing equipment.
- Exploiting the visual containment provided by existing woodland and topography
- Lowering of the main control building structure to reduce overall height.
- Aligning the proposed access track to avoid direct views to the new substation from the road.
- Local cut and fill balance to avoid massive import and export of materials, where possible.
- Ensuring proper water drainage.

This site selection and site planning process has been developed further and carried through to the detailed design of the control and ancillary buildings, earthworks and tree planting which in combination minimise the potential adverse impact arising from the development.

The design of the layout and buildings is discussed in further detail within Section 9: 'Landscape and Visual Impact'.

2.7 Summary

In order to identify the preferred cable route, Scira has progressed a detailed and iterative route identification process, taking into account environmental, technical, financial and risk considerations. This process has been carried out by Scira with the support of a team of environmental and technical specialists. In summary, the process has included:

- Initial key project decisions by Scira to progress an underground grid connection system, rather than any new overhead lines, and to investigate options utilising the carriageway of the existing road network as well as routes within agricultural land.
- Initial cable route identification studies to identify technical parameters including working widths, cable trench profiles and electrical design considerations and environmental constraints.
- Capture of aerial photography to aid route identification process and allow micro-siting to avoid, or take advantage of particular features.
- Detailed surveys, studies and assessments to gather information on the existing environmental within the area in relation to the natural, human and physical environment.
- Detailed technical assessments along proposed route options to confirm feasibility.
- Regular and thorough consultation with a range of consultees utilising a range of methods, including written consultations, meetings, site visits and public exhibitions, with statutory consultees, other interested organisations, landowners and tenants and other members of the public.
- Analysis, assessment and route modifications to identify the best-fit preferred route option, taking into account environmental, technical, financial and risk factors and any mitigation or monitoring measures which may be required to reduce any potential impacts to an acceptable level.

The identification of the proposed location for Scira's new substation has focused in and around the existing EDFE substation at Salle, near Cawston. A site located immediately adjacent to the south-east of the existing substation was selected as the preferred option, based primarily on space availability, proximity to the substation for grid connection and landscape and visual impact, as the site is naturally shielded to some degree already by the existing topography. The siting of the required equipment and the design of the substation buildings and screening has been designed to limit impact on the environment and blend with existing landscape and features already present.

An almost limitless number of route options and combinations are theoretically possible in order to connect the proposed Sheringham Shoal offshore wind farm to the grid, however Scira are confident that the detailed and iterative process which has been adopted has taken due account of all environmental and technical consideration in order to propose a buried grid connection route and new substation with minimal impact upon the natural, human and physical environment.

2.8 References

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Sheringham Shoal Offshore Wind Farm Environmental Statement

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 3

PROJECT DETAILS

3 PROJECT DETAILS

3.1 Introduction

This chapter of the Environmental Statement provides a detailed description of the Sheringham Shoal Offshore Wind Farm Onshore Grid Connection project, including an account of the project components and a description of the construction, operation, maintenance and decommissioning stages. This includes the proposed buried cable system between Weybourne and the existing substation at Salle, near Cawston, as well as the requirement for a new substation facility at Salle. Information relating to the works required within the existing substation facility by EDF Energy (EDFE) is also briefly described for context and to allow cumulative assessment, where necessary.

The design of the cable connection and the substation has reached a relatively detailed level, however certain elements would be dependant on the chosen Contractors and Suppliers following a competitive tendering exercise, relating both to the installation of the offshore wind turbines, as well as the specific cables and substation equipment to be installed. Where elements are unknown, or estimated, this is indicated. The Environmental Impact Assessment (EIA) has assessed the potential impact of the construction and operation of the onshore grid connection based on the realistic worse-case scenario.

3.2 Proposed Onshore Grid Connection Overview

The main components of the proposed cable system are as follows:

- A 132kV cable system, 21.3km in length, consisting of two circuits of three underground electrical cables installed within Unplasticised Polyvinyl Chloride (UPVC) or Polyethylene (PE) ducts.
- Fibre optic communication cables.
- Cable jointing pits.
- Cross bonding pits and/or pillars.

The main components of the proposed substation at Salle would include the following indoor and outdoor equipment:

- A 'Control Building' containing the switch gear and control gear for the mechanical switching and management of the wind farm. The dimensions of the building would be 15.4m in width and 27.4m in length. The overall above ground height would be 8.0m with an eaves height of approximately 6.5m.
- An 'Ancillary Building' immediately adjacent to the control building to house a workshop, store room, toilet and shower room, mess room and office. The dimensions of the building would be 6.1m width and 16.0m length.
- Two shunt reactors (one for each cable circuit), which would be up to 5.0m in height.
- Eight three-phase capacitor banks (four for each cable circuit; 24 single stacks), each up to 3.9m in height.
- Space for additional harmonic compensation equipment (if required).

- Associated access, hard standings, security fencing and tree planting.

These two main components, the cable system and the substation, are discussed in turn in Section 3.3 and Section 3.4 respectively, along with an account of the works required by EDFE within the existing substation in order to connect Scira's equipment (Section 3.5).

An overview of the proposed route alignment for the cable system, and the location of the proposed substation are given in **Figure 3.1**. An account of the process by which these preferred options have been selected is given within Section 2: 'Site Selection and Consideration of Alternatives'.

3.3 Description of the Cable System

3.3.1 Proposed route alignment

As outlined within Section 1: 'Introduction', the proposed Sheringham Shoal offshore wind farm has been the subject of a separate EIA and consenting process. The application for consent was submitted in May 2006 and is currently being determined by the Department for Business, Enterprise & Regulatory Reform; DBERR (previously Department of Trade and Industry, DTI). As well as the offshore wind farm itself, the application to DBERR also included some associated onshore works, comprising of the landfall point and crossing of the shingle ridge and low cliff, a jointing (or cable connection) pit, approximately 600m of underground cabling and a new switch room within the Muckleburgh Collection museum at Weybourne.

Since the submittal of this application, further assessment and analysis of the grid connection needs has established that a new substation would be required at the connection point to the electricity distribution grid at Salle, near Cawston. This new substation would contain all the necessary switching gear which was previously intended to be located in the proposed switch room building at the Muckleburgh Collection museum. Therefore, based on the current design, Scira no longer requires the switch room facility which was included in the DBERR application.

In order to avoid an unnecessarily circuitous route across the museum land and to maintain the necessary spacing required between cable lengths (discussed later within Section 3.3.5), the cable has been aligned in a direct route across the land.

The scope of the application for planning consent to NNDC and BDC and of the EIA therefore has a start-point of the jointing pit included within the DBERR application. This is illustrated diagrammatically on **Figure 3.2**.

The end point of the proposed cable system is located at the existing EDFE Salle substation, located to the west of Cawston.

As already discussed, the proposed route alignment of the cable connection has been the result of a detailed and multi-staged approach, which has taken into account consideration of environmental, technical, financial and risk factors in order to identify the best-fit option.

Figure 3.1 Proposed onshore grid connection overview

Figure 3.2 DBERR (blue) and NNDC/BDC (green) application interface at Weybourne

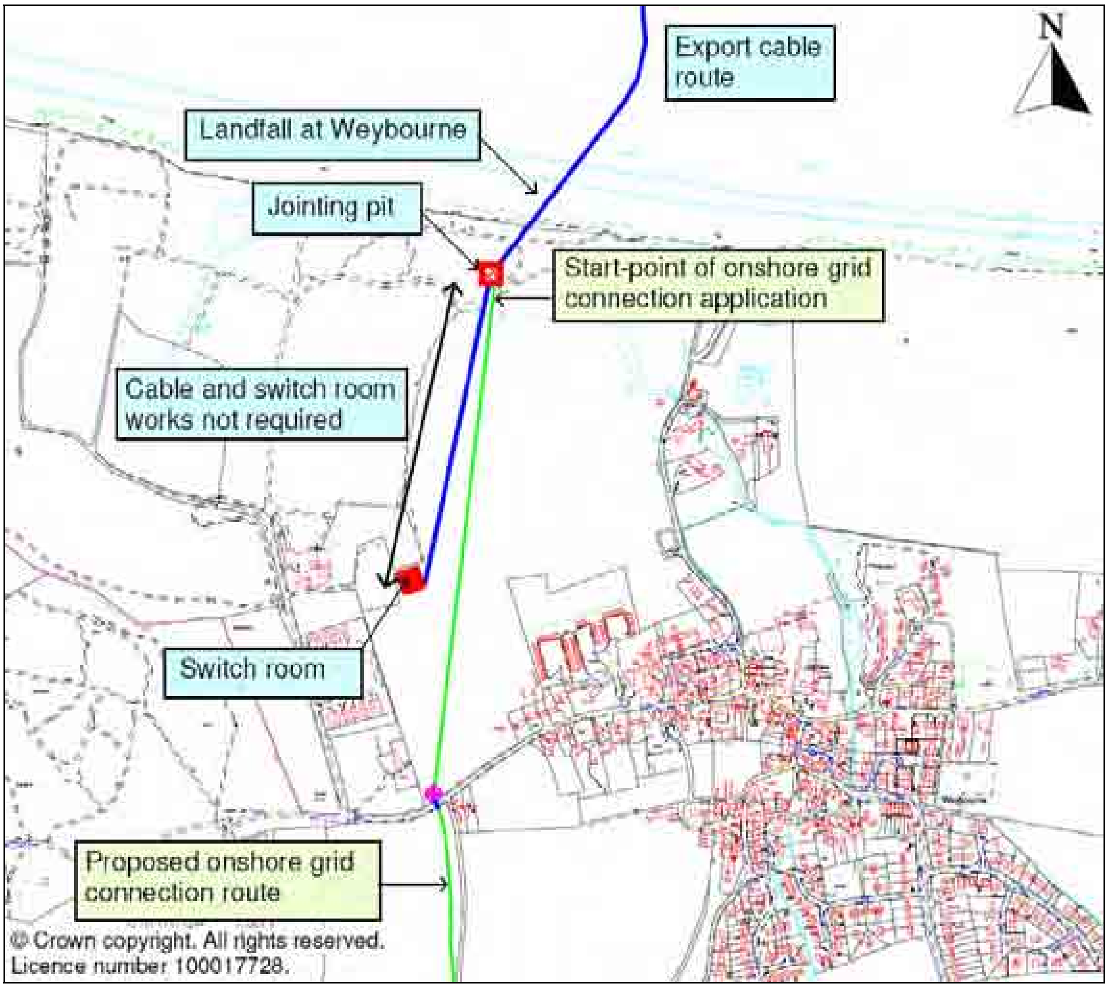
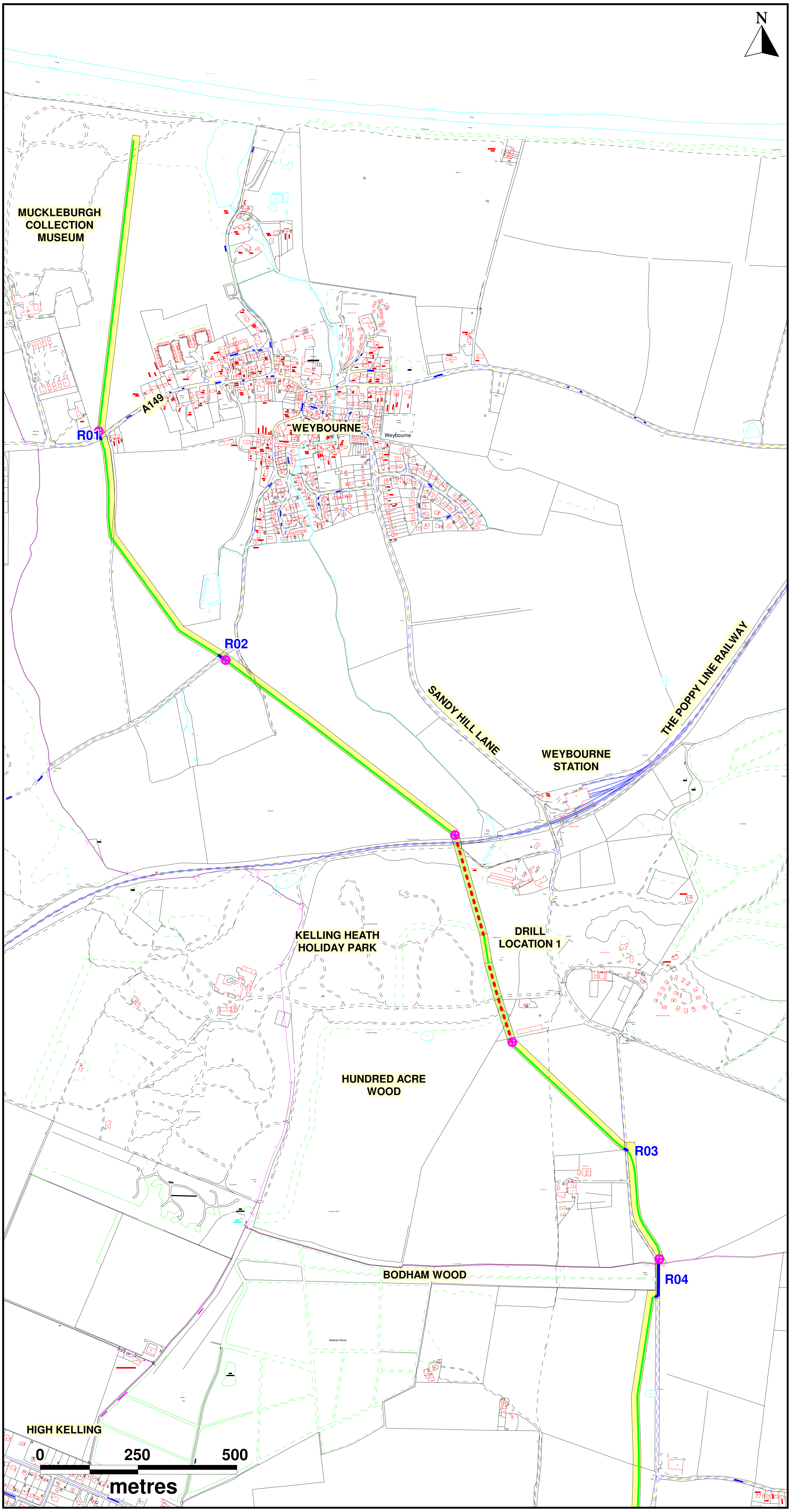


Figure 3.3 shows the proposed alignment of the cable system, along with the most likely locations for cross-bonding, which are discussed further in Section 3.3.5.

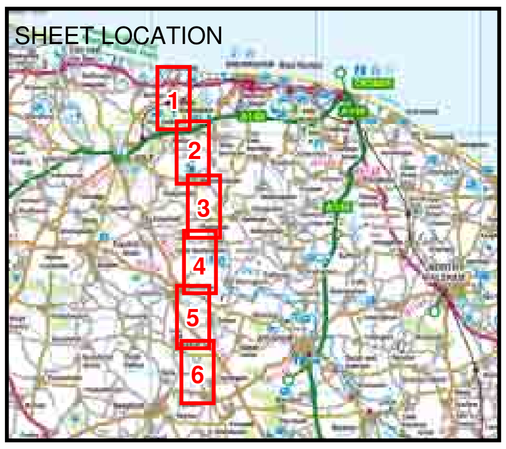
The proposed route alignment passes through the parishes of Weybourne, Bodham, Baconsthorpe, Matlaske, Plumstead, Little Barningham, Itteringham, Corpusty and Saxthorpe, Oulton, Heydon and Cawston.

The majority of the route is located within agricultural land, most of which is currently under arable cultivation, with some fields under pasture. Fields are typically bound by hedgerows with scattered trees. Watercourses are generally sparse along the route, the main feature being the River Bure and several smaller watercourses or drainage channels.

The route crosses the Public Highway in 21 locations. These locations are discussed in detail in Section 3.6.5 and shown on **Figure 3.3**. In one of these locations (Road Crossing No.4, adjacent to Bodham Wood along Sandy Hill Lane), the route is aligned within the carriageway itself for approximately 92m.



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- R01 Road crossing number
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Existing Features

- Gas main crossing points
- Existing EDFE substation boundary
- BODHAM Settlements and features within the study area

Title:
DETAILED PLAN OF PROPOSED ONSHORE GRID CONNECTION

SHEET 1 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

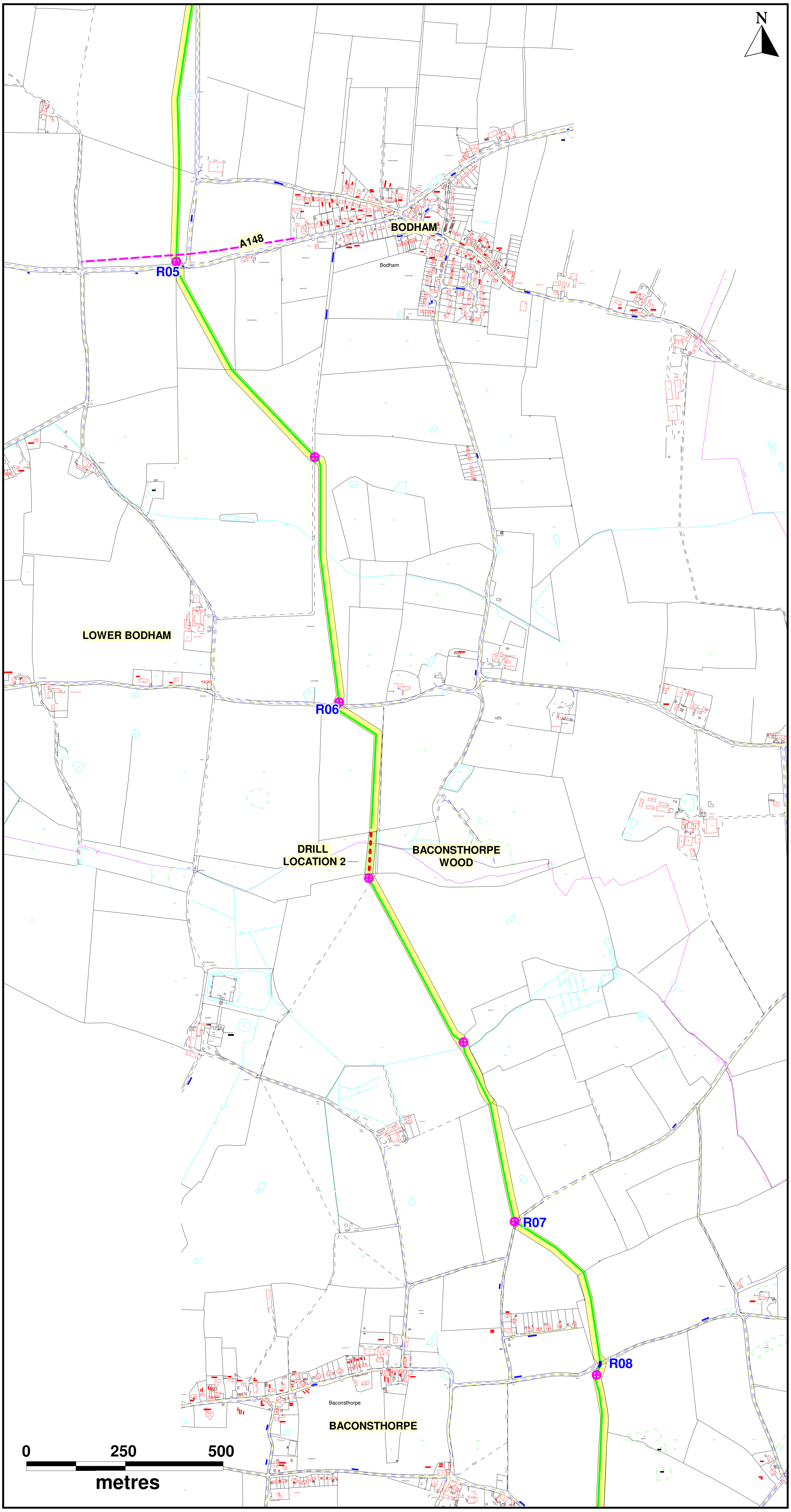
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

Scale:
NTS

Figure:
FIGURE 3.3 (1 of 6)

ROYAL HASKONING



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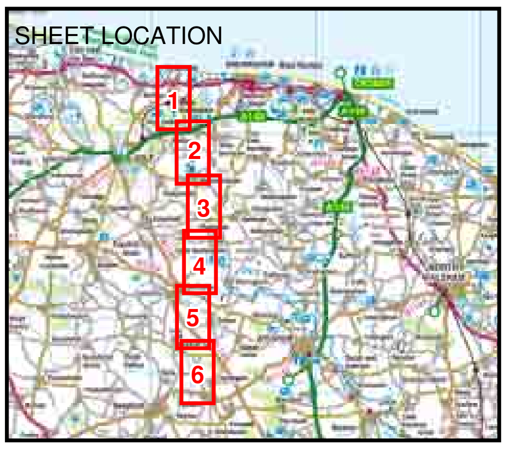


LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- R01 Road crossing number
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Existing Features

- Gas main crossing points
- Existing EDFE substation boundary
- BODHAM Settlements and features within the study area

Title:
DETAILED PLAN OF PROPOSED ONSHORE GRID CONNECTION

SHEET 2 OF 6

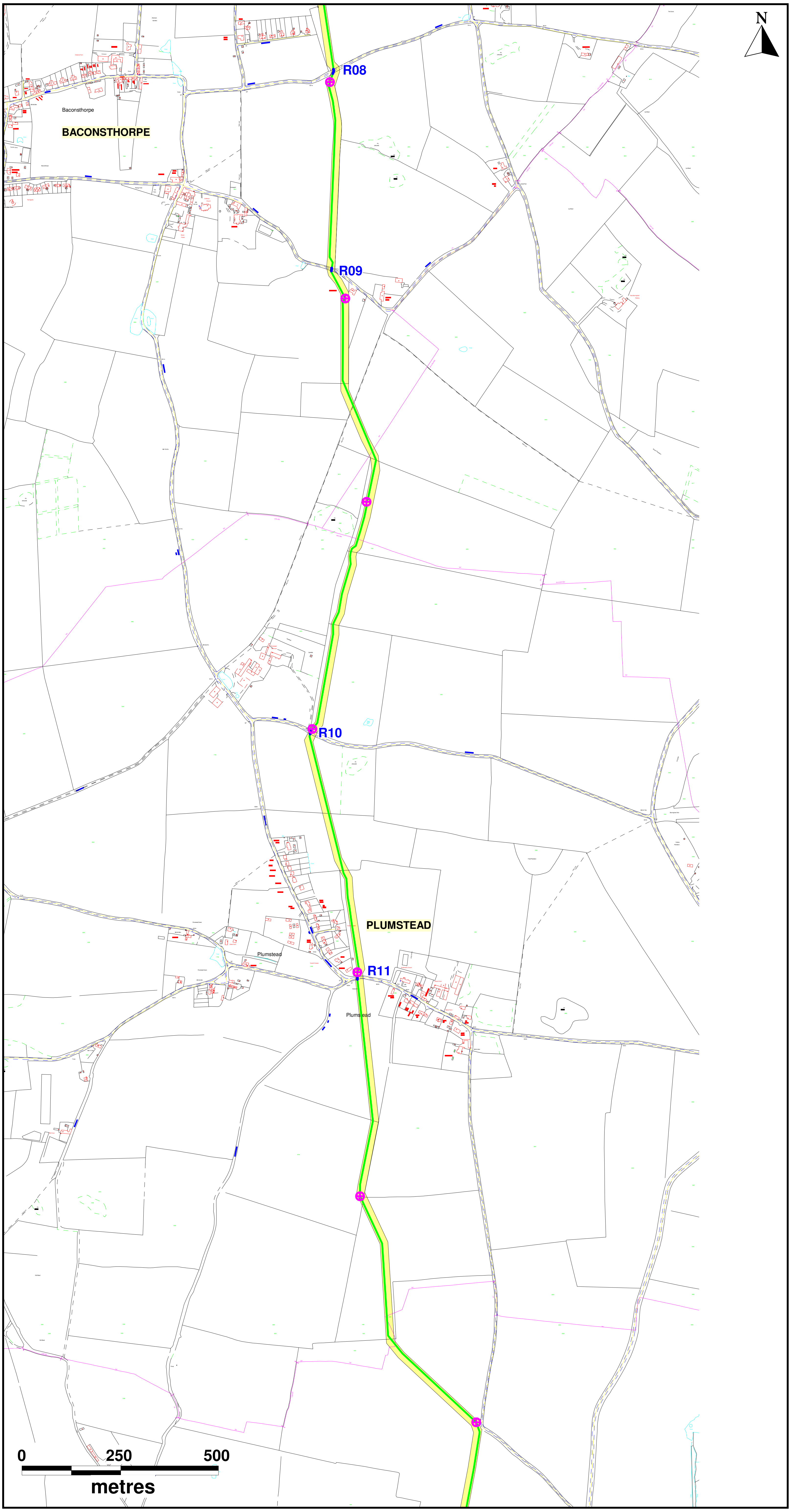
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 3.3 (2 of 6)

ROYAL HASKONING



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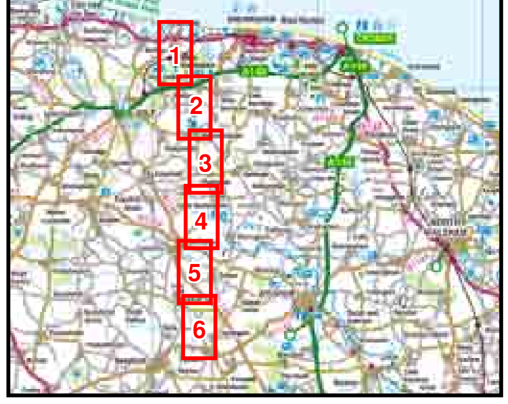


LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- R01 Road crossing number
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Existing Features

- Gas main crossing points
- Existing EDFE substation boundary
- BODHAM Settlements and features within the study area

Title:
DETAILED PLAN OF PROPOSED ONSHORE GRID CONNECTION

SHEET 3 OF 6

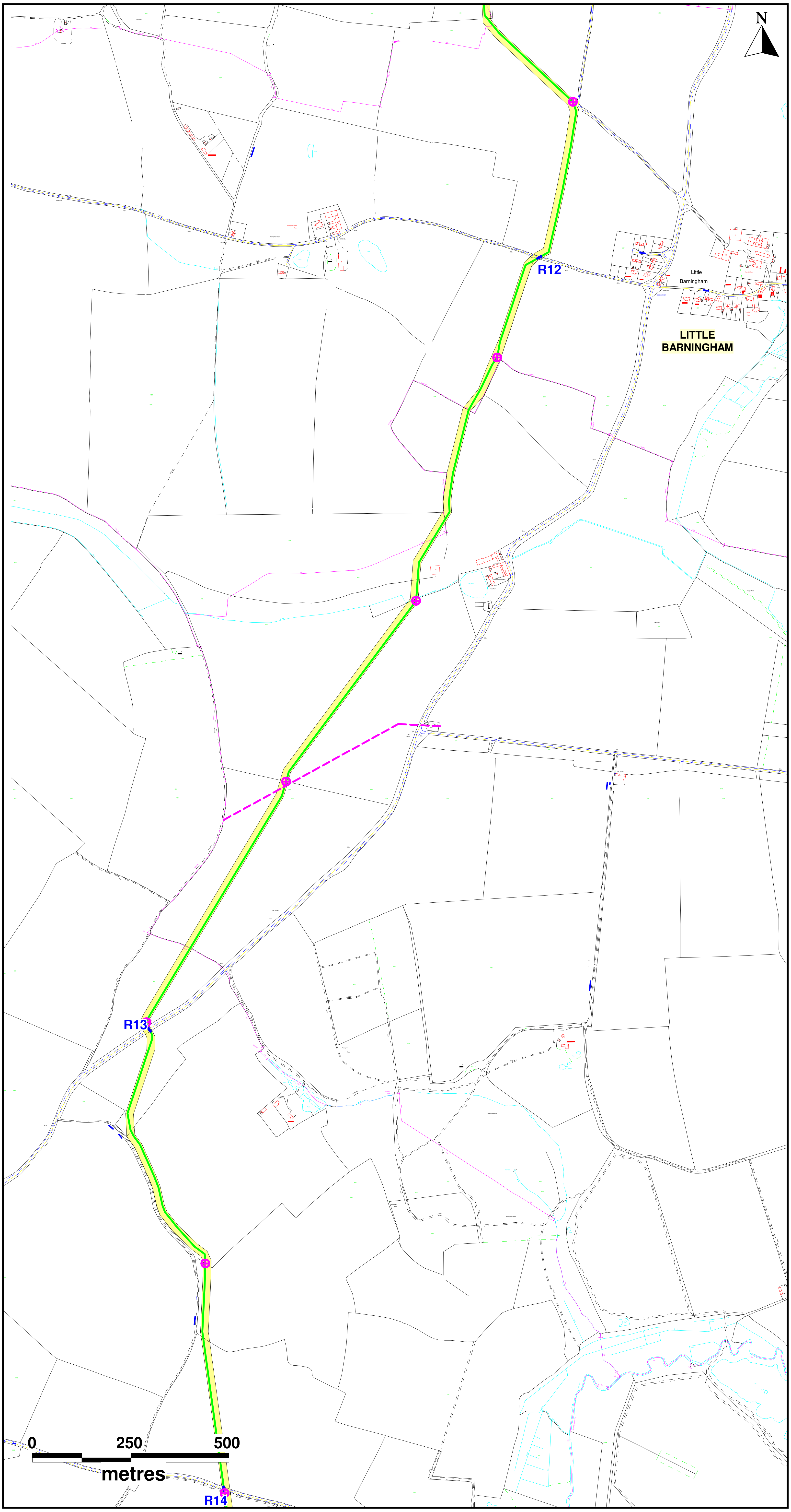
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 3.3 (3 of 6)

ROYAL HASKONING



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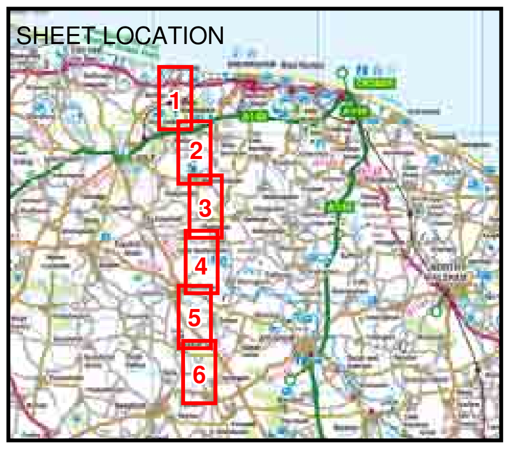


LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- R01 Road crossing number
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Existing Features

- Gas main crossing points
- Existing EDFE substation boundary
- BODHAM Settlements and features within the study area

Title:
DETAILED PLAN OF PROPOSED ONSHORE GRID CONNECTION

SHEET 4 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

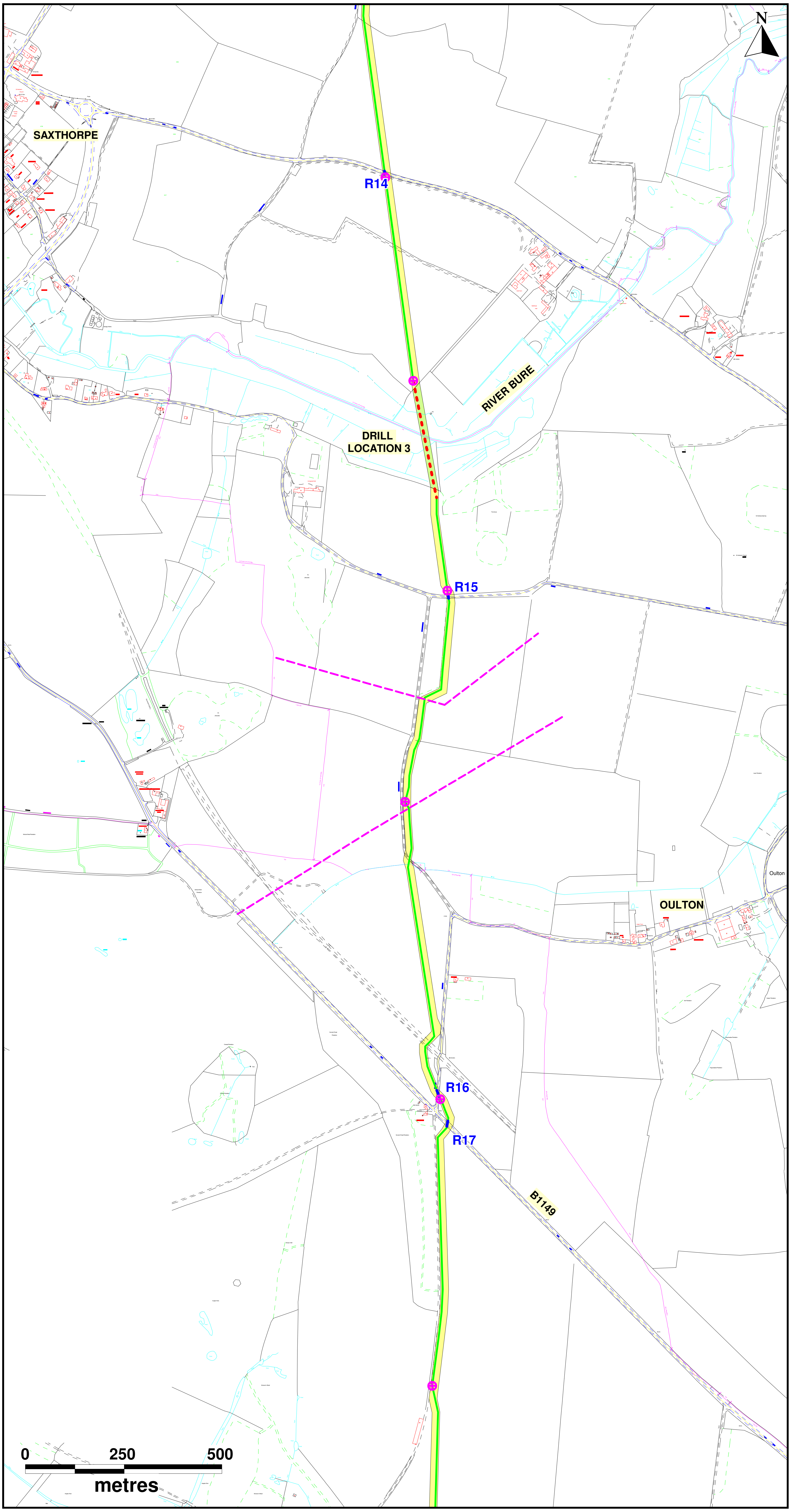
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

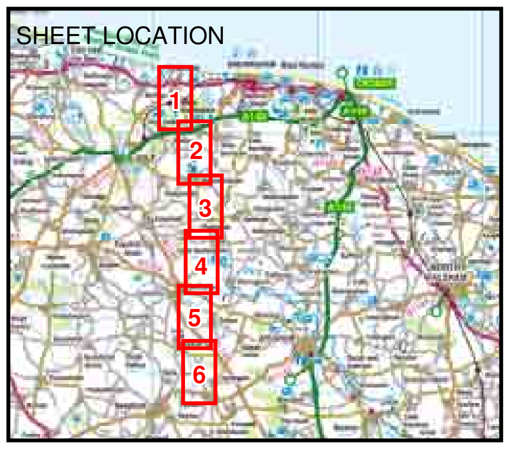
Scale:
NTS

Figure:
FIGURE 3.3 (4 of 6)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- R01 Road crossing number
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Existing Features

- Gas main crossing points
- Existing EDFE substation boundary
- BODHAM Settlements and features within the study area

Title:
DETAILED PLAN OF PROPOSED ONSHORE GRID CONNECTION

SHEET 5 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

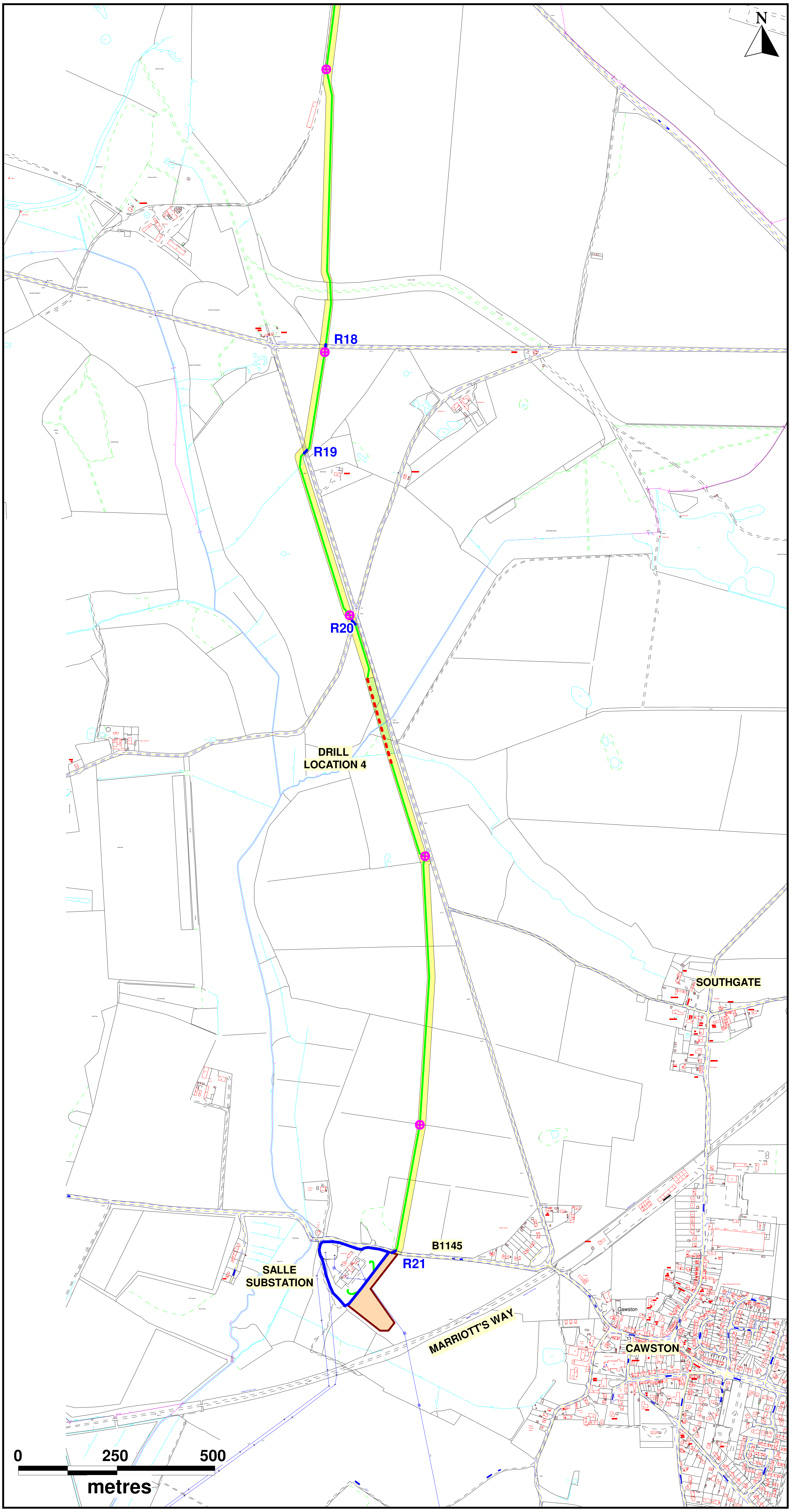
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

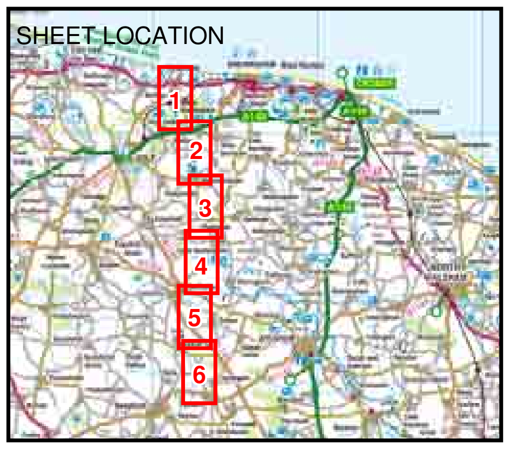
Scale:
NTS

Figure:
FIGURE 3.3 (5 of 6)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- R01 Road crossing number
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Existing Features

- Gas main crossing points
- Existing EDFE substation boundary
- BODHAM Settlements and features within the study area

Title:
DETAILED PLAN OF PROPOSED ONSHORE GRID CONNECTION

SHEET 6 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 3.3 (6 of 6)

ROYAL HASKONING

The proposed method for installing the cables along the majority of the cable route is via a system of open-cut trenching, and is discussed in Section 3.6. At four locations, the route passes through features where it has been assessed that open-cut trenching would either be technically unfeasible or problematic, and/or where the likely impact to environmental features are considered to be significant. In the following locations (also shown on **Figure 3.3**), a technique known as 'directional drilling' is instead proposed, which is discussed in detail in Section 3.3.6:

- Directional drill location 1: Poppy Line Railway and Kelling Heath Holiday Park (proposed to be drilled in two sections).
- Directional drill location 2: Baconsthorpe Wood.
- Directional drill location 3: River Bure.
- Directional drill location 4: Woodland East of Salle Park.

3.3.2 Cable components

The installation of the cable system between Weybourne and Salle substation would require two circuits of three cables operating at 132kV. At present, the concept of the proposed wind farm would be arranged as two electrically isolated wind farms and connected to the grid via separate and independent circuits. In addition to the two power cable circuits, fibre optic cables would be laid within the trench for communication purposes.

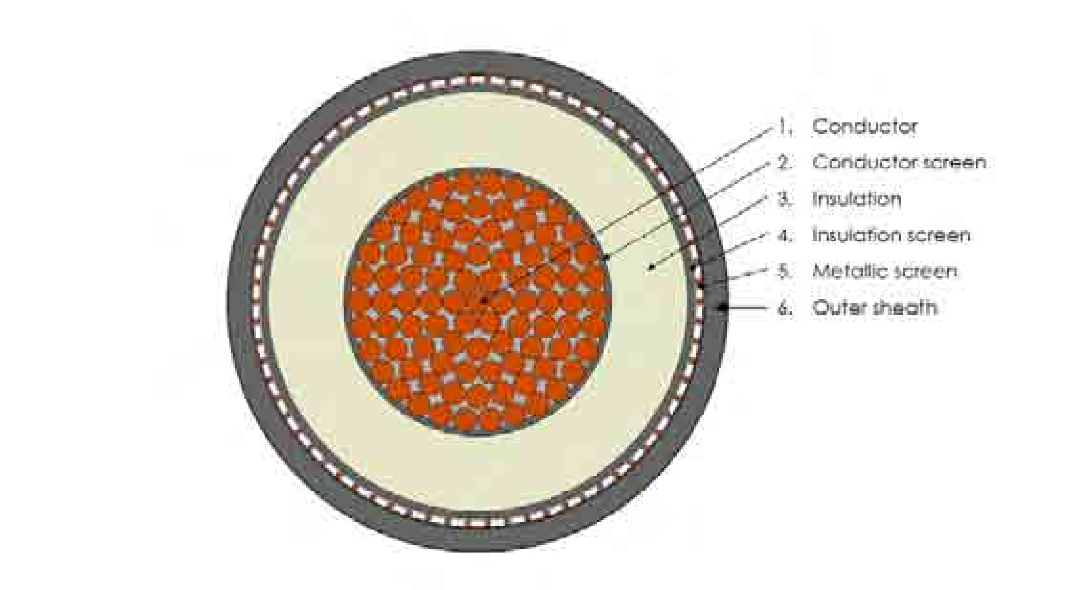
The cables, or 'conductors', would have either copper or aluminium cores, with cross-linked polyethylene (XLPE) insulation, metallic screening and an outer sheath. The final cables would not be confirmed until the detailed design stage and would either be aluminium or copper. For the purposes of this assessment, the maximum cable diameter under consideration has been used as a basis for assessment and identification of maximum trench width. The largest size of cables being considered has a conductor 1,600mm^2 in cross-sectional area. The overall diameter of the cables, including insulation and other layers would be in the range of 95-110mm. A diagram showing a typical cross-section of a cable is given as **Figure 3.4**.

3.3.3 Cable ducting

It is proposed that the cables would be installed within a ducted system. Using this method, the cable installation can be carried out in two stages. During the first stage, the cable trench is excavated, ducts installed and trench reinstated. During the second stage the duct joints are excavated and the cables pulled through and jointed. This system has several advantages:

- The construction process is quicker as there is often no need to timber the trench for support until the cable is installed and trench backfilled. It is also safer to minimise the amount of time the trench is left open.
- The two-staged cable installation process allows for the specialist cable pullers to be resourced just for the pulling stage.

Figure 3.4 Typical cross-sectional profile of the cables (conductors) under consideration



- Due to the long lead-in time for cable delivery, a ducted system means that the construction programme can commence with the cable ducting, prior to the cables being available. When the cable is delivered, this can then be installed straight away.
- The ducting provides an extra layer of protection to the cable.

Each of the six cables would be laid within its own duct, which are generally delivered and installed in lengths of approximately 6m and joined together on site using a 'push-fit' system. The external diameter of each of power cable duct is approximately 160mm. Fibre optic cables would also be installed within the trench, within their own ducts, which would be up to 90mm in diameter. The final dimensions would be subject to a series of variables, such as cable conductor material, cross-sectional area and installation method, however as discussed, maximum figures are provided for the purpose of this assessment.

3.3.4 Cable trench configuration

Two types of arrangement for the laying of cables within the excavated trench are available. In the 'trefoil' arrangement the cables are laid in two bundles of three, with each circuit bundle a fixed distance from the other to minimise heating effects. In the 'flat array' arrangement the cables are laid in a line at the same depth. In this case a smaller cable becomes theoretically feasible but the flat array has the consequence of a greater trench width. It is likely that the trefoil arrangement can be achieved within a trench width of 1.52m while the flat array arrangement could entail a trench width of up to 2.2m. In the trefoil arrangement, the fibre optic cable ducts would be grouped between the two cable circuits. In the flat array, the fibre optic cable ducts would be installed between the cables.

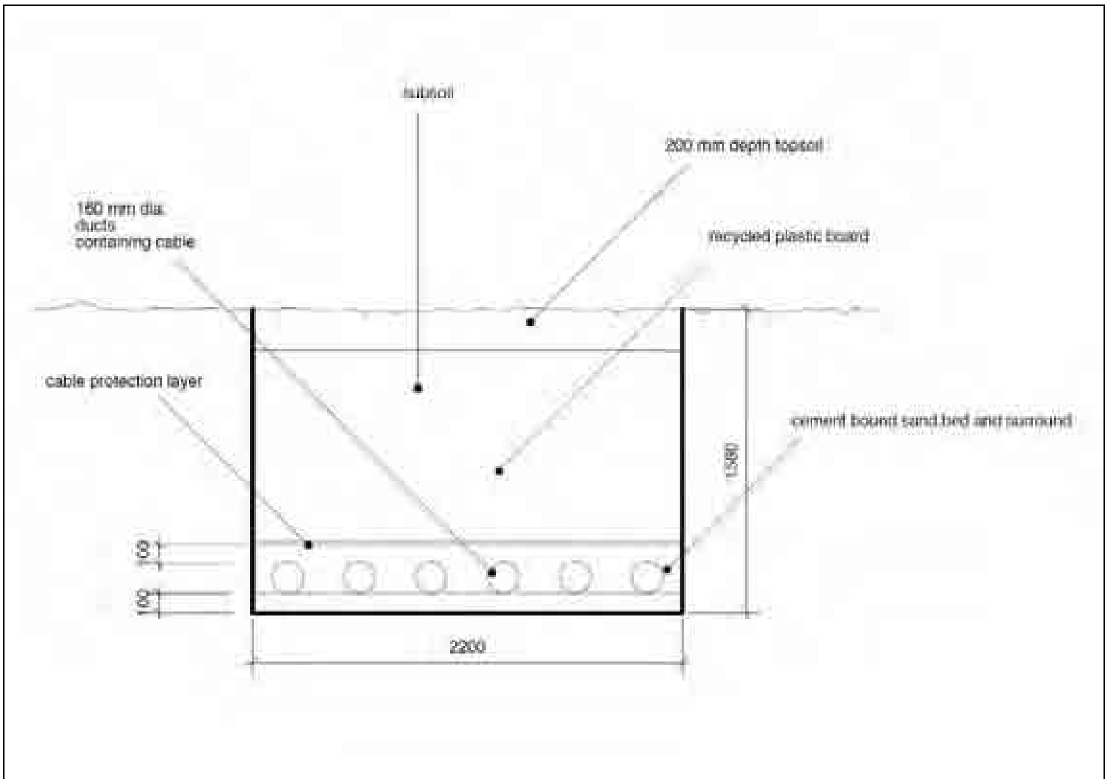
Regardless of the chosen cable arrangement, once the trench has been excavated the power cable and fibre optic cable ducts would be placed on the trench bed within a selected sand surround and adequately compacted. It is likely that the material used to surround the cables would need to be a Cement Bound Sand (CBS) or similar substance to maintain thermal resistivity. Protective cable tiles and marker tape would also be installed.

The depth of cover between the protective cable tiles and the surface within the agricultural land would be 1,200mm, in order to allow depth for the land to be ploughed safety. Where the proposed cable route crosses or runs along the Public Highway, the depth of cover would be 900mm.

In order to assess the realistic 'worse-case' scenario, it has been presumed within the EIA process, that the flat array system would be selected, as this would require the widest trench width.

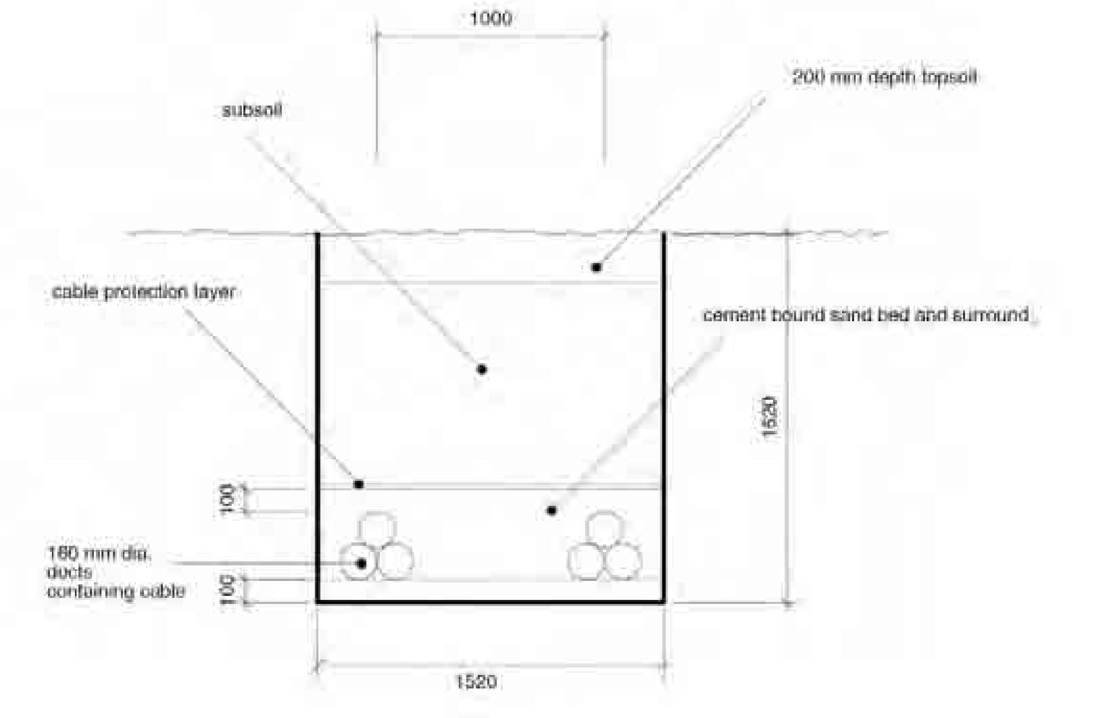
Typical trench profiles for each of the four scenarios are provided as **Figure 3.5** (a-d).

Figure 3.5a Typical cable trench configuration - flat array in the agricultural land



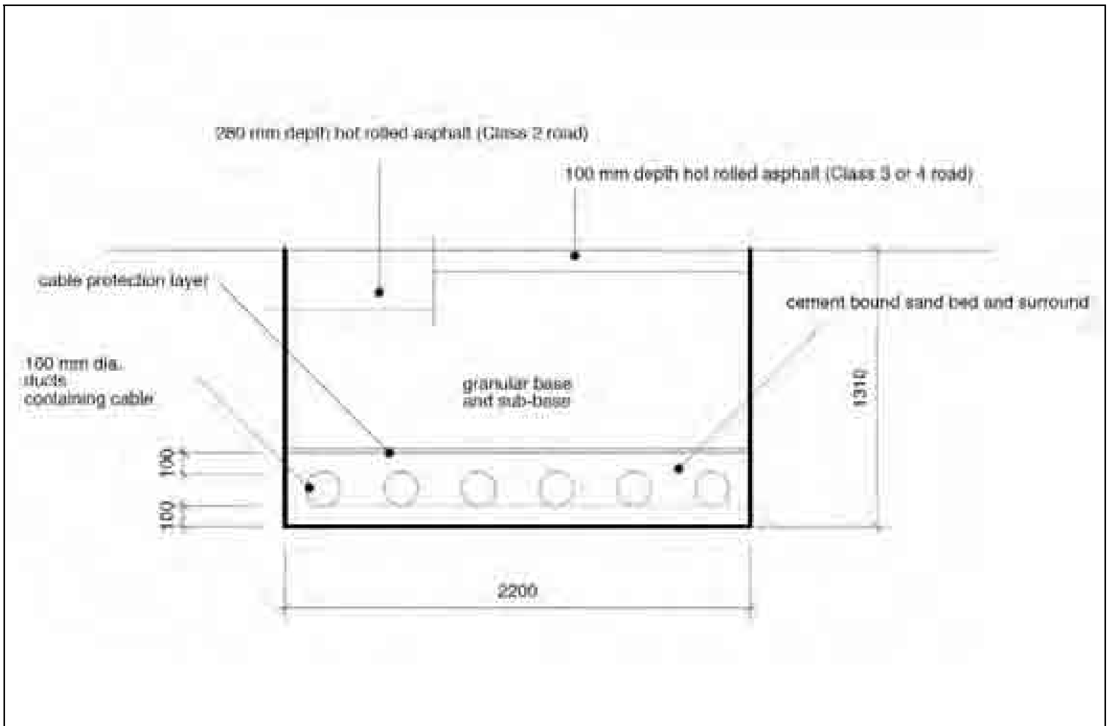
(source: Cambridge Landscape Architects)

Figure 3.5b Typical cable trench configuration – trefoil arrangement in the agricultural land



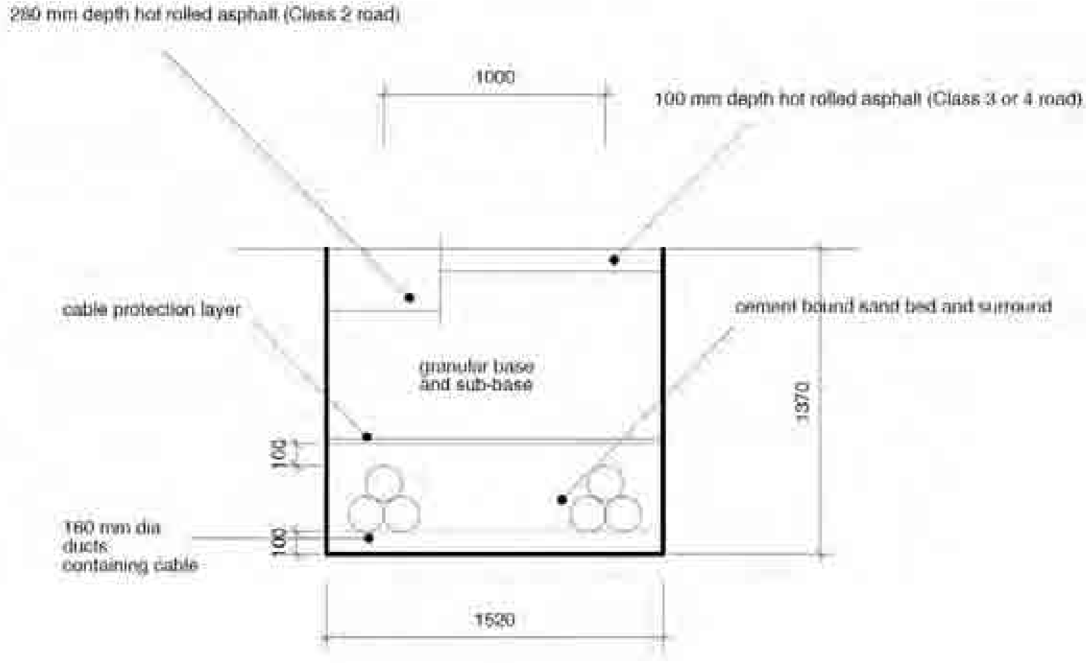
(source: Cambridge Landscape Architects)

Figure 3.5c Typical cable trench configuration - flat array in the Public Highway



(source: Cambridge Landscape Architects)

Figure 3.5d Typical cable trench configuration – trefoil arrangement in the Public Highway



(source: Cambridge Landscape Architects)

3.3.5 Cable jointing and cross-bonding

As already discussed in Section 2.4.2, each circuit of three cables would be laid in an arrangement of 'major' sections consisting of three shorter 'minor' sections. If these minor sections are not similar in length, voltages can be induced in the protective sheath of the jointing pit. To limit this, cables need to be laid in specific lengths, where each group of three minor sections are similar in length, with the variance between them minimised.

At each major and minor section, the three cables within each of the two circuits would be jointed together on site and buried within a jointing pit beneath the surface. Following construction, the area would be fully reinstated as no ongoing access is necessary. The jointing pits would require a wider trench excavation, approximately 3m in width, 7.5m in length and 2m in depth.

In addition, at each of the jointing locations, a process of cross-bonding is required whereby the earthing leads are connected remote from the jointing pit. The cross-bonding needs to occur within 10m of the joint and requires permanent access during the operational stage for maintenance. The cross-bonding is therefore installed within an inspection pit or pillar, which would be the only visible feature of the buried cable system, once reinstatement has occurred.

The preferred option will be to install cross-bonding pits, which would leave an exposed manhole, approximately 1m by 1m and small concrete marker post only. In some circumstances this is not considered the best option, due to the particular location of the cross-bonding. In these situations, pillars may be installed instead, which are approximately 1m in height and 1m in width. Cross-bonding is required for each of the two circuits, therefore at each minor section, there would be two cross-bonding pits or pillars.

In order to minimise restrictions to future agricultural (or other) uses of the land, these cross-bonding pits or pillars have been located at existing field boundaries (and ideally road crossings), wherever possible.

Examples of constructed cross-bonding pits and pillars are shown in **Plates 3.1 and 3.2**.

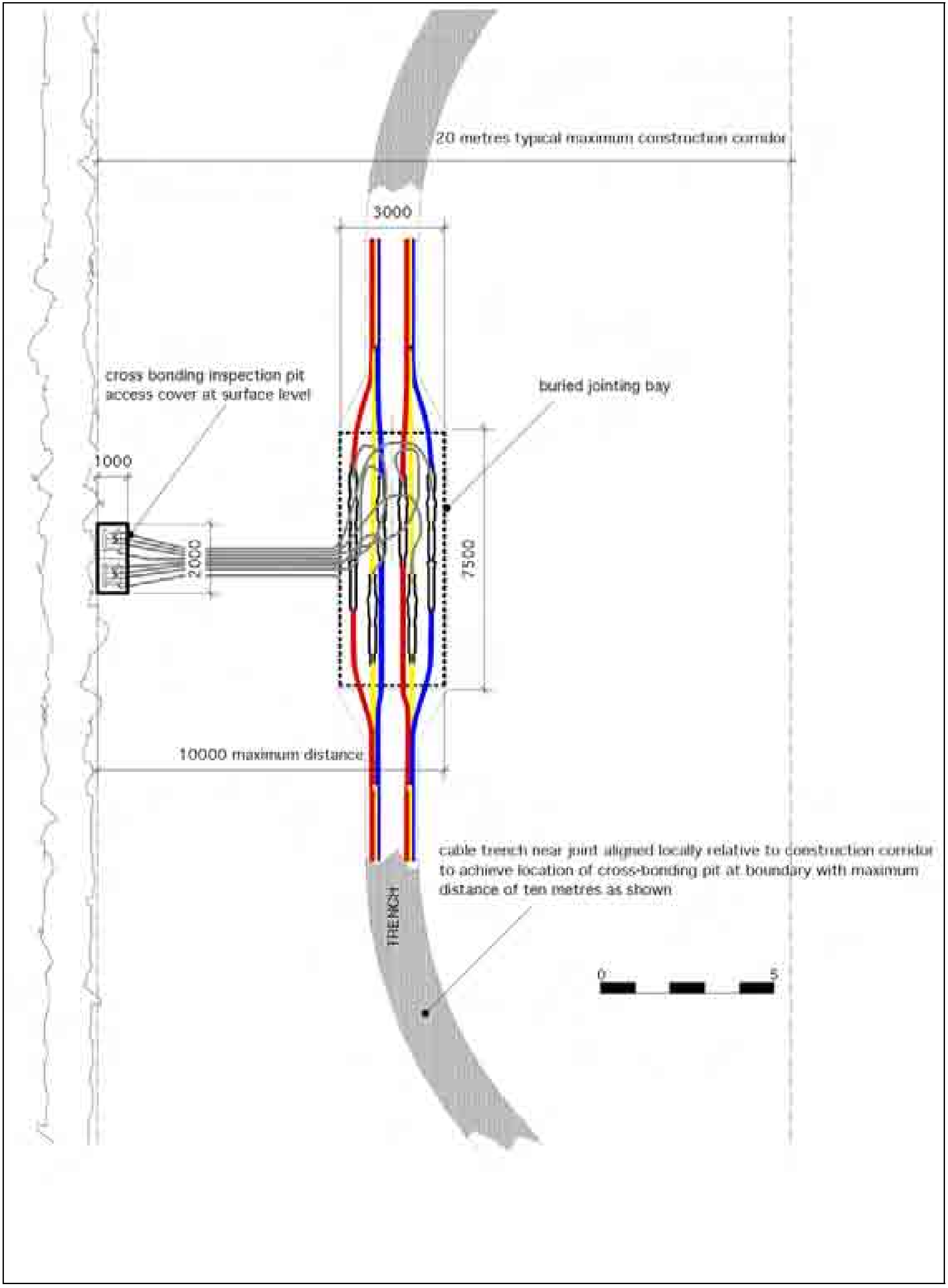
A typical arrangement for jointing is shown as **Figure 3.6**.

Plate 3.1 A typical cross-bonding pit link box and manhole

Plate 3.2 A typical cross-bonding link pillar

(pictures courtesy of Balfour Beatty Power Networks Ltd.)

Figure 3.6 Typical arrangement of jointing pit and cross bonding pits at each major and minor section

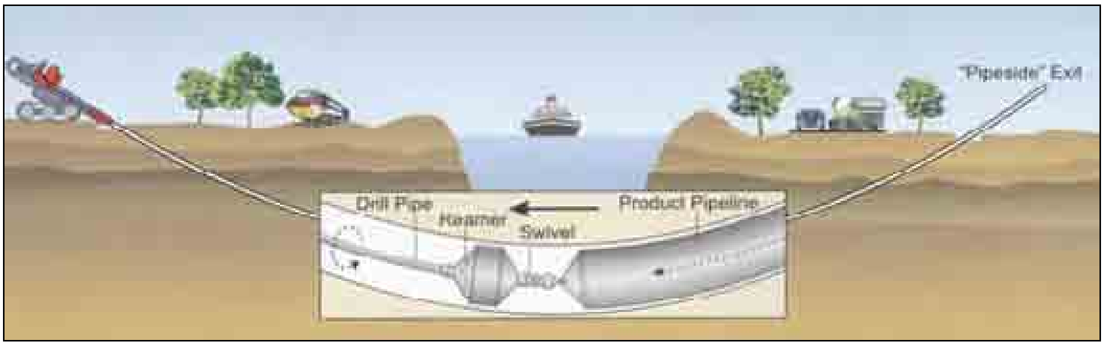


(source: Cambridge Landscape Architects)

3.3.6 Directional drilling

Underground cable installation across significant environmental or physical features and obstructions, such as major roads, railways, rivers and woodlands, can prove problematic in terms of open trenching. Directional drilling was developed in the 1980's from technology originally used in the oil industry to steer exploration bores during drilling and enables the avoidance of any surface impacts. A simplified illustration of the process is given as **Figure 3.7**.

Figure 3.7 Typical (simplified) directional drill arrangement



(source: Balfour Beatty Power Networks Ltd.)

Due to the nature of drilling, the depth below the surface of the buried cables is typically between approximately 1.5m and 4m, depending upon the characteristics of the site and topography, and the feature to be avoided or protected.

In order to ensure that the required thermal separation is achieved beneath the surface, the arrangement of cables requires a wider spacing beneath the surface. As with the open trench system, two scenarios are under consideration: a trefoil arrangement; and a flat array.

For the trefoil arrangement, each circuit consisting of the three smaller ducts would be installed in a larger duct or drill pipe. The two cable circuits would need to be separated by at least 3m. To ensure necessary thermal resistivity properties, grouting of the space between the smaller and large ducts could be required.

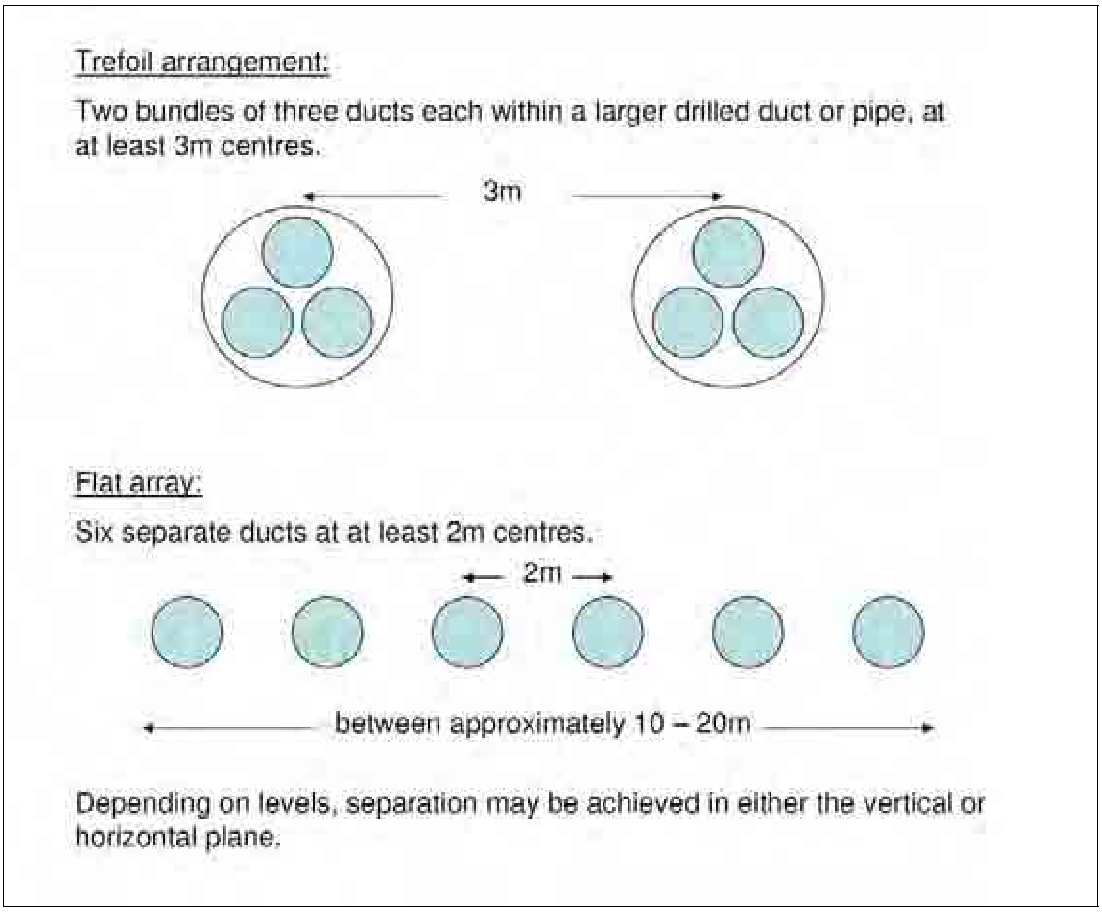
Using the flat array, each of the six cables would need to be separated at approximately 2m centres.

The two cable arrangements are illustrated in **Figure 3.8**.

There are four locations along the cable route, where directional drilling is proposed in order to avoid impact to surface features. These are discussed in turn below.

The directional drill construction process is discussed in detail within Section 3.7.

Figure 3.8 Two principle arrangements for spacing of ducts for directional drilling (in cross-section)

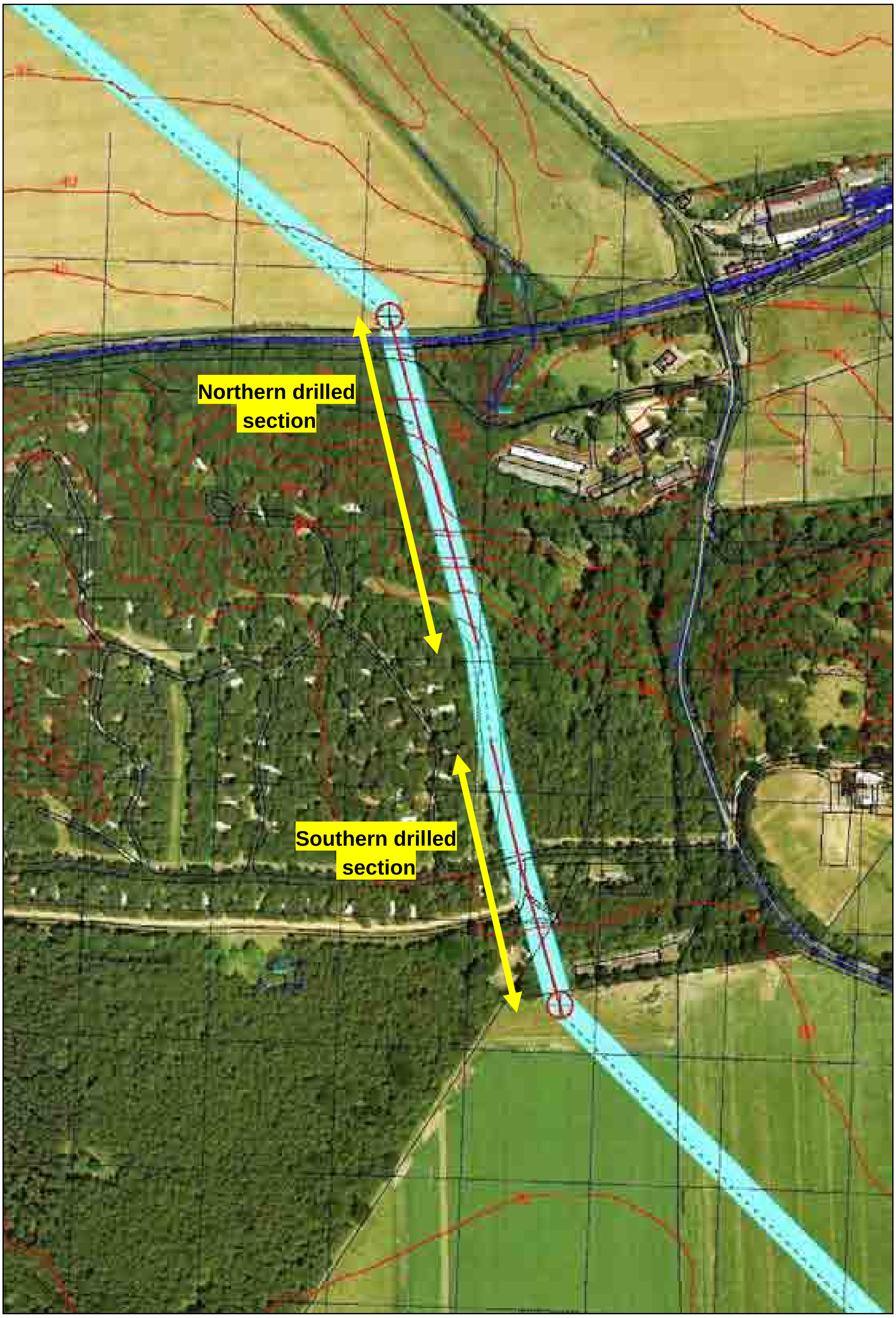


Drill 1: Poppy Line Railway and Kelling Heath Holiday Park

As discussed in Section 2: ‘Site Selection and Consideration of Alternatives’, it has been assessed for a number of environmental (natural, physical and social) and technical reasons, that the preferred option to cross the Cromer Ridge, located between Weybourne and Bodham, would be to drill beneath the Poppy Line Railway and the Kelling Heath Holiday Park, to the west of Sandy Hill Lane and the Weybourne Railway Station.

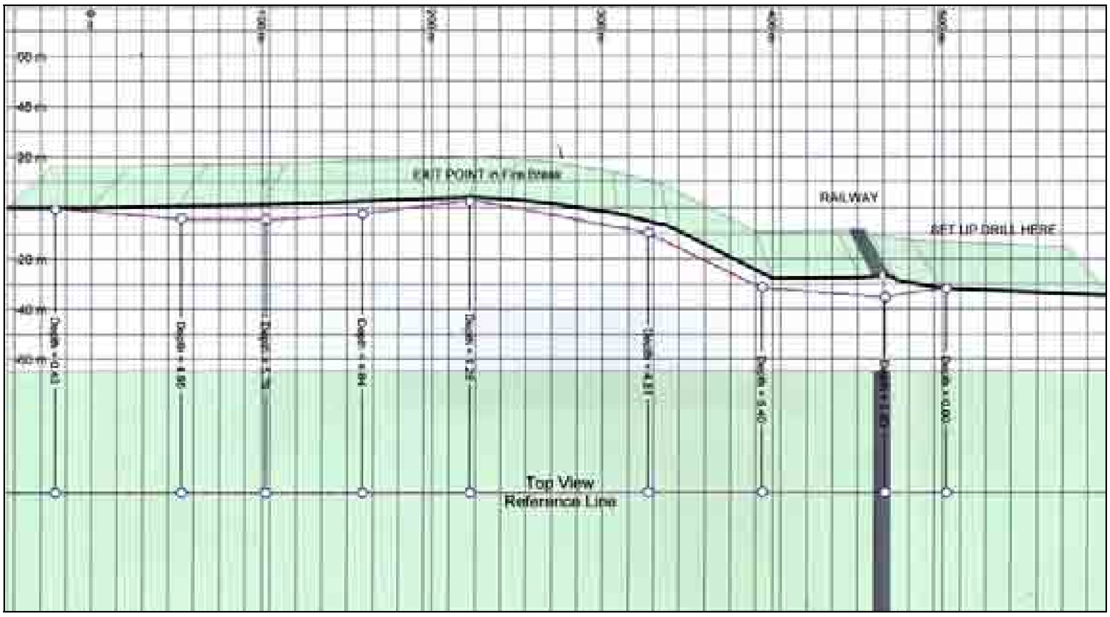
Due to the length of the drill, it is proposed that the drill is carried out in two stages, or ‘hits’. The northern drill section would be approximately 265m, and the southern drill approximately 220m. The two drilled sections would meet at the centre of the holiday park within an existing wide, grass strip, used as a firebreak. A short section of open trenching is also proposed within the firebreak to enable the two drilled locations to be connected. The route of the proposed drill is shown on **Figure 3.9**, which shows the Ordnance Survey map, overlain with the aerial photography. The proposed drill route in cross-section is given as **Figure 3.10**.

Figure 3.9 Proposed directional drill at Poppy Line Railway and Kelling Heath, plan view



(source: Cambridge Landscape Architects)

Figure 3.10 Proposed directional drill at Poppy Line Railway and Kelling Heath in cross-section



(source: A E Yates Trenchless Solutions)

Drill 2: Baconsthorpe Wood

The second proposed drill site is approximately 130m in length and located between Baconsthorpe and Lower Bodham. The drill is proposed in order to prevent any surface impact to the ecological and landscape value of the woodland and drainage channels running within it.

Drill 3: River Bure

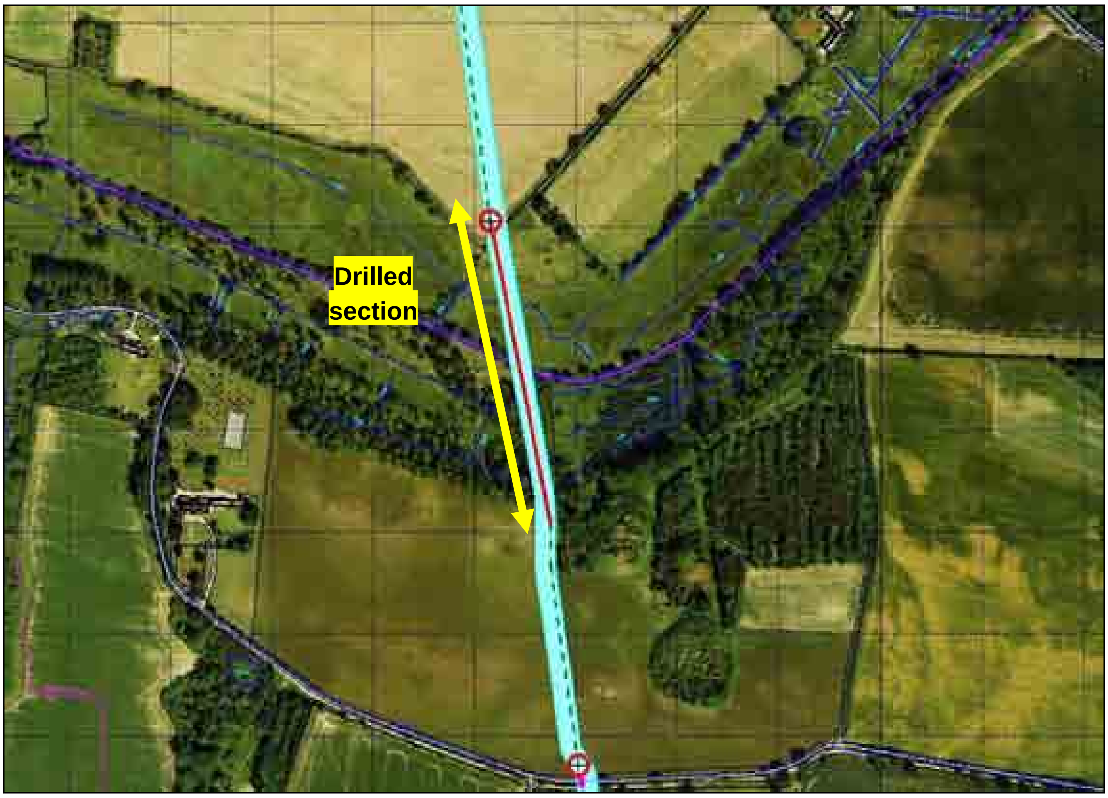
The cable route needs to cross the River Bure and it has been assessed that the preferred location is a point approximately 1.5km to the east of Saxthorpe and 2.2km to the west of Itteringham.

Although the river itself in this area is fairly narrow, it has a wide area of associated floodplain consisting of damp ditches, marshy grassland and wet woodland. The river and associated habitats also support otter (*Lutra lutra*) and water vole (*Arvicola terrestris*) which are both protected species (refer to Section 6: 'Nature Conservation and Ecology'). Therefore, due to these environmental sensitivities, and technical difficulties of open trenching in these unstable ground conditions, it is proposed that the River Bure, and its associated habitats to the north and south are directionally drilled.

The proposed drill would be approximately 300m in length.

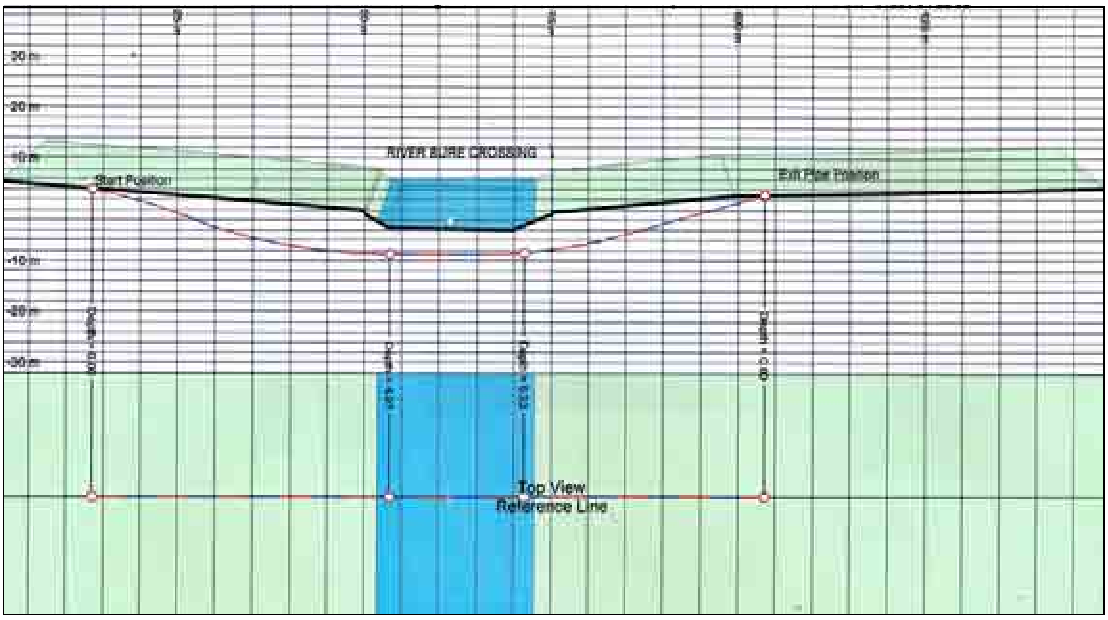
The route of the proposed drill is shown in plan view in **Figure 3.11** and in cross-section as **Figure 3.12**.

Figure 3.11 Proposed directional drill at the River Bure, plan view



(source: Cambridge Landscape Architects)

Figure 3.12 Proposed directional drill at the River Bure in cross-section



(source: A E Yates Trenchless Solutions)

Drill 4: Woodland East of Salle Park

The fourth and most southerly proposed drill site is located to the east of Salle Park, approximately 1.8km to the north north-west of Cawston. The length of drill at this location is approximately 220m. The proposed route involves drilling beneath a narrow belt of plantation, through which, an Internal Drainage Board (IDB) maintained drainage channel flows. Another drainage channel also flows along the southern boundary of the woodland and would also be included within the drill.

3.4 Description of the Scira Substation

3.4.1 Requirement

The electrical engineering design for the Sheringham Shoal offshore wind farm has identified a need for additional electrical plant and equipment to control and facilitate the supply of electricity from the wind farm to the grid. In order to achieve this, Scira is proposing to build and operate a new substation facility adjacent to the existing regional electricity grid substation at Salle, near Cawston, which is owned and operated by EDF Energy Power Networks Ltd. (EDFE).

3.4.2 Proposed location, layout and design

The process by which the preferred site, layout and design was established is discussed within Section 2: 'Site Selection and Consideration of Alternatives'.

Scira's proposed new substation would be located along the south-eastern boundary of the existing EDFE substation, approximately 0.5km to the west of Cawston and 2.5km to the east of Reepham. The site is currently under arable cultivation, with some parts currently agricultural set-aside. The site is bound to the north by the B1145 Cawston to Reepham road. Marriott's Way (a permissive path and cycle-way) is located approximately 50m to the south of the site.

The final design of the substation would be dependant on a number of factors, including the selected wind turbines to be installed offshore. For the purposes of Scira's application for planning consent, as well as the assessment of impact within this Environmental Statement, the proposed design is based on a realistic worse-case scenario, which entails the maximum amount of equipment at the maximum geometries. Based on this, the proposed substation would be made up of the following components:

- A 'Control Building' containing gas insulated switchgear (GIS) and control gear for the mechanical switching and management of the wind farms compensation system. The dimensions of the building would be 15.4m in width and 27.4m in length. The overall above ground height would be 8.0m with an eaves height of approximately 6.5m.
- An 'Ancillary Building' immediately adjacent to the control building would house a workshop, store room, toilet and shower room, mess room and office. The dimensions of the building would be 6.1m width and 16.0m length.
- Two outdoor shunt reactors (one for each cable circuit), which would be up to 5.0m in height.

- Eight outdoor three-phase capacitor banks (four for each cable circuit; 24 single stacks), each up to 3.9m in height.
- Space for additional outdoor harmonic compensation equipment (if required).
- Associated access, hard standings, security fencing and tree planting.

The location of Scira's proposed substation in relation to the proposed cable route and the existing EDFE substation is shown within **Figure 3.3** (Sheet 6).

The layout of the proposed substation is shown in **Figure 3.13**. Further detailed elevation plans showing the design of the buildings and layout of the associated equipment, along with landscape plans in relation to the existing topography and vegetation are provided and discussed in Section 9: 'Landscape and Visual Character'.

Control and ancillary buildings

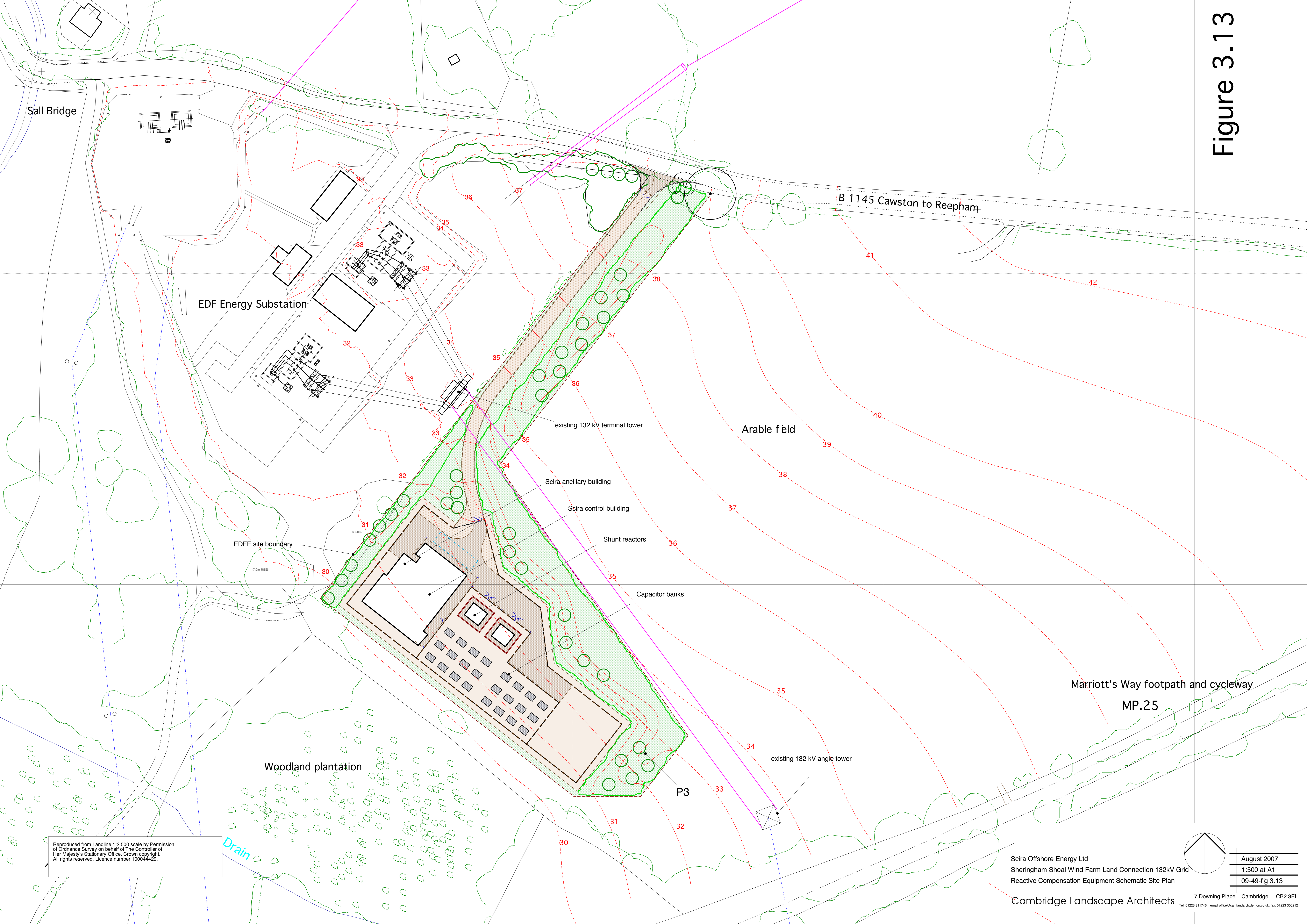
There are two buildings proposed within Scira's substation: the Control Building and an Ancillary Building. The upper elevations of the external walls and roof of both buildings would be constructed of corrugated fibre cement sheeting. The cable basement would have open galvanised steel mesh walls. Further information on the design of the buildings is provided in Section 9: 'Landscape and Visual Character'.

The main Control Building contains three separate sections: a switch room housing the gas insulated switchgear, a control room and a cable basement. The building would be 15.4m in width and 27.4m in length. The overall height, including the cable basement would be 9.0m, with 8.0m above ground, and an eaves height of approximately 6.5m.

The gas insulated switchgear inside the Control Building is required to accommodate the grid connection and reactive compensation circuits. It is assumed that two separate 132kV gas insulated switchgear sections would be required with each section containing a main incoming/outgoing bay, a reactor feeder bay and four capacitor bank feeder bays. Each of the two switchgear sections would be 6m in length and would require a 3m space between the two sections. This gives a total length of 15m for the switchgear sections to be installed. Additional control panels would also be required with the switchgear.

Although the external design of the Control Building is finalised, the internal equipment arrangement would not be confirmed until the detailed design stage (following consent). However in order to ensure adequate space has been retained, space has been allowed for local control panels and cubicles, metering cubicles, an uninterruptible power supply (UPS), batteries, supervisory control and data acquisition (SCADA) panels, plus a space allowance for any remote control and protection that might be necessary.

The cable basement provides a void beneath the control and switch rooms to provide a working area for handling of the large 132kV cabling and to accommodate the tray work for containing interconnecting control cabling. The basement has been sunk 1m below ground level in order to reduce the overall building height and because the cables would enter the building at approximately this depth.



Sall Bridge
EDF Energy Substation
B 1145 Cawston to Reepham
existing 132 kV terminal tower
Arable field
Scira ancillary building
Scira control building
Shunt reactors
EDFE site boundary
Capacitor banks
Marriott's Way footpath and cycleway
MP.25
existing 132 kV angle tower
P3
Woodland plantation
Drain
Reproduced from Landline 1:2,500 scale by Permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationary Office. Crown copyright. All rights reserved. Licence number 100044429.
Scira Offshore Energy Ltd
Sheringham Shoal Wind Farm Land Connection 132kV Grid
Reactive Compensation Equipment Schematic Site Plan
August 2007
1:500 at A1
09-49-fig 3.13
Cambridge Landscape Architects
7 Downing Place Cambridge CB2 3EL
Tel. 01223 311746, email office@camlandarch.demon.co.uk, fax. 01223 300212

Figure 3.13

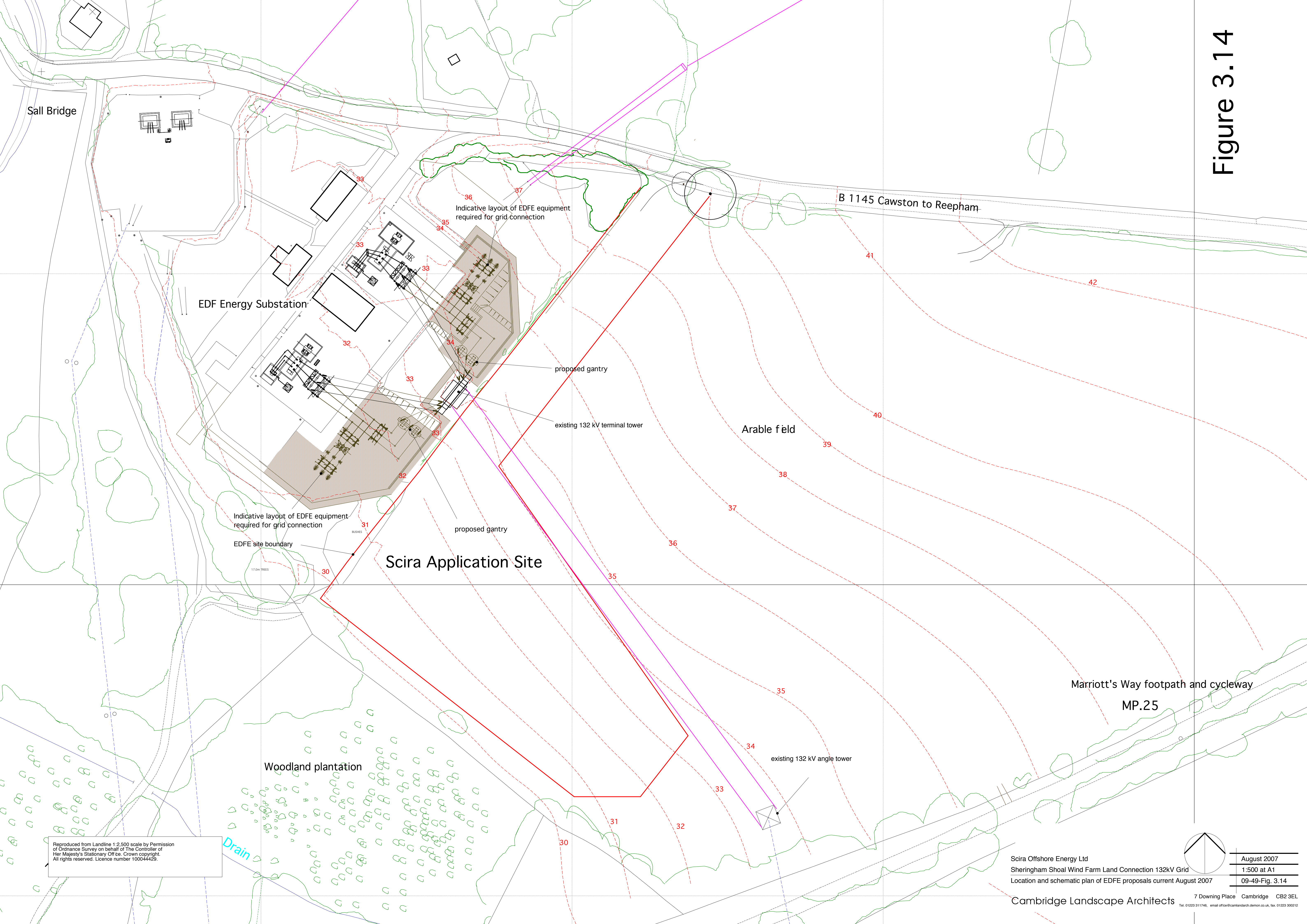


Figure 3.14
Sall Bridge
EDF Energy Substation
Indicative layout of EDFE equipment required for grid connection
B 1145 Cawston to Reepham
proposed gantry
existing 132 kV terminal tower
Arable field
Indicative layout of EDFE equipment required for grid connection
proposed gantry
EDFE site boundary
Scira Application Site
Marriott's Way footpath and cycleway
MP.25
existing 132 kV angle tower
Woodland plantation
Drain
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Scira Offshore Energy Ltd
Sheringham Shoal Wind Farm Land Connection 132kV Grid
Location and schematic plan of EDFE proposals current August 2007
August 2007
1:500 at A1
09-49-Fig. 3.14
Cambridge Landscape Architects
7 Downing Place Cambridge CB2 3EL
Tel. 01223 311746, email office@camlandarch.demon.co.uk, fax. 01223 300212

The Ancillary Building is would house a workshop, store room, toilets and shower room, mess room and office. The dimensions of the building would be 6.1m width and 16.0m length. This would be a lean-to structure on the side of the Control Building.

Reactors

Two shunt reactors are required: one for each cable circuit. The reactors are large items of plant in terms of dimensions (with a height of 5m) and weight. The reactors must be installed within a brick bunded compound to contain any oil spillage. The bund also acts as a barrier to maintain the relevant clearances required around the reactors. The bunded walls would be 8.0m width and 9.0m length and approximately 1.5m in height.

Capacitor banks

24 single phase capacitor stacks are proposed, which would form eight three phase capacitor banks (four for each cable circuits). Each capacitor stack is up to approximately 3.9m in height.

Harmonic compensation

An area has been retained for the provision of any future or additional equipment which may be necessary for the completion of the scheme, for example harmonic compensation equipment. It is likely that the area would be utilised during the construction phase for storage or compound facilities.

The area that has been reserved for this potential requirement is 23.7m by 20m. For elevation purposes, it is assumed that the height of the equipment would be approximately 5m in height.

Additional equipment/features

The substation would be enclosed within a fenced compound containing the external equipment outlined above, with the additional features:

- Interconnecting cables.
- Access tracks, gravel paths and hard standings.
- Security fencing.
- Earthworks and tree planting.

Further information regarding the design of the substation and the proposed landscaping is provided within Section 9: ‘Landscape and Visual Character’.

3.5 Description of EDFE Works in Salle Substation

In order to connect Scira's equipment and feed electricity from the proposed Sheringham Shoal offshore wind farm into the electricity distribution grid, it has been assessed that EDFE would need to install some additional equipment and make some modifications to the existing equipment within the existing Salle substation compound.

Works inside the Salle substation are to be constructed and operated by EDFE and do not form part of Scira's planning application.

For the purposes of the Sheringham Shoal onshore grid connection EIA, although not part of Scira's planning application, consideration has been given to the equipment to be installed by EDFE inside the existing Salle substation, where necessary and appropriate. For this reason a brief description of the additional and modified equipment required is listed below. Although the final details are not available, information on the construction and operation of EDFE additional equipment is also provided in Section 3.9 (Construction) and Section 3.13 (Operation).

EDFE works to connect Scira's equipment are shown on **Figure 3.14**, however it should be noted that these designs are not finalised and the drawing is for illustrative purposes only. In summary the works would need to include the following:

- Installation of two external steel gantries approximately 9m in height either side of the existing pylon on the south-eastern boundary.
- External electrical switching and connection apparatus up to approximately 6.5m in height.
- Potentially, the extension of an existing building to house control, protection and metering equipment.
- Retaining walls, fencing, shingle paths, associated earthworks and embankments.

3.6 Open Trench Cable Installation Construction Methodology

3.6.1 Ducted cable system

As noted in Section 3.3.3, Scira is proposing to install the cables within a ducted system. Therefore, the installation of cables would occur in two main stages. The first stage would involve the excavation of the cable trench, and installation of the UPVC/PE ducts, backfilling and reinstatement. The second stage would then involve the cables being pulled through the ducts and jointed. The cross-bonding would most likely occur at the same time as the cable jointing. The construction of parts of the route to be directionally drilled is discussed in Section 3.7.

3.6.2 Working area and site preparations

For the majority of the proposed cable system, the route is aligned through agricultural land (predominantly under arable cultivation, with some fields of grass). In order to maintain safe working within agricultural land, a corridor of 20m width is generally needed, based upon the following requirements:

- A trench width of up to 2.2m width for installation of the cable system, with sufficient space on either side for safety, and to protect the sides of the trench (at least 1m).
- A construction haul road of approximately 6m to allow the safe tracking of construction vehicles in two directions.
- Topsoil storage.
- Subsoil and imported material storage.
- Safety/landscape protection fencing.

This is illustrated in **Figure 3.15**, which shows a typical arrangement. The precise dimensions would vary according to particular site constraints and cable alignment within construction corridor.

In most cases, where the proposed cable route follows a field boundary, the alignment has been designed to locate the trench on the side furthest from the boundary in order to protect the root structure of any trees or hedgerows.

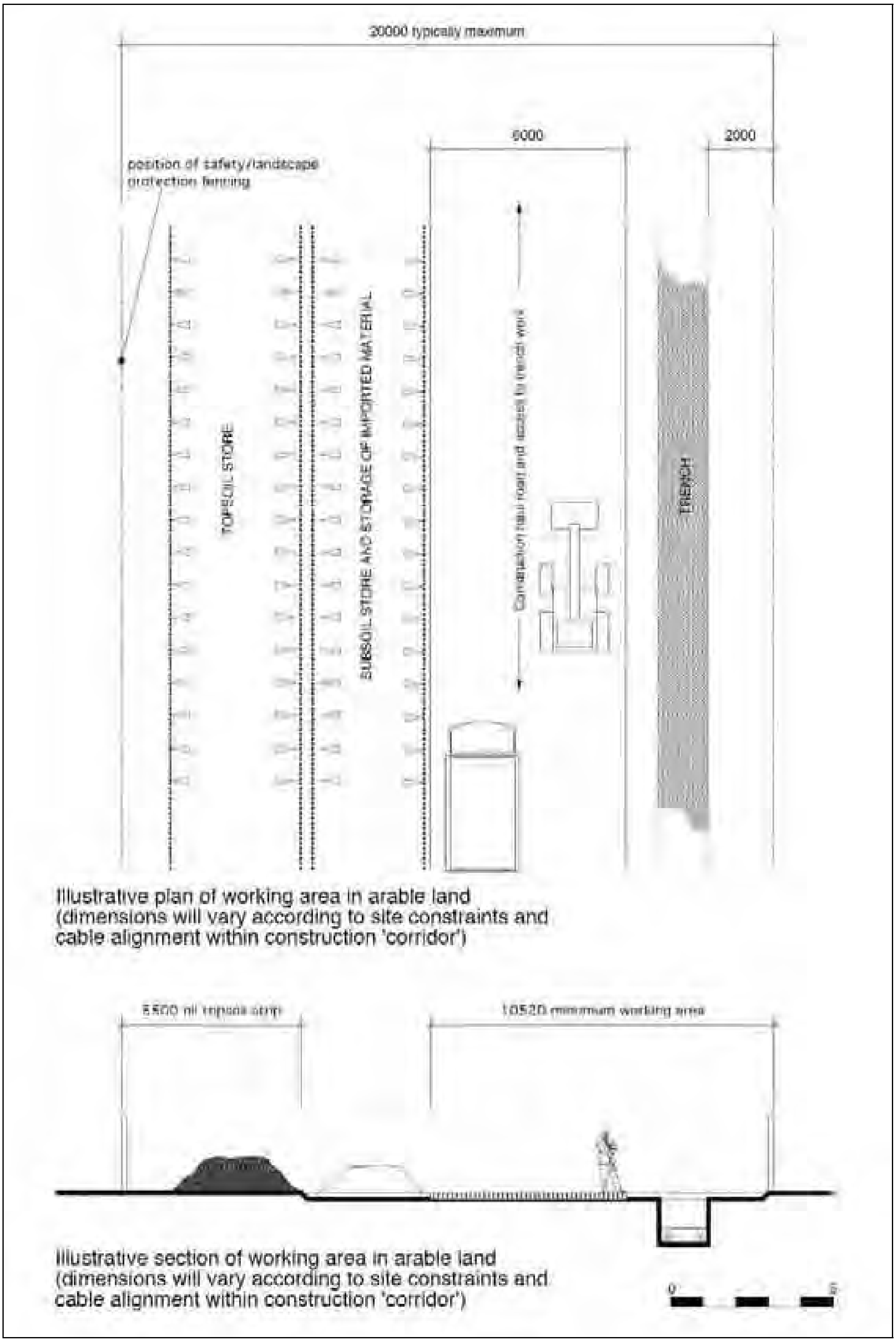
Although the presence of any significant service infrastructure (for example gas mains and overhead lines) has been established during the route planning stage, the Contractor would carry out the following to confirm the presence of any additional buried services:

- Consult existing service drawings to establish the presence of any buried services.
- If deemed necessary, incidental trial holes would be carried out along the route to record the depth of any services (or their protective tiles) and demarcate using marker posts.
- Prior to the works commencing, the cable route would be surveyed by trained and competent operative with a Cable Avoidance Tool (CAT) to locate buried services using radio frequency.
- For any identified services, the service owner would be consulted to agree a safe vertical distance between the service and the ducting to be installed and any other specific requirements.
- Once the Site Engineer is satisfied it is safe to commence, an Authorisation to Work would be issued.

It is possible to reduce the working width to approximately 10 - 11m in limited stretches, where required, by not storing top-soil or subsoil/imported material within that particular section. This method would only be carried out where necessary as it would reduce the speed of construction. An example of where this may occur is where the route is aligned across an ecologically significant hedgerow (refer to Section 6: ‘Nature Conservation and Ecology’).

The working corridor would be suitably fenced; the type of which would depend upon the farming activities and discussions with the landowner.

Figure 3.15 Illustrative arrangement of typical working area in farm land (plan and section)



(source: Cambridge Landscape Architects)

Tests along the route of the cable would be carried out at regular intervals to measure the subsoil's thermal resistivity properties. The results would be assessed to determine whether the subsoil is suitable for using as back-fill around the cables, or whether a cement-bound sand is required. The requirement is likely to be variable along the route of the cable, depending on the differing soil characteristics.

The Contractor would be responsible for ensuring the protection of the topsoil and reinstating the ground to its former condition following the construction phase. Generally, top-soil would be stripped from the working corridor using a mechanical excavator and stored to one side in the area allocated. The topsoil would not be stripped from the actual topsoil storage strip, as illustrated on **Figure 3.15**.

In most cases, the construction haul road along the working corridor would require no additional preparation, other than topsoil stripping. However, in certain circumstances, such as poor ground conditions, temporary surfacing, such as hardcore, geotextiles or re-useable plastic surfacing may be necessary. In some locations, it may only be necessary to strip the topsoil from the actual trench width, with the remaining working corridor being protected by means of temporary surfaces to protect the underlying soil structure.

Access to the working corridor is discussed in Section 3.6.12.

3.6.3 Cable trench excavation, ducting and backfilling

Once the working corridor has been prepared as described above, excavation of the cable trench would commence using a mechanical excavator (approximately nine tonnes (t)). Details of the cable trench width and depth would be as discussed in Section 3.3.4. Dumpers would be used to transport material to and from storage areas and a grab wagon (typically 24t) used to collect spoil or deliver materials. Any surplus spoil would be taken off site and disposed of in accordance with the Contractors' waste carrier licence. It would be the Contractor's responsibility to ensure that the nominated waste disposal sites to be used for disposal are appropriately certified.

A banksman would be in attendance to instruct the excavator operator accordingly. Excavated subsoil would be stored in the area allocated at a safe distance from excavations to eliminate overburden of the trench sides.

Care would be taken to ensure that the trench base is even and the sides are battered or supported to prevent collapse. If required, close or skeleton timbering would be carried out to support the sides trench. Steel or timber cross-supports, or struts, would also be installed, as shown in **Plate 3.3**.

Once the cable trench has been checked and is ready, a layer of either subsoil (if thermal resistivity properties are suitable) or a cement-bound sand will be applied to the trench bed.

The ducts would be delivered to site in 6m lengths, usually on a low-loader (or flat-bed HIAB wagon). The ducts for the power and fibre optic cables would then be laid within the trench according to the finalised trench profile plans (discussed in Section 3.3.4). The site foreman would supervise and instruct the installation of the ducts to ensure the

Plate 3.3 Timber shuttering to protect trench (if required)

(photograph courtesy of Balfour Beatty Power Networks Ltd.)

correct spacing and configuration is applied. The duct sections are generally joined together using a 'push-fit' system. The ducting arrangement at the end of each minor section would be aligned to facilitate the cable pulling and jointing stage, as shown in **Figure 3.6**.

Once the ducts are in place, the trench would be backfilled, with either subsoil or a cement-bound sand and compacted to a level 100mm above the ducts. Protective cable tiles and marker tape would then be installed.

Subsoil and topsoil reinstatement would then take place in accordance with a programme confirmed by a consultant prior to the works in terms of timing and conditions.

The process of trenching, duct installation and reinstatement is expected to occur at a rate of 40m per gang per day. During bad weather conditions this could be reduced to 30m per gang per day. Depending upon the Contractor, several gangs are likely to operate along the cable route at any one time.

It is envisaged that trenches would generally be excavated, ducted and backfilled on a daily basis, leaving only the head of the trench open to provide sufficient ramp egress. If trenches do need to be left open overnight, each section of trench would have one ramped end in order to facilitate the escape of any wildlife, such as badgers. Adequate pumps would be provided to ensure that the trench is maintained in a fit condition to work in. Trenches would also be inspected for safety each day prior to commencement of works.

3.6.4 Installation of cables, jointing and cross-bonding

The installation of the cables would occur as a separate phase of works and would be carried out as follows:

- The cables would be installed in minor sections, as already discussed.
- At the end of each minor section, the topsoil and subsoil would be re-excavated and stored separately, down to the duct levels.
- A pulling pit surrounding the duct joints would be excavated and would need to be approximately 3m in width, 7.5m in length and 2m in depth. The pulling pit would be timbered for support.
- If necessary, the pulling pit would be pumped of any water using a diesel pump and any debris cleared from the bedding material.
- Cables would be delivered to site on drums. Two drums would be loaded on to a low-loader (or flat-bed HIAB wagon) for delivery to site.
- Once at the site, the cable drums would be off-loaded into position by crane adjacent to each pulling pit. The cable drums would be jacked up onto ‘A’ frames with the use of hydraulic jacks and the protection removed.
- A bond would be fed through the ducts from the other end to the cable drum.
- The bond would then be attached to the nose of the cable and would be pulled back through the duct using a heavy duty 10 tonne winch. Care would be taken to ensure that the maximum weight on the cable is not exceeded.
- Once in position, the bond would be cut and the cable position corrected by hand.
- This process would be repeated for each of the six power cables and each of the fibre optic communication cables.
- The cables would be physically jointed together. Following this a casing would enclose the joint and would be filled with standard joint resin to seal air gaps. **Plate 3.4** illustrates a partially buried jointing pit.

Plate 3.4 Partially buried jointing pit

(photograph courtesy of Balfour Beatty Power Networks Ltd.)

The cross-bonding chamber would usually be constructed off-site by the manufacturer and delivered as a complete unit. As already noted, it is proposed that the majority of cross-bonding is installed within buried pits, rather than pillars. For the former option, a brick pit would be constructed on a concrete base and backfilled around. Following installation a manhole cover would be put in place and a marker post installed.

Once cable jointing and cross-bonding is completed, all land would be reinstated to its former condition.

The cable installation for each minor section (all six power cables and fibre optic cables) would take approximately nine days, including set-up. Cable jointing and cross-bonding would take approximately 14 days at each cable section.

3.6.5 Public Highway crossings

The proposed cable route crosses the Public Highway in 21 locations, as shown on **Figure 3.3**. In one of these locations (Road Crossing No.4, adjacent to Bodham Wood along Sandy Hill Lane), the route is aligned within the carriageway itself for approximately 92m.

The installation of the ducts within the carriageway would follow a similar process as already outlined for route sections within agricultural land, with some exceptions, as discussed below:

- Survey and assessment to identify any buried services, as before.
- A pre-construction photographic record would be carried out to ensure the road is fully reinstated to its former condition.
- The working width required to cross the boundary features either side of the road crossings would be reduced to approximately 10m, by removing the storage areas.
- Depending upon the width of the road, either full or partial closures would be required, as discussed below.
- The road surface and subsoils would be removed by trencher and mechanical excavator to a depth and width as shown in Figures 3.5c and 3.5d. Excavated material would be temporarily stored within the agricultural working corridor either side of the road crossing or alternatively taken straight away by wagon for off-site disposal.
- Ducts would be laid and covered with a cement-bound sand and protective tiles, as before. Cement-bound sand would be a definite requirement. A cover of 900mm would be retained between the protective tiles and surface level. The remaining trench would be in-filled with an imported granular sub-base backfill material.
- The road surface would be reinstated with either 100mm or 280mm hot rolled asphalt, depending upon the road class. Plant material required for reinstatement would include a 50kg Wacker and a 1400kg Vibrating Trench Roller.

- Verges and hedgerows on either side of the crossings would be fully reinstated and/or replanted.
- A post-construction photographic record would be carried out and the results presented to the Norfolk County Council Highways Authority for their sign-off.
- The installation of the ducts along Sandy Hill Lane (road crossing No.4) would follow a similar process. The excavations would be contained within the carriageway to avoid any detrimental impact to the adjacent verges, hedgerows and Bodham Wood.
- Unless cross-bonding is located on the road side, no further disruption would occur during the cable installation phase of works.

The method for traffic management during construction within the Public Highway is dependant upon the width of the road. Where a road is less than 6.75m in width, a complete temporary closure of the road would be necessary during the cable trenching, ducting and backfilling stage, as illustrated in **Figure 3.16**, in order to maintain safety for both the construction team and road users.

Under the New Roads and Street Works Act 1991 (NRSWA), the Contractor would need to obtain Temporary Traffic Orders, relating to temporary road closures, diversions and reinstatement with the Highway Authority, in this case Norfolk County Council (NCC). Suitable diversions would be planned and appropriate signage erected. Road closure signs and barriers would be placed at either side of the working corridor, however the actual road closures would be implemented between accessible junctions.

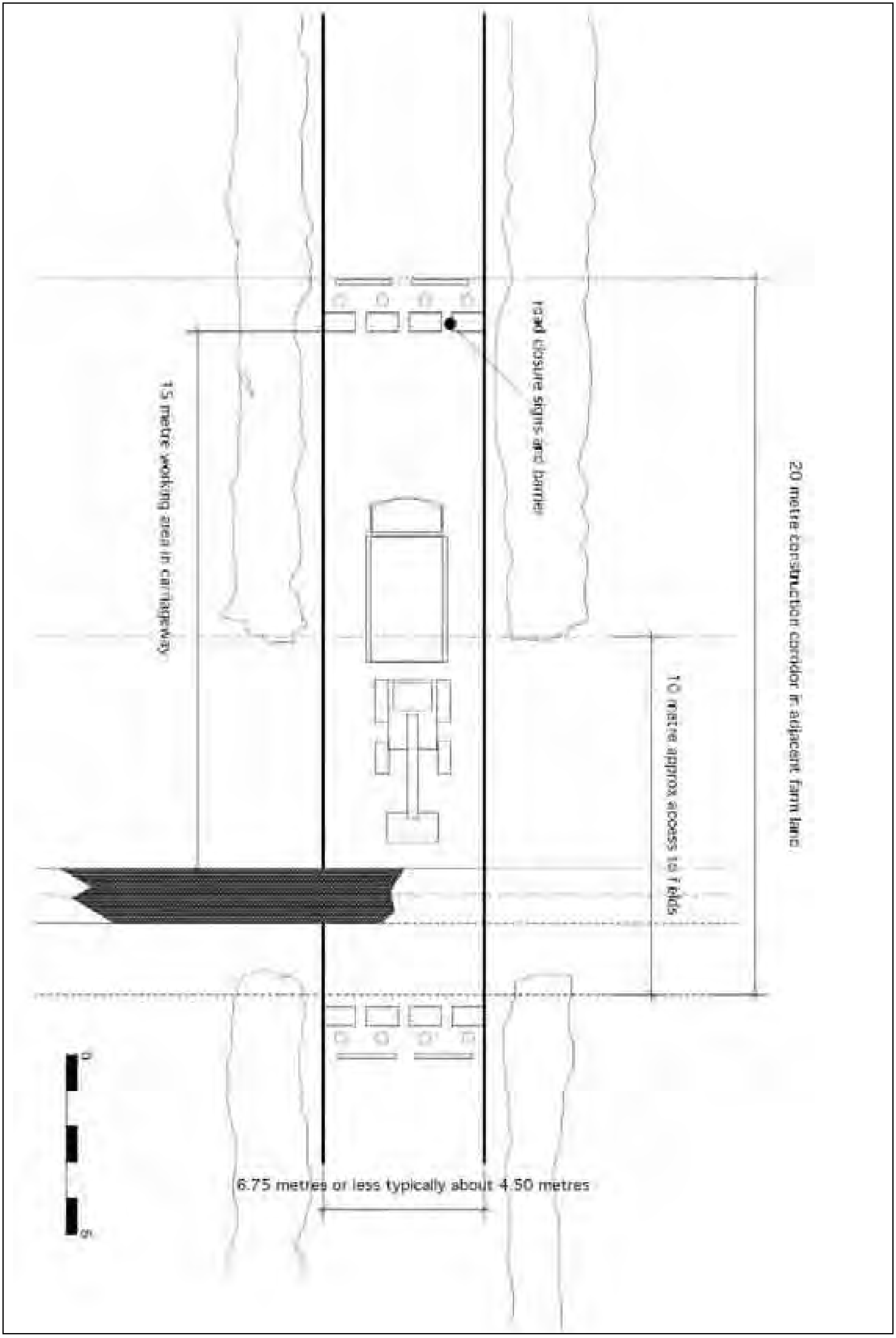
Where the road is wider than 6.75m it would be possible to maintain one-way traffic, as illustrated in **Figure 3.17**. Traffic management would involve temporary traffic lights, cones and signage to facilitate a shuttle-system. Consultation would be carried out with NCC Highways Authority to discuss and agree upon the arrangements for traffic management.

It has been assessed that the majority of the 21 crossing points would require full closures. The exception to this is at the A148 Cromer – Holt Road (Road Crossing No.5), and at the B1149 (Road Crossing No.17), where it is expected that one-way traffic could be maintained. Some minor temporary road widening is likely to be required along one side of the road in order to achieve the sufficient width of 6.75m. Any temporary widening would be fully reinstated to its former condition following the construction works.

The locations of each of the 21 crossing points are shown on **Figure 3.3**.

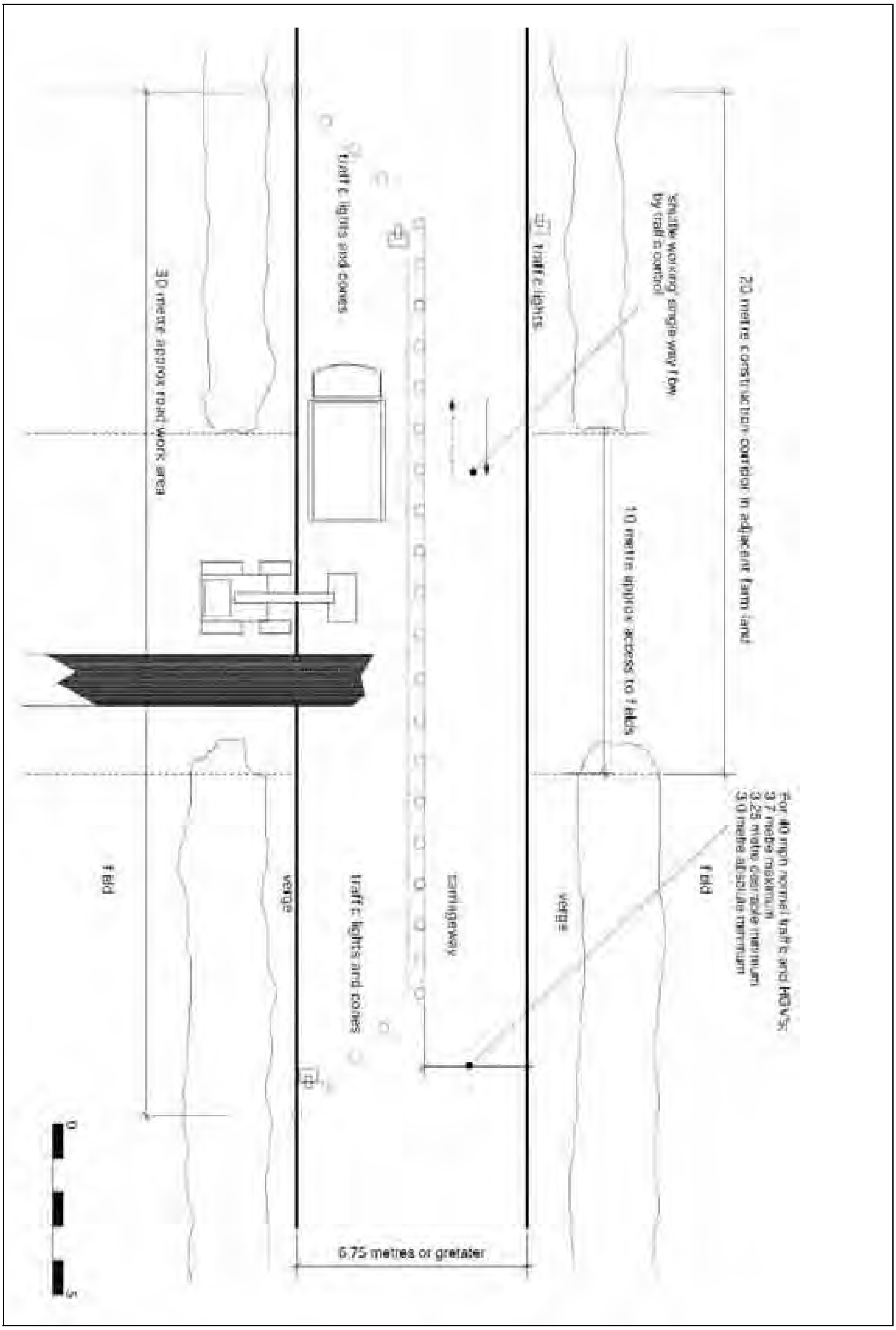
The expected duration of the works has been estimated for each of the 21 crossing points. One of the advantages of the proposed ducted system, is that once the cable ducts are installed and the road surface reinstated, there would be no requirement for any re-excavations of the carriageway to install the actual cables. Where cross-bonding is proposed in the road verge, there may be a requirement for further temporary road closures or traffic management, however in the majority of cases, where cross-bonding is located at interfaces with the Public Highway (an advantage during the operational and maintenance stage) the actual pit or pillar would generally be installed on the field side of the road boundary.

Figure 3.16 Illustrative arrangement of typical traffic management and working trench width to cross Public Highways less than 6.75m in width



(source: Cambridge Landscape Architects)

Figure 3.17 Illustrative arrangement of typical traffic management and working trench width to cross Public Highways more than 6.75m in width



(source: Cambridge Landscape Architects)

The installation of the cable ducts across the majority of the smaller road crossings is expected to be completed during one shift, with final road surface reinstatements taken place during a second shift. In some situations it may be possible to complete all duct installation and reinstatement works in one shift. Several of the more significant road crossings would take up to three shifts. The installation of the cable at Road Crossing No.4, where the route is aligned along the carriageway for approximately 92m, is expected to take between three and six shifts. Temporary surfacing would be provided in the interim period between shifts at all road crossings.

Consultation has been carried out with the NCC Highways Authority to discuss the 21 road crossings needed and to agree, in principal, any restrictions and preferred timings required to limit impact to the road network. **Table 3.1** summarises the expected duration of works to cross each of the 21 crossing points, along with any requirements in relation to road closures, diversion planning or traffic management, specified by NCC Highways Authority.

It was agreed that suitable diversion routes would be planned during the detailed design stage, following consent, however where specific requirements were specified, these are noted in the table. Diversion routes would need to be equivalent in class to the road being closed, however it is noted that local community familiar with the local road network would often use alternative diversions. Prior to works commencing all details would be formally agreed between the Contractor and the Highways Authority. This would consider the co-ordination of each of the road closures required.

Along with any general timing restrictions outlined in **Table 3.1**, detailed planning of any closures and diversions would avoid coinciding with any other periods of peak activity, such as bank holidays, school holidays and other events, in liaison with the Highway Authority. In several locations, the road crossings are listed as primary emergency routes and/or scheduled bus routes (detailed in **Table 3.1**). Where this occurs, additional consultation would be necessary to inform, propose and agree appropriate diversion routes.

3.6.6 Other public access crossings

The proposed cable system crosses 12 Public Rights of Way (11 Public Footpaths and one Public Bridleway), the Holt-Mannington Circular Path, and the Baconsthorpe Castle permissive path. Three of the Public Footpaths would be directionally drilled. Temporary closure and diversions would be necessary during construction in these locations. The temporary closure of the Norfolk Coast Path (a National Trail and Public Footpath) would also be necessary in relation to the cable installation across the low cliffs at Weybourne, however this is covered within the application to DBERR. Details of all public access likely to impacted by the construction of the onshore grid connection are discussed in Section 12: 'Land Use, Local Community, Tourism and Recreation'.

Liaison would be carried out with the Norfolk County Council Public Rights of Way officer in order to plan suitable diversions. Temporary Closure Notices to facilitate any required closures and diversions would be obtained in consultation with Norfolk County Council Highways Authority.

Table 3.1 Timing, duration and proposed traffic management at each Public Highway crossing point

Crossing number	Road name	Expected duration	Closure / traffic management	Timing restrictions and other requirements / comments
R01	A149	2 shifts	Closure	Either: • night-time closures, avoiding June to August inclusive, with mitigation to two residential properties adjacent to road-crossing; or • day time closure avoiding April to October inclusive. NB. Road is a primary emergency route and a scheduled bus route.
R02	Holgate Hill	1 - 2 shifts	Closure	No specific restrictions or requirements identified. NB. Road is a primary emergency route.
R03	Sandy Hill Lane	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R04	Sandy Hill Lane (route within carriageway for approx. 92m)	3 - 6 shifts	Closure	Either: • night-time closures avoiding June to August inclusive; or • day time closure avoiding April to October inclusive. NB. Night-time closures would be preferred, however this would take 5-6 shifts. If day-time closures are acceptable, construction period could potentially be reduced to 3 days.
R05	A148 Cromer – Holt Road	2 - 3 shifts	One-way traffic management	Either: • night-time works avoiding June to early September; or • day time works avoiding late March to September inclusive. One-way traffic management could be achieved with minor temporary road widening works using the southern road verge, with full reinstatement following the construction phase. NB. Road is a scheduled bus route.
R06	Unnamed road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R07	New Road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R08	Gresham Road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R09	Church Lane	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R10	Northfield Lane	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R11	Church Street, Plumstead	1 - 2 shifts	Closure	No specific restrictions or requirements identified by NCC. Night-time works may not be suitable due to number of residential receptors. NB. Road is a scheduled bus route.
R12	Unnamed road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R13	Unnamed road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R14	C593 (previously B1354)	1 - 2 shifts	Closure	Avoid closures during June to August inclusive. On route to Blickling Hall – timing of closure would be timed to avoid key events. NB. Road is a scheduled bus route.
R15	The Walk	1 - 2 shifts	Closure	No specific restrictions or requirements identified.

Crossing number	Road name	Expected duration	Closure / traffic management	Timing restrictions and other requirements / comments
R16	Spink's Lane	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R17	B1149	2 - 3 shifts	One-way traffic management	Either: • night-time works avoiding any key dates or holidays, with mitigation to two residential properties adjacent to road-crossing; or • day time works avoiding June to August inclusive. One-way traffic management could be achieved with minor temporary road widening works using either road verge, with full reinstatement following the construction phase. NB. Road is a primary emergency route and a scheduled bus route.
R18	Unnamed road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R19	Unnamed road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R20	Unnamed road	1 - 2 shifts	Closure	No specific restrictions or requirements identified.
R21	B1145	2 shifts	Closure	Night-time or day-time closures. Due to Heavy Goods Vehicles (HGVs) using this route, the official diversion would need to be via Norwich (using B1149, A140 ring road, A1067, then B1145 to Reepham). If works are programmed during night-time, NCC may be able to consider a shorter diversion. NB. Road is a primary emergency route and a scheduled bus route.

3.6.7 Watercourse crossings

The proposed route crosses one Environment Agency 'Main River' (the River Bure) and one Internal Drainage Board (IDB) watercourse to the east of Salle Park. It is proposed that both of these features are directionally drilled, the construction process of which is discussed further in Section 3.7. Due to their Main River/IDB status respectively, and as discussed further in Section 3: 'Legislative Context and the EIA Process, consent under the Land Drainage Act 1991, will be required for both of these crossings points. Two other drainage channels associated with Baconsthorpe Wood would also be crossed by means of directional drilling.

In addition to these watercourses, the proposed cable route crosses several other drainage channels. In these locations, in order to install the cable ducting, the channels would be dammed by means of ditch clay and straw bails. A pipe and/or pump would be used to ensure any flow of water is maintained during the cable installation process.

Substrate excavated from the channel bed, topsoil from the bank-sides and then subsoil would all be carefully segregated and stored separately. Following the installation of the ducts, the bank-sides and substrate would be fully reinstated. Adherence would be made at all times to the Environment Agency's Pollution Prevention Guidelines (PPGs) as discussed in Section 3.15.

Additional mitigation to minimise potential impacts to surface water features and ecological receptors are discussed further within Section 6: 'Nature Conservation and Ecology' and Section 8: 'Geology, Hydrogeology, Hydrology and Land Quality' respectively.

Information from the landowner relating to any underground land drains would be sought prior to excavations. Should any unknown underground drainage systems be encountered during the excavations, these would be fully reinstated.

3.6.8 Existing service crossings

As already discussed, the Contractor will locate the presence of any underground services prior to any excavation works taking place, demark with marker posts and agree a safe (vertical) distance to be maintained between the existing service and the new cables to be installed.

Due to the military history of the northern part of the study area (between the landfall point at Weybourne and Bodham), provision would also be made for the specialist detection of any unexploded ordnance.

It is known that the proposed route crosses four gas main pipelines. The location of these pipeline crossing points are shown on **Figure 3.3**. The following additional precautions would be carried out with respect to gas main crossings:

- As required by National Grid Transco (NGT), the route has already been aligned to cross these locations at no less than a 45 degree angle;
- A detailed method statement for crossing the four gas main pipelines would be agreed with NGT in advance;
- An NGT Engineer would locate the precise position of each of the gas mains by cathodic location methods and mark the surface using spray paint. Any indication of depth (if available) would also be recorded;
- The NGT Engineer would confirm (vertical) clearance required between the proposed cable ducts and the existing gas main and the distance from the gas main which will require hand-dig excavations only;
- An NGT Engineer must be on site at the time of excavations. At least seven working days notice prior to the excavations would be given to NGT;
- Trial holes would be carried out to positively locate the pipeline including depth; and
- Depending upon the depth of the pipeline the NGT Engineer and the Contractor would agree whether the new cable ducts are to be installed above or beneath the existing pipeline, taking into account clearances. At this stage, it is expected that the four gas main pipelines are installed approximately 4m below the surface and that the cable ducts would be able to be installed above the pipelines.

The proposed route also passes alongside and beneath numerous 11kV and 33kV pole-mounted electric power lines. Once the locations of these lines have been established by the Contractor, heights and voltages of each of the lines would be obtained along with land profile information. Safety 'goal-posts' would then be erected to ensure that safe working distances are maintained. Restrictors would be installed on excavators and certificated where the reaching arm is at its highest point before it conflicts with the safety working distance.

3.6.9 Reinstatement and notifications

Following completion of the cable system installation, the Contractor would be responsible for reinstating the working area to its previous condition. This would include:

- Reinstatement of any underground drainage systems encountered during the works.
- Reinstatement of surface water-course substrate and bank-sides at any drainage channel crossing points.
- Reinstatement of topsoil.
- Re-seeding of any fields of grassland, grass margins and ditch banks.
- Re-planting of hedgerows removed.
- Reinstatement of carriageway.

On completion, the Contractor would provide final 'As Built' drawings to Scira, showing the precise alignment of the final buried cable system. Scira, as a Statutory Undertaker, would maintain the record. 'As Built' documentation will be provided to EDFE.

Quarterly Highway Authorities and Utilities Committee (HAUC) meetings would be attended by Scira, or their representatives, to be kept involved and informed of any future proposed works which could affect the integrity of the cable system, for example new services to be installed and road works in area of Highway crossings.

3.6.10 Site compounds

The majority of materials would be stored within the working corridor of the cable route, however the Contractor would also require two or three main compound sites along the route of the proposed cable route to store plant, equipment, fuel bowser, secure steel container and other materials and provide necessary facilities for site staff (e.g. mess hut, toilet facilities, overnight security accommodation). The sites would need to be securely fenced and would most likely be subject to overnight security.

Site visits carried out during the route planning and EIA working determined that there are several suitable opportunities for these compound sites in the area of the proposed cable route, consisting of existing industrial storage facilities, large farm yards and an airfield at Oulton. The Contractor would identify suitable locations for compounds and agree terms with the relevant landowner during the detailed site planning stage. As discussed, it is envisaged that existing industrial locations (and site access points) would be utilised wherever possible.

If compounds are required on non-industrial use sites, for example on agricultural land, suitable ground preparations would occur to protect the soil structure. Full site reinstatement would be carried out on completion of the construction phase.

3.6.11 Construction lighting

The construction of the onshore cable system would be primarily constructed during daylight hours (refer to Section 3.10.1) and would therefore require no lighting.

Where the route crosses the local road network, in certain locations, as discussed in Section 3.6.5, it would be preferable to install the cable ducts and reinstate the road surface overnight. In these situations, flood lights would be necessary. Where overnight road crossings are required in the vicinity of residential receptors (for example at road crossings R01 – A148 and R17 – B1149), measures to protect the amenity of residents would be necessary. These would be discussed and agreed in consultation with the District Environmental Protection Team and the affected residential receptors.

With the exception of security lighting, compounds would not be permanently lit overnight.

3.6.12 Traffic and access

Site access and haul roads

Construction access to the agricultural working corridor would occur at the points where the proposed route interfaces with the Public Highway (i.e. at the 21 crossing points). The working corridor (as discussed in Section 3.6.2) has been designed with sufficient space to allow construction vehicles to track up and down. The preparation of the haul routes along the working corridor would ordinarily just involve stripping back the topsoil. In certain circumstances, such as poor ground conditions, temporary surfacing, such as laying of hardcore, geo-textiles or re-useable plastic surfacing may be required. The Contractor would be responsible for ensuring the protection of the topsoil and reinstating the ground to its former condition following the construction phase.

The cable route has also been designed to utilise existing access points off the Public Highway wherever feasible, in order to minimise the need for hedgerow removal. However where hedgerow removal is unavoidable, a maximum width of 10m would need to be removed to allow safe construction access.

Traffic management, road closures and diversions in relation to the 21 Public Highway crossing points are discussed in Section 3.6.5.

Vehicle numbers

Table 3.2 provides an estimation of the numbers of vehicle movements required during the cable system construction phase for each of the main vehicle types. One movement is a round trip (i.e. two journeys). The calculations below have been based on a realistic worse-case scenario. The largest numbers of movements are based on personnel vehicles and grab wagons required for the export and import of material onto and from the site.

Table 3.2 Number of vehicle movements required to construct cable system

Stage and details	Transit van	3.5t Tipper	7.5t Tipper	24t Grab Wagon	Low Loader	120t Crane
Trenching (including personnel journeys, duct and plant deliveries, export of spoil, import of fill material)	604		151	3399	197	
Cabling (including personnel journeys, cable and plant deliveries)	680	136			101	34
Jointing of cables (including personnel journeys, delivery of pre-assembled cross-bonding chambers, plant and materials)	408		68			
Totals	**1692**	**136**	**219**	**3399**	**298**	**34**

The numbers of personnel vehicle movements (transit vans) have been calculated on the numbers of gang days required for each stage. Therefore if the actual construction rates change, these numbers could increase or decrease.

The number of wagons required to export surplus spoil and soil from the site and also to import any fill material to site, is based on the worse-case scenario that all subsoil excavated from the cable trench, up to the top of the cable protection layer, would require replacement with a cement-bound sand. In reality, during the construction phase, resistivity testing of the material excavated from the trench would take place at regular intervals along the route. If it is assessed at that time that the subsoil has adequate thermal resisitivity ratings, then the volume of imported fill material (and exported spoil), and therefore wagon vehicle movements, would reduce significantly.

Low loader numbers predicted are likely to be fairly accurate as they are based on the known quantities of duct and cables requiring delivery to site. Crane movements are also accurate as these relate to the known number of minor cable sections, where the crane is required to lift the cable drums from the low-loader into position.

Final vehicle numbers would be dependent on a number of factors, including the Contractor; the type of cables selected; the thermal resistivity of the soil; and the actual rates of construction.

Vehicle types

Table 3.3 provides information on each of the main vehicle types which are envisaged to require access to the site during the cable system construction phase.

Other plant and equipment would need to be brought to the site, however the table provides details of the main vehicle movements required to site. Final vehicle types would be dependant upon the detailed design stage and the Contractor selected.

Table 3.3 Typical vehicle types required to construct cable system

Vehicle type	Overall length (mm)	Overall width (mm)	Overall height (mm)	Overall weight (kg)
Transit Van	5230	2360	2047	3000
3.5t Tipper	5214	2380	2020	3500
7.5t Tipper	3690	2286	2420	7500
24t Grab Wagon	7620	2490	2980	29500
Low Loader (flat-bed HIAB wagon)	16650	2560	3350	24850
Demag AC395 120t Crane	15115	3000	3860	60000

(source: Balfour Beatty Power Networks Ltd.)

3.7 Directional Drilling Construction Methodology

3.7.1 Working areas and site preparation

Bore holes, a topographical survey and a settlement analysis would be required prior to any works at each drill site in order to finalise the proposed drill characteristics. Boreholes and settlement analysis have already been carried out for the two longer drills (Kelling Heath/Poppy Line Railway and the River Bure) to confirm the technical feasibility of the proposed drills. The remaining two drill sites would be subject to bore hole and settlement analysis during the detailed design. Topographical surveys would be required at all four drill sites.

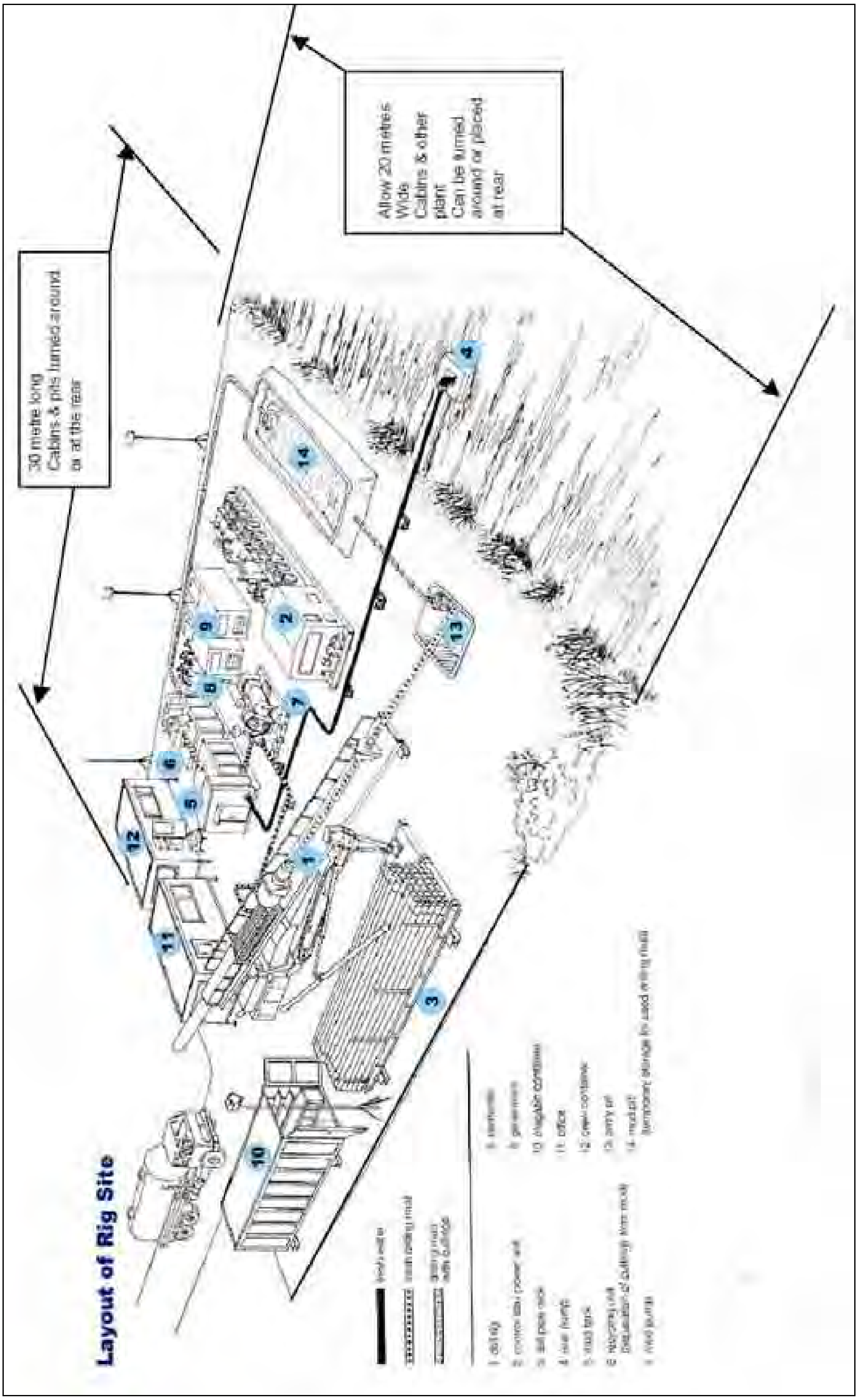
The presence of any existing underground services would be established as already outlined in Section 3.6.2. For any identified services, trial holes would be dug to identify the depth and actual positioning in relation to the proposed drill. The service owner would be consulted to confirm any necessary spacing of specific requirements.

A Risk Assessment would be prepared prior to each drill to identify any hazards and safety precautions required. All relevant authorities would be advised of the intended start-date of the directional drill and pipe pull.

A working area would be required at each side of the proposed drill. One working area is required for the Rig Site, another for the Pipe Site.

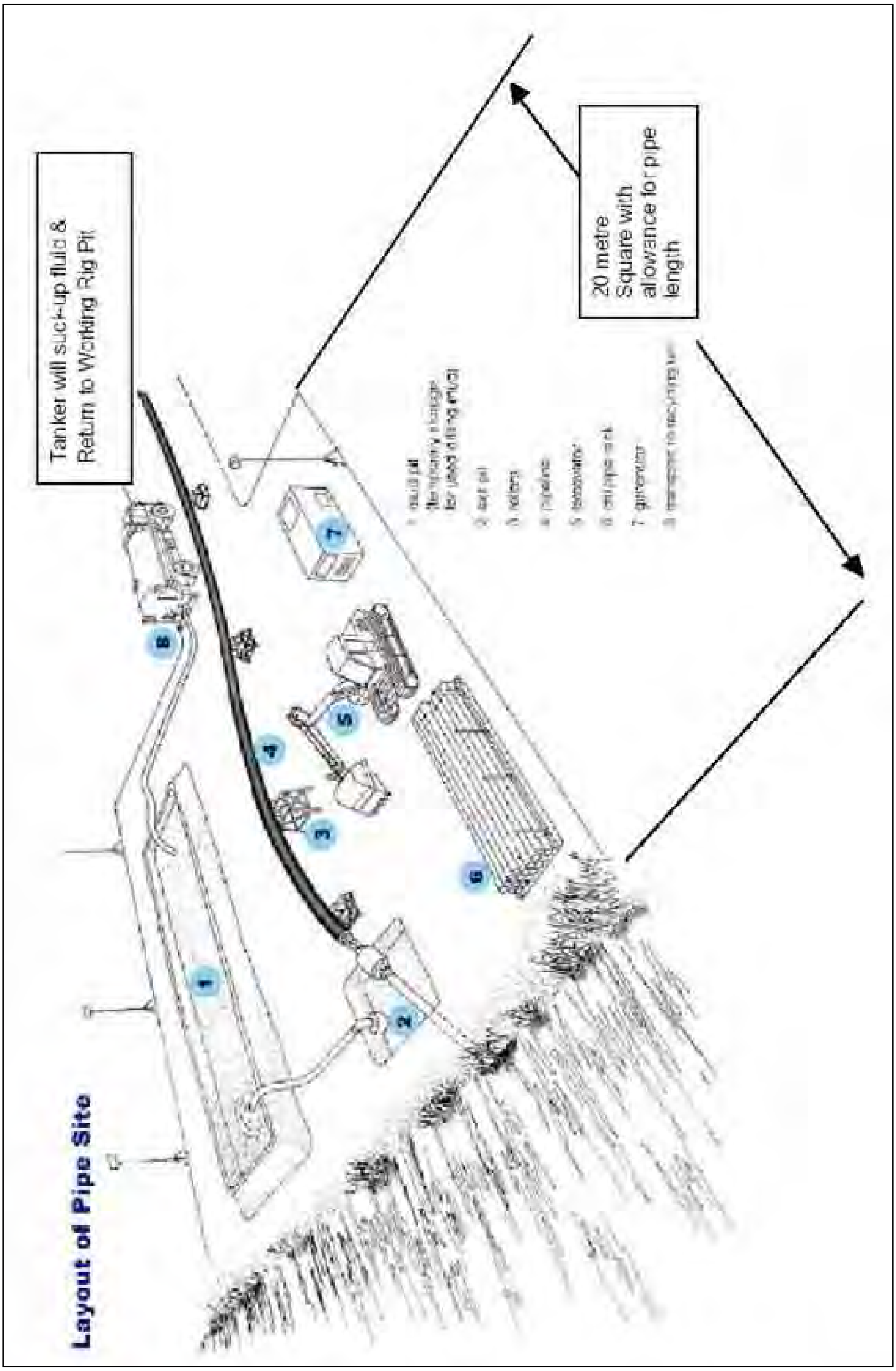
Figures 3.18 and **3.19** show the typical layouts of both types of working area.

Figure 3.18 Typical working layout of directional drill Rig Site



(source: A E Yates Trenchless Solutions)

Figure 3.19 Typical working layout of directional drill Pipe Site



(source: A E Yates Trenchless Solutions)

The main working site; the Rig Site, would be contained within the 20m working width within agricultural land. In order to fit the required equipment and plant into the 20m working area, the cabins and mud pits shown in **Figure 3.18** would be re-aligned lengthways, increasing the overall length of the working area along the proposed cable corridor within the adjacent agricultural land. The overall length of the working area is expected to be approximately 30m.

The smaller working site; the Pipe Site, shown on **Figure 3.19**, would be contained in a 20m by 20m working area. The width of the area can be reduced by modifying the layout to extend lengthways along the proposed cable corridor.

The Rig Site and the Pipe Site would be securely fenced to ensure a safe site, with safe access and egress for site staff, any visitors required and the emergency services.

A stable surface with an area of 9m by 6m would be required for the on- and off-loading of the drilling rig at the Rig Site. No services must be present to a depth of 1m below the anchoring augers. A banksman would be present to ensure safety during on- and off-loading.

Plate 3.5 Typical directional drill rig

(photograph courtesy of Balfour Beatty Power Networks Ltd.)

Both the Rig Site and Pipe Site would require entry (or launch) and receiving pits. These would need to be approximately 2.5m square and 1.2m depth. The excavation of these pits would follow the procedure for separation and storage of topsoil and subsoil already outlined in Section 3.6.2.

A water supply at the Rig Site would be necessary within 100m of the drilling rig to facilitate the installation of drilling mud. If there is no suitable water supply on site, this can be provided by tanker.

No additional compound area would be required. The drilling works would be carried out during daylight hours, therefore, with the exception of security lighting, no permanent overnight lighting would be necessary for the four drills.

The drill would be carried out by a specialist drilling Contractor. Following all preparation stages and prior to any excavations being made, a Permit to Work would be obtained from the main Contractor.

3.7.2 Drill process

In general the directional drill technique involves drilling an arc between two points, to pass underneath the obstacle to be avoided, and exit at a pre-determined completion point.

The first stage of the drill involves a small pilot hole being drilled with a cutting/steering head to set the path of the arc from the Rig Site towards the Pipe Site (see **Figure 3.20a**). The steering head would be attached to pilot rods. The steering of the initial pilot hole is accomplished using a ‘walk-over’ tracking system. Information from the tracking system is fed to a receiver remotely located at the drill rig to steer the depth, inclination and rotational orientation.

When the pilot bore is completed, the cutting/steering head is replaced with an appropriately sized back-reamer at the Pipe Site and pulled through the pilot hole from the drill rig towards the Rig Site (using the pilot rods/string) to enlarge the diameter of the hole (see **Figure 3.20b**). Depending on the final bore hole diameter required, it may be necessary to carry out the back-reaming in several stages, each time increasing the bore hole diameter gradually. Once the required diameter has been drilled, the back-reamer is sent through the bore one or two more times to ensure that the hole is clear of any large objects and that the mud slurry in the hole is well mixed.

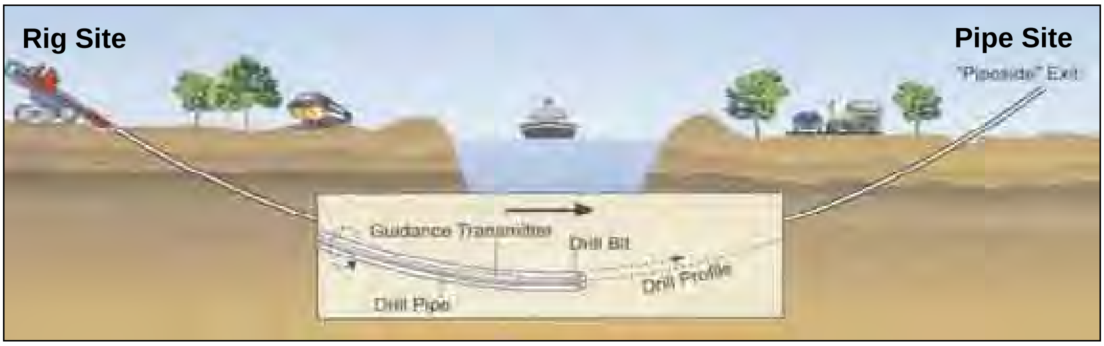
On the final pass, the product pipe (the cable ducts in this case) would be connected onto the back-reamer and the drill string at the Pipe Site, using an expending sealed towing head. The drill string is then pulled from the drill rig and retracted to the Rig Site cutting a larger diameter (clearance) bore whilst also installing the new pipe (the cable ducts) (see **Figure 3.20c**). The ducts for the drills would generally be supplied in 100m long coils which would be butt fused together on site, prior to attaching and pulling into the previously made bore hole.

The final bore hole diameter required would be dependant on the selected cable arrangement (discussed in Section 3.3.6 and shown in **Figure 3.8**). If in trefoil, the bore hole would need to be between 450mm and 600mm in diameter. If separate bore holes are required for each cable (i.e. flat array) these would need to be up to approximately 200mm in width.

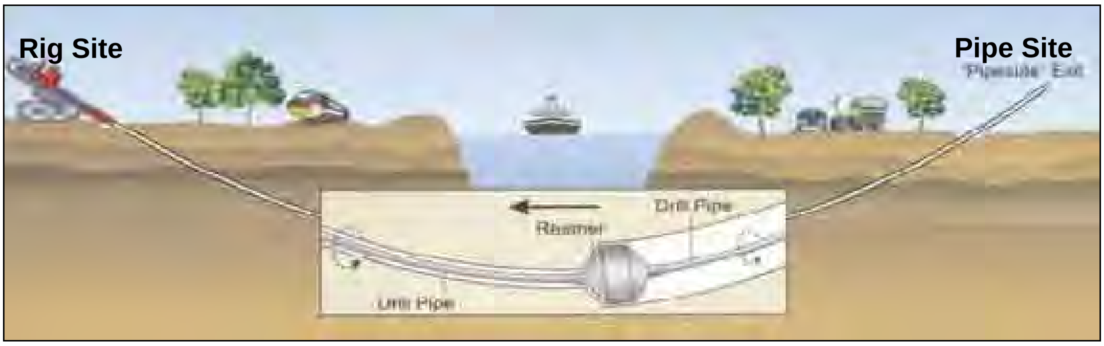
The drill process would be repeated until all required bore holes were drilled and all of the cable ducts installed.

Figure 3.20 Illustration of key directional drill stages (simplified)

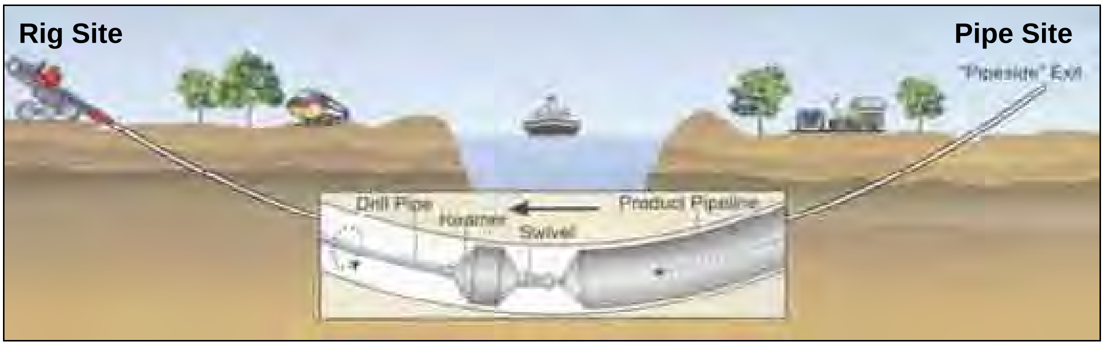
3.20a Pilot drill



3.20b Back-reaming



3.20c Pipe (duct) installation



(source: Balfour Beatty Power Networks Ltd.)

It is considered likely that the use of Bentonite (drilling mud) would be required in order to facilitate the drill. Drilling mud is essential for the lubrication of the drill; the continued cooling of the guidance transmitter; the maintenance of hydrostatic pressure; the removal of the spoil as the bore hole is enlarged; and the ability of the material to keep the bore hole open during the drill.

Bentonite is a powdered clay and a naturally occurring substance. The mud consists of a mixture of Bentonite clay, cement and freshwater. The liquid mud would be mixed on-site at the Rig Site using an on-board mud mixing system and the water supply. The consistency of the mixture would be determined following analysis of the soil conditions. In order to avoid any accidental spills of Bentonite, on-site safety working practices will be adopted by the approved contractor to ensure that the mud is contained and does not enter any sensitive areas (e.g. watercourses).

As the pilot pipes and back-reamers are drilled, drilling mud and excavated material is collected at either end of the crossing in the sumps located at both the Rig Site and Pipe Site. As the ducts are towed in behind the final reamer, an equivalent volume of mud is displaced ahead of the pipe, which is also collected in the sumps at the Rig Site.

The volume of drilling mud which returns to the sumps is dependant on the ground characteristics. In some situations, the majority is absorbed into the ground and little drilling mud returns. In other conditions, large quantities of drilling mud would be returned to the sumps. The Contractor would regularly empty the sumps as required. Any solids and drilling mud arising from the drilling operations would be stored on site temporarily in containment bunds and then exported off-site for disposal in accordance with the Contractors waste carrier licence. It would be the Contractors responsibility to ensure that the nominated waste disposal sites are appropriately certified.

Bentonite slurry would be retained in the drilled bore hole surrounding the ducts and would eventually dry out into its solid form, in order to aid thermal resistivity.

Following completion of each drill and the installation of the ducts, the drill pits, sump pits and ground surface would be fully reinstated. The drilling Contractor would provide final As Built drawings of the precise route and depth of the drills.

Cable installation and final reinstatements would follow the process already outlined in Sections 3.6.4 and 3.6.9.

3.7.3 Drill numbers 2, 3 and 4

The drills proposed at Baconsthorpe Wood (Drill No.2), the River Bure (Drill No.3) and Woodland East of Salle Park (Drill No.4) would all be fairly standard and would follow the procedure outlined. Detailed surveys would be carried out during the planning stage, including the topographical survey, bore holes and settlement analysis, the results of which would be assessed and the results incorporated into the detailed design for each drill.

The drill Contractor would determine the most suitable end for the main drilling rig (the Rig Site), based upon topography, site access and water supplies.

It has been estimated that each of the three drills would take approximately two weeks to complete, including set-up. This does not include the time required for cable pulling, which is included within Section 3.6.4.

3.7.4 Drill No. 1: Kelling Heath / Poppy Line Railway

The proposed drill at Kelling Heath/Poppy Line Railway (Drill No.1) would entail a slightly different process at it needs to be carried out in two stages.

It is proposed that the main Rig Sites are located on either side of the drill (i.e. in the field to the north of the railway, and in the field to the south of the Holiday Park).

The smaller Pipe Site working area would be located in the firebreak within the Holiday Park, shown in **Plate 3.6**. The layout of the Pipe Site would be arranged so that it was no wider than 15m in width to ensure the protection of the adjacent woodland. Possibilities for screening the Pipe Site working area from the main access road into the Holiday Park would be investigated during the detailed design stage, however this would need to consider the need for permanent construction access.

Plate 3.6 Proposed Pipe Site in Kelling Heath Holiday Park firebreak

Specific measures would also be required to ensure the protection of the Poppy Line Railway. The alignment of the drill across the Poppy Line Railway has been designed to cross beneath the tracks at a 90 degree angle. The railway line would also be monitored before, during and following the drill to take readings of the levels of the rails. If any movement outside of the required tolerances is detected the project engineer would be consulted. The monitoring would be compiled and logged and included as part of the final record. The final detailed methodology (including site specific risk assessment) would be approved by the Poppy Line Railway prior to works commencing.

It has been estimated that the drill would take approximately four weeks to complete, including set-up. This does not include the time required for cable pulling, which is included within Section 3.6.4.

3.7.5 Traffic and access

Construction access to the proposed drill sites would generally be via the cable corridor from the points where the proposed route interfaces with the Public Highway. Access to the Kelling Heath/Poppy Line Railway Pipe Site working area would be via the main access into the Kelling Heath Holiday Park from Sandy Hill Lane.

The following equipment and vehicles would typically need to be transported to each of the drill sites:

- JCB.
- Tracked excavator.
- Drilling rig machine.
- Support lorry and trailer.
- Butt-fusion equipment.
- Bunded bowser with fuel oil.
- Low-loaders and cranes for transport and off-loading of site facilities.
- Tankers for transporting Bentonite and fresh-water if a source is not available on-site.
- 24t wagons for removal and disposal of solid material.

The main vehicle movements associated with each of the four drills relate to personnel vehicles and wagons required for the export of solid material from the drill; and have been accounted for in **Table 3.2**. Deliveries of ducts and cables for the drilled sections have also been accounted for in **Table 3.2**.

The estimate for personnel vehicles is 100 transit van movements, calculated on the numbers of gang days required for each drill and a presumption of two gangs per site. Therefore, if the actual construction rates change, these numbers could increase or decrease.

The estimated for vehicles required to export spoil drilled from the bore hole is 65 24t wagon movements, and has been estimated on the realistic worse-case scenario, which in this case would be the requirement for two 600mm wide bore holes (required for the maximum trefoil arrangement option).

As discussed, the number of tankers required for transporting fresh-water to the site (for Bentonite mixing) and surplus Bentonite slurry off-site cannot be estimated at this stage, as it is dependent upon the ground characteristics and availability (or otherwise) of a fresh-water supply on site.

In addition to these movements, low loaders and cranes would be required to deliver and offload site equipment at each site.

Final vehicle numbers would be dependent upon a number of factors, including the Contractor; the type of cables selected; the chosen cable arrangement; the selected machinery and equipment; and the actual rates of construction.

Consultation with Norfolk County Council Highway Authority would take place to agree suitable construction routes and any restrictions during the detailed design stage.

3.8 Scira Substation Construction Methodology

3.8.1 Construction sequence and timing

The works required to construct Scira's proposed substation adjacent to the existing EDFE substation at Salle, near Cawston, would likely to be carried out in the following basic sequence:

- Site establishment.
- Site external access road construction.
- Main site ground works including removal of soil, levelling, foundations, compacting and surfacing, and drainage systems.
- Main site cable routes and internal access track works.
- Buildings construction.
- Installation of external equipment, i.e. reactors and capacitors.
- Installation of internal equipment, i.e. GIS switchgear and control gear.
- Installation of cabling.
- Testing and commissioning.
- Reinstatement works, earthworks and planting.
- Site disestablishment.

The sequence outlined above assumes a linear programme of works with an estimated timescale of 18 months. It would be possible to reduce the above timescales by overlapping the construction items which are independent of each other. For example, the building construction works and the on site cable routing/road works could coincide, as could the installation of the internal and external electrical equipment. Similarly, testing and commissioning could be undertaken at the same time as the landscaping works. Any realistic reduction in programme could only be determined by the Main Contractor and would be influenced by issues such as the delivery timescales for equipment and manpower resources. An estimate for the shortest timescale may be 15 months. Both timescales assume no special site difficulties.

3.8.2 Site preparation and earth works

During the construction phase, and in line with the Construction Design Management (CDM) Regulations 2007, the site boundary would be securely fenced using a suitable steel mesh and panel fencing system. A fixed hoarding system is recommended to a height of at least 1800mm.

A construction compound would be located within the site boundary, in the area reserved for harmonic compensation and potentially the permanent crane bay. This would include contractors offices/cabins plus an equipment storage area. Depending upon the Contractor, an additional off-site compound, possibly combined with one of the cable system compounds, may also be required for the delivery and storage of certain equipment, such as the switch gear and the capacitors, until they are required at the site.

It is likely that the construction site would require full time security attendance for a large part of the construction programme.

Significant ground works would be required in order to excavate the flat terrace upon which the proposed substation is to be built. In addition, the basement level of the proposed building would be sunk 1m below the surface, which would create additional spoil. Where possible, excavated material would be used to form the embankments, however this would not account for all the material generated. The use of any topsoil generated would be utilised within the embankment design.

It is estimated that approximately 6,000m^3 volume of subsoil and spoil would need to be taken off site and disposed of in accordance with the Contractors waste carrier's licence. It would be the Contractor's responsibility to ensure that the nominated waste disposal sites are appropriately certified.

It is estimated this phase of the civil engineering works would take approximately six to eight weeks.

Following the main earth works being constructed, it is expected that all cable ducting would be installed (as outlined for the overall cable system); drainage systems installed; all surfaces levelled and compacted; foundations built; and any site access and hard standings constructed.

3.8.3 Building construction works

The substation buildings would most likely be constructed immediately following the initial civil engineering works, with an estimated timescale of six months. The corrugated fibre cement sheeting, which would form the upper elevations and roof would most likely be delivered to site on flat-bed trailers and installed using a crane.

3.8.4 Mechanical and electrical works

Overall, it is estimated that the mechanical and electrical installation would take approximately six months to complete.

The large reactors would need to be delivered to site by a multi-axle low-loader vehicle and positioned within the bunded foundations with a large mobile crane. Capacitor banks would be delivered to site using flat-bed trailers.

The GIS equipment would not be delivered to the site until the building was completed and water-tight. Once ready, they would be delivered using a flat-bed trailer, one at a time, on a daily basis until all installed.

Once all electrical equipment is installed, testing and commissioning would take place.

3.8.5 Earthworks and planting works

A programme of topsoil reinstatement and planting works would be implemented to visually contain the new substation. Full details are provided in Section 9: 'Landscape and Visual Character'.

3.8.6 Traffic and access

Typical vehicles travelling to and from the site during the construction period would include:

- Flatbed trucks.
- Tipper trucks.
- Low Loaders.
- Excavators.
- Mobile cranes.
- Mobile mixers.
- Delivery vans.
- Labour transport (vans & cars).

Table 3.4 provides an estimate of the vehicles movements required during the construction period. This predicts not only the delivery of major plant items but also the daily travelling of the workforce, hence the large number of movements.

The figures outlined are indicative only. The actual plant and delivery vehicles, and the number of movements, would be based on a number of unknown constraints and may be significantly affected by local circumstances. Actual figures would be calculated by the Contractor during the detailed design stage.

Most vehicles used for the delivery of equipment during construction would be either flat bed or tipper trucks. These would generally have lengths ranging from 6m to 12m with a width of 2.5m. The Gross Vehicle Weights (vehicle plus payload) should not exceed 26 tonnes and would in the majority of cases be significantly less than this value.

The largest vehicles visiting the site would be the low loaders for the delivery of the reactors and the mobile crane required to off-load and install the reactors. These vehicles would have typical dimensions of 15m in length and 3m in width with Gross Vehicle Weights approaching 60 tonnes.

The majority of vehicle movements in the area during the construction period would be the car or small vans used to transport the labour force to and from site.

Consultation during the detailed design stage with Norfolk County Council Highway Authority would take place to agree suitable construction routes and any restrictions. Construction traffic routes would need to be from the east of the site, rather than through Reepham to the west.

Table 3.4 Estimated vehicle movements during construction of Scira's substation

Vehicle Movements - Outline Estimates

item	quantity	unit	per veh.	vehicles round-trips		sub-totals	comments
concrete - structure foundations	500	m3	6	83			Readymix truck
concrete - building foundations	50	m3	6	8			Readymix truck
concrete - roads/hard-standings	600	m3	6	100			Readymix truck
concrete - cable basement	1100	m3	6	183			Readymix truck
						2250	(assumes 75 kg/m3)
reinforcing steel	169	te	12	14			Flat-bed
timber shuttering	500	m2	12	42			Flat-bed
site gravel	300	m3	15	20			Tipper
Structural steel/secondary steel	25	te	10	3			Flat-bed
roofing	22	te	8	3			Flat-bed
full-height blockwork	250	te	10	25			pallet truck/self loader
ancillaries	5	te	0.2	25			Flat-bed
pipes/manholes/ducting		item		8			Flat-bed
palisade fencing (2.74m high)	5	te	1	5			Flat-bed
pre-cast stairs	6	nr	0.5	12			Flat-bed
tanking/paints etc	2	te	0.5	4			pallet truck/self-loader
spoil removal	6000	m3	12	500			Tipper
labour force cars/vans	1800	nr	1	1800			18 months
other vans	50	nr	1	50			
crane	1	nr	1	1			200 te capacity (assumed)
site plant	20	nr	1	20			assumed
self-drive plant	5	nr	1	5			assumed
electrical equipment	80	nr	1	80			Flat bed
Reactors	2	nr	1	2			Special low loader
site accommodation/welfare	6	nr	1	6			site huts/drying room/toilets etc
			Total Est.	**2999**			

(source: SKM)

3.9 EDFE Works Construction Methodology

The construction methodology for the works required by EDFE within the existing Salle substation have not been outlined in detail at this stage in the process, and would not form part of Scira's application for planning consent. A brief description is provided below for context only.

It has been estimated that civil works would take approximately seven months and electrical works approximately eight months, with the first month overlapping with the civils stage. This would give an overall construction period of approximately 14 months.

The works would generate a large quantity of waste soil which would need to be transported off-site. Volumes are not known at this stage. Vehicle movements are also not known, however typical construction vehicle types are likely to include wagons for disposal of waste off-site, personnel vehicles, occasional cranes, tele-handlers and tippers. It is noted that the existing substation site is already an operational site with staff reporting there daily, therefore there is already regular traffic.

Typical working hours would usually be 08.00 to 18.00.

3.10 Onshore Grid Connection Construction / Installation Programme

3.10.1 General working hours

If any work is within a 'residential zone', working hours would usually be 09.30 to 15.00, but would be agreed by the Contractor in liaison with the local authority during the detailed design stage.

The majority of the onshore grid connection is likely to be outside of residential zones; therefore normal working hours would be either daylight hours in winter, or 07.30 to 17.00 when possible.

Weekend working has not been included in the programme calculations; however the option of working weekends would be required for certain types of works, such as cable jointing and road crossings.

3.10.2 Construction / installation timings

In general terms, Scira is hopeful that the onshore cable system could be installed within an 18 month to two year period. It has been estimated that the proposed new substation would take between 15 and 18 months.

The overall time frame for the construction of the onshore grid connection cannot be determined at this stage, as there are many variables involved, including:

- Matters which would not be resolved until the detailed design stage.
- The chosen Contractors proposed construction programme, for example the number of gangs to be working along the cable route at any one time, and the timing of concurrent works.
- Delivery times for certain materials, equipment and plant.

Details of the rates of construction for each element of the programme have been discussed in the preceding sections and are summarised in **Table 3.5**. Work stages would often be carried out concurrently. In addition time must be allowed for mobilization, demobilization of contractors, seasonal restrictions, testing and commissioning of the cable system.

Table 3.5 Summary of construction rates / timings for each task

Item No.	Work element	Stage / task	Rate of construction	Total duration estimate
1	Cable system	Trench excavation, ducting and backfill / reinstatement across agricultural land	40m per working gang per day. 30m per day during adverse conditions.	20 weeks, based on 6 working gangs operating concurrently.
2	Cable system	Trench excavation, ducting and backfill / reinstatement across road crossings	1 – 3 shifts per crossing (20 standard crossings).	(Not estimated, likely to be carried out during Item No. 1)
3	Cable system	Trench excavation, ducting and backfill / reinstatement along 92m length of carriageway at Sandy Hill Lane	3 – 6 shifts depending on timing of works.	(Not estimated, likely to be carried out during Item No. 1)
4	Cable system	Directional drill and installation of ducts	4 weeks for Kelling / Poppy Line drill. 2 weeks for each of the other three drills.	10 weeks, based on one drilling gang carrying out the four drills back to back.
5	Cable system	Cable pulling	9 days per minor section, giving total of 150 cable installation days or 30 week duration.	30 weeks, likely to be carried out by one specialist cable pulling gang.
6	Cable system	Jointing and cross-bonding	14 days at each cable section, totalling 462 jointing/ cross-bonding days, or 92.4 weeks.	Number of jointing gangs dependant on Contractor. 3 gangs would enable the process to be completed in the same approximate timeframe as the cable pulling (31 weeks).
7	Scira substation	Whole construction phase	9 months for civils. 6 months for mechanical and electrical installation. 6 months for building works. 3 months for testing and commissioning.	15 to 18 months depending upon how tasks are overlapped.
8	EDFE works *	Whole construction phase	7 months for civils. 8 months for electrical works.	14 months (with one month of civils / electrical stages overlapped.

* EDFE works are not included within Scira's TCPA application; provided for context only.

3.11 Cable System Operation and Maintenance

3.11.1 Operation

Once operational, the onshore cable system would be primarily beneath the ground surface and buried to a sufficient depth to allow ploughing and other agricultural practices to continue. The only above ground feature would be related to the cross-bonding pits or pillars. These would be located at boundary features wherever feasible, which would minimise the impact to farming activities.

3.11.2 Maintenance

A full check of the cable system would be carried out on a five yearly basis. Access would be along the agreed cable route wayleave, on foot.

3.11.3 Fault repairs

In the unlikely event that there is any failure of cables, the cross-bonding pits/pillars would be utilised to locate the section of cable along which the fault has occurred. A fault finder with test gear would then locate the fault along the cable section. Once located, the area around the fault would be excavated and the fault repaired. If the cable could not be repaired, a new length of cable would be jointed on to replace the failed section.

3.11.4 Electro-magnetic fields

Electric and magnetic fields (EMFs) are the electromagnetic forces that are produced both in the natural world and through human activity. Wherever electricity is used, electric and magnetic fields are produced. Electric fields are produced by voltage, which is the pressure behind the flow of electricity. Electric fields are measured in volts per metre (V/m). Magnetic fields are measured in microTeslas (µT).

Underground cables, opposed to overhead power lines, do not produce any external electric fields.

Figure 3.21 shows the typical magnetic fields for a 132 kV underground electrical cable as a function of distance from the centre line.

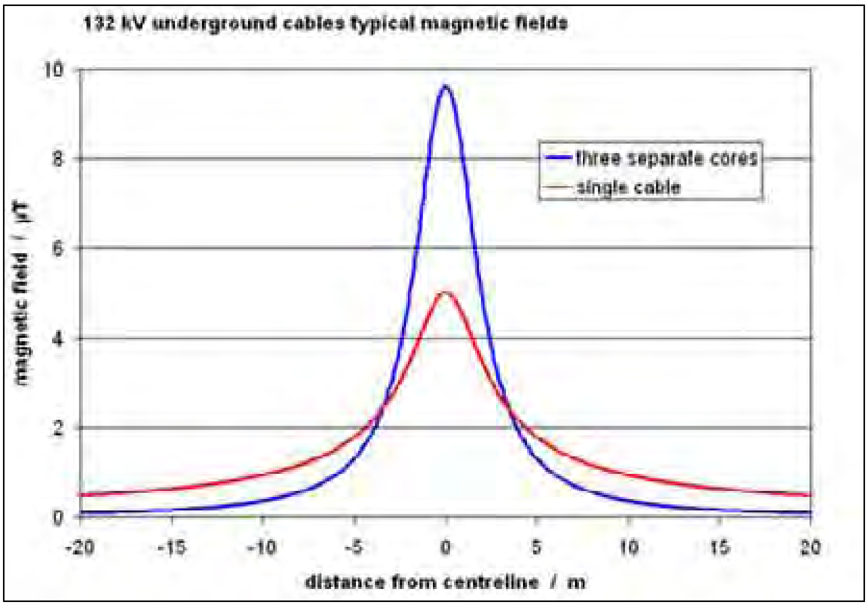
The magnetic field produced directly above the cable is likely to be approximately 9.62µT when the cables are arranged as separate cores in a flat array. This decreases significantly to approximately 1.31µT 5m either side of the cable. The magnetic field will even be lower if the cables are arranged in a trefoil arrangement.

In the past, EMFs have been investigated by scientists in relation to their links with certain long-term health problems, such as leukaemia. The largest ever study conducted on health effects of EMFs in the 1990s found no evidence that EMFs cause disease. However statistical research carried out in 2000 found a small, inconclusive suggestion of an increased link between EMFs and childhood leukaemia (Energy Networks Association, 2004).

Government guidelines state that the reference levels for public exposure to magnetic fields are 100 µT, above which further investigation is needed. The levels likely to be produced by the cable (less than 9.62 µT directly above the cable) fall well within this limit. As a point of reference, the magnetic field produced would be less than one-fifth of that which you would experience when standing next to a television set (Electric and Magnetic Fields [online]).

To summarise, the underground cable would not produce any external electric fields. The magnetic fields produced at the closest point to the cable are less than one-tenth of the government reference level for EMFs. Therefore it is deemed that there are no potential health risks from EMFs associated with the proposed cable.

Figure 3.21 Typical magnetic fields for a 132kV underground electric cable



(source: Electric and Magnetic Fields [on-line])

3.12 Scira Substation Operation and Maintenance

3.12.1 Operation

The proposed substation would not be permanently manned.

3.12.2 Maintenance

In summary, the main equipment at the proposed site would consist of reactors, capacitors and switchgear. The best practice guidelines for the frequency of maintenance of this equipment is summarised in **Table 3.6**, and would be adhered to during the lifetime of the operational phase.

Table 3.6 Operational maintenance required at Scira substation

Equipment	Maintenance frequency	Type of work
Oil filled reactor	Routine – annually Intermediate – four years Major – twelve years	a) Check silicagel and ventilator, check for oil leakage, check cooling equipment, general visual inspection b) Test for water content, dielectric strength, acidity and dissolved gas analysis c) Clean bushings and grease ventilator
Capacitors	Routine – annually	a) General visual inspection
GIS switchgear	Routine – annually Intermediate – six years	a) Check gas pressure, check and clean mechanisms and hydraulics b) Test protection and control equipment

It is envisaged that the maintenance works would only require a site visit by a transit van type vehicle. Any major equipment failure necessitating removal would require the use of suitable mobile cranes.

3.12.3 Utilities and environmental issues

Potable water for drinking and washing would need to be provided by a permanent connection to the local mains network. Wastewater disposal from site would be either facilitated by a permanent connection to the local sewer network or via a septic tank.

Surface drainage would be via soak-aways or by draining into the into the local sewer network if provided. The risk to water quality from pollution sources at the station is considered to be low. Surface water quality would be protected by the following measures:

- Oil retention bunds around the reactors.
- Oil interceptors on the surface water drainage gullies.

The reactors would be filled with mineral insulating oil but would be located within bunds for any leakage containment. The reactor noise rating will not exceed 90dB(A). The capacitors are sealed units and contain non-PCB, biodegradable liquid. The SF6 switchgear would be constantly monitored for gas pressure to detect any leakage.

It is not envisaged that the site would be provided with permanent lighting around the internal roads or equipment. Lighting may be provided over the main entrance doors for local access into the buildings. In the event of any essential works, temporary task lighting would be provided by the maintenance staff.

At this stage of the design, it is envisaged that a 400 volt electricity supply would be made available from the 33kV network located adjacent to the EDFE substation. A pole mounted transformer would be installed on the line and an underground service cable brought into the site Ancillary Building. The exact location and route of the cable would be subject to investigation by EDFE as the local distribution network operator (DNO) responsible for the provision of new connections.

3.13 EDFE Works Operation and Maintenance

Operational and maintenance information relating to the works required by EDFE within the existing Salle substation are briefly described below, in relation to any potential environmental impacts, for context:

- The switch gear and other plant to be installed are effectively silent in normal operation, therefore no increase in noise levels during the operational phase would occur.
- The new switch gear would be gas insulated therefore no specific environmental protection measures are required.
- The additional equipment would not require any permanent lighting.
- The requirement for maintenance of the additional equipment to be installed would be a negligible requirement, over and above what already occurs at the operational site.
- Checks would generally be carried out with associated plant maintenance on an 8 year cycle.

3.14 Decommissioning Plan

An overall Decommissioning Plan would need to be prepared for the whole Sheringham Shoal Offshore Wind Farm project. This would be a ‘live’ document which would be reviewed and updated over the lifetime of the project. The decommissioning of Scira’s proposed onshore grid connection, including the cable system and the proposed substation at Salle, would form a phase of the Plan.

The procedure and monitoring of the decommissioning operation would have to be in accordance with the agreed documentation.

In relation to the proposed substation at Salle, the programme for decommissioning would be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the project lifetime, but a brief outline could be as follows:

a) Removal of fluids and liquids from site.

b) Dismantling and removal of the capacitors, reactors and switchgear.

c) Removal of cabling from site.

d) Removal of any building services equipment.

e) Demolition of the buildings and removal of fence.

f) Landscaping and reinstatement of the site.

The disposal of all materials would be in accordance with the legislation and regulations in use at the time. The buildings may be retained and converted for other usage if agreed with the relevant parties.

At the time of decommissioning, Scira would evaluate whether the buried cable system could be used for another purpose. If this was not feasible, the above-ground features would be removed to a sufficient depth to allow agricultural (or other) practices to occur unhindered. This would most likely involve the removal of the cross-bonding pits and pillars and electrical isolation of the cable system. The underground cable system would be isolated and left in place unless otherwise specified by the local authority or as required by Scira.

In relation to the required works inside the Salle substation by EDFE, it has been reported that depending upon their age at the time of decommissioning, the plant is likely to be recovered for use elsewhere, or retained as spares. Switch gear typically has a 40 year design life, therefore would most likely be decommissioned. The extended outdoor switch gear compound are would remain, leaving space for possible future use.

3.15 Environmental Best Practice

Environmental Best Practice and pollution prevention measures will be incorporated into the design, construction, operational and decommissioning phases to ensure that the surrounding environment, including surface waters and groundwater are not adversely affected as a result of construction activities or during routine maintenance.

Adherence will be made at all times to the Environment Agency's Pollution Prevention Guidelines. These include the following:

- PPG01 General guide to the prevention of water pollution.
- PPG02 Above ground oil storage tanks.
- PPG05 Works in near or liable to affect watercourses.
- PPG06 Working at construction and demolition sites.
- PPG07 Pollution Prevention Guidelines Refuelling Facilities.
- PPG11 Pollution incident response planning.

An Environmental Action Plan (EAP) will be prepared to ensure that the mitigation measures committed to by Scira as part of the Environmental Statement and best practice are implemented correctly on site and as part of the construction contract. The EAP would be produced following planning consent in order to incorporate all relevant planning conditions.

3.16 References

Electric and Magnetic Fields (a National Grid maintained website)
132 kV underground cables: magnetic field
Available at www.emfs.info/132cable.asp [accessed 25/5/07]

Electric and Magnetic Fields (a National Grid maintained website)
Typical magnetic field levels from some common mains appliances in the home
Available at www.emfs.info/Source_Appliances.asp [accessed 25/5/07]

Energy Network Association 2004
EMF The Facts

HMSO 2007
Construction Design Management Regulations 2007

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection

Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 4

LEGISLATIVE CONTEXT AND THE EIA PROCESS

4 LEGISLATIVE CONTEXT AND THE EIA PROCESS

4.1 Introduction

This section outlines the consent and regulatory requirements relating to the construction and operation of the Sheringham Shoal Offshore Wind Farm Onshore Grid Connection. The approach taken in carrying out the EIA process is described, including the assessment methodology, consultation and communication exercise.

The consenting requirements for the offshore wind farm are also discussed for context.

4.2 Offshore Wind Farm Consent & EIA Requirements

An application for the development of the Sheringham Shoal Offshore Wind Farm is currently being determined by the Department for Business, Enterprise & Regulatory Reform (DBERR), formerly the Department of Trade and Industry (DTI). The developer, Scira, has applied for a number of consents that will be required for all phases of the offshore wind farm development (i.e. construction, operation and decommissioning). These are summarised in **Table 4.1**.

Table 4.1 Statutory consents applied for by Scira (May 2006)

Act of parliament	Consent type	Competent authority
Section 36 - Electricity Act 1989	For construction and operation of an offshore wind power generating station within territorial waters adjacent to Great Britain, including all ancillary infrastructure.	Department for Business, Enterprise & Regulatory Reform (DBERR).
Section 5 - Food and Environment Protection Act (FEPA) 1985	For depositing articles or materials in the sea/tidal waters below MHWS (mean high water springs) around Great Britain, including the placement of construction material or disposal of waste dredgings.	Department of Environment, Food and Rural Affairs (DEFRA) through the Marine Consents Environment Unit (MCEU).
Section 34 – Coast Protection Act (CPA) 1949	To make provision for the safety of navigation in relation to the inter array cabling and the export cable route.	DEFRA through MCEU.
Section 90 Town & Country Planning Act 1990	Deemed planning permission sought as part of the section 36 application for the onshore elements of the works (covering the landfall across the shingle ridge, a jointing pit, approximately 600m of underground cabling and a new switch room facility).	DBERR.

4.3 Onshore Grid Connection Consent & EIA Requirements

4.3.1 Planning consent and Environmental Impact Assessment

In most cases, the laying of an underground electrical cable by a statutory undertaker is considered Permitted Development under the Town and Country Planning (General Permitted Development) Order 1995 and does not require planning consent. A 'statutory undertaker' is classed as a developer who holds an Electricity Generation Licence under Section 6 of the Electricity Act 1989. Whilst Scira holds an Electricity Generation Licence, planning consent is still required for this development as explained below.

As already noted, the wind farm project is subject to an EIA, as required under the Electricity Works (Environmental Impact Assessment) Regulations 2000. The onshore grid connection between Weybourne and Salle forms an integral part of the wind farm project (for the purposes of EC Directives 85/337 and 97/11, and for the purposes of domestic legislation made under the Directives) and therefore will also need to be subject to EIA.

In turn, as the onshore grid connection requires EIA, the works will no longer be considered as Permitted Development under the 1995 Order and thus planning permission must be obtained from the relevant Local Planning Authority (LPA), under the Town and Country Planning Act (England and Wales) 1990.

It has therefore been determined that the new underground cabling required between Weybourne and Salle and the proposed new substation will be subject to EIA in accordance with the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, and that the resulting EIA report – the Environmental Statement – will be submitted with the planning applications.

The grid connection between Weybourne and Salle is located within the planning jurisdiction of two LPAs; North Norfolk District Council (NNDC) and Broadland District Council (BDC). This ES has been prepared for the entire grid connection between Weybourne and Salle, including Scira's proposed new substation adjacent to the existing EDFE substation at Salle. This ES will accompany the planning applications to be issued to the two LPAs.

Scira is applying for two separate planning consents. The first planning application covers the buried cable system and will be submitted to both NNDC and BDC. The second planning application covers the proposed new substation at Salle and will be submitted to BDC only.

The scope of this ES does not cover the offshore wind farm, export cables or the proposed landfall at Weybourne, which were covered in a previous ES document submitted to the DBERR in May 2006 (Scira, 2006).

4.3.2 Other consents and permissions

In addition to the requirement for planning consent and EIA, other consents and permissions will be required under relevant legislation at the appropriate time. These are all standard consents and would be obtained following receipt of Town and Country Planning Act consent. They include:

- Road crossings: As a Statutory Undertaker, Scira will not be required to obtain any Section 50 Licences under the New Roads and Street Works Act 1991 (NRSWA) in order to install the buried cable system within the Highway. Scira will still need to have regard to certain requirements of the NRSWA, such as the need for Temporary Traffic Orders from the Highway Authority, in this case Norfolk County Council.
- Other Highway matters: Consultation and agreement will be required with Norfolk County Council Highways Authority in order to plan and agree suitable construction routes for the delivery of certain plant and equipment.
- Public Rights of Way crossings: Temporary Closure Notices will be required from Norfolk County Council where the proposed cable route crosses or affects any Public Rights of Way during the construction phase.
- Watercourse crossings: Where work is required in or within 9m of certain watercourses, consent is required from the relevant authority under the Land Drainage Act 1991. This would apply to two watercourses. Where the route crosses an IDB watercourse to the east of Salle Park, Byelaw consent will be obtained from the Norfolk Rivers IDB (via the King's Lynn Consortium for Internal Drainage Boards, KLCIDB).
- Gas main crossings: The cable route crosses four gas main pipelines. In order to cross a gas main, formal authorisation and approval of method statements will be required from the National Grid UK, the statutory undertaker responsible for gas distribution in Norfolk.
- Railway crossings: The cable route crosses the North Norfolk 'Poppyline' Railway. No formal consent is required for this private rail crossing; however confirmation and approval of the method statement will be obtained from the operator: North Norfolk Railway Plc.
- Great crested newts: Where construction of the onshore grid connection could potentially impact upon great crested newts, a licence in respect of development will be required from the Natural England Wildlife Licensing Unit (refer to Section 6: 'Nature Conservation and Ecology').
- Waste disposal: The Contractor will be required to comply with the Landfill Regulations 2002 (as amended) and the Hazardous Waste Regulations 2005 for the disposal of any excavated materials.
- Discharge consents: Following the detailed design stage of the proposed new substation, if any discharge of foul or surface water is required, the need for Discharge Consents from the Environment Agency would need to be confirmed.

4.4 The Environmental Impact Assessment Process

EIA is a tool for systematically examining and assessing the impacts and effects of a development on the environment.

The resultant Environmental Statement (ES) reports on the EIA and contains:

- Description of the development proposal, including any alternatives considered.
- Description of the existing environment at the site and its environs.
- Prediction of potential impacts on the existing human, physical and natural environment at the site and assessment of subsequent effects.
- Description of mitigation measures to avoid or reduce such effects.
- Description of monitoring requirements.
- Non-Technical Summary.

The following stages are typically included in an EIA:

- Screening determination of whether a development proposal needs an EIA.
- Scoping determination of the issues to be addressed by the EIA.
- Consultation and public participation.
- Original data collection and surveys where necessary to fill data gaps.
- Impact identification and evaluation.
- Identification of mitigation and residual impacts.
- Identification of monitoring requirements.
- Submission of the ES to the relevant authorities as part of the consents process.
- Liaison and consultation to resolve matters or representations/objections.
- Decision on whether the development proposal should proceed.

4.4.1 Environmental screening and scoping

As outlined in Section 4.3.1, it was determined at an early stage that the Project would require EIA. This need for EIA was discussed and agreed with both NNDC and BDC and therefore a formal screening determination was not requested.

As part of the EIA process, and under the EIA Regulations 1999, a 'Scoping Opinion' was requested from both NNDC and BDC. The process of Scoping aims to ensure that all of the impacts and issues that are of concern to the local authority and other stakeholders are addressed in the EIA. A Scoping Report was sent to the planning departments of both district councils briefly describing the proposed development, setting out the issues that would be addressed and any work deemed to be necessary, with a formal request for a Scoping Opinion.

The Scoping Report is provided as **Appendix 2.1**.

Issues identified for specific assessment included:

- Nature conservation and ecology.
- Archaeology and cultural heritage.
- Geology, hydrology and contaminated land.
- Landscape and visual character.
- Traffic and access.
- Noise and vibration.
- Dust and air quality.
- Local community, land ownership, tourism and recreation.

The Scoping Report was circulated to the following organisations/departments:

- NNDC and BDC (Planning, Countryside and Environmental Health departments).
- Norfolk County Council (Planning, Highways, Ecology, Countryside and Public Rights of Way departments).
- Norfolk Landscape Archaeology.
- Natural England.
- Environment Agency.
- Norfolk Wildlife Trust.

A Scoping Opinion from NNDC was received on 31 August 2006 and is provided as **Appendix 2.2**.

The scope of the EIA outlined in the Scoping Report was generally considered appropriate to NNDC and the stakeholders consulted. The main additional requirements of the EIA requested from NNDC and other stakeholders consulted are summarised below:

- Construction: additional detail required on the identification of the exact locations of pulling pits, cross-bonding pits, turning heads and storage points in order to fully assess the impact of the works. Also, detail on the intended reinstatement methods to be used.
- Characterisation: a fully comprehensive photographic record of the road route prior to commencement of the works for the purposes of accurate reinstatement.
- Archaeology: the proposed methodology for the archaeological desk based assessment should be submitted to Norfolk Landscape Archaeology for approval, and there should be reference to national and regional standards documents.
- Rights of way: formal temporary closure orders would be required for any public rights of way that are affected; and Norfolk County Council to be fully consulted on any temporary road diversion routes.
- Traffic: Consideration should be given to the ecological impacts of the potential arable route and also to the disruption to traffic along the proposed road route.

The following feedback was also received from BDC on 21 August 2006:

- Conservation designations: the impact on Conservation Areas; Historic Landscapes, and Roadside Nature Reserves should be considered fully.
- Construction: detail and location of contractors compounds should be included.
- Construction: further details of the location of pulling pits; cross bonding pits and turning heads is required, particularly in regard to their impact on trees and the landscape.

Meetings were also carried out with BDC to discuss any additional surveys or studies which may be necessary to assess the impact of the proposed new substation; in particular impacts relating to landscape and visual character. The Environment Agency also confirmed that a Flood Risk Assessment for the proposed Salle substation would not be required as the site is located within Flood Zone 1 (defined as low probability of flooding) and would be less than 1 hectare in size.

4.4.2 Consultation and community involvement

Consultation with stakeholders and the communities involved and interested in the Project is an important part of the EIA process and has been carried out through written correspondence, telephone conversations, and meetings with statutory and non-statutory bodies representing key interest groups.

As well as ongoing consultation with key stakeholders throughout the EIA process, a consultation phase was carried out during April and May 2007. A consultation document was prepared which provided a description of the development, an overview of the EIA process being carried out and a request for feedback relating to any issues and any relevant information or data which may be held for inclusion in the EIA. At the time of issue, two main route options were under consideration, a road-based route and an off-road based route. In addition, two substation locations were also being considered. Feedback on all options was requested.

The consultation document is provided as **Appendix 4.1** and was issued to over 200 organisations, departments or individuals, including:

- NNDC and BDC (Planning, Countryside and Environmental Health departments and all Councillors).
- Norfolk County Council (Planning, Highways, Countryside, Landscape, Ecology and Public Rights of Way departments).
- All Parish Councils along the route.
- Environment Agency.
- Natural England.
- English Heritage.
- Norfolk Landscape Archaeology.
- Norfolk Wildlife Trust.

- The Royal Society for the Protection of Birds (RSPB).
- The National Trust.
- Forestry Commission.
- Norfolk Coast Partnership.
- King's Lynn Consortium of Internal Drainage Boards.
- Ramblers Association.
- Landowners and tenants.
- Members of the public registering for further information at the public exhibitions (see Section 4.4.3).
- Other local groups and holders of environmental data, including Norfolk Biological Records Centre, Norfolk Ornithologists Association, Norfolk Badgers, Norfolk and Norwich Naturalists Society, Norfolk Bat Group and Norfolk Amphibian and Reptile Group.

A full list of all organisations and groups consulted during the EIA along with a summary of the responses received is detailed in **Appendix 4.2**. Where particular issues or concerns were raised, a cross-reference to the relevant section the Environmental Statement where the issue is assessed is provided.

4.4.3 Public consultation

As is best practice, Scira has engaged with the local community throughout the EIA process in order to inform local people about the proposals, explain the development and its potential effects and take on board any concerns or issues. Reference has been made to the Statements of Community Involvement, prepared by both NNDC and BDC.

The following public consultation has been undertaken:

- Information was made available to the public through Scira's website (www.scira.co.uk) in relation to the onshore grid connection project, giving regular updates with progress on EIA surveys and studies and consultations.
- District councillors and the chair of the relevant committee received written consultation regarding information about the project, the proposed EIA surveys and studies to be undertaken, along with information about the public consultation to be carried out.
- The parish councils' clerks through which the route passes received written consultation and were further involved in public exhibitions.
- An advert was placed in the local newspaper announcing the project with reference to Scira's website for further information and included an invitation to public exhibitions.
- A series of public exhibitions were held (see details below).

Three public exhibitions were held in October 2006 to ensure that local people were aware of and involved with the EIA process. The exhibitions were advertised widely in the local press and posters were put up in libraries, schools, public notice boards.

Amongst the invitees and attendees were representatives from several parish councils, NCC highways officers, NNDC, BDC councillors and officers, landowners and other members of the general public.

A summary of attendance at each of the three exhibitions is given in **Table 4.2**.

Table 4.2 Public exhibition attendance

Location	Date	Number of attendees
Bodham	24 October 2006	57
Saxthorpe/Corpusty	25 October 2006	32
Cawston	26 October 2006	25

A total of 114 visitors attended the exhibitions, of which 38 returned a questionnaire. Information packs were issued to all attendees, which included a copy of the poster panels displayed in relation to the grid connection project. Further information on the feedback received during the exhibitions is provided within Section 12: 'Local Community, Land Use, Tourism and Recreation'.

4.4.4 Data collection and surveys

Further to the findings of the Scoping stage, the scope of data collection and surveys required were modified where necessary and implemented during the EIA process. Data collection and surveys undertaken are summarised within **Table 4.3**. Further detail on the scope is given in each of the relevant sections of the Environmental Statement.

Table 4.3 Data collection and surveys undertaken

Topic and ES Ref	Data collection and surveys carried out
Nature conservation and ecology (ES Section 6)	• Identification of nature conservation designations. • Ecological data search. • Extended Phase 1 Habitat survey. • Surveys for protected and Biodiversity Action Plans (BAP) species including badger, otter, water vole and great crested newts, and habitat opportunities for breeding birds, bats and invertebrates.
Archaeology and cultural heritage (ES Section 7)	• Archaeological desk-based assessment included collection of Norfolk Historic Environment Record (NHER) data, Listed Buildings, Scheduled Monuments and Registered Parks and Gardens.
Geology, hydrogeology, hydrology and contaminated land (ES Section 8)	• Desk based assessment collating data from local plans, historic maps and photographs. • Environmental data obtained from regulatory bodies, including data on surface and groundwater resources, geological conditions and environmentally sensitive areas. • Site reconnaissance visit.

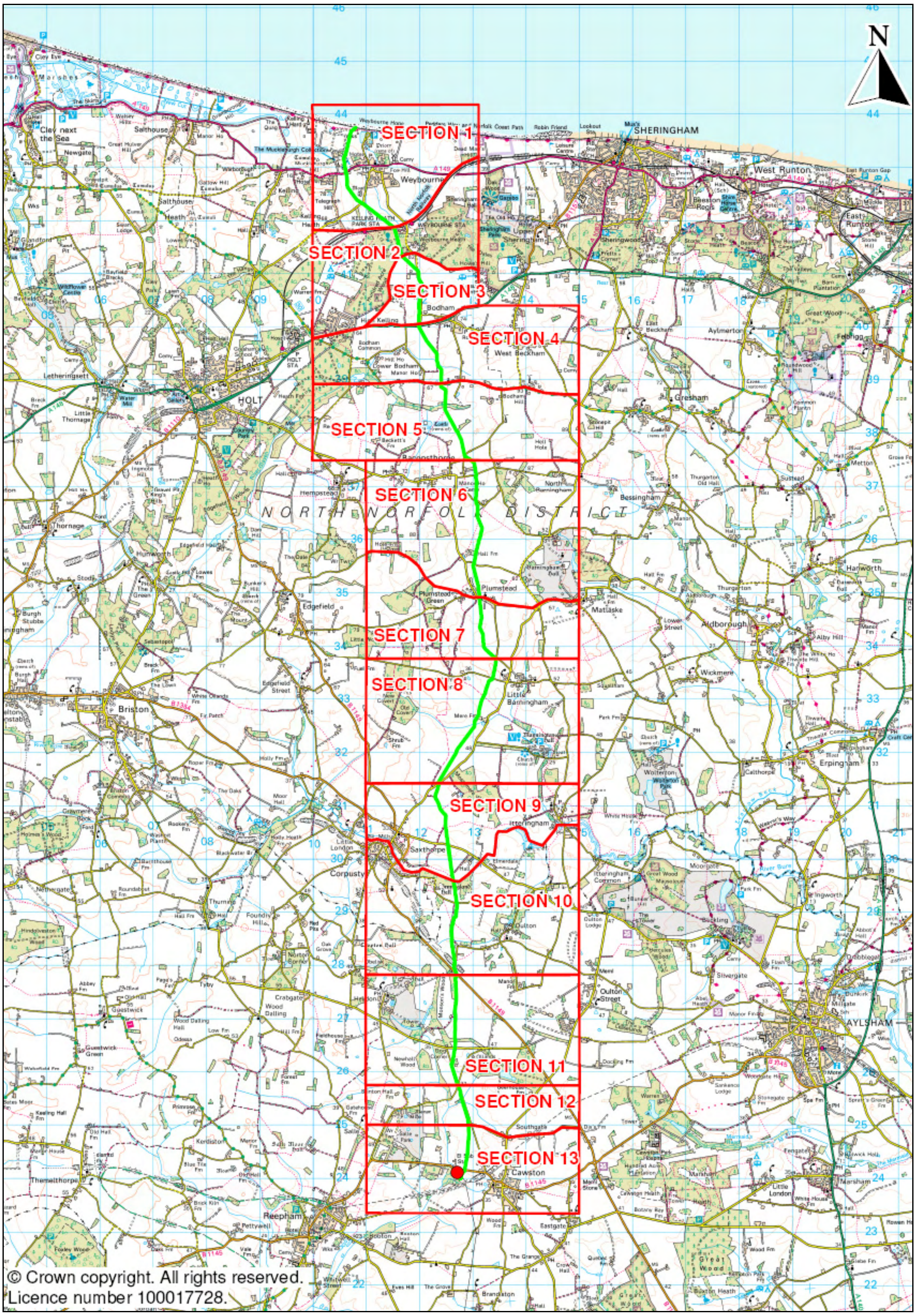
Topic and ES Ref	Data collection and surveys carried out
Landscape and visual character (ES Section 9)	• Identification of landscape designations and countryside character within the study area. • Interactive design process in relation to cable routing and the location, layout and design of the proposed substation.
Traffic and access (included within ES Section 3 Project Details)	• Consultation with NCC Highways Department to identify likely traffic impacts, including those relating to temporary road closures and diversions and construction access. • Identification of traffic movements and vehicle types during construction and operational phases.
Noise and vibration (ES Section 10)	• Desk based noise and vibration studies with reference to British Standards and other current relevant guidance.
Dust and air quality (ES Section 11)	• Desk based assessments with reference to existing air quality and monitoring data held by NNDC, BDC, and the National Air Quality Information Archive (NAQIA).
Local community, land use, tourism and recreation (ES Section 12)	• Desk based assessments with reference to local maps and data sources. • Identification of Public Rights of Way. • Local consultation, including public meetings held in Bodham, Corpusty/Saxthorpe, and Cawston.

For ease of descriptive purposes, the route of the onshore grid connection has been split into thirteen sections. These sections are referred to in certain parts of the Environmental Statement to describe the location of features present in the area of the proposed cable route.

These are listed below and shown on **Figure 4.1**.

- Section 1 - Muckleburgh to Poppy Line Railway.
- Section 2 - Kelling Heath/Hundred Acre Woods.
- Section 3 - North of Bodham.
- Section 4 – Bodham.
- Section 5 – Baconsthorpe Castle.
- Section 6 – Baconsthorpe to Plumstead.
- Section 7 – South to Plumstead.
- Section 8 – Little Barningham.
- Section 9 – North of Saxthorpe and River Bure.
- Section 10 – South of Saxthorpe and River Bure.
- Section 11 – Heydon.
- Section 12 – East of Salle Park.
- Section 13 – Salle Substation and land to North.

Figure 4.1 Cable route descriptive sections 1 to 13



4.4.5 Impact identification and evaluation

Identification and evaluation of impacts were carried out by a number of different processes including data collection and collation (both existing data and original surveys), literature review, consultation and evaluation techniques with reference to standards, guidelines and best practice.

Details of the assessment methodology and data sources used to identify and evaluate impacts for each environmental parameter are discussed in the relevant sections (Sections 6 to 12).

As discussed in Section 3: 'Project Details', there are certain parts of the detailed design of the onshore grid connection project that are not yet fully defined. For example: the cable material and width; the cable laying configuration (and therefore trench widths and depths); and the exact arrangement of electrical equipment in the new substation. In each of these cases, for the purpose of impact identification and evaluation, the realistic worse-case scenario has been assessed under each environmental parameter, such that the full range of impacts are evaluated and described. This approach has been taken on the basis that definitive project details are not yet known and a number of options and final decision making is dependent on various factors such as further geotechnical investigations, economic evaluation and procurement processes (see Section 3: 'Project Details').

Scira is aware that all development which may take place under the planning consents granted for this project, to the extent that it may give rise to significant environmental effects, must be adequately addressed in the EIA. This awareness is based on a number of court judgements, including R v Rochdale MBC ex parte Tew [1999 3PLR74] and R v Rochdale MBC ex parte Milne [2001 81PCR27].

The case law gives rise to a potential difficulty for many infrastructure proposals, including the proposed project, in that at the time consents are granted there will necessarily remain a number of features of the project which are not yet fully determined.

However, it is considered that the full range of possible options which may need to be built are described and assessed in this ES (i.e. they are within the so called 'Rochdale Envelope') including consideration of the worse realistic case for each environmental parameter assessed. This provides a degree of flexibility in the implementation of the project thus ensuring compliance with the awarded planning consents and EIA law, in addition to preserving the commercial need to implement the development in a variety of ways.

4.4.6 Significance levels

In order to provide a consistent framework for considering and evaluating impacts, significance levels have been assigned to each impact.

Table 4.4 sets out the assigned definitions.

Table 4.4 Terminology for Classifying Environmental Impacts

Impact Significance	Definition
No impact	There is an absence of one or more of the following: impact source, pathway or receptor.
Negligible	The impact is not of concern.
Minor adverse	The impact is undesirable but of limited concern.
Moderate adverse	The impact gives rise to some concern but is likely to be tolerable (depending on the scale and duration).
Major adverse	The impact gives rise to serious concern; it should be considered as severe.
Minor beneficial	The impact is of minor significance but has some environmental benefit.
Moderate beneficial	The impact provides some gain to the environment.
Major beneficial	The impact provides a significant positive gain.

To assess the significance of an impact, it is necessary to identify the magnitude of the effect and also the sensitivity of the receptor. The resulting significance is a balance of the two. A number of criteria have been utilised to determine these two factors during the assessment of significance, and include:

- Magnitude of the impact (local/strategic).
- Spatial extent of the impact (small scale/large scale).
- Duration of the impact (short term/long term).
- Reversibility of the impact (including species or habitat recoverability).
- Conservation or protected status.
- Probability of occurrence of the impact.
- Confidence in the impact prediction.
- The margins by which set values are exceeded (e.g. noise standards).

4.4.7 Mitigation measures and residual impacts

Where potentially significant adverse impacts are identified, mitigation measures are outlined, either as part of the design, or as a measure implemented during construction or operational phases. Good construction practice measures have also been identified where appropriate in order to minimise any possible effects further. Scira has agreed to these mitigation measures and they are therefore expressed as commitments.

The level of significance assigned to an impact in this Environmental Statement is the **residual** impact, following implementation of the stated mitigation methods, good construction or operational practice or relevant regulations and guidelines, and is emboldened in each section.

An Environmental Action Plan (EAP) will be prepared to ensure that the mitigation measures committed to by Scira as part of the Environmental Statement and best practice are implemented correctly on site and as part of the construction contract. The EAP would be produced following planning consent in order to incorporate all relevant planning conditions.

4.4.8 Monitoring

Monitoring, where required, is important to verify the predicted impacts of the proposed development on the site and surrounding area and habitats, particularly where levels of uncertainty remain following the EIA. Monitoring programmes are described where necessary.

4.4.9 Cumulative effects

It was identified that the construction and operation of additional equipment inside the existing Salle substation by EDFE should be considered in terms of potential cumulative impacts in relation to the proposed onshore grid connection works by Scira. Potential cumulative impact assessment has included:

- During construction:
  Increased traffic volumes and construction disruption resulting in increased impacts relating to noise and vibration, dust and air quality, local community and the travelling public. Refer to Sections 3: 'Project Details', Section 10: 'Noise and Vibration', Section 11: 'Dust and Air Quality' and Section 12: 'Local Community, Land Use, Tourism and Recreation'.
- During operation:
  Cumulative landscape and visual impact of new equipment inside Salle substation and the new proposed substation. Refer to Section 9: 'Landscape and Visual Impact'.

No other assessment of cumulative impact was identified as being required.

4.4.10 Consideration of alternatives

The cable route identification process has been an iterative process which has taken into account environmental, technical and financial considerations. The location, layout and design of Scira's new substation has also considered alternative options.

Full details of the process and alternatives considered can be found in Section 2: 'Site Selection and Consideration of Alternatives'.

4.5 The EIA Project Team

Royal Haskoning was commissioned by Scira to carry out the EIA of the proposed onshore grid connection project and report the findings within this Environmental Statement.

Significant input was also provided by Scira and a team of technical specialists, assembled to carry out the Project. This input is summarises within **Table 4.5**, along with details of any specific specialists who were contracted to undertake particular EIA surveys and studies.

Table 4.5 The EIA Project Team

Organisation	Subject area
Royal Haskoning	EIA project management and coordination, including consultation, specific studies relating to nature conservation, noise, air, traffic and other technical specialisms, Environmental Statement production and consent applications.
Cambridge Landscape Architects	Route analysis and design; substation layout and design including mitigation; landscape and visual impact assessment.
Freedom Group	Landowner easements and wayleaves.
Greene and Greene	Option agreements.
Bond Pearce	Legal review and compulsory purchase advice.
Balfour Beatty Power Networks Ltd.	Construction advice.
Sinclair Knight Merz (SKM)	Cable system and substation electrical design.
Norfolk Wildlife Services	Ecological surveys.
Robert Yaxley Ecological Surveys Ltd.	Great crested newt surveys.
NAU Archaeology	Archaeological desk based assessments.

4.6 References

HMSO 1949
Coast Protection Act

HMSO 1985
Food and Environmental Protection Act (FEPA)

HMSO 1989
Electricity Act

HMSO 1990
Town and Country Planning Act

HMSO 1991
Land Drainage Act

HMSO 1995
Town and Country Planning (General Permitted Development) Order

HMSO 1999
Town and Country Planning (Environmental Impact Assessment) Regulations (England and Wales)

HMSO 2000
Electricity Works (Environmental Impact Assessment) Regulations

Royal Haskoning 2006
Sheringham Shoal Offshore Wind Farm - Weybourne to Salle Onshore Grid Connection Scoping Report

Scira Offshore Energy Ltd. 2006
Sheringham Shoal Offshore Wind Farm
Environmental Statement

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

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SECTION 5

POLICY AND PLANNING GUIDANCE

5 POLICY AND PLANNING GUIDANCE

5.1 Introduction

This section describes the planning policy framework relevant to the Project. Its purpose is to outline the planning policy context of the proposed onshore grid connection to provide a background to the consideration of potential environmental effects and other implications of the project set out in the EIA.

The Project must be seen in the wider context of the proposed Sheringham Shoal Offshore Wind Farm as it is part of this larger renewable energy proposal. Therefore it is relevant and necessary to assess the application by reference to renewable energy policies, as well as those addressing environmental effects.

5.2 Renewable Energy Background and Policy

Section 1.5 of this ES (Statement of Need) describes the international, European and national renewable energy background and policy. This background culminates in the recent Energy White Paper 2007 which states that taking urgent action to mitigate the effects of climate change is the only strategy consistent with long-term economic growth and global stability. The White Paper acknowledges that the 20% renewables target for 2020 is an ambitious goal representing a large increase in Member States' renewables' capacity. The latest data show that the current share of renewables in the UK's total energy mix is around 2% and for the EU as a whole, around 6%. Projections indicate that, on the basis of existing policies in the UK and the EU, by 2020, renewables would contribute around 5% of the UK's consumption and are unlikely to exceed 10% of the EU's.

As stated in Section 1: 'Introduction', the Sheringham Shoal offshore wind farm would have an installed capacity of 315MW. The UK has set a target of 15% energy supply by renewable energy sources by 2015; this 15% target is expected to require the generation of 57.5TWh per year. Once operational, the proposed offshore wind farm would contribute approximately 1.0TWh per year, or 1.74% of the total amount of renewable energy required to meet this 15% target.

5.3 Planning Policy Framework

Section 38(6) of the Planning and Compulsory Purchase Act 2004 requires that the determination of planning applications under the Town and Country Planning Act should be made in accordance with the Development Plan, unless material considerations indicate otherwise.

This Section identifies the adopted Development Plan and the policies within that plan that are relevant to the Project, before going on to identify any relevant material considerations.

When addressing proposals relating to renewable energy, it is important to have regard to the overall context within which that proposal sits, i.e., the international and European obligations that the UK has entered into in relation to renewable energy targets and need, in addition to the national planning policy for renewable energy and climate change contained within Planning Policy Statement 1 (PPS1: Delivering Sustainable Development); and PPS22 (Renewable Energy). Development Plan policy should be interpreted with those overall imperatives in mind.

The 2004 Act has introduced new planning tools and a change in the planning hierarchy previously used in England.

At the national level, the Communities and Local Government ministerial office (previously the Office of the Deputy Prime Minister (ODPM)) is responsible for issuing guidance on the planning system in England and publishes a range of Planning Policy Guidance notes (PPG) after public consultation. Under the 2004 Act, PPGs are gradually being reviewed and reissued as Planning Policy Statements (PPS). PPGs and PPSs explain statutory provisions and provide guidance to local authorities and others on planning policy and the operation of the planning system. Local authorities must take their contents into account in preparing their Development Plans.

Government Offices work at the regional level in order to implement and monitor Regional Spatial Strategies (RSS), which set out the Government's planning policy for each of England's ten regions, for a 15-20 year period. The strategies provide frameworks for determining planning applications, as well as for preparing Local Development Documents (LDD).

Under the 2004 Act, county level Structure Plans are being abolished, with much of the guidance now being incorporated into the RSS. District and borough councils will in future prepare Local Development Frameworks (LDF) instead of Local Plans, which will be made up of a number of different LDDs, which must conform to the policies outlined within the RSS. These plans, once adopted, will form the Development Plan for the purposes of Section 38(6) of the 2004 Act, i.e., for the purposes of determining planning applications.

Until those new plans have been adopted, some current Regional Planning Guidance has been adopted as the RSS (until they are replaced) and Structure Plans and Local Plans which have already been adopted will be 'saved' for three years from the start date of the 2004 Act (28 September 2004). 'Saved' plans remain part of the formal Development Plan and policies continue to apply for the saved period or until they are replaced by another plan.

The proposed onshore grid connection lies within the planning jurisdiction of Broadland District Council (BDC) and North Norfolk District Council (NNDC) at the local level and Norfolk County Council (NCC) at the county level. On a regional level the development occurs within the East of England Government Region.

The Development Plan for the purposes of the Project is:

- The Regional Spatial Strategy (RSS) for the East of England is currently the Regional Planning Guidance RPG6 for East Anglia (approved on 23 November 2000). RPG6 guides the development in East Anglia, which includes the county of Norfolk, to 2016.

- The Norfolk Structure Plan adopted on 29 October 1999, provides the strategic land use, transport and environmental planning policy framework for Norfolk up until 2011.
- The North Norfolk Local Plan, adopted on the 2 April 1998, provides a detailed framework for the control of development and use of land that will guide most day-to-day planning decisions in North Norfolk. Its policies will remain the basis for decision making at least until 2007.
- The Broadland District Local Plan (Replacement) adopted by the council in May 2006. The Local Plan covers the period 1 January 1993 – 30 June 2011.

The relevant policies within the Development Plan are set out in Section 5.4.

Other material considerations for the purposes of Section 38(6) are:

- National Planning Policy and advice (discussed in Section 5.5), which includes PPS1 (Delivering Sustainable Development) and PPS22 (Renewable Energy).
- Emerging Development Plans:
  - The Draft East of England RSS was initially submitted in November 2004. It has been through examination in public and in December 2006 the Secretary of State published proposed changes for consultation. The consultation period was between 19 December 2006 to 9 March 2007. The publication of the adopted plan is expected during late 2007.
  - North Norfolk District Council is preparing its Local Development Framework and a draft Core Strategy and Site Specific Proposals have been published for consultation.
  - Broadland District Council is also preparing its Local Development Framework and these are in the early stages of drafting.

5.4 Development Plan Policies

5.4.1 Local policy environment

The proposed cable route runs for some 21.3km from Weybourne through to the substation location. As set out in Section 3: 'Project Details', the route passes through the parishes of Weybourne; Bodham; Baconsthorpe; Matlaske; Plumstead; Little Barningham; Itteringham; Corpusty and Saxthorpe; Oulton; Heydon and Cawston. The majority of the route is within agricultural land, but also crosses the Public Highway in 21 locations, along with 12 Public Rights of Way.

The proposed substation is located on agricultural land along the south-eastern boundary of the existing EDFE substation, approximately 0.5km to the west of Cawston and 2.5km to the east of Reepham.

Table 5.1 summarises the presence of any international, European, national or county/local designations within or around the proposed onshore grid connection. For further detail on each of the sites and an assessment of any potential impact, reference should be made to the relevant section of this ES, given within the table.

Table 5.1 Summary of international, European, national and local level sites

Environmental parameter	Hierarchical level	Summary of sites / features and location in relation to onshore grid connection
Nature conservation & ecology (ES Section 6)	International / European sites within 2km	North Norfolk Coast Ramsar/Special Protection Area (SPA)/ Special Area of Conservation (SAC) and the Wash and Norfolk Coast SAC - all approximately 1.2km to west of cable route at its northern most part at Muckleburgh.
		Norfolk Valley Fens SAC - approximately 1.5km to south-west of substation.
	National sites within 2km	Five Sites of Special Scientific Interest (SSSI) within 2km - nearest is Kelling Heath SSSI (located approximately 0.2km to west of cable route).
		No National Nature Reserves (NNR).
	County, district or local level sites and other listings within 2km	No Local Nature Reserves (LNR).
		30 County Wildlife Sites (CWS) - cable route passes through Kelling Heath Park and Hundred Acre Woods CWS and Brake Hills Plantation and Carman's Belt CWS.
		Cable route does not pass across any Roadside Nature Reserves (RNRs); two are located in study area.
		13 blocks of woodland listed on Ancient Woodland Inventory (AWI) (none along route corridor).
	Protected species	In summary ecological surveys recorded great crested newts, water vole, otter and several Schedule 1 listed birds. Refer to Section 6 for detail.
Archaeology and cultural heritage (ES Section 7)	National sites within 0.5km	Two Scheduled Monuments located 70m and 190m from cable route.
		13 Listed Buildings, nearest located 38m from cable route.
		Two Registered Parks and Gardens - Heydon Hall Grade II* - cable route runs adjacent and across a narrow section included in the designation. - Mannington Hall Grade II – cable route 220m from site.
	County, district or local level sites and other listings within 0.5km	Several Conservation Areas in the area - cable route crosses Baconsthorpe Conservation Area (settlement based) and the Heydon/Salle large-scale Rural Conservation Area.
		Other archaeological sites: - over 100 sites listed on Norfolk Historic Environment Record (NHER) - route crosses several of these - refer to detail in Section 7.
Landscape and visual (ES Section 9)	National sites within 2km	Heritage Coast - approximately 1.2km to west of cable route at its northern most part at Muckleburgh.
		Area of Outstanding Natural Beauty (AONB) - northern part of cable route located in the Norfolk Coast AONB.
		Scheduled Monuments, Registered Parks and Gardens and Listed Buildings – see above.
	Local plan designations and features	North Norfolk Area of High Landscape Value (AHLV) covers most of remaining cable route in North Norfolk area, excluding approximately 4.5km from Mere Farm to the BDC border. Broadland AHLV covers the whole cable route and substation located in the Broadland District.
		Conservation Areas – see above.

The documents making up the Development Plan contain a number of policies which are relevant to the Project. The following Sections provide a summary of the relevant policies for the following topic areas; renewable energy; nature conservation and ecology, archaeology and cultural heritage; landscape; and general and other environmental matters.

The Sections summarise the relevant regional, county and local level planning policies. Policies are grouped according to the Development Plan document from which they were extracted. A reference to the relevant section of the Environmental Statement is provided where applicable.

5.4.2 Renewable energy development plan policies

Level	Policy Summary	ES Reference
Regional Planning Policy - RPG6 East Anglia		
Policy 60: Renewable Energy	Policy 60 requires LPAs to include proposals for renewable energy generation in their plans, and sets out criteria against which applications for such schemes should be considered.	General ES
Regional Planning Policy - Draft East of England Plan		
Policy ENV8: Renewable Energy and Energy Efficiency	Includes several component polices which aim to help region move towards energy self-sufficiency, and meet and improve on its renewable energy targets. Renewable energy targets for the East of England region: 2010 (including Offshore Wind) 14%, 2020 (including offshore wind) 44%.	Refer to ES Section 1 (Statement of Need)
County Planning Policy - Norfolk Structure Plan		
Policy RC9: Renewable Energy	Policy RC9 encourages renewable energy developments that would not have any significant adverse environmental impact. It suggests that careful scrutiny should be given to designated sites, and states that where there is potential harm, the need to protect the county's assets will be weighed against the advantages of the proposed level of renewable energy generation.	Refer to ES Section 1 (Statement of Need) and General ES
Local Planning Policy - North Norfolk Local Plan		
Policy 99: Wind Turbines	Policy 99 states that the Council will take account of the benefit of clean renewable energy that will be generated and will balance this with the need to protect certain areas. Proposals will only be permitted when proven national interest and a lack of suitable alternative sites would justify an exception.	As above
Local Planning Policy - Broadland Local Plan		
Policy CS7: Renewable Energy	Policy CS7 encourages renewable energy developments that would not have any significant adverse environmental impact.	As above

5.4.3 Nature conservation and ecology development plan policies

Level	Policy Summary	ES Reference
Regional Planning Policy - RPG6 East Anglia		
Policy 38: Protection of Designated Sites	Policy 38 requests that Development plans give priority to protecting and enhancing areas that are designated at international and national level.	Refer to Section 6: 'Nature Conservation & Ecology'
Regional Planning Policy - Draft East of England Plan		
Policy ENV3: Biodiversity and Earth Heritage	Planning authorities and other agencies in their plans, policies and proposals will ensure that the internationally and nationally designated sites in the region are given the strongest level of protection.	As above
County Planning Policy - Norfolk Structure Plan		
Policy ENV6: Nature Conservation: Designated Sites	Policy ENV.6 determines that development which adversely affects Ramsar Sites, SPAs or SACs will not be permitted unless there is no alternative, overriding public interest, or an appropriate set of compensatory measures.	As above
Policy ENV7: National Designations	Developments adversely affecting NNR or SSSI will be resisted.	As above
Policy ENV8: Local Sites	Developments affecting sites of local importance including County Wildlife Site will only be permitted where it can be demonstrated that there are reasons for the proposals which outweigh the need to safeguard the interest of the site.	As above
Local Planning Policy - North Norfolk Local Plan		
Policy 28: Hedgerows, Trees and Woodland	Encouragement will be given to the conservation of hedgerows, trees and woodlands.	As above
Policy 32: Statutorily Designated Sites of Nature Conservation Importance	Policy 32 will not permit development proposals that could be significantly detrimental to the nature conservation interests of designated Ramsar Sites, Special Protection Areas, Special Areas of Conservation, Sites of Special Scientific Interest, the Broads, or National or Local Nature Reserves, either directly or indirectly.	As above
Policy 33: Nature Conservation Outside Statutorily Designated Sites	Policy 33 will not permit development proposals that could be significantly detrimental to a County Wildlife Site, either directly or indirectly, unless the proposed development is in the public interest and cannot be accommodated elsewhere. The Council will seek to protect the wildlife interest of other areas of nature conservation importance.	As above

Level	Policy Summary	ES Reference
Local Planning Policy - Broadland Local Plan		
Policy ENV4: Protection of habitats and species	Planning permission will not be given for a development proposal which would be likely to result in harm to a protected species or its habitat, unless measures will be taken to ensure that the species or habitat is protected.	As above
Policy ENV5: Management of natural features	Where appropriate, natural or semi-natural features will be protected, the establishment of new features sought, and appropriate management promoted. Particular importance will be attached to habitats referred to in the Norfolk Biodiversity action plan and the targets therein.	As above
Policy ENV6: SSSI's, local nature reserves and national nature reserves	Development in or near a Site of Special Scientific Interest (SSSI) or National Nature Reserve which would damage its special interest will not be permitted.	As above
Policy ENV7: Areas of local nature conservation importance	Development which would significantly adversely affect the wildlife interest of areas of local nature conservation importance, including county wildlife sites and ancient woodlands identified by English Nature, or the value of regionally important geological/ geomorphological sites (RIGS), will not be permitted.	As above

5.4.4 Archaeology and cultural heritage development plan policies

Level	Policy Summary	ES Reference
Regional Planning Policy – RPG6 East Anglia		
Policy 40: Conservation of East Anglia's Built and Historic Environment	Policy 40 requires plans to ensure that new development respects and enhances local character.	Refer to Section 7: 'Archaeology and Cultural Heritage'
Regional Planning Policy - Draft East of England Plan		
Policy ENV5: The historic environment	Protection will be given to the historic environment, its archaeology, historic buildings and areas of historic landscapes.	As above.
County Planning Policy – Norfolk Structure Plan		
Policy ENV13: Historic Buildings, Archeology and the Historic Environment	ENV13 seeks to protect Listed Buildings, historic landscapes, sites of archeological importance (whether scheduled or not), and their settings.	As above
Local Planning Policy – North Norfolk Local Plan		
Policy 25: Historic Parks and Gardens	Policy 25 resists developments which would be detrimental to the appearance or character of Historic Parks or Gardens, or their settings.	As above

Level	Policy Summary	ES Reference
Policy 35: Preservation of Listed Buildings	Policy 35 identifies that the Council will seek to ensure the preservation of all Listed Buildings and their settings.	As above
Policy 39: Development near Listed Buildings	Policy 39 requires that special attention will be paid to the need to protect the character of the Listed Building, when considering development proposals in the vicinity of a Listed Building.	As above
Policy 42: Development in Conservation Areas	Policy 42 resists developments that would not preserve or enhance the appearance or character of Conservation Areas.	As above
Policy 45: Archaeology	Policy 45 will require the submission of an archeological evaluation where proposals affect sites of archeological significance or potential significance. Physical preservation *in situ* is the preferred option where development is likely to have an adverse effect on important archaeological remains or their settings where they are of national importance.	As above
Local Planning Policy – Broadland Local Plan		
ENV10: Historic Parklands	Policy ENV10 resists development that would adversely affect the character of historic parkland and historic gardens.	As above
ENV14: Setting of Listed Buildings	Policy ENV14 resists development that would detract from setting of a Listed Building.	As above
ENV16: Conservation Areas	Policy ENV14 states that the character and appearance of Conservation Areas will be protected and enhanced.	As above
ENV17: Ancient monuments and Archeological sites	Policy ENV17 resists development that would adversely affect scheduled ancient monuments or other nationally important archeological sites and monuments or their settings.	As above
ENV18: Evaluation, recording and excavation of archaeological sites	Policy ENV18 states that where there is no overiding case for preservation of archaeological sites, development will only be permitted where agreement has been reached to evaluate, record and where desirable, excavate, the site.	As above
ENV20: Evaluation of archaeological significance	Policy ENV20 states that development proposals which appear to raise archaeological issues will be subject to evaluation.	As above

5.4.5 Landscape development plan policies

Reference should also be made to Section 5.4.4 in relation to policies relating to features of cultural heritage interest, such as Scheduled Monuments, Registered Parks and Gardens, Conservation Areas and Listed Buildings.

Level	Policy Summary	ES Reference
Regional Planning Policy - RPG6 East Anglia		
Policy 38: Protection of Designated Sites	Policy 38 requests that development plans give priority to protecting and enhancing areas that are designated at international or national level.	Refer to Section 9 'Landscape and Visual Impact'
Regional Planning Policy - Draft East of England Plan		
Policy ENV2: Landscape Character	States that planning authorities and other agencies in their plans, policies and programmes will provide the strongest levels of landscape character protection for the East of England's finest landscapes and areas of national importance.	As above
County Planning Policy - Norfolk Structure Plan		
Policy ENV2: Landscape: Protection of Designated Areas	Policy ENV2 will not permit development that is detrimental to any Area of Outstanding Natural Beauty (AONB), the Heritage Coast or the Broads, unless there is a proven national need for the development and there are no alternatives.	As above
Policy ENV3: Areas of Importance for Landscape Quality	Policy ENV3 states that proposals for development will only be acceptable where they can be shown to conserve and are sensitive to the appearance and character of areas of important landscape quality.	As above
Policy ENV12: Design	A high standard of design will be required for all new development reflecting where appropriate local styles, character and materials.	As above
Local Planning Policy - North Norfolk Local Plan		
Policy 20: Norfolk Coast AONB	This policy resists development which would be significantly detrimental to the Norfolk Coast Area of Outstanding Natural Beauty (AONB).	As above
Policy 21: Area of High Landscape Value	This policy resists development which would be significantly detrimental to the Area of High Landscape Value	As above
Policy 30: Important Landscape Features	Policy 30 states that development proposals that would be significantly detrimental to the appearance or character of important landscape features will not be permitted.	As above
Policy 42: Development in Conservation Areas	Policy 42 determines that development proposals within Conservation Areas will not be permitted unless they preserve or enhance the appearance or character of the Conservation Area. Development proposals affecting the setting of a Conservation Area or views into or out of the Conservation Area will be considered against the same criteria.	As above
Local Planning Policy - Broadland Local Plan		
Policy ENV8: Areas of Landscape Value	Policy ENV8 seeks to protect areas of landscape value and development will only be permitted where this is not detrimental to the character, scenic quality or visual benefit of the area.	As above

5.4.6 General and other environmental development plan policies

Level	Policy Summary	ES Reference
Regional Planning Policy - Draft East of England Plan		
Policy ENV1: Environmental Infrastructure	Environmental infrastructure will be identified, developed and implemented in the region to ensure that a healthy and enhanced environment is provided for the benefit of present and future communities and to contribute to economic objectives.	General ES
County Planning Policy - Norfolk Structure Plan		
Policy ENV.1 : Overall Strategy	Policy ENV1 seeks to protect the county's environmental assets, with special emphasis given to the protection, conservation and enhancement of areas of local landscape character or wildlife value, historic urban or rural environments, the setting of urban areas, towns and villages, and the environment generally.	General
Policy RC1: Protecting Water Quality	Development which will lead to a material deterioration in the quality of underground surface or coastal water will not be acceptable.	Refer to Section 8: 'Geology, hydrogeology, hydrology and land quality'
Policy RC4: River Corridors and Coastal Margins	Development will not be acceptable where it will have an adverse effect on fisheries, nature conservation, landscape and recreation in river corridors, coastal margins and other waterside areas.	Refer to Sections 6, 8, 9 and 12
Policy RC5: Agricultural Land	Development of the best and most versatile agricultural land and other agricultural land of value to wildlife will not be considered unless opportunities have been assessed for accommodating development needs on specified sites elsewhere.	Section 12: 'Land use, local community, tourism & recreation'
Local Planning Policy - North Norfolk Local Plan		
Policy 16: Pollution Control	Policy 16 resists developments which may result in nuisance, an unacceptable health risk or loss of amenity to, or significantly affect pollution-sensitive developments or statutory designated nature conservation sites, the AONB or wider countryside.	General ES
Policy 17: Control of Noise	Policy 17 will not permit proposals for noise-generating developments where the resulting ambient noise levels will affect noise sensitive developments or statutory designated sites of nature conservation importance, the Norfolk Coast AONB, the Broads or the wider countryside, or their quiet enjoyment.	Refer to Section 10 'Noise and Vibration'
Policy 22: Agricultural land	Policy 22 resists development on the best and most versatile agricultural land unless there is no suitable alternative on lower grade land.	Section 2 and 12
Policy 95: Groundwater Protection	Policy 95 resists development in areas around potable groundwater sources or over vulnerable areas of aquifers where the Council, in consultation with the Environment Agency, considers that there would be a significant risk to the quality of the groundwater.	Refer to Section 8: 'Geology, hydrogeology, hydrology and land quality'

Level	Policy Summary	ES Reference
Policy 97: Overhead Service Lines	Policy 97 states that development proposals for new overhead lines should seek to avoid the Norfolk Coast AONB and Conservation Areas unless a more suitable route is unavailable. In these areas, cables should be placed underground or in suitably concealed locations unless there would be no significant effect on landscape; or the negative effects of undergrounding outweigh the advantages.	Section 2: 'Site Selection and Consideration of Alternatives'
Local Planning Policy - Broadland Local Plan		
Policy GS3: Considerations for all development proposals	This policy lists a variety of considerations to be taken into account when considering all development proposals and development will not be permitted where there are unacceptable effects in terms of various criteria set out.	General ES
Policy ENV1: Protection and enhancement of environmental assets	Policy ENV1 seeks that the environmental assets of the District, including the character and appearance of the countryside and towns, villages and urban areas, will be protected.	General ES
Policy ENV2: Standards of layout and design	This policy requires a high standard of layout and design, including scale, form, height, mass, density, layout, landscape, access and crime prevention, and the use of appropriate materials	ES Sections 2, 3 and 9
Policy ENV21: Agricultural land quality	Policy ENV21 resists development on the best and most versatile agricultural land unless special justification can be shown and states a preference for development on areas of poorer quality land.	Section 12: 'Land use, local community, tourism & recreation'
Policy CS3: Ground water resources	Policy CS3 resists development which will have an unacceptable risk to the underlying groundwater in areas around potable ground water sources or over areas of vulnerable aquifers.	Refer to Section 8: 'Geology, hydrogeology, hydrology and land quality'
Policy CS12: Pollution prevention	Policy CS12 development will only be permitted where it will not result in a significant adverse environmental impact; including the effects on health, the natural environment, and general amenity. Where there is a risk of pollution by means of release to water, land or air, appropriate pollution prevention and control measures will be required.	General ES
Policy CS14: Noise levels	Policy CS14 resists development that will create high noise levels close to existing noise sensitive areas where noise levels are not so great, but still a potential problem. Any planning permissions will be subject to appropriate conditions or legal agreements requiring mitigating measures to be taken.	Refer to Section 10 'Noise and Vibration'

5.5 National Planning Policy

5.5.1 Introduction

As already noted, national planning policy is a material consideration when determining planning applications. The following sections provide a summary of the national Government Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) notes that are relevant to the Project.

5.5.2 Planning Policy Statement 1: Delivering Sustainable Development (PPS1)

Planning Policy Statement 1: 'Delivering Sustainable Development' (PPS1) establishes sustainable development as the core principle underpinning the planning system. The Government set out four aims for sustainable development in its 1999 strategy 'A Better Quality of Life – A Strategy for Sustainable Development in the UK' (HMSO, 1999). These are:

- Social progress which recognises the needs of everyone.
- Effective protection of the environment.
- The prudent use of natural resources.
- The maintenance of high and stable levels of economic growth and employment.

The implementation of renewable energy is recognised as an important mechanism for helping achieve sustainable development. Other principles embodied in PPS1 include the use of a spatial planning approach, the promotion of high quality design and the involvement of the community in delivering sustainable development.

5.5.3 Planning Policy Statement 22: Renewable Energy (PPS22)

The current Government policy guidance on renewable energy is Planning Policy Statement 22: Renewable Energy (PPS22), which replaced Planning Policy Guidance note 22 (PPG22) in 2004. PPS22 states that *'Increased development of renewable energy resources is vital to facilitating the delivery of the Government's commitments on both climate change and renewable energy'.* It sets out the principles that regional planning bodies and local planning authorities must take account for in the preparation of the relevant RSS and LDDs respectively. The policies may also be material to decisions on individual planning applications. 'Planning for Renewable Energy: A Companion Guide to PPS22' (ODPM, 2004) provides more details about particular technologies, as well as a range of good practice guidance on planning and renewable energy.

The key principles of PPS22 include:

- *'Regional spatial strategies and local development documents should contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources.'*
- *'At the local level, planning authorities should set out the criteria that will be applied in assessing applications for planning permission for renewable energy*

projects. Planning policies that rule out or place constraints on the development of all, or specific types of, renewable energy technologies should not be included in regional spatial strategies or local development documents without sufficient reasoned justification.'

- *'The wider environmental and economic benefits of all proposals for renewable energy projects, whatever their scale, are material considerations that should be given significant weight in determining whether proposals should be granted planning permission.'*
- *'Local planning authorities, regional stakeholders and Local Strategic Partnerships should foster community involvement in renewable energy projects and seek to promote knowledge of and greater acceptance by the public of prospective renewable energy developments that are appropriately located. Developers of renewable energy projects should engage in active consultation and discussion with local communities at an early stage of the planning process, and before any planning application is formerly submitted.'*
- *'Development proposals should demonstrate any environmental, economic and social benefits as well as how any environmental and social impacts have been minimised through careful consideration of location, scale, design and other measures.'*

5.5.4 Planning Policy Statement 9: Biodiversity and Geological Conservation (PPS9)

PPS9 was published in August 2005 and replaces PPG9, which had been in circulation since 1994. PPS9 promotes ways to conserve and enhance the diversity of England's wildlife and geology through land-use planning.

The document sets out key principles for how Government expects the planning system to meet its objectives. These include a clear requirement for the planning system to prevent harm to biodiversity and, wherever the right opportunities exist, to incorporate beneficial natural features into the design of development.

5.5.5 Planning Policy Guidance 15: Planning and the Historic Environment (PPG15)

The current Government policy guidance on the historic environment is Planning Policy Guidance 15: Planning and the Historic Environment (PPG15). The guidance sets policies for the identification and protection of historic buildings, conservation areas, and other elements of the historic environment. PPG15 seeks to give a sound basis on which to establish development plan policy and determine applications.

5.5.6 Planning Policy Guidance 16: Archaeology and Planning (PPG16)

The current Government policy guidance on archaeology is Planning Policy Guidance 16: Archaeology and Planning (PPG16), which sets out the Secretary of State's policy on archaeological remains. It acknowledges the fragile and finite nature of such remains, and states that the desirability of preservation of archaeological remains and their setting is a material consideration within the planning process.

PPG16 provides that there is a presumption in favour of the physical preservation of nationally important archaeological remains. Where preservation *in situ* is not justified it is reasonable for planning authorities to require the developer to make appropriate and satisfactory provision for excavation and recording of remains.

PPG16 suggests that it is in developers' own interests to include an initial assessment of whether the site is known or likely to contain archaeological remains as part of their research into the development potential of a site. It also adds that local planning authorities can expect developers to provide the results of such assessments as part of their application for sites where there is good reason to believe there are remains of archaeological importance. PPG16 identifies, however, that in spite of the best pre-planning application research, there may be occasions when the presence of archaeological remains only becomes apparent once development has commenced.

5.5.7 Planning Policy Statement 7: Sustainable Development in Rural Areas (PPS7)

PPS7 replaces PPG7 and is concerned with development in the countryside. The PPS sets out specific government objectives for rural areas, which include raising the quality of life and the environment in rural areas. Sustainable development is quoted as the core principle underpinning land use planning, and forms a key principle of PPS7. PPS7 endorses renewable energy generation in rural areas as long as they do not have significant adverse impacts on the landscape resource and designated sites.

With regard to local landscape designations, PPS7 does not automatically rule out development in landscapes of locally high value, noting in Para. 24 that:

> *'the Government recognises and accepts that there are areas of landscape outside nationally designated areas that are particularly highly valued locally. The Government believes that carefully drafted, criteria-based policies in LDDs, utilising tools such as landscape character assessment, should provide sufficient protection for these areas, without the need for rigid local designations that may unduly restrict acceptable, sustainable development and the economic activity that underpins the vitality of rural areas.'*

5.5.8 Planning Policy Guidance 24: Planning and Noise (PPG24)

PPG24 is the Government's current Planning Policy Guidance on Planning and Noise. It provides advice on how noise issues should be balanced with other material planning considerations in the determination of planning applications. The document recognises the need to give special consideration of noise issues where development is proposed in or near SSSI. Similarly, the PPG indicates that special consideration should also be given to development that would affect the quiet enjoyment of AONBs or Heritage Coasts. The effect of noise on the enjoyment of other areas of landscape, wildlife and historic value should also be taken into account.

5.6 References

Broadland District Local Plan (Replacement) 2006
Broadland District Council

Department of Communities and Local Government 2003
Sustainable Communities Plan

East of England Regional Assembly 2004
East of England Plan
Draft Revision to the Regional Spatial Strategy for the East of England

Government Office for the East of England 2000
Regional Planning Guidance for East Anglia to 2016
RPG6 November 2006

HMSO 1999
A Better Quality of Life - A Strategy for Sustainable Development for the UK
CM 4345, May 1999

Norfolk County Council 1999
Norfolk Structure Plan

North Norfolk District Council 1998
North Norfolk Local Plan

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 6

NATURE CONSERVATION AND ECOLOGY

6 NATURE CONSERVATION AND ECOLOGY

6.1 Introduction

This section provides information on the existing nature conservation and ecological interests within the vicinity of the proposed onshore grid connection development. This includes information on any statutory or non-statutory nature conservation sites, habitats of ecological importance and any protected or Biodiversity Action Plan (BAP) species.

Detailed ecological surveys have been carried out to gather information on the baseline environment. This information has been supplemented with data obtained through desk-study, data searches and consultation with Natural England, Norfolk Wildlife Trust, the Environment Agency, and other local interest groups.

Potential impacts on these interests arising from the construction and operation of the project have been assessed and mitigation measures outlined where appropriate in order to prevent, reduce or minimise any possible effects.

6.2 Assessment Methodology

6.2.1 Relevant policy, legislation, guidance and best practice

In addition to the national, regional, county and district policy and planning guidance outlined in Section 5: ‘Planning Policy and Guidance’, the nature conservation and ecological assessment has been undertaken with reference to the following legislation, policy, guidance and best practice documents:

- EC Habitats Directive (Council Directive 92/43/EEC).
- EC Birds Directive (1979) (Council Directive 79/409/EEC).
- The Conservation (Habitats, &c) Regulations 1994 (Council Directive 92/43/EEC).
- Wildlife and Countryside Act 1981 (as amended).
- Countryside Rights of Way (CRoW) Act (2000).
- Guidelines for Ecological Impact Assessment in the United Kingdom (Institute of Ecology and Environmental Management (IEEM), 2006).
- UK Biodiversity Action Plan (1994).
- Norfolk Biodiversity Action Plan (working document).

6.2.2 Impact identification, significance levels and mitigation

The significance level (negligible, minor, moderate, major adverse or beneficial) of identified impacts are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification and Table 4.4 for definitions of significance levels.

6.2.3 Desk-based assessment

The initial cable route identification studies included the identification and collation of information on any statutory and non-statutory nature conservation designations or habitat inventories available in the public domain, for a wide study corridor, including:

- Ramsar sites.
- Special Protection Areas (SPAs).
- Special Areas of Conservation (SACs).
- Sites of Special Scientific Interest (SSSIs).
- National Nature Reserves (NNRs).
- Local Nature Reserves (LNRs).
- Ancient Woodland Inventory (AWI).
- County Wildlife Sites (CWS).
- National Inventory of Woodland and Trees (NIWT).
- Other features of ecological significance (e.g. woodlands, grassland, heath-land, wetland habitats).

The presence of these sites was taken into consideration during the early stages of the route identification process. Where possible, the route corridor options were designed by Scira to avoid any ecologically sensitive sites. Once the route identification process had narrowed down the potential area to a preferred road-based route and a wide area of agricultural land under consideration for off-road options (refer to Section 2: 'Site Selection and Consideration of Alternatives'), a search of records held by Norfolk Wildlife Trust of any protected species occurring in this study corridor was carried out by Norfolk Wildlife Services. The micro-planning of the off-road route also involved analysis of detailed aerial photography to align the route to avoid individual trees and utilise existing gaps in hedgerows wherever possible (also discussed in Section 2).

6.2.4 Consultation and ecological data search

A meeting was held with Natural England at the initial stage of the route identification and EIA process in order to discuss and agree the scope of ecological survey and assessment necessary. Several meetings with North Norfolk District Council and Broadland District Council Countryside officers were also carried throughout the EIA process.

Further written consultation during the EIA process relating to ecological assessment was carried out with Natural England, Norfolk Wildlife Trust, Environment Agency, RSPB and several other local interest groups and organisations. Specific consultation was carried out with Natural England in relation to great crested newt (*Triturus cristatus*) and with Norfolk Wildlife Trust relating to the Kelling Heath Park and Hundred Acre Wood County Wildlife Site.

A thorough ecological data search was carried out which included a search of the Norfolk Biological Records Centre (NBRC) database. As part of the EIA consultation, organisations and interest groups were also requested to provide any relevant ecological data which may be held.

A record of any responses is included in **Appendix 4.2** (Consultation Summary). Where relevant data was obtained, this has been incorporated and considered in the overall assessment.

6.2.5 Site surveys

Overview

A detailed set of ecological surveys were carried out by specialists Norfolk Wildlife Services (NWS) on behalf of Royal Haskoning between July 2006 and May 2007 in order to identify the habitats and species present. The study area covered the road-based route under consideration at the time of the surveys, as well as off-road route corridors across agricultural land being assessed.

A separate survey programme for great crested newts was conducted by Robert Yaxley Ecological Surveys Ltd. on behalf of Royal Haskoning between February and May 2007. The surveys covered both the road and off-road based routes under consideration.

The rest of this Section discusses only the areas surveyed in relation to the proposed cable system alignment and the location of the proposed substation at Salle, however, full details of the two survey programmes, which covered both road and off-road routes under consideration, can be seen in **Appendix 6.1** (Ecological Survey Report, Norfolk Wildlife Services, 2007) and **Appendix 6.2** (Great Crested Newt Survey Report, Robert Yaxley Ecological Surveys Ltd., 2007).

The methodology for each element of the surveys is summarised below. For full detail the reader is referred to the original survey reports.

Extended Phase 1 Habitat survey

A Phase 1 Habitat Survey was undertaken in September 2006. The surveys followed the methodology outlined in the 'Handbook for Phase 1 Habitat Survey: A technique for environmental audit' (JNCC, 2003). The survey was 'extended' to assess the suitability and availability of habitats for protected species, as discussed further below. The habitat surveys included land up to 50m either side of the route corridors being surveyed.

All habitats within the study area were recorded and mapped using annotated coded maps indicating broad habitat and boundary features. Hedgerows were subject to a detailed level of botanical survey in order to record the composition of woody species within the hedgerow, hedgerow trees, climbers and ground flora. Grass verges were also surveyed for their botanical composition.

Within any areas of natural or semi-natural vegetation, including woodlands, scrub, grasslands and water features, detailed target notes were taken to record the key characteristics and dominant species present. Target notes were also used to map any rare or scarce plants.

Further surveys were carried out during April and May 2007 along any road verges adjacent to woodlands and at two Roadside Nature Reserves (RNR). The purpose of these additional surveys was to reinforce the previous year's survey, to record any vernal (spring) botanical species which would not have been present during the initial surveys, and to identify species for which the RNRs were designated. Any new off-road route sections which had been proposed since the original surveys, due to ongoing route modifications throughout the EIA process, were also subject to survey in spring 2007.

Badger survey

The study area was surveyed for evidence of badger (*Meles meles*) activity during September 2006 and April and May 2007. This involved recording any suitable habitat, runs, snuffle holes, hairs, scratch marks, setts and sightings. Any badger setts recorded were subject to a further level of survey to record sett characteristics and activity levels.

Otter and water vole survey

Any watercourses or water-bodies adjacent to or crossing the route corridors were surveyed for their suitability to support otter (*Lutra lutra*) and water vole (*Arvicola terrestris*) and to record any evidence of the two species. The survey area was extended to 100m either side of the routes being surveyed. Where watercourses ran adjacent to a route, these were surveyed in their entirety. Specific survey forms were completed to record the characteristics of each watercourse or water-body and any evidence of otter, water vole, rat (*Rattus norvegicus*), mink (*Mustela vison*) or any other wildlife.

Surveys to record evidence of water vole followed the methods outlined in the "Water vole conservation handbook" (Strachan, 1998). Field signs searched for (and mapped if present) included droppings, latrines (piles of droppings), burrows, nests, feeding stations, runs and any sightings. Otter signs were searched for by looking for spraints, footprints, slides, and potential holt and resting sites within the survey areas.

Great crested newt survey

Great crested newt surveys were conducted in three phases: initial water-body assessments; presence/absence surveys; and population estimates. Full details of the process are included in **Appendix 6.2**. The survey methodology followed Natural England's recommendations outlined in the 'Great crested newt mitigation guidelines' (English Nature, 2001). This entailed the identification of a study area consisting of a 500m distance either side of any off-road route options under consideration, which is based upon the theoretical area that great crested newts could potentially utilise as terrestrial habitat between breeding ponds. Following discussions with Natural England

and in consideration of the minimal potential for impact, it was agreed during the Scoping stage that this distance would be reduced to 50m either side of any road-based routes being assessed. All ponds, or other suitable water features within the study area were identified from an analysis of Ordnance Survey mapping. This was supplemented with a rapid walkover to identify any additional ponds not shown in proximity to the routes.

Providing access was obtained, all ponds were subject to initial water-body assessments: firstly to assess their suitability for supporting great crested newts; and secondly to assess the likelihood of any impact occurring to the species in relation to the proposed grid connection. This second element considered the distance and the types of habitats or physical barriers between the pond and the proposed route/s, as well as the presence of suitable terrestrial and aquatic habitat in proximity to the pond. The information was used to assess the likelihood of any impact occurring and therefore, the need (or otherwise) for further detailed survey to establish whether great crested newts were present or absent from the ponds. A report summarising the assessments and the ponds recommended for further presence/absence surveys, was presented to Natural England for their approval. Natural England confirmed that the approach and recommendations for further survey was acceptable to them.

Following Natural England guidelines (English Nature, 2001), the surveys to determine presence or absence of great crested newts involved four survey visits, carried out between mid-March and mid-June, with at least two of the visits being carried out between mid-April to mid-May (the key survey season, during which newts are most active, and therefore recordable, in their aquatic habitat). Depending upon the characteristics of each of the ponds, each survey visit consisted of three of the four following survey methods: torch survey; bottle trapping; pond netting; or egg searching. The sex and life stage of any great crested newts found were recorded. Any other amphibian species or other wildlife encountered during the surveys was also noted, along with weather conditions and any evidence of disturbance.

In line with the Guidelines, in order to assess the level of any potential impact and design suitable mitigation, where great crested newts have been recorded as present, it is necessary to estimate the population size. This third and final stage involved two additional survey visits to any ponds where great crested newts had been recorded, following the same survey methodology as carried out during the presence/absence surveys. The timing of these additional two survey visits also needed to be carried out between mid-March and mid-June, making sure that in total, three of six visits were carried out between mid-April to mid-May. The surveys were all carried out before the end of May 2007 and were therefore in line with the recommended timing (English Nature, 2001).

The great crested newt survey programme was not completed for certain ponds due to refused or revoked access. Full details are provided in **Appendix 6.2** along with an assessment of the effect that this may have had on the accuracy of the results, for the purposes of impact assessment.

Following the identification of the proposed route alignment, a workshop was held between the great crested newt surveyors and Royal Haskoning in order to discuss and outline a suitable mitigation strategy to minimise impact to great crested newts in relation to the proposed onshore grid connection.

Assessment of habitat for other protected or BAP species

As discussed, the standard Phase 1 Habitat survey was extended in order to assess the suitability of the habitats present to support any other protected or Biodiversity Action Plan (BAP) faunal species or groups. This included the recording and mapping of any suitable habitat, evidence or sighting of the following groups:

- Bats - Potential bat roost sites, such as mature trees and dilapidated buildings were noted and mapped, along with any foraging opportunities.
- Breeding birds - Suitable habitat for supporting breeding birds was recorded and mapped and any sightings were noted. Specific surveys for breeding birds were scoped out during the Scoping stage, based on the characteristics of the project, and in consultation with Natural England.
- Other amphibians – Suitable habitat for amphibians was noted during the habitat surveys. Detailed surveys for great crested newts (outlined above) also recorded the presence of other amphibians in the water-bodies surveyed.
- Reptiles - No targeted surveys were carried out for reptiles; however suitable habitat within the study area was identified and recorded and any incidental sightings noted.
- Invertebrates - Any watercourses (e.g. ditches, streams) crossed by the route corridors surveyed were assessed for their invertebrate interest. Other habitats likely to contain important assemblages of invertebrates were also noted, along with any incidental sightings.
- White-clawed crayfish - Any features likely to support white-clawed crayfish (*Austropotamobius pallipes*) were noted, mapped and flagged for further survey work, if required.

Other surveys and visits

In addition to the survey programmes outlined, site visits were also carried out by a Royal Haskoning ecologist to look at the specific route alignments and working area needs.

Surveys carried out in relation to the current application to the Department of Business, Enterprise and Regulatory Reform (DBERR) for the Sheringham Shoal Offshore Wind Farm were also utilised. These included an extended Phase 1 Habitat Survey and specific surveys for great crested newts, reptiles and breeding birds in the general area covered by the Muckleburgh Collection museum, from the shingle beach south to the A149 road. The surveys were carried out by Norfolk Wildlife Services between March and July 2005 and reported within the Environmental Statement which accompanied the application to DBERR (NWS 2005, appended to Scira, 2006). An additional reptile survey was also carried out during April and May 2006 (NWS, 2006) and provided as supplementary information to DBERR.

6.3 Existing Environment

6.3.1 Nature conservation designations

Overview

The route of the proposed cable system has been designed to avoid close contact with features of ecological significance, such as nature conservation sites and habitat inventories, wherever feasible. In some circumstances, due to technical issues, other environmental parameters, or the need to avoid unnecessary diversions, this has not been possible.

The following sections detail the presence of any statutory or non-statutory nature conservation sites or inventories located in a 2km radius of the proposed cable system and substation. The location of these sites is shown on **Figure 6.1**.

Any sites which are likely to be affected by the proposed onshore grid connection during the construction or operational phases are discussed in more detail in Sections 6.4 and 6.5 respectively.

International statutory sites

Relevant international nature conservation designations include Ramsar sites, Special Protection Areas (SPAs) and Special Areas of Conservation (SACs).

Ramsar sites are designated under the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the “Ramsar Convention”). The Convention’s remit goes beyond birds, however, to provide a framework for national action and international co-operation for the conservation and wise use of wetlands and their natural resources.

SPAs are statutory designated sites, which are classified under EU law in accordance with Article 4 of the EC Directive on the conservation of wild birds (79/409/EEC), also known as the “Birds Directive”. SPAs are designated for supporting significant populations of rare and vulnerable birds, listed in Annex I to the Birds Directive, and for regularly occurring migratory species.

SACs are sites designated under the EU Directive 92/43/EEC on the conservation of habitats and of wild fauna and flora (the “Habitats Directive”) because they make a significant contribution to conserving priority habitat types and species, excluding birds, listed in the Annexes to the Directive. SACs together with SPAs form the Natura 2000 network, which is designed to protect Europe’s most important areas for wildlife.

The location and boundaries of international nature conservation sites in the general study area are shown on **Figure 6.1**.

Sites located within 2km of the proposed onshore grid connection are summarised in **Table 6.1**.

Table 6.1 International nature conservation designations within 2km

MapID	Name	Easting	Northing	Area (ha)
Ramsar				
RAM 1	North Norfolk Coast	576,629	345,447	7861.4
SPA				
SPA 1	North Norfolk Coast	576,629	345,447	7861.4
SAC				
SAC 1	North Norfolk Coast	588,325	345,731	3150.0
SAC 2	The Wash and Norfolk Coast	554,095	342,236	107,732.25
SAC 3	Norfolk Valley Fens	598,188	312,053	616.5

National statutory sites

Statutory national sites include Sites of Special Interest (SSSI) and National Nature Reserves (NNR).

SSSI is a statutory national designation awarded to the country's best biological and geological sites, of which there are currently around 4,000 in England. SSSIs are notified and afforded protection under the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act 2000).

The presence of any SSSI located in the general study area is shown on **Figure 6.1**. There are five SSSIs within 2km of the onshore grid connection, as summarised within **Table 6.2**.

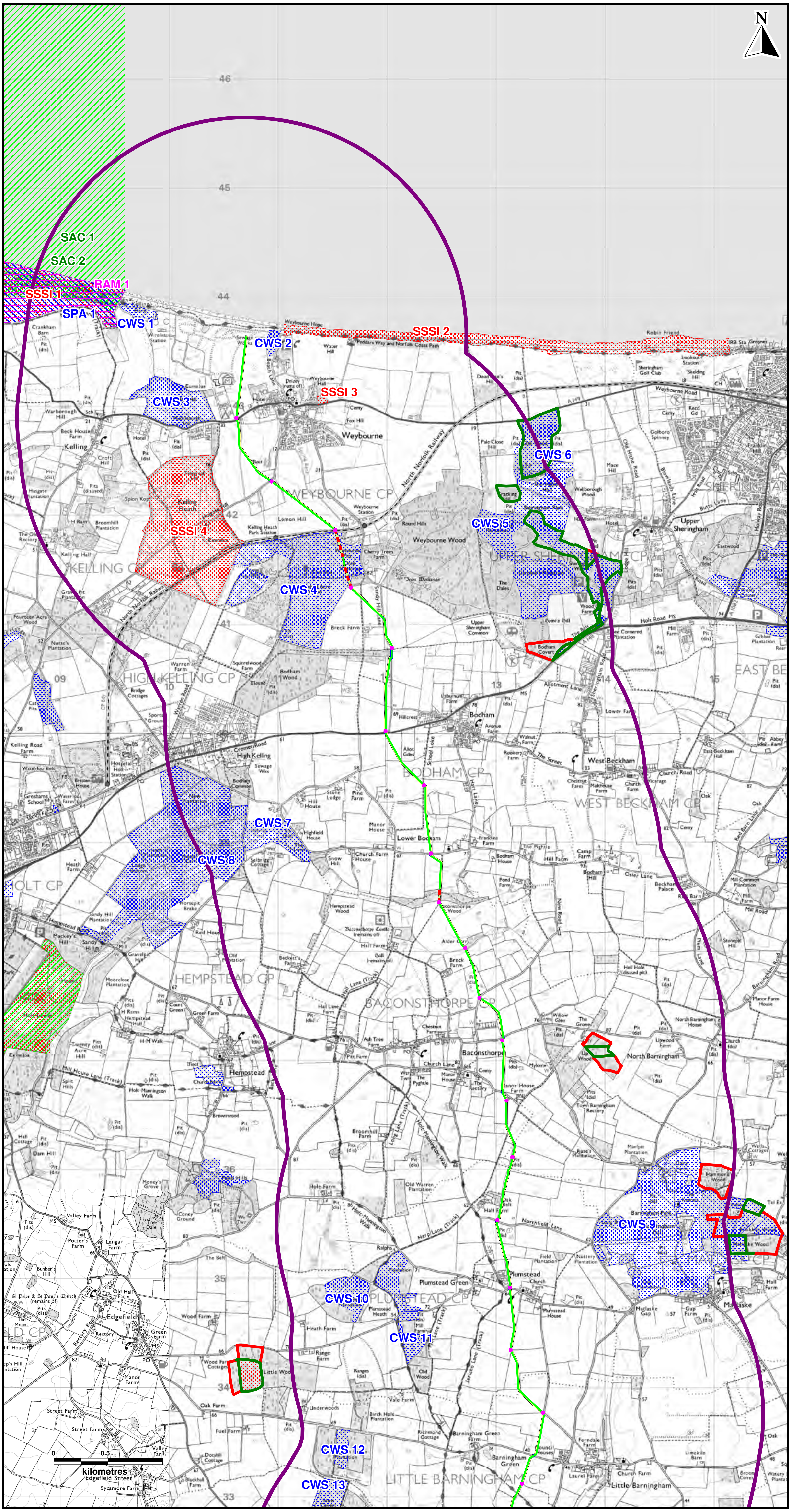
There are no NNR within 2km of the proposed onshore grid connection. Clarification has been provided within the table as to whether the outlined sites are designated for the biological or geological interest, or both.

Table 6.2 SSSI within 2km

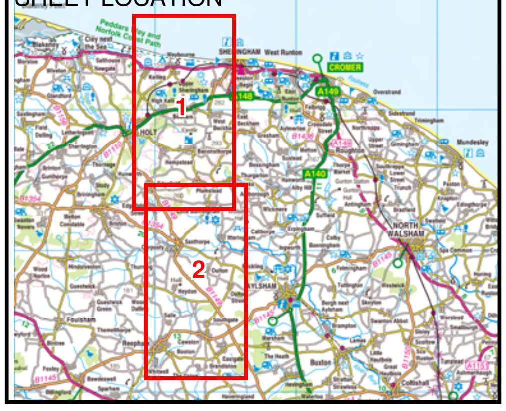
MapID	Name	Biological / Geological	Easting	Northing	Area (ha)
SSSI 1	North Norfolk Coast	Biological	576,629	345,447	7861.4
SSSI 2	Weybourne Cliffs	Biological & Geological	612,810	343,605	40.9
SSSI 3	Weybourne Town Pit	Geological	611,410	343,057	0.6
SSSI 4	Kelling Heath	Biological & Geological	610,191	342,012	89.5
SSSI 5	Booton Common	Biological	611,245	322,985	8.2

Local sites and other listings

This category includes sites designated as Local Nature Reserves (LNR) as well as any sites listed as County Wildlife Sites (CWS), areas of land listed on Natural England's Ancient Woodland Inventory (AWI) and Roadside Nature Reserves (RNR).



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor

Substation

- Total extent of proposed substation

Nature Conservation Sites

- RAMSAR sites
- Special Protection Areas
- Special Areas of Conservation
- Sites of Special Scientific Interest
- County Wildlife Sites
- Ancient woodland (semi-natural)
- Ancient Woodland (replanted)
- Roadside Nature Reserves
- 2km buffer from construction corridc

Data Source/s:
RAMSAR, SPA, SAC, NNR, AWI boundaries
© Natural England.
CWS boundaries supplied by Norfolk Wildlife Trust.

Title:
NATURE CONSERVATION SITES

SHEET 1 OF 2

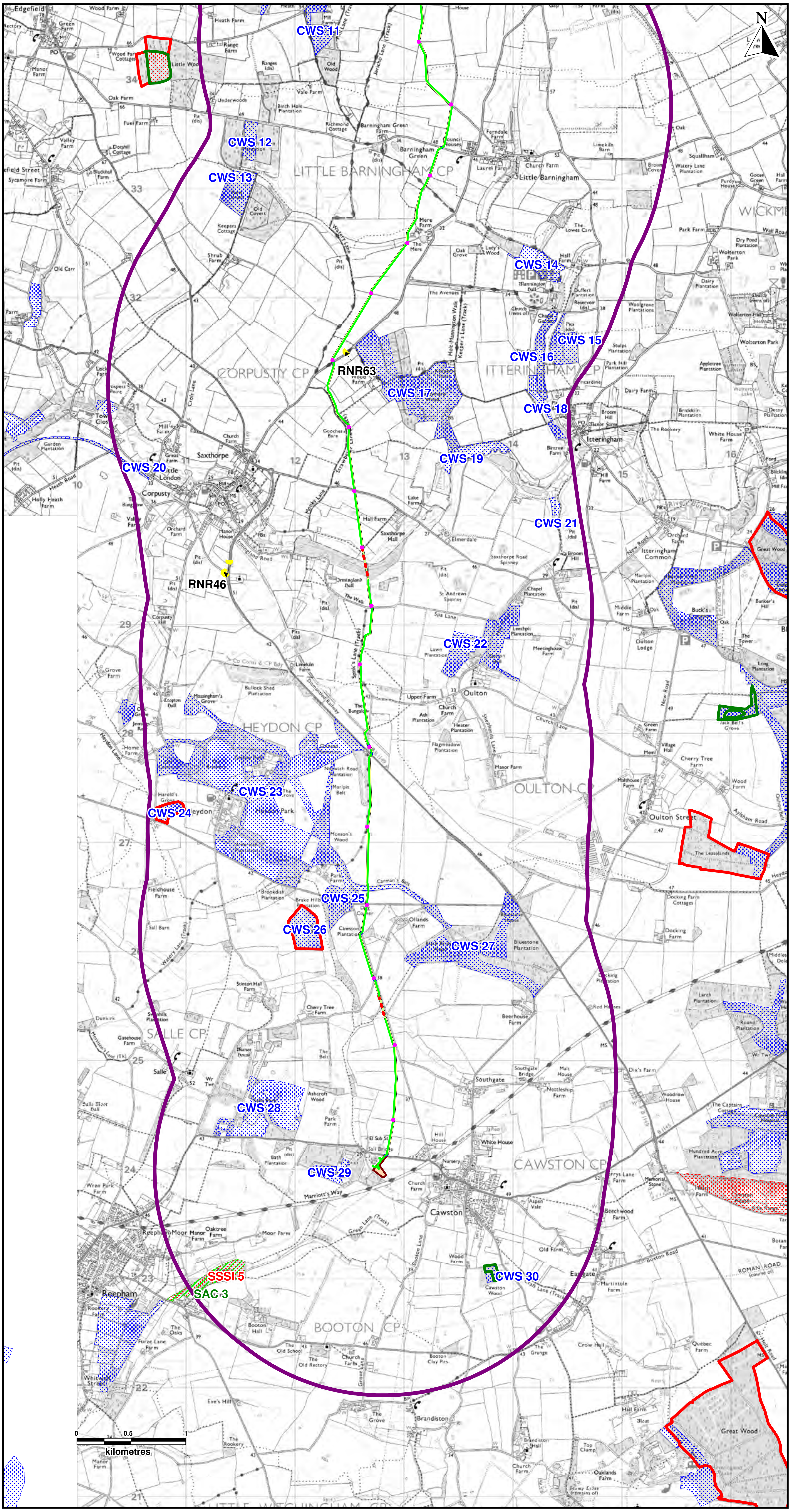
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 6.1 (1 of 2)

ROYAL HASKONING



LEGEND:

Proposed Onshore Grid Connection

Cable System

Open trenching in agricultural land

Open trenching across or within Highway

Directional drilling

Likely location of jointing pits and cross-bonding pits

Open trenching construction corridor

Substation

Total extent of proposed substation

Nature Conservation Sites

RAMSAR sites

Special Protection Areas

Special Areas of Conservation

Sites of Special Scientific Interest

County Wildlife Sites

Ancient woodland (semi-natural)

Ancient Woodland (replanted)

Roadside Nature Reserves

2km buffer from construction corridor

Data Source/s:
RAMSAR, SPA, SAC, NNR, AWI boundaries
© Natural England.
CWS boundaries supplied by Norfolk Wildlife Trust.

Title:
NATURE CONSERVATION SITES

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 6.1 (2 of 2)

ROYAL HASKONING

CWS are a non-statutory notification which recognises the wildlife value of a site and creates a partnership between landowners and conservation agencies. The CWS system in Norfolk is managed by Norfolk Wildlife Trust (NWT), in partnership with Natural England, Department for Environment, Food & Rural Affairs (DEFRA) and Norfolk County Council. CWS are listed within the relevant Local Plans and all local councils within the study area have developed policies that provide CWS some protection. If a CWS is, or appears to be, likely to be affected by a development, the views of NWT will be sought as part of the consultation process.

Natural England's Ancient Woodland Inventory (AWI) lists areas of ancient woodland that have had a continuous woodland cover since at least 1600 AD. The inventory is split into two categories. Ancient Semi-Natural Woodland (ASNW) has retained a native tree and shrub cover that has not been planted, although it may have been managed by coppicing or felling and allowed to regenerate naturally. Plantation on Ancient Woodland Sites (PAWS); are where the original tree cover has been felled and replaced by planting, often with conifers, and usually over the last century.

The location of CWS, AWI and RNR sites in the general study area are shown on **Figure 6.1**. There are no LNR in the nearby study area. **Table 6.3** summaries the sites within a 2km radius of the proposed onshore grid connection.

Table 6.3 CWS and AWI sites within 2km

MapID	Name	Easting	Northing	Area (ha)
CWS				
CWS 1	Kelling Hard	609,721	343,585	2.9
CWS 2	Beach Lane, Weybourne	610,956	343,583	1.9
CWS 3	Muckleburgh Hill	610,030	343,036	21.2
CWS 4	Kelling Heath Park and Hundred Acre Wood	611,191	341,310	65.3
CWS 5	Sheringham Wood and Park	613,483	341,581	77.0
CWS 6	Oak Wood	613,372	342,650	17.0
CWS 7	Old Decoy, Selbrigg Pond, The Lows	610,993	339,019	12.7
CWS 8	Land south of High Kelling	609,943	338,861	116.4
CWS 9	Barningham Park Estate	614,303	335,500	115.1
CWS 10	Fir and Nineways Plantation	611,636	334,812	18.8
CWS 11	Old Wood	612,219	334,458	5.6
CWS 12	Barningham Green Plantation	611,588	333,456	4.0
CWS 13	New Covert	611,476	332,951	8.3
CWS 14	Home and Lady's Meadows	614,216	332,307	7.3
CWS 15	Park Hill Plantation	614,472	331,620	7.2
CWS 16	The Cut	614,254	331,469	6.5
CWS 17	Mossymere Wood	613,049	331,133	38.9
CWS 18	Land adjacent to New Cut	614,300	330,988	3.5
CWS 19	Bure Valley	613,533	330,533	5.6
CWS 20	Dismantled Railway	608,159	330,563	5.7
CWS 21	Grove Meadow	614,381	330,084	1.0
CWS 22	Lawn and Leachpit Plantations	613,566	328,833	18.2
CWS 23	Heydon Park	611,686	324,479	120.6
CWS 24	Harold's Grove	610,860	327,275	3.1

MapID	Name	Easting	Northing	Area (ha)
CWS 25	Brake Hills Plantation and Carman's Belt	612,441	326,497	12.0
CWS 26	Newhall Wood	612,096	326,223	8.7
CWS 27	Blackbridge Wood	613,640	326,059	27.0
CWS 28	Salle Park	611,669	324,582	23.3
CWS 29	The Former Common	612,315	323,983	3.4
CWS 30	Cawston Wood	613,805	323,045	1.6
AWI				
There are 13 blocks of woodland listed on the AWI within 2km; six are semi-natural; seven are replanted. Sites are not listed separately, but shown on Figure 6.1.				

6.3.2 Habitats and plants

Overview

The predominant habitat across the general area subject to survey consists of land under arable cultivation with occasional fields of grassland, the majority of which are improved or neutral/poor semi-improved grassland. Fields are generally enclosed by hedgerows and occasional trees. Areas of woodland and parkland are present and scattered across the study area. The surveyed area is fairly dry and water features are restricted to the River Bure, Spring Beck and small tributaries of the River Wensum and River Glaven, several ditches, and field ponds.

A Phase 1 Habitat map of the corridor surrounding the proposed onshore grid connection is given as **Figure 6.2**.

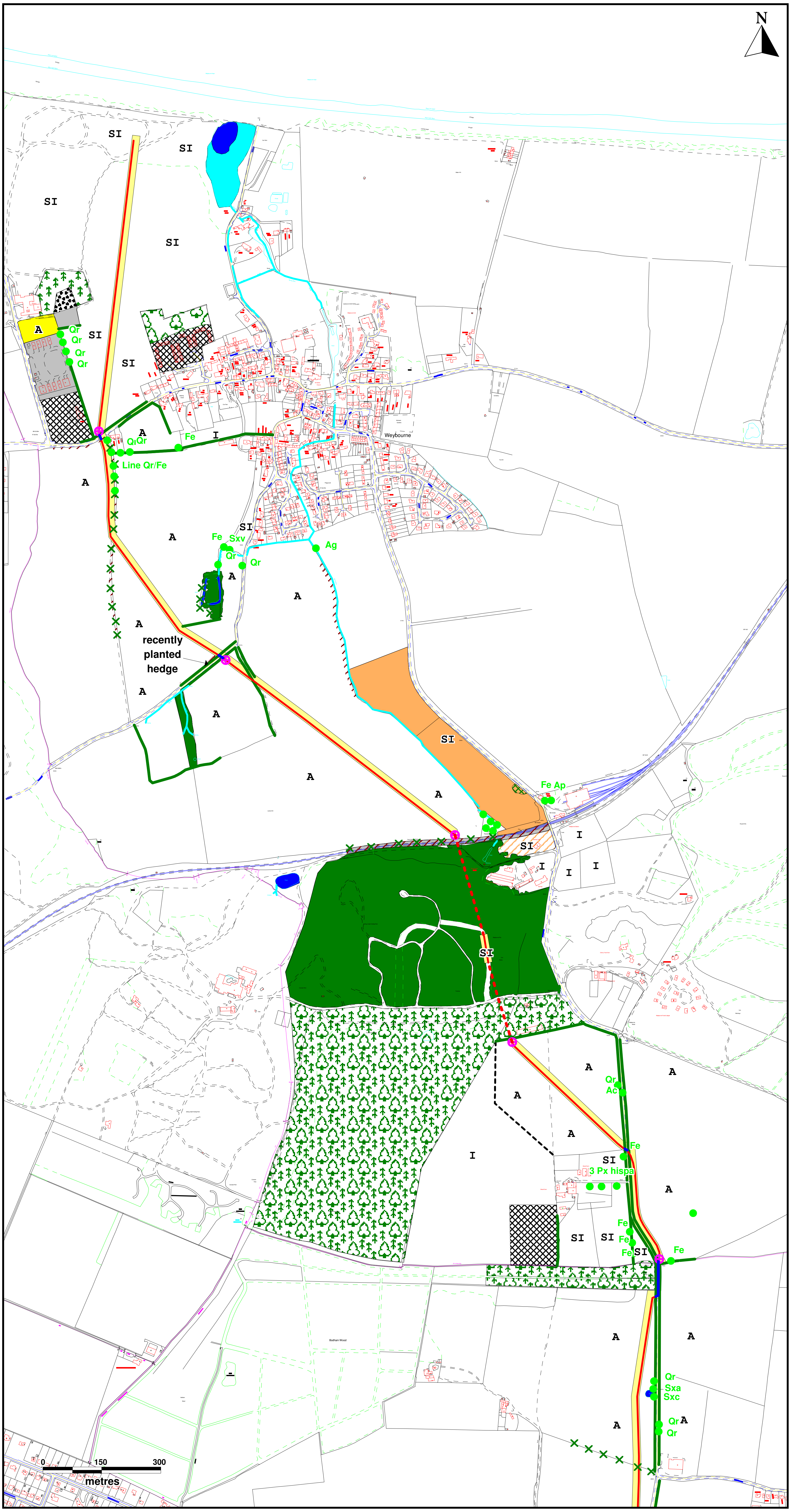
Descriptions of each of the main habitats present in the general corridor of the proposed grid connection are discussed below. The presence of any rare or scarce plants are also highlighted where recorded.

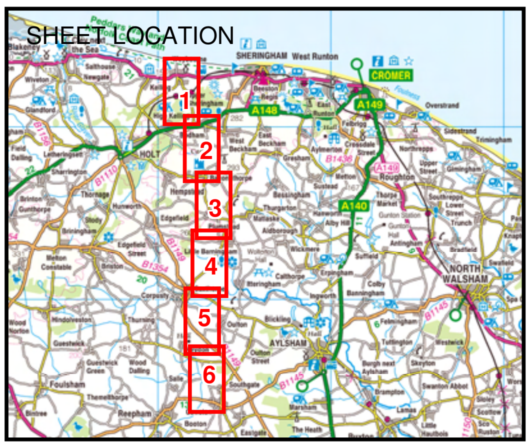
An inventory of all of the habitats and boundary features through which the proposed cable system passes, and the site of the proposed substation is given as **Appendix 6.3**.

Hedgerows and scattered trees

The hedgerows present along the survey corridor are typical of recent enclosure landscape and are mostly of minor to moderate ecological value with some of high value along the route. Dominant species present are hawthorn (*Crataegus monogyna*) and blackthorn (*Prunus spinosa*). Other woody hedgerow species frequently encountered include elder (*Sambucus nigra*), dog rose (*Rosa canina*), field maple (*Acer campestre*), ash (*Fraxinus excelsior*) and pedunculate oak (*Quercus robur*), and to a lesser extent dogwood (*Cornus sanguinea*), sycamore (*Acer pseudoplatanus*), gorse (*Ulex europaeus*) and hazel (*Corylus avellana*).

The hedgerows recorded typically contain between four and six woody species, although in some areas hedgerows contain very high numbers of species. Of particular note is the area to the north and south of Baconsthorpe, where a higher number of hedgerows were recorded as high or moderate value.





LEGEND:

Proposed Onshore Grid Connection

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross bonding pits
- Open trenching construction corridor
- Total extent of proposed substation

Phase 1 Habitat types

- Semi-natural broadleaved woodland
- Plantation broadleaved woodland
- Plantation mixed woodland
- Plantation coniferous woodland
- Scattered broadleaved trees
- Orchard
- Dense scrub
- Scattered scrub
- SI Semi-improved neutral grassland
- SI Semi-improved acid grassland
- Marshy grassland
- Floodplain valley mire
- SI Poor semi-improved grassland
- I Improved grassland
- Tall ruderal
- Open water
- Running water
- Dry ditch
- Swamp
- Hedgerow
- A Arable field
- A Amenity grassland
- Caravan site
- Bare ground
- Hard standing and buildings
- Habitat boundary

Title:
PHASE 1 HABITAT MAP

SHEET 1 OF 6

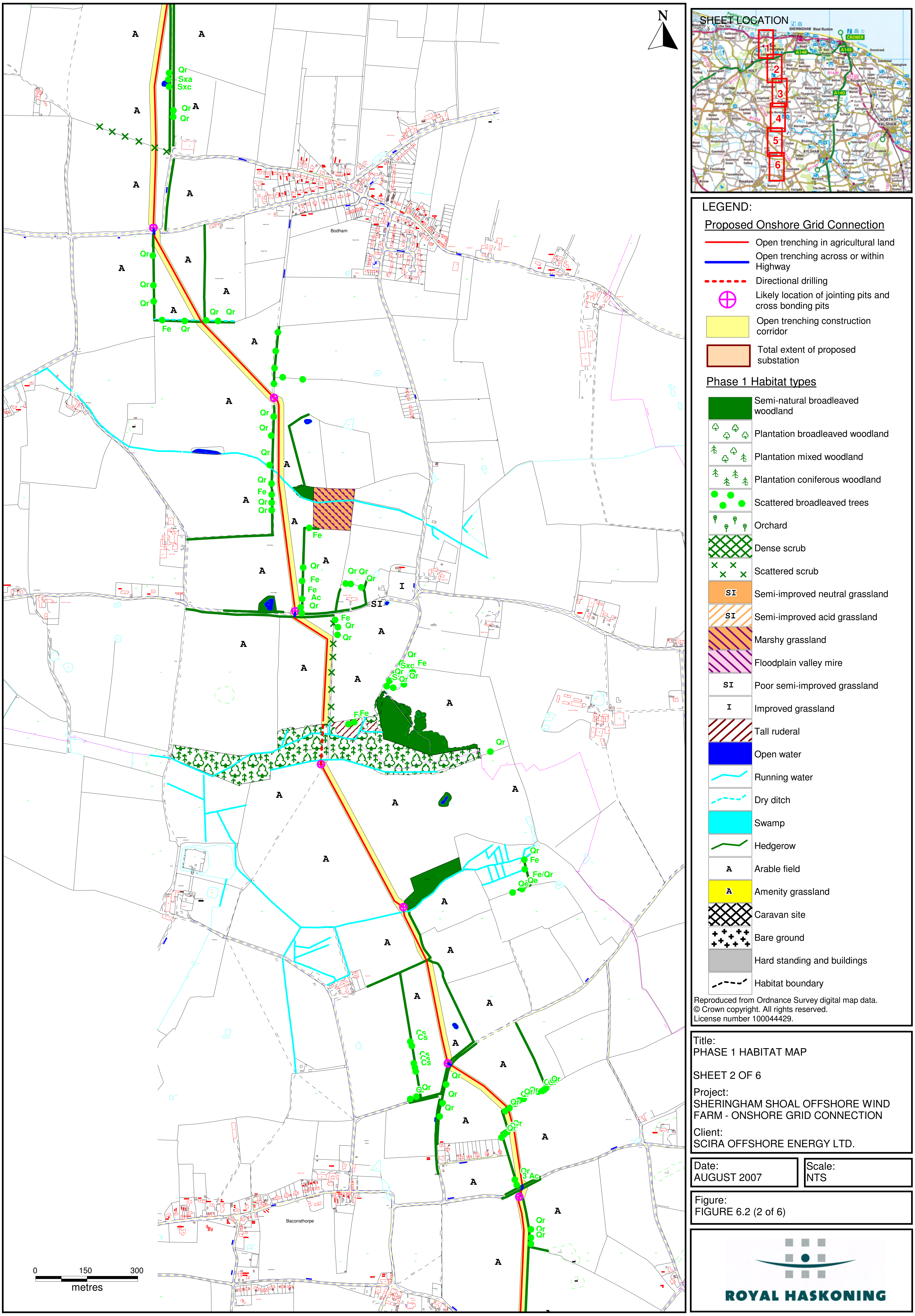
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 6.2 (1 of 6)

ROYAL HASKONING



Title:
PHASE 1 HABITAT MAP

SHEET 2 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

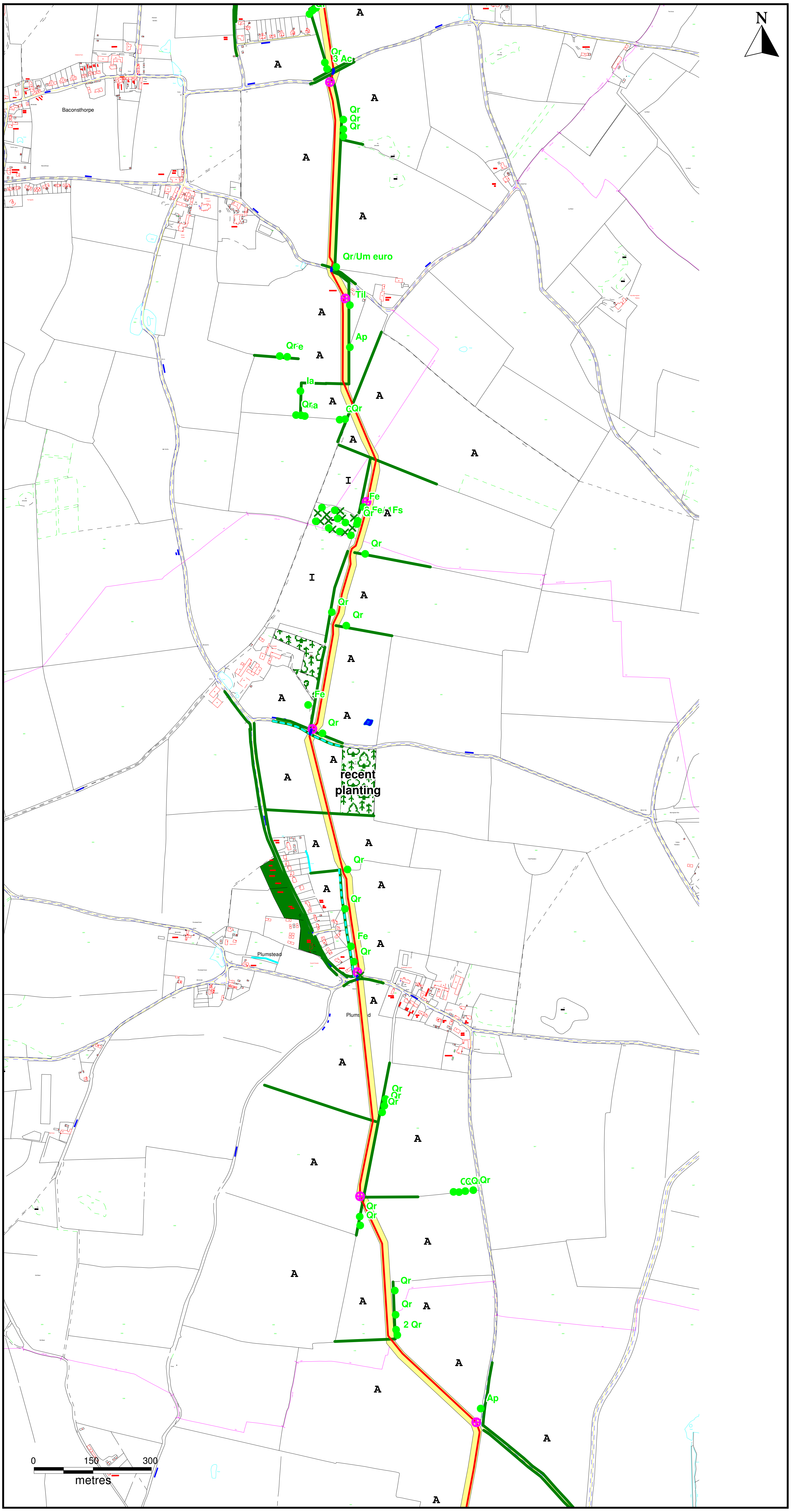
Client:
SCIRA OFFSHORE ENERGY LTD.

Date: AUGUST 2007

Scale: NTS

Figure:
FIGURE 6.2 (2 of 6)

ROYAL HASKONING



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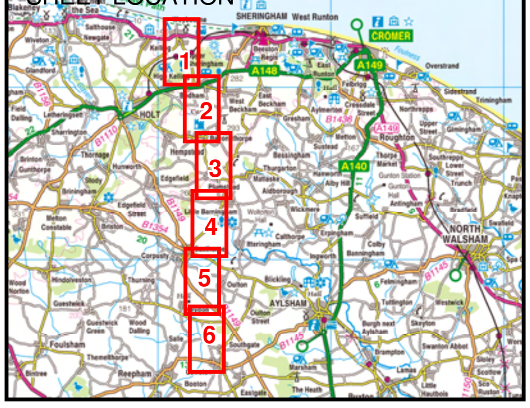

LEGEND:

Proposed Onshore Grid Connection

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross bonding pits
- Open trenching construction corridor
- Total extent of proposed substation

Phase 1 Habitat types

- Semi-natural broadleaved woodland
- Plantation broadleaved woodland
- Plantation mixed woodland
- Plantation coniferous woodland
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- Orchard
- Dense scrub
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- Floodplain valley mire
- SI Poor semi-improved grassland
- I Improved grassland
- Tall ruderal
- Open water
- Running water
- Dry ditch
- Swamp
- Hedgerow
- A Arable field
- A Amenity grassland
- Caravan site
- Bare ground
- Hard standing and buildings
- Habitat boundary

Title:
PHASE 1 HABITAT MAP

SHEET 3 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

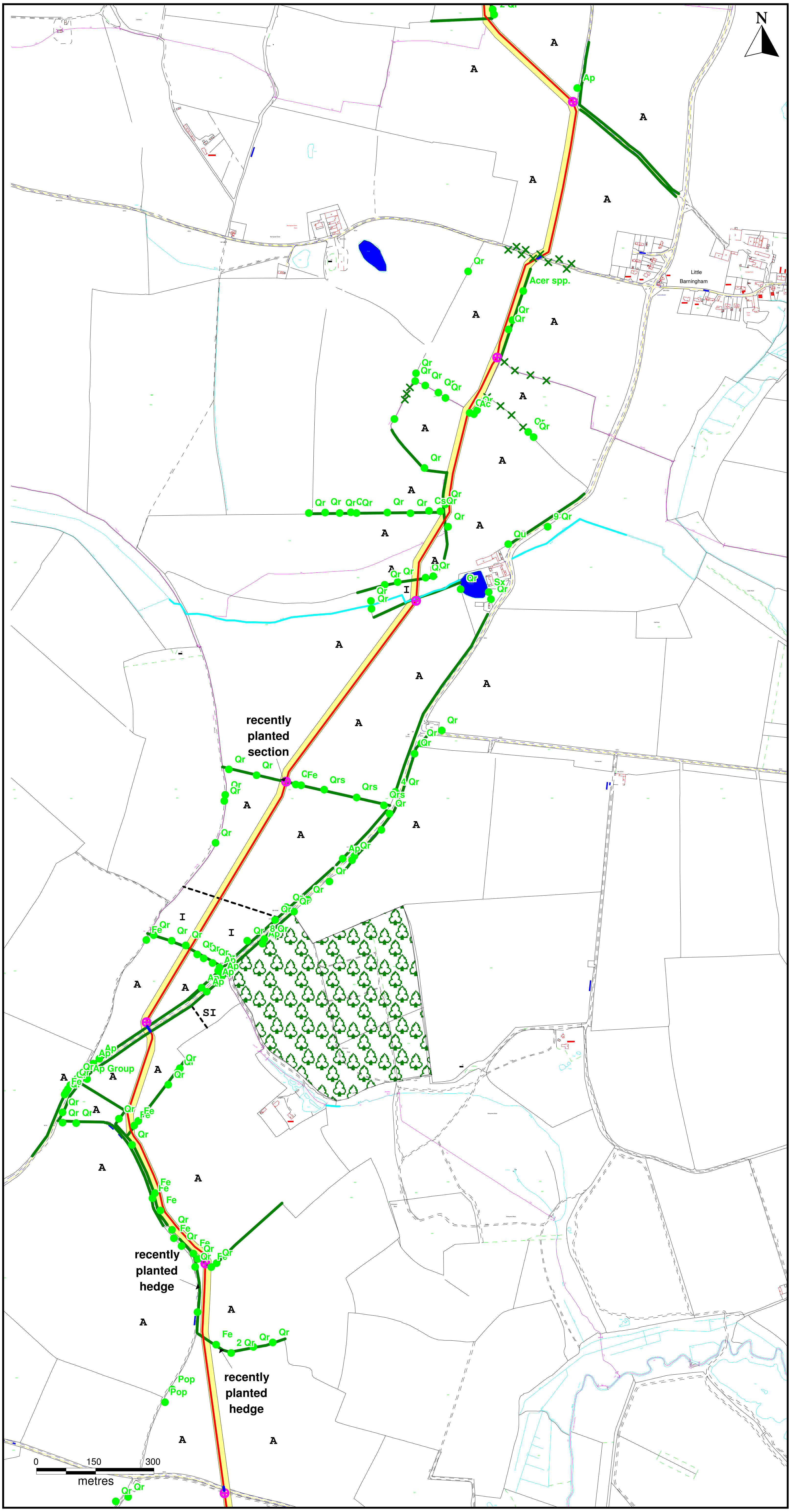
Client:
SCIRA OFFSHORE ENERGY LTD.

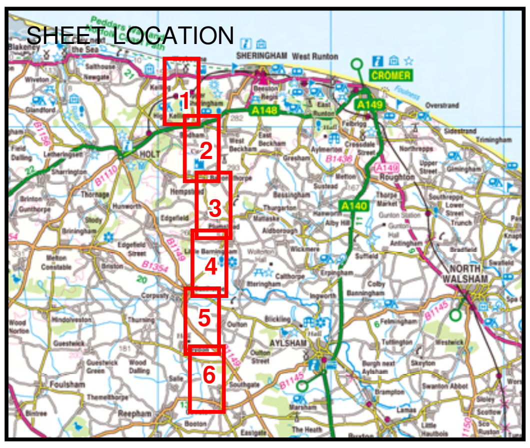
Date: AUGUST 2007

Scale: NTS

Figure:
FIGURE 6.2 (3 of 6)

ROYAL HASKONING





LEGEND:

Proposed Onshore Grid Connection

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross bonding pits
- Open trenching construction corridor
- Total extent of proposed substation

Phase 1 Habitat types

- Semi-natural broadleaved woodland
- Plantation broadleaved woodland
- Plantation mixed woodland
- Plantation coniferous woodland
- Scattered broadleaved trees
- Orchard
- Dense scrub
- Scattered scrub
- SI Semi-improved neutral grassland
- SI Semi-improved acid grassland
- Marshy grassland
- Floodplain valley mire
- SI Poor semi-improved grassland
- I Improved grassland
- Tall ruderal
- Open water
- Running water
- Dry ditch
- Swamp
- Hedgerow
- A Arable field
- A Amenity grassland
- Caravan site
- Bare ground
- Hard standing and buildings
- Habitat boundary

Title:
PHASE 1 HABITAT MAP

SHEET 4 OF 6

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

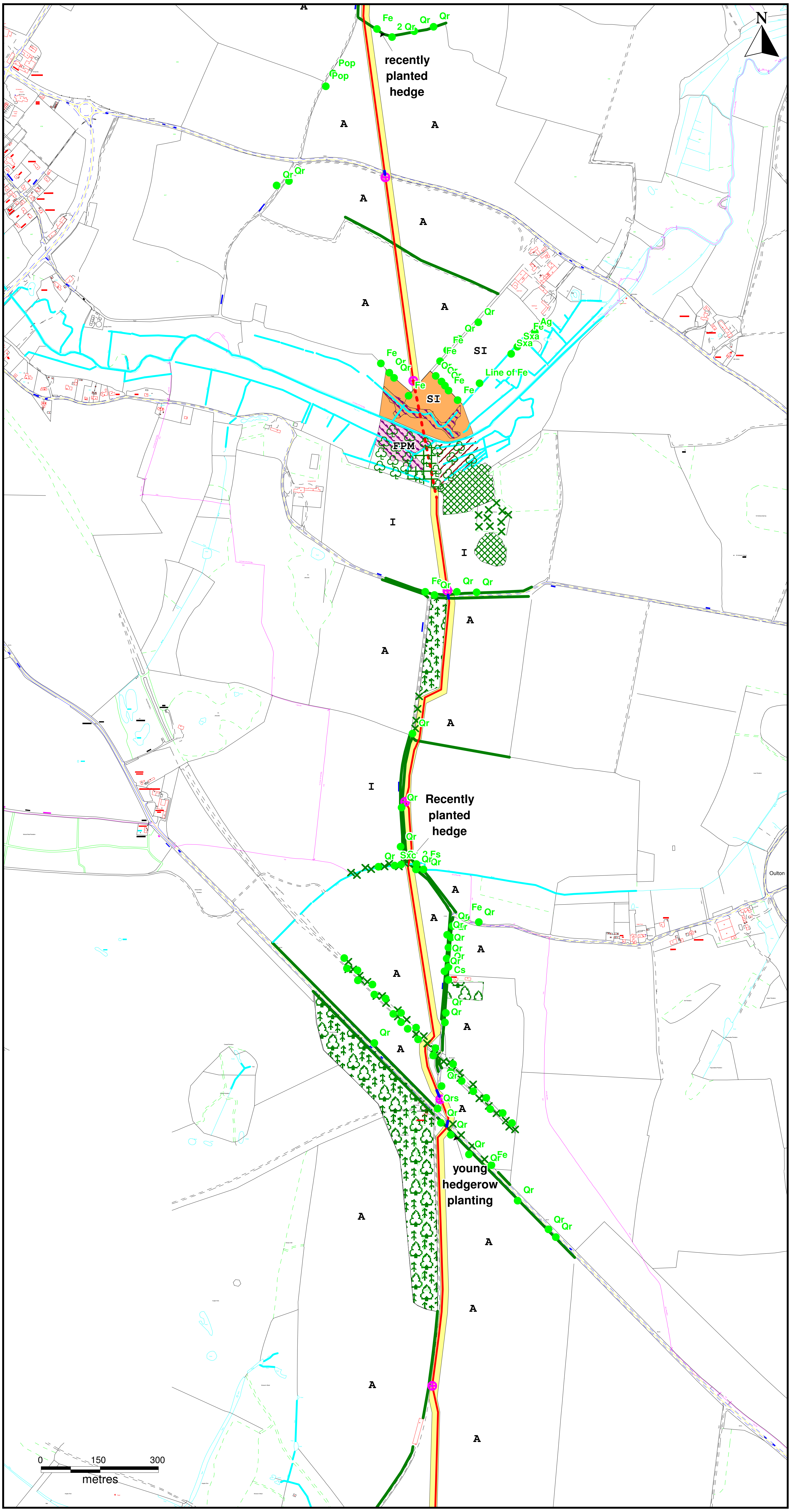
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

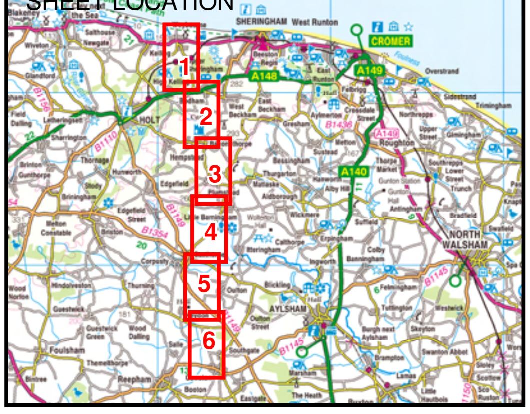
Scale:
NTS

Figure:
FIGURE 6.2 (4 of 6)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross bonding pits
- Open trenching construction corridor
- Total extent of proposed substation

Phase 1 Habitat types

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- Tall ruderal
- Open water
- Running water
- Dry ditch
- Swamp
- Hedgerow
- A Arable field
- A Amenity grassland
- Caravan site
- Bare ground
- Hard standing and buildings
- Habitat boundary

Title:
PHASE 1 HABITAT MAP

SHEET 5 OF 6

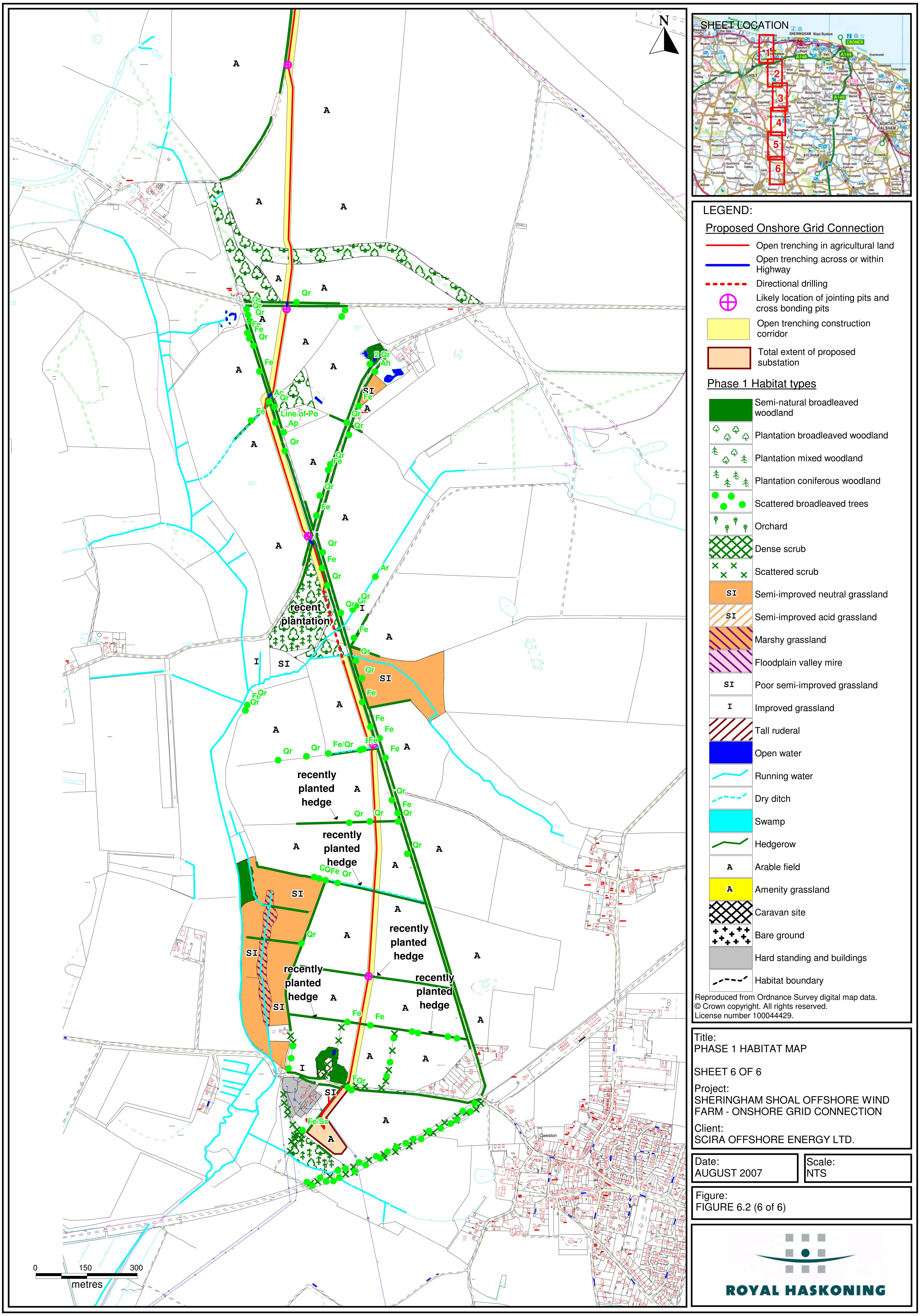
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 6.2 (5 of 6)

ROYAL HASKONING



SHEET LOCATION
LEGEND:
Proposed Onshore Grid Connection
Open trenching in agricultural land
Open trenching across or within Highway
Directional drilling
Likely location of jointing pits and cross bonding pits
Open trenching construction corridor
Total extent of proposed substation
Phase 1 Habitat types
Semi-natural broadleaved woodland
Plantation broadleaved woodland
Plantation mixed woodland
Plantation coniferous woodland
Scattered broadleaved trees
Orchard
Dense scrub
Scattered scrub
SI Semi-improved neutral grassland
SI Semi-improved acid grassland
Marshy grassland
Floodplain valley mire
SI Poor semi-improved grassland
I Improved grassland
Tall ruderal
Open water
Running water
Dry ditch
Swamp
Hedgerow
A Arable field
A Amenity grassland
Caravan site
Bare ground
Hard standing and buildings
Habitat boundary
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Title:
PHASE 1 HABITAT MAP
SHEET 6 OF 6
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION
Client:
SCIRA OFFSHORE ENERGY LTD.
Date:
AUGUST 2007
Scale:
NTS
Figure:
FIGURE 6.2 (6 of 6)
ROYAL HASKONING
N
recent plantation
recently planted hedge
Line of Po
Cawston
0 150 300
metres

Approximately 40% of the hedgerows are defunct (containing more than 10% gaps). In some areas, especially towards the southern part of the study area, new hedgerow planting is frequently encountered.

The majority of the hedgerows have associated trees, predominantly pedunculate oak or ash, with some beech (*Fagus sylvatica*), sycamore and Scot's pine (*Pinus sylvestris*). The presence of isolated trees in fields (i.e. not associated with hedgerows or other boundary features) is limited.

The Hedgerow Regulations 1997 mean that it is illegal to remove certain hedgerows which are deemed of national importance (according to the criteria of the regulations). It is also against the law to remove most countryside hedgerows without permission of the local council. To be important, the hedgerow must be at least 30 years old and meet certain other specific criteria including species richness and diversity (MAFF, 1997).

Woodland and scrub

Small areas of woodland are present throughout the corridor with the largest block located on the Cromer Ridge, in the north part of the survey corridor. This area is a broadleaved semi-natural woodland which is also a County Wildlife Site: Kelling Heath Park and Hundred Acre Wood. The woodland itself is unmanaged with scattered/fallen branches throughout with some beech standards; but predominantly sycamore with some ash, pedunculate oak, silver birch (*Betula pendula*) and hawthorn scrub. The area forms part of a holiday park with footpaths and cycle paths running through and some wider mown grass rides. There are several old boundary ditches and steep banks running throughout the wood.

Elsewhere the corridor crosses several strips of mixed or broad-leaved plantation woodland; including Baconsthorpe Wood (a plantation along the southern side of the River Bure), Carman's Belt; a woodland to the east of Salle Park; and a disused railway with scattered trees and scrub to the north of the B1149. None of the areas of woodland in the immediate route corridor are listed on the Ancient Woodland Inventory (AWI).

Grassland and field margins

As outlined, the majority of the study area is under arable cultivation and there are only a few fields supporting grassland throughout the corridor. In general, where present, these fields consist of improved or poor semi-improved grassland, with dominant species including false oat-grass (*Arrhenatherum elatius*), cock's-foot (*Dactylis glomerata*) and red fescue (*Festuca rubra*). Two exceptions to this are at the Muckleburgh Collection museum and at the River Bure.

The floodplain habitats to the north and south of the River Bure contain a more diverse assemblage of damp grassland habitats. To the north side, a network of slow-flowing or stagnant ditches are surrounded by areas of marshy grassland and semi-improved neutral grassland, with typical species including soft rush (*Juncus effusus*), Yorkshire fog (*Holcus lanatus*), tufted hair-grass (*Deschampsia cespitosa*) and greater pond-sedge (*Carex riparia*). To the south of the river is an area of poplar plantation, underlain by a mosaic of damp grassland and floodplain mire habitats, with abundant great horsetail (*Equisetum telmateia*) and Himalayan balsam (*Impatiens glandulifera*).

The majority of the habitat in the Muckleburgh Collection museum, at the northern limit of the cable system corridor, consists of semi-improved, neutral to slightly acidic grassland, on well-drained soils. The area is heavily rabbit grazed, mown in some places and subject to disturbance by military vehicles. The sward is dominated by Yorkshire fog, with a low diversity of herbs, including creeping cinquefoil (*Potentilla reptans*) and ground ivy (*Glechoma hederacea*). Courser herbs include creeping thistle (*Cirsium arvense*), spear thistle (*C. vulgare*), ragwort (*Senecio jacobaea*), hogweed (*Heracleum sphondylium*), rosebay willowherb (*Chamerion angustifolium*), Alexanders (*Smyrnium olustratum*) and common nettle (*Urtica dioica*), with occasional hoary mullein (*Verbascum pulverulentum*) recorded.

Field margins with high or moderate ecological value were recorded scattered across the survey corridor in the areas between Baconsthorpe and Plumstead; to the west of Mossymere Wood; and to the east of Salle Park.

Aquatic habitat

The presence of watercourses which are crossed by the proposed cable corridor are shown in **Figure 6.2** and assigned numerical reference numbers (W01 to W14). These features, along with any others in the nearby vicinity are discussed in Section 8: 'Geology, Hydrogeology, Hydrology and Land Quality'. Information on the ecological characteristics of each crossing are also detailed in **Appendix 6.3**.

The only Environment Agency maintained 'Main River' crossed by the cable route corridor is the River Bure, at a point approximately 1.5km east of Saxthorpe and Corpusty (W08). The river in this location is between 2-5m wide and 1-2m deep with a medium flow, with abundant submerged vegetation. North of the river there is an area of wet marshy grassland with associated water-filled ditches with frequent emergent vegetation. South of the river consists of open, very wet old poplar (*Populus* spp.) plantation with associated drainage ditches and occasional pools created by fallen trees.

Elsewhere along the proposed cable route, watercourses are a fairly rare feature and concentrated mainly in the areas of Weybourne; between Bodham and Baconsthorpe; and Salle. In summary, these include small slow moving streams and ditches, including the following:

- Spring Beck (not crossed but in proximity to corridor).
- River Glaven tributary near Lower Bodham (W02).
- Drainage channels within (W03) and to the south (W04) of Baconsthorpe Wood.
- Drainage channel between Baconsthorpe and Baconsthorpe Wood, at 'Alder Carr' (W05).
- Drainage channel at Mere Farm (W07).
- Drainage channel crossing Spinks Lane (W09).
- Watercourses in (W11) and to the south (W12) of the woodland east of Salle Park.

- River Wensum tributary to south and west of Salle substation (although not in immediate proximity to proposed substation site or cable corridor).
- Four additional dry drainage channels (W01, W06, W10, W13 and W14).

There are also numerous field ponds located in the study area, clusters of which occur in the areas of Weybourne; Bodham to Baconsthorpe, Saxthorpe and Corpusty; and Salle and Cawston. These are also discussed further in Section 8.

Plant species

In the area to the west of Mossymere Wood; the scarce arable weed Weasel's snout (*Misopates orontium*) was found on the northern edge of a bridleway, on the southern edge of a sugar beet field. One plant was found amongst mostly common species. This species is classified as Vulnerable within the Vascular Red Data List for Great Britain Species and considered to be facing a high risk of extinction in the wild.

Herb-Paris (*Paris quadrifolia*) (approximately six plants) was recorded during the spring survey within an area of neglected coppice ('Alder Carr') to the south of Baconsthorpe Wood. The Joint Nature Conservation Committee (JNCC) classifies this species as of 'Least Concern' although it is 'Scarce' in Norfolk.

The presence of invasive alien plant species was fairly limited along the survey corridor at the time of surveys and was restricted to:

- Japanese knotweed (*Japanese knotweed*); recorded next to a track in the woodland to the south of the existing substation site at Salle.
- Himalayan balsam (*Impatiens glandulifera*); recorded in the floodplain habitats surrounding the River Bure).
- New Zealand pygmyweed (*Crassula helmsii*); recorded in a pond to the north-east of Baconsthorpe Wood.

The route corridor is not aligned along any of the locations where these specific plants were recorded.

6.3.3 Badger

Badgers are fully protected by the Protection of Badgers Act 1992, which subsumed all previous legislation covering this species. This Act makes it an offence *inter alia* to wilfully kill, injure or take a badger, to damage or obstruct access to a badger sett or to disturb a badger when it is occupying a sett.

Badgers are known to be scarce within the north Norfolk area. Their known distribution within the Holt-Cromer Ridge area and is limited to occasional records from Hempstead, Little Barningham and Northrepps (Vine, 1993).

A search was carried out by Norfolk Badgers (local badger group) during the ecological data search and located any records of badger activity 2km either side of the proposed area of works. The results are recorded in **Table 6.4**.

Table 6.4 Badger activity recorded by Norfolk Badgers

Badger activity	Number	Locations
Badger setts and sightings	13	TG1241, TG1341, TG1148, TG1537, TG1238, TG1133, TG1431, TG1031, TG1030, TG1229, TG1328, TG1325, TG1424
Road Traffic Accidents	5	TG132404, TG136407, TG119412, TG110316, TG121242

The nearest known sett is located in the Cawston area, approximately 300m from the proposed grid connection route. This sett was checked by Norfolk Badgers in April 2007 and found to be very active.

The results of the Norfolk Biological Records Centre (NBRC) data search also indicate that badger have previously been historically recorded in Weybourne (1957 to 1980) and Bodham (1959 to 1961) and more recently in Oulton (2001), Corpusty and Saxthorpe (both 2003).

During the targeted surveys, no evidence of badgers being present was found within the area surveyed. Several areas of potentially suitable habitat were found within the area of search. These are set out in **Table 6.5**.

Table 6.5 Habitat potentially suitable for badgers in study corridor

Location	Type of habitat
Hundred Acre Wood and Weybourne Wood	Woodland with steep banks.
Bodham	Woodland, hedgerows, scrub.
Baconsthorpe	Plantation and scrub.
Mossymere Wood, Corpusty	Woodland with earth banks.
Corpusty	Hedgerows suitable for foraging.
Heydon	Woodland and dismantled railway. embankment.
Heydon	Woodland and areas of scrub
Salle	Steep wooded pit with sandy banks

Along the route there were small woodland areas and dense hedgerows that may also provide suitable foraging habitat for badgers.

6.3.4 Water vole

Water vole habitat is protected under the 1981 Wildlife and Countryside Act. This protection makes it an offence to intentionally damage, destroy or obstruct access to any structure or place, which water voles use for shelter or protection, or to disturb them while they are using such a place. The scope of this legislation is expected to be extended and changes will be introduced to help protect the species from killing, injuring and taking, as well as the habitat.

Records received during the NBRC data search were limited to occasional reports of water vole in Weybourne (1997), Plumstead (2001) and Corpusty (1986). Norfolk Wildlife Trust also hold records of water vole occurring on Spring Beck (north of Weybourne) during 1997 and 2005, along with numerous sightings and evidence of water vole along the River Bure between 1997 and 2005. Records from a local naturalist dated between 2003 and 2006 also reveal that water vole are recorded frequently along the River Bure.

A detailed survey of the River Bure (W09) and its associated ditch network in the area of the proposed route corridor recorded evidence of water vole along the length of the ditch system with minor evidence along the actual river channel. A high number of latrines and feeding stations were observed together with some burrows.

Surveys of the River Bure in the area of road bridge at Saxthorpe / Corpusty, carried out in relation to the road-based route under consideration at the time of survey, also recorded some signs of water vole within the ditch running east of the road, to the south of the river, in the form of a single latrine close to a small culvert and pathways through the vegetation. Further evidence was found of pathways and feeding stations around the large pond north of the river, east of the road.

It is concluded that water voles are present in the study area along the ditch network associated with the River Bure, but occasionally also within the river itself.

Active water vole signs were also found along a ditch running north to south in grassland and grazing meadows to the west of the Salle substation (which is a tributary of the River Wensum). Ten latrines were recorded together with a number of feeding stations and runs.

No other evidence of water vole was recorded along the other watercourses or drainage ditches surveyed, however it was noted that some of these do offer suitable habitat.

6.3.5 Otter

Otters and their places of rest and shelter are protected under the Wildlife and Countryside Act, 1981, and are listed under the Conservation (Natural Habitats &c.) Regulations, 1994 (Schedule 2).

Otter records received from Norfolk Wildlife Trust include numerous sightings and other evidence along the River Bure (W08) between 1997 and 2005. A local naturalist, who provided ecological records during the EIA process, also confirmed that otter are regularly recorded along the length of the River Bure. The results of the NBRC data search also revealed a historic record of otter in Holt (1988).

In the area of the route corridor across the River Bure, a number of otter spraints were recorded during the 2007 surveys at the edges of the associated ditches and along the river channel. A fresh spraint was also recorded during the 2006 survey along with possible otter runs into the river. A local landowner advised that in early September 2006 three otters were observed in this area although the exact location was not confirmed. The river at this location provides good potential habitat for otter holts in the form of exposed tree roots and good cover with no obvious disturbance.

During the surveys of the Bure at Corpusty / Saxthorpe during 2006, a total of 12 otter spraints were observed under the road bridge, along with fresh footprints and anal gel. Further evidence was found of pathways around the large pond to the north of the river, east of the road.

No other evidence of otter was found along any other watercourse or drainage ditches surveyed, although potential habitat was noted within the two watercourses which flow east to west through the woodland to the east of Salle Park.

6.3.6 Bats

All British bats are protected under the Wildlife and Countryside Act, 1981 (Schedule 5) and are listed under the Conservation (Natural Habitats &c.) Regulations, 1994 (Schedule 2). It is an offence deliberately to capture, kill or disturb all species of bat, or to damage or destroy a breeding or resting place.

The NBRC data search found several records of bats from within the study area, as summarised in **Table 6.6**.

Table 6.6 Bat records in study area

Species	Location	Year
Barbastelle (*Barbastella barbastella*)	Weybourne	1999
Daubenton's (*Myotis daubentoni*)	Oulton	1990
Natterer's (*Myotis nattereri*)	Weybourne	1972
Pipistrelle (*Pipistrellus pipistrellus*)	Weybourne	1999
	Baconsthorpe	2001
	Little Barningham	2000
	Mannington	1995
	Saxthorpe	1997
Brown long-eared (*Pleccotus auritus*)	Weybourne	1999

(extracted from NBRC data search)

During the habitat surveys and assessments, suitable bat roosting opportunities were identified within several dilapidated buildings and occasional mature/veteran trees along the entire route corridor. Suitable foraging habitat for bats was also observed within the woodland areas identified, and numerous hedgerows.

6.3.7 Other mammals

Records of other mammals previously recorded in the study area are summarised in **Table 6.7** from the data search carried out by NBRC. These species do not receive any legislative protection, except for certain actions relating to cruelty, killing, trapping and sale for specific species or groups. An indication of their conservation status is given.

Table 6.7 Other mammals previously recorded in study area

Species	Location/s	Year (most recent)	Conservation status
Brown hare (*Lepus lepus*)	Baconsthorpe, Bodham, Oulton, Heydon, Kelling Heath, Little Barningham, Mannington, Matlask, Plumstead, Salle, Saxthorpe, Weybourne	2003	Priority species under UK Biodiversity Action Plan and Norfolk BAP species
Red deer (*Cervus elaphus*)	Bodham, Kelling, Plumstead, Mannington, Gresham, Baconsthorpe, Saxthorpe, Heydon, Oulton, Irmingland	2002	Native, widespread and common
Fallow deer (*Dama dama*)	Bodham, Baconsthorpe and Oulton	2001	Naturalised
Roe deer (*Capreolus capreolus*)	Plumstead, Saxthorpe, Heydon, Oulton, Briston	2003	Native, widespread and common
Muntjac (*Muntiacus reevesi*)	Bodham, Kelling, Baconsthorpe, Heydon, Oulton, Mossymere Wood	2003	Introduced, widespread
Bank vole (*Clethrionomys glareolus*)	Saxthorpe	1985	Common
Field vole (*Microtus agrestis*)	Bodham, Baconsthorpe, Plumstead, Saxthorpe, Heydon	2001	Locally common
Harvest mouse (*Micromys minutus*)	Saxthorpe, Bodham, Corpusty, Kelling, Little Barningham, Mannington, Oulton	2003	Once common and widespread, now vulnerable
Wood mouse (*Apodemus sylvaticus*)	Bodham, Weybourne, Baconsthorpe, Plumstead, Oulton, Corpusty	2002	Common
Common shrew (*Sorex cireneus*)	Kelling Heath, Baconsthorpe, Baconsthorpe, Plumstead and Saxthorpe	2001	Common and widespread
Water shrew (*Neomys fodiens*)	Weybourne, Bodham	2006	Species of conservation concern (UK Biodiversity Steering Group)
Stoat (*Mustela erminea*)	Weybourne, Bodham, Kelling, Mannington, Corpusty, Baconsthorpe, Plumstead, Oulton, Saxthorpe, Heydon	2001	Common and widespread

(extracted from NBRC data search)

Evidence or sightings were also recorded during the site surveys and other visits of the following species or groups:

- Brown hare: sightings in the area of the River Bure and Salle.
- Roe deer: one seen in Weybourne; droppings recorded to north of Lower Bodham; droppings (either roe deer or muntjac) in Heydon area.

- Red deer: herd seen emerging from Mossymere Wood in a north-west direction across the fields.
- Water shrew: seen in two ponds; one to the west of Irmingland Hall; one to south of Bodham.

6.3.8 Birds

The Wildlife and Countryside Act 1981 protects all wild birds and their nests and eggs. In addition, certain rare breeding birds, listed on Schedule 1 to the 1981 Act, are also protected against disturbance whilst building a nest or on or near a nest containing eggs or young.

Schedule 1 species observed during the surveys included kingfisher (*Alcedo atthis*) along the River Bure and at Mere Farm; barn owl (*Tyto alba*) in a dilapidated building at Mere Farm; and an unconfirmed report of common quail (*Coturnix cotnurnix*) in the area of Little Barningham / Mere Farm.

Buzzard (*Buteo buteo*) were observed in the area around Mossymere Wood, the River Bure and between Baconsthorpe and Plumstead. Although not scheduled, this species is uncommon in the East of England region.

Biodiversity Action Plan (BAP) species observed during the surveys are listed in **Table 6.8**.

Table 6.8 Biodiversity Action Plan bird species recorded

UK BAP Species	Location/s
Skylark *	Weybourne to Bodham; Little Barningham (30 individuals); Mere Farm to the River Bure; and Heydon area.
Tree sparrow *	North of Plumstead.
Linnet	A15, A17, A19
Bullfinch	River Bure area.
Song thrush *	Mosseymere Wood to the River Bure; and west of Oulton.

* Also Norfolk BAP

Throughout the corridor of the onshore grid connection; the hedgerows, trees, grassland margins and occasional fields of grassland provide good habitat for small breeding birds.

6.3.9 Great crested newts and other amphibians

Great crested newts and their aquatic and terrestrial habitat are fully protected under both UK and EU legislation, are listed as UK and Norfolk BAP species and are a species of principle importance under Section 74(2) of the CRoW Act 2000.

Other common amphibians, such as smooth newt (*Triturus vulgaris*), common toad (*Bufo bufo*) and common frog (*Rana temporaria*) are protected under the WCA 1981 in respect of Schedule 9(5) only, relating to sale.

Great crested newts are widespread throughout East Anglia with good populations known in north east Norfolk, for example at Mannington Hall. It is thought that the species is under-recorded throughout the region; for example, the nearest record of great crested newt obtained during the NBRC data search was from Holt, over 3km from the cable corridor. Additional data searches carried out as part of the great crested newt survey programme revealed that the species has been recorded previously near Lower Bodham at Lime Kiln Pits (TG11892890 and TG11902880) (outside of the survey area). Anecdotal records from a local pond surveyor, also reported great crested newts in several ponds to the south of Bodham (within the survey area).

During the great crested newt survey, the species were recorded in 15 ponds. The location of the ponds are indicated on **Figure 6.3** and the results are summarised in **Table 6.9**. This includes details of the maximum number of great crested newts recorded during each survey visit; whether any eggs were recorded (an indication of breeding); and an estimation of the population size, based on the 'Great crested newt mitigation guidelines' (English Nature, 2001). Data is only given for those ponds where great crested newts were recorded as positive. The full survey report can be viewed in **Appendix 6.2**.

Table 6.9 Great crested newt survey results

	Number of Great Crested Newts recorded at each visit							Population size class
Pond no.	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**Visit 5**	**Visit 6**	**Eggs**	
9	0	Access revoked					Yes	Undetermined *
20	1	0	0	0	0	0	Yes	Small
24	0	0	0	1	0	0	No	Small
26	0	1	4	0	4	2	Yes	Small
27	0	5	3	Access Revoked			No	Small **
30	0	17	0	15	8	5	Yes	Medium
31	0	0	0	3	0	0	Yes	Small
33	0	0	0	0	2	1	Yes	Small
34	0	13	7	3	4	1	Yes	Medium
37	0	0	0	0	2	3	Yes	Small
67	0	4	2	0	1	1	No	Small
68	1	0	0	2	0	0	Yes	Small
87	19	31	11	17	20	16	Yes	Medium
93	0	3	1	2	Access Revoked		Yes	Small **
106	1	1	0	0	0	1	Yes	Small

(source: Yaxley, 2007b)

* undetermined (access revoked during survey period, although eggs found during initial visit).

** access revoked during later visits, however sufficient visits were made to estimate the population size on the available survey data.

Figure 6.3a Great crested newt ponds and theoretical meta-populations 1 (top) and 2 (bottom)

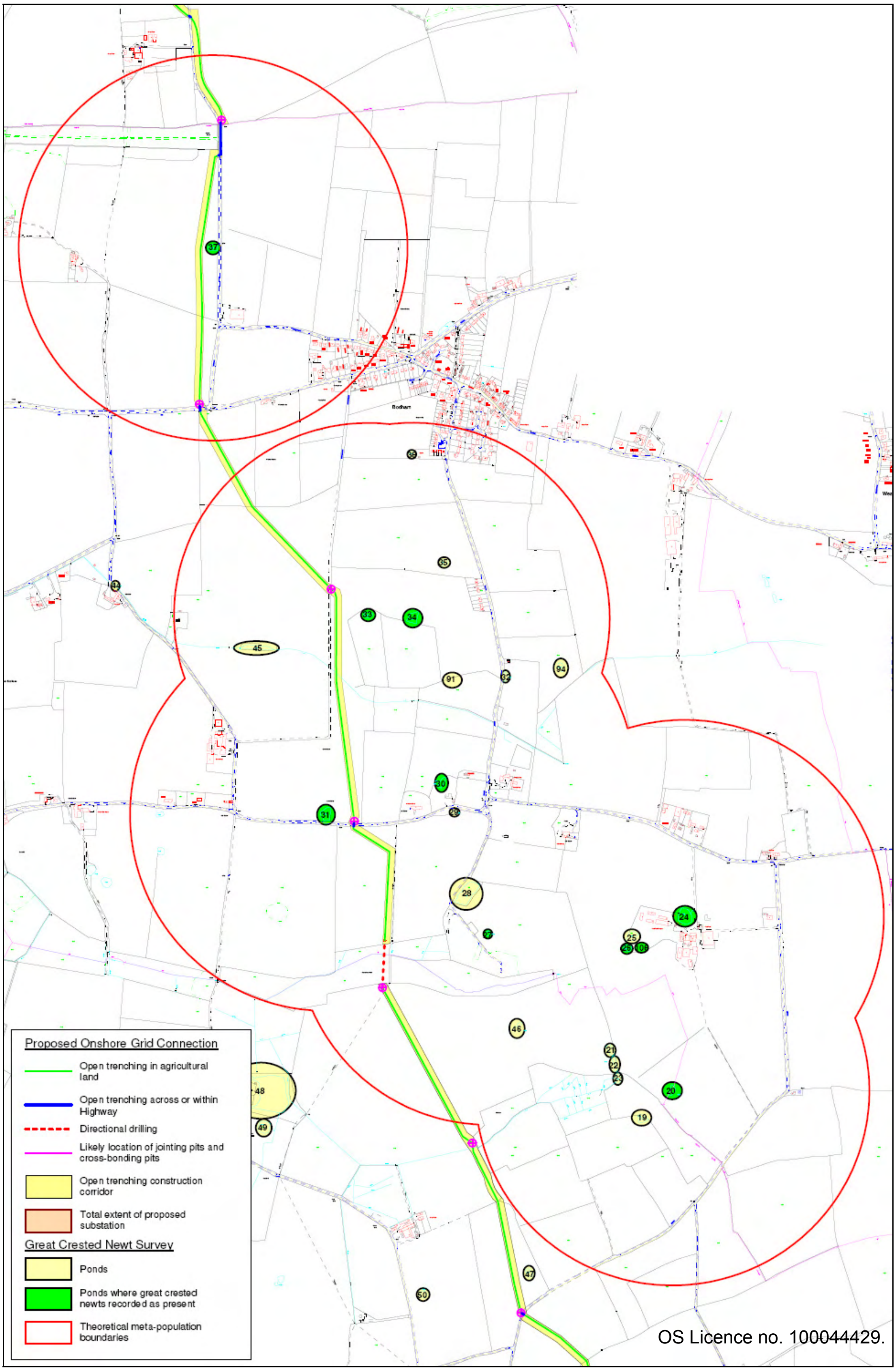
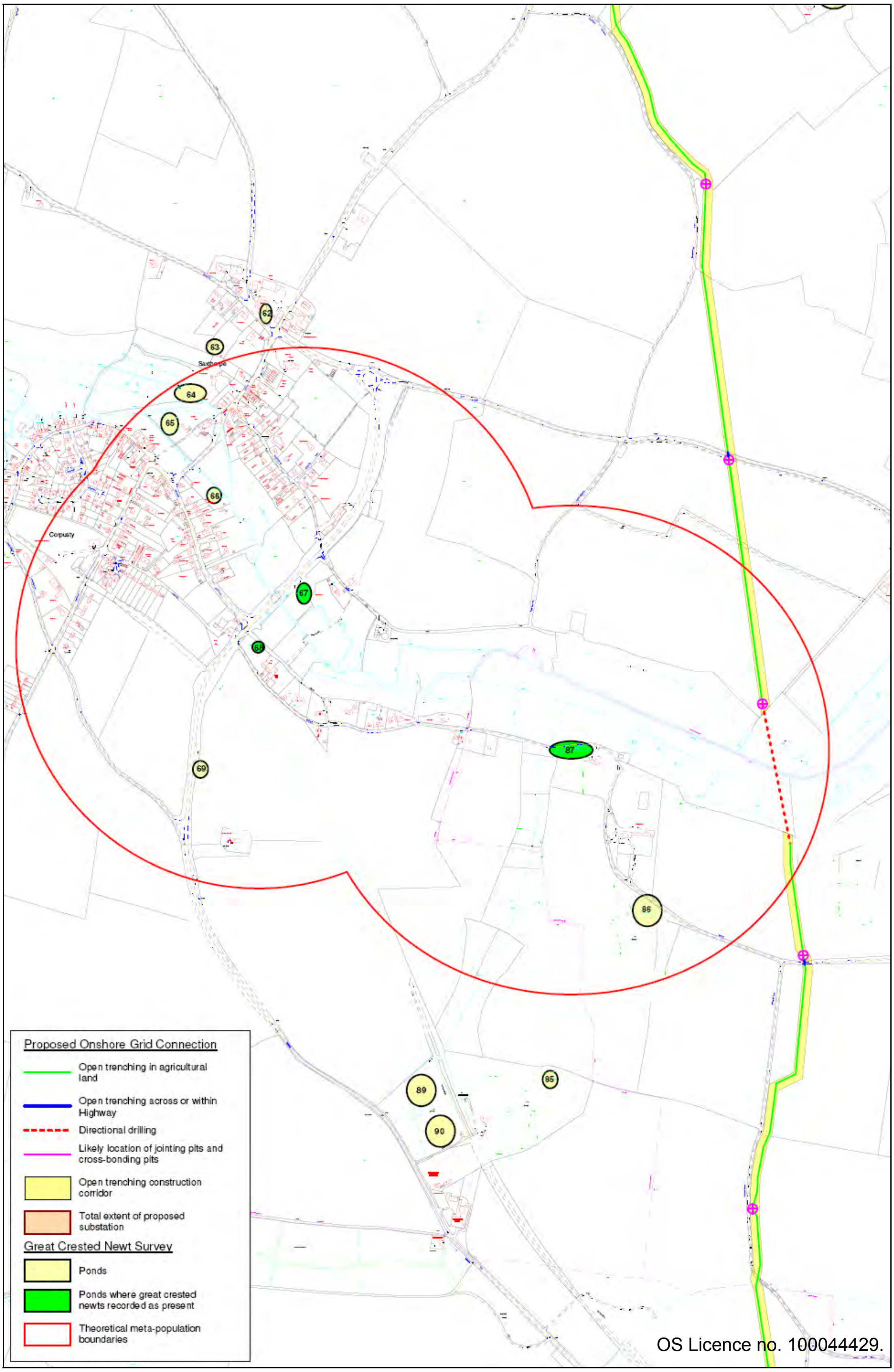
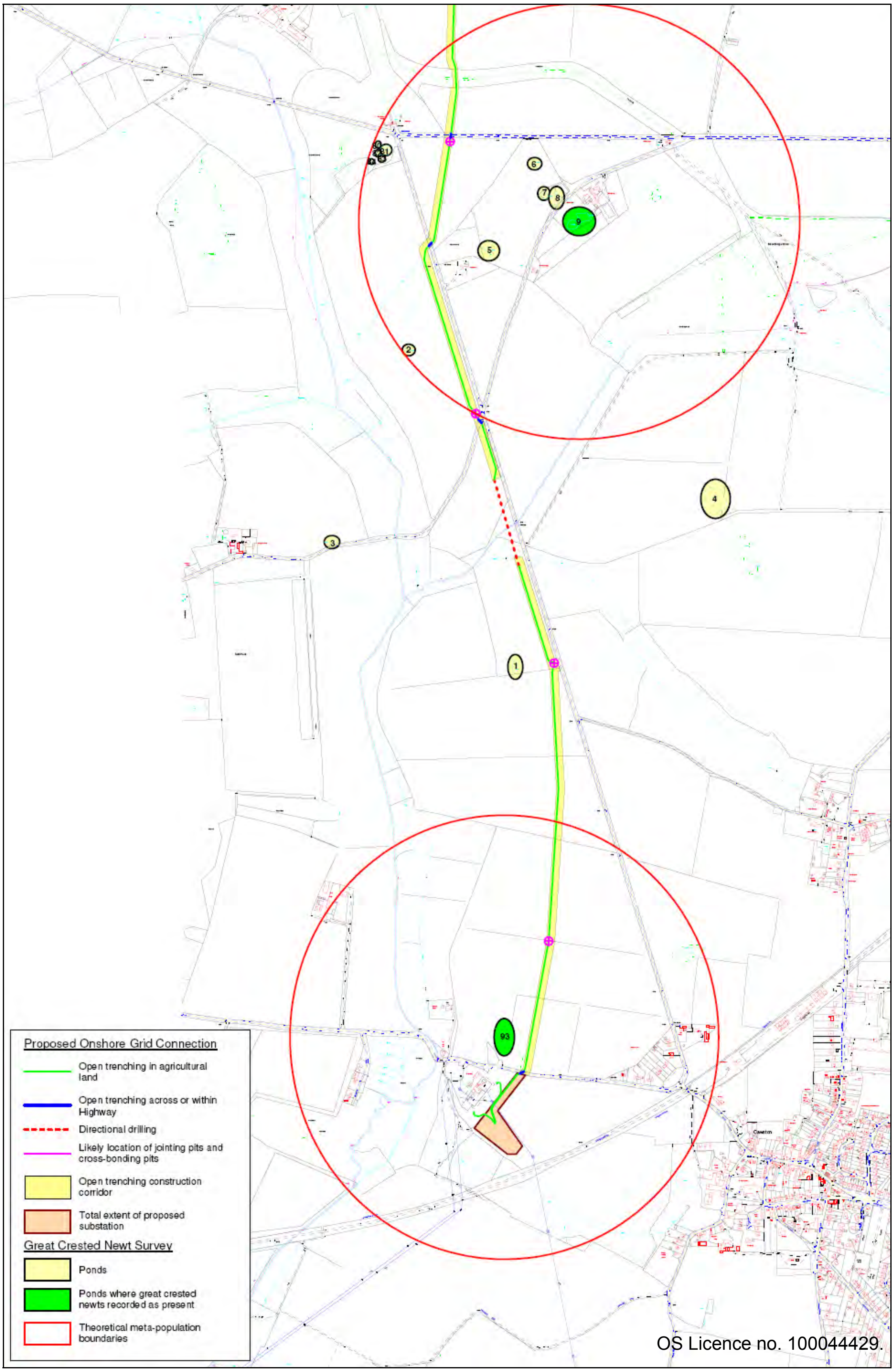


Figure 6.3b Great crested newt ponds and theoretical meta-population 3



ROYAL HASKONING

Figure 6.3c Great crested newt ponds and theoretical meta-populations 4 (top) and 5 (bottom)



The 15 ponds have been grouped into five meta-populations, based on an analysis of the results; the distances between the ponds; and the surrounding terrestrial habitat. The ecological value of the meta-populations has been assessed with reference to the IEEM Guidelines (2006) and is summarised in **Table 6.10**. The five meta-populations are also indicated in **Figure 6.3**.

Table 6.10 Great crested newt meta-populations

Meta-population	Ponds	Ecological value
1	37	Local
2	20, 24, 26, 27, 30, 31, 33, 34, 106	District
3	67, 68, 87	District
4	9	Local
5	93	Local

(source: Yaxley, 2007)

During the surveys, common frog and common toad were recorded in approximately two thirds of the ponds surveyed. Smooth newt were recorded in approximately one third of the ponds.

6.3.10 Reptiles

Common reptiles are given partial protection under the Wildlife and Countryside Act 1981, which prohibits *inter alia* the intentional killing, injuring or taking of protected species.

Four reptile species; common lizard (*Lacerta vivipara*), slow worm (*Anguis fragilis*), grass snake (*Natrix natrix*) and adder (*Vipera burus*), are known to occur in the coastal areas of north Norfolk (Norfolk Wildlife Services, 2005). NBRC data searches provided records of adder at Weybourne from 1972; viviparous lizard at Kelling Heath from 1977; and slow worm at Weybourne in 2004.

During the surveys, adder was observed in Bodham Wood. Suitable habitat for reptiles was found recorded throughout the survey corridor, and included woodlands; watercourse banks; disused or active railway embankments; hedge banks and some grass margins. An assessment determined that the most likely species being present would be viviparous lizard, grass snake and slow worm. A full reptile survey was conducted at the Muckleburgh Collection museum, in the area of the cable corridor in 2006. No reptile species were recorded.

6.3.11 Invertebrates

A brief assessment for invertebrate interest was carried out during the habitat surveys. Good invertebrate habitat was observed along the survey corridor in areas such as the River Bure valley, ponds, ditches, wet grassland, woodland and scrub. No records of protected or BAP invertebrates were received during the ecological data search.

6.3.12 White-clawed crayfish

Under the Wildlife and Countryside Act 1981, it is an offence to intentionally take, sell, barter or exchange white-clawed crayfish. White-clawed crayfish shelter amongst boulders, tree roots and in crevices within the river channel; therefore 'taking' can occur during engineering or maintenance works, for example when channel substrate is removed from the river.

White-clawed crayfish are listed as a priority species under the UK Biodiversity Action Plan; and are also a Norfolk BAP species. The Norfolk BAP states that the species has previously been recorded on the River Bure, although the location is not specified.

Suitable habitat for white-clawed crayfish was identified at the River Bure, which is a high quality chalk river. In addition, an anecdotal report was received during the surveys from a landowner that a white-clawed crayfish had been found in the River Bure at Corpusty. Given the availability of suitable habitat and previous records, it is considered there is a high probably that the species is present along the River Bure.

A signal crayfish (*Pacifastacus leniusculus*) was observed within the drainage channel located within the woodland to the east of Salle Park, where the channel is culverted beneath the road. Signal crayfish are listed as a non-native species under the Wildlife and Countryside Act 1981. If these species are captured, it is an offence to release them into the wild.

No other watercourses were identified as being suitable for crayfish during the survey.

6.4 Impacts During Construction

6.4.1 Nature conservation sites

International, European and nationally protected sites

The route of the proposed cable system and the location of the new substation at Salle have been designed to avoid sites of international, European and national importance; including all Ramsar, SPA, SAC and SSSI sites identified in Section 6.3.1.

The nearest site is Kelling Heath SSSI, which is located approximately 220m to the west of the proposed route at Weybourne. The nearest international or European site is the North Norfolk Coast Ramsar/SPA/SAC/SSSI; located approximately 1.2km to the west at the northern limit of the proposed cable route.

Due to the location and the short-term duration of the proposed onshore works, it is considered that there would be **no impact** to the ecological interest features of any of the outlined nature conservation designations. No mitigation measures are therefore considered necessary.

Ancient woodland

There would be **no impact** to the value of any woodlands listed on Natural England's Ancient Woodland Inventory.

County Wildlife Sites

The cable route has been aligned to avoid the majority of County Wildlife Sites (CWS) in the study area; however due to other environmental and technical constraints, as discussed in Section 2: 'Site Selection and Consideration of Alternatives', it has been necessary to align the route across two CWS; Kelling Heath Park and Hundred Acre Wood CWS and Brake Hills Plantation and Carman's Belt CWS (shown on **Figure 6.1**).

As outlined in Section 3: 'Project Details', it is proposed to drill across the majority of the area covered by the Kelling Heath Park and Hundred Acre Wood CWS. The drilled sections would avoid any impact to the ecological value of the woodland and would be at a sufficient depth to ensure that there would be no impact to trees roots.

The drill would be carried out in two sections, and would need to surface within a wide mown grass firebreak in the centre of the holiday park, which has been assessed to be of low ecological significance. The drill site within the firebreak has been designed to avoid any impact to the adjacent woodland interest of the site. The following measures would be carried out to minimise any indirect impact to the site and to reinstate the firebreak following the construction period.

Mitigation – Kelling Heath Park / 100 Acre Wood CWS during construction
• Reduce working width to 15m width along fire-break (including access). • Working area clearly demarcated and fenced to avoid impact to adjacent habitats. • Workforce briefed on sensitivity of site. • Topsoil and subsoil to be carefully separated and stored. No storage of equipment, vehicles or materials outside of the working area. • Following construction, full reinstatement of firebreak grassland habitat, with appropriate seed-mix to be agreed with the landowner and Norfolk Wildlife Trust.

Given successful implementation of the outlined measures and in recognition of the limited extent of works required, the impact to the value of the CWS as a result of the work within the firebreak area is considered to be **negligible**. There would be **no impact** to the ecological value of the remaining area of the CWS, including the two sections of woodland to be directionally drilled.

Towards the southern end of the cable system, the proposed cable route crosses a strip of plantation woodland known as Carman's Belt, which is connected to a larger area of woodland at Dog Corner and also Heydon Park. The route has been aligned to utilise an existing gap in the trees, immediately to the west of an existing overhead line, as shown on **Plate 6.1**.

Plate 6.1 Carman's Belt woodland (route aligned to west (right) of existing overhead line)

The woodland in this location is of relatively low ecological value, being dominated by sycamore and a rank scrub and under-storey with abundant bramble. It is proposed that due to the space available and the low value of the woodland, that the cable ducts would be installed in this section using open-trenching. It is not envisaged that any large trees would require removal, however, some younger trees, under-scrub and ground flora would need to be felled and cleared to provide adequate space for the cable trenching. The following mitigation would be implemented in order to reduce the impact to the overall value of the site and the CWS status.

Mitigation – Brake Hills Plantation and Carman's Belt CWS during construction
• Reduce the 20m working corridor to the minimal width that is technically feasible, whilst maintaining safety measures (including those relating to the overhead line). No storage of equipment or material in woodland. • Working area clearly demarcated and fenced to avoid impact to adjacent woodland. • Workforce briefed on sensitivity of site. • Trees and under-scrub to be cleared outside of bird breeding season. • Topsoil and subsoil to be carefully separated and stored. • Following construction, full reinstatement, including a programme of tree and scrub planting within the existing gap of appropriate species to maintain required vertical clearance beneath overhead line, in discussion with the landowner and Norfolk Wildlife Trust.

In the short-term, in the period that the replanted vegetation matures sufficiently, there would be a slight severance of the wildlife corridor, which currently links the larger blocks of woodland at Heydon Park and Blackbridge Wood (all also CWS). However, once the habitat has been reinstated and planting has become established, it is considered that there would be no effect to the overall value of the CWS, therefore the overall residual impact is assessed to be **negligible**.

The cable route crosses an unnamed road between Saxthorpe and Little Barningham (road crossing R13) at a point approximately 115m south of a Roadside Nature Reserve (RNR63). The route crosses at an existing farm access point and therefore the ecological value of the verge at this point is limited. No direct effect to the value of the RNR is envisaged, however to ensure there is **no impact**, the construction team would be briefed on the presence and sensitivity of the roadside verges in the area. **No impact** is envisaged to any other RNR in the study area.

6.4.2 Habitats and plants

Hedgerows and individual trees

The route of the proposed cable system has been carefully designed to minimise ecological effects by utilising gaps in hedgerows wherever possible. In addition, the route avoids any direct impact to sizeable or noteworthy trees located along hedgerow and other field boundaries. Inevitably, there will be some locations where the installation of the cable system will require a breach in a field boundary consisting of hedgerow scrub and small trees.

A detailed inventory of the features crossed by the proposed route at each boundary is provided as **Appendix 6.3**. To summarise, the route crosses approximately 90 field boundaries along the 21.3km route. 57 of these boundaries consist of hedgerows of some description. At 23 of these boundaries, the cable route has been aligned within an existing gap in the hedge, usually associated with existing farm access points, therefore there will be no require requirement for any hedgerow removal in these areas.

At the remaining 34 locations, hedgerows would need to be breached to allow sufficient space for the working corridor. The characteristics of these 34 hedgerows are as follows:

- 9 consist of very recently planted hedges.
- 5 consist of gappy sections of hedge (one of which is species-rich).
- 11 consist of intact species-poor hedges.
- 9 consist of intact species-rich hedges.

The location of the species-diverse hedges which will need to be breached are concentrated in two areas; to the east of Baconsthorpe; and in the area between Heydon and Salle Park.

Mitigation will be incorporated to minimise the potential effect and reinstate any breached sections, and to prevent any indirect effects on sections of hedgerow and scattered trees outside of the construction corridor, as outlined in the table below.

Mitigation – Hedgerows and scattered trees during construction
• Reduce 20m working corridor where possible by removing storage areas (i.e. 10m of the working width). • Working width fenced to protect habitat to be retained. • Hedgerow sections which need to be breached to be cleared outside of bird breeding season. • No storage of equipment or material in proximity to trees, in line with BS5837 and NJUG10.

Mitigation – Hedgerows and scattered trees during construction
• Following construction, full reinstatement of all hedgerow sections. Hedges to be replanted with a species-diverse mix of woody species and tree standards. The species mix will take account of the species already present in each of the hedges to be breached.

In consideration of the total distance of the route, and the relatively small numbers of hedgerow breaches required; as well as the reversibility of the effect, based upon the mitigation stated, it is considered that the overall residual impact to hedges is **short-term** and **minor adverse**.

With the exception of one ash tree which would need to be removed at the Salle substation (and replaced as part of the landscaping scheme), it is not envisaged that any other sizeable or noteworthy trees would require felling. Full reinstatement and replanting would ensure that the overall impact would be **negligible**.

Woodland and scrub

The route of the proposed cable has avoided woodlands and areas of scrub wherever feasible, however, in the following locations, the proposed route crosses areas of woodland and scrub (north to south):

- Kelling Heath / Hundred Acre Woods (directionally drilled).
- Baconsthorpe Wood (directionally drilled).
- Plantation south of River Bure (directionally drilled).
- Dismantled railway parallel to north of B1149 (open-trench).
- Carman's Belt (open-trench).
- Woodland belt east of Salle Park (directionally drilled).

The impact relating to the proposed directional drill across Kelling Heath / Hundred Acre Woods and open-trenching across Carman's Belt have been discussed and assessed in Section 6.4.1.

The woodland strips at Baconsthorpe Wood, the plantation south of the River Bure, and the woodland to the east of Salle Park would all be directionally drilled. Due to the depth of the drill, **no impact** to the ecological value of the woodlands or tree roots is envisaged and no further mitigation is considered necessary.

The remaining location relates to the disused railway running parallel to the north of the B1149 (north-east of Heydon Park). The disused tracks (now bare ground) are in a cutting and lined on both sides by trees and scrub, including ash, sycamore, pedunculate oak, hawthorn and blackthorn. The route has been aligned to cross at a point where the embankments are lined with scrub and it is not envisaged that any sizeable or noteworthy trees would require removal.

In order to minimise the impact the following mitigation would be implemented.

Mitigation – Disused railway during construction
• Working corridor will be reduced to the minimal feasible whilst maintaining required safety distances. If necessary, the trench should be hand dug across the embankments either side of the disused railway line to avoid impact to sizeable or noteworthy trees. • All equipment, plant and vehicles will be stored in the adjacent arable fields. • Any scrub clearance necessary will be carried out outside of the bird breeding season. • Following construction, embankment banks will be re-graded and planted with appropriate scrub and tree species.

The residual impact to the disused railway is assessed to be **short-term** and **negligible**.

Grassland and field margins

The route corridor crosses four small fields supporting improved grassland. Due to the very low ecological value of this habitat, **no impact** is envisaged.

The mosaic of damp grassland and floodplain mire habitats on either side of the River Bure would be directionally drilled, therefore **no impact** to the value of these habitats is envisaged and no additional mitigation is required.

The only other area where the cable crosses fields of grassland is at the Muckleburgh Collection museum. The installation of the cable ducts in this area would result in the temporary disturbance of a relatively narrow corridor of semi-improved grassland of low ecological significance. Elsewhere, the route crosses numerous field margins associated with hedgerows, drainage channels and tree-lined boundaries. The following mitigation measures will be implemented to ensure that the impact to the grassland habitat, including field margins, is minimised.

Mitigation –grassland and field margins during construction
• The cable trenching working corridor will be minimised wherever feasible. • Top-soil and sub-soil will be carefully separated and stored during the cable trenching process. • Following the cable installation, the disturbed grassland will be fully reinstated to its former condition. This will include re-seeding with a diverse mix of native species of local provenance.

The residual impact to the grassland habitats present in the vicinity of the onshore works is considered to be **short-term** and **negligible** due to the generally low ecological value of the habitat.

Aquatic habitats

As already discussed, the route of the proposed cable has avoided any direct impact to several watercourses along the route alignment; including the River Bure (W08), two drainage channels within Baconsthorpe Wood (W03 and W04), and two drainage channels within the woodland to the east of Salle Park (W11 and W12).

However, it is proposed that open-trenching is utilised to cross four smaller drainage channels and five dry ditches during the installation of the cable ducts. The ecological value of these features was not recorded as significant during the surveys, however mitigation would be utilised as described below in order to minimise the impact to the habitat further and any associated faunal species.

Mitigation – Drainage channels during construction
• Reduce 20m working corridor where possible by removing storage areas (i.e. 10m of the working width). No storage of equipment or material in proximity to watercourse banks. • Installation of temporary vehicle crossing points to minimise impact to bank habitats and channel features. • Within trench alignment, careful separation, storage and reinstatement of channel substrate, bank-side topsoil and subsoil. • Following construction, full reinstatement of all watercourse banks. Bank-sides will be planted with a species-diverse seed mix to avoid the colonisation of aggressive weed species.

Additional measures to maintain hydrological characteristics and avoid any pollution of the watercourses, and other surface water features in the area of the proposed works are discussed further in Section 8: 'Geology, Hydrogeology, Hydrology and Land Quality'. In consideration of the stated measures and the temporary nature of the construction period, **no impact** is envisaged to aquatic habitats during the construction period.

Rare plants

None of the identified rare of scarce plants recorded during the surveys are located in the area of proposed cable route, therefore there would be **no impact**.

In addition, no invasive alien plant species were recorded along the alignment of the cable, with the exception of areas of Himalayan balsam at the River Bure, however this area would be drilled, therefore, no spread of this species is expected as a result of the proposed works. Any invasive plant species present at the time of the construction phase would be dealt with by the Contractor, following best practice.

6.4.3 Badgers

No setts or any other evidence of badgers was recorded during the ecological surveys. However, as badgers are known to occur in the nearby area, and due to the presence of suitable habitat, there is the possibility that badgers may forage across the construction corridor. Possible impacts to foraging badgers would relate to potential severance of foraging habitat and dangers (e.g. to passage) caused by trench excavations and general construction sites.

As discussed in Section 3: 'Project Details', it is envisaged that any trenches would be excavated and backfilled during the same day. However, if trenches do need to remain open over-night, a ramped egress would be maintained at one end of the trench to allow any badgers (and any other trapped nocturnal wildlife) to escape unharmed. The type of fencing along the cable corridor is not envisaged to represent a barrier to foraging badgers, therefore no habitat severance is expected. The Salle substation site and any cable system compound sites would be securely fenced to prevent foraging badgers from accessing the areas.

Due to the delay between the surveys already carried out and the construction programme, there is the possibility that additional setts may be built in the interim period. To avoid any possible impact to future setts, the badger survey will be repeated prior to the construction phase. If any active badger setts are recorded within 30m of the construction corridor, a suitable mitigation strategy would be discussed and agreed with Natural England and any appropriate licencing obtained.

Precautionary badger mitigation is summarised below.

Mitigation – Badgers during construction
• Cable system construction corridor to be fenced with suitable and appropriate fencing to allow foraging badgers to cross. Any trenches left overnight will include a ramped egress to allow any trapped badgers to escape. • Salle substation and other cable compound sites will be securely fenced to prevent any danger to foraging badgers. • Re-survey of working corridor and substation area (and land up to 50m either side) prior to construction phase. Further consultation with Natural England if any active setts are recorded.

Based on the successful implementation of the stated mitigation measures, and also based on the current status of badger in the area of the proposed onshore grid connection, **no impact** is envisaged on the local badger population.

6.4.4 Water vole and otter

Evidence of water vole and otter during the site surveys (and data searches) was extensive along the River Bure and its associated network of drainage ditches within the immediate floodplain. In addition, evidence of water vole was recorded along the drainage channel to the west of the Salle substation.

The River Bure will be directionally drilled to a sufficient depth and lateral distance either side of the river to avoid any impact to water voles or otters. The proposed cable route and substation are both also located at least 200m to the east of the drainage channel where water vole were recorded, therefore there would be no impact to water vole.

With the exception of the watercourses within the woodland to the east of Salle Park (W11 and W12), which is also to be directionally drilled, no other suitable habitat for otter was identified during the surveys. However, other drainage channels across the study area were assessed as providing suitable water vole habitat. In order to confirm that water vole have not inhabited these drainage channels in the period between the surveys and work commencing, an additional survey of the crossing points will be carried out prior to the construction stage. Also, if any evidence of water vole is recorded along ditches where open-cut installation methods are proposed, further mitigation will be incorporated, in liaison with Natural England.

Based on the current status of water vole and otter in the study area, **no impact** is envisaged.

6.4.5 Bats

No buildings or other possible roost sites, such as bridges or culverts, would need to be demolished. One ash tree requires removing at the Salle substation site and several smaller trees could also potentially require removal along the cable route, for example at Carman's Belt and the disused railway to the north of the B1149. Although none of these individual trees were highlighted as having potential to support roosting bats, this would be reassessed prior to any felling taking place and any appropriate mitigation incorporated to ensure that there would be **no impact** to any bat roost sites during the construction phase.

Any impact to foraging bats would be of a short-term duration and would relate to the severance of short sections of hedgerow which would be fully reinstated following the construction phase. With the exception of some Highways' crossings, it is intended that working hours would generally be restricted to daylight hours, therefore disturbance to foraging bats would be limited.

Overall, **no impact** to bats is predicted during the construction stage and no additional mitigation is considered necessary.

6.4.6 Breeding birds

The potential impact to breeding birds would be dependant upon the timing of the construction phase in relation to the breeding bird season, which typically runs from March to August. If construction occurs outside of the breeding season, the only potential impact to breeding birds would relate to a temporary loss of nesting habitat during the period whilst reinstated habitat matures, and therefore no additional mitigation measures would be necessary.

If site preparation work, habitat clearance (e.g., hedgerow removal) and trenching/ excavation works occur during the breeding bird season, there could be potential impacts to nesting birds. Under the Wildlife and Countryside Act 1981, it is an offence to kill or injure any wild bird, to damage or destroy a nest or to take or destroy birds' eggs.

Unless relating to specific circumstances along the route, it is not considered feasible (or necessary) to restrict the construction phase during the breeding bird season, therefore a suitable mitigation strategy will instead be required to prevent any significant impact, where works are scheduled between March and August. This will require careful programming in advance, in liaison with the landowner/s and farming tenants.

Along sections of the cable corridor where duct installation is planned during the breeding season, all hedgerows to be breached will need to be removed prior to the onset of the season (i.e., before the end of February) to ensure that there are no active nests present.

In order to avoid any impact to the three Scheduled 1 species recorded (or reported) – barn owl, kingfisher and quail – in the Mere Farm area, the installation of the cable ducts will not be carried in this particular area during the bird breeding season.

A summary of mitigation to avoid any impact to breeding birds is given below.

Mitigation – Breeding birds during construction
• Trenching operations in Mere Farm area to be carried out outside of breeding season (March to August). • Where construction is planned during breeding season, all scrub (hedgerow breaches) will be cleared, prior to the onset of the season. • If any unforeseen scrub clearance is required during the breeding season, the area to be cleared will be checked first for any nests by an ornithologist. If nests are found, the area shall not be cleared until chicks are hatched. • Full reinstatement of any breeding bird habitat disturbed will take place following the construction phase.

The successful implementation of the outlined measures would ensure that there would be **no impact** to breeding birds. Following reinstatement, with the exception of the loss of a relatively small area of arable habitat at the site of the substation and small areas associated with the cross bonding pits/pillars, there would be no net loss of breeding bird habitat.

6.4.7 Reptiles

During the ecological surveys, possible habitat for reptiles was identified along the surveyed corridors in the form of woodlands, watercourse banks, damp grassland areas, hedge banks, disused or active railway embankments, and some grassland features, although it is not considered that the area is of any significance to reptiles. This was also indicated during the results of the ecological data searches carried out.

The cable system has been designed to avoid impact to woodlands, watercourses and associated habitats by avoidance or directional drilling, where appropriate. The only areas of grassland which provide suitable habitat are at the Muckleburgh Collection and at some grass field margins. A reptile survey carried out in 2005 at the Muckleburgh Collection museum recorded no reptiles, therefore it is considered that the likely impact is insignificant.

Potential impacts to areas of habitats which will still be directly impacted, for example hedgerows breaches and open-cut watercourse crossings, could potentially result in some impact to reptiles which may be present. Habitat mitigation measures already outlined, including the reduction of the working width within these sensitive areas, and habitat management (maintaining short vegetation), is considered to be sufficient to avoid any significant impacts to occasional reptile species which may occur.

Habitat reinstatement following the construction phase will ensure that there is no net loss of suitable habitat for reptiles. Overall, the potential impact to reptiles during construction is considered to be **negligible**.

6.4.8 Great crested newts

Under Natural England's great crested newt mitigation guidelines (English Nature, 2001), any land within a 500m buffer zone of a breeding pond should be considered as potential terrestrial habitat. Construction work within any terrestrial habitat utilised by great crested newts could potentially result in destruction, disturbance or damage to terrestrial habitat and cause injury or death to great crested newts. All of these activities are illegal without a great crested newt licence in respect of development from the Natural England Wildlife Licensing Unit. The location of the breeding ponds identified during the surveys and the theoretical meta-populations identified are shown on **Figure 6.3**.

The construction of the onshore grid connection would not result in any loss or direct impact to any breeding ponds (or any other ponds). In addition, there would be no long-term loss, modification, fragmentation or isolation of terrestrial habitats.

The construction phase within the terrestrial areas located within each of the five meta-populations could theoretically result disturbance and severance of habitat, as well as possible injury or death of individual animals. The likelihood of any impact occurring is dependant upon the combination of a number of factors, including: the habitat types to be affected; the season during which construction is to take place; the distance between the works and the breeding ponds; and any intervening habitats.

An assessment of the likelihood and severity of any impact occurring has been carried out for each of the five meta-populations. Where a potential impact has been identified, a suitable mitigation strategy has been outlined to avoid or minimise the level of impact.

In order to finalise the strategy, further information on the timing of the construction works will be necessary, which will not be available until the detailed design stage. Following consent determination, an application for a Natural England licence would be also required, which would include the formulation of a detailed mitigation strategy. A summary of the likely measures to be incorporated have therefore been outlined for the purpose of this impact assessment only and would be subject to further analysis and refinement during the detailed design stage, in consultation with Natural England.

It should be considered, that since the issue of the great crested newt mitigation guidelines (English Nature, 2001), Natural England has since published a research report which assesses the efficiency of capture techniques and the value of different habitats for great crested newts (English Nature, 2004). The report states:

> *"The most comprehensive mitigation, in relation to avoiding disturbance, killing or injury is appropriate within 50m of a breeding pond. It will also almost always be necessary to actively capture newts 50-100m away. However, at distances greater than 100m, there should be careful consideration as to whether attempts to capture newts are necessary or the most effective option to avoid incidental mortality. At distances greater than 200-250m, capture operations will hardly ever be appropriate."*

This has been taken into account during the assessment of mitigation needs. A summary of the likely mitigation required at each of the meta-populations is given in **Table 6.11**. Any fencing recommendations are indicated on **Figure 6.4**.

Table 6.11 Great crested newt outline mitigation strategy

Meta-population and ecological value	Distance to construction area	Outline mitigation strategy
Meta-population 1 (Pond 37) – Local value	15m	Construction during winter months: No mitigation as arable habitat to be temporarily disturbed does not offer suitable terrestrial habitat. Construction during rest of year: • Temporary newt fencing to be installed prior to trench, duct and backfill stage, as follows (see also **Figure 6.4a**): - Fencing to surround pond and section of field cut-off between cable alignment and road to prevent newts already in the pond from entering the construction area, along with any newts trying to migrate from the east. - Fencing along western side of construction area with curved ends to deflect any newts trying to migrate to the pond from the west. • Hand-searching of any areas of suitable terrestrial habitat within construction corridor, e.g. hedge banks and verges. • Removal of all fencing on completion of ducting stage (estimated duration 11 days).
Meta-population 2 (Ponds 20, 24, 26, 27, 30, 31, 33, 34, 106) – District value	Pond 33: 58m Pond 34: 172m Pond 31: 51m Pond 30: 218m Remaining ponds: >250m	No mitigation required: No mitigation recommended for ponds south of the road (20, 24, 26, 27 and 106) due to distance and presence of good terrestrial habitat between ponds and cable construction area. Construction during winter months: No fencing or detailed mitigation as arable habitat to be temporarily disturbed does not offer suitable terrestrial habitat. Construction during rest of year: • Temporary newt fencing to be installed prior to trench, duct and backfill stage, as follows (see also **Figure 6.4b**): - Fencing along eastern side of construction corridor to prevent newts from migrating from Ponds 30, 33 and 34. - Fencing along western side of construction corridor and to the south of Pond 31 to prevent newts migrating into construction corridor, and being forced into road. • Hand-searching of any areas of suitable terrestrial habitat within construction corridor, e.g. the ditch banks. • Removal of all fencing on completion of ducting stage (estimated duration 22 days).

Meta-population and ecological value	Distance to construction area	Outline mitigation strategy
Meta-population 3 (Ponds 67, 68, 87) – District value	Pond 87: 370m Ponds 67 & 68 >920m	No mitigation required due to distance between cable trenching and ponds and abundance of suitable habitats surrounding the ponds (i.e. River Bure and associated woodlands, scrub, rough grassland, etc.).
Meta-population 4 (Pond 9) – Local value	Pond 9: 310m	No mitigation required due to distance between cable trenching and ponds; the availability of suitable habitat closer to the pond and physical barriers located between the pond and the works (i.e. a road).
Meta-population 5 (Pond 93) – Local value	Pond 93: 54m to cable corridor; 90m to substation construction site	<u>Need:</u> Resurvey prior to construction phase to re-confirm presence (pond is likely to dry up and is subject to disturbance). If no longer present, no mitigation required. If still present, the following mitigation is recommended. <u>Salle substation works</u> Due to the longer duration of the substation works, permanent 'ACO' type newt-fencing recommended along road verge for duration of construction period to deflect any newts migrating from the pond across to the substation site (see blue fencing on **Figure 6.4c**). Newts would either be deflected to the east or west or encouraged to remain in the wooded pit. Fencing to be removed on completion of construction phase. <u>Cable works during winter months</u>: No fencing or detailed mitigation as arable habitat to be temporarily disturbed does not offer suitable terrestrial habitat. <u>Cable works during rest of year</u>: • Temporary newt fencing to be installed along west side of construction corridor prior to trench, duct and backfill stage, to prevent newts migrating from the pond into the construction corridor (see also pink fencing shown on **Figure 6.4c**). • Hand-searching of any areas of suitable terrestrial habitat within construction corridor, e.g. the hedge and grass banks. • Removal of all fencing on completion of ducting stage (estimated duration 5 days).

Figure 6.4a   Suggested temporary newt fencing (pink) for meta-population 1

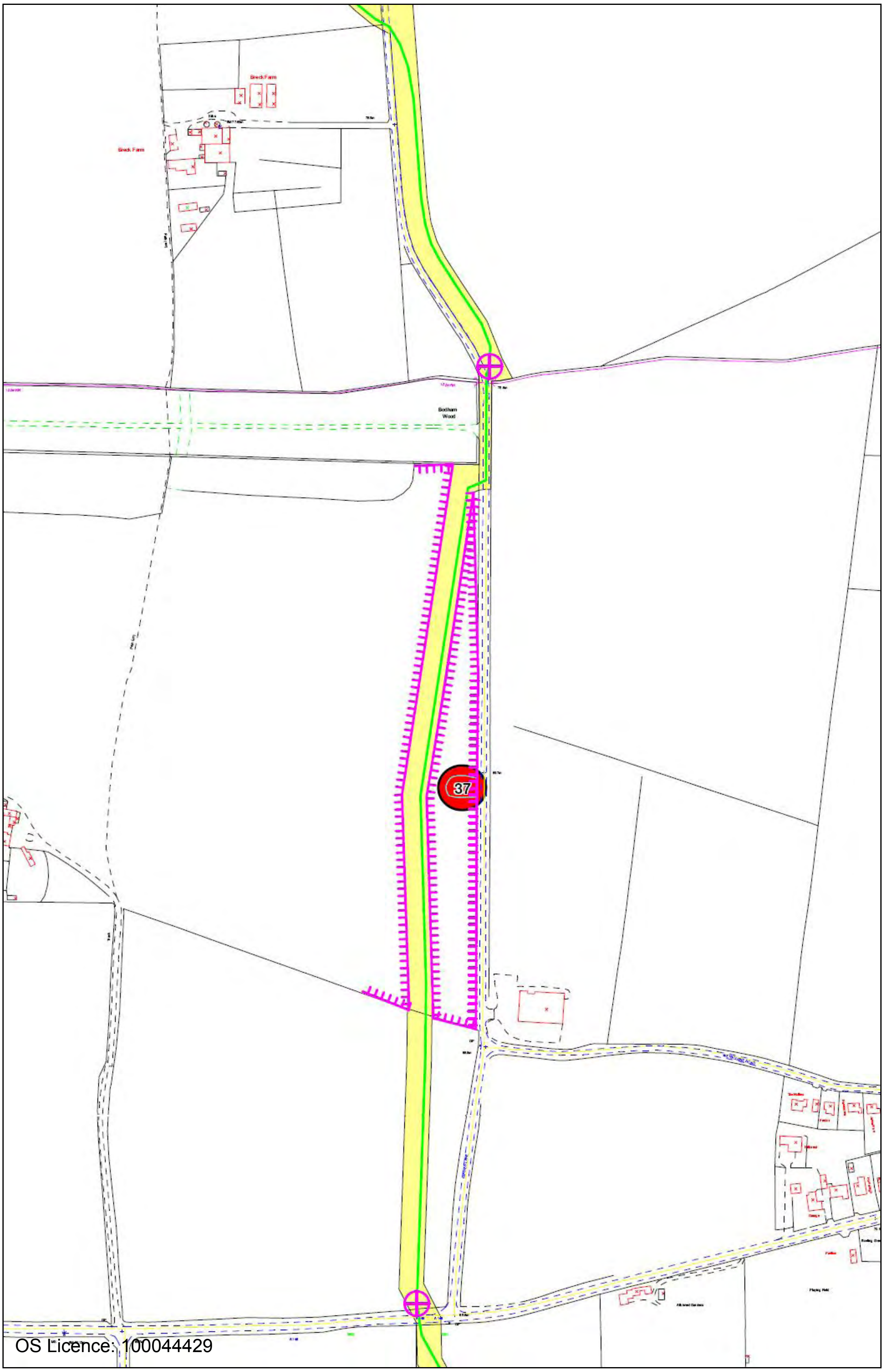


Figure 6.4b Suggested temporary newt fencing (pink) for meta-population 2

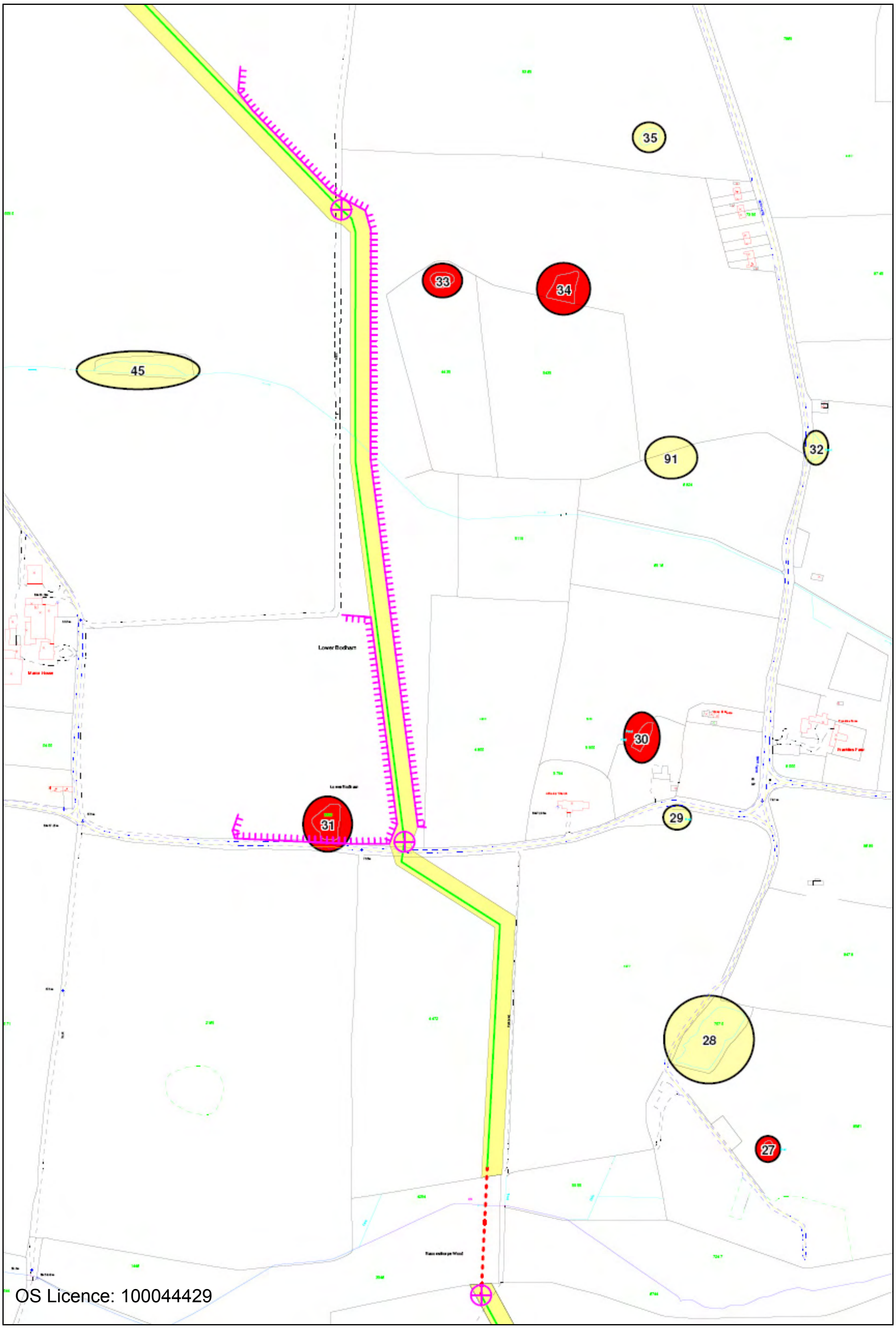
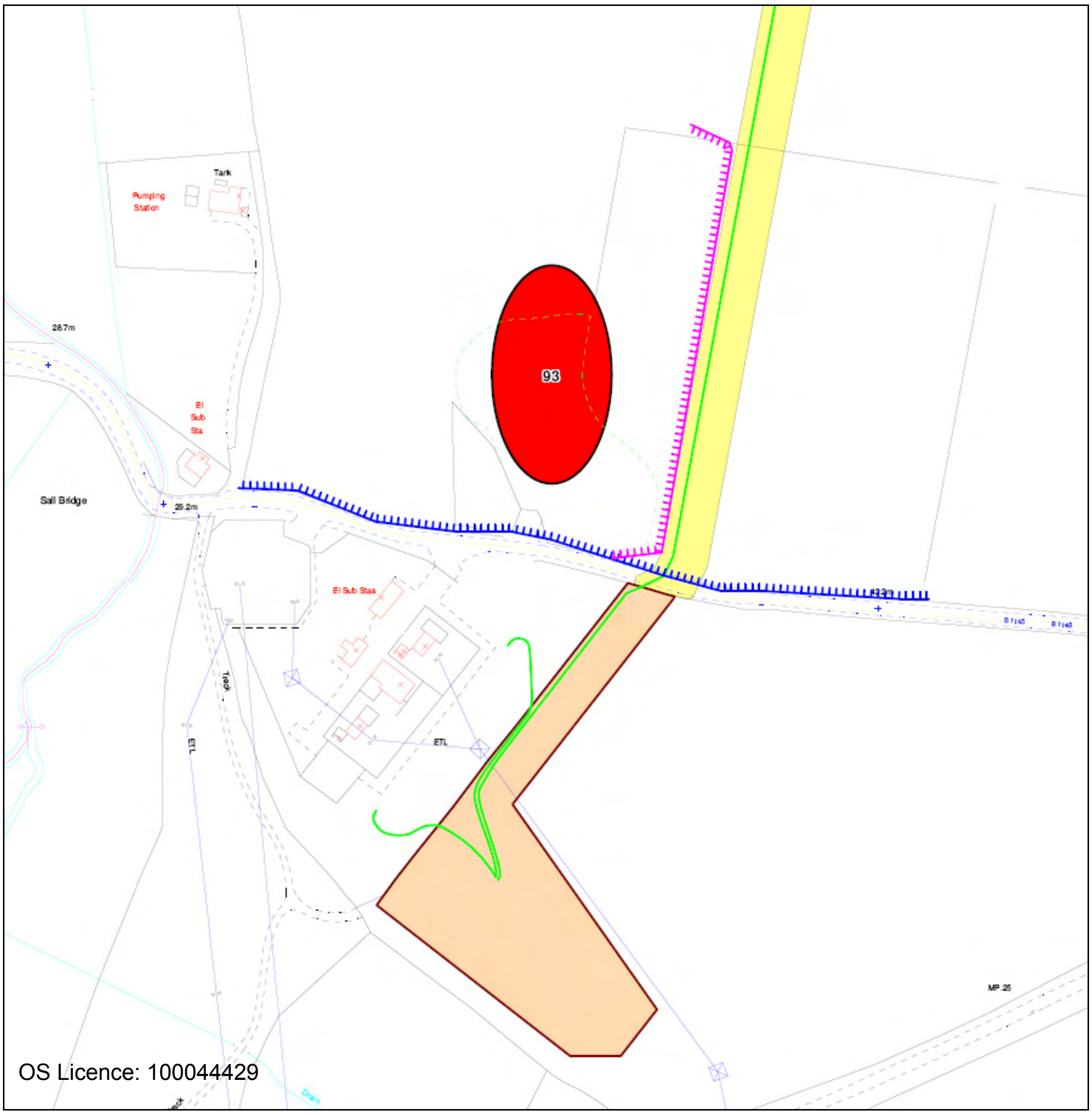


Figure 6.4c Suggested newt fencing for meta-population 5 (pink: temporary cable system fencing, blue: longer-term substation fencing)



Following finalisation and successful implementation of the outline mitigation strategy, it is considered that there would be **no impact** to great crested newts in the study area.

6.4.9 Invertebrates including white-clawed crayfish

Both watercourses which were identified as offering suitable habitat for white-clawed crayfish; the River Bure (W08) and the watercourse in the woodland to the east of Salle Park (W11); are to be directionally drilled, therefore **no impact** would occur to this species and no further mitigation would be necessary.

There is the potential for some invertebrate interest within the general route corridor, however, as already noted, the cable system has been designed to minimise direct habitat to features such as woodlands, wet grasslands, ponds and ditches, which are likely to hold the more significant assemblages of invertebrates. In addition, no records of protected or BAP invertebrate species were recorded during the surveys or received during the ecological data searches, therefore the potential significance of any impact is likely to be minimal.

Mitigation measures already outlined in relation to woodland, hedgerow, grassland, and aquatic habitats will minimise the potential impact further; for example, the separation, storage and reinstatement of any substrate excavated from ditch banks will reduce the impact to any invertebrate assemblages present.

Habitat reinstatement following the construction phase will ensure that there is no net loss of suitable habitat for invertebrates. Overall, the potential impact during the construction phase is considered to be **negligible**.

6.5 Impacts During Operation

Once the onshore grid connection is operational, there would be **no impact** to any of the nature conservation sites or ecological receptors identified.

6.6 Summary

The cable route and substation site identification process has avoided any impact to international, European and national nature conservation sites in the general study area. There would also be **no impact** to any woodland sites listed on Natural England’s Ancient Woodland Inventory or any Roadside Nature Reserves. The majority of County Wildlife Sites are also avoided.

The utilisation of directional drill techniques has prevented or minimised impact to several sites of nature conservation importance and habitats of ecological interest, including woodland and aquatic features at Kelling Heath and Hundred Acre Woods (a County Wildlife Site), Baconsthorpe Wood, the River Bure and a woodland to the east of Salle Park.

Cable routing has been aligned to utilise any existing gaps in hedgerows, as well as avoiding any sizeable or noteworthy individual trees along field boundaries wherever possible. Further mitigation measures, including full reinstatement, will ensure that the residual impact to hedgerow habitat and individual trees would be of a short-term and **minor adverse impact** level.

The majority of woodlands which are crossed by the cable route would be directionally drilled with the exception of a belt of woodland known as Carman’s Belt (a County Wildlife Site), and a disused railway lined with trees and scrub, both in the Heydon area. Minimisation of the working corridor, careful alignment to avoid any large or valuable trees and full reinstatement, would ensure that the residual effect to these woodlands would be **negligible**.

Likewise, the crossing of several small drainage channels utilising open-cut trenching techniques would be carefully managed to ensure that there would be **no impact** once reinstatement has occurred. The impact to grassland habitat along the cable corridor would be **negligible** and limited to areas of grassland within the Muckleburgh Collection museum and field margins. The new substation would result in the permanent loss of a small area of arable habitat, of no ecological significance.

No evidence of badgers were recorded along the route corridor, therefore **no impact** is envisaged. Water vole and otter are present along the River Bure and its floodplain, however there would be **no impact** to these species as the area is to be directionally drilled. Mitigation would be incorporated to ensure that there would be **no impact** to breeding birds, or the known population of great crested newts in the study area during the construction phase. In addition, **no impact** to any potential bat roost sites or habitat suitable for supporting white-clawed crayfish would occur. Based on the management and minimisation of impacts to woodland, grassland and wetland habitats, impacts to any reptiles or diverse invertebrate assemblages present would be **negligible**. Badger and water vole surveys would be repeated nearer to the construction period to re-confirm the results and incorporate any additional mitigation which may be necessary.

Once the onshore grid connection is operational, there would be **no impact** upon any of the nature conservation or ecological receptors identified.

6.7 References

Anon 1979
EC Directive on the Conservation of wild birds (Council Directive 79/409/EEC) 'Birds Directive'

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EU Directive on the Conservation of natural habitats and of wild fauna and flora (Council Directive 92/43/EEC) 'Habitats Directive'

English Nature 2001
Great crested newt mitigation guidelines English Nature

HMSO 1981
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HMSO 1994
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HMSO 2000
Countryside Rights of Way (CRoW) Act

Institute of Ecology and Environmental Management 2006
Guidelines for Ecological Impact Assessment in the United Kingdom

Joint Nature Conservation Committee (JNCC) Revised reprint 2003
Nature Conservancy Council ; NCC, 1990
Phase 1 Habitat survey: a technique for environmental audit

Natural England 2004
An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt *Triturus cristatus*

Norfolk County Council Various - ongoing
Norfolk Biodiversity Action Plan

Norfolk Wildlife Services 2005
Habitat and Wildlife Surveys - Weybourne / Muckleburgh

Norfolk Wildlife Services 2006
Reptile Surveys – Muckleburgh

Norfolk Wildlife Services 2007
Ecological Survey Report

OPDM 2005
Planning Policy Statement 9: Biodiversity and Geological Conservation

OPDM 2005
Planning for Biodiversity and Geological Conservation: A Guide to Good Practice

Robert Yaxley Ecological Surveys Ltd. 2007
Great Crested Newt Survey Report

Scira Offshore Energy Ltd. 2006
Sheringham Shoal Offshore Wind Farm Environmental Statement

Strachan 1998
Water vole conservation handbook

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 7

ARCHAEOLOGY AND CULTURAL HERITAGE

7 ARCHAEOLOGY AND CULTURAL HERITAGE

7.1 Introduction

This section describes the baseline environment in relation to the known archaeological and cultural heritage resource. Information has been obtained via an Archaeological Desk Based Assessment (ADBA) in order to gather information on any Scheduled Monuments, Listed Buildings, Registered Parks and Gardens, Conservation Areas and other known archaeological finds or features, from a variety of sources.

The data obtained have been analysed and assessed with reference to policy and best practice guidance in order to identify any areas where the importance of the feature is such that preservation *in situ* is necessary or the preferred option. Where such important features have been identified, these have been taken into account during the route identification and micro-siting process wherever possible.

Where the alignment of the grid connection route unavoidably encounters archaeological features (for other environmental or technical reasons), the construction of the onshore grid connection could result in the potential disturbance or irreversible loss of archaeological finds or features. In these cases, an assessment has been carried out to outline a suggested strategy for archaeological recording to minimise the significance of the potential loss or disturbance.

7.2 Assessment Methodology

7.2.1 Legislative and policy context

The assessment of potential impacts upon features of significant archaeological and cultural heritage value has been made with reference to the following national planning guidance.

Planning Policy Guidance 16: Archaeology and Planning (PPG16)

PPG16 sets out the Secretary of State's policy on archaeological remains. It acknowledges the fragile and finite nature of such remains, and states that the desirability of preserving archaeological remains and their setting is a material consideration in the planning process. PPG16 provides that there is a presumption in favour of the physical preservation of nationally important archaeological remains. Where preservation *in situ* is not justified it is reasonable for planning authorities to require the developer to make appropriate and satisfactory provision for excavation and recording of remains.

PPG16 suggests that it is in the developers' own interests to include an initial assessment of whether the site is known or likely to contain archaeological remains as part of their research into the development potential of a site. It also adds that local planning authorities can expect developers to provide the results of such assessments as part of their application for sites where there is good reason to believe there are remains of archaeological importance. PPG16 identifies, however, that in spite of best pre-planning application research, there may be occasions when the presence of archaeological remains only becomes apparent once development has commenced.

Planning Policy Guidance 15: Planning and the Historic Environment (PPG15)

PPG15 gives guidance on Government policies for the preservation, protection and classification of Listed Buildings and Conservation Areas. The fundamental principle behind PPG15 is the need to retain physical reminders of our past, and that the preservation and protection of historic buildings and areas adds to our national identity and quality of life.

PPG15 states that archaeological significance in relation to historic monuments and buildings must be assessed before planning applications are determined. Advice in PPG15 includes:

- Listed Buildings should be protected from demolition or change unless a convincing argument can be put forward for such change.
- Any development that may affect the setting of a Listed Building should also be carefully considered by the local authority before planning permission is granted.
- Local authorities should strongly presume against any development which conflicts with the preservation or character of a Conservation Area.

PPG15 advises local authorities not to prevent all development, but to control and manage change carefully. When granting planning permission, local authorities are advised to assess which areas of the historic environment are irreplaceable, and where there is capacity for change.

In addition to the outlined planning guidance, the following legislation is relevant to the assessment of impact to features of archaeological or cultural heritage significance:

- Ancient Monuments and Archaeological Areas Act (1979).
- National Heritage Act (1983).
- Planning (Listed Building and Conservation Areas) Act (1990).

Regional, district and local planning policy guidance

The key policies contained within regional, county and district-level plans are detailed fully in Section 5: ‘Policy and Planning Guidance’.

7.2.2 Impact identification, significance levels and mitigation

The significance level (negligible, minor, moderate, major adverse or beneficial) of identified impacts are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification and Table 4.4 for definitions of significance levels.

7.2.3 Desk-based assessment

The assessment has taken the form of an Archaeological Desk-Based Assessment (ADBA), with reference to 'Standards and Guidance for Archaeological Desk-Based Assessments' (Institute of Field Archaeologists, 1994, Revised Edition, 2001). The ADBA was carried out by NAU Archaeology, which is an Institute of Field Archaeologists (IFA) registered organisation.

The scope of the ADBA was agreed at the Scoping stage and the following tasks were undertaken:

- Identification of Scheduled Monuments, Listed Buildings and Registered Parks and Gardens.
- Collection of National Monument Record (NMR) data.
- Collection and compilation of data from the Norfolk Historic Environmental Records (NHER).
- Collection and compilation of cartographic data from county archives offices.
- Collection and compilation of aerial photographic data, where appropriate.
- Collection and compilation of data from literature.
- Assessment of likelihood of previously unrecorded archaeological finds and features within area of proposed onshore grid connection works.
- Assessment of impacts resulting from the proposed onshore grid connection works.
- Devising of proposals and strategies for mitigation to minimise any residual impact.

The study area for the ADBA covered a 500m wide corridor for the cable system, approximately 21.3km in length. The corridor starts just to the west of Weybourne, and heads south to a point just west of Cawston. The area surrounding the substation was also included in the study area.

A full ADBA assessment was also carried out for an alternative road-based route (NAU Archaeology, 2007a) which was previously under consideration (refer to Section 2 'Site Selection and Consideration of Alternatives').

The potential for the development to impact indirectly upon the visual setting of any features of cultural heritage significance identified during ADBA, such as Listed Buildings, Registered Parks and Conservation Areas, is assessed in Section 9: 'Landscape and Visual Character'.

7.2.4 Consultation

Norfolk Landscape Archaeology was consulted during the Scoping stage on the content of the ADBA. During the EIA consultation phase, feedback and comment on the proposed onshore grid connection options under consideration was requested from both English Heritage and Norfolk Landscape Archaeology.

Additional consultation with both organisations was also undertaken during the EIA process regarding cable routing in proximity to specific features identified within the study area.

A summary of all consultation responses is provided within **Appendix 4.2**.

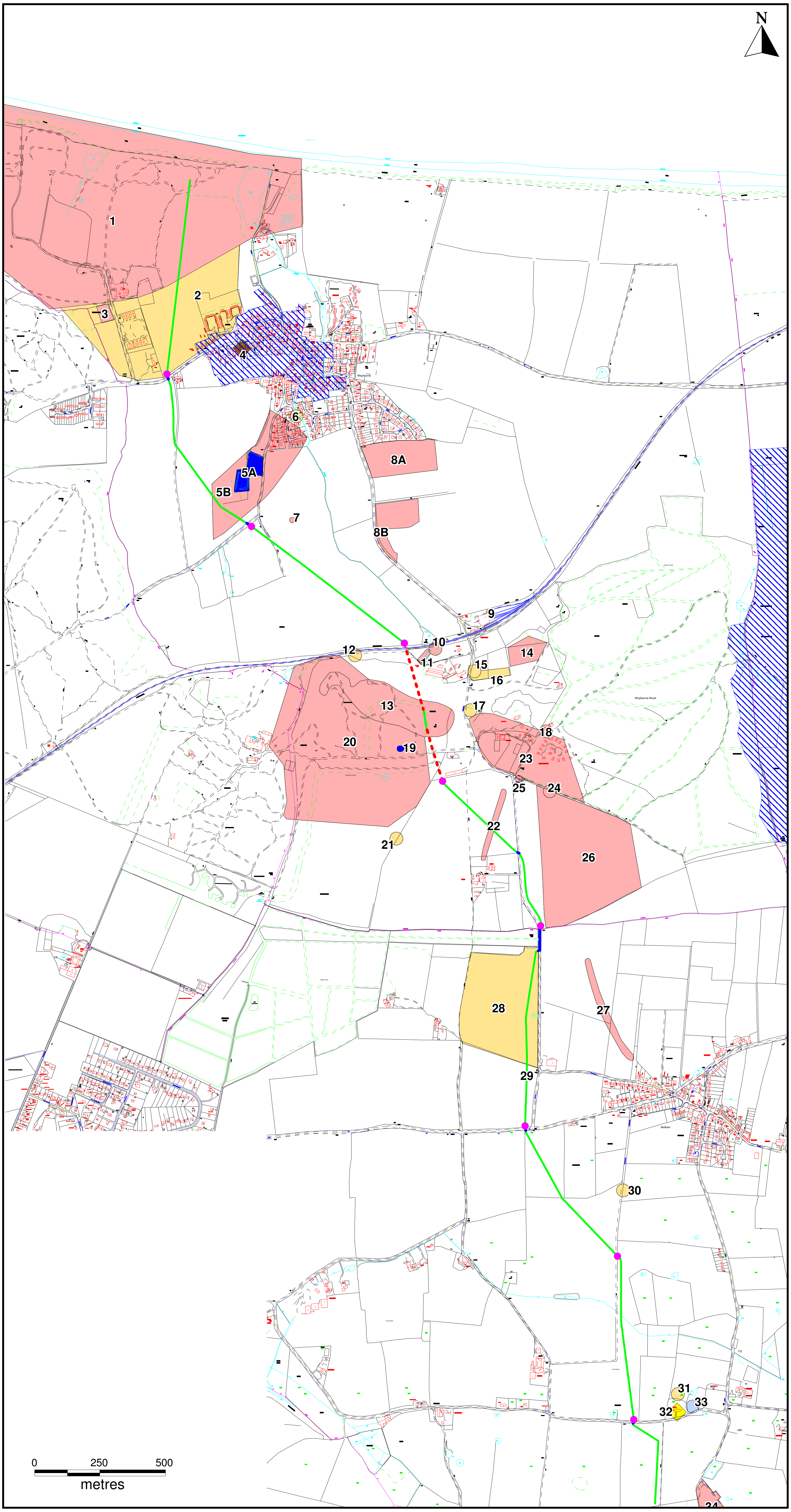
7.3 Existing Environment

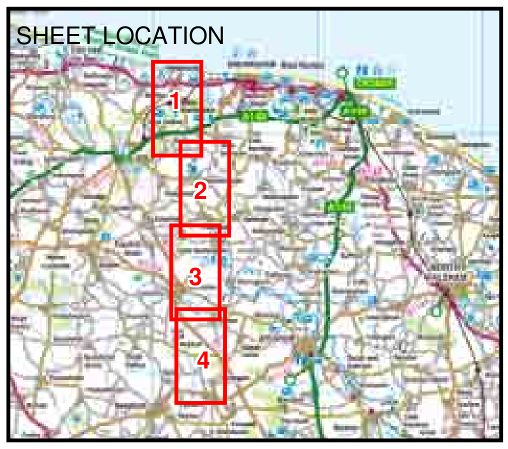
Within the study area, a total of 108 archaeological sites are recorded in the Norfolk Historical Environment Record (NHER). These include two Scheduled Monuments, several Listed Buildings and two Registered Parks and Gardens of Special Historic Interest (RPaG); Mannington Hall (Grade II) and Heydon Hall (Grade II*). Significant archaeological sites within the survey area include earthworks, cropmarks, findspots, and structures from a variety of time periods including Prehistoric, Iron Age, Roman, Medieval, Post-Medieval, and World War I and II eras.

Each of the sites identified has been given unique reference numbers, which are referred to hereon within the text, figures and tables. The locations of the identified sites are shown in **Figure 7.1**. The full ADBA report (NAU, 2007b) is appended as **Appendix 7.1** with the results summarises below.

There are several clusters of known archaeological remains in the study area. The most significant of these areas are:

- The World War II Weybourne Training Camp (**Ref. 1**) and various associated WW II sites such as gun positions and pillboxes on the higher ground to the south and west of Weybourne, including the site of the existing Muckleburgh Collection museum.
- A Medieval moated complex to the south-west of Weybourne (the central area of which is a Scheduled Monument) extends the width of the study area (**Refs. 5a, 5b**) and comprises of a main ditched enclosure, earthworks of former moats, gardens and fishponds.
- A Bronze Age barrow (Scheduled Monument) (**Ref. 19**) is located south of Weybourne within the Kelling Heath / Hundred Acre woods. Other finds and features in this area include several WW II sites (**Refs. 10, 20, 23, 24, 25)**, ancient iron working pits (**Ref. 13**), Roman pottery (**Ref. 16**) and prehistoric flints including axe-heads and arrowheads (**Refs. 15, 17, 21**).
- A group of Roman finds and features are recorded between Lower Bodham and Baconsthorpe, including: a large 3rd century coin hoard and evidence of settlement from pottery and tiles within the topsoil; the former indicating built remains (**Refs. 37, 42, 43, 44, 46, 47, 48, 52**). Important Prehistoric remains found north of Baconsthorpe include a burnt flint mound (**Ref. 46**), a scatter of flints (**Ref. 43**) and several cropmark sites likely dating from later prehistory. A Bronze Age barrow is also located to the east of Baconsthorpe (**Ref. 53**).





LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits

Substation

- Total extent of proposed substation

Archaeological and Cultural Heritage Sites

- Scheduled Monument
- Listed Building
- Registered Park and Garden
- Monument
- Findspot
- Other building
- Negative excavation
- Conservation Areas

Title
ARCHAEOLOGICAL AND CULTURAL HERITAGE SITES

SHEET 1 OF 4

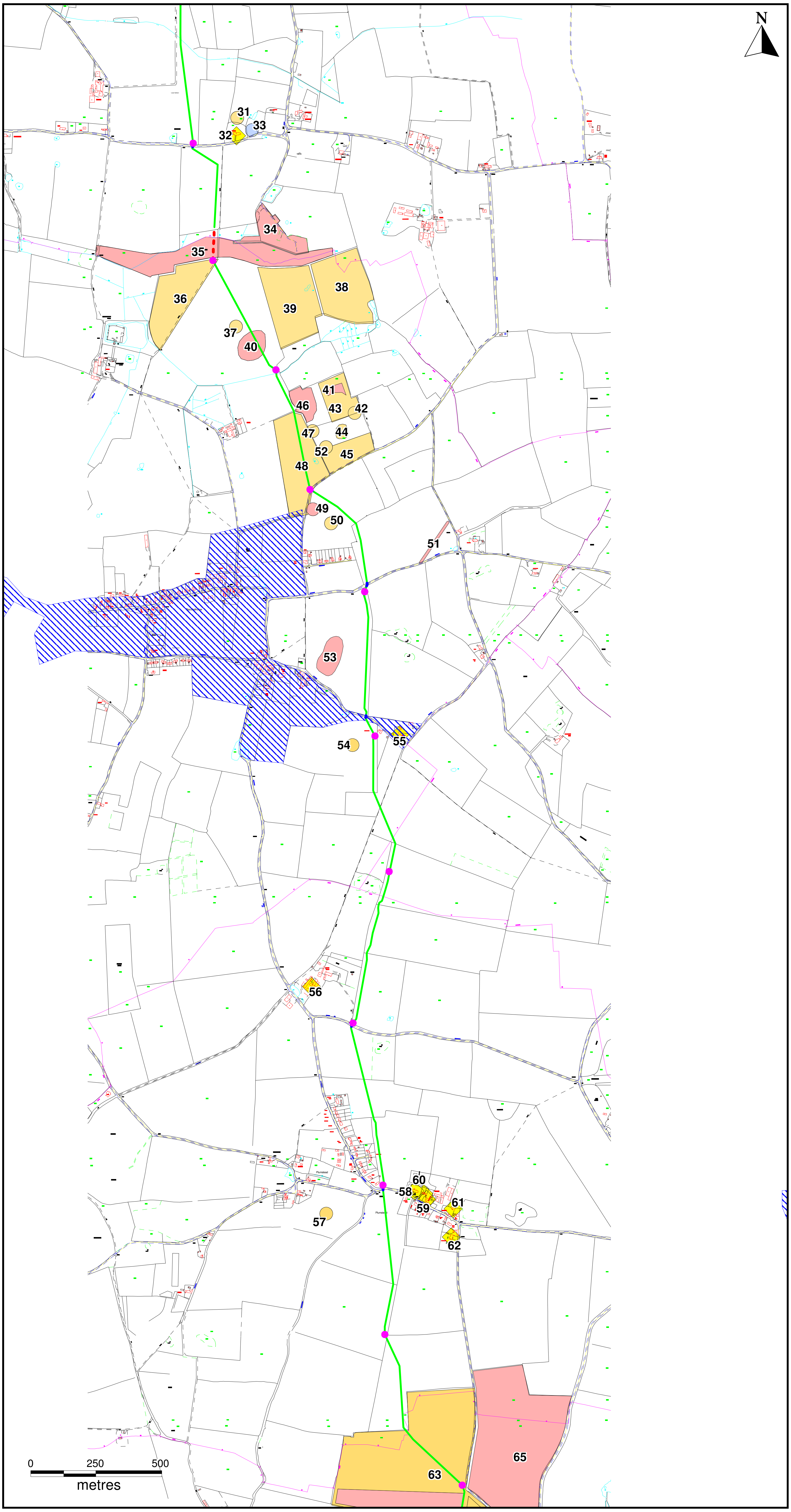
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

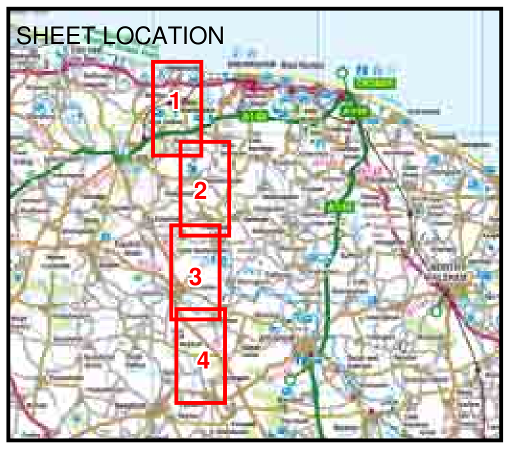
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 7.1 (1 of 4)

ROYAL HASKONING





LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits

Substation

- Total extent of proposed substation

Archaeological and Cultural Heritage Sites

- Scheduled Monument
- Listed Building
- Registered Park and Garden
- Monument
- Findspot
- Other building
- Negative excavation
- Conservation Areas

Title
ARCHAEOLOGICAL AND CULTURAL HERITAGE SITES

SHEET 2 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

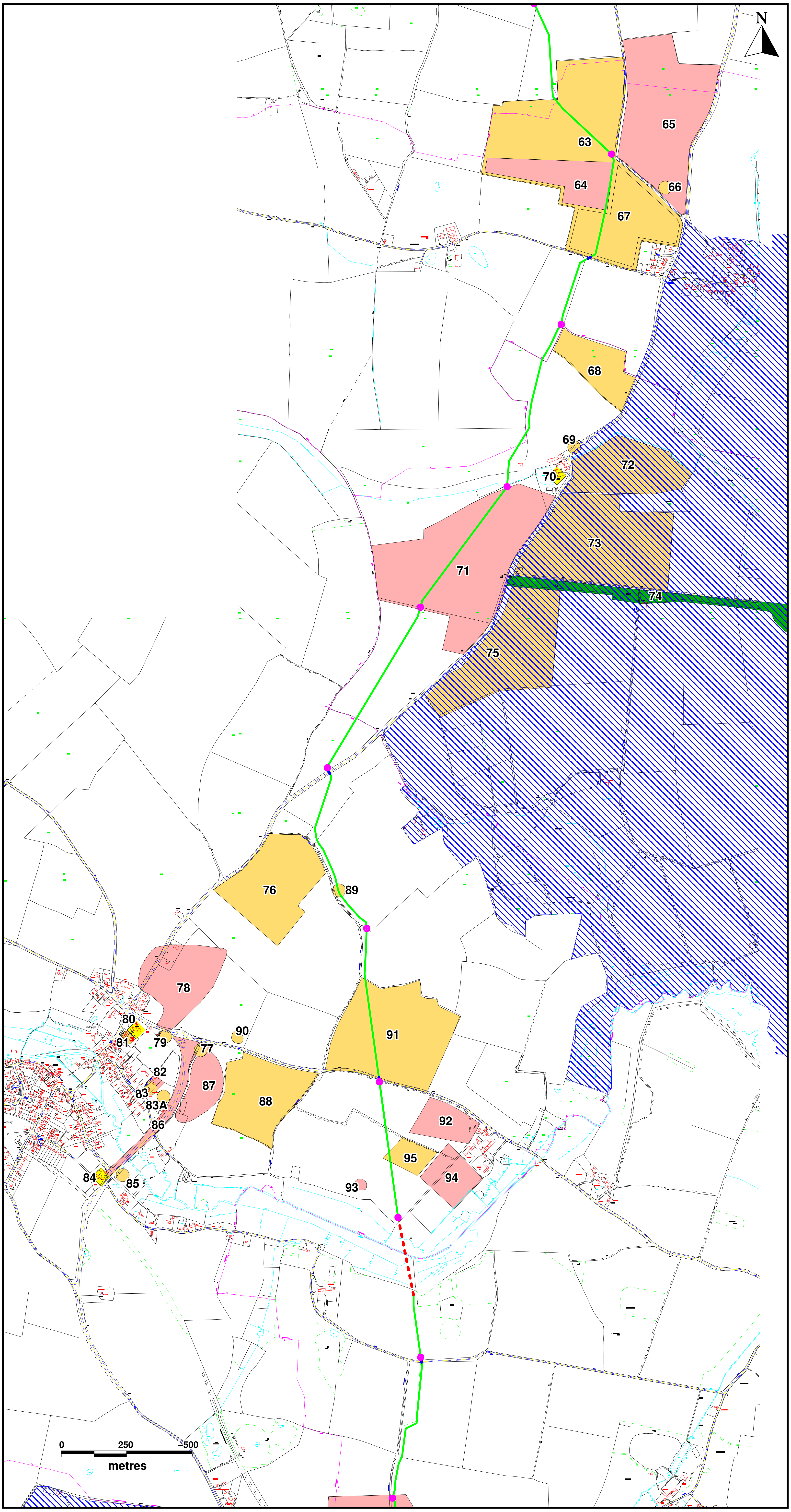
Client:
SCIRA OFFSHORE ENERGY LTD.

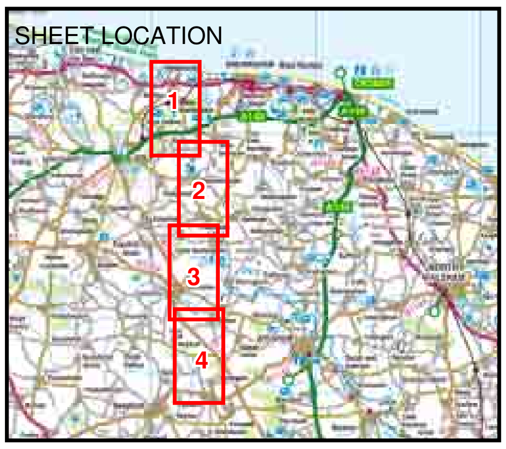
Date:
AUGUST 2007

Scale:
NTS

Figure:
FIGURE 7.1 (2 of 4)

ROYAL HASKONING





LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits

Substation

- Total extent of proposed substation

Archaeological and Cultural Heritage Sites

- Scheduled Monument
- Listed Building
- Registered Park and Garden
- Monument
- Findspot
- Other building
- Negative excavation
- Conservation Areas

Title
ARCHAEOLOGICAL AND CULTURAL HERITAGE SITES

SHEET 3 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

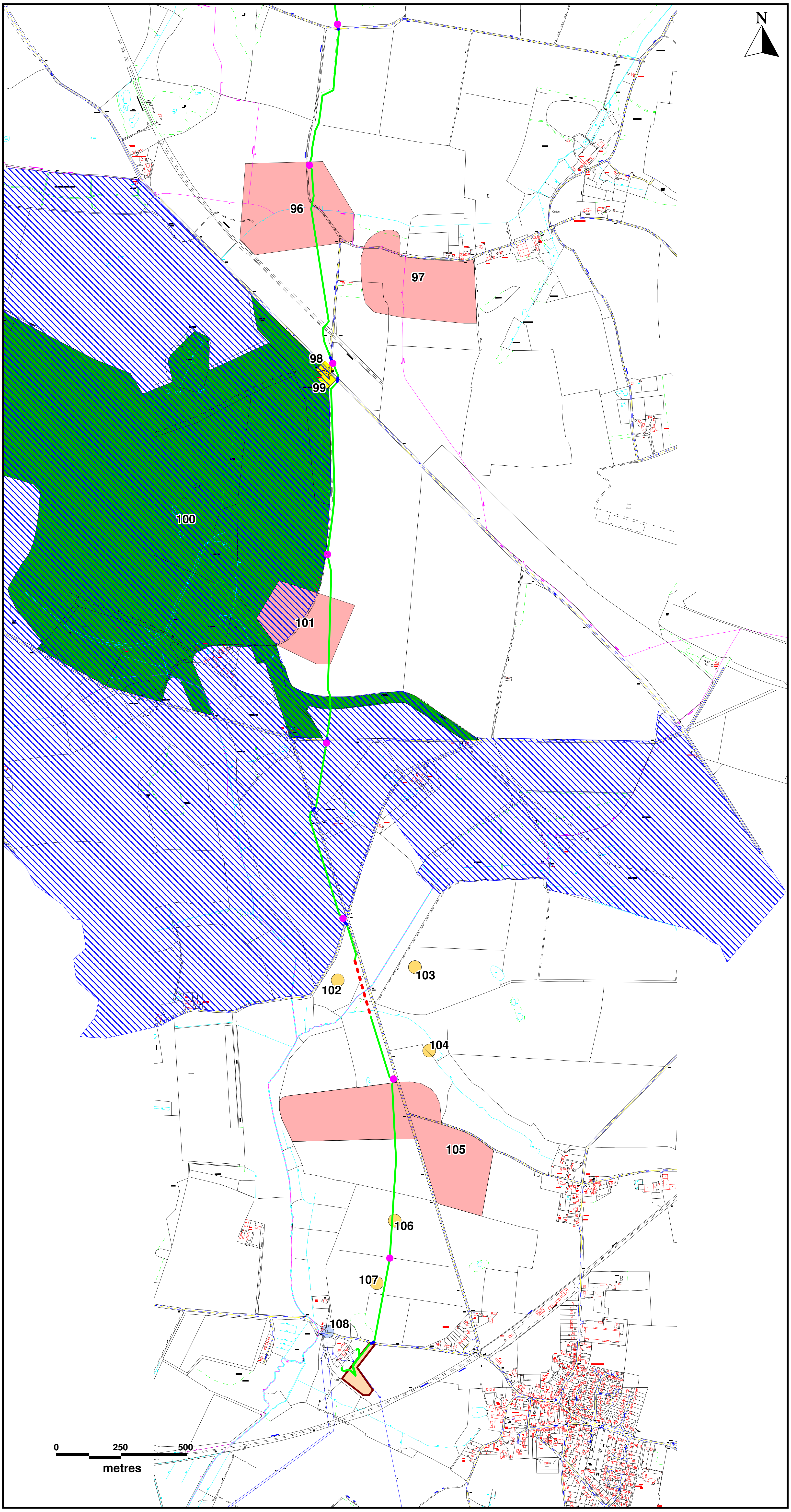
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

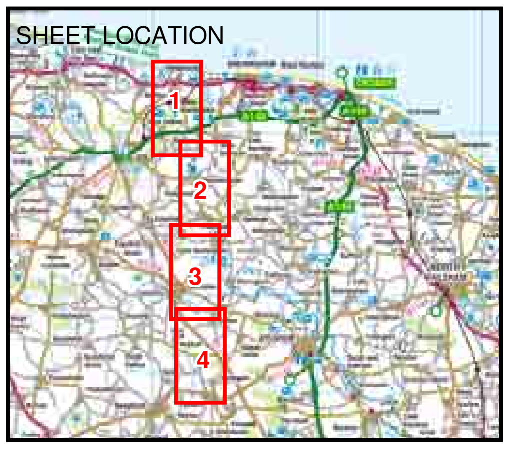
Scale:
NTS

Figure:
FIGURE 7.1 (3 of 4)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits

Substation

- Total extent of proposed substation

Archaeological and Cultural Heritage Sites

- Scheduled Monument
- Listed Building
- Registered Park and Garden
- Monument
- Findspot
- Other building
- Negative excavation
- Conservation Areas

Title
ARCHAEOLOGICAL AND CULTURAL HERITAGE SITES

SHEET 4 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

Scale:
NTS

Figure:
FIGURE 7.1 (4 of 4)

ROYAL HASKONING

- An area of undated cropmarks, with ovoid enclosures, pits and ditches (**Ref. 65**) is located to the north-west of Little Barningham. Several Roman, Medieval and Post-Medieval coins and pottery finds have also been recovered from this locality (**Refs. 63, 66, 67**).
- The cultural heritage at the Mere Farm estate, located between Little Barningham and Saxthorpe, comprises a Listed Building, thought to originate in the 17th century but consisting mainly of 19th century fabric (**Ref. 70**), and an area of undated cropmarks (**Ref. 71**). A variety of finds dating from the Iron Age, Roman, Saxon and Medieval periods have been recovered from the surface, in association with the cropmark complex (**Refs. 68, 72, 73, 75**), suggesting that the underlying features date from a variety of periods. Also within this area lies Mannington Park; a Grade II Registered Park (**Ref. 74**), which extends across the study area.
- There are several cropmark sites with discrete features which fall within the study area east of Saxthorpe. This includes a possible Bronze Age concentric ring-ditch (**Ref. 93**) and several other undated sites. There are also several findspots deriving from metal detecting within the area, which include Roman, Saxon Medieval and Post-Medieval coins, personal accessories, pottery and other metalwork (**Refs. 75, 76, 77, 79, 81, 83, 83a, 85, 88, 89, 90, 91**).
- The study area passes through two complexes of mainly undated cropmarks with rectilinear enclosures and linear features. One contains a rectilinear double-ditched enclosure which is possibly of Roman date according to the NHER (**Ref. 96**); the other is undated (**Ref. 97**). Both these complexes are likely to represent a combination of later prehistoric and Romano-British settlement and field system remains.
- The study area passes the Grade II* Heydon Hall Registered Park (**Ref. 100**) and two Listed Buildings associated to the estate (Eagle Lodge North and South, **Refs. 98, 99**).
- Between Heydon Hall and Salle is a complex of undated cropmarks, consisting of linear features and a possible Bronze Age ring ditch (**Ref. 105**). In the close vicinity, several Pre-historic flint axe-heads (**Refs. 102, 103, 104**), a Medieval coin (**Ref. 107**) and a Saxon brooch fragment (**Ref. 106**) have been recorded.

In addition, there are several settlement-based Conservation Areas (Weybourne, High Kelling, Bodham, Baconsthorpe, Saxthorpe, and Heydon) within the study area, as well as two larger-scale Rural Conservation Areas at Wolverton/Mannington and Heydon/Salle. Potential impacts to these sites are discussed in Section 9 'Landscape and Visual Character'.

The results of the ADBA are summarised in **Table 7.1**. Where there is uncertainty regarding the age or type of the find or feature, this is indicated.

The full archaeological report (NAU Archaeology, 2007b) can be viewed in **Appendix 7.1**.

Table 7.1 Archaeological sites located within study area

Ref	NHER	Type and brief description	Period	Location
1	11335	Monument - *WW II/post-war training camp*	WW II	TG10174359
2	39345	Findspot - *Five Roman coins*	Roman	TG1032343413
3	38368	Monument - *WW II earthworks*	WW II	-
4	21885	Other building - *Building with pebble flint/brick dressings*	Post-Medieval	TG109429
5a	6304	Scheduled Monument - *Medieval moat enclosure*	Roman/Medieval	TG10974250
5b	6304	Monument - *Earthworks and cropmarks relating to moat enclosure*	Roman/Medieval	TG10974250
6	29809	Findspot - *14th century ring brooch*	Medieval	TG111427
7	32048	Monument - *Cropmark or round barrow*	Undated (possible Bronze Age)	TG11104233
8a	38275	Monument - *Cropmarks*	Post-Medieval	TG1151642565
8b	34181	Monument - *Searchlight battery*	WW II	TG11444229
9	18108	Monument - *Pillbox*	WW II	TG11844198
10	18109	Monument - *Mortar base*	WW II	TG11644184
11	31323	Monument - *Pool with pumping station*	Post-Medieval	TG11604181
12	30417	Findspot - *Flint flake*	Prehistoric	TG11344182
13	6280	Monument - *Ironworking quarry, pits*	Undated	TG11474162
14	38637	Monument - *Earthwork pits, mounds and banks*	Undated	TG11994183
15	40546	Findspot - *Flint axe-head*	Neolithic	TG1179541758
16	30046	Findspot - *Roman pottery sherds*	Roman	TG11854174
17	6257	Findspot - *Several prehistoric flint finds*	Neolithic, Mesolithic	TG11784161
18	6283	Monument - *Quarry, hammer stones*	Undated	TG12074153
19	6261	Scheduled Monument - *Round barrow*	Undated (possible Bronze Age)	TG11514146
20	38644	Monument - *WW II training and defence features*	WW II	TG11324149
21	6259	Findspot - *Flint axe-head*	Prehistoric	TG11504112
22	27987	Monument - *Linear cropmarks/track-way(?)*	Unknown	TG1186941172
23	38639	Monument - *Barbed wire enclosures*	WW II	TG11994142
24	40350	Monument - *Mortar base*	WW II	TG1208241301
25	30708	Monument - *Pillbox*	WW II	TG11964134
26	27993	Monument - *Linear cropmarks*	Uncertain	TG1221841054
27	27982	Monument - *Linear cropmarks/track-way(?)*	Undated (possible Medieval)	TG1228740467
28	42834	Findspot - *Two Neolithic flint axes*	Neolithic	TG1188940474
29	27981	Monument - *Pillbox*	WW I and WW II	TG12044023
30	25808	Findspot - *Medieval lead object*	Medieval	TG1239 TG13NW
31	30117	Findspot - *Two medieval coins*	Medieval	TG12573900
32	6573	Listed Building - *14th century church*	Medieval	TG12563893
33	41247	Other - *Archaeological watching brief*	-	TG1262538952
34	44020	Monument - *Military camp*	WW II	TG1270038576

Ref	NHER	Type and brief description	Period	Location
35	44016 44017 44018 44019	Monument - *Earthworks*	Undated	TG1210438465 TG1237938456 TG1255438494 TG1224838402
36	35205	Findspot - *Neolithic/Mesolithic flint axe*	Prehistoric	TG12363828
37	16756	Findspot - *Roman coin copper alloy*	Roman	TG12563820
38	35210	Findspot - *Stoneware and pottery*	Medieval/Post Medieval	TG12963835
39	35204	Findspot - *Stone/post medieval brick/tiles. Possible building*	Post-Medieval	TG12773827
40	32948	Monument - *Arched brick culvert*	Undated	TG126381
41	6565	Monument - *Rectilinear cropmarks*	Undated	TG12943796
42	18061	Findspot - *3 Roman pottery fragments*	Roman	TG13023787
43	32897	Findspot - *Multi-period finds scatter finds*	Prehistoric/Roman	TG1237
44	25169	Findspot - *Multi-period finds scatter finds*	Roman	TG12973779
45	35208	Findspot - *Building materials*	Roman/Post-Medieval	TG12983771
46	17942	Monument - *Burnt mound/finds scatter*	Prehistoric/Iron Age/Roman	TG12823790
47	6559	Findspot - *Coin hoard*	Roman	TG12843779
48	35206	Findspot - *Scattered finds*	Roman/Post-Medieval	TG12753764
49	6567	Monument - *Cropmarks*	Undated	TG12863750
50	35207	Findspot - *Neolithic flint scraper*	Prehistoric	TG12933745
51	30317	Monument - *Cropmarks – Track-way*	Undated	TG13323737
52	18060	Findspot - *Four pieces Roman pottery*	Roman	TG12913774
53	6568	Monument - *Cropmarks/Ring ditch or barrow*	Bronze Age	TG12923694
54	6558	Findspot - *Sandstone querm stone*	Roman	TG13013660
55	44468	Listed Building - *Farmhouse Grade II*	Post-Medieval	TG1319336640
56	DNF 5172	Listed Building - *Grade II Barn*	Post-Medieval	TG1285835680
57	6647	Findspot - *Flint flake*	Prehistoric	TG12913481
58	6691	Listed Building - *Grade II church*	Medieval	TG13283488
59	13664	Listed Building - *Grade II 17th century house*	Post-Medieval	TG13283488
60	13665	Listed Building - *Grade II 16th/17th century church farmhouse*	Post-Medieval	TG13293846
61	DNF 5174	Listed Building - *Grade II farmhouse*	Post-Medieval	TG1339734825
62	22736	Listed Building - *Grade II late 16th/early 17th century house*	Post-Medieval	TG13393472
63	39390	Findspot - *Roman pot and post-medieval coin*	Roman/Post-Medieval	TG1333
64	36778	Monument - *Cropmarks/field boundary/track-way*	Undated	TG13183365
65	36779	Monument - *Ovoid enclosures/ditches/pits*	Undated	TG13653388
66	39704	Findspot - *Three medieval coins*	Medieval	TG1333

Ref	NHER	Type and brief description	Period	Location
67	44076	Findspot - *Various coins/tokens*	Roman/Medieval /Post-Medieval	TG1333
68	34538	Findspot - *Post-medieval coin*	Post-Medieval	TG1332
69	35100	Findspot - *Copper alloy object*	Undated (possible Iron Age)	TG13283265
70	13108	Listed Building - *Grade II house*	Post-Medieval	TG13203256
71	11339	Monument and Findspot - *Cropmarks, burnt mound, artefact scatter, coins*	Prehistoric/Roman Medieval/Post-Medieval	TG1387531200
72	28026	Findspot - *Artefact scatter*	Roman/late Saxon	TG134325
73	28024	Findspot - *Artefact scatter*	Roman/late Saxon Medieval/Post-Medieval	TG1332
74	30471	Monument - *Mannington Hall Grade II Registered Park*	-	TG1332
75	28038	Findspot - *Pottery*	Medieval/Post-Medieval	TG12973187
76	39311	Findspot - *Artefact scatter*	Roman/Medieval/Post-Medieval	TG1230
77	37528	Findspot - *Coins*	Medieval	TG1130
78	36439	Monument - *Cropmarks*	Undated	TG11783059
79	36632	Findspot - *Large copper ring*	Roman	TG1130
80	6682	Listed Building - *Grade I church*	Medieval	TG11613042
81	25935	Findspot - *Medieval coin/Post-Medieval object*	Medieval/Post-Medieval	TG1130
82	12392	Monument - *Site of chapel/workhouse*	Medieval/Post-Medieval	TG11683021
83	6669	Findspot - *Neolithic axe-head/jade*	Prehistoric	TG1166930199
83a	39666	Findspot - *Pottery sherd*	Late Saxon	TG11723017
84	11529	Listed Building - *Grade II house*	Medieval	TG11472987
85	34871	Findspot - *Ewer/token*	Late Medieval/Post-Medieval	TG1129
86	36118	Monument - *Retting/tanning features*	Prehistoric/Medieval	TG11703009
87	36440	Monument - *Cropmarks/features and ditches*	Undated	TG11853021
88	34868	Findspot - *Early Saxon brooch, Medieval key*	Saxon/Medieval	TG1230
89	28973	Findspot - *Iron Age coin, gold stater*	Iron Age	TG1230
90	41988	Findspot - *Roman coins/Post-Medieval book clasp*	Roman/Post-Medieval	TG1230
91	34869	Findspot - *Pottery and metalwork*	Medieval/Post-Medieval	TG1230
92	29568	Monument - *Cropmarks/rectangular enclosure*	Undated	TG12793008
93	29564	Monument - *Cropmarks/Ring ditch*	Undated (possible Bronze Age)	TG12472983
94	36406	Monument - *Cropmarks/Linear features*	Undated	TG12812986
95	36594	Findspot - *Artefact scatter*	Roman/Medieval	TG1229
96	36407	Monument - *Cropmarks/Linear and Rectilinear features*	Undated (possible Roman)	TG12542847
97	36408	Monument - *Cropmarks/Linear and Rectilinear features*	Undated	TG13012820

Ref	NHER	Type and brief description	Period	Location
98	43264	Listed Building - *Mid 19th century Grade II lodge*	Post-Medieval	TG1264727851
99	43265	Listed Building - *Mid 19th century Grade II lodge*	Post-Medieval	TG1264727837
100	30440	Monument - *Heydon Hall Grade II* Registered Park*	Post-Medieval	TG119272
101	32245	Monument - *Cropmarks*	Undated	TG12572688
102	7325	Findspot - *Neolithic flint axe*	Prehistoric	TG12702552
103	7340	Findspot - *Neolithic flint axe*	Prehistoric	TG12992556
104	7334	Findspot - *Neolithic flint axe*	Prehistoric	TG13052525
105	21848	Monument - *Cropmarks*	Undated (possible Bronze Age)	TG130248
106	37457	Findspot - *Saxon brooch fragment*	Saxon	TG12922460
107	37463	Findspot - *Medieval coin*	Medieval	TG12852436
108	31422	Other - *Negative watching brief*	-	TG1272242324

7.4 Impacts During Construction

7.4.1 Salle substation

No archaeological sites have been identified in the area of Scira's proposed substation. In addition, archaeological investigations carried out in the area in relation to previous construction works did not record any archaeological finds or features (**Ref. 108**). Although there is always a chance that unknown remains may be present, based on the evidence available, it is considered that the potential impact to features of archaeological or cultural heritage significance would be **negligible** during the construction phase.

Temporary construction impacts which may affect the indirect 'setting' of any features of cultural heritage significance in the substation area are discussed in Section 9: 'Landscape and Visual Character'.

7.4.2 Cable system

General

As discussed in Section 2: 'Site Selection and Consideration of Alternatives, and in line with the policies enshrined in PPG16, as well as regional, county and local planning policy, the route planning at each stage of the process has been designed to avoid features of archaeological or cultural heritage significance wherever possible, in order to retain features of archaeological significance *in situ*.

However, as illustrated in **Figure 7.1**, in some areas, due to the widespread nature of some of the finds or features, it has not been feasible to avoid all of the identified sites entirely. In these situations, there is the potential for the excavation of the cable trench, pulling pits and cross-bonding pits to result in permanent and irreversible damage or loss to archaeological finds and features.

In areas where directional drilling is proposed, although a pit would need to be excavated at either end of the drill, the cables would generally be installed between 1.5m and 4.0m below the surface. The majority of archaeological finds and features are most likely contained within the first 2.5m from the surface, for instance a ring-ditch surrounding a barrow is unlikely to extend more than 2m below the surface. Therefore, depending upon the depth of the drill at each site, which would be dependant on a number of technical considerations, this technique has a strong potential to completely avoid damage or loss of archaeological remains.

Table 7.2 provides a summary of the identified archaeological sites which are located within 50m of the proposed cable route. It should be noted that the locations of the archaeological sites identified are generally of mixed accuracy and so distances to the proposed route given are indicative only. "0m" indicates that the proposed route crosses a site.

Table 7.2 Archaeological sites located within 50m of proposed cable route

Ref	NHER	Type and brief description	Period	Distance from route
1	11335	Monument - *WW II/post-war training camp*	WWII	0m
2	39345	Findspot - *Five Roman coins*	Roman	0m
5b	6304	Monument - *Earthworks and cropmarks relating to moat enclosure*	Roman/ Medieval	0m
13	6280	Monument - *Ironworking quarry, pits*	Undated	0m
20	38644	Monument - *WW II training and defence features*	WWII	10m
22	27987	Monument - *Linear cropmarks/track-way(?)*	Unknown	0m
26	27993	Monument - *Linear cropmarks*	Undated	20m
28	42834	Findspot - *Two Neolithic flint axes*	Neolithic	0m
35	44016 44017 44018 44019	Monument - *Earthworks*	Undated	0m (drilled)
36	35205	Findspot - *Neolithic/Mesolithic flint axe*	Prehistoric	0m
37	16756	Findspot - *Roman coin copper alloy*	Roman	15m
40	32948	Monument - *Arched brick culvert*	Undated	0m
46	17942	Monument - *Burnt mound/finds scatter*	Prehistoric/Iron Age/Roman	10m
47	6559	Findspot - *Coin hoard*	Roman	30m
48	35206	Findspot - *Scattered finds*	Roman/Post-Medieval	0m
49	6567	Monument - *Cropmarks*	Undated	30m
50	35207	Findspot - *Neolithic flint scraper*	Prehistoric	30m
54	6558	Findspot - *Sandstone querm stone*	Roman	50m
63	39390	Findspot - *Roman pot and post-medieval coin*	Roman/Post-Medieval	0m
64	36778	Monument - *Cropmarks/field boundary/track-way*	Undated	0m

Ref	NHER	Type and brief description	Period	Distance from route
65	36779	Monument - *Ovoid enclosures/ditches/pits*	Undated	20m
67	44076	Findspot - *Various coins/tokens*	Roman/ Medieval/Post-Medieval	0m
68	34538	Findspot - *Post-medieval coin*	Post-Medieval	20m
71	11339	Monument and Findspot - *Cropmarks, burnt mound, artefact scatter, coins*	Prehistoric/Roman Medieval/Post-Medieval	0m
76	39311	Findspot - *Artefact scatter*	Roman/ Medieval/Post-Medieval	40m
89	28973	Findspot - *Iron Age coin, gold stater*	Iron Age	0m
91	34869	Findspot - *Pottery and metalwork*	Medieval/Post-Medieval	0m
95	36594	Findspot - *Artefact scatter*	Roman/ Medieval	0m
96	36407	Monument - *Cropmarks/Linear and Rectilinear features*	Undated (possible Roman)	0m
98	43264	Listed Building - *Mid 19th century Grade II lodge*	Post-Medieval	30m
99	43265	Listed Building - *Mid 19th century Grade II lodge*	Post-Medieval	38m
100	30440	Monument - *Heydon Hall Grade II* Registered Park*	Post-Medieval	0m
101	32245	Monument - *Cropmarks*	Undated	0m
105	21848	Monument - *Cropmarks*	Undated (possible Bronze Age)	0m
106	37457	Findspot - *Saxon brooch fragment*	Saxon	0m
107	37463	Findspot - *Medieval coin*	Medieval	10m

Scheduled Monuments

The proposed route of the underground cable passes close to two Scheduled Monuments in the northern part of the study area:

- The Medieval moated area (**Ref. 5a**) southwest of Weybourne, which is trapezoidal in shape and up to 19m wide. It sits at the centre of a larger area of cropmarks, earthworks, former moats, gardens and fishponds, although only the central moated area is a Scheduled Monument.
- The (possible Bronze Age) barrow (**Ref. 19**) located south of Weybourne. The barrow is approximately 26m in diameter and lies in woodland on Weybourne Heath.

The route has been designed to avoid the Medieval moated area (**Ref. 5a**) by 70m in order to avoid any direct impact to the value of the site. The Bronze Age barrow (**Ref. 19**) lies 190m to the west of the proposed route. The route has been designed to avoid this Scheduled Monument, and to minimise impact to the Kelling Heath area where it is located. The majority of the route in the vicinity of the barrow would be installed through directional drilling, meaning there will be no disturbance at the ground surface.

Whilst no likelihood of significant environmental impact is predicted, as a precautionary measure, in order to ensure that no indirect impacts occur, the following good construction mitigation measures will be undertaken.

Mitigation – Scheduled Monuments during construction
• Notify construction personnel of Scheduled Monument status. • Fenced construction to ensure no storage of machinery or equipment in vicinity of Scheduled Monuments.

Given the above mitigation measures, it has been assessed that there would be **no impact** to Scheduled Monuments.

Listed Buildings

With the exception of two sites, the routeing of the proposed cable has avoided all other Listed Buildings identified within the study area by more than 50m.

The proposed route passes close to the following Listed Buildings (both shown on **Plate 7.1).**

- Eagle Lodge North (**Ref. 98**) a mid 19th century Grade II Listed red brick lodge associated with Heydon Hall. Originally identical to the south lodge, it later had a first floor and additional chimney stack added to its northwest range (30m from cable corridor; 38m from trench).
- Eagle Lodge South (**Ref. 99**) a mid 19th century Grade II Listed red brick lodge associated with Heydon Hall (38m from cable corridor; 43m from trench).

Plate 7.1 Listed Buildings: Eagle Lodge North and South

The route alignment has been designed to be located at sufficient distance to ensure that there would be no likelihood of any significant impact to either of these buildings, however to ensure that there is no risk from accidental damage during construction, the following good construction steps will be taken.

Mitigation – Listed Buildings during construction
• Notify HGV driving personnel of Listed Building status to avoid accidental damage. • Location of the cable trench on the opposite side of the access track to increase distance between excavations and the Listed Buildings. • Reduction of working widths in the area of Listed Buildings (and storage areas/compounds to be sited away from these features).

Given the implementation of the mitigation methods described above, **no impact** is envisaged to any Listed Buildings within the study area, including Eagle Lodge North and Eagle Lodge South.

Registered Parks and Gardens

The proposed route is located approximately 220m to the west of the western boundary of Mannington Hall, which is a Grade II Registered Park (**Ref. 74**). **No impact** is envisaged to the value of this park and no mitigation is considered necessary.

The proposed route passes through and adjacent to the Heydon Hall Grade II* Registered Park (**Ref. 100**). The route has been designed to avoid direct impact to this site wherever possible, however at one location, there is no other feasible option but to cross a narrow belt of plantation woodland, included in the Registered Park boundary, known as Carman's Belt. In order to minimise the potential impact, the route has been designed to cross the plantation at a point where there are no significant trees (see **Plate 7.2**), due to an existing overhead line crossing. It is proposed that the route is located immediately to the west of the overhead line crossing.

Plate 7.2 Proposed route crossing at Heydon Hall Registered Park (looking north)

In addition, the route runs alongside, but outside of, the eastern boundary of Heydon Hall, along a woodland known as "Norwich Road Plantation". The route at this point is located to the east of a track (Spink's Lane) which runs alongside the plantation woodland. The distance between the edge of the woodland and the cable trench would ensure that there would be **no impact** to the trees within the woodland plantation, and therefore **no impact** to the value of the Registered Park in this area.

To minimise the impact to the value of the Registered Park further, the following mitigation measures will be carried out.

Mitigation – Heydon Hall Registered Park during construction
Carman's Belt crossing: • A construction method statement will be compiled and conveyed to the construction team. • The working area through Carman's Belt would be adapted in order to minimise the width required. No materials, equipment or vehicles would be stored within the plantation belt. • A replanting scheme will be implemented to compensate for any disturbance to the woodland at this location. General mitigation: • Working areas and storage sites will be clearly demarcated in the general area of Heydon Hall Registered Park, particularly along the boundary of Norwich Road Plantation to ensure there is no risk of accidental damage to the park.

The residual impact to the cultural heritage value of the Heydon Hall Registered Park, given successful implementation of the above measures, has been assessed to be **negligible**. The potential impact to the setting of the Registered Park during construction is assessed in Section 9: 'Landscape and Visual Character'.

Other archaeological sites

The route has been designed to avoid areas of significant archaeology wherever possible. However there are several sites along the route where this has not been feasible, either for environmental, technical or financial reasons, in particular in the area of Kelling Heath / Hundred Acre Woods and at Baconsthorpe.

The significant number of archaeological finds and features in the Kelling Heath area indicate the presence of former settlements. As can be shown from **Figure 7.1,** the route has been devised to avoid impact to the majority of these features. In addition, the proposed development involves underground directional drilling within the majority of the site, so that the majority of surface features would not be disturbed.

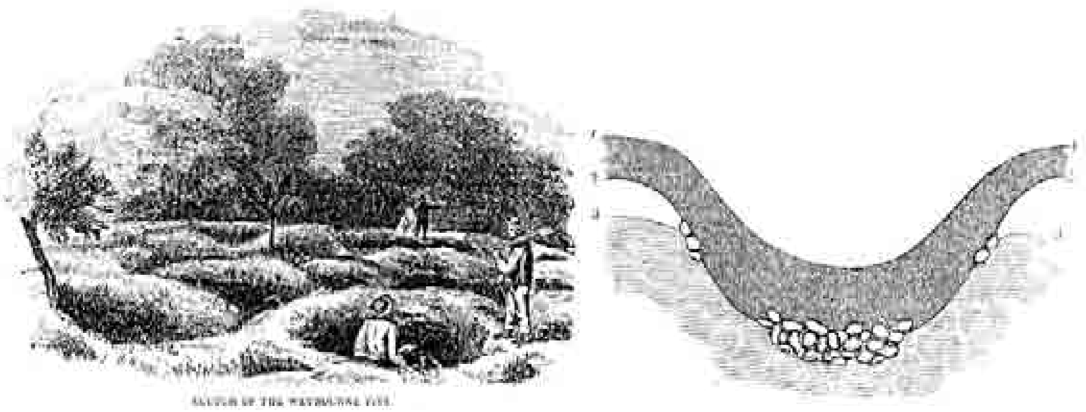
However, within an existing open grass ride (and firebreak) at the centre of the site, there would need to be pits excavated for the purposes of drilling, along with a short section of open-cut trenching. A band of undated Ironworking Quarry Pits (**Ref. 13**) cross the site in this location. These pits have been described as:

> *'..Bowl shaped hollows, former in a sandy soil… a ridge of stones placed around the other sides of a circular excavation. In size they vary from eight to twenty feet*

> *in diameter, and from two to six feet in depth… At the bottom of each pit is a large quantity of stones, many of them from the beach and of considerable size.'* (K Penn, 2007).

An artist's impression of the pits, along with a typical cross section is shown as **Plate 7.3**.

Plate 7.3 Weybourne Pits



(H Harrod, 1852, 'On the Weybourne Pits' *Norfolk Archaeology III*, 232-240.)

The area between Baconsthorpe and Baconsthorpe Wood contains a significant cluster of archaeological finds and features. As can be seen in **Figure 7.1**, the proposed route through this area has been aligned to avoid the majority of these sites wherever feasible. However the route does pass through four archaeological sites in this area:

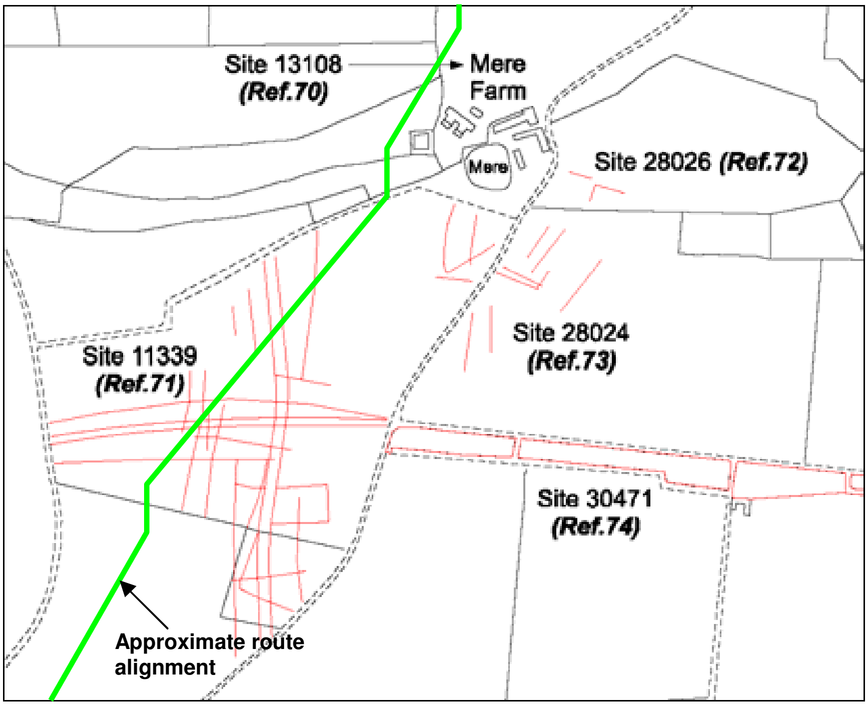
- The area of earthworks (**Ref. 35**) in Baconsthorpe Wood.
- The eastern tip of the Neolithic flint axe find spot area (**Ref. 36**).
- An undated brick culvert in Fourteen Acres field (**Ref. 40**).
- A Roman/Post-Medieval find spot (**Ref. 48**).

It should be noted however, that the potential impact to Baconsthorpe Wood would be minimised through the use of Directional Drilling, which would not impact upon features located between the ground surface and the final drill depth.

Also in the Barningham area, to the south of Mere Farm, the proposed route passes through an area of cropmarks of enclosures and a track-way that have been identified from Ordnance Survey aerial photographs, which may be interpreted as an area of Roman settlement between the 1st and 2nd centuries AD from metalwork finds (**Ref. 71**).

Field-walking and metal detection have recovered a range of finds from the prehistoric to the post-medieval period, which also include a hoard of Roman coins, cosmetic sets, a key, rings, and pottery. Medieval find scatters may represent the edge of some concentration close to the Mere. Cropmarks recorded in the general area (as well as **Ref. 71** specifically) are illustrated on **Plate 7.4**.

Plate 7.4 Cropmarks at Mere Farm



(Source, NAU Archaeology, 2007b)

In addition to these particular areas, the proposed cable route also passes through several other previously recorded finds or features:

- The WW II/post-war training camp west of Weybourne (**Ref. 1**) and Roman coin findspot (**Ref. 2**).
- Medieval earthworks and cropmarks (**Ref. 5b**) surrounding the Medieval moat complex (Scheduled Monument, **Ref. 5a**); which the route avoids; southwest of Weybourne.
- An undated, isolated linear cropmark (**Ref. 22**) south of Kelling Heath woods.
- An isolated, Neolithic axehead findspot (**Ref. 28**) northwest of Bodham.
- An area of undated cropmarks (**Ref.64**) and Roman/Medieval/Post-Medieval findspots (**Refs. 63, 67**) northwest of Little Barningham.
- Scattered Iron Age/Roman/Medieval/Post-Medieval findspots (**Refs. 89, 91, 95)** east of Saxthorpe.
- Rectilinear and linear undated/Roman cropmarks (**Ref. 96**) southeast of Saxthorpe.
- An area of undated cropmarks (**Ref. 101**) to the east of Heydon Park.
- An area of (possible) Bronze Age cropmarks (**Ref. 105)** north of Cawston.
- An isolated Saxon findspot north of Cawston (**Ref. 106**).

To summarise, there are several areas along the route where potential direct impact to identified archaeological sites could not be avoided. In these areas, the stripping of top-soil from the working width and the excavation of the cable trench, jointing pits and cross-bonding pits could potentially result in the irreversible damage, disturbance and loss of archaeological remains.

In order to minimise the potential impact, preservation by record will be necessary, to make appropriate and satisfactory provision for recording of remains, prior to any development commencing.

Prior to any construction works taken place, a detailed strategy will be discussed and agreed with the archaeological planning advisor at Norfolk Landscape Archaeology. The scope and extent of mitigation will need to be outlined on a site-by-site basis, however in general terms, and based upon the importance of the find or feature and the magnitude of impact expected; the archaeological planning advisor may find the following suggested level of mitigation acceptable:

- In relation to the WWII sites and findspots located at the Muckleburgh Collection museum (**Refs. 1, 2**), previously agreed mitigation in relation to the Sheringham Shoal Offshore Wind Farm (and associated onshore works) was to undertake an Archaeological Watching Brief during soil stripping and trench excavation.
- At Baconsthorpe Wood (**Ref. 35**) the entire feature would be directionally drilled, therefore there would be negligible impact to the site and no requirement for further mitigation.
- Where the route passes through locations where there have been previously recorded findspots (e.g. **Refs. 28, 36, 48, 63, 67, 89, 91, 95, 106**), an Archaeological Watching Brief during soil stripping and trench/pit excavations may be sufficient. Where there are significant concentrations of surface recovered artefacts, evaluation may be required by the archaeological planning advisor. If significant remains are detected then further recording may be necessary.
- Where the route passes through isolated or undated archaeological cropmarks (e.g. **Refs. 22, 64, 96, 101, 105**) some further archaeological evaluation, including field-walking and potentially geophysical survey, may be necessary to further define the feature. The requirement for more detailed evaluation involving trial trenching could then be discussed and agreed. Archaeological evaluation would potentially then be followed by excavation of areas shown to be at risk.
- Where the route passes through more significant cropmarks or features, with an indication of previous occupancy or industry, it is considered likely that a detailed level of archaeological evaluation followed by recording will be necessary (e.g. **Refs. 5b, 13, 71**).
- Due to the potential for previously unrecorded finds and features, especially within areas where main activity has previously been recorded, the strategy will also need to allow for the recording of any previously unrecorded finds and features. A watching brief on the topsoil stripping of the area of the easement may be required by the local authorities' archaeological advisors.

Scira's commitment towards the provision of mitigation to properly record the archaeological finds and features is summarised below.

Mitigation – Other archaeological sites during construction
• Following the receipt of planning permission and confirmation of the final consented cable routes and construction methodologies, Scira will carry out mitigation to ensure that any archaeological sites identified, which cannot be preserved *in situ*, are properly recorded, by way of an Archaeological Mitigation Strategy, the scope of which to be agreed with Norfolk Landscape Archaeology. The strategy will also outline a provision for any previously unrecorded finds or features. • The scope will be outlined on a site-by-site basis, but could potentially involve some or all of the following measures: - Minimisation of working widths within sensitive areas. - Minimisation of stripped working area, utilising geo-textile grids (or similar) to preserve underlying features, where appropriate. - Archaeological evaluation, including field-walking, geophysical survey, targeted trial-trenching. - Archaeological excavation to record significant remains that cannot be preserved in situ - Archaeological watching brief. • The results of the mitigation will be reported and presented to Norfolk Landscape Archaeology.

Given the incorporation of a suitable mitigation strategy, and the routing of the cabling to avoid significant finds and features, wherever possible, the residual impact to other archaeological sites has been assessed to be **minor adverse**.

7.5 Impacts During Operation

During the operational life of the onshore grid connection, including works at Salle substation, there would be no ground disturbance during route maintenance; therefore there would be **no impact** to archaeological finds or features.

Should any sections of the proposed cable route, or the workings at Salle substation require any significant replacement works, these would all be located within the areas of land previously disturbed during construction; therefore no additional impact would occur to any archaeological features.

Overall, there would be **no direct impact** to any features of archaeological or cultural heritage significance during the operation of the onshore grid connection.

With the exception of cross-bonding pits, once installed, the proposed cable route would be entirely below ground. In addition, any visible evidence of the construction works will have been reinstated. For example all hedgerow breaches would have been replanted. The proposed operational impact of the Salle substation extension works on the setting of any features of cultural heritage significance, such as Scheduled Monuments, Listed Buildings or Registered Parks, is considered further within Section 9: 'Landscape and Visual Character'.

7.6 Summary

An Archaeological Desk-Based Assessment was carried out to identify archaeological and cultural heritage sites and monuments within a 500m corridor, to inform decisions concerning the proposed route alignment and allow an assessment of impact significance and mitigation requirements. The ADBA identified that over 100 Norfolk Historical Environmental Record (NHER) sites were located within the proposed onshore grid connection study area. This included two Scheduled Monuments, several Listed Buildings, and two Registered Parks and Gardens. The NHER records document a variety of findspots, structures, cropmarks and other sites relating to past activity during a variety of periods.

The route of the proposed buried cable connection between Weybourne and Salle has been designed in order to avoid any identified sites of importance wherever feasible, in order to preserve any archaeological or cultural heritage sites *in situ*. However where this has not been possible, the potential impact of the development on archaeological and cultural heritage resources has been assessed and a programme of mitigation to ensure that the archaeological resource is properly recorded has been suggested.

The majority of Listed Buildings are over 50m from the proposed route, with the exception of Eagle Lodge North (30m from cable corridor; 38m from trench) and Eagle Lodge South (38m from cable corridor; 43m from trench). The two identified Scheduled Monuments are located 70m and 190m from the proposed route. Although no impact is envisaged, additional mitigation to ensure that the sites are not accidentally damaged during the construction phase have been outlined in order to ensure that there would be **no impact**.

The proposed cable route crosses a narrow plantation belt, known as 'Carman's Belt', which is within the Heydon Hall Grade II* Registered Park and Garden. The route has been located adjacent to an existing overhead line crossing, where there are no significant trees, in order to minimise impact. Further mitigation, including minimising the working width and adopting additional precautionary measures to ensure there is no accidental damage, would ensure that the impact to the Registered Park would be **negligible**. There would be **no impact** to the value of the Mannington Hall Grade II Registered Park during construction.

There are several locations where the proposed route passes through sites listed on the NHER database. These include: a World War II training area at Muckleburgh; a belt of ancient iron-working pits at Kelling Heath; earthworks within Baconsthorpe Wood; Roman cropmarks in the area of Mere Farm, near Barningham; Medieval cropmarks at Weybourne; Bronze Age cropmarks at Cawston; as well as several undated cropmarks elsewhere along the route and findspots ranging from several periods, generally located in the Weybourne, Baconsthorpe, Mere Farm, Saxthorpe and Cawston areas.

In these areas, the construction of the cable system could potentially result in irreversible damage, disturbance and loss of archaeological remains. In order to minimise the potential impact, a detailed mitigation strategy will be agreed and implemented in consultation with Norfolk Landscape Archaeology in order to record any archaeological remains, prior to development commencing. The level of mitigation will be dependant on the value of the feature and the likely level of disturbance, and is likely to range from an archaeological watching brief during construction, to more intensive archaeological excavation. Given the incorporation of a suitable mitigation strategy; and the routing of cable connection to avoid significant finds and features, wherever possible; the residual impact to other archaeological sites has been assessed to be **minor adverse**.

A previous archaeological watching brief in the area of the proposed workings at Salle substation has proved negative in finding archaeological remains. However, to take into account the potential for unknown archaeological remains at this site, the impact has been deemed to be **negligible**.

During the operational phase, during normal operations there would be no ground disturbance. If any elements of the onshore grid connection do require replacement, any excavations would be in the area of previously disturbed ground. Therefore there would be **no impact** to archaeological and cultural heritage features during operation.

7.7 References

Department of Environment 1990
Planning Policy Guidance Note 16 (PPG16): Archaeology and Planning

Department of Environment 1994
Planning Policy Guidance Note 15 (PPG15): Planning and the Historic Environment

Institute of Field Archaeologists (IFA) 2001
Standards and Guidance for Archaeological Desk-Based Assessments
1994, Revised Edition 2001

NAU Archaeology (Penn, K. and Watkins, P.) 2007a
An Archaeological Desk Based Assessment of the Sheringham Shoal Offshore Wind Farm Grid Connection
2a – Detailed ADBA of Road Route

NAU Archaeology (Penn, K. and Watkins, P.) 2007b
An Archaeological Desk Based Assessment of the Sheringham Shoal Offshore Wind Farm Grid Connection
2b – Detailed ADBA of Arable Route

NAU Archaeology (Penn, K.) 2007c
Note on Weybourne Pits NHER 6280, June 2007

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 8

GEOLOGY, HYDROGEOLOGY, HYDROLOGY AND LAND QUALITY

8 GEOLOGY, HYDROGEOLOGY, HYDROLOGY AND LAND QUALITY

8.1 Introduction

This Section assesses the potential direct and indirect impacts of the proposed Sheringham Shoal Offshore Wind Farm Onshore Grid Connection with respect to geology, hydrogeology, hydrology and land quality.

Potential impacts arising from the construction and operation of the onshore cables and substation are identified and assessed, taking account of the environmental baselines, such as: site geology; location and description of watercourses and still water-bodies; the presence of aquifers; Source Protection Zones; identification of potential sources of past or present land contamination; the sensitivity of relevant features and the likely magnitude of effects. Where potentially significant effects are predicted, appropriate mitigation actions are proposed. Good practice during construction and operational phases are also outlined in order to minimise or avoid any effects further.

8.2 Assessment Methodology

8.2.1 Relevant legislation, guidance and best practice

The assessment of impacts to geology, hydrogeology, hydrology and land quality has been made with reference to the following legislation, guidance and best practice:

- Water Resources Act (WRA; 1991).
- Anti-Pollution Works Regulations (1999).
- Land Drainage Act (1991, as amended).
- Water Framework Directive (2003).
- European Directive on Groundwater (80/68/EEC), as implemented by the Groundwater Regulations 1998 (Statutory Instrument 1998 No. 2746).
- Environmental Protection Act (1990).
- Landfill Regulations (2002; as amended) and the Hazardous Waste Regulations (2005).
- Construction (Design & Management) Regulations 2007 (CDM 2007).
- Environment Agency Pollution Prevention Guidance (PPG) and codes of good practice,
- BS10175:2001 Investigation of potentially contaminated sites, code of practice.
- BS5930:1999 Code of practice for site investigations.
- Assessing Risks Posed by Hazardous Ground Gases to Buildings (CIRIA, 2006).
- Control of Water Pollution from Construction Sites – A Guide to Good Practice (CIRIA, 2001).
- Control of Pollution from Construction Sites C532 (CIRIA, 2001).
- Environmental Good Practices – Working on Site C503 (CIRIA, 2000).

- Environmental Good Practices on Site C502 (CIRIA, 2000).
- Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present (NHBC & RSK Group, 2007).

8.2.2 Impact identification, significance levels and mitigation

The significance level (negligible, minor, moderate, major adverse or beneficial) of identified impacts are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification and Table 4.4 for definitions of significance levels.

8.2.3 Desk-based assessment

A desk-based assessment of existing environmental conditions initiated the assessment and included the following activities:

- The collation and examination of available local maps, historic plans and photographs (where available) detailing the historical development of the preferred proposed route.
- The provision and interpretation of environmental data from regulatory authorities or record holders including potentially polluting processes, discharge consents, landfill sites, water abstraction points and other potential sources of pollution that have been registered and are present on public registers.
- The provision of general environmental and geographical information relating to the site and surrounding area such as surface water and groundwater resources, geological conditions and environmentally sensitive areas.

Some of this information has been obtained as part of a commissioned EnviroCheck report (Report Reference 20209603-1-2, 2006).

Other data sources were also consulted as part of the assessment, and are listed in the Reference Section 8.8. These included Ordnance Survey and British Geological Survey mapping; data supplied by the Environment Agency; Institute of Geological Sciences hydrogeological mapping; and other relevant reports and data obtained during the EIA process.

These sources have been used to characterise the existing environment and to enable the identification, as far as is practicable, of potential impacts on controlled waters (both surface water and groundwater) and land quality from the proposed development.

As has been described in Section 4: ‘Legislative Context and EIA Process’, for ease of descriptive purposes, the onshore grid connection project has been split into 13 sections. These route sections are shown on the Figures and referred to in the text.

8.2.4 Site walkover

Site visits were carried out to determine the current land uses of the areas of the proposed works and neighbouring areas to provide further information regarding potential sources and extent of contamination and characteristics of any surface water features.

Following a review of the relevant historical maps and environmental disclosure information (Royal Haskoning, 2006), a number of potential pit locations and other potential sources of contamination were identified along the corridor of the proposed cable route and in the area of the substation. These locations were inspected in order to verify their presence and nature. Verification was based on visual observations at the time of the visit.

8.2.5 Consultation

Specific consultation was carried out during the EIA process with the Environment Agency, Natural England, the Kings Lynn Consortium of Internal Drainage Boards (KLCIDB) and environmental pollution/prevention officers from both North Norfolk District Council and Broadland District Council, in order to gather available relevant data and identify issues or concerns.

The Environment Agency confirmed during the EIA process that a Flood Risk Assessment for the proposed Salle substation would not be required as the site is located within Flood Zone 1 (defined as low probability of flooding) and would be less than 1 hectare in size.

Natural England (pers. comm. Peter Lambley, 2006), the University of East Anglia (pers.comm. Dr. Kevin Hiscock, 2006) and Adrian Green (a professional Hydrogeologist who based his PhD thesis on the study area) were also consulted specifically in relation to reported springs in the Weybourne area.

8.2.6 Conceptual Site Model

In accordance with the Environmental Protection Act 1990, for contaminated land to exist there should be a source of contamination, a receptor where “significant harm” or “significant possibility of significant harm” may be caused, or pollution of controlled waters is being or likely to be caused, and a pathway which connects the two. Should any element of this contaminant linkage not be present (or severed) then the land may not be regarded as contaminated land, as defined in Part 2A of the Environmental Protection Act 1990.

In accordance with the above approach, a Conceptual Site Model (CSM) has been produced which describes the likely sources and pathways associated with the site and the potential receptors which may be adversely impacted by a pollutant linkage. Subsequently, in order to assess the risk posed by the various source, pathway and receptor linkages that may exist at the site, a “linkage model” has been produced.

The risk rating terms used to describe the risks identified are based on the Department of Environment (now DEFRA) and Contaminated Land Research Report series (CLR Report No. 6) 'Prioritisation and categorisation procedure for sites which may be contaminated', as defined in **Table 8.1**.

Table 8.1 Contamination risk rating terminology

Risk Rating	Description
High risk	• Contaminants very likely to represent an unacceptable risk to identified targets. • Site probably not suitable for proposed use. • Enforcement action possible. • Urgent action required.
Medium risk	• Contaminants likely to represent an unacceptable risk to identified targets. • Site probably not suitable for proposed use. • Action required in the medium term.
Low risk	• Contaminants may be present but unlikely to create unacceptable risk to identified targets. • Site probably suitable for proposed use. • Action unlikely to be needed whilst site remains in current use.
Negligible risk	• If contamination sources are present they are considered to be minor in nature and extent. • Site suitable for proposed use. • No further action required.

8.3 Existing Environment

8.3.1 Geology and soils

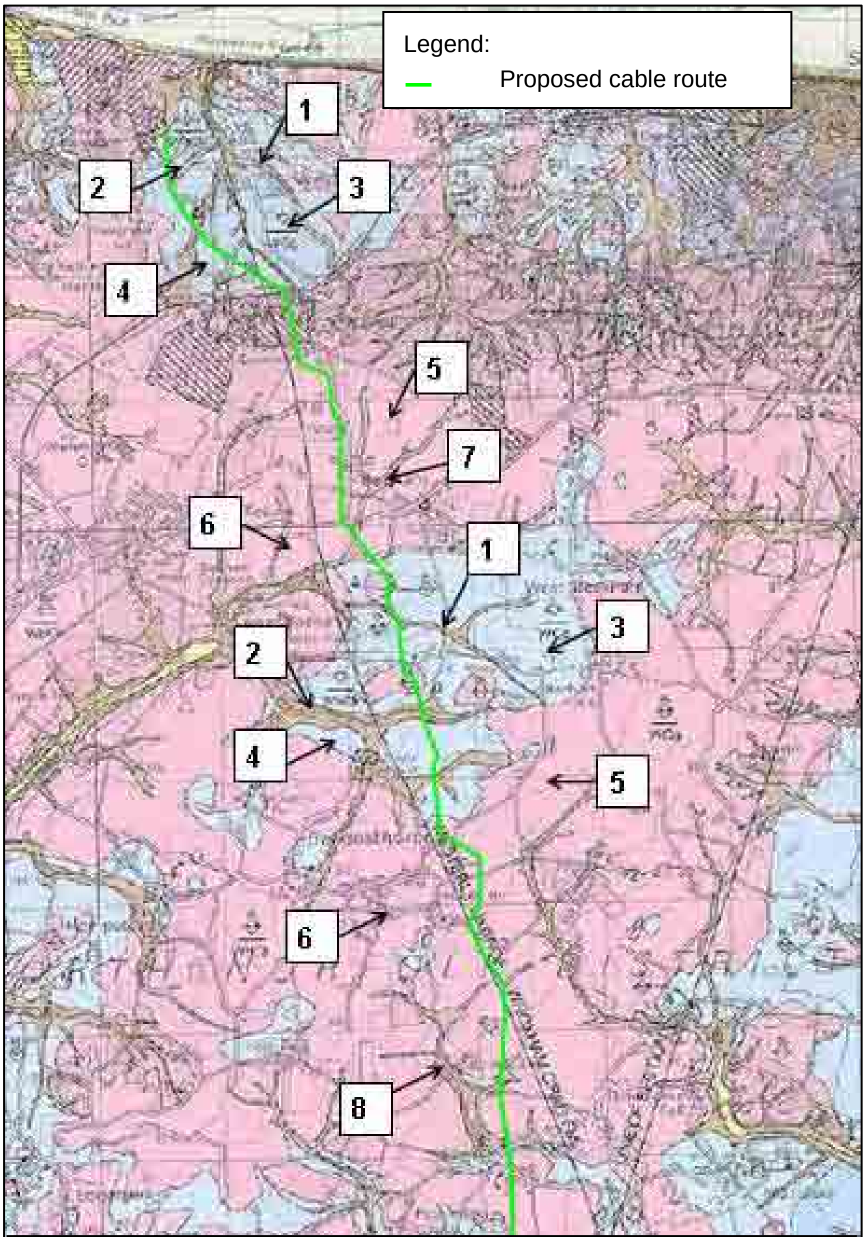
General study area

The British Geological Survey (BGS) Solid and Drift Geology Map Sheet 131: Cromer, and the associated publication entitled "Geology of the Cromer District" details the geology of the northern stretch of the cable route corridor from Weybourne to Plumstead. A review of these documents revealed the following characteristics relating to this area:

- The geology of the area consists largely of Chalk, overlain by Glacial Deposits and Alluvium. In the Cromer region, the sequence consists of Blown Sand, Peat and Alluvium, overlying Marine Deposits of gravel mud and sand, with Head (sandy clay and clayey sand) and River Terrace Deposits beneath. Underlying these are Glacial Deposits (sand, gravel, silt and clay deposits) which overlie Glaciofluvial Sand and Gravel and organic silts. The solid geology beneath these drift deposits consist of the Crag Group of sand and gravel with quartz and quartzite unconformably overlying the Chalk Group. Beneath the Chalk are the Lias Group of mudstones, the Mercia Mudstone and Penarth Group, with Sherwood Sandstone Group and older Permo-triassic rocks beneath.

- The westerly limit of the Wroxham Crag Formation passes through the areas of the cable route options in a south easterly direction from the centre of the town of Weybourne to east of Plumstead village, resulting in this formation only generally being present in the northern and eastern areas of all proposed cable routes.
- The Wroxham Crag forms a gently north-eastward dipping sheet which rests unconformably on the Norwich Crag at Ludham and Ormesby, and cuts down to the west and north to rest on the Upper Chalk at Wroxham and the North Norfolk coast. The Wroxham Crag comprises a complex of coarse sands, gravels and clays. The Wroxham Crag is considered to include all the Crag which has a significant proportion of far-travelled pebbles in its gravel fraction. Clay bodies are also important throughout the sequence and may be up to 4m thick.
- The proposed route passes through areas with the following indicated geological sequences (shown in **Figure 8.1**):
    - Quaternary Head deposits (mainly stony, sandy clay and clayey sand) which follows the river / stream valleys, overlying Glacial Till of the Lowestoft Formation (mainly pebbly chalky sandy silty clay (diamicton)), overlying Wroxham Crag Formation (sand and gravel, with quartz and quartzite), which overlies the White Chalk Sub Group **(1)**.
    - Quaternary Head deposits (mainly stony, sandy clay and clayey sand) which follows the river / stream valleys, overlying Glacial Till of the Lowestoft Formation, which overlies the White Chalk Sub Group **(2)**. The Wroxham Crag Formation is not present in this area.
    - Glacial Till, overlying Wroxham Crag Formation, which overlies the White Chalk Sub Group **(3)**.
    - Glacial Till, directly overlying the White Chalk Sub Group **(4)**.
    - Briton's Lane Sand and Gravel Member of the Overstrand Formation, underlain by The Wroxham Crag Formation, which overlies the White Chalk Sub Group **(5)**.
    - Briton's Lane Sand and Gravel Member of the Overstrand Formation, directly underlain by the White Chalk Subgroup **(6)**.
    - Quaternary Head deposits which follows the river / stream valleys, overlying Briton's Lane Sand and Gravel Member of the Overstrand Formation, overlying Wroxham Crag Formation, which overlies the White Chalk Sub Group **(7)**.
    - Quaternary Head deposits which follows the river / stream valleys, overlying Briton's Lane Sand and Gravel Member of the Overstrand Formation, which overlies the White Chalk Sub Group **(8)**.
    - It should be noted that that these sequences are based on information from the geological map and that other drift deposits, such as glaciofluvial deposits, may intervene which are not detailed by the map.

Figure 8.1 Extract from the BGS geology map for the Cromer district

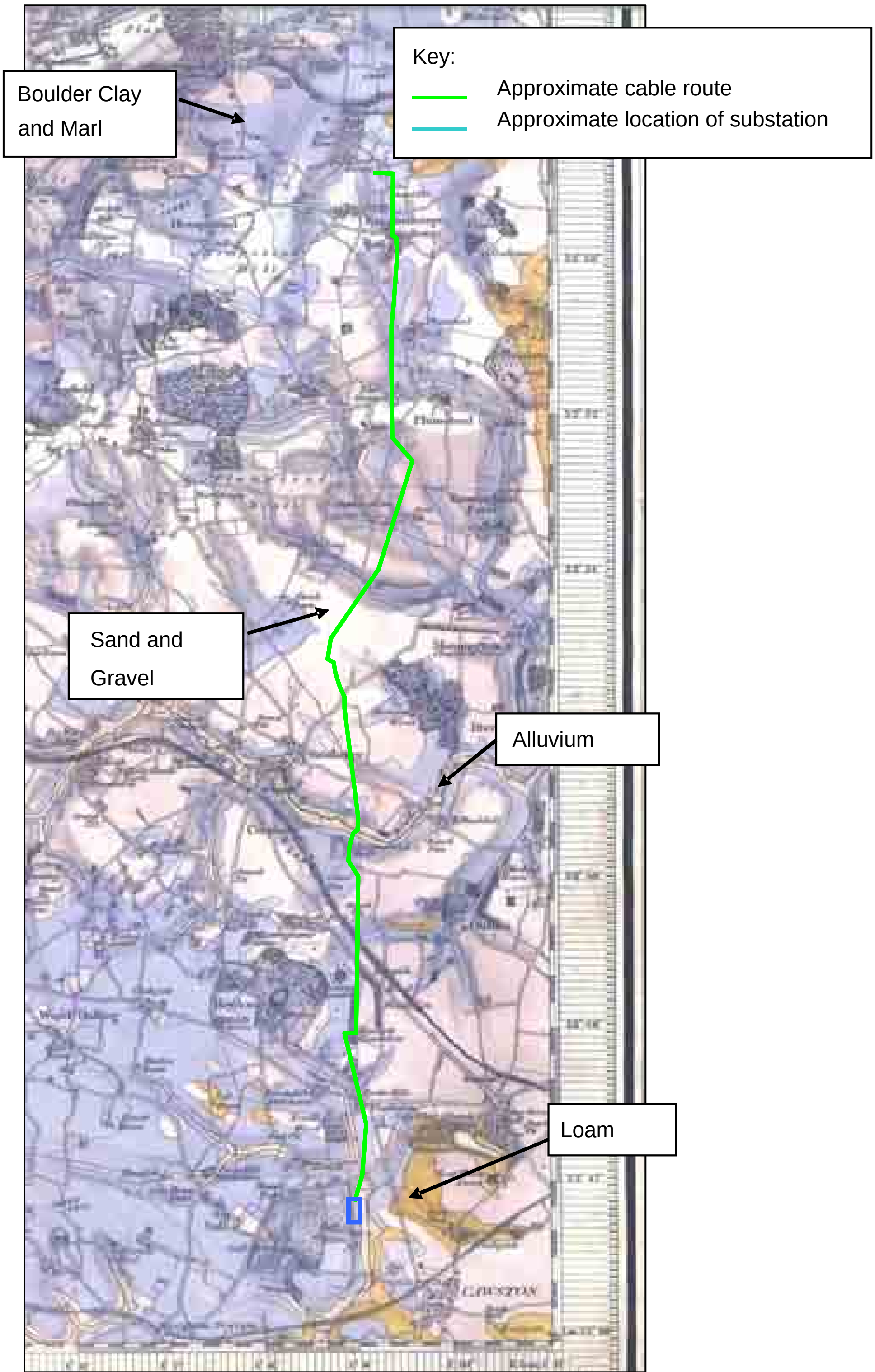


- The geological map notes that the Wroxham Crag Formation lies at between 0m and 30m thickness in the Cromer area, whereas the White Chalk Sub Group extends to up to approximately 430m in thickness.

For the southern half of the route, there is no modern geological map available and information has been drawn from the BGS Geological Survey of England and Wales drift geology map dated 1885, number LXVIII SW. This indicates that the areas in which the proposed routes lie passes through areas of sand and gravel, boulder clay and marl (all considered by the BGS map to be glacial deposits), with alluvium (post glacial) along the course of the River Bure and Loam (glacial) in the area around Cawston (**Figure 8.2**).

These sequences differ to those quoted for the northern areas due to the age of this map and developments in stratigraphic nomenclature.

Figure 8.2 Extract from the BGS drift Geology Map Number LXVIII SW



Cable route corridor

In the northern part of the route corridor, drift geology observations indicates that the cable route lies mainly over either the Glacial Till of the Lowestoft Formation or Briton's Lane Sand and Gravel Member of the Overstrand Formation underlain by the Glacial Till. Where the cable route passes rivers or streams, the drift map showed the presence of Head Deposits underlain by either Briton's Lane Sand and Gravel Member of the Overstrand Formation overlying the Glacial Till or immediately overlying the Glacial Till.

Solid geology maps show that the cable route located to the east of the westerly limit of Wroxham Crag Formation, is underlain by the Crag Formation ranging from 0m to 30m thick which is in turn underlain by the Chalk Group. Areas located to the west are underlain by the Chalk Group directly, which extends up to 430m in thickness. Information from the BGS states that the Wroxham Crag reaches a maximum thickness at Wroxham and thins to the north and east.

In the southern part of the route corridor, the drift map shows that the cable route lies mainly over a Boulder Clay and Marl layer or a sand and gravel layer. The route lies over Alluvium where it crosses the River Bure. To the north-west of Cawston, the cable route corridor lies over a layer of Loam.

Areas of proposed directional drilling

There are four proposed locations for directional drilling, the location of which are shown on **Figure 3.3**. The following description of drift and solid geology is based on approximate locations. Drift and solid geological maps show the following:

- Drill 1 – Poppy Line Railway and Kelling Heath Holiday Park (northern drill section):
  The northern section of the proposed drill is underlain by what is described as Landscaped Ground with some localised areas of Head Deposits. However, the majority of the area comprises the Briton's Lane Sand and Gravel Member of the Overstrand Formation which is underlain by the Wroxham Crag Formation and the White Chalk sub group. It is possible that the Crag Formation may be relatively thin as it is known to thin to the north and east.
- Drill 1– Kelling Heath Holiday Park (southern drill section):
  The area lies over Briton's Lane Sand and Gravel Member of the Overstrand Formation which is in turns underlain by the Wroxham Crag Formation and the White Chalk sub group. As for the northern section of this drill, the Crag Formation could be relatively thin.
- Drill 2 – Baconsthrope Wood:
  This area lies mainly over Head Deposits overlying Glacial Till. This is in turns underlain by the Wroxham Crag group and the White Chalk sub group.
- Drill 3 –River Bure:
  This drill area lies over Alluvium. A layer of Boulder Clay and Marl may be present on each side of the Alluvium layer corresponding to the two banks of the river.

- Drill 4 – Woodland East of Salle Park:
  This area is underlain by a layer of Boulder Clay and Marl. Streams are present within this location and it is probable that alluvium may be encountered.

In drill locations 1 and 2, the thickness of the Crag Formation could be relatively thin as those locations are situated in the proximity of the Westerly Limit of Wroxham Crag Formation which is thought to thin to the north and east.

For Locations 3 and 4, the solid geology map was not available and it was not possible to determine on which side of the Westerly Limit of the Wroxham Crag Formation those locations are situated.

Area of the proposed substation

The drift map shows that the location of the proposed substation lies over a layer of Loam in the south-west part and over a layer of Boulder Clay and Marl in the north-east part.

Borehole data

A total of 11 borehole logs were obtained from the British Geological Survey (BGS). Borehole logs and more detailed information are presented in **Appendix 8.1**. These boreholes are located along or within the surrounding areas of the proposed route and substation area. The locations are shown on **Figure 8.3**.

Information obtained from the borehole logs, located in the northern part of the study area (from Weybourne to the north-west of Little Barningham) confirmed the geology described on the geological map (i.e., Pleistocene drift or sand and gravel overlying the Crag Formation and the Chalk, in turn and Pleistocene drift or sand and gravel overlying the Chalk). Borehole logs also confirmed that when the boreholes were drilled close to the western limit of the Crag Formation, the Crag Formation was thinner than when the boreholes were drilled further to the east. Borehole logs also indicated that buried channels may be present.

For the southern part of the study area, including the proposed cable route and substation area, borehole logs provided information regarding the solid geology. Drift geology encountered comprised of: Sand and gravel underlain by Boulder Clay; Pleistocene drift underlain by Boulder Clay; and Boulder Clay. Where available, data indicated that the drift geology ranges from approximately 9m to 34m thick.

Drift Deposits are underlain by either Chalk or the Crag Formation and the Chalk in turn. This shows that if the borehole is located to the west of the western limit of the Crag Formation, Chalk will be encountered immediately beneath the drift geology whereas on the east side, the Crag Formation underlain by the Chalk will be encountered.

Figure 8.3 Borehole Log Location Plan

8.3.2 Hydrogeology

General study area

The groundwater vulnerability map shows the general study area to be underlain by a major aquifer of high permeability with soils of either high or intermediate leaching potential.

The Environment Agency R&D publication 'The physical properties of minor aquifers in England and Wales' indicates that the Crag aquifer covers a large part of the eastern region of East Anglia. It notes that groundwater flow within the Crag is intergranular, with yields depending on the coarseness of the sand and gravel fraction and on the degree of sorting. The flow system is controlled by alternating layers of clays, silts and sands and their contrasting permeabilities. The Crag is generally considered to be an unconfined aquifer, with recharge occurring over its whole extent. It also mentions that it is possible that the lowering of Crag water levels below sea levels by pumped drainage of the marshes may also result in saline intrusion near the coast or tidal rivers. In the west of the area, the Crag is directly underlain by the Chalk, with which it is in hydraulic continuity. However, the piezometric surface in the Chalk tends to be lower than that in the Crag. Consequently, it is unlikely to provide any upward leakage to the latter. Rather the reverse may be the case in some areas, with the Crag providing an important contribution of recharge to the Chalk. Crag water may be high in iron, nitrates, manganese and hydrogen sulphide.

The BGS Publication 'The physical properties of major aquifers in England and Wales' describes the Upper Chalk as forming the main aquifer unit and the Crag as the minor aquifer. It notes that where the Crag directly overlies the Chalk there may be direct hydraulic continuity between the aquifers. The piezometric surface for the Chalk occurs within the overlying glacial drift causing the aquifer to be confined or semi-confined locally; the true confining nature of the drift is not known due to a lack of detailed investigation of its permeability characteristics. It also mentions that buried channels are found throughout the area which may provide high yield of water supplies.

The BGS publication 'Geology of the Cromer District' notes that the cliffs at Weybourne are reported to show an alternation of poorly consolidated sands and clays with perched water tables within the cliffs, leading to numerous small falls and larger slips.

A review of the Institute of Geological Sciences Hydrogeological Map of Northern East Anglia (Sheet 1: Regional Hydrological Characteristics and Explanatory Notes) shows a number of springs in the vicinity of the proposed cable route including several to the south of Weybourne, the north-west of Heydon and to the south-west of Saxthorpe. The locations of these springs are shown in **Figure 8.4**. Springs of greater relevance are those located to the south of Weybourne as they are situated close to the cable route and the location of proposed directional drilling (drill location 1).

The general area of the onshore grid connection is underlain by a major aquifer of high permeability with soils of either high or intermediate leaching potential. The excavation of the cable trench would be up to 1.62m below ground level, therefore it is probable that perched water may be encountered within the drift deposits.

The cable route encompasses four locations where directional drilling is proposed, some of which have a potentially high water table. Directional drilling can create pathways for contaminant migration.

Source Protection Zones

The Environment Agency has defined Source Protection Zones (SPZs) for 2,000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

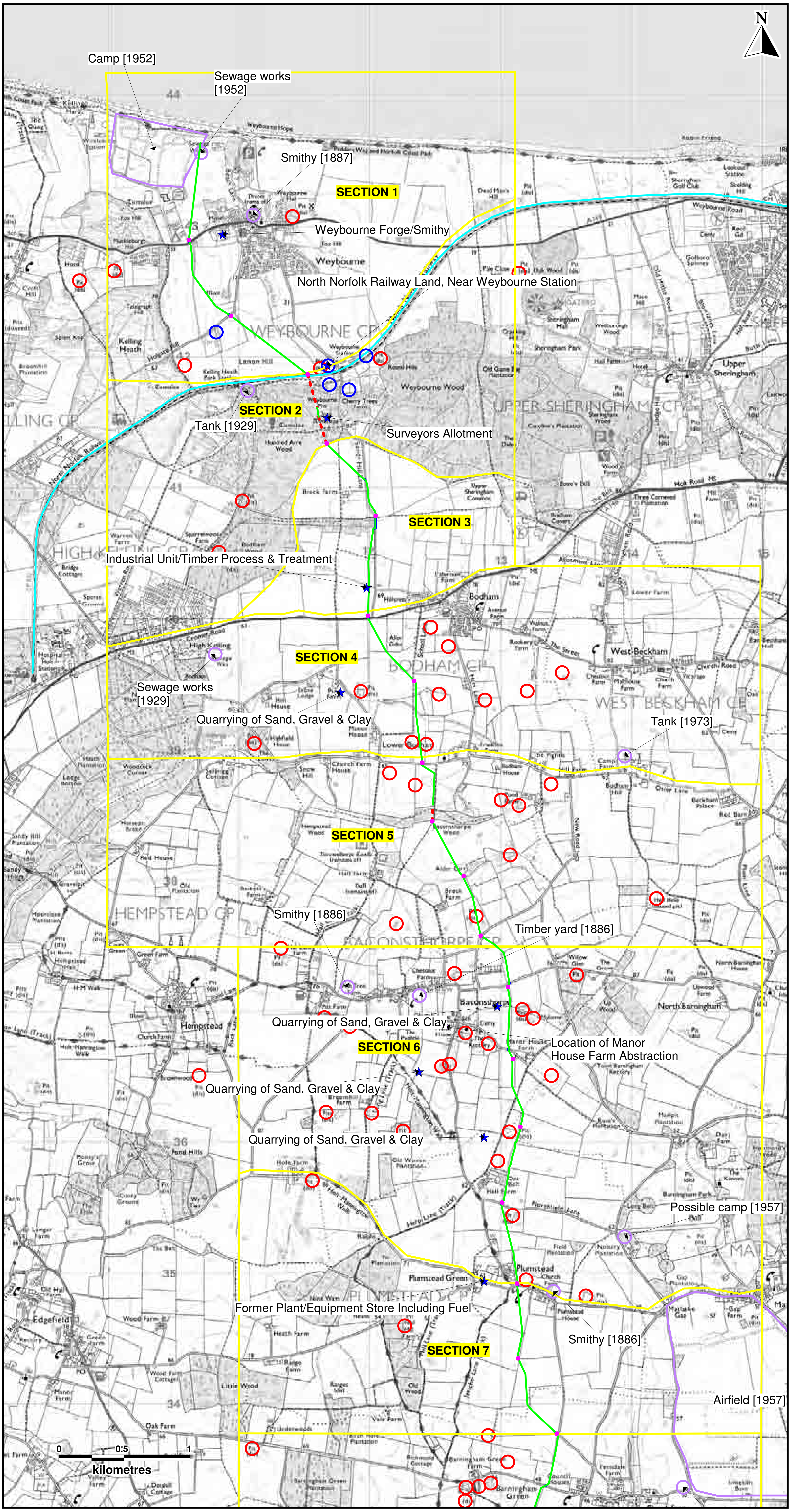
The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. The zones are divided as follows:

- **Zone I** (Inner protection zone): Any pollution that can travel to the borehole within 50 days from any point within the zone is classified as being inside zone 1. This applies at and below the water table. This zone also has a minimum 50m protection radius around the borehole. These criteria are designed to protect against the transmission of toxic chemicals and water-borne disease.
- **Zone II** (Outer protection zone): The outer zone covers pollution that takes up to 400 days to travel to the borehole, or 25% of the total catchment area – whichever area is the largest. This travel time is the minimum amount of time pollutants need to be diluted, reduced in strength or delayed by the time they reach the borehole, according to the Environment Agency.
- **Zone III** (Total catchment): The total catchment is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.
- **Zone of special interest**: This is usually where local conditions mean that industrial sites and other polluters could affect the groundwater source even though they are outside the normal catchment area.

The proposed cable route corridor passes through a SPZ III (Total Catchment) to the north-east of Baconsthorpe and then through a SPZ II (Outer Zone) to the south-east of Baconsthorpe. The cable route also passes through a SPZ III (Total Catchment) and then II (Outer Zone) when passing to the north-west of Cawston. The southern end of the proposed cable route and the proposed substation at Salle are situated within a SPZ I (Inner Zone). Water abstraction data described previously shows the presence of several groundwater abstractions, mainly for drinking water supplies within the surrounding areas.

Nitrate Vulnerable Zones

Within the area to the north of Bodham (Cable Section 3), the cable route lies within a Surface Water Nitrate Vulnerable Zone (NVZ), which is an area at risk of having a high nitrate concentration (greater than 50mg/l). There are no other NVZ along the cable route or in the area of the substation.



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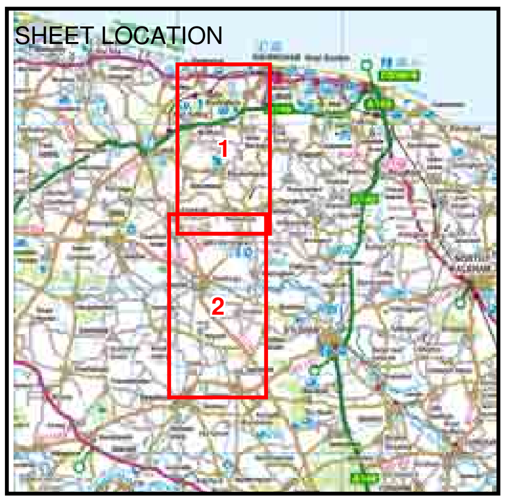


LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits

Substation

- Total extent of proposed substation

Study Area

- SECTION EIA study area divisions

Known/Potential Sources of Contaminated Land and Receptors

- Potential Contaminated Land Sites
- Railway (Current or Dismantled)
- Other Potential Source of Contamination
- Possible Location of Pit
- Spring

Title:
KNOWN/POTENTIAL SOURCES OF CONTAMINATION AND RECEPTORS

SHEET 1 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

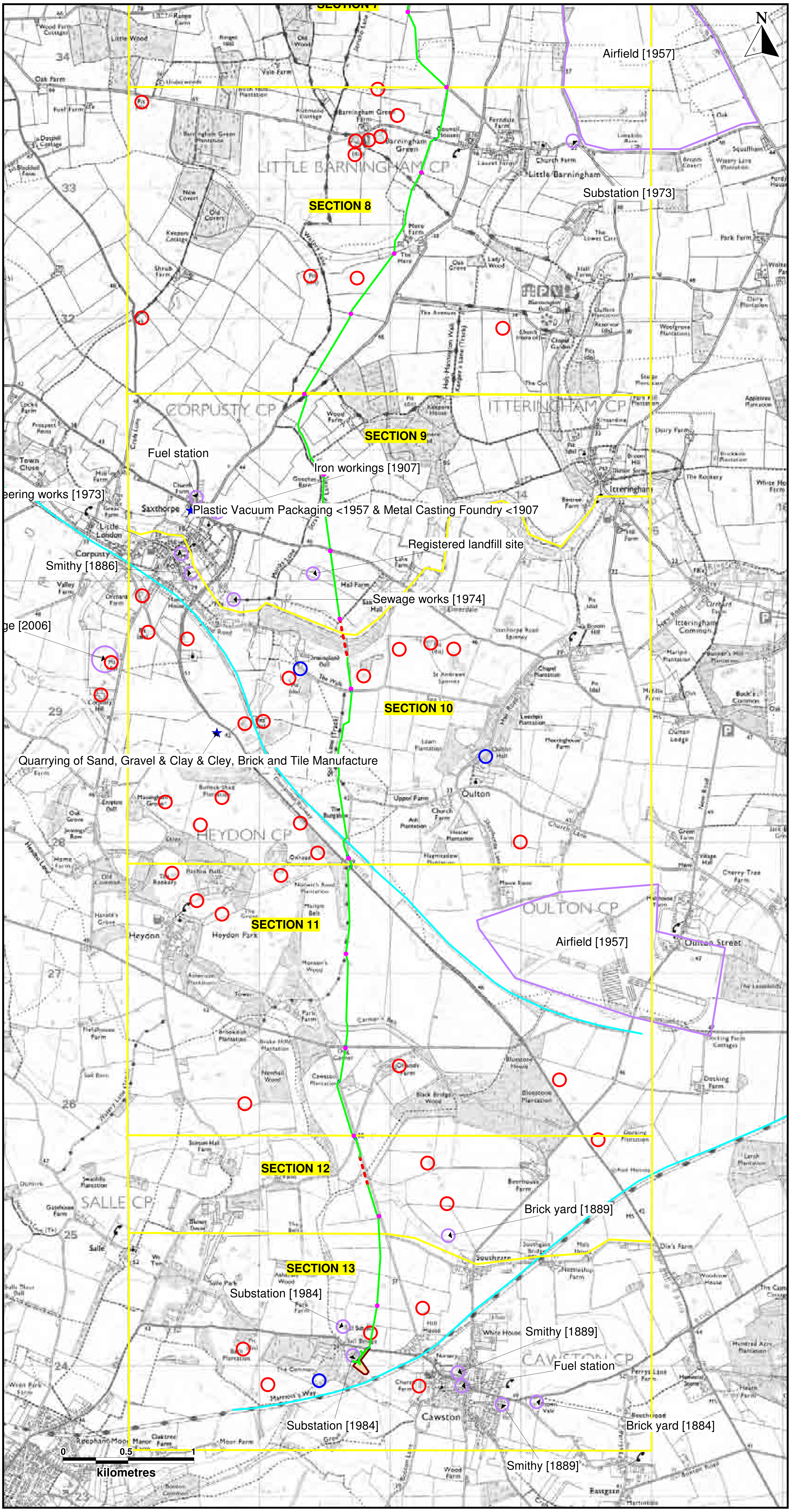
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

Scale:
NTS

Figure:
FIGURE 8.4 (1 of 2)

ROYAL HASKONING



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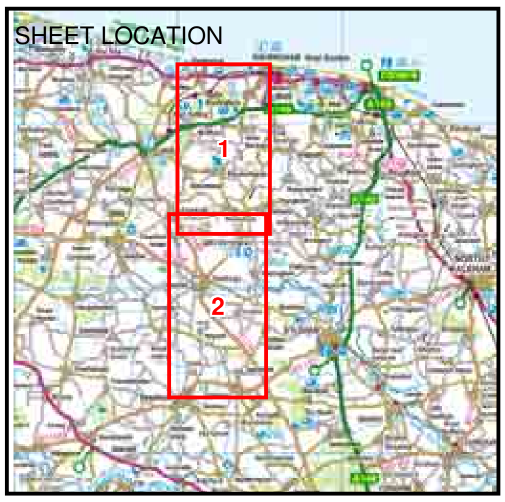

LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits

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- Total extent of proposed substation

Study Area

- SECTION EIA study area divisions

Known/Potential Sources of Contaminated Land and Receptors

- Potential Contaminated Land Sites
- Railway (Current or Dismantled)
- Other Potential Source of Contamination
- Possible Location of Pit
- Spring

Title:
KNOWN/POTENTIAL SOURCES OF CONTAMINATION AND RECEPTORS

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

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Figure:
FIGURE 8.4 (2 of 2)

ROYAL HASKONING

Weybourne Springs

Specific research was carried out into some springs at Weybourne, following on from initial consultation with Natural England (pers. comm. Peter Lambley, 2006) where mention was made of 'powerful' springs to the south of Weybourne at approximate grid reference TG116418. The springs in question were to the east of the proposed cable route and to the south of the railway line. The origin of Spring Beck, which flows northwards to discharge at the coast, is found here. Natural England believed this to be an artesian spring.

The location of these springs coincides with the boundary between the Briton's Lane Sand and Gravel and the Glacial Till. Topography of the area shows that springs are located at the bottom of a hill and on its northern face which is steeper that the southern side. Geological and hydrogeological memoirs and maps described the Glacial Till as made of mainly pebbly, chalky, sandy, silty, clay and the aquifer within the Chalk as semi-confined to confined. Consequently, it is likely that the Glacial Till is generally relatively permeable. It is likely that rainfall passes through the Bacon Green Till and then out as this meets a more impermeable layer, hence water will be preferentially released via the Weybourne Springs (for example). This would also explain the seasonal variations of the water flow.

The hydrogeological map also shows the probable course of a buried channel starting at the approximate location of the Weybourne Springs and extending northward to the coast. The map suggests that this buried channel is mainly in the Chalk. A further buried channel crosses the proposed routes to the north of Saxthorpe, running from west to east. It is noted that, where the Chalk is below Eocene and thick Boulder Clay, groundwater in the Chalk is confined under pressure and that often seasonal artesian flow has been recoded but that there are no substantial areas of artesian overflow. Chalk water levels are likely to be highest in April, in response to rainfall, and lowest in October or November, with the highest fluctuations along the Cromer Ridge, which passes from Holt to Mudesley. The spring fed pool to the south of Weybourne Station is shown in **Plate 8.1**.

Plate 8.1 Spring-fed Pool at Weybourne

Consultation with the University of East Anglia (UEA) (pers. comm. Dr. Kevin Hiscock, 2006) revealed that the university has not researched the Weybourne Springs specifically, but that the Chalk is indicated to have an artesian head of approximately 5m in this area. Consultation with the Environment Agency (Ipswich Office) revealed that they do not hold any information on the Weybourne Springs or on the pressure of the groundwater system in this area. The Chalk is at roughly 0m above ordnance datum (AOD) in this area and was thought likely to influence springs further down the coast but unlikely to produce significant pressure at Weybourne.

Consultation with Adrian Green (a professional hydrogeologist who based his PhD thesis on this area) revealed that along stretches of the beach front in north Norfolk, there is a saltmarsh barrier, but that this had been lost at Weybourne. The saltmarsh will act as a lower permeability barrier to groundwater seeping out through the cliff face. There are reportedly springs at the cliff face here and a watercourse emanating from an inland spring. Further up the coast, where the chalk is more competent (near Glandford and Burnham), it was considered more likely that the springs would be powerful. However, given the size of the groundwater catchment and the large tidal range near Weybourne, it was also considered possible that the springs might be powerful here. At Thornham, to the west of Weybourne, the groundwater level is at 3 to 4m (AOD), but here there is a large saltmarsh barrier and at nearby Titchwell, Natural England had excavated some ponds through the drift deposits and these had overtopped due to artesian groundwater flow. At Glandford, however, the groundwater is close to tidal levels.

8.3.3 Hydrology

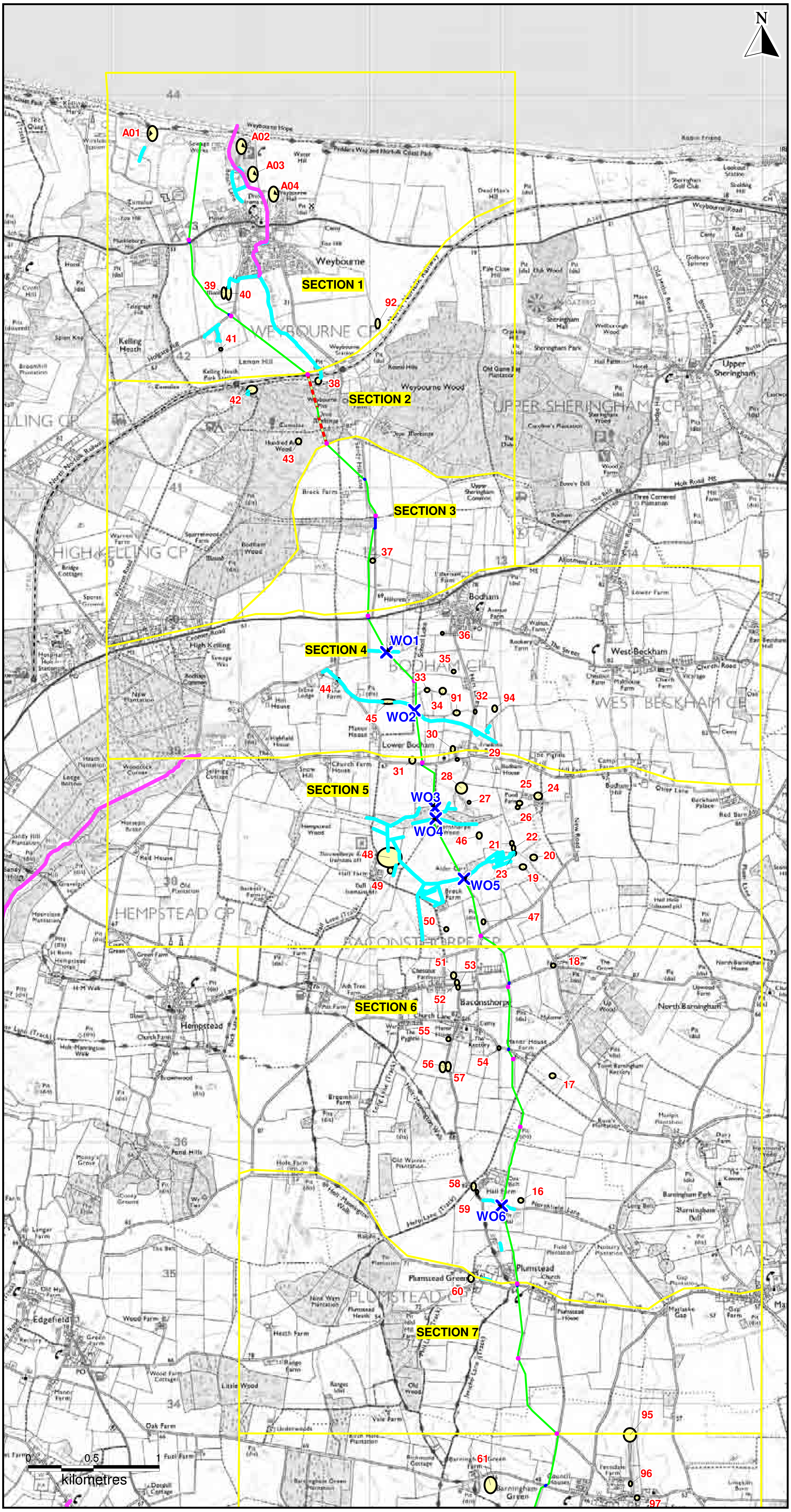
Rainfall

Norfolk is one of the driest counties in England with warm summers and an average annual rainfall of only 624.7mm (based on a 34-year average between 1969 and 2002). This is below the annual average for England which is 851.5mm, and well below the UK average of 1,176.3mm. Droughts are a regular feature of the climate in the region, and there have been notable periods of drought in the early 1990's (Norfolk County Council, 2003). These have resulted in limited ground water recharge and reduced river flows in many parts of Norfolk.

Topography, drainage network and surface water features

The topography of the land throughout north Norfolk is relatively flat, with the majority of land below 60m AOD. Along the corridor of the proposed grid connection there are some areas of raised ground associated with Edgefield (90m AOD) and Stonepit Hill (80m AOD).

A number of surface water features exist throughout the study area, consisting of rivers, streams, ditches and still water bodies such as ponds and lakes, and are shown on **Figure 8.5**.



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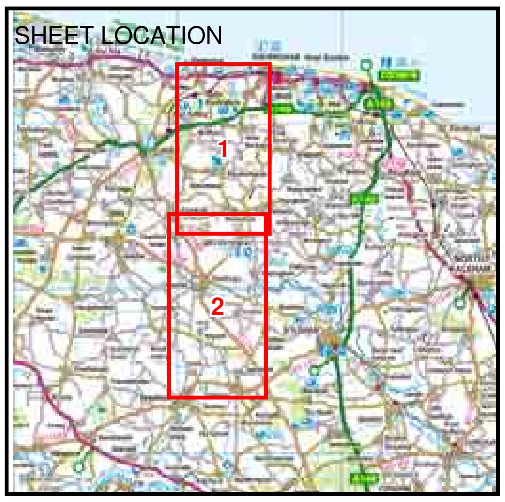

LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross bonding pits

Substation

- Total extent of proposed substation

Study Area

- SECTION EIA study area divisions

Surface Water Features

- Main river
- Ordinary watercourse
- IDB maintained watercourse
- Watercourse crossing location (W0X)
- Pond (location and reference number)

Title:
SURFACE WATER FEATURES

SHEET 1 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
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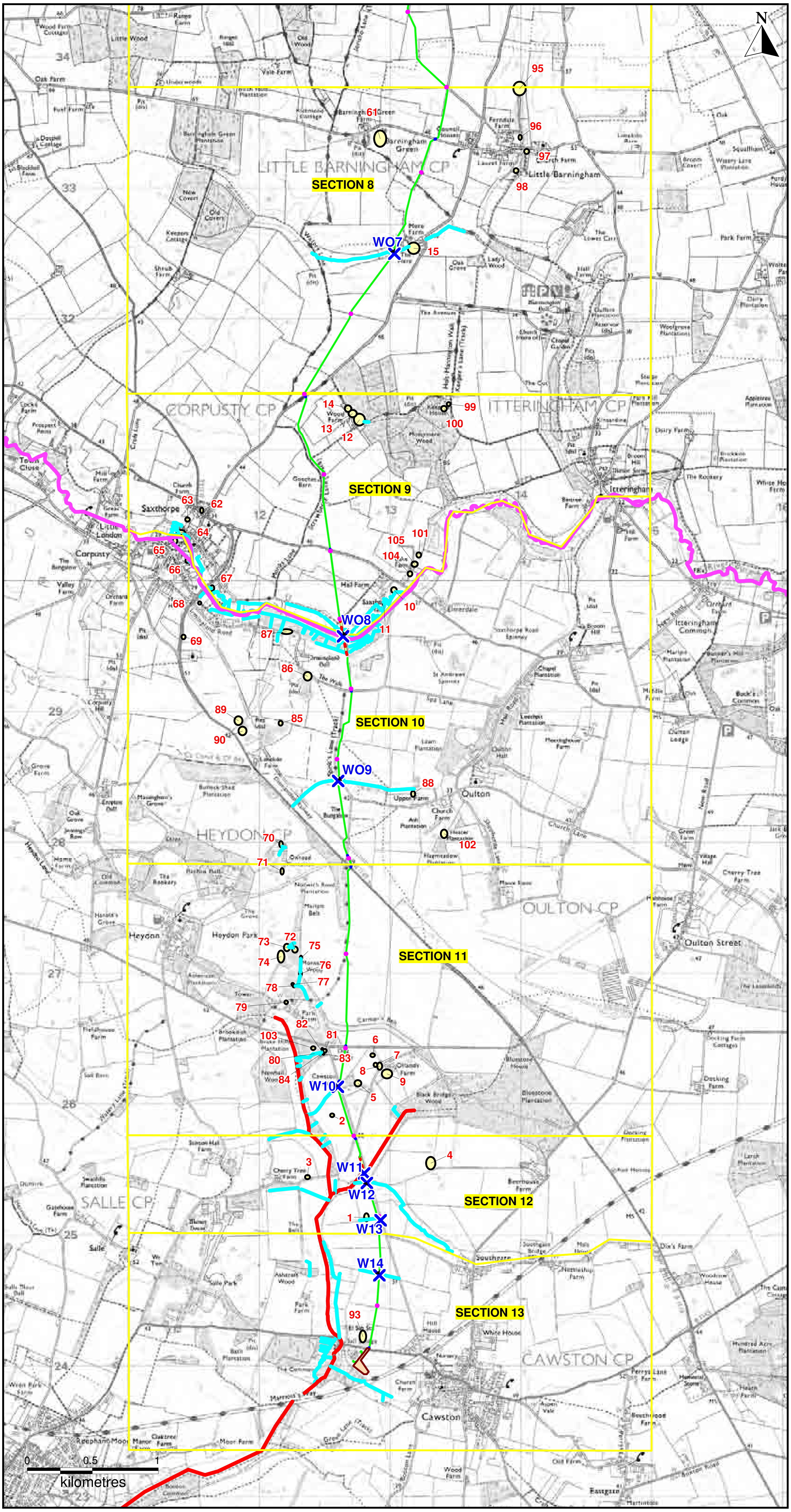
Figure:
FIGURE 8.5 (1 of 2)

ROYAL HASKONING



SHEET LOCATION

LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
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Substation

- Total extent of proposed substation

Study Area

- SECTION — EIA study area divisions

Surface Water Features

- Main river
- Ordinary watercourse
- IDB maintained watercourse
- Watercourse crossing location (W0X)
- Pond (location and reference number)

Title:
SURFACE WATER FEATURES

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

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Figure:
FIGURE 8.5 (2 of 2)

ROYAL HASKONING

Some of the rivers within the study area are categorised as 'Main River' whilst others are categorised as 'Ordinary Watercourses'. Main Rivers are typically larger streams and rivers, but also include smaller watercourses of strategic drainage importance. A Main River is defined as a watercourse shown as such on a Main River map (defined by Defra), and can include any structure or appliance for controlling or regulating the flow of water in, into or out of a Main River. The Environment Agency's powers to carry out flood defence works apply to Main Rivers only. However, the Environment Agency's other duties and functions extend to all watercourses. Consent under the Land Drainage Act (1991, as amended) is required for works which fall within nine metres of a Main River.

An ordinary watercourse is every river, stream, ditch, drain, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a Main River. The Local Authority, or Internal Drainage Board (IDB) where relevant, has powers for ordinary watercourses.

Main Rivers

The proposed cable route crosses one Main River (the River Bure) at a location east of Saxthorpe (see **Figure 8.5**). The cable route also crosses tributaries of the River Glaven and River Wensum. At its northern end, the cable route runs parallel with the Spring Beck, a Main River which rises at the Weybourne Springs (discussed in Section 8.3.2) south of the North Norfolk Railway line near Weybourne Pits.

Table 8.2 summarises the key characteristics of the Main Rivers that are relevant to the study area.

Table 8.2 Main Rivers located within the study area

Main River	Location of river and cable route crossings	Key river characteristics
Spring Beck	The proposed cable route does not cross the Spring Beck or any of its tributaries but runs parallel to it. The river channel lies at a level 5-10m lower than the course of the cable route therefore the impacts of runoff during construction need to be considered and mitigated.	Rises at springs near Hundred Acre Wood before flowing through a culvert beneath the North Norfolk railway line. Then flows north for a distance of 1.9km towards Weybourne. Beyond Weybourne the spring feeds a large lagoon at the Weybourne Beach car park.
River Bure	Flows in an easterly direction across the southern section of the study area. Most of the River Bure lies within The Broads National Park, to the east of the study area. The proposed route crosses the River Bure at a location east of Saxthorpe (TG126295).	The Bure rises near Aylsham which was the original head of navigation. The river flows for a distance of 84km and has two main tributaries, the River Thurne and the River Ant.

Main River	Location of river and cable route crossings	Key river characteristics
River Glaven	The proposed cable route does not cross the River Glaven, but crosses several watercourses which feed into it (see following section).	Flows in a northwest direction for a distance of 17km from its headwaters in Baconsthorpe to its junction with the North Sea behind a shingle spit at Blakeney point. There are two major tributaries of the Glaven, the Stody Beck which joins the river above Hunworth Mill (TG 066 356) and the Thornage Beck which joins close to the unbridged ford on the Thornage to Hunworth road (TG 062 363).
River Wensum	The River Wensum itself lies to the south of the proposed cable route. However, several watercourses located in the vicinity of the electricity substation at Salle flow south, connecting with the Wensum 6-7km downstream.	The River Wensum is a lowland chalk river and is a designated SSSI and priority site for water level management improvement. The river is navigable from the New Mills Yard in the centre of Norwich to its confluence with the River Yare. The river flows in a south easterly direction from its source near the villages of Colkirk and Whissonsett, through the centre of the City of Norwich. The river merges with the River Yare to the south of the City before flowing eastward through Breydon Water to the North Sea at Great Yarmouth.

Ordinary watercourses

Several watercourses within the study area are maintained by the King's Lynn Consortium of Internal Drainage Boards (KLCIDB). The Consortium's maintained network consists of over 800km of watercourses, grouped into catchment areas. A key role for the consortium is to ensure that these watercourses are capable of carrying sufficient volumes of water across the hydrological network. The proposed cable route crosses one IDB maintained watercourse, 0.5km east of Cherry Tree Farm, near Cawston. It is proposed that this watercourse is directionally drilled (drill location 4: Woodland East of Salle Park).

There are also several relatively small lentic (still) water-bodies within the cable route corridor, with some areas of open water, including lakes and ponds associated with Great Water and Saw Mill Pond (Hanworth), Felbrigg Pond (Felbrigg) and Costessey Pits (Costessey CP). There are additional surface water features located in the area of the onshore grid connection. These are described in more detail in the following section.

Watercourse crossings

The cable route corridor crosses 14 watercourses, most of which are small, ephemeral ditches or drainage channels which remain dry throughout long periods of the year. Watercourses in the vicinity of the proposed cable route were surveyed in September 2006 as part of the ecological survey programme (refer to Section 6: 'Nature Conservation and Ecology'). A second survey of the River Bure was undertaken in spring 2007. A description of each watercourse crossing is provided in **Table 8.3** along with a reference number (e.g. WO1). The location of each of the crossing points are shown on **Figure 8.5**. There are no watercourses in the immediate area of the proposed substation.

Table 8.3 Watercourses crossed by the proposed cable route

Location	Description of Watercourse	Crossing Type
TG121397 (WO1)	North-east of Pine Farm, Bodham, the proposed cable route crosses a small ditch. At the time of survey, the ditch was damp but with no flow. The ditch does not connect to any other significant watercourse.	Dam and pipe (or pump), or open-cut trench
TG123393 (WO2)	South-east of Pine Farm, Bodham, the proposed cable route crosses a steep-sided watercourse with banks approximately 1.5m in height. The watercourse flows in a westerly direction from its source near Franklins Farm past Stone Lodge and Hill House before connecting with Selbrigg Pond, Holt. Selbrigg Pond subsequently feeds into the River Glaven which initially flows southwest towards Hunworth.	Dam and pipe (or pump), or open-cut trench
TG125385 (WO3)	As the route enters Baconsthorpe Wood the route passes beneath a small drain which flows east-west, eventually connecting with Selbrigg Pond to the west. The route will be directionally drilled at this location.	Directionally drilled
TG125384 (WO4)	A second small drain, which runs parallel with WO4, is located at the southern end of Baconsthorpe Wood. This drain appears to connect with a number of associated drains in the area which flow west towards Selbrigg Pond. The route will be directionally drilled at this location.	Directionally drilled
TG126379 (WO5)	At Alder Carr, the route crosses a steep sided drainage channel which feeds the moat surrounding Baconsthorpe Castle. The channel connects with a series of smaller ditches to the east. At the time of survey the drainage channel contained a slow flow of water.	Dam and pipe (or pump), or open-cut trench
TG130355 (WO6)	The proposed route will cross a dry ditch along the southern side of Northfield Lane (on the road side of the hedge). The ditch is approximately 20.5m long and 0.75m below the level of the road. The ditch is not connected to any other significant watercourses.	Dam and pipe (or pump), or open-cut trench
TG129325 (WO7)	The proposed route will cross a drainage channel which flows from west to east into a large mere (Ref: Pond 18) at Mere Farm. The ditch is located on the northern side of the hedgerow.	Dam and pipe (or pump), or open-cut trench
TG126295 (WO8)	The proposed route crosses the River Bure (see Table 8.2) and a number of associated drainage channels east of Saxthorpe.	Directionally drilled

Location	Description of Watercourse	Crossing Type
TG126284 (WO9)	The proposed route crosses a small drainage channel (<0.5m deep, 1-2m wide) 0.5km west north-west of Upper Farm. The ditch makes the perimeter of the small field and flows west to east, connecting with a medium sized pond near Oulton Hall. At the time of survey, the ditch contained a flow of semi-turbid water, shallow water.	Dam and pipe (or pump), or open-cut trench
TG126261 (W10)	At Cawston Plantation, near Heydon, the route crosses a narrow drainage ditch, 50m long, which flows south east. The route crosses the ditch at its upstream end and was dry at the time of survey.	Dam and pipe (or pump), or open-cut trench
TG128254 (W11)	0.5km east of Cherry Tree Farm, the route crosses an IDB maintained drainage channel. The drainage channel at this location flows through a narrow belt of plantation and will be directionally drilled. This drainage channel is passed through a culvert beneath the road to the east which connects Cawston with Heydon.	Directionally drilled
TG128254 (W12)	The cable route crosses a small (<0.5m deep, 1m wide) drainage channel at the southern boundary of a woodland east of Cherry Tree Farm. This drainage channel passes through a culvert beneath the road to the east which connects Cawston with Heydon. The crossing will be directionally drilled.	Directionally drilled
TG129251 (W13)	To the south of Cherry Tree Farm, the route crosses a small ditch associated with a field boundary (hedge). The ditch does not appear to connect with any other watercourses.	Dam and pipe (or pump), or open-cut trench
TG128244 (W14)	0.75km north of Cawston, the route crossed a ditch (dry at time of survey) adjacent to a new hedge boundary. The ditch is not marked on ordnance survey mapping.	Dam and pipe (or pump), or open-cut trench

Other surface water features

The cable route corridor runs close to several other surface water features, as illustrated in **Figure 8.5** (reference numbers given in the text refer to those on the figure). A description of any features in close proximity to the route is given below:

- The proposed cable route runs close to two ponds (Refs. 39 and 40) which form the moat enclosure of a Scheduled Monument to the south west of Weybourne (TG109425). These ponds feed a tributary of the Spring Beck, which connects with the river immediately to the south of Weybourne.
- As the route enters Hundred Acre Wood, it passes Weybourne Springs and a spring-fed pool (Ref. 38) 50m to the east, near a disused gravel pit to the south of North Norfolk Railway line.
- As the route continues south, past Breck Farm, it passes close (20m) to a small pond (Ref. 37) on the western side of Sandy Hill Lane.
- The proposed route will cross a drainage channel which flows from west to east into a large 4,500m^2 mere (Ref. Pond 18) at Mere Farm. Several other small drainage ditches also flow into this drainage channel to the west of Watery Lane. The mere itself lies approximately 110m to the east of the proposed cable route.

Several surface water features are located in the area surrounding the proposed new electricity substation at Salle (see **Figure 8.5**). Watercourses to the west and south of the area connect with other small watercourses that subsequently flow in a south/westerly direction towards Reepham, joining the River Wensum at Lenwade.

In the immediate vicinity of the proposed substation, a small drainage channel flows from the south-east beneath Marriott's Way, through the woodland located to the south of the proposed site. This channel feeds a larger watercourse which subsequently joins a drainage channel maintained by the KLCIDB. The KLCIDB maintained drainage channel flows from north to south from Beerhouse Farm (to the north of the substation) to its confluence with River Wensum at Lenwade.

Discharge consents

There are 76 discharge consents within approximately 1km of the proposed onshore grid connection. 11 of these are located within approximately 250m radius of the cable route. These relate to the discharge of unknown effluents onto land/soakaway and trade effluent into the River Wensum.

There is one discharge consent located approximately 300m to the north-west of the substation. This relates to the discharge of trade effluent into the River Wensum tributary and is held by Anglian Water Services Ltd.

Pollution incidents to controlled waters

There are no registered pollution incidents to controlled water within approximately 500m radius of the proposed substation. There is one pollution incident to controlled water registered within approximately 500m radius of the proposed cable route, which relates to the release of oils into a tributary of the River Bure and is classified as significant (Category 2). There are ten other pollution incidents registered within approximately 1km of the proposed onshore grid connection.

Water abstractions

There are 78 licensed water abstractions within approximately 1km of the proposed onshore grid connection. Of these, 17 are located within approximately 250m radius of the proposed cable route. 14 of them relate to abstractions of groundwater from the chalk or glacial sand and gravel for general farming and domestic, spray irrigation (direct), agriculture (general), potable water supply and public water supply. Two of them relate to abstractions of stream water for spray irrigation and the status of both is described as "revoked".

There are nine licensed water abstractions within approximately 500m radius of the proposed substation. All of them relate to abstractions of groundwater for water public supply and potable water supply. The status of one of them is described as "revoked" and two of them as "time limit". The status of the six other water abstraction licences is not supplied.

Flood risk

According to the maps obtained from the Envirocheck Report, generally, the area of the proposed onshore grid connection does not lie within an area at risk from extreme flooding and/or flooding from rivers or sea without defences. However, there are a few exceptions identified below.

There are three locations where the cable route corridor lies within an area at risk from flooding from rivers or sea without defences:

- Area surrounding a tributary of the River Bure (to the south-west of Little Barningham).
- Area surrounding the River Bure (Saxthorpe).
- Area surrounding a tributary of the River Wensum.

The substation area does not lie within areas which are at risks from flooding from rivers or sea without defences. However, areas at risk are located approximately 100m to the west of the substation area.

River water quality

The cable route crosses several surface water features as described above.

River water samples from Main Rivers are routinely tested by the Environment Agency for ammonia, biochemical oxygen demand (BOD) and dissolved oxygen. The results are compared with limits set for each of six grades, ranging from A (very good) to F (bad).

The Environment Agency also undertake surveys of macro-invertebrate populations. The range of species found is compared with that which would be expected in a river which was not polluted and a grade is also assigned from A (very good) to F (bad).

The Environment Agency's monitoring has shown that water quality in the River Glaven was classed as "fairly good" (Grade C), the River Bure as "very good" (Grade A) and the Blackwater drain (tributary of the River Wensum) as "good" (Grade B) (**Table 8.4**).

Table 8.4 Water quality classifications in the River Glaven, Bure and Wensum

Sample Point	Water Quality Parameter Classification	
	Chemistry	Biology
River Glaven – Bodham to Hill House Farm	C (2000 to 2004)	B (2000 to 2004)
River Glaven – Hill house farm to Selbrigg Lake outflow	C (2000 to 2004)	B (2000 to 2004)
River Bure – Little London to Itteringham Bridge	A (2000 to 2004)	A (2000 to 2004)
River Bure – Briston to Little London	--	A (2000 to 2004)
Blackwater – Cawston to Wensum	B (2000) A (2002 to 2004)	--

8.3.4 Contaminated land

Site history

The 1:10,000, 1:2,500 and 1:1,250 scale historical maps were reviewed in the area of the proposed grid connection. In general, the review revealed little evidence of past or current contaminative land uses in the vicinity of the proposed cable route or the substation area. The area of the cable route has been in predominantly agricultural use, with scattered settlements, from the 1800s to the present day. This has resulted in few potentially contaminative uses of the land being identified. Information was also provided by North Norfolk District Council (pers. comm. J Wilson, 2007) regarding potentially historical contaminative activities. The potentially contaminating features have been transcribed on to **Figure 8.4** which shows their approximate locations.

Within the area of the proposed cable route, the maps reviewed indicated:

- A military camp to the west of Weybourne (now the site of the Muckleburgh Collection museum).
- Springs to the south-west of Weybourne and close to Weybourne railway station.
- A registered landfill site at Saxthorpe.
- Railway lines (operational and dismantled) crossing at Weybourne and Heydon.
- A spring to the south-east of Saxthorpe.
- A former plant/equipment store including fuel at Plumstead.
- Two electrical substations at the grid connection which forms the terminus of the route.
- Numerous possible pits/quarries, which may have been infilled with unknown materials.

Within the area of the proposed substation, historical maps show the presence of an electrical substation immediately to the north-west of the proposed substation area (the existing EDFE site). The proposed area and the surrounding areas have remained occupied by farm land over the past century. A pit is located approximately 50m to the north of the proposed area, which may have been infilled with unknown materials. Observations from the site walkover showed that the pit was partially covered by a pond and that there was evidence of fly-tipping, but no evidence of extensive infilling.

There are several other potentially contaminative features close to the proposed route and substation area, including possible military camps and a sewage works to the north-west of Weybourne; tanks to the south of Weybourne and at Bodham Hill; a timber yard and smithy at Weybourne, Plumstead, Saxthorpe, Cawston and Baconsthorpe; a possible military camp and airfield to the east of Plumstead; an Engineering Works (formerly an iron works) at Saxthorpe; a substation to the east of Little Barningham; a rifle range to the south-west of Saxthorpe; a further airfield at Oulton and smithies; brick yards and fuel stations at Cawston and Saxthorpe.

Land quality

The area of the proposed onshore grid connection has been in predominantly agricultural use, with scattered settlements, from the 1800's to the present day. This has resulted in few potentially contaminative uses of the land being identified.

The proposed cable route passes predominantly through farmland and occasionally across roads, a river and several small streams or ditches. There is a potential for contaminants such as pesticides and hydrocarbons to be present within the farmland areas as a result of agricultural activities. There is also a potential for contaminants contained within surface water run-off to have impacted the immediate surrounding of the roads. Contaminants may include hydrocarbons, oils and metals. Finally, there is a potential for Made Ground to be found in some areas and therefore for a wide range of contaminants to be found.

Historical maps show the current or former presence of a landfill site, military camps, railway lines (both operational and dismantled), a former plant equipment / store including fuel storage, electric substations and pits (see '*Site history*' for further details).

Where pits / quarrying have been noted close to the route or substation, there is a risk for a wide range of contaminants to be present under leachable or gaseous form. Such contaminants may have migrated onto the area of the proposed works. However, there was no evidence of significant infilling activities from information gained during the site walkover. In addition, where the route crosses railway lines (both operational and dismantled), there is a risk for contaminants such as metals, fuels, pesticides and Poly-chlorinated biphenyls (PCB).

The former plant equipment / store (including fuel storage) sites may have been subject to surface or underground leaks or spills of fuels during the delivery, storage and/or transfer.

A landfill site was identified on the EnviroCheck report approximately 300m to the west of the cable route in the Saxthorpe area. Authorised wastes listed were 'Norfolk category A – non-decomposing waste' with the status is described as 'surrendered'. It is therefore unlikely to produce significant quantities of landfill gas; however, it is possible that contaminants in the waste mass may have the potential to leach to underlying groundwater. Records received from the Environment Agency indicate that this landfill site is now closed but previously accepted a mixture of inert and liquid wastes. The Environment Agency also reported that the proposed route is located within a 250m buffer zone of the closed landfill. Further information, such as the waste management licence for the site, landfill gas monitoring data, or waste receipts, were requested during the EIA process but were not available.

The route terminates at the EDFE Salle substation. There is a potential for contaminants such as fuel oils, oils, PCB and asbestos to be present in such locations.

The proposed substation area is currently used for agricultural purposes. There is therefore a risk for pesticides and hydrocarbons to be present within the soil. The area is situated to the south-east of two electric substations. There is a risk for contaminants to have migrated from the electrical substations areas onto the proposed areas.

Contaminants may include fuel oils, oils, PCB and asbestos. However, no evidence of leaks or spills was noted during the site walkover.

Waste

As noted in *'Land quality'* , there is one registered landfill site located to the south-east of Saxthorpe and approximately 300m to the west of the proposed cable route.

Hazardous substances

There was one Notification of Installations Handling Hazardous Substances (NIHHIS) located to the south-west of Oulton Street, approximately 2.2km to the east of the proposed cable route. This related to the former airfield. The status was described as "record ceased to be supplied under NIHHS Regulations (1982)". It is considered that this is unlikely to have any significant influence onto the proposed works.

Contemporary trade directory entries

There are 21 trade directory entries within approximately 1km of the onshore grid connection area, including a Cabinet Makers 110m from the route and the North Norfolk Railway, 250m to the north-east. There are no trade directory entries within approximately 500m of the proposed substation area.

Fuel station entries

There are no fuel station entries located within approximately 250m of proposed onshore grid connection.

Natural and mining cavities – coal mining affected areas

The proposed onshore grid connection is situated in an area which is not registered as being affected by coal mining activities. A number of natural cavities have been recorded within approximately 500m of the proposed cable route, including cavities formed by surface water entering cave systems and natural cavities (sinkholes).

Radon gas

The EnviroCheck report and the Radon Atlas of England and Wales (National Radiological Protection Board, November 2002) state that less than 1% of homes are above the Action Level as defined by the National Radiological Protection Board. No basic radon protective measures are considered necessary in the construction of new dwellings or extensions according to the British Geology Survey.

Potential for contamination

Based on the historical maps of the site there is evidence of potential sources of contamination or processes having taken place in the area which may have resulted in contamination. These include:

- Roads: edges of the road network may have been contaminated by run-off waters. Contaminants may include metals, hydrocarbons, greases and oils. In addition, filling materials may have been used to level the road and there is the possibility that these may contain a wide range of contaminants.
- Farmland: contaminants may include pesticides and hydrocarbons through leakage from tractors and farm machinery.
- Made Ground: a layer of Made Ground is likely to be found in the areas which have been developed such roads and electric substations. The nature of the Made Ground is unknown and there is the possibility of a wide range of contaminants such as metals, hydrocarbons, asbestos, hydrocarbons being present.
- Railway lines (operational and dismantled): may have a range of contaminants associated with the trains themselves (such as metals and fuels); the fill used to construct the track; the maintenance of the track (e.g. pesticides application); and the railway infrastructure (e.g. use of PCB transformers).
- Military camps: may have a range of contaminants associated with the past use, such as fuel oils and metals.
- Timber yard (process / treatment): may have contamination present from leaks or spills of timber preservatives, etc.
- Numerous pits / quarries throughout the area, (mostly disused) and a registered landfill site. It is not uncommon for small pits to have been infilled using wastes and hence these may contain a wide range of potentially contaminated materials. From the information available from the site visit, there is no evidence that the potential pits identified have been landfilled. However, it is noted that not all of the potential pit locations were visited.

From the initial information reviewed, potential contamination risk could exist within the immediate area, as contaminants, if present, may have migrated through the soil to groundwater or its gaseous form through the pores and fractures of the soil and hence into the study areas.

Key observations from the site walkover

A site walkover was carried out in order to investigate several aspects which arose from preliminary assessment of the proposed cable route and substation area. It should be noted that the site walkover also covered the road route previously under investigation.

An inspection was made, as far as was possible, of the existing EDFE substation infrastructure west of Cawston and the proposed new substation site, although no access was gained to the actual substation at the time of the site visit.

The existing EDFE substation site appeared to be in good repair, with no evidence of leaks or spills (see **Plate 8.2**). There was also no evident signs of contamination on the site of the proposed new substation (see **Plate 8.3**).

Plates 8.2 and 8.3 Substation at Salle

Plate 8.2 Existing EDFE substation

Plate 8.3 Site of the proposed substation

The historical maps show a number of features which may have been pits and which could, potentially, have been infilled with waste materials (see **Figure 8.4**). Inspections were made of several of these features. A summary of the findings are shown in **Table 8.5**. Photographs of a pit located to the north of the substation at Salle are also provided as **Plates 8.4 and 8.5**.

Table 8.5 Pit inspections

Pit location	Comments
TG131244	Remained as a pit, partially covered by a pond and with no evidence of infilling. Some fly-tipping was evident (refer to Plate 8.3 and 8.4). Located adjacent to the cable route and to the north of substation.
TG132238	Not visible. Located to the south of the previously considered road route.
TG132245	Existing pit densely vegetated and fenced off. Unclear if any tipping had taken place but was visible at the time of the visit. Located to the east of the proposed cable route.
TG132246	Not visible. Located to the east of the proposed cable route.
TG133248	Existing pit. Located immediately to the east of the proposed cable route.
TG125237	Not visible. Located to the west of the proposed cable route.

Plates 8.4 and 8.5 Pit to north of Salle substation

Plate 8.4 Partially covered pond

Plate 8.5 Some evidence of fly-tipping

8.4 Conceptual Site Model

8.4.1 Introduction

The following section summarises the potential hazards associated with the contaminants which may be present and potential receptors that may be affected by such contamination. The risks posed by site contamination are then considered based on a source-pathway-receptor linkage assessment, as described in Section 8.2.

8.4.2 Potential sources

Contamination sources can include neighbouring land uses and historical activities. In general, the review has revealed little evidence of past or current contaminative land uses in the vicinity of the proposed cable route or the substation area. The area has been in predominantly agricultural use, with scattered settlements, from the 1800's to the present day.

To recap, as identified in Section 8.3.4, the following potential contamination sources have been identified:

- Railway lines (operational and dismantled).
- Farmland.
- Made Ground / fill materials.
- Electricity substation.
- Former plant equipment / store.
- Former military camps.
- Timber process / treatment unit.
- Landfill site (closed).
- Drainage ditches and associated contamination and sediments.

8.4.3 Potential pathways

The potential migration pathways that may currently be present include:

- *Permeable ground* – fill materials and Made Ground may be fairly permeable and thereby enable the migration of contaminants in gaseous or aqueous form, both laterally and vertically. In addition, drift Deposits such as Briton's Lane Sand and Gravel Member and Head Deposits may also be relatively permeable and enable the migration of contaminants.
- *Drainage ditches and surface water drains* – drainage ditches may act as a pathway for migration of contaminants and sediment off or onto the area of works. Flooding of the site may increase the potential for migration of contaminants, if present.
- *Perched groundwater* – it is possible that perched groundwater may be present within the fill material / Made Ground and also within the underlying

Briton's Lane Sand and Gravel Member. This perched groundwater could facilitate the migration of contaminants either laterally or vertically.

- *Groundwater within major aquifer* – the solid geology indicated to underlie the area is shown by the relevant Groundwater Vulnerability Map to constitute a major aquifer of high permeability. These strata may favour the migration of contaminants (if present). Contaminants dissolved or suspended in groundwater may migrate off site and to potentially sensitive receptors. Nevertheless, the major aquifer was also described as semi-confined to confined.
- *Direct contact* – ingestion or dermal contact with contaminants that are present at or near the surface.
- *Inhalation* – of airborne particles, ground gases and vapours which may be present on site.

8.4.4 Potential targets

The targets that may be significantly harmed or polluted by contamination, if present, include:

- *Human health (site workers)* – are considered to be a sensitive receptor due to the close proximity in which they are required to work with contaminated soils and / or contaminated surfaces (if present).
- *Humans (future site users)* – are considered to be of low sensitivity as cables will be buried and capped with appropriate materials. In addition, use of the substation area will be discontinuous and limited to periodic maintenance activities. Future users are potentially at risk via direct contact (dermal), ingestion or inhalation of contaminants (if present) in shallow soil, water or vapours.
- *Groundwater within major aquifer* – is considered to be a sensitive receptor due to the proximity with a number of river and streams and the potential for hydraulic continuity between these two water bodies.
- *Surface water* – is considered to be of moderate sensitivity in areas where the cable routes cross and where directional drilling is proposed.
- *Neighbouring properties & land use* – the cable route and substation areas are located within a rural area comprising mainly farmland, occasionally passing close to small towns and villages. As such neighbouring land uses are considered to be of low sensitivity.
- *Ecological receptors* (fauna and flora) – are considered to be of low sensitivity.
- *Buildings and structures* – considered to be of low sensitivity to any chemically aggressive ground conditions or potential risks from ground gas present.

8.4.5 Conceptual Site Model (CSM) preliminary risk assessment

In order to assess the risk posed by the various source, pathway and receptor linkages that may exist at the site, a linkage model has been produced and is presented in **Table 8.6**.

The risk rating terms used to describe the risks identified at the site are based on the Defra and Contaminated Land Research Report series (CLR Report No. 6) site prioritisation and categorisation rating system, as discussed in Section 8.2. From a review of the information provided and the conceptual site model compiled from this information, a preliminary qualitative risk assessment has been developed for to the site.

It is important to note that these risks have been determined based on the information provided to date from the desk-based assessment, supplemented with information received during the EIA consultation as well as the site reconnaissance survey. As such, the risks are considered to be preliminary.

Table 8.6 Assessment of risks

Hazard	Comment / linkage	Risk	Risk management action
Risk to human health – site workers	Excavation of potentially contaminated soils or waste (pits) could pose a risk to site workers from contact with contaminated soils and leachate and the potential presence of gases / vapours such as methane, carbon dioxide, hydrogen sulphide etc. In addition, a landfill site was recorded approximately 300m to the west of the route for non-decomposing waste. Its size and extent is not known. Other areas may also be of concern such as the timber process / treatment unit and the former equipment store. Contaminants such as metals and hydrocarbons may be found beneath these areas and surrounding areas.	*Low*	At this stage limited details on the contamination issues are available. However, few potentially contaminative uses of the cable route and the substation area have been identified (e.g. railway lines, farm land, roads, pits and electric substation). Further information regarding the landfill site will be sought, and options for monitoring and/or mitigation assessed, once planning permission has been obtained, in order to assess further the risks to the development. It is likely that the risk to site workers may be controlled through safe site working and the use of appropriate Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) as necessary.

Hazard	Comment / linkage	Risk	Risk management action
Risk to human health – future site users	Future site users may be at risk via direct contact (dermal), ingestion or inhalation of contaminants (if present) in shallow soil, water or vapours. Nevertheless, cables will be buried and covered by appropriate capping materials either soft (e.g. subsoil, topsoil, thermal resistant materials) or hard (e.g. concrete and tarmac). In addition, the exposure to the cable route or substation areas will be limited (e.g. maintenance, walkers, and farm activities).	*Low*	Few potentially contaminative uses of the cable route and substation area have been identified. Therefore, risks may be mainly limited to localised areas such as railway lines, pits, landfill site, etc. Risks may be reduced by removing and disposing contaminated material off site, if encountered. Nevertheless, the provision of protection measures such as a capping layer may be a suitable and sufficient technique to act as a barrier between future site users and underlying potentially contaminated soils. Capping may take many forms such as tarmac / concrete, clean subsoil and topsoil.
Risk to shallow groundwater	The construction will involve the clearance of existing hardstanding (e.g. at road crossings) and the digging of open trenches. This may enable greater percolation of rainfall across the working area and enable the mobilisation of some contaminants, if present. In addition, there is a potential for contamination from leaks and spills on the ground surface to penetrate into the underlying strata. In some areas, such as on the banks of drainage ditches, the perched water may be in hydraulic continuity with water bodies.	*Low to medium*	Environment Agency monitoring has shown that water quality in the different rivers range from 'fairly good' to 'very good'. Appropriate techniques should be used to minimise risks to shallow groundwater. Adherence to good site practices is required in order to limit risks to shallow groundwater.
Risk to groundwater within major aquifer	The underlying geology is regarded as a major aquifer. Nevertheless, information suggested that the major aquifer is semi-confined to confined, the Glacial Till acting as a permeable layer. Depending on which layer directional drillings will be undertaken in, there is a risk that drilling may create a pathway and favour the migration of contaminants, if present.	*Low*	It has not been possible to obtain groundwater quality information at this stage. The groundwater within parts of East Anglia is known as being rich in iron and other minerals, requiring treatment prior distribution. Care should be taken during directional drilling to minimise risks to groundwater.

Hazard	Comment / linkage	Risk	Risk management action
Risk to watercourses and surface water bodies	Surface water / leachate and associated fine sediment may run-off to the adjacent rivers or be transported by flood waters. In addition, directional drilling may create a preferential pathway for the groundwater, favouring the migration of contaminants, if present. Increase in impermeable surface area may also contribute to increased runoff.	*Medium*	Extra care will be taken particularly where the cable route crosses rivers. In addition, care should be taken during directional drilling to minimise risks to controlled waters. Water collected, when drilling, will need to be tested and disposed of in an appropriate manner to avoid contamination of controlled waters in agreement with the Environment Agency or sewerage undertaker.
Risk to neighbouring properties and land use	The surrounding areas are mainly composed of farm lands and settlements.	*Low*	Given the past land uses of the cable route areas and substation area, risks are considered to be low.
Risk to ecological receptors	The River Bure supports protected species and sensitive ecological habitats and as such could be sensitive to pollution, particularly water pollution. Where the cable road crosses the River Bure, it is intended to use directional drilling.	*Negligible to low*	Risks may be minimised by working in accordance to good practices on the site.
Risks to buildings and structures	There is a potential that any contaminants present may impact building materials, structures and services e.g. degradation of plastic pipes, concrete, etc. In addition, potential for landfill gases to be present is low as authorised wastes were non-biodegradable wastes. Naturally derived ground gases may also be present, although these are likely to be derived from the chalk which is indicated to be present at some depth below the substation site. Vertical migration of gas is likely to be impeded by intervening groundwater.	*Negligible*	Further information regarding the landfill site will be sought, and options for monitoring and/or mitigation assessed, once planning permission has been obtained, in order to assess further the risks to the development.

Although a number of risks have been identified, these risks may be reduced by following on-site good practice and other specific mitigation measures, as outlined within Section 8.5 and 8.6.

8.5 Impacts During Construction

8.5.1 General impacts, mitigation measures and good construction practice

In order to minimise any potential impacts to geology, hydrogeology, hydrology and land quality associated with the construction phase (for example leaks or spills associated with construction works or disturbance of any existing areas of contamination), the project will adhere to the Environment Agency Pollution Prevention Guidance (PPG) notes, as well as general good construction practice, as summarised in the table below.

Mitigation – General measures during construction
The construction of the onshore grid connection will adhere to the following PPG notes and codes of good practice: • PPG01 - General guide to the prevention of water pollution (Environment Agency). • PPG05 - Works near or liable to affect watercourses (Environment Agency). • PPG06 - Working at construction and demolition sites (Environment Agency). • PPG08 - Storage and disposal of used oils (Environment Agency). • PPG20 - Dewatering of underground ducts and chambers (Environment Agency). • PPG11 - Preventing pollution at industrial sites. • Control of water pollution from construction sites – A guide to good practice, CIRIA (2001). If an intrusive investigation is required, it should be done in accordance with the following British Standards: • BS10175:2001 Investigation of potentially contaminated sites, code of practice. • BS5930:1999 Code of practice for site investigations. Other good construction practice measures to be incorporated include: • Minimise excavated volume. • Minimise length of time that excavations are kept open. • Reinstatement of the excavated areas using appropriate fill materials. • Good site practice, hygiene and use of appropriate personal protective equipment (PPE) and / or respiratory protective equipment to protect site workers. • Construction areas will be defined. Areas outside the construction limits will be identified and clearly marked, and equipment operators will be instructed to avoid these areas. Unexpected sources of pollution and contamination during site works: • Consultation of environmental professionals if unexpected sources of pollution are encountered and undertaking of excavation work in accordance with a pre-agreed method statement.

8.5.2 Impact of cable system installation by open trench methods

Site workers

Digging trenches through potentially contaminated soil or waste materials (e.g. pits and quarrying) could potentially impact upon site worker health via dermal (direct) contact, ingestion or inhalation of soil, dust and any associated ground gases. Site workers would be in close or direct contact with contaminants, if present; however, the risk assessment detailed in Section 8.4.5 indicates a low risk to site worker health due to the few potentially contaminative uses identified on land lying along the proposed cable route. Adherence to the good construction practices already outlined in Section 8.5.1 will ensure that the likely significance of this impact is **negligible**.

Mobilisation of contaminants by rainfall

The construction will involve the digging of open trenches and the clearance of existing hardstanding at road crossing points. This may enable greater percolation of rainfall across the working area and enable the mobilisation of contaminants, if present. However, few areas with historic potentially contaminative uses have been identified in the vicinity of the proposed cable route, therefore **no significant impact** is envisaged following adherence to the measures outlined in Section 8.5.1.

Perched water

There is a potential for contamination from leaks and spills on the ground surface to penetrate into the underlying strata. In some areas, such as on the banks of rivers and ditches (e.g. River Bure and the tributaries of the River Glaven and River Wensum), the perched water may be in hydraulic continuity with water-bodies. The likely significance of impact after incorporation of good construction measures outlined in Section 8.5.1 is considered to be **negligible** and no additional measures have been deemed necessary.

Major aquifer

The cable route layout is underlain by a major aquifer (the Chalk). The Chalk is overlain by the Wroxham Crag Formation in some areas and the Glacial Till or immediately by the Glacial Till. The Chalk or the Crag Formation may also be overlain by Sand and Gravel. The Glacial Till, due to its composition (mainly pebbly chalky sandy silty clay), is likely to form a lower permeability barrier to vertical migration of contaminants. The Crag and the Chalk are likely to be in hydraulic continuity. The major aquifer (the Chalk) was described as semi-confined to confined. Nevertheless, some areas lie within SPZ. In addition, The Crag is generally considered to be an unconfined aquifer, with recharge occurring over its whole extent. It is possible that the hydrogeological and subsurface flow paths may be impacted by the laying of cables, should any leaks or spills of contaminants occur or any existing contaminants be mobilised. As outlined in Section 3: 'Project Details', only small-scale sections of relatively shallow depth would be excavated at any one time. In addition, in consideration of the general best practice measures outlined in Section 8.5.1 to be observed, the likely significance of impact would be **negligible**.

Surface water

During any excavations, surface water may infiltrate and increase the leaching of contaminants, if present. Once infiltrated, the water may then be in hydraulic continuity with the nearby rivers and surface water bodies. As with the potential impacts to major aquifers discussed above, only small-scale sections of relatively shallow depth would be excavated at any one time. General best practice measures would also ensure that the likely significance of impact would be **negligible**.

Where the cable route crosses watercourses (excluding the River Bure and the IDB watercourse which are to be directionally drilled), the "dam and pump", or "dam and pipe” methods will be used during the cable duct installation process. These techniques involve damming the watercourse at the upstream end of crossing point. Streamflow is then be diverted around the crossing point (via a pump or gravity-fed pipe), whilst a trench is dug into the stream bed. After the cable ducts are laid, the bed of the watercourse is reinstated and the dam is removed and any flow restored. This technique can adequately transfer streamflow volumes around the work area where there are no concerns about sensitive species passage or localised flooding.

This method is only suitable for narrow streams (<5m wide) with low flows. All 12 watercourses to be crossed by open-trench methods are narrow (less than 2m width), and several have very low or no flow. Where a watercourse is sufficiently small or insignificant (in terms of drainage and/or nature conservation value) and there is no potential for downstream transport of sediment to potentially sensitive sites, it may be possible to install the cable ducts using an open-cut crossing method, without any need for any “dam and pump”, or “dam and pipe” measures.

In either case, specific mitigation measures will be carried out in order to minimise any impact to the water features. These will include: the use of sediment traps; measures to prevent scour; separation of topsoil, subsoil and substrate; and appropriate reinstatement; and are detailed in the table below. The likely significance of impact after incorporation of these measures and good construction practice is considered to be **negligible**.

Soil erosion and runoff

Earthworks associated with digging the cable trench are likely to increase localised soil erosion. Mobilised sediment can make its way into nearby watercourses through surface runoff. This can have serious adverse effects on the geomorphological and ecological functioning of the receiving watercourse. Given that surface water features across the study area are generally small and infrequent; the potential for such impacts is relatively minor. However, care will be taken to reduce the impact wherever possible, particularly where the cable route passes close to, or directly through a surface water feature. Specific mitigation measures to reduce the impacts will include: avoiding construction during and following wet weather where possible; the use of sediment traps or silt fences; and stabilised construction entrances with tire wash facilities. The likely significance of impact after incorporation of these measures is considered to be **negligible**.

Landfill site

A closed landfill site is located to the west of the proposed cable route at Saxthorpe. Authorised wastes listed from the EnviroCheck report were ‘Norfolk category A – non-decomposing waste’, however the Environment Agency has reported that the landfill accepted a mixture of inert and liquid wastes. It has been assessed that it is unlikely that the landfill produces significant quantities of landfill gas, however, it is possible that contaminants in the waste mass may have the potential to leach to underlying groundwater. Further information, such as the waste management licence for the site, landfill gas monitoring data, or waste receipts, were requested during the EIA process, but were not available.

In order to further establish whether there are any possible risks to the development in relation to the landfill site, further information regarding the landfill site will be sought from the Environment Agency and other sources. A risk assessment for the area of the cable route in the locality of the landfill site will then be prepared to design any mitigation measures which may be necessary and make recommendations for any monitoring which might be required during the construction or operational phases. Possible measures to be incorporated whilst trenching in the general area of the landfill may include: monitoring of gas levels in the trenches as they are excavated; or altering the design of the material surrounding the cables in order to allow vents to be installed (e.g. gravel) or gas membranes, if necessary, to avoid accumulation of gases and to avoid the cable route from becoming a preferential pathway for gas migration.

These measures would be agreed in consultation with the Environment Agency, during the detailed design stage. At this stage, due to the distance between the closed landfill and the area of works; the relatively shallow nature of the trenching; the types of wastes which are thought to have been accepted at the landfill; and the incorporation of a suitable mitigation strategy and good construction practice, the potential impact relating to the closed landfill is assessed to be of **negligible** significance.

Excavated materials

Installation of cables will involve trench digging and the excavation of soil. This soil may then be re-used if it has the appropriate thermal resistivity required to achieve the cable ratings. Unsuitable material will be disposed of and replaced by material possessing the required thermal properties. Excavated materials may also be temporarily stored along the proposed route. Measures will be required to minimise and deal with any excavated waste requiring off-site disposal in the appropriate manner and in line with relevant legislation. The likely significance of impact after incorporation of the measures outlined in the mitigation box below is considered to be **negligible**.

Mitigation – specific measures during open trench cable system installation
Surface water crossings: *"Dam and pump" or "Dam and pipe"* • Construct dams with materials that prevent sediment and other pollutants from entering the waterbody (e.g. sandbags or clean gravel with plastic liner). • Use sufficient pumps, including on-site backup pumps, to maintain downstream flows. Install screen pump intakes. • Prevent streambed scour at pump/pipe discharge. • Monitor the dam and pumps to ensure proper operation through the watercourse crossing; *Open-cut crossing method* • Limit the use of equipment operating in the waterbody. • Complete instream construction activities (including trenching, pipe installation, backfill, and restoration of the streambed contours) within 24 hours. • Separate and store topsoil, subsoil and substrate and reinstate soil structure post construction (bank and watercourse bed). • Replant disturbed riparian areas with grasses, legumes or native plant species. Soil erosion and runoff: • Where practically possible, avoid undertaking construction during/following wet weather. • Where significant runoff problems are anticipated, ditches should be constructed at the

Mitigation – specific measures during open trench cable system installation
bases of slopes to convey sediment into sediment traps. • Install silt fences where necessary. • Stabilised construction vehicle entrances will be established with tire wash provisions to reduce the mobilisation of surface material/soil. Landfill at Saxthorpe: • Gain and assess further information related to the registered landfill site, including waste management licence, landfill gas monitoring records or waste receipts (if available). Produce risk assessment. • Consultation with the Environment Agency to design and agree upon a suitable level of mitigation to be incorporated during the installation of the cable system in the area of the landfill. Excavated materials: • Minimise volume of materials excavated and stored. • Characterisation and segregation of excavated materials. • Any material excavated and requiring disposal off site will be characterised and disposed of in accordance with the Landfill Regulations 2002 (as amended). • Excavated materials will be stored in an appropriate manner in order to prevent any cross-contamination and leaching of contaminants. • Any imported filled material to backfill the trenches will be tested to confirm that it is chemically suitable for its proposed use. • All potential waste activities will be undertaken in accordance with the Waste Management Licensing Regulation 1994 (as amended).

8.5.3 Impact of cable system installation by directional drilling methods

Site workers

In four locations, directional drilling has been proposed in order to pass through major features such as the railway lines to the south of Weybourne, woods, the River Bure and the River Wensum.

Drilling through potentially through contaminated strata could impact upon site workers, working in close or direct contact with the soil. Exposure of site workers through dermal contact, ingestion or inhalation of contaminated soil or dust could result in adverse health effects, which would be dependent on the degree of exposure and the nature of the contaminant. However, the risk assessment detailed in section 8.4.5 indicates a low risk to site worker health due to the few potentially contaminative uses identified on land lying along the proposed cable route. Adherence to the good construction practices already outlined in Section 8.5.1 will ensure that the likely significance of this impact is **minor adverse**.

Controlled waters

Relatively permeable strata and fill materials may be encountered at drilling locations. Drilling may create a preferential pathway for both surface water and perched water, affecting the hydrogeological and subsurface flow paths. Depending on the depth of the directional drilling, groundwater from deeper strata (e.g. the major aquifer) may be impacted. This may facilitate the migration of mobile contaminants, if present. In addition, there is a potential for contamination from leaks and spills on the ground surface to penetrate into the underlying strata.

In some areas, such as on the banks of rivers and ditches (e.g. River Bure and at the IDB watercourse east of Salle Park), the perched water may be in hydraulic conductivity with water bodies. To the south of Weybourne, springs have also been identified. It is likely that, in this area, drilling may encounter groundwater flows. Only directional drill location 4 (Woodland east of Salle Park) is located within a SPZ (limit between SPZ II and SPZ III).

In addition, intrusive work may generate fine sediment that could potentially runoff into ditches and rivers in the area and adversely affect in-channel physical habitat conditions. Fine sediment generation will be minimised through the adoption of best practice measures outlined in Section 8.5.1.

As discussed in Section 3: 'Project Details', Bentonite clay would be used during the directional drill process. Bentonite is highly alkaline and can impact upon water quality. Measures are therefore required to ensure that the Bentonite is contained during the construction process, and are outlined in the mitigation box below.

Although few areas have been identified with historically contaminative uses, there is the potential for localised areas of unidentified contamination to be present. Based on the factors described above, the likely significance of impact after incorporation of these measures to controlled waters is considered to be **minor adverse**.

Excavated materials

Potential impacts relating to excavated materials and the requirement for appropriate measures to avoid or minimise these are as already discussed in Section 8.5.2.

Specific mitigation measure required in relation to directional drills, in addition to those outlined in Sections 8.5.1 and 8.5.2 are given in the table below.

Mitigation – specific measures during directional drill cable system installation
General: • Minimise areas of directional drilling. • Use of appropriate drilling materials and Best Available Techniques for directional drilling. Controlled waters: • Dewatering in accordance with a method statement agreed with the Local Authority and Environment Agency. • In order to avoid or minimise Bentonite entering into surface water or groundwaters, specific methods will be used to minimise grout loss during drilling and de-reaming. Washout will be carried out in designated impermeable and contained areas and washout water will not be allowed to flow or drain into surface waters. Washout water from excavations will be reused as much as possible then disposed of by tinkering off site in accordance with the Contractors' duty of care. In the event of any spills, these will not be hosed down into surface water drains.

8.5.4 Impact during construction of the proposed substation

Site workers

During the construction of the proposed substation, as with the cable system construction, there is the potential for construction workers to be in close / direct contact with contaminated soil or waste materials, if present, through direct (dermal) contact, ingestion or inhalation of soil or dust.

Although data reviewed did not identify any specific sources of contamination, the substation area is located within an arable field and it is possible that areas where waste materials have been deposited may have remained unidentified. Adherence to the good construction practices already outlined in Section 8.5.1, will ensure that the likely significance of this impact is **negligible**.

Perched water

The construction will involve earthworks, which may enable greater percolation of rainfall across the working area and enable the mobilisation of some contaminants, if present. In addition, there is a potential for contamination from leaks and spills on the ground surface to penetrate into the underlying strata. The proposed substation is located within an SPZ I.

Adherence to the good construction practices already outlined in Section 8.5.1, such as minimising the volume of excavations, and the duration of any open excavations, will be required to ensure that the likely significance of this impact is **negligible**.

Major aquifer

The substation area is underlain by a major aquifer (the Chalk). Drift Deposits are mainly composed of loam and Boulder Clay and Marl. The major aquifer (the Chalk) was described as semi-confined to confined. The proposed substation also lies over a SPZ I, and water abstraction licences are noted within the vicinity of those areas for dinking water supplies.

As detailed in Section 3: 'Project Details', the design of the substation has incorporated necessary features such as bunded areas and oil interceptors where required in order to avoid or minimise any such pollution incidents from occurring. Adherence to the good construction practices already outlined in Section 8.5.1 will also ensure that the likely significance of this impact is **negligible**.

Surface water

During any excavations, surface water may infiltrate and increase the leaching of contaminants, if present, which may be in hydraulic continuity with the nearby tributaries of the River Wensum located to the west and south of the proposed substation site. In addition, fine sediment may be generated that could runoff and be transported to the nearby watercourses and have an adverse impact on physical habitat conditions within the tributaries and the River Wensum itself. Adherence to the good construction practices already outlined in Section 8.5.1 will also ensure that the likely significance of this impact is **negligible**.

Excavated materials

The construction of the substation would involve foundation and trench digging and the excavation of soil to install a cable basement 1m below existing ground level. Some of this soil will be re-used for the proposed earthworks surrounding the substation site. Unsuitable and surplus material will need to be disposed of off-site. It is estimated that approximately 6,000m^3 volume of subsoil and spoil would need to be taken off site. This material will be disposed of in accordance with the Contractors waste carrier's licence. The requirement for appropriate measures to avoid or minimise impacts relating to excavated materials are as already discussed in Section 8.5.2. The likely significance of the residual impact is assessed to be **negligible**.

8.6 Impacts During Operation

8.6.1 Cable system

There are unlikely to be any additional operational impacts on the hydrology, geology, hydrogeology and land quality once the cable system is installed and reinstatement works have taken place. It is possible that the laying of the cable system may continue to affect hydrogeological and subsurface flow paths if it did so during the construction phase. However, the successful implementation of the stated mitigation and good practice measures required during the construction phase would also result in a **negligible** impact during the operation stage.

The cable would be insulated and protected to ensure minimum maintenance requirements. Therefore, there would be little potential for soil contamination, compaction or erosion resulting from the operational phase of the cable route.

Occasional maintenance works will still be required following during the operational phase, however these would not result in any ground disturbance or potential impacts. In the event of a cable failure, it may be necessary to re-excavate the cable trench and replace/repair the faulty cables along limited stretches. If repair works are required, the mitigation measures proposed in the previous section of this report should be adhered to, in order to reduce or minimise any possible impacts to an acceptable level.

8.6.2 Substation

Pollution incidents

As discussed in Section 3: 'Project Details', the two shunt reactors located in the proposed substation would be filled with mineral insulating oil, located within bunds for any leakage containment. The capacitors are sealed units and contain non-PCB, biodegradable liquid. The SF6 switchgear would be constantly monitored for gas pressure to detect any leakage. In addition, surface water quality would be protected by the use of oil retention bunds around the reactors and oil interceptors on the surface water drainage gullies. Regular monitoring of the site and any pollution control measures will take place as part of a maintenance plan. The likely occurrence of any significance impact is therefore considered to be **negligible**.

Ground gases

The area of the proposed substation has been assessed to be at low risk of radon emissions. No evidence to suggest that any other ground gases might be expected was identified during the assessment. The only possibility for ground gases would relate to carbon dioxide, due to the location of the site overlying the Chalk (although at some depth). The CIRIA guidance on ground gases (Wilson *et al*, 2006) identifies the potential impact relating to chalk as unlikely. The substation buildings have been designed to include mesh floor and walls above the basement, which will provide ventilation where necessary. Therefore, **no impacts** are expected to occur in relation to ground gases.

8.7 Summary

This chapter has assessed the potential direct and indirect impacts of the proposed cable system and substation with respect to geology, hydrogeology, hydrology and land quality.

The areas of the routes have been in predominantly agricultural use, with scattered settlements, from the 1800s to the present day. This has resulted in few potentially contaminative uses of the land being identified (e.g. pits, quarries, landfill sites etc.)

The route crosses over, and near to, a number of watercourses and surface water features. However, these are generally infrequent and small in size. The route directly crosses 14 watercourses, including one Main River and one watercourse managed by the regional Internal Drainage Board, which would both be directionally drilled. The main hydrological impacts of the project are associated with direct interference to local watercourses and increased sedimentation/soil erosion associated with earthworks and excavation.

Based on the findings of the desk study, the development of the conceptual site model has identified the following potential environmental risks associated with the site: Risks to the surface waters are considered to be medium; risks to shallow groundwater are considered to be low to medium; risks to site workers, future site users and neighbouring properties and land use are considered to be low; risks to ecological receptors are considered to be low to negligible; and risks to buildings and structures are considered to be negligible.

Based on the findings of this risk assessment and the application of good construction practice and specific mitigation measures, the impacts of the development with respect to geology, hydrogeology, hydrology and land quality have been identified as **negligible** with the exception of the potential impacts of directional drilling on construction workers and controlled waters, should any contamination be encountered, which were assessed as **minor adverse** impacts.

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ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 9

LANDSCAPE AND VISUAL CHARACTER

9 LANDSCAPE AND VISUAL CHARACTER

9.1 Introduction

This section addresses the potential effects of the proposed development and the required construction process upon the landscape and its visual characteristics. It has two purposes; firstly to provide a description of the existing landscape to facilitate the assessment of the development by the planning authorities and secondly to identify the extent and way in which the landscape may be changed by the development. It is necessary to refer to the application drawings and other sections of this statement on topics that interrelate with the landscape resource.

The consideration of the landscape has been a major determinant of both the cable route planning and the site selection and design of the installation of the substation at Salle. A chartered landscape architect has coordinated both of these utilising a number of procedures outlined in Section 2: 'Site Selection and Consideration of Alternatives'.

Current best practice acknowledges that Environmental Impact Assessment (EIA) and landscape design are iterative processes and this has been reflected in the management of the project. It also encourages the method of assessment to be refined and tailored to suit the particular circumstances of the proposed development.

The key issues identified in the route search, the detailed planning of the project and in particular the conclusions drawn about the need for mitigation measures are addressed in this section. The cable route and the installation at Salle substation are dealt with separately.

The landscape and visual effects associated with the offshore wind farm are not considered here. For information on the selection process that led to the choice of the landfall point and the visual aspects of the wind farm, reference should be made to the Environmental Statement which accompanied the application for the wind farm to the Department for Business, Enterprise & Regulatory Reform (DBERR) (Scira, 2006).

The key decision made in the planning of the onshore grid connection development was to install the cables underground. This decision is fundamental to the consideration of landscape effects and directly related to the perception of the quality of the landscape resource of the area affected by the grid connection. Cables at this voltage are normally installed above ground on steel towers.

9.2 Assessment Methodology

9.2.1 Policy context, best practice and impact significance

The assessment of impact on landscape and visual character has been carried out with reference to The Landscape Institute / Institute of Environmental Management and Assessment document titled 'Guidelines for Landscape and Visual Impact Assessment Second Edition' 2002. This uses a slightly different terminology than is used for the remaining Environment Statement, outlined in Section 4: 'Legislative Context and the EIA Process'.

However, consistent with the rest of the Environmental Statement, the significance level (negligible, minor, moderate, major adverse or beneficial) of identified effects are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification. The legislative framework of the application and the EIA is also addressed in Section 4.

A review of the relevant planning policy context of the proposed onshore grid connection has been carried out in Section 5: ‘Policy and Planning Guidance’ and includes details of the relevant landscape policies included in the Development Plan, as well as any relevant national policy.

9.2.2 Consultation

During the route planning and project design a series of meetings were held with conservation, landscape and planning officers representing both North Norfolk District Council (NNDC) and Broadland District Council (BDC) and the senior landscape officer for Norfolk County Council (NCC). These consultations have helped to identify key receptors and project features to be given particular focus. The methodology for representing the proposals for Salle was derived from the consultation with BDC.

Written consultation was exchanged with the Norfolk Coast Partnership in respect of the Norfolk Coast Area of Outstanding Natural Beauty (AONB).

9.2.3 Components of the development

The project would entail the installation of 21.3km high-voltage cabling underground between Weybourne and Salle near Cawston and the construction of a new substation at Salle. A description of all the components and processes of the project is given in detail in Section 3: ‘Project Details’ and can be summarised as follows:

- Trenching work in a construction corridor with a typical width of 20m and an overall duration of between 18 months and two years.
- Underground directionally controlled drilling in certain sections to avoid surface construction activity.
- Buried cables in a fully reinstated trench less than 2.2m wide.
- Thirty-four pairs of earth 'cross-bonding' pits (flush with ground 2m x 1m) or pillars (approximately 1m in height).
- A substation comprising a Control Building, an Ancillary Building, external electrical equipment, hard surfacing, an access road, fencing and tree planting.

The location of the cable trenching is shown in **Figure 3.3**. The details and dimensions of the substation are given in **Figures 9.1** (and later within Figures 9.9 and 9.10). The substation total site area is 0.87 ha. The Control Building would be 15.4m in width and 27.4m length. The overall height, including the cable basement would be 9.0m, with 8.0m above ground, and an eaves height of approximately 6.45m.

The area of search for the cable route is shown and discussed in Section 2: 'Site Selection and Consideration of Alternatives'.

The following groups of components have been assessed as having different receptors and effects in respect of landscape and visual impact.

- The construction phase for cable trenching and installation.
- The operational phase for surface fixtures of cables.
- The construction phase of substation at Salle near Cawston.
- The operational phase of substation at Salle.

9.2.4 Assessment of construction of cable trenching and installation

The assessment method has responded to certain key aspects of the project.

- When completed the construction is underground and out of sight.
- The construction method and visual activity end to end is largely uniform.
- The landscape has generally cohesive characteristics.
- Adverse landscape effects have been minimised at a broad and detail level in the planning of the route.

The entire electrical cable connection between the landfall point at Muckleburgh near Weybourne and the grid connection at Salle near Cawston is to be installed underground and the surface restored to the current land-use. The route planning process was designed to avoid any significant long-term adverse effects on the landscape. The consultation undertaken at the Scoping Stage of the preparation of this assessment identified no long-term impacts.

With the exception of the narrow coastal strip, the landscape through which the cable route passes is recognised as having both unifying characteristics and also significant variations in character at the much smaller scale at the level of the individual land parcel. Accordingly, the assessment methodology reflects the fact that the impacts of the cable system are primarily related to the relatively short period of construction and has not necessitated a systematic definition of a sub-set of landscape character areas. It is based on the identification of specific features and receptors. Designated landscape features and areas have been identified and the effects investigated separately.

As a consequence of the work undertaken in defining route options, the landscape assessment has addressed a wide zone between the landfall and the grid substation (refer to Section 2: 'Site Selection and Consideration of Alternatives'). More detailed assessment has been undertaken by field work and reference to aerial photography in a zone extending about 500m either side of the route.

9.2.5 Assessment of operational phase for surface fixtures of cables

Once the cables are installed and current land-uses resume, the only visual evidence and activity associated with the operational phase is the presence of the earth-linking or 'cross bonding' pits. The assessment addresses these as a group.

9.2.6 Assessment of construction phase of substation at Salle

The construction phase of the substation was assessed as producing adverse effects on the landscape different to those applying in the operational phase. Accordingly this has been addressed separately in this statement but must be assessed in conjunction with the findings on construction traffic and noise dealt with in Section 10: ‘Noise and Vibration’, Section 11: ‘Dust and Air Quality’, and Section 12: ‘Land Use, Local Community, Tourism and Recreation’. An account of the likely vehicle types and volumes are given in Section 3: ‘Project Details’.

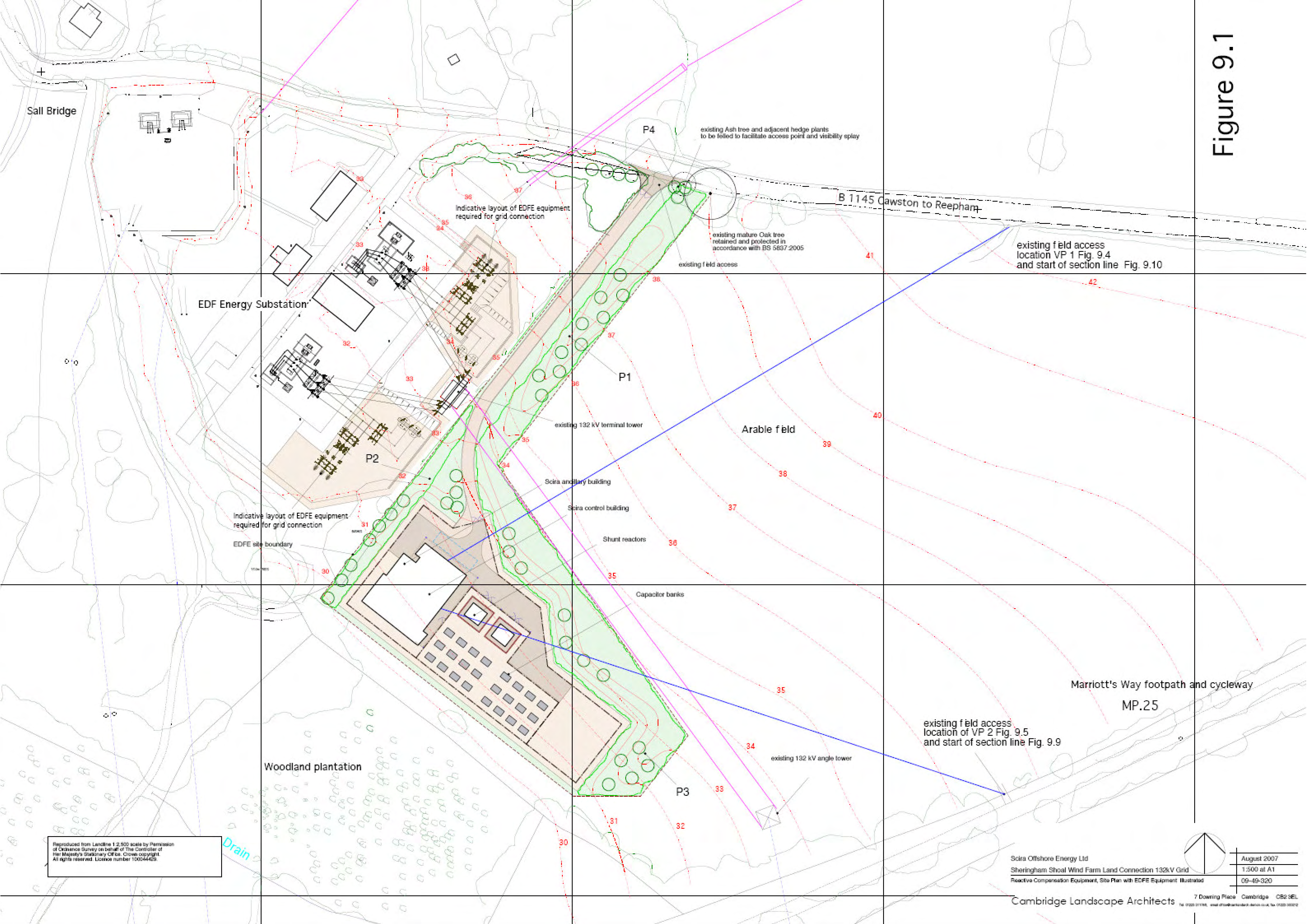
9.2.7 Assessment of operational phase of the substation at Salle

The landscape assessment and the site planning and design of the substation have been an iterative process and this in turn has enabled the survey method and presentation material to be tailored to the case in consultation with Broadland District Council. The proposed reactive compensation equipment would be installed in an arable field adjacent to the existing substation owned and run by EDFE. The primary environmental effect potentially arising from this proposed development was considered to be the change in views from dwellings and for the travelling public.

A full topographic survey of the existing sub-station was undertaken together with spot levels along the centre line of the adjacent road. The topographic survey was coordinated with the Ordnance Survey (OS) data at the scale of 1:2,500. High-resolution aerial photography was commissioned for the project and the images 'geo-referenced' into the OS information to enable features to be identified and mapped. Contours at five metre intervals were added to the 1:2,500 plan data and additional levels at height intervals of one metre interpolated from that data locally to the site.

Key potential viewpoints were identified through a 'desk study' of the assembled map information. Locations accessible to the public were then surveyed 'in the field' to ascertain the potential visual envelope and effects. Due to the fact that the existing substation ground levels were known and the heights of the existing structures were also known and visible in views on the ground, it was possible to establish a sufficient understanding of the potential visual envelope without the need for a computer generated Visual Envelope Map. The field visits were undertaken at different times of the year to consider seasonal variations in vegetation cover.

Within the existing substation there is a need for additional equipment to be installed for the wind farm electrical connection. While this is not a part of the planning application to which this assessment relates it is clearly a factor in understanding the cumulative visual effects of the three elements; the existing substation, the alterations in the existing substation and the additional substation. The cumulative effects to landscape and visual character are assessed and identified in this section.


Sall Bridge
EDF Energy Substation
P4
existing Ash tree and adjacent hedge plants
to be felled to facilitate access point and visibility splay
B 1145 Cawston to Reepham
Indicative layout of EDFE equipment
required for grid connection
existing mature Oak tree
retained and protected in
accordance with BS 5837:2005
existing field access
existing field access
location VP 1 Fig. 9.4
and start of section line Fig. 9.10
P1
existing 132 kV terminal tower
Arable field
P2
Scira ancillary building
Scira control building
Indicative layout of EDFE equipment
required for grid connection
Shunt reactors
EDFE site boundary
Capacitor banks
Marriott's Way footpath and cycleway
MP.25
existing field access
location of VP 2 Fig. 9.5
and start of section line Fig. 9.9
existing 132 kV angle tower
Woodland plantation
P3
Drain
Reproduced from Landline 1:2,500 scale by Permission
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Scira Offshore Energy Ltd
Sheringham Shoal Wind Farm Land Connection 132kV Grid
Reactive Compensation Equipment, Site Plan with EDFE Equipment Illustrated
August 2007
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09-49-320
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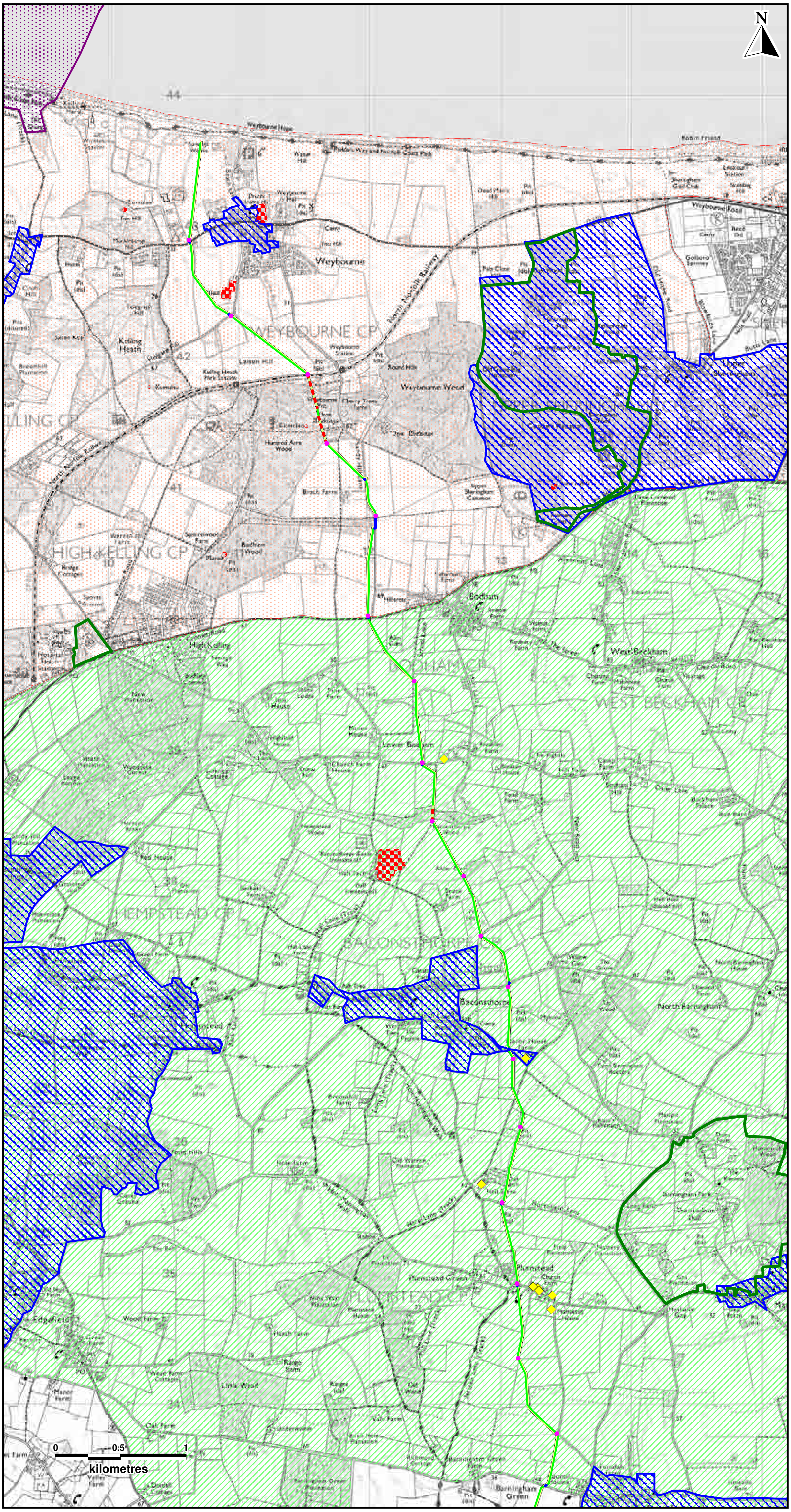
7 Downing Place Cambridge CB2 3EL

Figure 9.1



SHEET LOCATION

LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Landscape Designations & Features

- Norfolk Coast Area of Outstanding Natural Beauty (AONB)
- North Norfolk Heritage Coast
- North Norfolk Area of High Landscape Value (AHLV)
- Broadland District AHLV
- Scheduled Monument
- Listed Buildings (within 250m of cable route only)
- Registered Parks & Gardens
- Conservation Areas

Title:
LANDSCAPE DESIGNATIONS AND OTHER FEATURES IN THE STUDY AREA

SHEET 1 OF 2

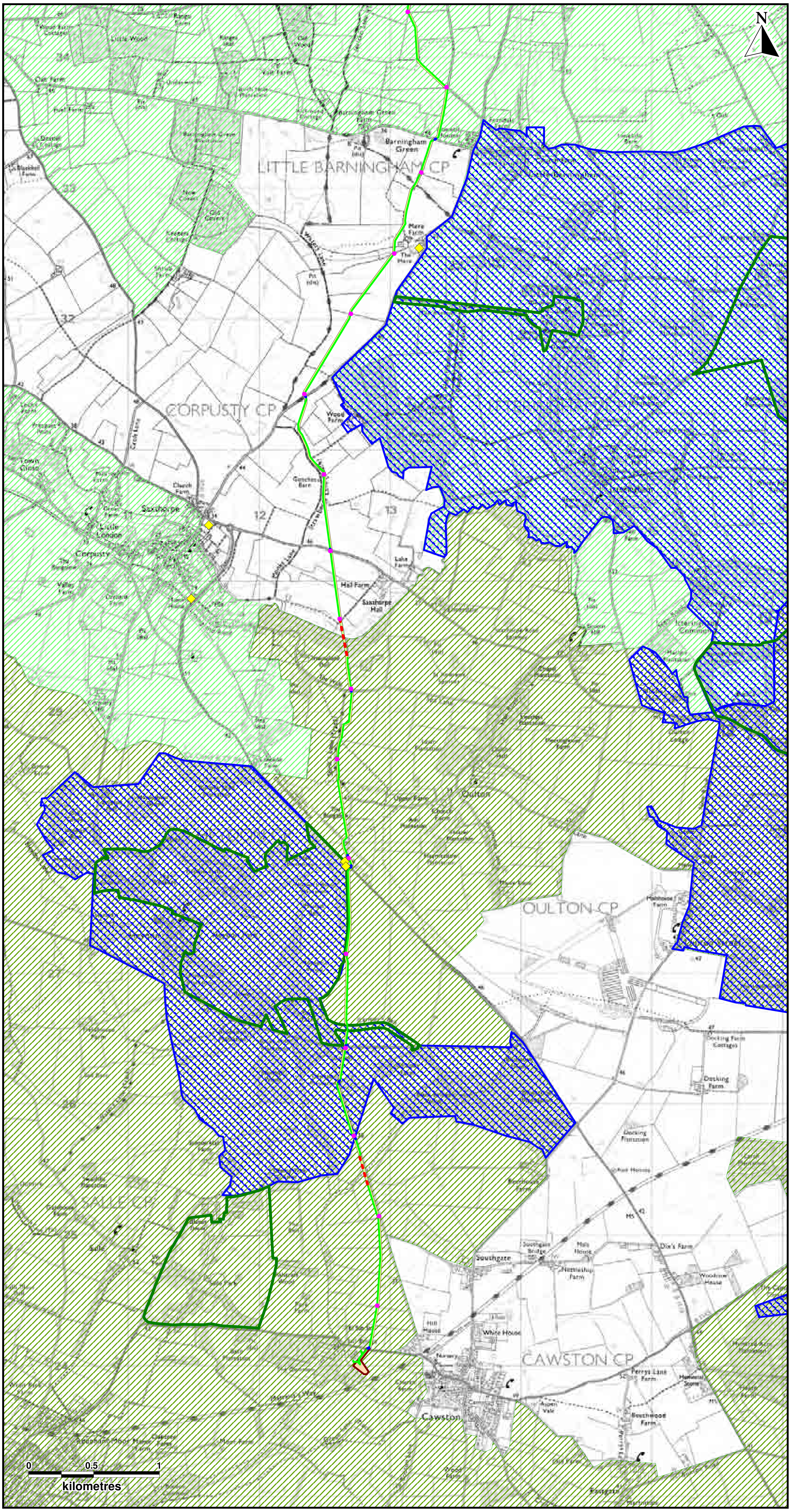
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

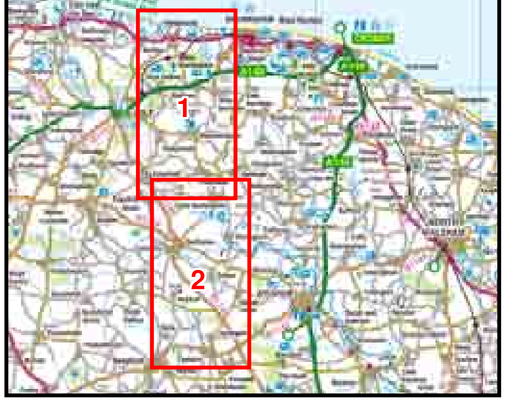
Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 9.2 (1 of 2)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Landscape Designations & Features

- Norfolk Coast Area of Outstanding Natural Beauty (AONB)
- North Norfolk Heritage Coast
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- Broadland District AHLV
- Scheduled Monument
- Listed Buildings (within 250m of cable route only)
- Registered Parks & Gardens
- Conservation Areas

Title:
LANDSCAPE DESIGNATIONS AND OTHER FEATURES IN THE STUDY AREA

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 9.2 (2 of 2)

ROYAL HASKONING

Figure 9.3

Scira Offshore Energy Ltd
Sheringham Shoal Wind Farm Land Connection 132kV Grid
Reactive Compensation Equipment at Salle - Landscape Context

July 2007
1:2500 at A1

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7 Downing Place Cambridge

9.3 Existing Environment

9.3.1 Landscape character definitions

Natural England (formerly the Countryside Commission) undertook a systematic evaluation of the countryside in order to subdivide it for strategic planning purposes into separate areas each having distinctive characteristics. The study area for the wind farm grid connection project is primarily within one of the defined 'Countryside Character Areas' (CCAs) named Central North Norfolk. It also crosses the narrow eastern end of the 'North Norfolk Coast' character area and a short section near Heydon lies in the 'Mid Norfolk' character area.

The landscape of the area is primarily rural with a long-settled agricultural character interspersed with woodland, parkland and occasionally heath. The terrain is gently undulating with the exception of north edge of the Cromer Ridge, an unusually dramatic topographic feature for East Anglia. The land cover is typically the dominant feature of the landscape, notably groups of farm buildings, villages and church towers that punctuate the horizon and convey the sense of scale.

Field boundaries can be geometric but are more commonly irregular conveying a sense of a very long established pattern of land-use and stability.

The area is relatively well wooded with a variety of woodland types including mixed coniferous belts in the northern section, copse and deciduous plantations and poplar plantations in the valleys. Hedgerows containing occasional mature trees are frequent. Large mature hedgerow oaks are a feature of the lanes in the area but more rarely found within field boundary hedges. Woodland and parkland associated with large county houses produces distinct local characteristics while at the same time conveying visual qualities to the area as a whole.

The landscape is subdivided by numerous narrow roads; a historical legacy of the type of landownership of the area. Many of these do not provide the principal link between settlements and consequently are very quiet and attractive features in their own right.

The national Countryside Character Areas are broad scale definitions recognised as having imprecise boundaries and containing land with characteristics distinct from the general picture. Accordingly, Local Planning Authorities undertake smaller scale assessments to define Local Character Areas (LCAs) following recognised procedures to produce a sub-set of area definitions.

Within the North Norfolk District Council boundary, three Local Character Areas apply to the context of the cable route (NNDC, 2005). They are:

- 'Rolling Coastal Heath and Arable' (north of the Cromer ridge at Weybourne Station).
- 'Wooded and Parkland' (the Cromer ridge forestry belt and parkland and substantial pockets to south associated with large estates further south).
- 'Randomly Enclosed Rolling Open Farmland' (from the Cromer ridge to the Bure).

South of the River Bure the area is defined by Broadland District Council as 'Local Character Area D' (BDC, 2002). This LCA groups agricultural landscape characteristics with parkland and river valleys. The characteristics of the area are an undulating, well-tended, agricultural landscape incised by the tributaries of rivers including the River Bure. The area contains parkland estates, settlements with historic features and a strong vernacular character.

The Broadland District Landscape Assessment (Supplementary Planning Guidance Consultation Draft 2002) defines the LCA as 'high landscape quality' and includes it in the 'Area of Important Landscape Quality' covering most of the western part of the district. Local planning policy aims to protect such landscapes and permits development only where it is not detrimental to the character, scenic quality or visual benefit of the area.

9.3.2 Landscape designations

While the route planning has aimed to avoid sensitive landscape features at all scales, the route passes through or close by a number of areas and features of particular value in the landscape that have warranted specific designation by the local planning authorities. These sites are shown on **Figure 9.2**.

In geographical sequence commencing at the landfall near Weybourne these are:

- North Norfolk Coast Area of Outstanding Natural Beauty (AONB) (coast to A148 near Bodham).
- North Norfolk Heritage Coast.
- Weybourne village Conservation Area.
- North Norfolk District Council Area of High Landscape Value (AHLV).
- Baconsthorpe village Conservation Area.
- The Conservation Area containing Little Barningham and Itteringham.
- The Registered Park and Garden of Mannington Hall.
- Broadland District Council AHLV (south of the River Bure at the district boundary, extending beyond grid connection at Salle near Cawston).
- The Conservation Area of Heydon village and Heydon Hall.
- The Registered Park and Garden of Heydon Hall.
- The Registered Park and Garden of Salle Park.

Of the total distance of 21.3km for the cable route only approximately 4km (less than 20%) falls outside areas designated as having 'outstanding' landscape quality (AONB) or 'high' landscape value (AHLV) defined in local plans.

A number of Listed Buildings exist within the area of search for the construction corridor. Those that are within 250m of the cable route are identified in **Figure 9.2**.

Individual and group Tree Preservation Orders (TPOs) have not been specifically identified in the data gathered for the route planning. It is understood that few trees outside of conservation areas have been designated as protected trees. Trees existing within conservation areas are effectively protected to the same extent that they would be if the subject of an individual or group TPO through a legal requirement for notification of intended work on trees (Town and Country Planning Act 1990). The effect of proposed development on trees protected by a tree preservation order ranks as a material consideration in the development control process.

The route planning has taken account of individually significant trees regardless of status relative to TPOs and Conservation Areas and has been based on the guidelines contained in British Standard 5837:2005 'Guide for Trees in relation to Construction' and the National Joint Utilities Group Publication Number 10 'Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees'. In summary these documents preclude open excavation of the ground to protect roots within a specified distance of a tree often corresponding to the canopy spread.

9.3.3 Landscape setting of the cable corridor

The great majority of the construction corridor of 21.3km is situated in cultivated arable land. Wherever possible, the route alignment has been arranged to run parallel and to one side of field boundaries where these have a generally north to south alignment. Where this is not possible the route bisects fields.

No section of the route entails construction in a built up area. There are 21 locations where the construction corridor crosses the Highway (usually direct crossings of short length) including a section of about 92m to the north west of Bodham (adjacent to Bodham Wood) where the construction is within the Highway and mostly in the road surface. The locations of these crossing points are numbered R01 to R21 and shown on **Figure 3.3** within Section 3: ‘Project Details’.

There are a number of locations where the construction corridor runs close to residential properties. These are:

- Houses east of road crossing R01 on the A149.
- Seasonal dwellings in the Kelling Heath Holiday Park south west of Weybourne Station.
- Breck Farm on the Weybourne to Bodham road.
- Houses at Breck Farm south east of Baconsthorpe Castle.
- Houses in Stonefield Road Baconsthorpe.
- The Rectory, The Manor Lodge and Manor Farm House on Church Lane Baconsthorpe.
- Plumstead Hall Farm on Northfield Lane north of Plumstead.
- Houses fronting Cherry Tree Lane, Plumstead.
- Houses adjacent to Plumstead Church.
- Houses near Dog Corner, Little Barningham including Parva Close.

- The main house and converted stables at Mere Farm south of Little Barningham.
- Houses including Hall Farm and Saxthorpe Hall on the B1354 east of Corpusty.
- Irmingland Hall on The Walk, Saxthorpe.
- House called The Bungalow, Spink's Lane east of Heydon Hall.
- Eagle Lodge South (east gatehouse) Heydon Hall on B1149.
- Park Farm, Heydon Park.
- Dog Corner Lodges, Heydon Hall (south gatehouse).
- House called The Ollands south of Heydon.
- Houses in Glebe Crescent, Cawston.

The route crosses the 'Poppy Line' North Norfolk Railway to the west of Weybourne Station. This is in part a recreational resource providing access and a visual experience of north Norfolk.

The construction corridor also crosses 12 Public Rights of Way and some 'permissive paths' established through farm payment and other schemes. These are an important component of the landscape resource. The location of any Public Rights of Way and other permissive paths within the study area are discussed in Section 12: ‘Land Use, Local Community, Tourism and Recreation’ and shown on **Figure 12.1**.

The route is within woodland in some instances and in the majority of these locations construction is by underground directional drilling.

Only two significant watercourses are crossed and in both cases construction is by directional drilling. These are the River Bure east of Saxthorpe and an Internal Drainage Board drain to the east of Salle Park.

9.3.4 Landscape setting of the substation at Salle

Reference should be made to **Figure 9.3** which shows an annotated aerial photograph of the area surrounding the Salle substation, with labels indicating features discussed within this assessment.

The application site for the additional substation is an arable field to the west of Cawston adjoining the existing grid substation owned and managed by EDFE. The site area is approximately 0.87 hectares (ha) in size.

The existing substation operational site has a surface area of approximately 1.7ha and contains brick enclosed transformers, brick built control buildings and steel fabricated above ground electrical equipment and switches. The existing equipment has a height of up to about ten metres above ground level. The functional areas of the substation occupy substantially less than half the area (0.7ha) as it includes grass areas and embankments where no equipment has been installed but which is nevertheless part of the 'operational area' of the substation.

The existing substation is 'fed' by 132 kV cables in two circuits carried above ground on steel towers or 'pylons'. The 'terminal tower' is positioned on the edge of the existing substation. The next tower in the line is an 'angle tower' located in the same field as the application site. Both these tower types have a more robust construction and consequently more prominent appearance than other towers in the line due to the additional loads imposed on the structures at changes in direction and at the termination point. The two towers are the most prominent visual element of the immediate context of the application site both having a height exceeding 27m. This is illustrated in **Figures 9.4 and 9.5** which show the existing views from two representative viewpoints; Viewpoint 1 from the B1145 at Cawston (**Figure 9.4**); and View 2 from the Marriott's Way (**Figure 9.5**).

The existing grid substation forms part of a group of service utilities occupying terraces constructed on the east side of a valley which extends roughly north to south between Cawston and Salle Park. In addition to the grid substation, the group includes a small water pumping station, a local electricity substation, the associated pole mounted cable cluster and a water treatment facility all north of the adjacent road. The group is adjacent to the B1145 that connects Cawston and Reepham. The road crosses the stream at Sall Bridge at the narrowest and steepest point along the valley.

At the bridge the road level is at 29m Above Ordnance Datum (AOD) and the valley quite steep sided rising to above 40m AOD at Cawston to the east and Salle Park to the west. The width of the more pronounced and narrow part of the valley is about 440m measured along the road east to west. To the south of the site a tributary valley of the River Wensum exists on an east to west axis. The application site thus occupies a position with rising ground to the north-east and fairly level ground of the valley floor to the south-west.

Marriott's Way is an important visual and recreational feature of the area. It is a disused railway line now serving as a recreational resource for walkers, riders and cyclists approximately 50m to the south east of the site. It forms a topographic feature being partly in cutting to the north east of the site and elevated on embankments to the south. The embankments are now wooded with self-sown trees and shrubs and consequently it forms a strong spatial separation between Cawston and the fields around the site and also severs the valley to the south.

Vegetation cover is a significant element of the immediate context of the site. The trees along Marriott's Way have the appearance (due to density and overlapping effect with scrub vegetation on both sides) of woodland cover of greater depth than exists in reality on that side of the site.

A former quarry pit exists to the north of the site and mature self-sown trees are established on the side slopes and field boundary. Some coniferous trees have been added to the scrub at the base of the pit although these have suffered wind throw due to unsuitability for the conditions.

An extensive block of woodland exists in the valley to the south and west of the site. This has a width greater than 160m and contains recently established and mature plantations including coniferous species and alder carr. A prominent group of mature conifers exists directly to the south of the site in close proximity to Marriott's Way. These trees exceed 15m in height. Willows are established in the woodland belt along the river. These are up to about 20m in height. The woodland is managed for forestry production and as game cover. Extensive areas have been replanted in recent years.

Public access in the vicinity of the site is limited to the Cawston to Reepham road (B1145), the lane from Cawston to Heydon and Marriott's Way. Few Public Rights of Way footpaths exist in the area. A footpath connects Cawston to Reepham roughly parallel to Marriott's Way but about 400m further south.

The village of Cawston is due east of the site. The nearest dwellings are 440m distance from the east end of the application site. Marriott's Way lies between the houses and the site.

A group of houses exist to the north east of the site (Glebe Crescent). They are about 295m from the application site and occupy an elevated position fronting the B1145 and the lane between Cawston and Heydon. Those nearest the site are at an elevation about 43m AOD. They have a ground floor level about 13m higher than the lowest level of the application site. Six houses in the group overlook the field containing the application site. Other than sparse hedge vegetation and the topography of the field there are no significant features between the houses and the site.

Park Farm is positioned on the opposite side of the valley and to the north of the application site. The principal elevation of the house has an outlook slightly west of due south. The house is about 630m from the main part of the application site. The existing EDFE substation is positioned between the two locations.

Five houses on Commonside, a cul-de-sac off the B1145, are also positioned on the west side of the valley. The entrance elevations face Commonside and east towards the application site. They are approximately 314m from the application site and have a ground floor level at approximately 30.50m AOD. Between the houses and the application site substantial mature trees exist in the woodland and along the valley floor. The woodland has a depth of over 280m measured on a line between the two locations.

9.4 Impacts During Construction

9.4.1 Cable system

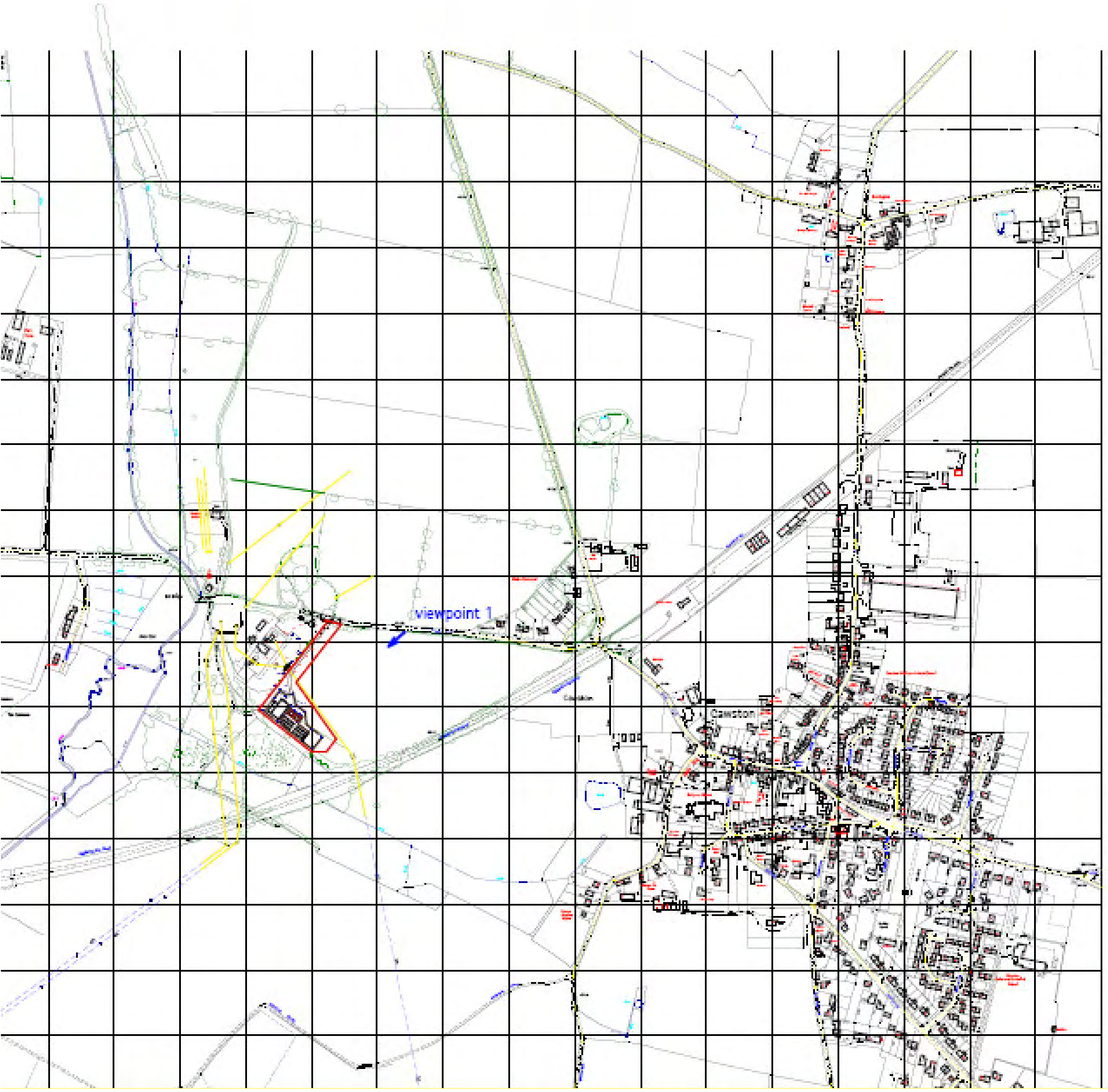
Impacts on landscape character and large-scale landscape quality

The construction corridor will produce an unusual feature in the landscape due to the presence of stored soil, stored construction materials (such as ducts and cable drums), construction vehicles within the working area and fencing associated both with safety requirements and the protection of landscape features. Additionally, the development has a strongly linear, geometric character at a large scale. In combination these features contrast with and strike a discordant note in the scale and generally informal and irregular character of much of the countryside through which it passes.

The construction phase generates increased traffic on the lanes in the area and the increased activity will temporarily change the quiet and remote character of the area.

Figure 9.4

Viewpoint 1 - from B1145 Cawston to Reepham road adjacent to houses in Glebe Crescent and field access point



Scira Offshore Energy Ltd
Sheringham Shoal Wind Farm Land Connection 132kV Grid
Reactive Compensation Equipment - Viewpoint 1 - South-west B1145 Cawston

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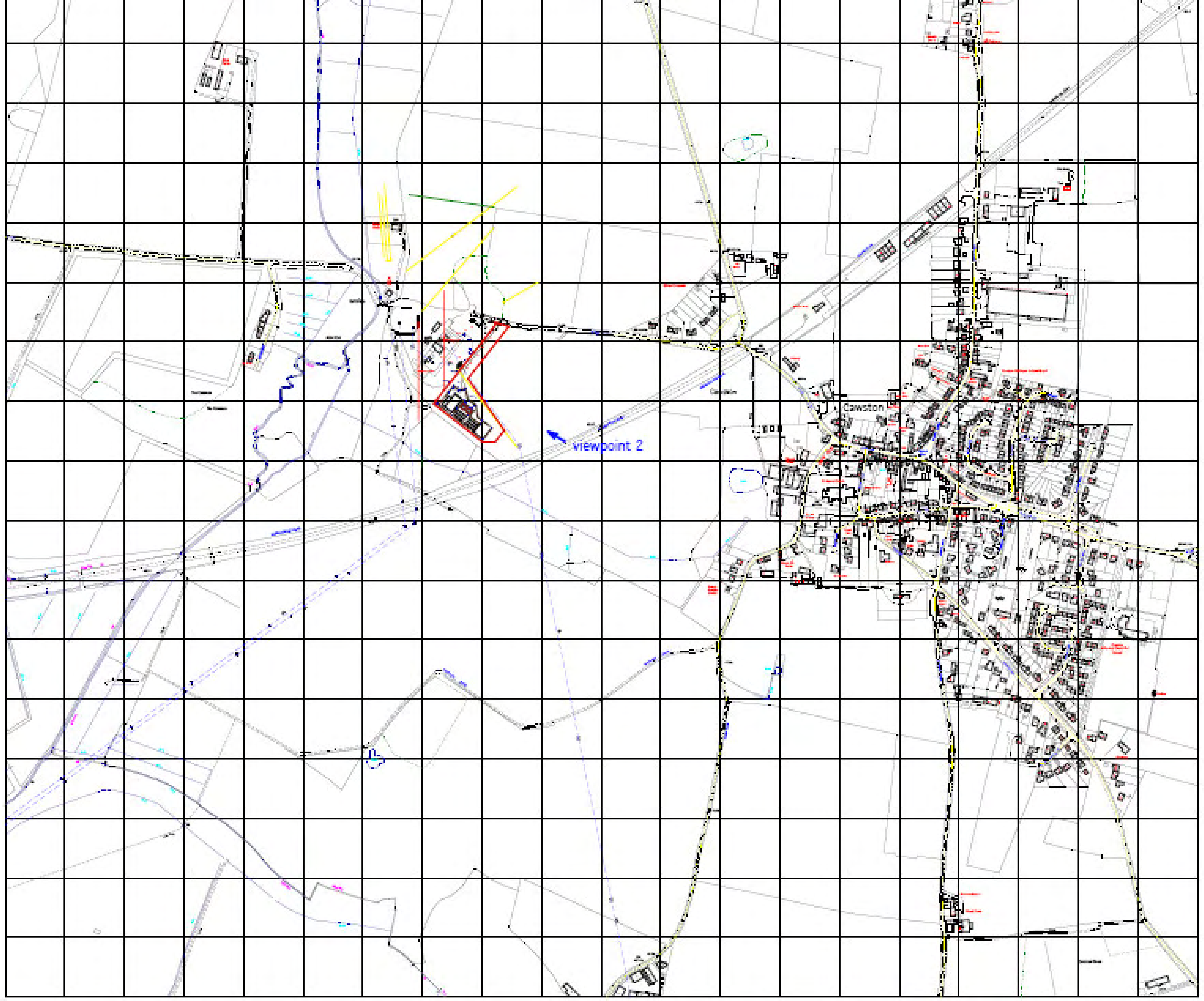
Figure 9.5



Viewpoint 2 - from Marriott's Way field access point looking south west

Scira Offshore Energy Ltd	July 2007
Sheringham Shoal Wind Farm Land Connection 132kV Grid	1:2000 at A1
Reactive Compensation Equipment - Viewpoint 2 - West from Marriotts Way	09-49-319 A

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The North Norfolk AONB (shown on **Figure 9.2**) has topographic conditions that distinguish that section of the route from areas around the cable construction corridor further south. Additionally it is an area used more intensively as an important recreational and tourism resource.

Within the AONB north of the Cromer ridge the field size in the immediate vicinity is large and the ground surface slopes up from the coast to the foot of the ridge in effect presenting the fields to view from the coast road. On the shallower back-slope of the ridge the field size is large and hedgerows sparse. It has been assessed that the cable laying work will have **a moderate adverse effect** on the character of this part of the AONB but the effect is short-term.

These general adverse effects on the character of the area and the AONB in particular are essentially unavoidable as no route options outside high-quality, sensitive landscapes were available in the project planning.

However, this level of effect should be considered in the context of features inherent and built-in to the project. The project costs are minimised by reducing cable length. This in turn minimises the distance and extent of landscape affected by the work. Additionally, the project costs are directly related to construction time over the ground. Reducing the duration of the work minimises the period when adverse effects are experienced.

In the case of the North Norfolk AONB it is estimated that the duration of the conventional trenching and reinstatement operations would be less than three months from the landfall to the railway and less than two months between the drilling location at Kelling Heath Holiday Park and the edge of the AONB at the Cromer to Holt road (A148). Reference should be made to Section 3: 'Project Details' for an estimated installation sequence and duration by task.

The extent of the North Norfolk Heritage Coast is shown on **Figure 9.2**. Heritage Coasts are a non-statutory landscape definition, although they are recognised within the statutory planning system. The North Norfolk Heritage Coast spans approximately 63.2 km of coast between Home-next-the-Sea and Weybourne It identifies the significance of the coastal salt-marshes that are considered to be a last true wilderness in Lowland Britain. Development control policy is by its inclusion in the AONB designation.

The eastern extremity of this designated area is approximately 1.2 km from the nearest point along the cable route within the Muckleburgh Museum site. The boundary of the area is the edge of Salthouse Marshes and the higher and 'developed' land of the Muckleburh estate is excluded from the designation. Muckleburgh Hill and the site of the former airfield and wireless station separate the construction corridor from the marshes to the west. The cable system has been assessed as having **no adverse effect** on the character of the Heritage Coast.

Given that the cable trenching would be fully reinstated following construction and the previous land-use restored, it is considered that there will be **no residual adverse effects** on landscape character arising from the cable route development.

Effects on designated landscapes features and structures

The effects on large-scale designated landscapes are addressed above. The cable construction corridor passes close to but avoids Scheduled Monuments and Listed Buildings (as shown on **Figure 9.2** and discussed in Section 7: 'Archaeology and Cultural Heritage'). The protection of the setting of Listed Buildings is required both for the buildings themselves and for the contribution that they make to the wider landscape. Construction activity will be visually disruptive and adversely affect the setting of the buildings.

These locations can be considered to have a medium to high sensitivity to change in their landscape setting but due to the relatively short duration of the construction phase the significance of this effect is considered to be minor. An assessment of any direct physical impacts to any features of cultural heritage significance is included within Section 7: 'Archaeology and Cultural Heritage'.

In the majority of cases the cable construction corridor would be located some distance from Listed Buildings (as shown on **Figure 9.2** and discussed in Section 7: 'Archaeology and Cultural Heritage'). Intervening built features or vegetation would provide a degree of visual separation.

The following list (in sequence from north to south) identifies the Listed Buildings in closest proximity to the cable route:

- Lower Bodham Church – 129m distance.
- Manor Farm, Baconsthorpe – 88m distance.
- Plumstead Hall Farm – 164m distance.
- Plumstead Church – 109m distance.
- Mere Farm – 172mdistance.
- Eagle Lodge North, Heydon – 38m distance.
- Eagle Lodge South, Heydon – 43m distance

At Eagle Lodge North and South (gatehouses for Heydon Hall) the trench in the road crossing would be at a distance of 38m. While the construction process would detract from the setting of the pair of buildings, given that the context is the busy B1149 Norwich to Holt road and the work is of short duration, the resultant adverse effect on visual setting is considered to be minor.

The setting of the churches can be considered to have a wider orbit than many listed buildings due to the height of the towers and their significance as prominent and characteristic features of the landscape in the area.

Consequently it is assessed that the construction phase would have **a short-term moderate adverse effect** on the setting of some Listed Buildings and churches within 250m of the construction corridor. This effect is of short duration and only applies for the period of construction of the section near to each building rather than the total span of construction activity along the construction corridor.

The cable route passes through countryside where historically significant planned landscapes exert a strong influence through having formed the structure of the landscape outside their currently defined boundaries. The construction corridor runs close to the Registered Historic Parks and Gardens at Mannington Hall and Salle Park and also runs through part of the area of Heydon Park also included in the Register.

Heydon Park includes a belt of woodland (Carman's Belt) that borders a ride linking the park to the fields to the east and the lake in Black Bridge Wood. It is poorly managed and contains few significant trees in the section near the construction corridor. The cable route crosses the tree belt close to the point at which an existing wooden pole mounted electricity line runs through it so producing an existing gap.

A **minor adverse effect** on the setting of Historic Parks and Gardens during the construction phase is predicted. The effect would be of short duration and would not bear strongly on views from within the parks themselves (refer to mitigation for designated landscape features below).

Mitigation – designated landscape features during cable system construction
• Undertake detailed tree survey prior to construction to list vegetation removed at field and hedge breaches. • Produce method statements for work near trees categories A and B in BS 5837:2005. • Undertake construction in accordance with BS 5837:2005. • Immediately prior to construction install protective measures as BS 5837:2005.

No long-term adverse effects on the setting of historic parks and gardens are predicted as a consequence of the cable construction phase.

Effects on landscape features

The cable route planning has been based upon geo-referenced aerial photography at a level of resolution sufficient to enable existing landscape features, particularly mature trees, to be located and their extents mapped (some of this work is represented by the 'traced feature' graphic in the application drawings). This process has also applied to the avoidance where possible of small ponds, ditches, streams, scrub vegetation and pasture grassland in addition to functional features of the farms such as crop storage hard standing areas.

The results were supported by field-walking to verify the existence and condition of the features mapped in that process. Additionally, survey work undertaken to assess the effects on the wildlife and ecology, has been cross-referenced with this work. The cable route alignment and, in particular, the relationship between it and the position of cross bonding pits, has followed current best practice in relation to trees.

An individual assessment of trees using the method described in BS 5837:2005 has not been undertaken. Rather, the route planning and decisions made on construction methods required in particular circumstances have been based on avoiding trees which might be classified 'A' or 'B' (respectively 'High' or 'Moderate' quality or value individually or as a group) by that method. Trees in those categories are not numerous in the area except in some woodland areas and adjacent to roads.

While generally the construction corridor has a width of approximately 20m, about half this width allows for the storage of materials. Where openings are required between fields or at junctions between the construction corridor and the Highway, the extent of removal of vegetation would potentially be minimised by a local reduction in the width of the working to about ten metres.

The construction working widths in relation to the general corridor within agricultural land and at Highway crossings are given as **Figures 9.6 and 9.7**.

For operational and safety reasons the cable trenching is usually offset from the centreline of the construction corridor. It is necessary to strip topsoil only in the areas where subsoil is to be stored and in the area of trenching operations (about fifteen metres overall width). These factors enable trees to be retained even when they are adjacent to the construction corridor by avoiding excavation through the tree roots.

The requirement for hedgerow breaches during the construction phase has been minimised in route planning by selecting existing gaps or sections of weaker growth where this is possible. However, in 34 locations, a breach would still be necessary. This comprises nine very recently planted hedges; five defunct (gappy) sections of hedge; eleven intact species-poor hedges; and nine intact species-rich hedges. It includes some tree felling within the Carman's Belt part of the Heydon Registered Park and Garden. The associated ecological impact is discussed further within Section 6: 'Nature Conservation and Ecology', along with mitigation measures to minimise the potential ecological impact further.

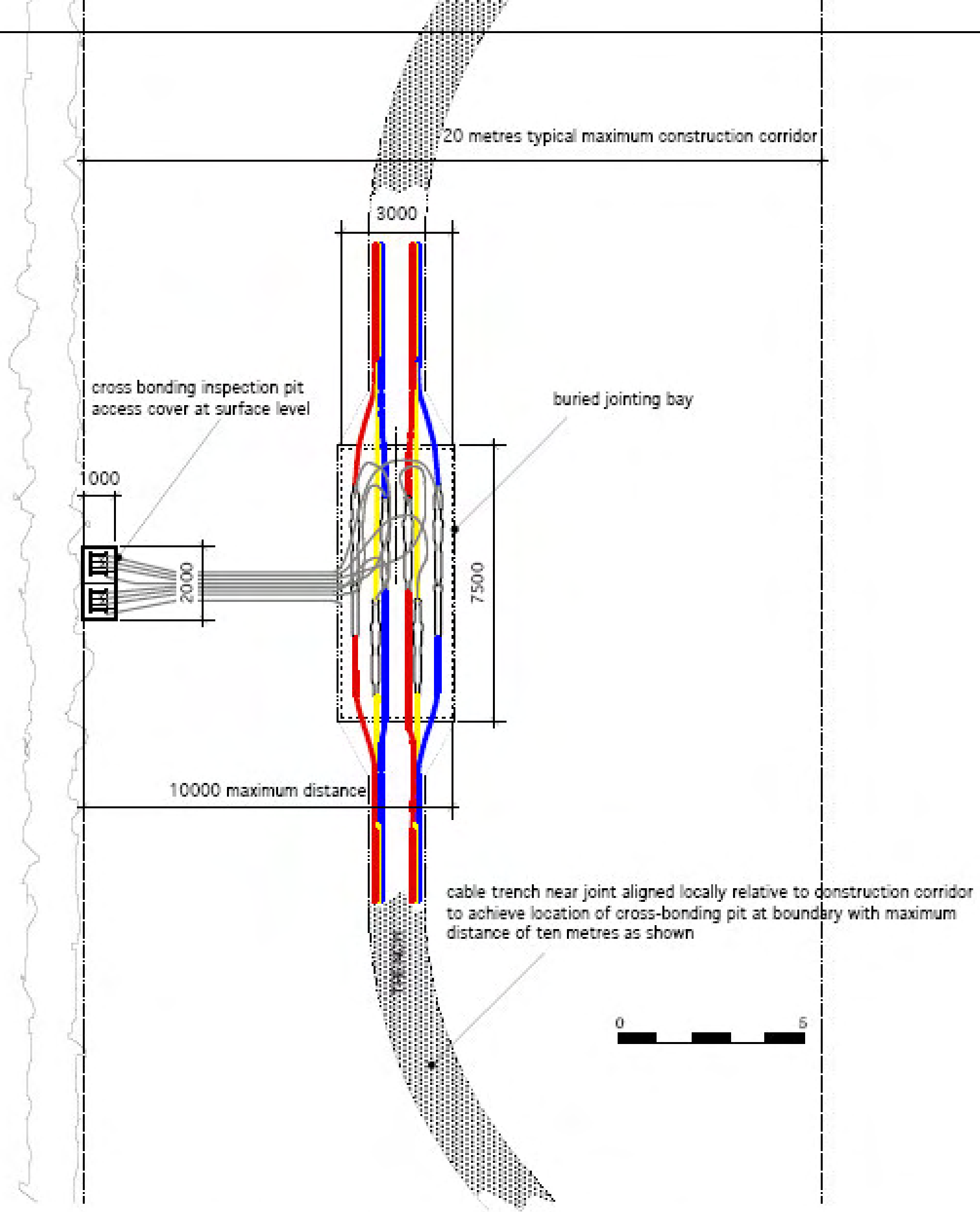
It is anticipated that, following construction, a scheme of planting of the gaps would be designed and implemented. This would utilise native species already represented in each location and the scheme would be prepared in consultation with specialist officers of the District Councils.

The cable system includes cross bonding pits visible at the surface. These are typically brick built structures below ground but with surface access covers and provide connections between earth cables associated with joints in the cable. These are discussed further in Section 3: 'Project Details'. Dimensions of the cross-bonding pits and their position relative to the cable trench are also shown on **Figure 9.6**.

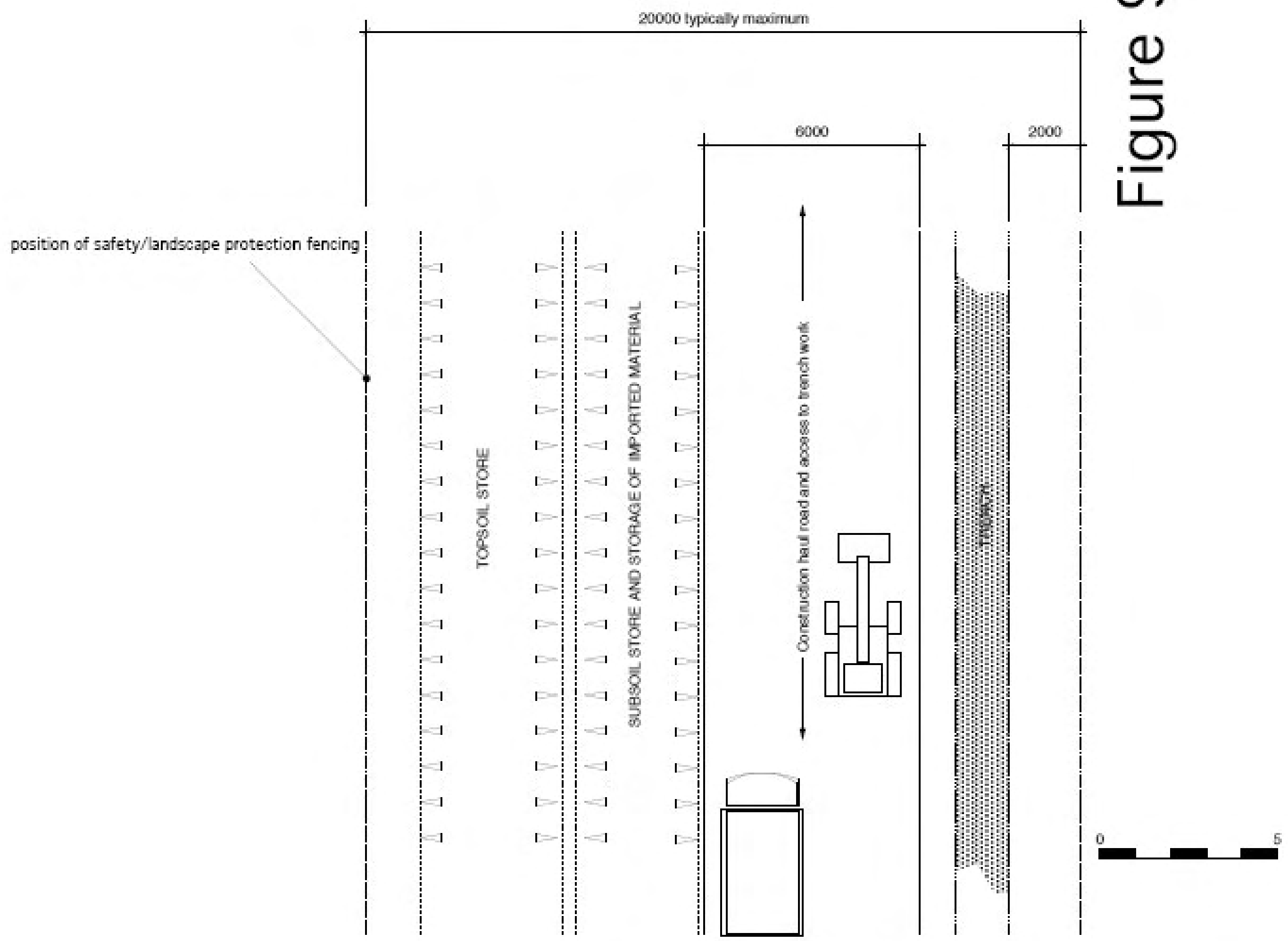
As a result of the constraints imposed on the general location of the bonding pits, particularly the need to locate them outside cultivated land and adjacent to field boundaries, they were assessed as having a potentially greater adverse landscape effect than the cables. Additionally the cross bonding pits would be the only visible part of the cable system.

The application layout of cables, joints and the cross bonding pits takes account both of engineering parameters and the aim of minimising the clearance of hedgerow vegetation. However, detailed survey work revealed that in most instances a substantial degree of flexibility was available in micro-siting them within the construction corridor while still avoiding (for example) excavation in the root zone of trees.

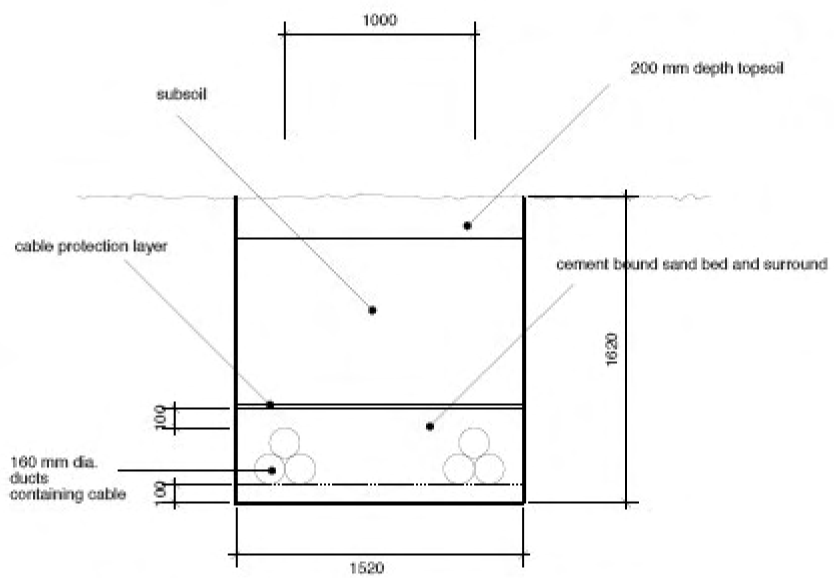
Figure 9.6



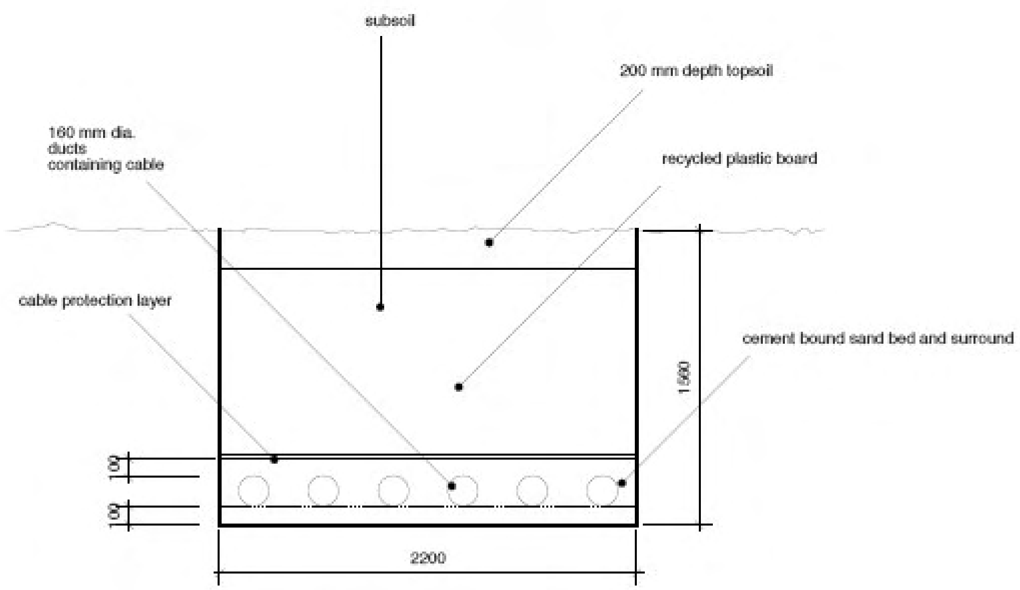
Illustrative plan - dimensions and relative positions of buried joint bay and surface cross bonding pit



Illustrative plan of working area in arable land
(dimensions will vary according to site constraints and
cable alignment within construction 'corridor')

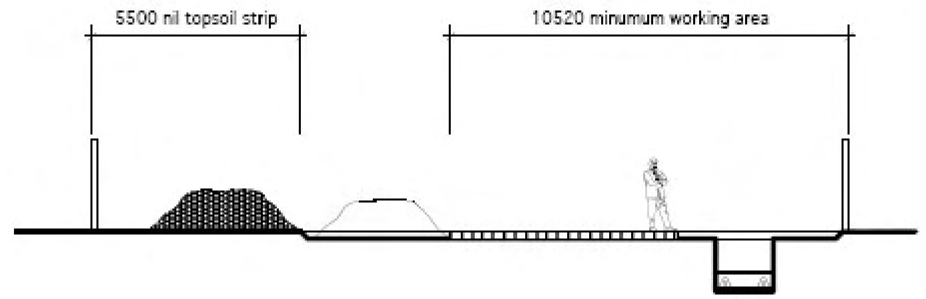


SECTION - TREFOIL ARRANGEMENT OF DUCTS



SECTION - FLAT ARRAY OF DUCTS

Typical trench sections in farm land (trefoil and flat arrays of ducts options shown)



Illustrative section of working area in arable land
(dimensions will vary according to site constraints and
cable alignment within construction 'corridor')

Scira Offshore Energy Ltd	July 2007
Sheringham Shoal Wind Farm Land Connection 132kV Grid	scale as shown
Construction information - farm land	09-49-128

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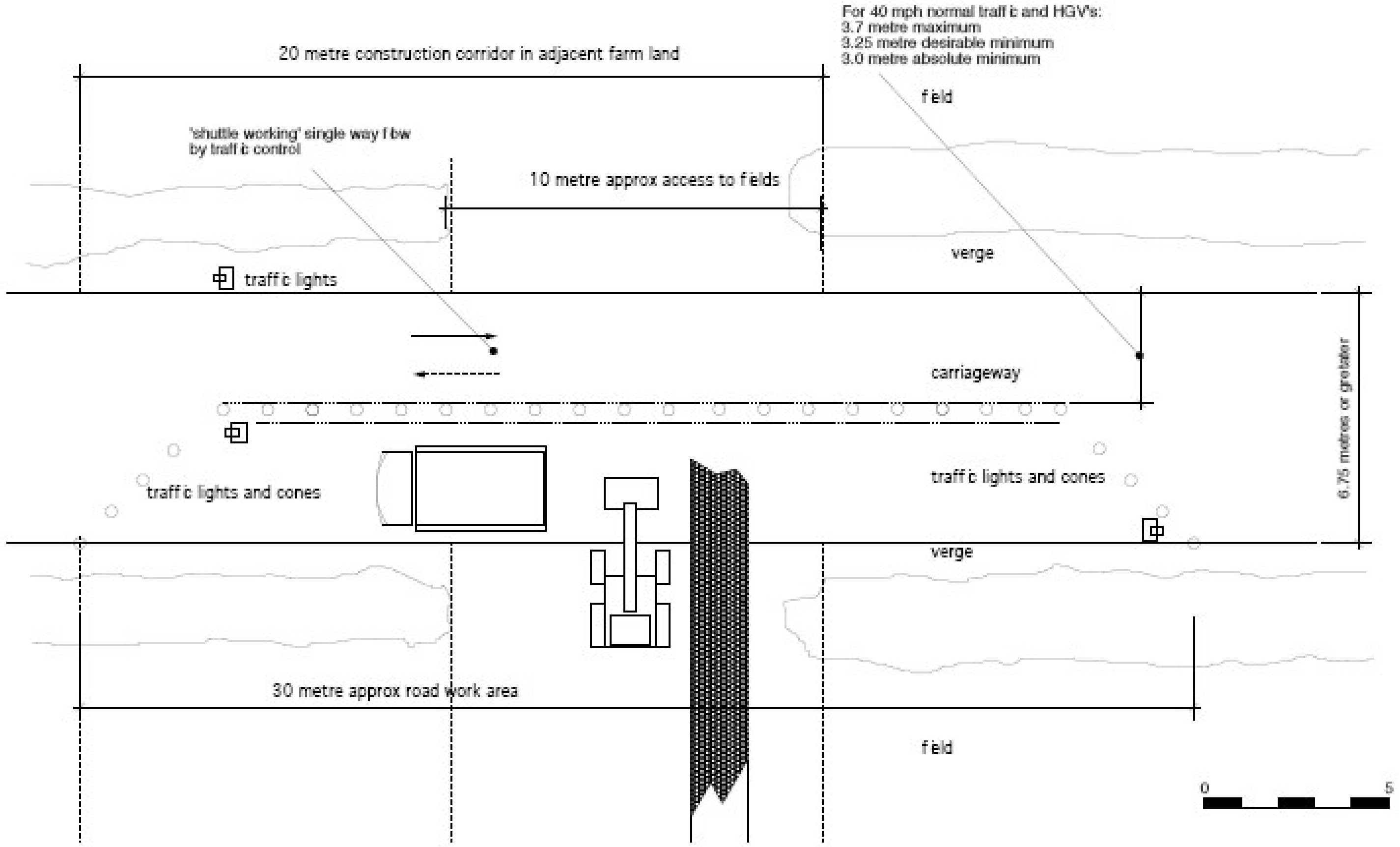
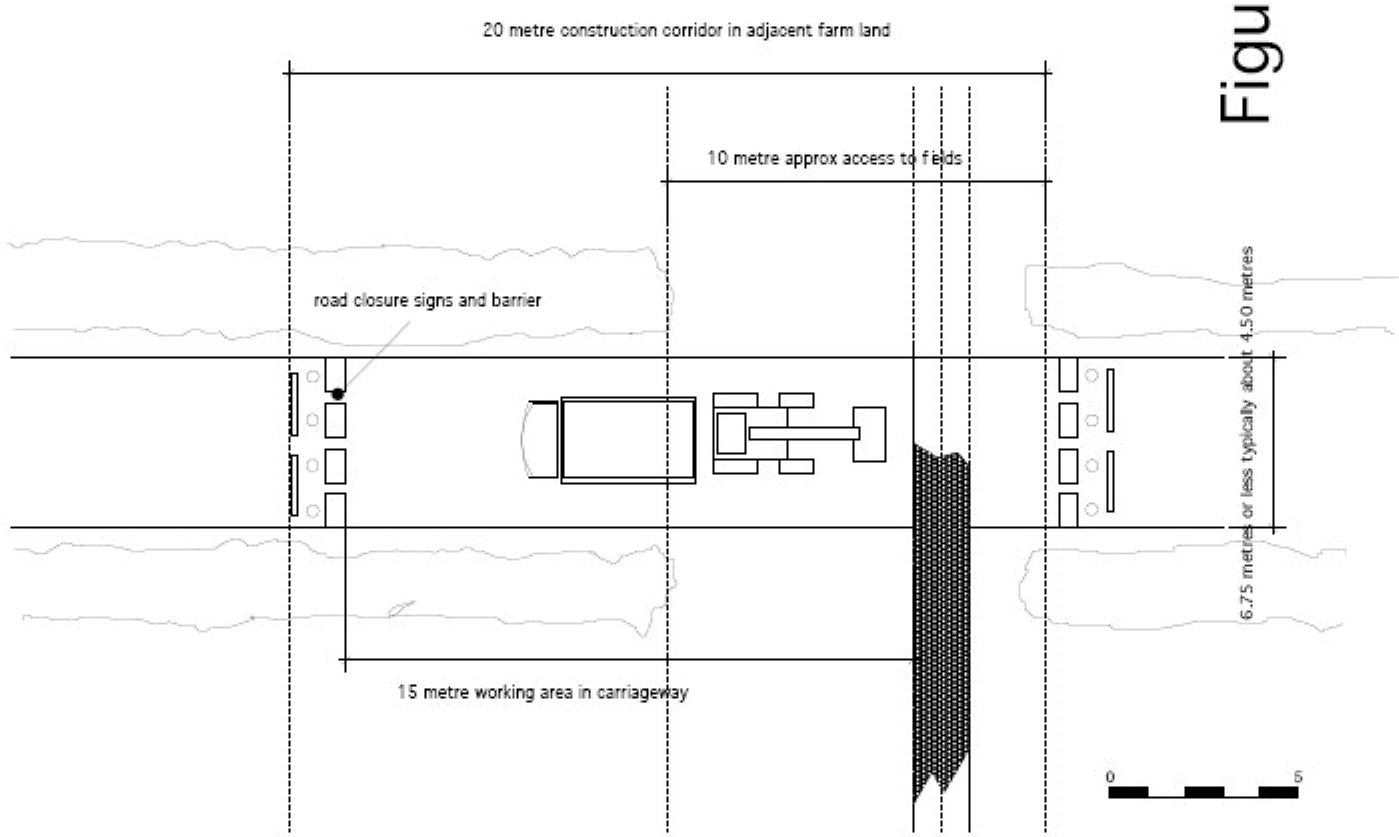
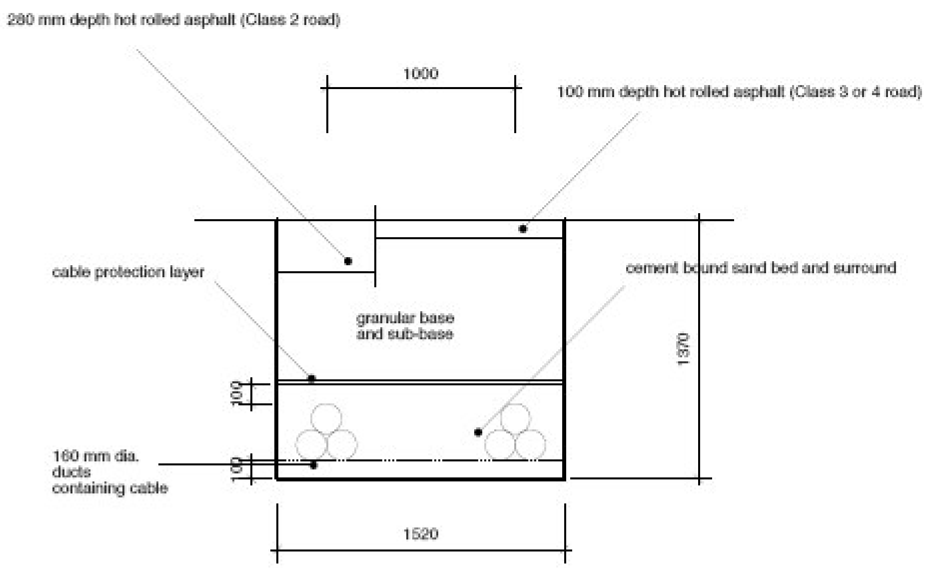
Figure 9.7



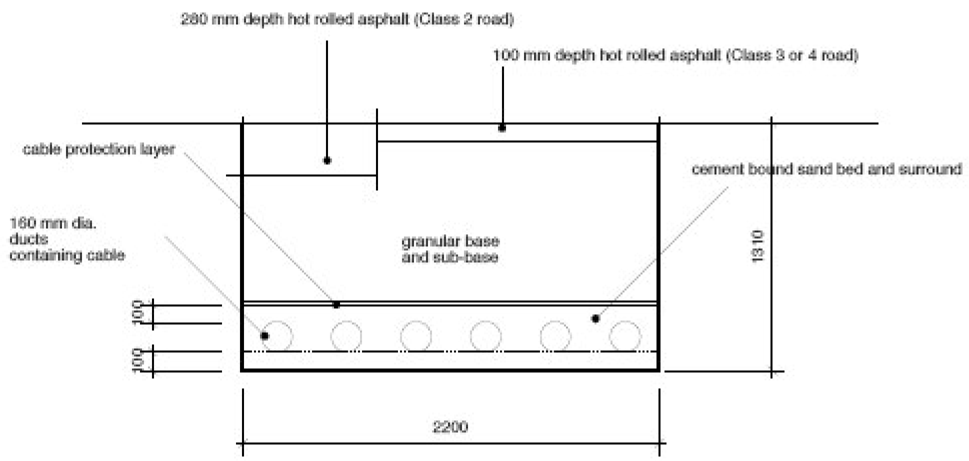
Indicative plan view cable crossing Highway - road greater than 6.75 metres width (alternate single way working in carriageway possible)



Indicative plan view cable crossing Highway - road less than 6.75 metres width (road closure required)



SECTION - TREFOIL ARRANGEMENT OF DUCTS



SECTION - FLAT ARRAY OF DUCTS

Typical trench sections in Highway land (trefoil and f at arrays of ducts options)

Scira Offshore Energy Ltd	July 2007
Sheringham Shoal Wind Farm Land Connection 132kV Grid	scale as shown
Construction information - Highway land	09-49-129

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There are four locations (discussed in Section 3: 'Project Details' and shown on **Figure 3.3**) where directional drilling is the proposed method of construction instead of open trenching in order to enable the full protection of significant landscape features. This method is described in detail in Section 3 and is designed to avoid not only open trenching within the area to be protected but also avoid the need for vehicular construction traffic on the surface.

The cable construction has been assessed as having a **minor adverse effect** on landscape features along the route during the construction phase.

Mitigation – landscape features during cable system construction
• Undertake detailed tree survey prior to construction to list vegetation to be removed at field hedge breaches. • Produce method statements for work near trees categories A and B in BS 5837:2005. • Undertake construction in accordance with BS 5837:2005. • Immediately prior to construction install protective measures as BS 5837:2005. • Restore field boundary structures including banks and fencing to match existing. • Restore hedgerow breaches through replacement planting of native species. • Transplant suitable semi-mature trees in plantations where coincident with corridor (woodland Heydon Estate north of directional drill location 4). • Restore ground surface to existing profiles including drains and ditches.

Provided that mitigation measures are undertaken, **no residual adverse effects** on landscape features are predicted.

Visual effects

The landscape is of high quality and is regarded as having a high sensitivity to change. The construction phase of the cable laying introduces new features to the landscape including linear bunds of stored soil, machinery and equipment. These will be noticeable in views for the travelling public (via rights of way, permissive footpaths and roads) and in views from residential properties.

The construction activity will have generally negative consequences for these receptors which in the main currently have fine views within a high quality landscape. The visual features are similar in some respects to modern agricultural activity (earth moving and large machines) but larger in scale and contained within a clearly defined corridor.

However, the construction phase has a limited duration, is sequential over the ground (although potentially with a number of separate areas undergoing construction concurrently) and only a small proportion of the total construction activity will bear on a particular receptor at any given time. Due to the effects of topography and landcover, and the sequential nature of the work, the view of the construction activity would, in most cases be restricted to distances of a few hundred metres. It has been assessed that the construction phase represents a **moderate adverse visual effect**.

9.4.2 Scira substation

The construction of the proposed substation would give rise to a number of adverse effects that would not apply following the completion of the development and the establishment of vegetation cover around the site.

Landscape effects

The construction of the access road requires the enlargement of an existing field access point on the B1145 road. The associated Highway visibility requirements will necessitate the removal of an Ash tree (girth 400mm) and some hedgerow shrubs on the east side of the access point. It also necessitates the removal of some scrub vegetation and lowering of ground levels on the west side of the access road. The adjacent mature oak tree adjacent to the proposed road junction will be retained as will the important group of semi-mature trees in the north-east corner of the EDFE substation.

The planting proposals included in the application include the planting of native trees and hedging plants behind the required visibility splay. Consequently, **a negligible effect** is predicted for vegetation adjacent to the site in relation to the construction phase. The removal of vegetation is assessed as a reversible effect.

The existing site is under arable cultivation. The construction activity will extend over the entire site area (including land which would be planted at completion of the development) and will have an industrial character contrasting strongly with the character of the surrounding rural landscape. However, the site is immediately adjacent to the existing substation and the cluster of service utility equipment which includes the two electricity towers and these modify the character of the site environs. Taking this into account together with the relatively short duration of construction it has been assessed that the construction phase has **a moderate adverse effect on landscape character**.

Visual effects

The contract phase for the substation is predicted to last between fifteen and eighteen months. During this time the construction activity would entail the use of cranes, scaffolding, security fencing and the like which would be visible in views from some residential properties. It would also affect the travelling public (views from B1149 Cawston to Reepham Road and from some elevated locations along Marriott's Way).

Temporary earthworks would be steep, lack vegetation cover and consequently be out of character with the site. The construction vehicles and the building structure prior to cladding would have colours noticeable against the generally wooded background in some views.

While in the operational phase vehicle traffic to the site will be an unusual event, during the building work construction and delivery vehicles would substantially increase the volume of traffic on the B1149, add to the visual disturbance associated with it and consequently affect the character of the immediate environs of the site.

These effects would primarily apply to the views from some houses near the site and the experience of the landscape gained by the travelling public including users of Marriott's Way. The site planning and design has specifically responded to these viewpoints to the north and east in locating the site at low level in the south west corner of the field.

Given the context of the existing substation and the screening effect of intervening vegetation, these adverse effects have been assessed as having **a minor effect** for houses west of the site. They are assessed as having **a moderate effect** in respect of the setting and views from houses in Glebe Crescent and a **moderate effect** on the landscape for the travelling public.

Mitigation – landscape views during substation construction
• Minimise contract duration overall subject to engineering constraints. • Minimise interval between construction operations. • Plan construction to occur in quieter seasons if other constraints permit. • Plan construction access routes to minimise distance on minor roads.

No residual effects particular to the construction operations have been identified.

9.5 Impacts During Operation

9.5.1 Cable system

The cables are to be buried and there is no requirement for access to the cables, ducts or joint bays. No routine maintenance operations or physical inspections are required during the design life of the buried cable system.

The cross bonding pits (or pillars) require occasional inspections, maintenance and testing. They are designed to be accessible at the surface and via pedestrian access. The visits would be infrequent and no permanent physical arrangements (such as hard standings or access routes) are required. The cross bonding pits (or pillars) are a visible component of the development. If the cross-bonding is achieved within pits (the generally preferred method) then only the surface covers are visible. In some instances (due to site constraints such as sloping ground) the connections may me made in metal cabinets called pillars. These stand about a metre in height but even so would not generally be prominent in views due to the scale of the landscape context.

Consequently **no effect** is predicted for landscape character and landscape features during the operational phase of the cable system and for views of the landscape near cross-bonding pits or pillars a **negligible adverse effect** is predicted.

9.5.2 Scira substation including cumulative effects relating to EDFE works

Landscape effects

Other than the road boundary hedge and trees, the application site contains no permanent vegetation cover due to the existing arable land-use. The effect on the roadside vegetation is addressed above.

The development would produce a permanent change in the land-use and landscape character of the immediate environs of the site. The context is already affected by the existing electricity towers, the existing two substations and water treatment works. The footprint of the hard surfaces, buildings and structures does not occupy the entire site area.

The native tree and shrub planting associated with the development will greatly increase the vegetation cover of the site, occupy a substantial portion of the site area and have characteristics consistent with adjacent landcover. Consequently, the effect on the character of the local landscape has been assessed as less than that which would apply during the construction phase. Given that the effect is permanent, **a moderate adverse effect** on landscape character is predicted. The alterations proposed within the existing substation have been assessed as having no bearing on this effect as they are contained within the operational site area.

The tower of Cawston Church (Grade 1 Listed Building, 543m distance) is a prominent feature in views from west of the site towards Cawston and contributes to the setting of the village and the quality of the landscape around it. Given the relative heights and elevations of the two buildings and the fact that there are few locations from which views of both are possible concurrently. A **negligible effect** on the setting of the church is predicted.

Salle Park lies on higher ground to the west of the site at a distance of 780m. Due to distance and the visual containment provided by landform and landcover it has been assessed that the development will have **no effect** on the setting of the park.

Visual effects

The key impact relating to the substation concerns the visual effects of the development, its interrelationship with specific receptors and the cumulative effect of development anticipated nearby.

Visual effects in this case are substantially determined by the relative heights of the components of the development and the level of the ground where they are sited.

The key elements of the proposals for the substation that relate to the assessment of visual effects are summarised in **Table 9.1**.

Table 9.1 Project characteristics related to potential visual effects

Element	Description
Context	• Valley location visually contained in part by topography mainly to north and east. • Wooded context visually contained in part by vegetation mainly to south and west. • Adjacent to group of service utility installations and towers, 'industrial' character already exists. • Location between two tall steel 'pylon' towers.
Site selection and site planning	• Selected site as close as possible to existing substation. • Development components in compact group.

Element	Description
	• Selected site at lowest available elevation. • Tallest components furthest from exposed viewpoints
Design	• Site in cutting (not 'cut and fill' terrace) to reduce apparent height. • Cutting enables landform screening in advance of vegetation growth • Site includes land to enable space for earthworks and tree planting. • Access road alignment closes off views from junction. • Building basement set one metre below ground to reduce height of building. • Building roof design in shallow opposing pitches avoid orthogonal outline and reduce height. • Building colour responds to wooded (not skyline) backdrop. • Building cladding matches roof cladding to blur form. • Planting of native species appropriate to location. • Planting primarily shrub species for long-term density at low level. • Some surplus cut material used in earth embankments.

The relationship in the levels of components that are critical to the assessment is illustrated by **Table 9.2**.

Table 9.2 Construction components and context - relative levels (approximate)

Component	Base level AOD	Height relative to ground level	Top level
Valley floor near site and to south	25.000	-	29.000
Top of valley to north west	-	-	40.000
Top of valley to north east	-	-	45.000
Level Marriott's Way meets field level			about 36.500
Ground floor houses Glebe Crescent			43.000
Compound level of proposed substation	30.100	-	30.300
Proposed building	29.300	8 metres	38.300
Shunt reactors	30.100	5 metres	35.100
Capacitor banks	30.100	3.9 metres	34.000
Top of bank to north	-	-	above 33.500
Potential additional equipment	30.100	4.5 metres approx	34.600
Proposed vegetation on bank to north after 15 to 20 yrs	-	about 4 to 5 metres	about 37.000
Road at end of access track			38.400
Road at Glebe Crescent			43.000
Existing terminal tower	34.000	over 27 metres	61.000
Existing substation compounds	31.530 to 33.340	-	max 33.340
Existing EDFE substation buildings	about 32.000	up to 4 metres	about 36.000

Component	Base level AOD	Height relative to ground level	Top level
Existing EDFE substation electrical structures	up to about 33.000	up to about 10 metres	max about 43.000
Proposed new compounds in existing EDFE substation (potentially)	31.500 to 33.900		33.900
Proposed new equipment in EDFE (potentially)	33.900	up to 9 metres approx (estimated)	est 44.000

From the above table it can be seen that all the elements of the application proposals are below the level of the road and below the top level of the existing equipment in the EDFE substation (**Figure 9.10**). The control building is a substantial structure 8m in height (above ground) and over twice the height of the existing adjacent substation buildings but due to the difference in ground levels is only 2.3m above them (roughly the equivalent of a storey height). It is for this reason that the roof of the control building has an unconventional form responding directly to the visual assessment. The new structures would be small in comparison to the electricity towers existing close by one east and one to the west of the site (shown at **Figure 9.10**).

The top of the proposed shunt reactors is just over a metre above the level of the field on the north boundary and the top of the capacitors about the same level as the ground level at the site boundary. In ground level views from the B1145 to the north the upper half of the capacitor banks and shunt reactors would be visible until the establishment of vegetation on the site boundary due to the fact that viewpoints are elevated above the site (**Figures 9.4 and 9.10**).

Similarly the upper parts of the shunt reactors and capacitor banks would be visible in views from a short section of Marriott's Way (where it is at or above the level of the field south of viewpoint 2) until the establishment of vegetation on the site boundary (**Figures 9.5 and 9.9**). These views are substantially screened by the existing dense shrubby vegetation on the edges of Marriott's Way and the woodland that intervenes in potential lines of sight.

Extensive tree and shrub planting is proposed as part of the development, as shown on **Figure 9.8**, on cut embankments north of the compound and raised embankments east of the access road. In combination with the arrangement of levels the vegetation will substantially screen all but the upper parts of the control building within fifteen to twenty years in views from the east, north and west where the visual envelope is already limited in distance by topography.

Significantly, this applies also to views from Marriott's Way. **Figure 9.5** (viewpoint 2) illustrates the view from the point at which the track bed (path surface) meets the level of the fields on either side and a farm access track crosses the path forming an opening in the dense vegetation that borders the path. To the north of this point the path is in a cutting. South of this point the path is elevated above the field but views from the path are substantially screened by vegetation even in the winter months. The cross section shown in **Figure 9.9** shows that vegetation established within the site will screen all but the upper parts of the control building within fifteen to twenty years.

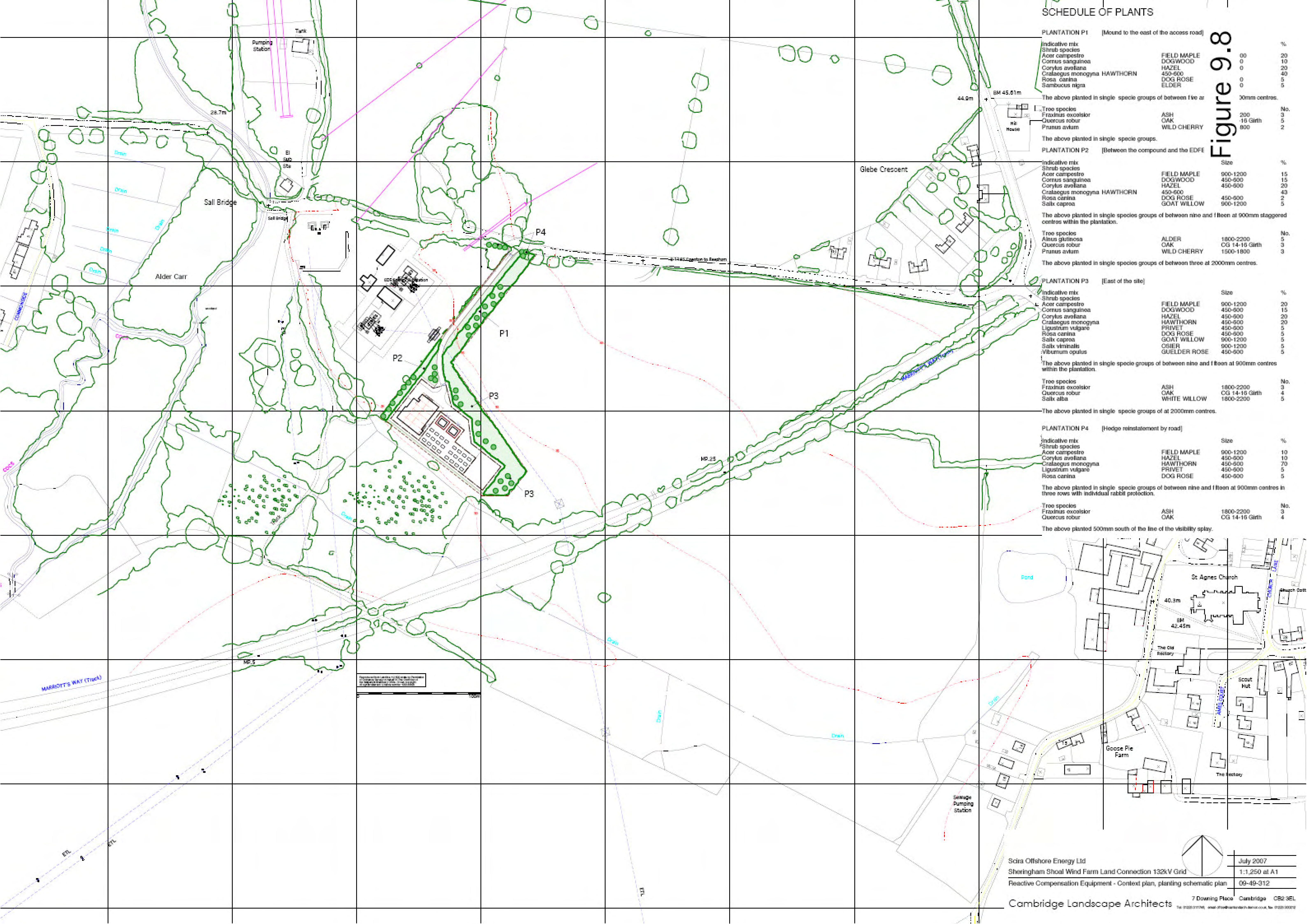

Figure 9.8

SCHEDULE OF PLANTS

PLANTATION P1 [Mound to the east of the access road]

Indicative mix			%
Shrub species			
Acer campestre	FIELD MAPLE	00	20
Cornus sanguinea	DOGWOOD	0	10
Corylus avellana	HAZEL	0	20
Crataegus monogyna HAWTHORN	450-600		40
Rosa canina	DOG ROSE	0	5
Sambucus nigra	ELDER	0	5

The above planted in single specie groups of between f ive ar 00mm centres.

Tree species			No.
Fraxinus excelsior	ASH	200	3
Quercus robur	OAK	-16 Girth	5
Prunus avium	WILD CHERRY	800	2

The above planted in single specie groups.

PLANTATION P2 [Between the compound and the EDFE

Indicative mix		Size	%
Shrub species			
Acer campestre	FIELD MAPLE	900-1200	15
Cornus sanguinea	DOGWOOD	450-600	15
Corylus avellana	HAZEL	450-600	20
Crataegus monogyna HAWTHORN	450-600		43
Rosa canina	DOG ROSE	450-600	2
Salix caprea	GOAT WILLOW	900-1200	5

The above planted in single species groups of between nine and f fteen at 900mm staggered centres within the plantation.

Tree species			No.
Alnus glutinosa	ALDER	1800-2200	5
Quercus robur	OAK	CG 14-16 Girth	3
Prunus avium	WILD CHERRY	1500-1800	3

The above planted in single species groups of between three at 2000mm centres.

PLANTATION P3 [East of the site]

Indicative mix		Size	%
Shrub species			
Acer campestre	FIELD MAPLE	900-1200	20
Cornus sanguinea	DOGWOOD	450-600	15
Corylus avellana	HAZEL	450-600	20
Crataegus monogyna	HAWTHORN	450-600	20
Ligustrum vulgare	PRIVET	450-600	5
Rosa canina	DOG ROSE	450-600	5
Salix caprea	GOAT WILLOW	900-1200	5
Salix viminalis	OSIER	900-1200	5
Viburnum opulus	GUELDER ROSE	450-600	5

The above planted in single specie groups of between nine and f fteen at 900mm centres within the plantation.

Tree species			No.
Fraxinus excelsior	ASH	1800-2200	3
Quercus robur	OAK	CG 14-16 Girth	4
Salix alba	WHITE WILLOW	1800-2200	5

The above planted in single specie groups of at 2000mm centres.

PLANTATION P4 [Hedge reinstatement by road]

Indicative mix		Size	%
Shrub species			
Acer campestre	FIELD MAPLE	900-1200	10
Corylus avellana	HAZEL	450-600	10
Crataegus monogyna	HAWTHORN	450-600	70
Ligustrum vulgare	PRIVET	450-600	5
Rosa canina	DOG ROSE	450-600	5

The above planted in single specie groups of between nine and f fteen at 900mm centres in three rows with individual rabbit protection.

Tree species			No.
Fraxinus excelsior	ASH	1800-2200	3
Quercus robur	OAK	CG 14-16 Girth	4

The above planted 500mm south of the line of the visibility splay.

Scira Offshore Energy Ltd
Sheringham Shoal Wind Farm Land Connection 132kV Grid
Reactive Compensation Equipment - Context plan, planting schematic plan

July 2007
1:1,250 at A1
09-49-312

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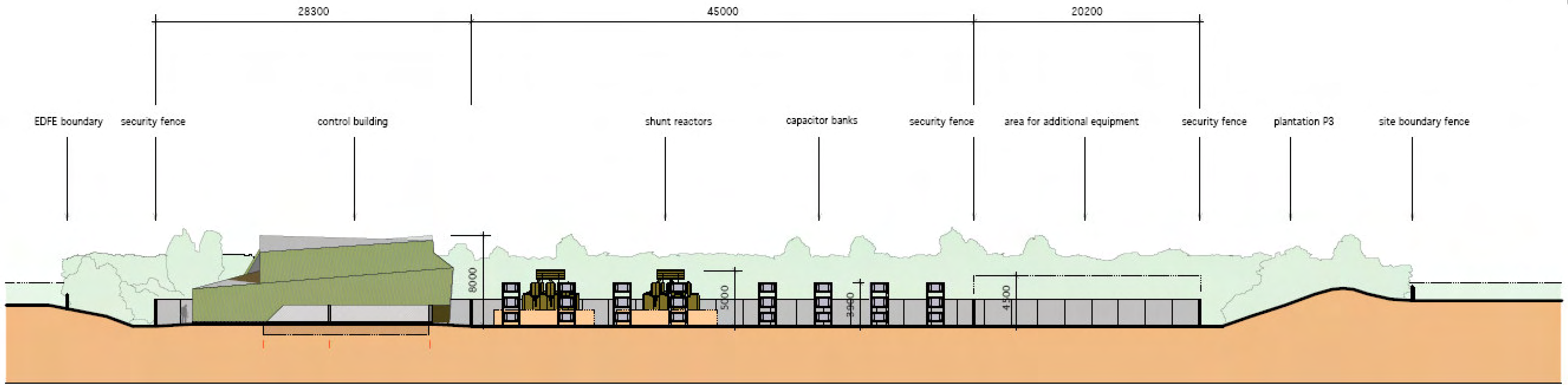
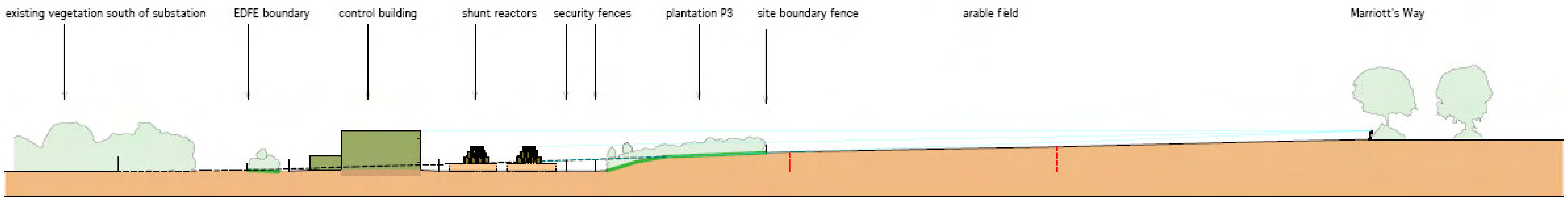
Figure 9.9



South-west elevation (vegetation in plantations indicated at betweeen 15 and 20 years growth) scale 1:200



Section between control building and Marriott's Way
Vegetation illustrated after 15 to 20 years growth. View lines to building and equipment shown.
Extent of cutting shown, building outline simplified (accurate maximum height) scale 1:500

Scira Offshore Energy Ltd	July 2007
Sheringham Shoal Wind Farm Land Connection 132kV Grid	1:500 and 1:200
Reactive Compensation Equipment - Sections and elevations - Sheet 1	09-49-314-

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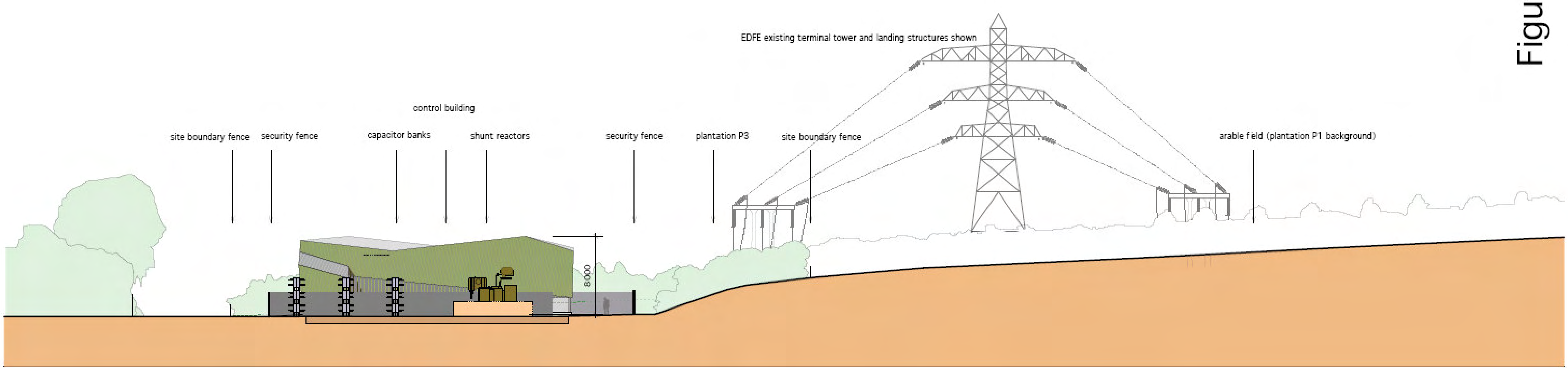
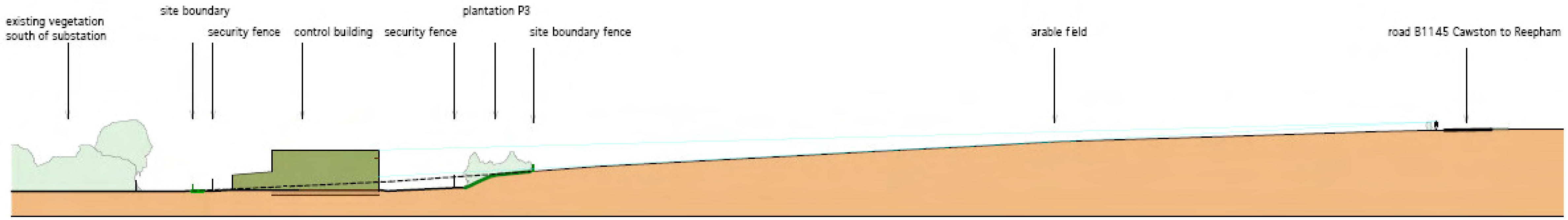
Figure 9.10



South-east elevation (vegetation in plantations indicated at betweeen 15 and 20 years growth) scale 1:200



Section between control building and B1145 cawston to Reepham road
Vegetation illustrated after 15 to 20 years growth. View lines to building and equipment shown.
Extent of cutting shown, building outline simplified (accurate maximum height) scale 1:500

Scira Offshore Energy Ltd	July 2007
Sheringham Shoal Wind Farm Land Connection 132kV Grid	1:500 and 1:200
Reactive Compensation Equipment - Sections and elevations - Sheet 2	09-49-315

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No earthworks or tree planting are proposed for the south boundary of the application site. The potential visual envelope extends a considerable distance along the valley to the south towards Booton (2km). However, the existing woodland has a substantial depth and contains coniferous species notably on a potential line of site to Marriott's Way to the south-east and Marriott's Way itself closes off potential views from further south.

The depth of vegetation along the river masks potential views from the houses in Commonside towards the application site, many of the trees being considerably taller than the substation building.

A similar effect applies to views from Park Farm but in this case vegetation along the river banks and the existing substation intervene in the theoretical line of sight.

The development will be visible from the houses in Glebe Crescent (shown on **Figure 9.4** - Viewpoint 1). They are elevated above the site and relatively visually exposed. The cross section in **Figure 9.10** indicates the relationship of levels between the site and the road level by the houses. Private dwellings are receptors acknowledged as being highly sensitive to landscape change. The site planning and design arrangements summarised above are substantially focused on the visibility from this direction. The effect of topography and relative levels in relation to this viewline is shown on **Figure 9.10**. In this view the visual presence of the development would be limited to the upper parts of the electrical equipment and control building seen against a backdrop of trees. The vegetation planted within the site would in time merge with the backdrop and woodland in the periphery of views towards the site.

Overall the development is assessed as having **a minor adverse effect** in the short term in views experienced by the travelling public. It is assessed as having **a moderate adverse effect** in the short term in respect to views from private dwellings (Glebe Crescent). It is assessed as having a negligible adverse effect on views from Commonside and Park Farm. Following the full establishment (within fifteen to twenty years) of trees and shrubs planted on the boundaries of the site where viewpoints are most critical, **minor residual effects** are predicted. The vegetation would subsequently increase in density rather than height (except the tree species) due to the emphasis in the planting design on shrubby species rather than trees (**Figure 9.8**).

Cumulative effects

The development requires some alterations and additional equipment in the existing EDFE substation, as discussed in Section 3: ‘Project Details’. The assessment has identified a potential cumulative visual effect associated with the same key viewpoints identified in connection with the new substation. The full details of those intended developments had not been confirmed during the preparation of the ES but a schematic plan and schematic elevations were available. The location (**Figure 9.1**) of the proposed alterations is between the boundary with the Scira substation and the existing electrical equipment. The majority of the land required is a grassed slope at present.

The EDFE engineering requirements fall outside the application, the ES and consultation procedures that are required for the cables and the reactive compensation equipment in the new substation. It potentially alters the context of the application site increasing the extent to which the new development could register as a noticeable enlargement of the group of nearby service utilities and so amplify the effect that they have on the views from adjacent locations accessible to the public and from houses nearby.

As is the case with the new substation, the alterations will require the excavation of level terraces in the slope but the narrowness of the available operational land would require retaining structures and terracing at a higher level than the new substation terrace. The structures required will be of a similar height to the control building in the new substation (table 9.2). Some of them will be founded at a higher level and closer to public viewpoints than the reactive compensation plant. Consequently they would be seen above the elements of the new substation in some views. However, none of the anticipated additional components are taller than the existing equipment in the substation and the additions would have a similar largely open framework structure.

The Scira substation proposals include a strip of land east of the application site. It accommodates incoming cables, site temporary buildings and storage during the construction phase and also provides space for the site disposal of a proportion of the excavated subsoil. On the completion of the development it will be graded and planted as a wide thicket of native shrubs and trees. This planting belt is shown and scheduled as P1 on **Figure 9.8**. In combination with the earthworks it would have the effect of screening views towards the existing substation and the new equipment it would contain in views from the road. It is predicted that this beneficial effect would begin to be achieved within five years and be complete after fifteen to twenty years.

For these reasons it has been assessed that the cumulative effect of the associated developments in the two substations is unlikely to conflict with or contradict either the site planning and design strategy or the assessment of effects which has been applied to the Scira development proposals.

9.6 Summary

This Section and Section 2: ‘Site Selection and Consideration of Alternatives’ has identified the approach that has been adopted in the route planning for the grid connection cables and the site planning and design of the substation at Salle. Landscape considerations including the protection of landscape character, physical features and visual characteristics have been an inherent part of the process including the selection of options. The mitigation of landscape effects has been 'built-in' to the application proposals when this has been enabled by engineering considerations.

Consequently, where the assessment has identified impacts, few opportunities for further mitigation have been identified for reporting in the ES.

The assessment has drawn on the extensive use of high-resolution aerial photography and field-walking to build up a full understanding of the context of the development both of the cable route and the substation at Salle. Reference to countryside character assessments and consultation with planning officers has also informed the process and made a sufficiently robust basis for the assessment.

For the cable route the main effects that have been identified concern the construction phase. A degree of mitigation is available through the management of the project programme. The effects (on landscape character and views) are of short duration. Few permanent effects in respect of landscape features were identified. Overall **no major effects** ('significant impacts' in the terms of the Environmental Impact Assessment Regulations) have been predicted.

The construction phase of the work on the Scira substation was assessed as having a potentially greater impact on the local landscape than the operational phase and found to be incapable of mitigation. This is offset by the relatively short duration.

In the case of operational phase of the substation, the key effect identified was the potential change in views for the travelling public and for the occupants of a small number of dwellings near to the site. Despite the size of the proposed building the topography and existing vegetation substantially contain the site. This is amplified by the integral mitigation measures of landscape and building design. Tree planting forms part of the development and within fifteen to twenty years will substantially marry the north and east site boundaries with the woodland on the valley floor.

The cumulative effects associated with work in the existing EDFE substation have been examined. It was found that the application proposals for the new substation integrate and assimilate the whole and have the beneficial side-effect of screening the existing equipment and structures. These are higher than the structures in the proposed substation.

It has been assessed that the completed development of the substation entails **negligible** effects on landscape features. The assessment concludes that it would not be prominent in views and overtime would be assimilated into the landscape and so have only **moderate adverse visual effects**.

9.7 References

British Standards Institute 2005
BS5837:2005
Trees in relation to construction – Recommendations

Broadland District Council 2002
Landscape Assessment
Consultation Draft

Landscape Institute / Institute of Environmental Management and Assessment 2002
Guidelines for Landscape and Visual Impact Assessment
Second Edition

National Joint Utilities Group 2005
NJUG10
Guidance for the planning, installation and maintenance of utility services in proximity to trees

North Norfolk District Council 2005
Landscape Character Assessment for Local Development Framework
Draft Version

Scira Offshore Energy Limited 2006
Sheringham Shoal Offshore Wind Farm Environmental Statement

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection

Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 10

NOISE AND VIBRATION

10 NOISE AND VIBRATION

10.1 Introduction

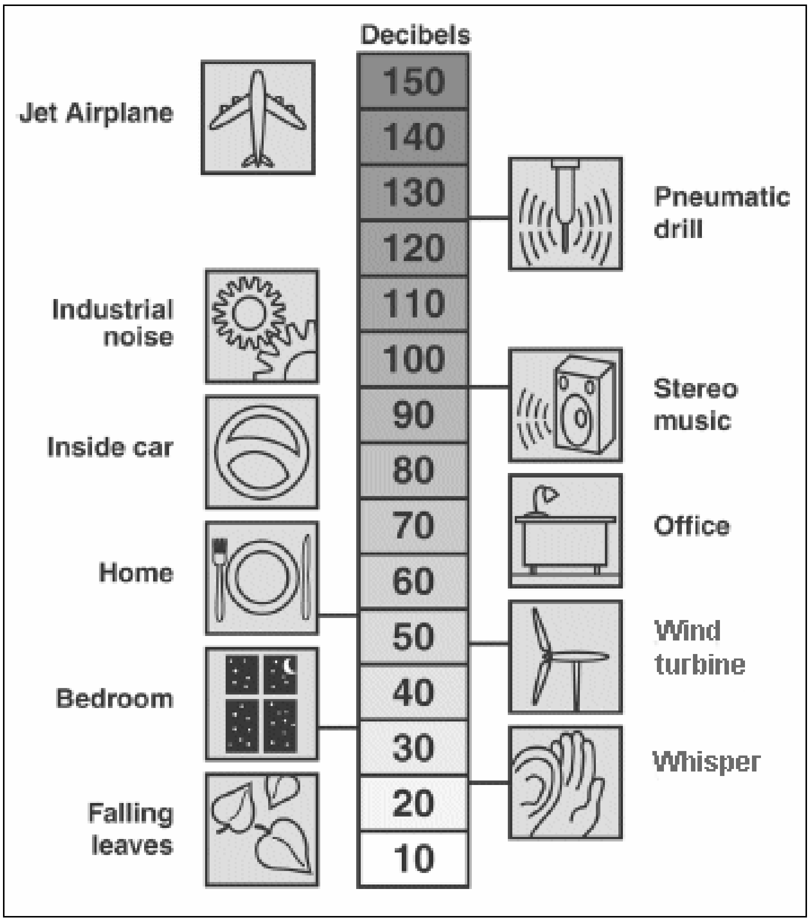
This section of the report examines the potential noise and vibration impacts arising from the installation and operation of the proposed grid connection.

Noise impacts may arise as a result of:

- The excavation/tunnelling of the trench for the cabling.
- The transport of equipment and materials associated with the construction works.

The construction works will principally affect those potentially noise and vibration sensitive receptors close to the proposed cable route and substation. Transport-related noise may affect a wider distribution of the local population along local roads and site haul roads or access routes. There are not anticipated to be any significant operational vibration impacts arising from the cable route works.

In order to set out some context about the environmental noise issues discussed in this section, the following diagram sets out some typical decibel levels.



(source: Ontario MAFRA, 2003)

10.2 Assessment Methodology

10.2.1 Desk-based assessment

Noise

A desk-based assessment of noise from construction activities has been carried out with reference to various British Standards and other relevant current guidance.

The cable-route construction activities are assessed with reference to the guidance contained in British Standard (BS) 5228: Part 1: 1997 "Noise and vibration control on construction and open sites". This presents methods of predicting receptor noise levels resulting from construction activities, based on quantitative source noise data for typical construction operations and equipment. The calculation methods contain corrections to the predicted noise levels to take account of the percentage of the construction period during which that equipment operates (i.e. "on time"). Screening by the presence of buildings or barriers and the nature of the ground over which the sound propagates is also taken into account.

Source noise level data and construction methods are obtained from either Annex C of the Standard, the recently updated DEFRA construction equipment noise database (Defra, 2004) or, in the case of directional drilling, from personal communications with experienced operators.

Information regarding potentially noise sensitive receptors was obtained from examination of Ordnance Survey mapping and project route plans supplemented by site knowledge established during various EIA site visits. Noise sensitive receptors in this area are principally permanently inhabited residential properties including static caravans.

There are no statutory permissible noise levels for construction activities in UK legislation or other guidance. Due to the transient and relatively temporary nature of construction operations, along with a general acceptance that they are, by their very nature, noisy activities, an acceptable noise level for day time activities would generally be in the region of 65 to 70 dB L_{Aeq}. For the purposes of this assessment, the upper limit, **70 dB L_{Aeq}**, will be taken as an **acceptable level of daytime noise**.

With regard to night time noise levels, an indication of acceptable night time noise levels can be obtained by reference to BS 8233: 1999 "Sound insulation and noise reduction for buildings – Code of Practice". This document recommends that internal building noise levels should not exceed 30 dB L_{Aeq} in order to ensure "good" conditions for sleep. This would be equivalent to an external noise level of 40 dB L_{Aeq}, allowing for 10 dB of sound attenuation through an open window. The Standard suggests that "reasonable" conditions for sleep would be achieved with noise levels 5 dB higher and thus an **acceptable night time noise limit** can be set at **45 dB L_{Aeq}**.

Aside from the strict acceptability of the construction noise levels, an indication of the perceived significance of noise level changes associated with construction activities, at noise sensitive receptors, can be obtained by reference to research which has shown that a 3dB change in noise levels is the least audible change in noise levels for humans, that a 5dB change would be clearly audible and that 10dB would be subjectively perceived to be a doubling (or halving) of the noise in question. It has also been shown that under laboratory conditions, changes as low as 1dB may be audibly detected by humans. In view of this and with due regard for the rural nature of the environment along the proposed cable route, the following significance criteria are defined for construction noise levels:

- <1 dB change negligible.
- 1 to 2.9 dB change minor.
- 3 to 4.9 dB change moderate.
- 5 to 9.9 dB change substantial.
- 10+ dB change major.

The baseline noise levels against which construction noise *significance* (as opposed to acceptability above) are assessed are:

- Night-time noise: 40 dB L_{Aeq} based on BS 8233: 1999.
- Day time: 50 dB L_{Aeq} obtained by reference to the World Health Organisation "Guidelines for community noise", published in 1999. These suggest that, to prevent annoyance to the majority of people, external areas of dwellings should not be exposed to noise levels in excess of 50 dB L_{Aeq} during the day time.

Thus, a day time construction noise level of 65 dB L_{Aeq} would be deemed to be *acceptable* as it is below 70 dB $_{LAeq}$ but would, potentially, also have a major adverse *significance*, being 15 dB greater than the WHO guideline limit of 50 dB L_{Aeq}. Similarly, a night time construction noise level of 43 dB L_{Aeq} would be deemed to be *acceptable* as it is below 45 dB $_{LAeq}$ but would, potentially, also have a moderate adverse *significance*, being 3 dB greater than the BS 8233 guideline limit of 40 dB L_{Aeq}.

It is not possible at this time to carry out a quantitative assessment of transport-related noise as this would require detailed information on existing traffic volumes on all local roads potentially used by construction traffic as well as a detailed break down of the numbers of vehicles travelling on each road section and the timescale for these movements. A qualitative assessment is therefore made, based on expert knowledge and experience of similar construction schemes.

Where appropriate, suitable construction and transport noise mitigation by the use of physical means and the application of best practice working methods, is discussed.

Vibration

Vibration may be either air-borne or ground-borne. Air borne vibration generally arises as the result of the operation of diesel powered equipment or other sources of low frequency sound energy and can manifest itself as the rattling of doors, windows, loose fittings and, in extreme cases, as the vibration of ornaments within dwellings. Ground-borne vibration can arise from piling, tunnelling or the movements of heavy plant equipment and vehicles on construction sites or public roads. Humans are very sensitive to ground-borne vibration and may perceive its existence at very low levels, significantly below levels that might cause even minor cosmetic damage to buildings. This perception can, however, lead to alarm and distress, particularly if the vibration occurs without warning.

BS 7385 “Evaluation and measurement for vibration in buildings” sets out guideline ground-borne vibration levels at, or above, which cosmetic damage might occur to buildings. The Standard does not give source vibration levels and the propagation of vibration is very site specific, dependant on ground and soil type, depth and type of foundations, depth of bedrock etc. For these reasons it is not usual to attempt to predict receptor vibration impacts and a qualitative assessment of potential air-borne and ground-borne vibration is presented along with suitable best practice guidance and the use of suitable mitigation where appropriate.

As has been described in Section 4: ‘Legislative Context and EIA Process’, for ease of descriptive purposes, the onshore grid connection project has been split into 13 sections. These route sections are shown on the figures and referred to in the text.

10.2.2 Consultation

Consultation was carried out with the Environmental Protection Officers from both North Norfolk and Broadland District Council. Consultation took the form of written correspondence and meetings with the District Councils.

10.2.3 Relevant policy, legislation, guidance and best practice

The assessment is based on previous expert knowledge of such proposals with additional reference to the following standards and guidance:

- BS 5228: Part 1: 1997 “Noise and vibration control on construction and open sites: Code of Practice for basic information and procedures for noise and vibration control”.
- BS 8233: 1999 “Sound insulation and noise reduction for buildings – Code of practice”.
- World Health Organisation “Guidelines for community noise”, 1999.
- BS 7385 “Evaluation and measurement of vibration in buildings”.

10.2.4 Impact identification, significance levels and mitigation

The significance level (negligible, minor, moderate, major adverse or beneficial) of identified impacts are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification and Table 4.4 for definitions of significance levels.

10.3 Existing Environment

10.3.1 Existing noise environment

In terms of the ambient noise climate, the study area comprises a mix of rural residential and commercial receptor locations with suburban and urban receptors on the fringes of the more substantial towns and villages. From experience, day time noise levels in the study area will tend to be in the range of 35 dB L_{Aeq}, in rural areas without any agricultural activity taking place, to 65 dB L_{Aeq} on the outskirts of the villages and towns. There is likely to be little variation between day and night time background noise levels except near main roads where distinct daytime traffic increases might occur.

10.3.2 Existing Sources of Vibration

There are currently no known existing sources of either air-borne or ground-borne vibration in the area, other than existing, negligible, traffic-related vibration.

10.4 Impacts During Construction

10.4.1 Cable system

The main impacts that would arise during the cable route construction phase are from the movement of construction-related heavy goods vehicles (HGVs), off-loading of materials, the diesel engines of earth-movers and excavators, and diesel generators or pumps.

Vehicle types to be utilised during the construction period are detailed in Section 3: ‘Project Details’. Indicative source noise levels for these vehicles are obtained from Annex C of BS 5228 of the updated DEFRA database. It has been presumed that the size (diameter) and length of bore for each of the proposed directional drills indicates that it is likely that a relatively small “walk-on” drilling rig would be used. These types of rig are generally powered by a super-silenced hydraulic power source and do not use grit cleaners/vibrating screens, which tend to be one of the main sources of noise, and therefore are unlikely to be a significant source of noise (T Donbavand, pers. comm.). The greatest noise associated with the directional drilling is likely to occur as a result of the initial site preparations/clearance and delivery of equipment, particularly as areas of hardcore will need to be laid and compacted to prevent equipment bogging down; these noise levels are unlikely to be significantly different to the other cable trenching activities. The calculations of construction activity noise levels are presented in **Appendix 10.1**.

As most activities would occur during daytime hours and the excavation would generally be in soft earth, overall construction impacts would be relatively limited. However, the requirement to keep water out of trenches overnight, by the use of pumps, has the potential to cause significant disturbance.

In this situation, potentially noise sensitive receptors would comprise residential buildings adjacent to the cable route. In accordance with the guidance in BS 5228, the study area is limited to those receptors within 300m of the cable route; beyond this distance, attenuation of the noise due to distance can be significant and, additionally, the influence of meteorological impacts can make predictive noise calculations unreliable. Where groups of properties occur, the receptor specified is the closest; the presumption being that protection of amenity at this property would ensure protection for more distant properties.

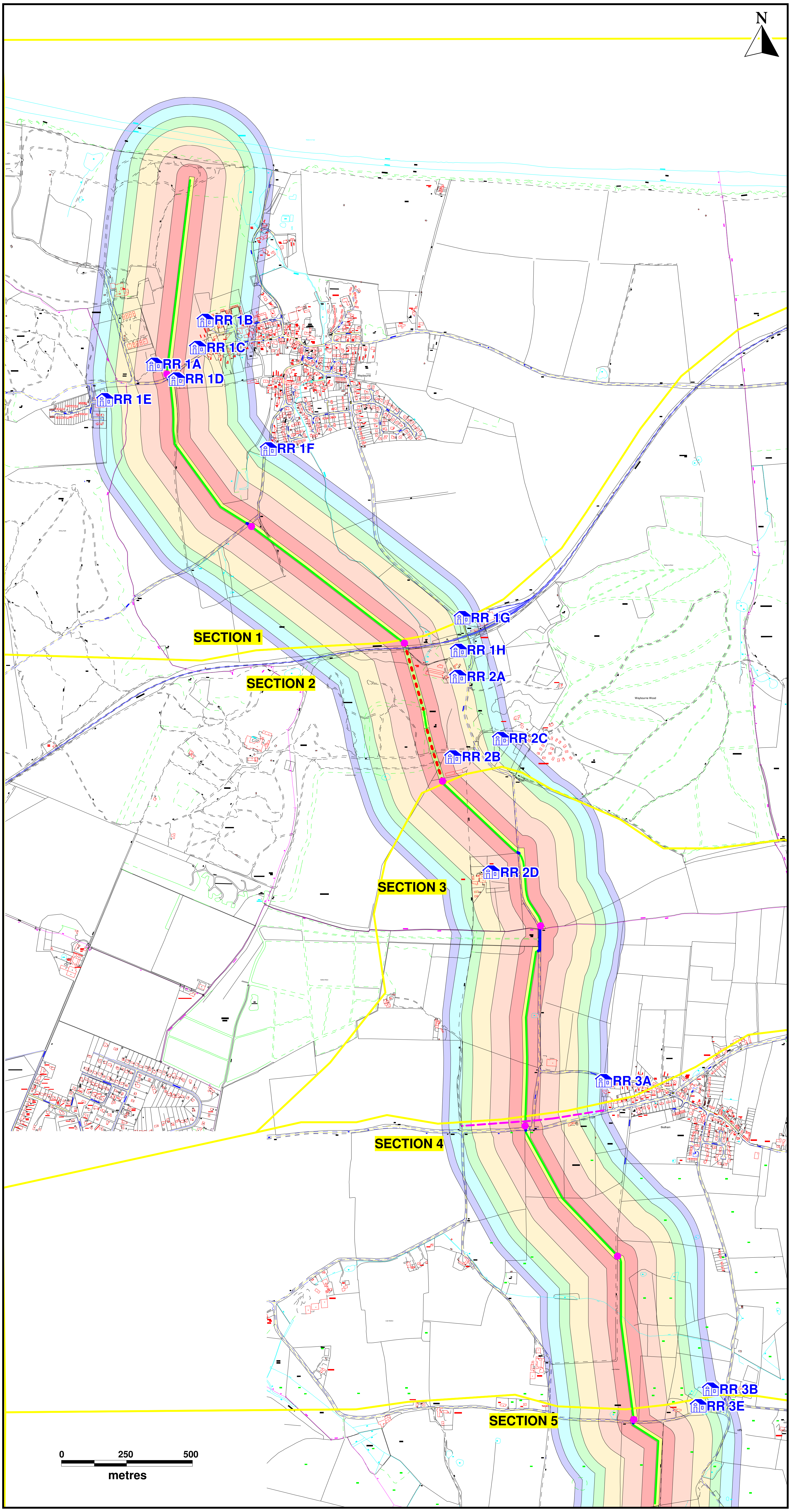
Table 10.1 outlines the closest potentially noise sensitive receptors along each section of the onshore grid connection [1], listed approximately in order from north to south. These receptors; each assigned a reference number, can be viewed in **Figure 10.1**.

Table 10.1 Representative noise sensitive receptors and approximate distance to construction area

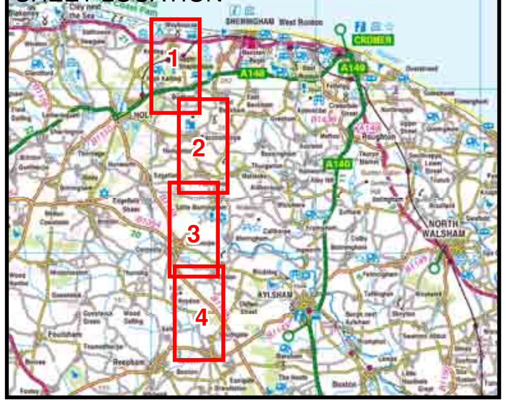
Route Section	Property identification (inc reference number and GB grid reference where necessary)	Distance to construction works (m)
1. Muckleburgh to Poppy Line Railway	Foxhills, Weybourne **(Ref 1a)**	20
	35 (to 40) Priory Wood, Weybourne **(Ref 1b)**	160
	Old Orchard House, the Street, Weybourne **(Ref 1c)**	120
	Highfields, The Street, Weybourne **(Ref 1d)**	15
	1, 2 & 7 Weynor Gardens **(Ref 1e)**	260
	Holt Road (TG 110 426) **(Ref 1f)**	260
	Station House, Sandy Hill Road **(Ref 1g)**	230*
	Springs Farm **(Ref 1h)**	200
2. Kelling Heath/Hundred Acre Woods	Springs **(Ref 2a)**	160
	Static caravan at property on E edge of Hundred Acre Wood (TG 117 414) **(Ref 2b)**	80**
	New house at Cherry Trees Farm riding school **(Ref 2c)**	250
	Breck Farm & caravans (TG 118 409) **(Ref 2d)**	170
3. North of Bodham	The Hollies, Weybourne Road, Bodham (and Hillcrest) **(Ref 3a)**	300
	Alanu-et-Mente, Lower. Bodham **(Ref 3b)**	280
	Property to E of All St Church, L. Bodham) (TG 126 389) **(Ref 3c)**	250
4. Bodham	Breck Farm, Baconsthorpe **(Ref 4a)**	140
5. Baconsthorpe Castle	11 & 12 Stonefield Road, Baconsthorpe **(Ref 5a)**	30
	The Rectory, Baconsthorpe **(Ref 5b)**	220

(table continued page 11)

[1] Sections refer to the standard sections of the onshore grid connection outlined in Section 4: ‘Legislative Context and the EIA Process’ and are also shown on Figure 10.1.



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION — EIA study area divisions

Levels of Day Time Noise Acceptability

- Unacceptable (0m - 48m)
- Major adverse (49m - 120m)
- Substantial adverse (121m - 191m)
- Moderate adverse (192m - 230m)
- Minor adverse (231m - 276m)
- Negligible (276m - 303m)
- Representative noise sensitive receptors

Title
BUFFER ZONES OF NOISE ACCEPTABILITY FROM CONSTRUCTION AREA AND REPRESENTATIVE NOISE SENSITIVE RECEPTORS

SHEET 1 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

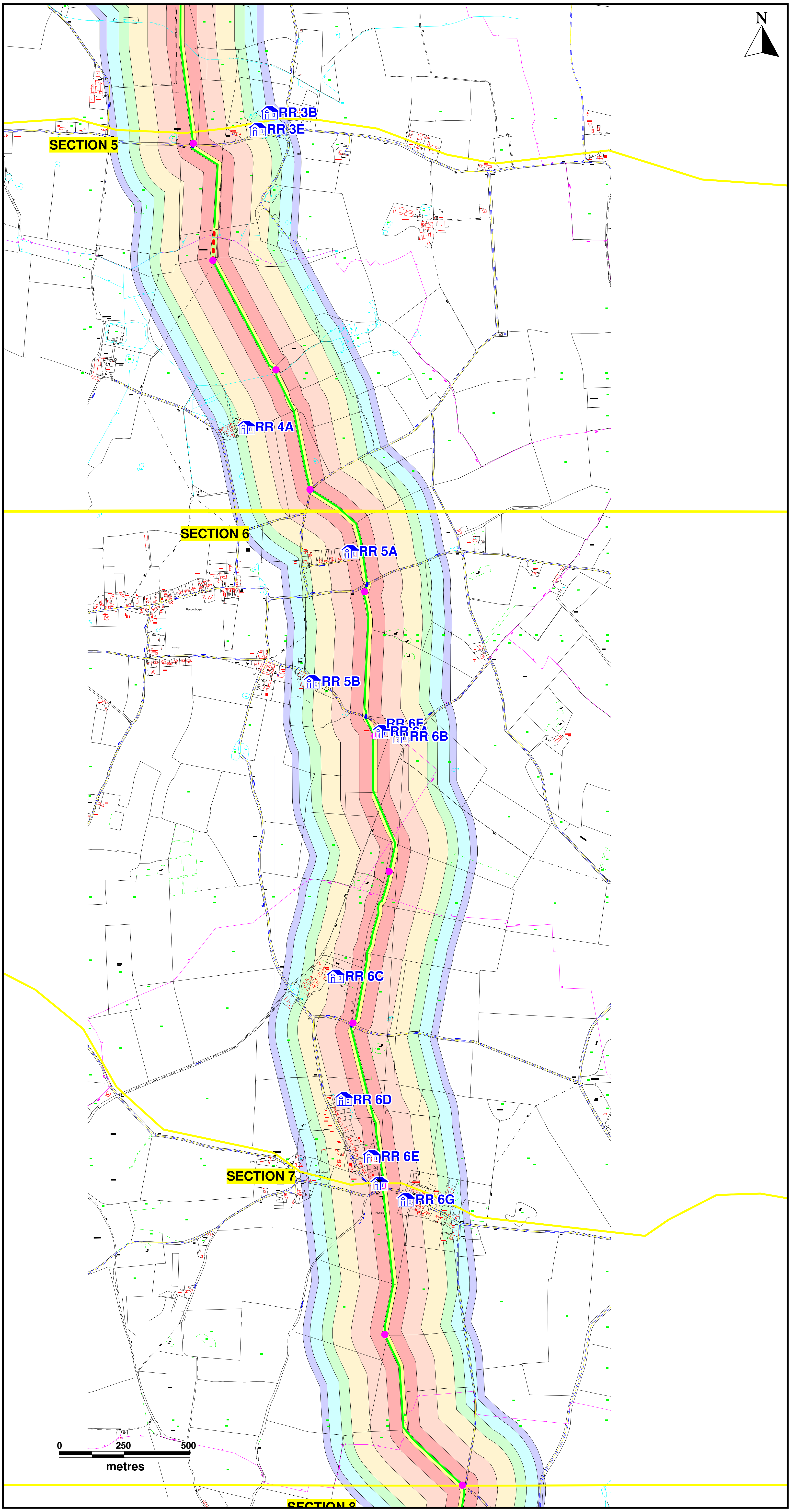
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

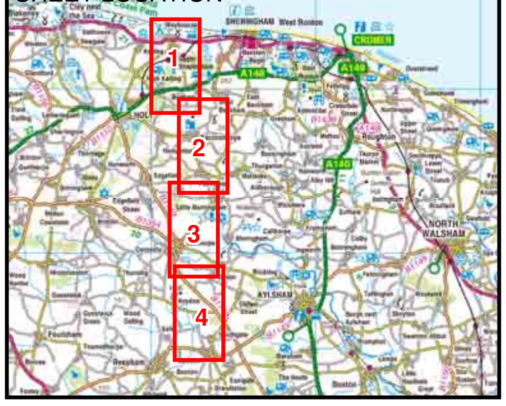
Scale:
NTS

Figure:
FIGURE 10.1 (1 of 4)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION — EIA study area divisions

Levels of Day Time Noise Acceptability

- Unacceptable (0m - 48m)
- Major adverse (49m - 120m)
- Substantial adverse (121m - 191m)
- Moderate adverse (192m - 230m)
- Minor adverse (231m - 276m)
- Negligible (276m - 303m)
- Representative noise sensitive receptors

Title
BUFFER ZONES OF NOISE ACCEPTABILITY FROM CONSTRUCTION AREA AND REPRESENTATIVE NOISE SENSITIVE RECEPTORS

SHEET 2 OF 4

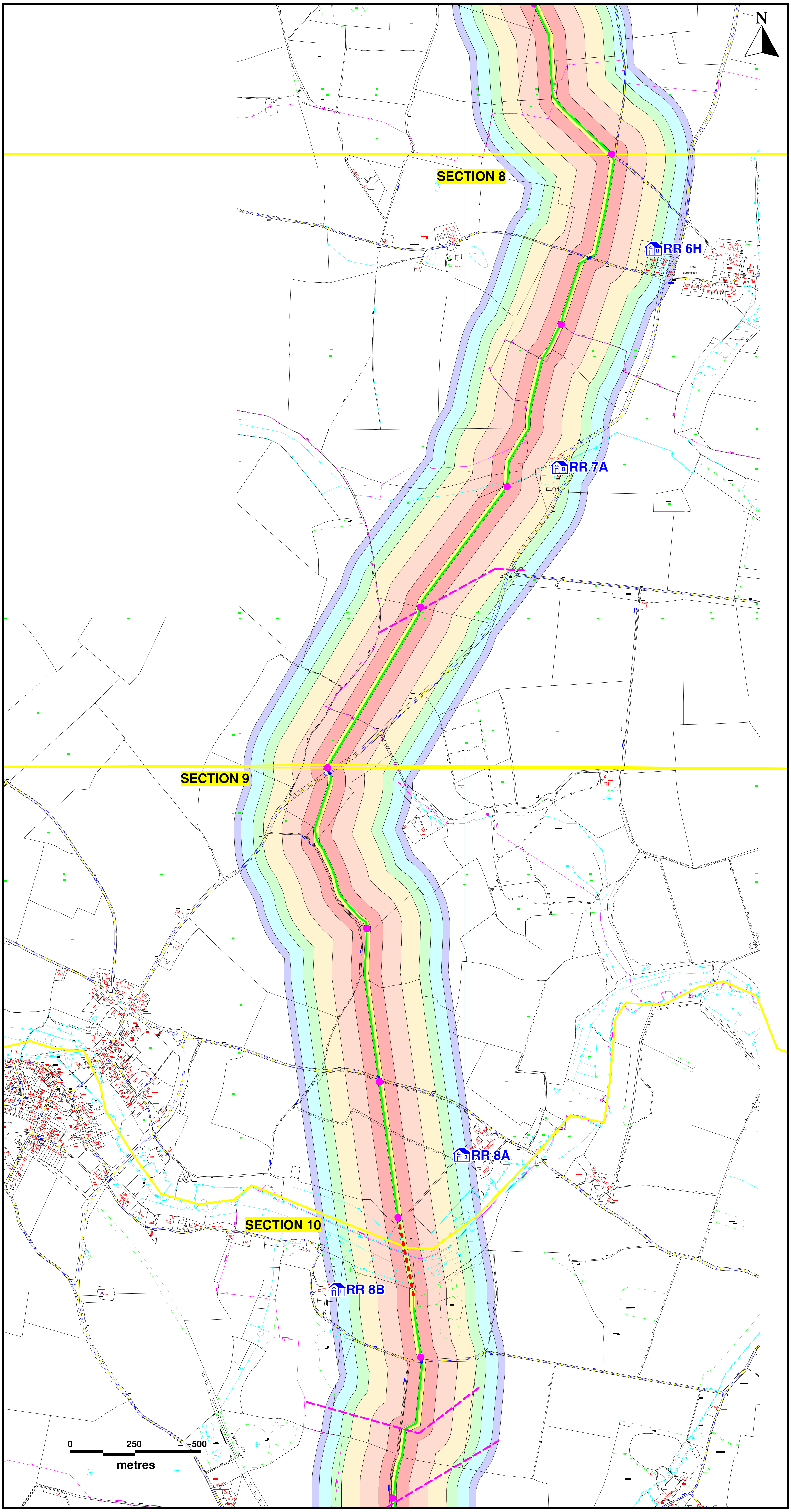
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

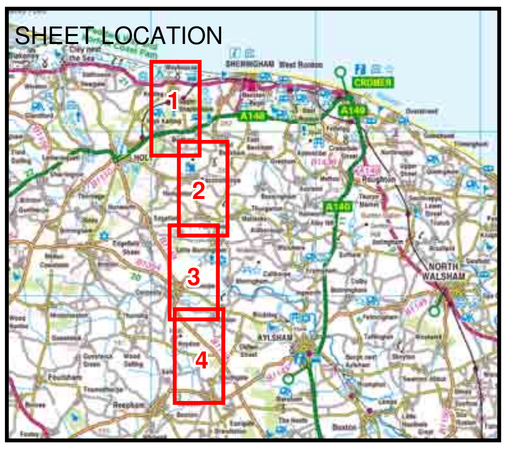
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 10.1 (2 of 4)

ROYAL HASKONING





LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION EIA study area divisions

Levels of Day Time Noise Acceptability

- Unacceptable (0m - 48m)
- Major adverse (49m - 120m)
- Substantial adverse (121m - 191m)
- Moderate adverse (192m - 230m)
- Minor adverse (231m - 276m)
- Negligible (276m - 303m)
- Representative noise sensitive receptors

Title
BUFFER ZONES OF NOISE ACCEPTABILITY FROM CONSTRUCTION AREA AND REPRESENTATIVE NOISE SENSITIVE RECEPTORS

SHEET 3 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

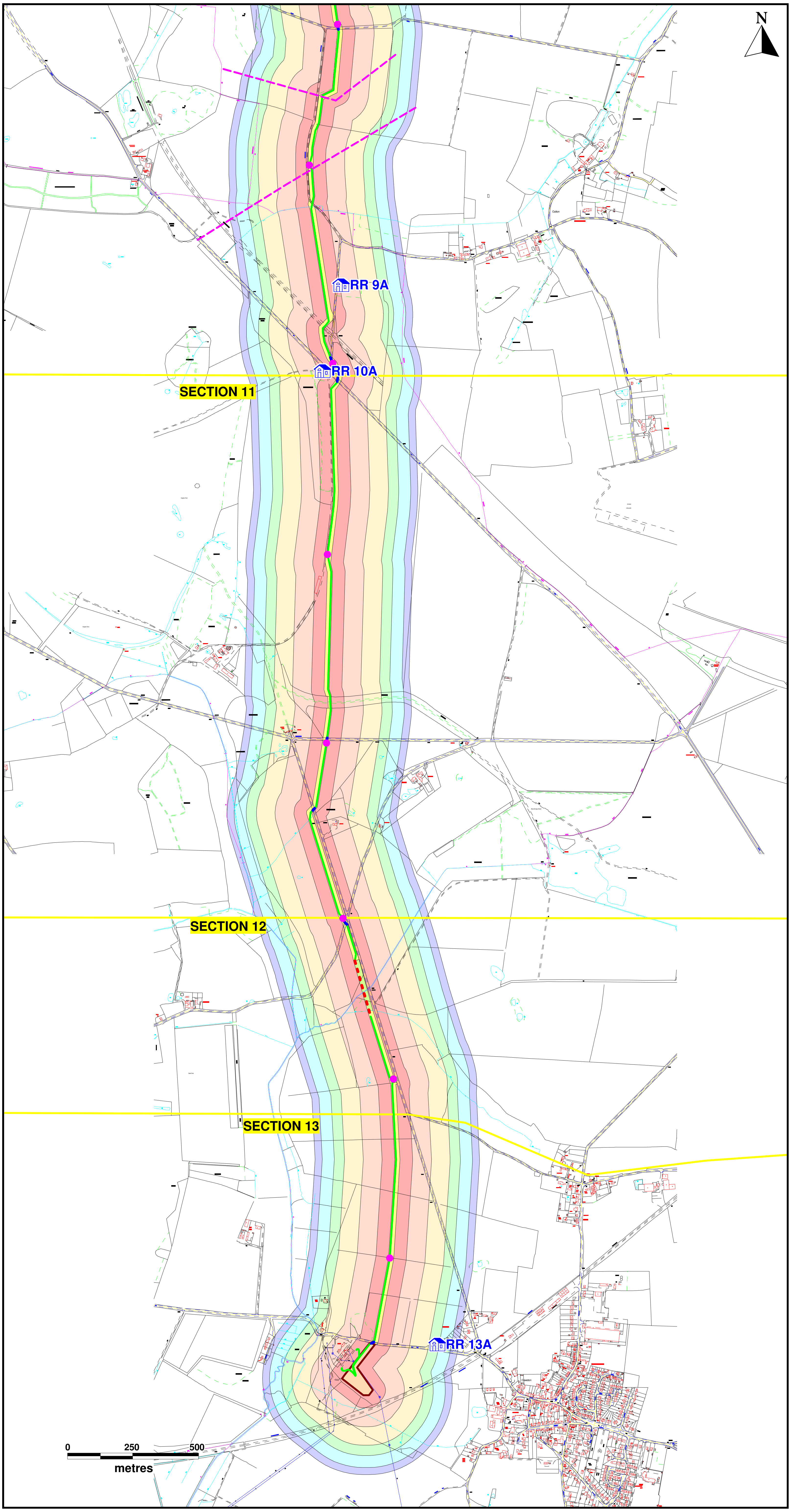
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

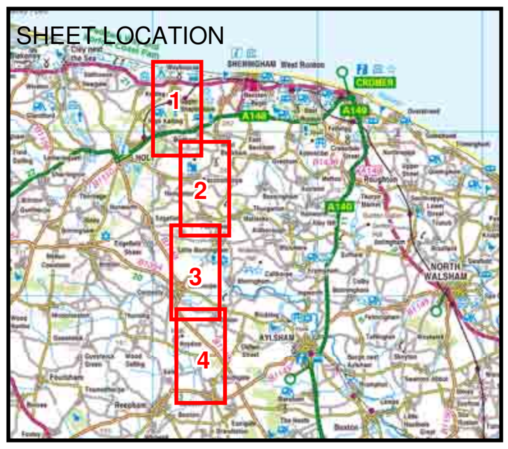
Scale:
NTS

Figure:
FIGURE 10.1 (3 of 4)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION EIA study area divisions

Levels of Day Time Noise Acceptability

- Unacceptable (0m - 48m)
- Major adverse (49m - 120m)
- Substantial adverse (121m - 191m)
- Moderate adverse (192m - 230m)
- Minor adverse (231m - 276m)
- Negligible (276m - 303m)
- Representative noise sensitive receptors

Title
BUFFER ZONES OF NOISE ACCEPTABILITY FROM CONSTRUCTION AREA AND REPRESENTATIVE NOISE SENSITIVE RECEPTORS

SHEET 4 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 10.1 (4 of 4)

ROYAL HASKONING

Route Section	Property identification (inc reference number and GB grid reference where necessary)	Distance to construction works (m)
6. Baconsthorpe to Plumstead	The Manor Lodge, Baconsthorpe **(Ref 6a)**	10
	Manor House Farm **(Ref 6b)**	90
	Hall Farm, N of Plumstead **(Ref 6c)**	110
	Cherry Tree House, Cherry Tree Road, Plumstead **(Ref 6d)**	110
	5 to 9 Cherry Tree Road (Council Houses) **(Ref 6e)**	30
	Applewood, Cherry tree Road **(Ref 6f)**	10
	Carpenters Cottage, Church Street, Plumstead **(Ref 6g)**	80
	The Beeches & 7 to 10 Parva Close, L. Barningham **(Ref 6h)**	210
7. South to Plumstead	Mere Farm (TG 132 325) (new dwelling) **(Ref 7a)**	70
8. Little Barningham	Hall Farm (TG 128 299) **(Ref 8a)**	280
	Irmingland Hall (TG 123 294) **(Ref 8b)**	290*
9. North of Saxthorpe and River Bure	The Bungalow, Spink's Lane (TG 127 281) **(Ref 9a)**	30
10.South of Saxthorpe and River Bure	Eagle Lodge North & South (TG 126 278) **(Ref 10a)**	15
11. Heydon	Dog Corner Lodge and Arch Lodge (TG 125 264) **(Ref 11a)**	60
12. East of Salle Park	None present	n/a
13. Salle Substation and land to north	14 Glebe Crescent, Cawston **(Ref 13a)**	240

* Open trenching and directional drilling
** Only directional drilling

Based on predicted construction activities presented in **Appendix 10.1**, **Table 10.2** outlines the main construction activity noise levels and subsequent noise levels at each of the residential properties identified in **Table 10.1**, taking account of distance attenuation, screening and the proportion of the assessment period that each piece of equipment will operate at full power. All noise levels are assessed over a 10-hour working day.

Table 10.2 Construction noise levels at nearest representative noise sensitive receptors (Bold text indicates noise levels greater than 50 dB L_{Aeq}, red highlight additionally indicates noise levels greater than 70 dB L_{Aeq})

Property identification	Distance to construction works (m)	Construction activity receptor noise levels (dB $L_{Aeq, 10h}$)					
		Clearance	Cable installation	Drill area prep	Directional drilling	Bentonite pumping	Water pumps
Foxhills, Weybourne	20	**71**	**79**	**70**	N/A	N/A	**83**
35 (to 40) Priory Wood, Weybourne	160	45	**53**	44	N/A	N/A	**57**
Old Orchard House, the Street, Weybourne	120	48	**56**	47	N/A	N/A	**60**
Highfields, The Street, Weybourne	15	**73**	**81**	**72**	N/A	N/A	**85**
1, 2 & 7 Weynor Gardens	260	40	48	39	N/A	N/A	**52**
Holt Road (TG 110 426)	260	40	48	39	N/A	N/A	**52**
Station House, Sandy Hill Road	230	41	49	40	39	**51**	**53**
Springs Farm	200	42	50	41	40	**52**	**54**
Springs	160	45	**53**	44	39	**51**	**57**
Static caravan Hundred Acre Wood (TG 117 414)	80	**52**	**60**	**51**	47	**62**	**64**
New house at Cherry Trees Farm riding school	250	40	48	39	38	50	**52**
Breck farm & caravans (TG 118 409)	170	44	**52**	43	N/A	N/A	**56**
The Hollies, Weybourne Road, Bodham (and Hillcrest)	300	38	46	37	N/A	N/A	50
Property to E of All Saints Church, L. Bodham) (TG 126 389)	250	40	48	39	N/A	N/A	**52**
Alanu-et-Mente, L. Bodham	280	39	47	38	N/A	N/A	**51**
Breck Farm, Baconsthorpe	140	46	**54**	45	N/A	N/A	**58**
11 & 12 Stonefield Road, Baconsthorpe	30	**63**	**71**	**62**	N/A	N/A	**75**
The Rectory, Baconsthorpe	220	41	49	40	N/A	N/A	**53**
The Manor Lodge, Baconsthorpe	10	**77**	**85**	**76**	N/A	N/A	**89**
Manor House Farm	90	**51**	**59**	50	N/A	N/A	**63**
Hall Farm, N of Plumstead	110	49	**57**	48	N/A	N/A	**61**

Property identification	Distance to construction works (m)	Construction activity receptor noise levels (dB $L_{Aeq,\ 10h}$)					
		Clearance	Cable installation	Drill area prep	Directional drilling	Bentonite pumping	Water pumps
Cherry Tree House, Cherry Tree Road, Plumstead	110	49	**57**	48	N/A	N/A	**61**
5 to 9 Cherry Tree Road (Council Houses)	30	**63**	**71**	**62**	N/A	N/A	**75**
Applewood, Cherry tree Road	10	**77**	**85**	**76**	N/A	N/A	**89**
Carpenters Cottage, Church Street, Plumstead	80	**52**	**60**	**51**	N/A	N/A	**64**
The Beeches & 7 to 10 Parva Close, L. Barningham	210	42	50	41	N/A	N/A	**54**
Mere Farm (TG 132 325) (new dwelling)	70	**54**	**62**	**53**	N/A	N/A	**66**
Hall Farm (TG 128 299)	280	39	47	38	N/A	N/A	**51**
Irmingland Hall (TG 123 294)	290	38	46	37	36	48	50
The Bungalow, Spink's Lane (TG 127 281)	30	**63**	**71**	**62**	N/A	N/A	**75**
Eagle Lodge North & South (TG 126 278)	15	**73**	**81**	**72**	N/A	N/A	**85**
Dog Corner Lodge and Arch Lodge (TG 125 264)	60	**56**	**64**	**55**	N/A	N/A	**68**
14 Glebe Crescent, Cawston	240	41	49	40	N/A	N/A	**53**

The results indicate that potentially unacceptable day time noise levels of greater than 70 dB $L_{Aeq,\ 10h}$ will be experienced by those properties closest to the works, with diminishing impact significance with increasing distance from the works.

Day time directional drilling noise is predicted to affect residential properties only in the vicinity of Hundred Acre Wood and at Irmingland Hall. Of these only the bentonite pumping noise affecting the static caravan at Hundred Acre Wood is of any particular note; the noise would be deemed to acceptable but may potentially be of major adverse significance.

The noisiest activities are the pumping operations, particularly as these are more likely to continue indefinitely rather than occurring intermittently. In order to define in more detail the distances at which particular impact significance might occur, based on the significance criteria defined in Section 10.2.1 above, a simple distance calculation can be carried out. Taking the pumping noise as the source noise level, the distance at which, for example, the pumping noise changes from 70 dB L_{Aeq} to 69.9 dB L_{Aeq} can be calculated. This calculation assumes propagation of noise over soft ground. From this, it is predicted that:

- **Unacceptable** day time noise levels greater than 70 dB L_{Aeq} are predicted to occur where the construction activities occur within 48 metres of a receptor or group of properties.
- **Major adverse** impacts of 60 dB L_{Aeq} or more are predicted to occur between 49 and 120 metres from the construction activities.
- **Substantial adverse** impacts of 55 to 59.9 dB L_{Aeq} are predicted to occur between 121 and 191 metres from the construction works.
- **Moderate adverse** impacts of 53 to 54.9 dB L_{Aeq} are predicted to occur between 192 and 230 metres from the construction works.
- **Minor adverse** impacts of 51 to 52.9 dB L_{Aeq} are predicted to occur between 231 and 276 metres from the construction works.
- **Negligible adverse** impacts of 50 to 50.9 dB L_{Aeq} are predicted to occur between 276 and 303 metres from the construction works.

From the above predictions, the relevant distance bands can be drawn onto base maps, and these are presented in **Figure 10.1**. This allows identification of the number of properties, in addition to the selected representative receptors, that fall within each band as follows:

- **Unacceptable** day time noise levels greater than 70 dB LAeq are predicted to occur for approximately 15 properties.
- **Major adverse** impacts of 60 dB LAeq or more are predicted to occur for approximately 44 properties.
- **Substantial adverse impacts** of 55 to 59.9 dB LAeq are predicted to occur for approximately 32 properties (plus an additional 18 static caravans).
- **Moderate adverse impacts** of 53 to 54.9 dB LAeq are predicted to occur for approximately 14 properties (plus an additional 8 static caravans).
- **Minor adverse impacts** of 51 to 52.9 dB LAeq are predicted to occur for approximately 26 properties.
- **Negligible adverse impacts** of 50 to 50.9 dB LAeq are predicted to occur for approximately 32 properties.

With regard to night time noise levels, the only activities likely to occur are pumping operations, but it can be seen that all properties within the 300m study area would be subject to unacceptable noise levels greater than 45 dB L_{Aeq}. The calculation used above suggests that properties as far away as 480m from the pumps would experience noise levels of 45 dB L_{Aeq} or more, although the potential unreliability of noise predictions at distances greater than 300m from the activities should be borne in mind.

It is also worth noting that light to moderate wind conditions, particularly at night, can cause elevated downwind noise levels, of up to 10 to 15 dB, such that properties beyond 300m might experience audible adverse impacts or properties within 300m might experience an adverse impact *greater* than that predicted above. It is not possible to predict these effects or the level of potential noise increase that might occur, but the Contractor should be aware of these potential noise increases in assessing the on-going nature of the construction operations and in dealing with calls from local residents regarding noise.

It is not possible at this stage to quantitatively assess the potential impacts of construction-related traffic travelling to and from work areas with materials as this would require detailed information regarding the existing traffic flows on all affected roads and detailed information regarding numbers of construction-related vehicles per hour or per day. Qualitatively, however, personal experience of assessment for other construction projects allows a reasonable qualitative assessment to be made.

Slow-moving low-loaders bringing large equipment to site are generally not a significant source of noise. More significant issues tend to arise as a result of the movements of general HGV traffic on local roads. The adverse impacts of these tend to range from **minor** to **moderate** with potentially **major** adverse impacts possible where large numbers of vehicles regularly pass properties that do not currently experience significant volumes of traffic. Because the relative impact of increased noise is subjective from person to person, adverse perception of noise impacts can also be exacerbated by cumulative-pollutant effects; for example, significant levels of dust raised by moving construction traffic can create a general negative perception of the activities by residents leading to *perceived* adverse impacts greater than measurement of noise levels might otherwise suggest. Thus potential noise impacts should be considered alongside other potentially adverse impacts that might occur, rather than simply being considered in isolation.

Similarly, the setting up and operation of site compounds may give rise to adverse noise impacts, particularly if night time power is required necessitating the operation of generators, etc. The location of these is not yet known and the variable nature of operations in and around them means that quantitative noise prediction is not possible. The degree of potential for adverse impact is dependant on proximity to residential properties and the nature that activities on the site are conducted. Generic mitigation is often required, and this is detailed below.

10.4.2 Mitigation and residual impact

Working hours restrictions will be discussed and agreed in consultation with the Environmental Protection Officers of NNDC and BDC. The Contractor will apply the principles of Best Practicable Means (BPM), as defined in BS 5228: Part 1: 1997, to all elements of the construction works. BPM requires the contractor and his staff to apply Best Practice working methods, to use modern, properly attenuated equipment, to ensure that such equipment is well maintained, to avoid unnecessary revving of vehicles or allowing vehicles to stand idling when not working for example.

Site compounds will, where possible be located as far from potentially noise sensitive receptors as possible. Activity in and around the compounds will be restricted to day time working hours and the principles of BPM will be applied to the construction and operation of the compounds as well as to the general construction activities. Where generators for power are required these will be sited as far from noise sensitive receptors as possible and so that buildings or natural features provide screening. Where necessary, physical mitigation may be required; the types of mitigation that might be utilised are discussed below.

In some cases, where *unacceptable* noise levels in excess of 70 dB L_{Aeq} during the day, or 45 dB L_{Aeq} at night, impact upon residential properties, physical mitigation may be required. The simplest mitigation is to use natural features and the screening provided by construction-related buildings, by non-residential buildings (barns, etc.), using the natural topography or by piling excavated earth into temporary bunds. Alternatively, hay bales can be used to provide simple, cheap and relatively mobile screening for small items of plant such as generators and pumps.

Where ground conditions permit, equipment can be located in pits or trenches. Where more significant noise reduction is required, temporary screens comprising plywood and absorptive lining will be constructed. As a general rule, if a source of noise can just be seen over the top of a barrier, approximately 5 dB of attenuation may be achieved whilst completely obscuring the line of sight of the receptor for the source can noise can achieve up to 10 dB of attenuation. Note, however, that the sound *insulation* performance of the screening material plays a significant role and where reductions of 10 dB or more are required, more detailed specification of the materials used may be required, dependant on type of noise, acoustic-frequency content (i.e. whether the noise contains significant low frequency noise etc.) and amount of sound of attenuation required.

Details of typical specifications for such screens are available in BS 5228 and can be readily specified once the detailed nature of the source noise is known. Noise mitigation of 10 dB or more will only be required for those receptors where noise levels are in excess of 80 dB L_{Aeq}, the intention being to reduce noise levels to at least 70 dB L_{Aeq}. Ideally, mitigation should be applied to all activities that cause noise levels in excess of 60 dB L_{Aeq} or more during the day or 50 dB L_{Aeq} or more at night, assessed at the nearest noise sensitive property.

Mitigation of adverse impacts from construction-related traffic is most easily achieved by the enforcement of construction-traffic speed limits through built-up areas, where the roads pass very close to residential or other noise sensitive buildings or where the nature or condition of the road surface results in excess vehicle body noise. Additionally, where possible, the Contractor will ensure that HGVs do not travel on local roads before or after the general construction activities and do not stand idling or queuing outside residential properties waiting for site compounds to open. The public relations exercise mentioned above should be extended to those properties close to roads and where the movements of HGVs and other construction traffic might cause a substantial adverse impact.

Timely and 'honest' public relations can be the most effective means of reducing adverse perception regarding construction noise. Local residents will be informed of the works before they commence and provided with details of a system by which they can contact the Contractor in the event of adverse noise. Any such complaints will be promptly and effectively dealt with. Feedback to the complainant on the outcome of any complaint investigation is an important part of this process. To this end, letter drops will be carried out for those properties that might be adversely affected by the works (potentially, all residential properties within 300 metres of the construction works) explaining the nature, extent and duration of the works and providing a manned contact telephone number for any complaints or queries regarding the works.

Mitigation (summary) – Noise and vibration during construction
• Working hours restrictions agreed in consultation with NNDC and BDC. • The contractor will apply the principles of Best Practicable Means (BPM), as defined in BS 5228: Part 1: 1997, to all elements of the construction works. • Site compounds will, where possible be located as far from potentially noise sensitive receptors as possible. • Activity in and around the compounds will be restricted to day time working hours and the principles of BPM will be applied to the construction and operation of the compounds as well as to the general construction activities. • Where generators for power are required these will be sited as afar from noise sensitive receptors as possible and so that buildings or natural features provide screening. • Where *unacceptable* noise levels in excess of 70 dB L_{Aeq} during the day, or 45 dB L_{Aeq} at night occur, impact upon residential properties may require physical mitigation in the form of screening. • Mitigation of adverse impacts from construction-related noise by the enforcement of construction-traffic speed limits will be carried out through built-up areas. • Contractor will ensure that HGVs do not travel on local roads before or after the general construction activities and do not stand idling or queuing outside residential properties. • Timely and 'honest' public relations will be undertaken to reduce the adverse perception regarding construction noise. • Letter drops will be carried out for those properties that might be adversely affected by the works (potentially, all residential properties within 300 metres of the construction works).

The application of the outlined mitigation measures for construction noise in general will help to reduce any adverse noise impacts, but the use of modern and quiet equipment plus the use of substantial noise screens will be used to reduce noise levels to 55 dB L_{Aeq} or less during the day and 45 dB L_{Aeq} or less at night.

The degree of mitigation required and the effectiveness would be very site dependant, but if these noise levels can be achieved, the significance of construction noise will be reduced to a **minor adverse** impact. Where this degree of physical mitigation is not possible and quantitative assessment shows the predicted noise levels to be of moderate adverse significance, the public relations element of the mitigation strategy becomes more critical and the effective use of this might ensure that the *subjective perception* of adverse impacts is of only **minor** significance to local residents.

Construction traffic impacts would be reduced to no more than **minor** adverse if speeds and excess vehicle body noise are reduced alongside other general nuisance mitigation measures.

10.4.3 Specific impacts relating to the proposed substation

The substation is approximately 240 metres from nearest residential. Construction noise impacts relating to those identified for the cable system would also apply.

Day time noise from pumping operations, predicted to be 53 dB L_{Aeq}, would be acceptable and of potentially minor to moderate adverse significance. Night time pumping activities however, being 53 dB L_{Aeq}, would be of potentially major adverse significance. In addition to measures outlined for the cable system, it is recommended that mitigation as described below should be employed.

Mitigation – substation during construction
• The use of modern and quiet equipment. • Physical screening.

Mitigation of 10 dB would reduce day time noise levels to 43 dB L_{Aeq}, below the 50 dB L_{Aeq} impact criterion level, and night time noise levels to an *acceptable* level of 42 to 43 dB L_{Aeq} with a minor to moderate adverse significance. However, mitigation of 13 dB necessary to reduce night time noise levels to 40 dB L_{Aeq} would be such that **no adverse impact** is caused.

10.4.4 Cumulative impacts

There is a possibility that the cable laying activities and construction of the new substation will overlap with proposed works to EDFE's existing substation near Salle. Full details of the proposed activities and vehicle numbers accessing the site are not currently available, however it is known that the construction activities will occur only during the day time and will necessitate the off-site removal of large amounts of waste soil; although the precise transport routes are not known.

However, the assessment of Scira's substation construction, which is marginally closer to the nearest residential properties, has shown that there would be an acceptable but potentially minor to moderate adverse noise impact during the day. Presuming the EDFE construction activities gave rise to similar noise levels the unmitigated impacts would be approximately 3 dB higher, approximately 56 dB L_{Aeq}, and would therefore be of potentially substantial adverse significance. Mitigation as already discussed would potentially reduce this noise level to 46 dB L_{Aeq}, below the day time impact criterion level of 50 dB L_{Aeq} and reduce the adverse impacts to a **minor adverse** level.

Similarly, it has not been possible to accurately quantify the road vehicle noise impacts associated with Scira's activities and detailed information of EDFE's potential construction traffic levels are not available. The assessment of Scira's construction-related road traffic noise noted that the adverse impacts may range from minor to major, depending on vehicle numbers and relative location; the same is true for the EDFE activities and, in the absence of more detailed information, it is our professional judgement that the cumulative road traffic noise impacts may be moderate to major. The application of suitable mitigation measures, as previously discussed, may reduce the adverse impacts to **minor** or **moderate**.

10.5 Impacts During Operation

There are not judged to be any adverse impacts arising from the operation of the cable system, the substation operation or EDFE's substation operations. Minor periodic inspections and maintenance would be required but these would invariably occur during the day time, would be of short duration and would create **negligible** noise.

Any more significant maintenance works will need to consider suitable mitigation as previously described.

10.6 Summary

An assessment has been made of potential construction noise levels arising as a result of the construction of the cable system. Predictions of construction noise levels affecting the closest potentially noise sensitive receptors to the cable route, have been carried out based on the guidance contained in British Standard 5228: Part 1: 1997 "Noise and vibration control on construction and open sites" and using noise levels typical of such construction operations. The assessment has considered potentially noise sensitive buildings within a 300 metre zone either side of the proposed construction route.

The assessment has shown that at certain locations the construction activities come to within 10 metres of residential properties, leading to unacceptable day time noise levels of up to 85 dB L_{Aeq}, as assessed against an acceptable noise limit of 70 dB L_{Aeq}. For a number of other properties, acceptable construction noise levels of below 70 dB L_{Aeq} are experienced but, judged against a baseline noise level of 50 dB L_{Aeq} as given in the World Health Organisation Guidelines for community noise, these properties still potentially experience minor to major adverse noise impacts.

Night time activities involving the operation of pumps are predicted to give rise to unacceptable noise levels of greater than 45 dB L_{Aeq} for all properties within the 300 metre study area.

Mitigation in the form of the application of current Best Practice working methods, the use of modern and quiet equipment and, where necessary, the use of physical screening, will ensure that noise levels are reduced such that no more than a **minor adverse impact** occurs. Where this is not possible, the effective and timely use of a public relations strategy should ensure that *subjective perception* of noise, that might otherwise quantitatively be assessed as being of moderate adverse significance, is reduced to a **minor adverse** significance.

Controls on the speed and times of operations of construction-related traffic will ensure that impacts from these activities are only of **minor adverse** significance.

The sub-station extension construction activities are at sufficient distance from residential properties such that day time noise levels are potentially of only **minor adverse** significance. Night time noise levels might be of major adverse significance, but the implementation of suitable mitigation should ensure that this is reduced such that **no adverse impact** is caused.

10.7 References

British Standards Institute 1990 & 1993
BS 7385
Evaluation and measurement of vibration in buildings
BSI, London
Part 1: 1990 and Part 2: 1993

British Standards Institute 1997
BS 5228: Part 1: 1997
Noise and vibration control on construction and open sites: Code of Practice for basic information and procedures for noise and vibration control
BSI, London, 1997

British Standards Institute 1999
BS 8233: 1999
Sound insulation and noise reduction for buildings – Code of practice
BSI, London, 1999

Defra 2004
Update of noise database for prediction of noise on construction and open sites
Report by Hepworth Acoustics Ltd.

Ontario MAFRA – Ministry of Agriculture Food and Rural Affairs 2003
website: www.omafra.gov.on.ca/.../facts/03-047f12.gif

Personal communications
Tony Donbavand, Land and Marine Engineering services

World Health Organisation (WHO) 1999
Guidelines for community noise

ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 11

DUST AND AIR QUALITY

11 DUST AND AIR QUALITY

11.1 Introduction

This section describes an assessment of the air quality impacts of the Sheringham Shoal onshore grid connection. The assessment has considered existing air quality in the region and the potential impacts of the cable system and substation on local air quality.

The significance of the impacts has been discussed in the context of the Government's air quality objectives, existing conditions and the sensitivity of the receptors affected by any changes.

11.2 Assessment Methodology

11.2.1 Desk-based assessment

This assessment has considered the impact of airborne dust during the construction period and emissions from traffic, including heavy goods vehicles (HGVs), generated by the operation of the scheme. It has been undertaken following NSCA, DEFRA and Greater London Authority best practice guidance.

Impacts have been assessed qualitatively with reference to information from the following sources:

- Updating and Screening Assessments of Local Air Quality for North Norfolk District Council (2007), and Broadland District Council (2007).
- Results from air quality monitoring undertaken by North Norfolk District Council and Broadland District Council.
- Estimated background air pollution concentrations from the National Air Quality Information Archive (NAQIA).

As has been described in Section 4: 'Legislative Context and the EIA Process', for ease of descriptive purposes, the onshore grid connection project has been split into 13 sections. These route sections are shown on the figures and referred to in the text.

11.2.2 Consultation

Environmental Protection teams from North Norfolk District Council (NNDC) and Broadland District Council (BDC) have agreed the scope of work for this air quality assessment.

11.2.3 Relevant policy, legislation, guidance, best practice

The Environment Act 1995 introduced a framework of Local Air Quality Management and placed a duty on local authorities to formally assess air quality in their area against standards and objectives in the National Air Quality Strategy. These Standards and Objectives are incorporated in The Air Quality Regulations 2000 and Air Quality

(Amendment) Regulations 2002 and have adopted into UK law the limit values required by EU Daughter Directives on Air Quality. A summary of these objectives is given in **Table 11.1**.

Table 11.1 The Air Quality (England) Regulations 2000 as amended by the Air Quality (England) (Amendment) Regulations 2002

Pollutant	Objective		Date to be achieved by
	Concentration	Measured as	
Objectives for the protection of human health			
Benzene	16.25μg/m^3 (microgram/ m3)	Running annual mean	31 December 2003
	5μg/m^3	Annual mean	31 December 2010
1,3-Butadiene	2.25μg/m^3	Running annual mean	31 December 2003
Carbon Monoxide	10mg/m^3 (milligram/m^3)	Maximum daily running 8 hour mean	31 December 2003
Lead	0.5μg/m^3	Annual mean	31 December 2004
	0.25μg/m^3	Annual mean	31 December 2008
Nitrogen dioxide	200μg/m^3 not to be exceeded more than 18 times a year	Hourly mean	31 December 2005
	40μg/m^3	Annual mean	31 December 2005
Particles, PM_{10} (gravimetric)	50μg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31 December 2004
	40μg/m^3	Annual mean	31 December 2004
Sulphur Dioxide	350μg/m^3 not to be exceeded more than 24 times a year	Hourly mean	31 December 2004
	125μg/m^3 not to be exceeded more than 3 times a year	24 hour mean	31 December 2004
	266μg/m^3 not to be exceeded more than 35 times a year	15 minute mean	31 December 2005

Standards for air pollution are concentrations over a given time period that are considered to be acceptable in light of what is known about the effects of each pollutant on human health and the environment. The Objectives specify the number of times a standard may be exceeded each year, and set a date by which this must be achieved.

If a local authority predicts that any of the Objectives are not likely to be achieved, the location must be designated as an Air Quality Management Area (AQMA). The local authority must then devise and implement a Local Air Quality Action Plan to improve air quality.

Whilst the existence of an AQMA is not necessarily a presumption against development, the potential air quality impact of a scheme within or around a designated AQMA will be subject to detailed consideration by the local planning authority.

In 2004 the Office of the Deputy Prime Minister (ODPM; now Communities and Local Government) published its Planning Policy Statement 23 (PPS 23): *Planning and Pollution Control*, advising that any air quality consideration that relates to the use and development of land is capable of being a material planning consideration. Whether it is a material planning consideration or not and the weight which should be accorded to it by the decision-maker will depend on the facts of the individual case.

Possible exceedences of air quality objectives (**Table 11.1**) should be assessed at locations where relevant public exposure would be expected, in consideration of the averaging period for the pollutant in question. This includes locations which are situated outside of buildings or other natural or man made structures, above or below ground, and where members of the public are regularly present. Examples of where the air quality objective for nitrogen dioxide and fine particles (PM_{10}) should or should not apply are provided in **Table 11.2**.

Table 11.2 Examples of where the Air Quality Objectives for Nitrogen Dioxide should/should not apply (LAQM.TG(03)

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual Mean	All locations where members of the public might be regularly exposed. For example: building facades of residential properties, schools, hospitals, libraries etc.	Building façades of offices or other places of work where members of the public do not have regular access. For example: gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour Mean and 8-hour Mean	All locations where the annual mean objective would apply. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour Mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend 1-hour or more. Any outdoor locations to which the public might reasonably expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

11.2.4 Impact identification, significance levels and mitigation

The significance level (negligible, minor, moderate, major adverse or beneficial) of identified impacts are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification and Table 4.4 for definitions of significance levels.

11.3 Existing Environment

11.3.1 Air quality in North Norfolk and Broadland districts

General

The Sheringham Shoal onshore grid connection would extend from Weybourne (a coastal village on the North Norfolk coast) for a distance of approximately 21.3km, to the Salle substation near Cawston (a village approximately 12 miles north of Norwich). The route has been numbered in sections from 1-13 for consistency, as discussed in Section 4: 'Legislative Context and the EIA Process'. The onshore grid connection would be located within the jurisdiction of two local authorities: NNDC and BDC.

The grid connection will pass through rolling coastal heath, arable land, wooded parkland, rolling open farmland, and underneath or in close proximity to the following roads: A149, A148, B1354, B1149, and B1145.

Air Quality Updating and Screening Assessments (USA) were completed by NNDC and in 2006.

The USA for NNDC predicted compliance for all air quality objectives in the North Norfolk area. The USA for BDC predicted compliance for all air quality objectives except PM_{10}, which was predicted to exceed the 24 hour mean objective at one location - a busy junction on the outskirts of Norwich.

The 2006 USAs undertaken by NNDC and BDC indicate that the proposed onshore grid connection is located in an area where the health based air quality objectives, including those for nitrogen dioxide and particulate matter, as outlined in **Table 11.1** are likely to be met.

There are no air AQMA's in either North Norfolk or Broadland District Council areas.

Nitrogen dioxide

Nitrogen dioxide air quality monitoring is carried out by NNDC and BDC.

Continuous automatic monitoring is not carried out by BDC. However, monitoring of NO_2 concentrations is undertaken at ten locations around the city of Norwich using diffusion tubes.

Air quality around the city is not representative of air quality within the study area, therefore nitrogen dioxide monitoring data from BDC's diffusion tube network will not be considered further in this assessment.

NNDC uses diffusion tubes to monitor nitrogen dioxide at eleven sites located in Cromer, North Walsham, Fakenham, Hoveton and Bacton. Continuous automatic monitoring for nitrogen dioxide is carried out at one site located in Bacton. For the year 2005 Annual mean concentrations of nitrogen dioxide at these sites (diffusion tube and automatic) were below national air quality objectives (data provided as **Appendix 11.1**).

NNDC has included coastal and inland sites in its nitrogen dioxide monitoring network. Results from these sites may be considered broadly representative of the study area, although monitoring results from sites located in Bacton may be influenced by emissions from the Bacton Gas Terminals. NNDC's nitrogen dioxide monitoring results for the year 2005 are provided in **Appendix 11.2**.

Average local background NOx and NO_2 concentrations across BDC and NNDC were taken from the national pollutant maps on the NAQIA. Concentrations in future years were calculated using the year adjustment factors also on the NAQIA website.

The derived pollutant concentrations shown in **Table 11.3** indicate levels of NOx and NO_2 well below the annual mean air quality objective for nitrogen dioxide in 2007, and 2010. 2007 is taken as the base year for the scheme and 2010 is the year set for compliance with the EU Limit value for NO_2.

NAQIA factors account for the likely changes in background concentrations resulting from changes in emissions, incorporating the expected impact of both changes in activity (such as traffic movements) and emission factors (such as tighter vehicle and fuel standards) for both traffic and stationary sources. They have been calculated as the average of site-specific projections of concentrations at a range of sites around the UK.

These data include estimated contributions from nearby roads and industrial sources. Concentrations are predicted to decrease over the period 2007-2010. Technical Guidance (TG (03)) to Part IV of the Environment Act 1995, relating to Local Air Quality management, states that:

> "*background concentrations of all the regulated pollutants are expected to decline in future years, as a result of Government and EU policies and legislation to reduce pollutant emissions*".

Particulate Matter PM_{10}

PM_{10} air quality monitoring is not carried out by BDC. Continuous automatic monitoring for concentrations of PM_{10} is carried out by NNDC at one site located in Bacton. For the year 2005 concentrations of PM_{10} were below national air quality objectives at this site. Monitoring results from sites located in Bacton may be influenced by emissions from the Bacton Gas Terminals. NNDC's PM_{10} monitoring results are provided in **Appendix 11.2**.

Average local background PM_{10} concentrations across BDC and NNDC were taken from the national pollutant maps on the NAQIA. Concentrations in future years were calculated using the year adjustment factors also on the NAQIA website.

The derived pollutant concentrations in **Table 11.3** show PM_{10} background concentrations well below the 2004 annual mean air quality objective for PM_{10} in 2007 and 2010. These data include estimated contributions from nearby roads and industrial sources.

Table 11.3 NAQIA Estimated Average Background Concentrations (μg.m^{-3}), Broadland District Council and North Norfolk District Council

Year	NO_x 2007	NO_x 2010	NO_2 2007	NO_2 2010	PM_{10} 2007	PM_{10} 2010
Broadland District Council	12.6	11.4	10.11	8.9	19.2	18.3
North Norfolk District Council	10.8	9.8	8.7	7.7	18.1	17.2
Directional drilling site 1	10.5	9.6	8.5	7.5	17.6	16.7
Directional drilling site 2	10.6	9.6	8.5	7.5	17.9	17.0
Directional drilling site 3	10.6	9.6	8.5	7.5	18.0	17.2
Directional drilling site 4	10.8	9.8	8.7	7.7	18.2	17.3
Area of proposed substation	11.0	10.0	8.9	7.8	18.4	17.5
Annual Mean Air Quality Objective NO_2 & PM_{10}	40μg/m^3					

11.3.2 Air quality in grid connection study area

In area of proposed cable route

Air quality in the area of the proposed route will be as described for the general study area (Section 11.3.1).

In areas of proposed directional drilling

Directional drilling will take place at locations where open trenches are not feasible, for example through wooded areas, water courses or railways. It is anticipated that directional drilling will be undertaken in four areas as discussed in Section 3: 'Project Details'.

Air quality monitoring is not carried out in the areas of proposed directional drilling. Local background NOx, NO_2 and PM_{10} concentrations for the proposed areas of directional drilling were taken from the national pollutant maps on the NAQIA. The derived pollutant concentrations shown in **Table 11.3** indicate levels below the 2005 annual mean air quality objectives for NO_2 and PM_{10} in 2007 and 2010.

In area of proposed substation

Air quality monitoring is not carried out in the area of proposed substation. Local background NOx, NO_2 and PM_{10} concentrations for this area were taken from the national pollutant maps on the NAQIA. The derived pollutant concentrations shown in **Table 11.3** indicate levels below the 2005 annual mean air quality objectives for NO_2 and PM_{10} in 2007 and 2010.

11.3.3 Existing sources of dust

Dust particles in the atmosphere arise from a wide variety of sources. Particles may be generated mechanically, for example by the wind, may be emitted directly to the atmosphere or may be formed by reactions in the atmosphere from precursor gases. The three major sources of dust are outlined below:

- Chemical reactions of gases in the atmosphere.
- Combustion processes.
- Mechanical generation.

Naturally occurring fine particles are included in the PM_{10} data above. The majority of dust in the study area is thought to be formed through mechanical generation for example, friction from wear of vehicle tyres and brakes, particles emitted from erosion of agricultural soils, and sea-salt particles.

11.4 Impacts During Construction

11.4.1 Emissions from road vehicles

National Society for Clean Air and Environmental Protection (NSCA) guidance suggests that the need for an air quality assessment should be considered for developments that will result in increased congestion, changes in traffic volumes (for example 5% Annual Average Daily Traffic (AADT) or peak), vehicle speed (+/- 10kph), or changes in traffic composition (e.g., number of HGVs), on roads with greater than 10,000 vehicles per day. The pollutants of concern arising from traffic are nitrogen oxides (NOx), and particulate matter (PM_{10}).

It is anticipated that installation of cables within the cable route, directional drilling, and construction of the substation would result in changes in traffic volume and composition on haul roads used by construction vehicles. In addition, construction works would result in disruption to traffic due to temporary road closures, temporary traffic lights and detours, potentially resulting in significant traffic congestion.

Vehicle emissions increase on congested roads due to changes in traffic speed. The highest vehicle emission rates occur at very slow speeds (<5 km/hr) for all pollutants. The lowest emission rates occur at 60-65 km/hr for NOx, 65-80 km/hr for PM_{10}.

Vehicle emissions would increase around temporary construction laydown/compound areas which would be established at suitable locations (not yet identified) along the length of the proposed cable route and at the Salle substation. The impact of road traffic emissions associated with the compound areas is predicted to be minor on the basis of both the duration and scale of the work.

There is potential for more significant air quality impacts along the main haul routes as both the number of vehicle movements and the duration of the impact will be greater. Identification of haul routes, likely access points, and diversion routes to be used during road closures, will be agreed with Norfolk County Council Highways Authority following consent.

Clarification on the size and number of heavy goods vehicles to be used and location of compound areas would also be provided following consent. Therefore the impact of emissions from on road vehicles associated with installation of the onshore cable can not be assessed at this time.

11.4.2 Emissions from non road mobile machinery

Emissions of NOx and PM_{10} from diesel off-road vehicles (known as non-road mobile machinery, NRMM) can be significant. Emissions from NRMM used during construction are predicted to have a minor adverse impact on air quality.

Mitigation – Emissions - non road mobile machinery during construction
• All NRMM should use fuel equivalent to ultra low sulphur diesel (fuel meeting the specification within EN590:2004) wherever feasible. • All NRMM shall comply with either the current or previous EU Directive Staged Emission Standards (97/68/EC, 2002/88/EC, 2004/26/EC). As new emission standards are introduced the acceptable standards will be updated to the previous and most current standard. • All NRMM shall be fitted with Diesel Particulate Filters (DPF) conforming to a defined and demonstrated filtration efficiency (load/duty cycle permitting). • The ongoing conformity of plant retrofitted with DPF, to a defined performance standard, shall be ensured through a programme of on-site checks. • Implementation of energy conservation measures including throttle down or switch off idle construction equipment, switch off the engines of trucks while they are waiting to access the site and while they are being loaded or unloaded, maintain equipment to ensure efficient energy consumption.

As a result of the implementation of the above mitigation measures, there will be a **negligible** residual impact from NRMM on local air quality.

11.4.3 Construction dust

The effect of construction dust is difficult to quantify accurately as it depends on a number of factors including the activity taking place, the type of dust emitted, the location and nature of sensitive receptors and meteorological conditions. This issue is therefore dealt with qualitatively in this assessment.

A summary of activities during cable installation and substation construction that could lead to dust emissions and their potential to emit dust (assessed with respect to the duration of the activity or the potential of the dust to become airborne) is outlined in **Table 11.4**.

Fugitive construction dust emissions have the potential to cause significant nuisance at nearby receptors, such as residential properties and ecologically sensitive areas, by causing soiling of surfaces. In addition, a proportion of dust emitted will be in the form of fine particles which can have an adverse effect on human health. However, studies have shown that typically only around 20% of total suspended particulate matter from construction activity is in the PM_{10} size range.

Table 11.4 Potential for dust emissions from construction activities

Activity	Duration of Activity	Potential for Dust Emission
Excavation of trenches and earthworks	Ongoing	Varies depending on meteorological conditions
Loading/Unloading activities	Ongoing	Varies depending on nature of material and exposure to wind.
Dust from road haul transportation on site.	Ongoing	May be significant depending on vehicle size and nature of roads (surfaced or unmade).
Stockpiles and storage mounds	Ongoing	Significant depending on nature of material and exposure to wind.

There is no definitive source of information on the generation of fugitive dust from construction activities. The DEFRA Technical Guidance on air quality assessment for the purposes of local air quality management (TG (03)) provides a screening approach for the determination of the likely contribution of various pollutant sources to ambient air quality. For the review and assessment of fugitive and uncontrolled PM_{10} sources, including major construction works, TG (03) states:

> "*Emissions from these sources are not well quantified and it is therefore difficult to predict PM_{10} concentrations with any accuracy. It should be noted that these fugitive sources will only impact upon the objectives if they are in operation in or after 2004 or 2010*".

The guidance further states that *"concentrations fall off rapidly on moving away from the source"* and the determination of public exposure should consider the distance to the actual source and not to the site boundary.

Potential exposures beyond 200m of the source can be ignored (for the purposes of assessment against the PM_{10} objective) if the background concentration is less than 26µg/m^3. Background concentrations of PM_{10} in the study area are estimated by the NAQIA to be well below this and so only those receptors within 200m of the construction activities have the potential to be significantly affected.

In order to identify the distance of sensitive receptors from the proposed cable route four buffer zones were created along the length of the route at the following distances from the route: 0-50m, 50-100m, 100-200m and 200-300m (**Figure 11.1**).

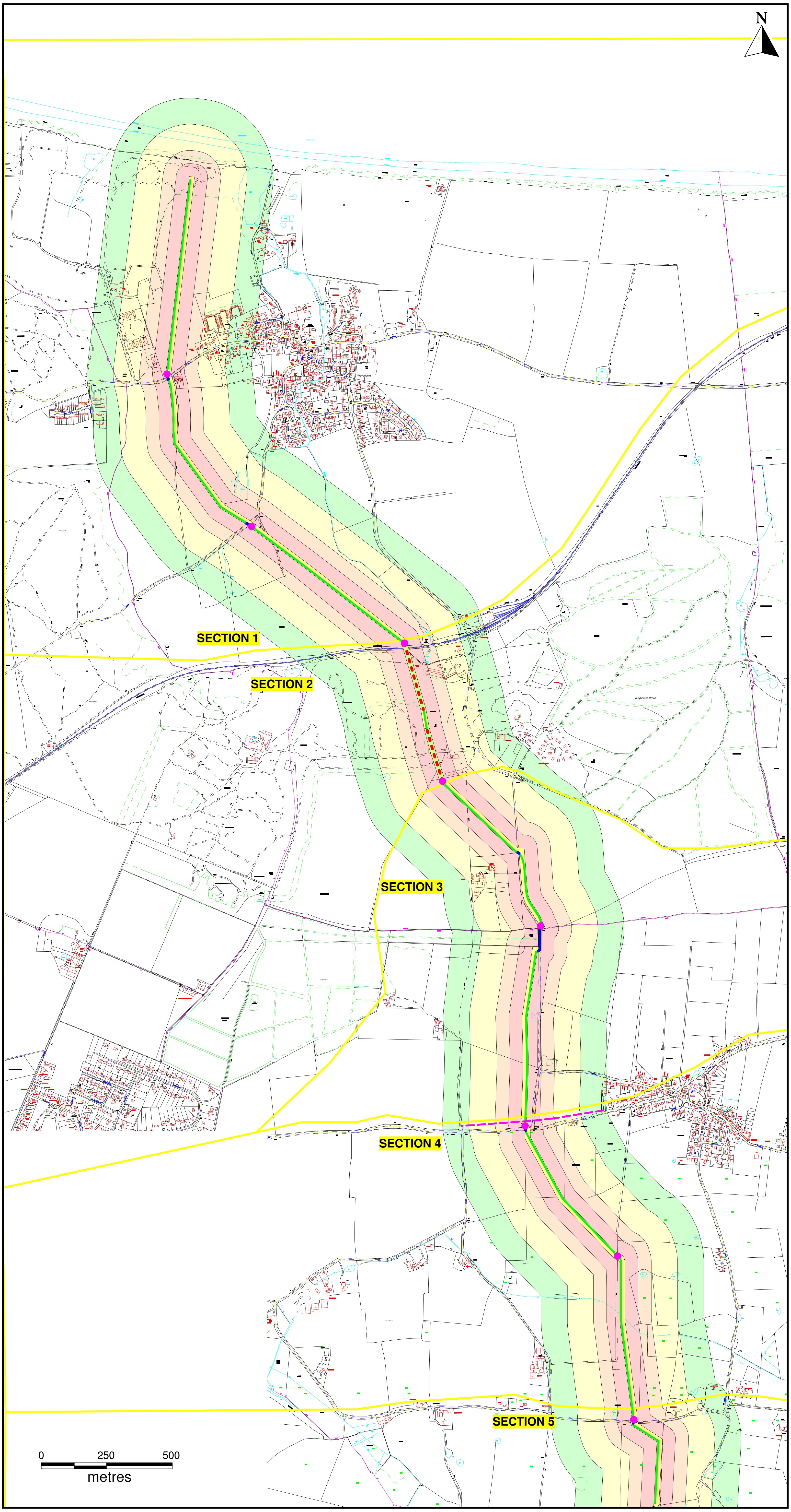
Table 11.5 identifies the proximity of receptors along the route.

A large number of sensitive receptors were identified in close proximity (within 200m) to construction works along the following sections of the proposed route: 1, 2, 3, 5, 6, 7, 8, 10 and 11 (sections refer to the standard sections of the route outlined in Section 4: 'Legislative Context and the EIA Process'). Receptors within route sections 1, 6, and 10 are within very close proximity (50m) of directional drilling.

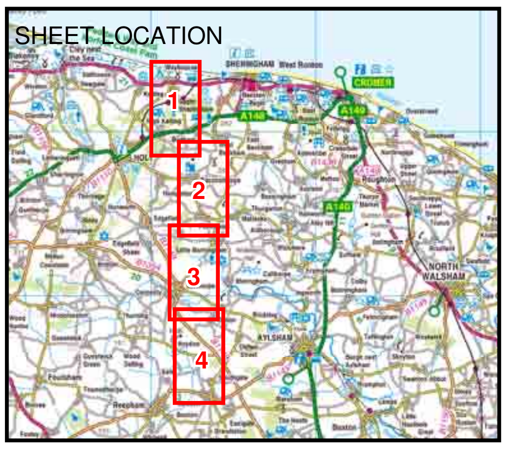
Table 11.5 Proximity of sensitive receptors along proposed onshore cable route
✓ = sensitive receptors present

Route Section	Location	0-50m	50-100m	100-200m	200-300m
1	Muckleburgh to Poppy Line Railway	✓	✓	✓	✓
2	Kelling Heath/Hundred Acre Woods		✓	✓	✓
3	North of Bodham			✓	✓
4	Bodham				✓
5	Baconsthorpe Castle			✓	✓
6	Baconsthorpe to Plumstead	✓	✓	✓	✓
7	South to Plumstead		✓	✓	✓
8	Little Barningham		✓	✓	✓
9	North of Saxthorpe and River Bure				✓
10	South of Saxthorpe and River Bure	✓	✓		✓
11	Heydon			✓	
12	East of Salle Park				
13	Salle Substation and land to North				✓

The proximity of sensitive receptors to proposed areas of directional drilling is outlined in **Table 11.6**. Sensitive receptors within 200m of directional drilling were identified at directional drill locations 1, 2 and 3. Receptors at directional drill location 2 are within very close proximity (50m) of directional drilling.



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION EIA study area divisions

Air Quality Buffer Zones

- 0m - 50m
- 50m - 100m
- 100m - 200m
- 200m - 300m

Title:
BUFFER ZONES FROM CONSTRUCTION AREA FOR AIR QUALITY ASSESSMENT

SHEET 1 OF 4

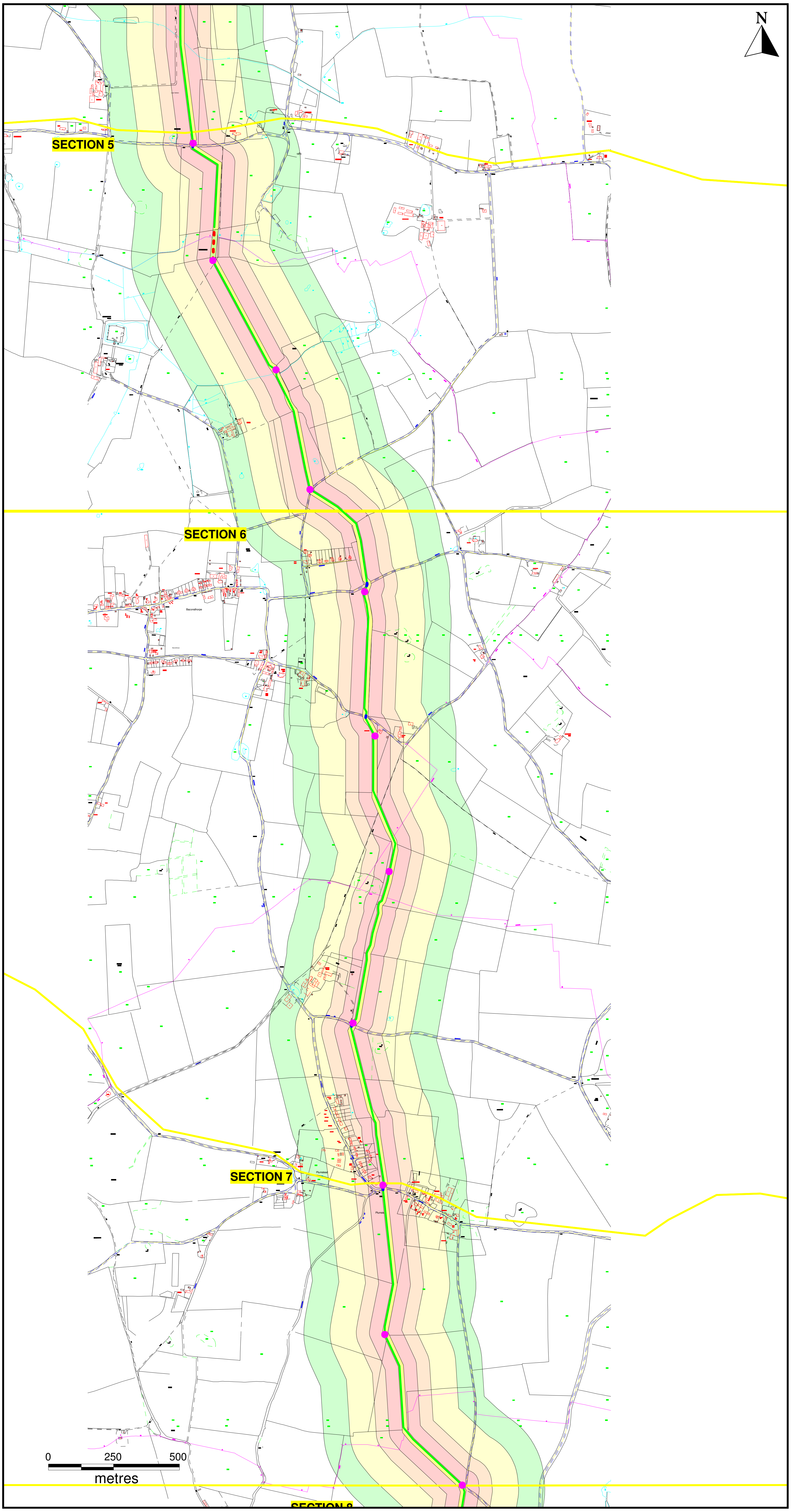
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

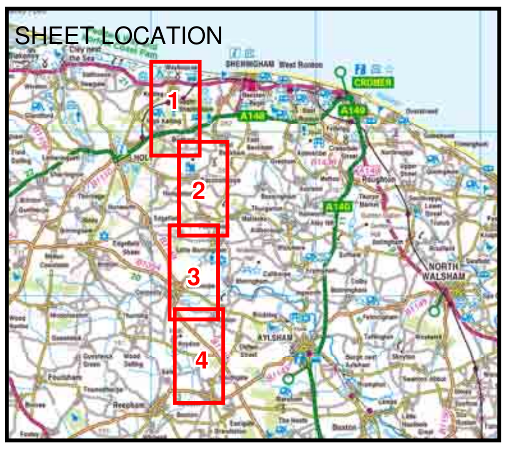
Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 11.1 (1 of 4)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION — EIA study area divisions

Air Quality Buffer Zones

- 0m - 50m
- 50m - 100m
- 100m - 200m
- 200m - 300m

Title:
BUFFER ZONES FROM CONSTRUCTION AREA FOR AIR QUALITY ASSESSMENT

SHEET 2 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

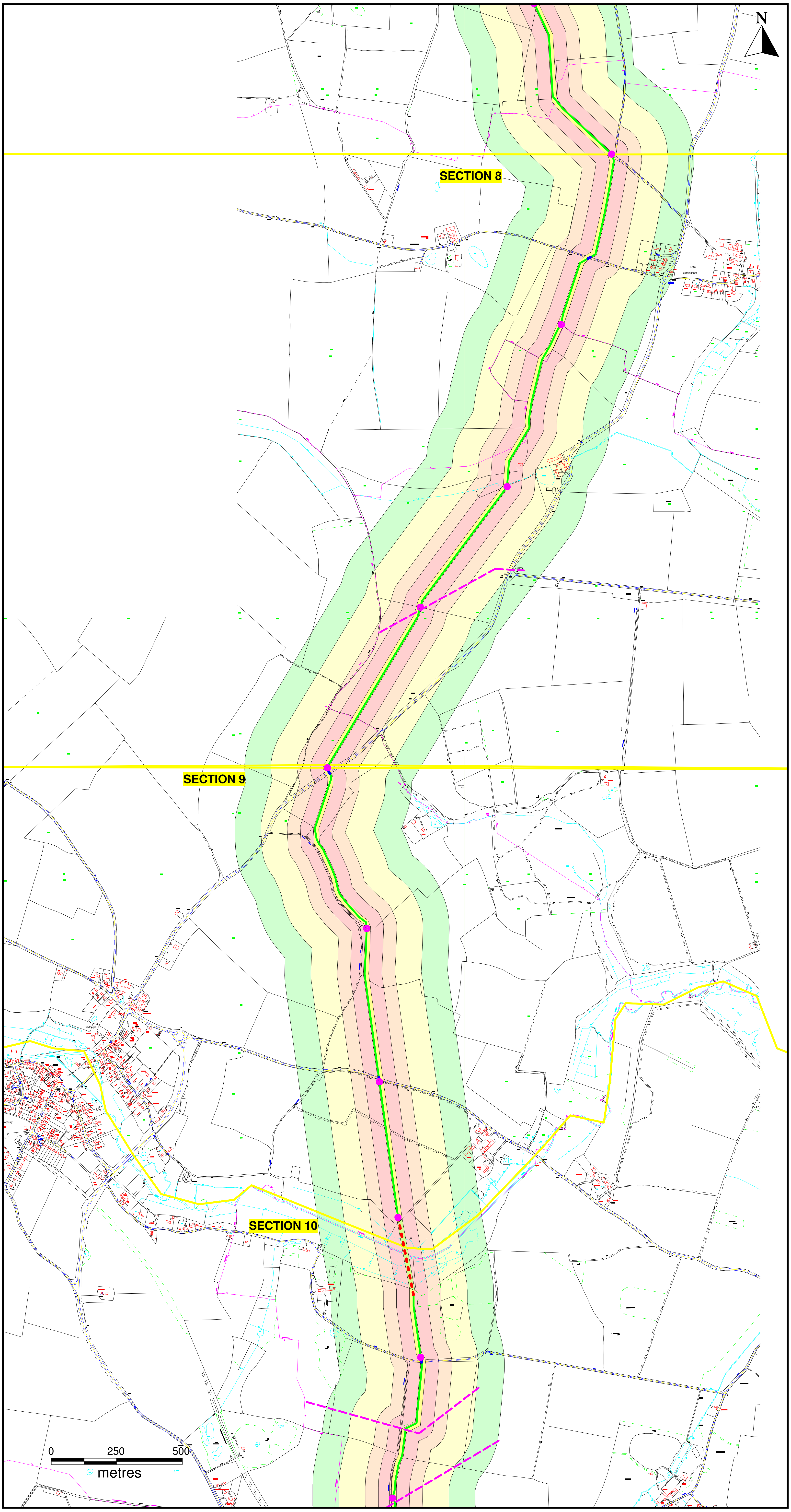
Client:
SCIRA OFFSHORE ENERGY LTD.

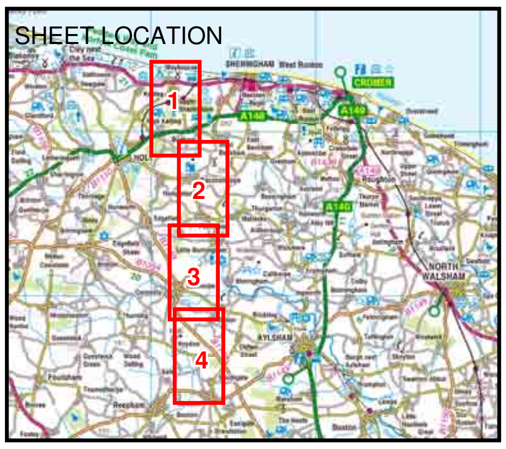
Date:
AUGUST 2007

Scale:
NTS

Figure:
FIGURE 11.1 (2 of 4)

ROYAL HASKONING





LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION — EIA study area divisions

Air Quality Buffer Zones

- 0m - 50m
- 50m - 100m
- 100m - 200m
- 200m - 300m

Title:
BUFFER ZONES FROM CONSTRUCTION AREA FOR AIR QUALITY ASSESSMENT

SHEET 3 OF 4

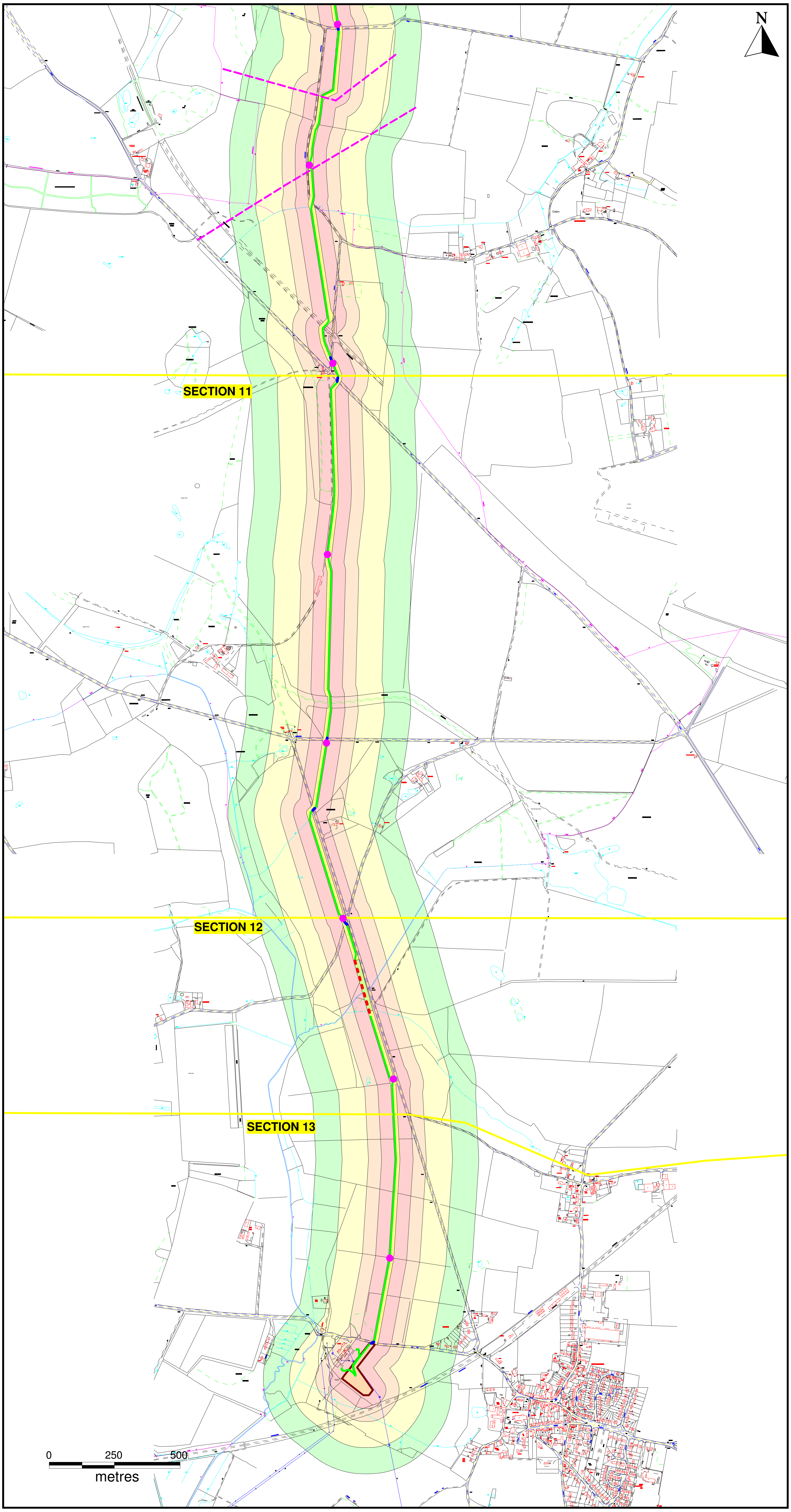
Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

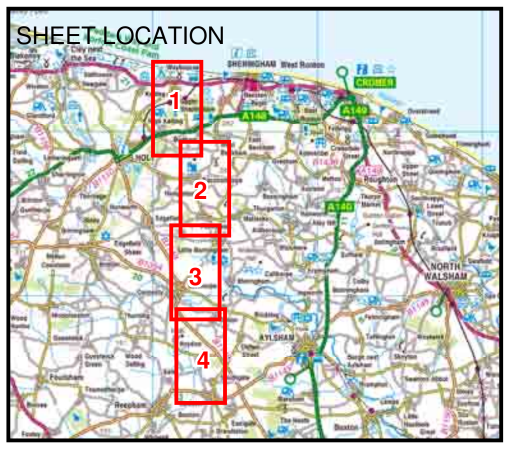
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 11.1 (3 of 4)

ROYAL HASKONING





LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor
- Extent of underground cabling for directional drills

Substation

- Total extent of proposed substation

Study Area

- SECTION — EIA study area divisions

Air Quality Buffer Zones

- 0m - 50m
- 50m - 100m
- 100m - 200m
- 200m - 300m

Title:
BUFFER ZONES FROM CONSTRUCTION AREA FOR AIR QUALITY ASSESSMENT

SHEET 4 OF 4

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 11.1 (4 of 4)

ROYAL HASKONING

Table 11.6 Proximity of sensitive receptors to proposed directional drill locations
✓ = sensitive receptors present

Drill No.	Drill Location	0-50m	50-100m	100-200m	200-300m
1	Poppy Line Railway and Kelling Heath Holiday	✓		✓	✓
2	Baconsthorpe Wood				
3	River Bure				✓
4	Woodland East of Salle park				

There are no sensitive receptors within 200m of the proposed substation.

Potential exposures beyond 200m of the source can be ignored.

In assessing the impact of construction dust emissions the following factors have been considered:

- Although the impact will be localised (i.e., within 200m of the source), it will occur on a large scale as the onshore grid connection will be approximately 21.3km long.
- The installation of cable works are anticipated to occur at a rate of 1000 metres per gang per week.
- The impacts are predicted to be short term i.e. they will occur during construction activities only.
- Dust nuisance is reversible i.e., it will occur during construction activities only.
- The impact is certain to occur although the properties affected will vary depending on where the dust raising activity takes place and the wind direction.

Without mitigation, construction dust emissions from cable installation, directional drilling and the substation construction activities are predicted to have a short term moderate adverse impact on sensitive receptors within 200m of construction activities. The following mitigation measures would be carried out:

Mitigation – dust during construction
• A Code of Construction Practice (COCP) will be implemented for the construction of the onshore grid connection as outlined in the Greater London Authority and London Councils Best Practice Guidance. • The COCP will incorporate construction dust minimisation and management techniques. • The approach should follow Best Practice Guidance on the control of dust emissions from medium risk construction activities.

Effective implementation of the stated mitigation measures will reduce the impact of construction emissions on sensitive receptors to short term **minor adverse**.

11.4.4 Specific impacts relating to substation

The air quality impact of emissions from on road vehicles, non road mobile machinery, and construction dust in the area of substation are described in sections 11.4.1, 11.4.2 and 11.4.3.

It should be noted that the duration of construction works at the substation is likely to be 15 to 18 months, which is longer than that of other single location associated with the cable route. Dust emissions are likely to be significant only during particular activities, such as the main ground works (removal of soil, levelling, foundations, compacting and surfacing, drainage systems), site reinstatement and landscaping.

As shown in **Table 11.5** and **Figure 11.1**, the closest sensitive receptors to the site are more than 200m away.

Following the implementation of suitable mitigation measures already specified, impacts as a result of nuisance dust or a deterioration in air quality are predicted to be **minor adverse**.

11.4.5 Cumulative impacts

It is understood that EDFE would need to undertake additional work at the existing Salle substation, with a likely duration of 14 months. This would comprise seven months of civil works and eight months of electrical works, with a one month overlap. It is not yet known whether this work would coincide with the cable and substation work to be carried out by Scira.

The EDFE work would involve significant earth movements resulting in a large number of HGV vehicle trips to remove waste soil. There would also be movements of personnel vehicles, occasional cranes, tele-handlers and tippers. The total number of vehicle movements is not known, but these are likely to be concentrated in the seven months of civil work.

Should the Scira and EDFE work coincide, the cumulative impact in terms of construction dust, NRMM and road vehicle emissions would be greater. It is possible that the two projects, in combination, would cause greater local road congestion, slowing vehicle speeds and increasing the overall impact on air quality. However, as a result of the separation distance between the substation and sensitive receptors and the relatively short duration, the impacts are predicted to be of moderate significance, reducing to minor if appropriate measures are adopted into the COCP.

In the case that the construction periods do not overlap, the impact of the EDFE work in terms of air quality would not be affected. However, the longer period of disturbance may increase the public perception of nuisance and loss of amenity. This will be reflected in the mitigation measures adopted as part of the COCP, ensuring that disruption is minimised as far as is practical.

11.5 Impacts During Operation

Following the installation of the cable system and the substation, traffic would return to its normal routing. The operation of the buried cable system is not predicted to result in an increase in traffic during operation; therefore there would be **no impact** on local air quality.

For the operational substation, traffic generation would be limited to annual maintenance visits, carried out in light vehicles; therefore **no impact** on local air quality is envisaged.

11.6 Summary

Exceedences of UK air quality objectives are not predicted in the area proposed for the onshore grid connection. Local background concentrations of NO_2 and PM_{10} are below air quality objectives in 2007 and 2010.

Identification of haul routes, likely access points, and diversion routes to be used during road closures, would be agreed with NNDC and BDC following consent. Therefore the impact of emissions from on road vehicles associated with installation of the onshore cable can not be assessed at this time. Emissions from NRMM used during construction are predicted to have a minor adverse impact on air quality. Implementation of the proposed mitigation measures will reduce the impact from NRMM on air quality to **negligible**.

In assessing the impact of construction dust emissions a number of factors were considered including the magnitude, special extent, duration, and reversibility of the impact. The probability of occurrence of the impact was also considered.

The air quality assessment has reported that construction emissions are predicted to have a short term moderate adverse impact on sensitive receptors within 200m of construction activities. However the successful implementation of proposed mitigation measures will reduce the impact of construction emissions on sensitive receptors near the cable route to short term, **minor adverse** significance. Following the mitigation methods outlined, the construction of the substation is likely to cause a **minor adverse** impact on air quality. It is therefore not necessary to undertake monitoring of dust during the construction phase.

Following completion of the cable system and substation the operational phase would result in **no impact** on local air quality.

11.7 References

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Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 12

LAND USE, LOCAL COMMUNITY, TOURISM AND RECREATION

12 LOCAL COMMUNITY, LAND USE, TOURISM AND RECREATION

12.1 Introduction

This section describes the current land use of the areas potentially affected by the construction and operation of the onshore components of the Sheringham Shoal Wind Farm grid connection and discusses some of the land use and local community issues raised as part of the EIA consultation project, which are not already dealt with elsewhere within this Environmental Statement.

The Scoping stage identified that although no major sensitivities or problems were envisioned; it was necessary to assess the impact on land use, tourism and the interests of the local community.

12.2 Assessment Methodology

12.2.1 Relevant planning policy

Planning Policy Statement 1: Delivering Sustainable Development (PPS1) sets out the importance of community involvement in the planning process:

> '*The outcomes from planning affect everyone, and everyone must therefore have the opportunity to play a role in delivering effective and inclusive planning. Community involvement is vitally important to planning and the achievement of sustainable development.'*
>
> *'Local communities should be given the opportunity to participate fully in the process for drawing up specific plans or policies and to be consulted on proposals for development.'*

Planning Policy Guidance 17: Planning for Open Space, Sport and Recreation (PPG17) sets out the policies that need to be taken into account by regional and local planning authorities with regard to open space, sport and recreation. The objectives of PPG17 include supporting networks of high quality, well managed open spaces, sports and recreational facilities; supporting rural recreation; promoting social inclusion and community cohesion; improving health and wellbeing through recreation; and supporting sustainable development within sport, open spaces and recreational facilities. A number of points raised within PPG17 are relevant to the development:

> *'Rights of way are an important recreational facility, which local authorities should protect and enhance'.*
>
> *'Existing open space, sports and recreational buildings and land should not be built on unless an assessment has been undertaken which has clearly shown the open space or the buildings and land to be surplus to requirements'.*
>
> *'Developers will need to consult the local community and demonstrate that their proposals are widely supported by them'.*
>
> *'Open space and sports and recreational facilities that are of high quality, or of particular value to a local community, should be recognised and given protection by local authorities through appropriate policies in plans. Areas of particular quality may include…small areas of open space in urban areas that provide an important local amenity and offer recreational and play opportunities; and… areas of open space that particularly benefit wildlife and biodiversity'.*

12.2.2 Data collection

Information concerning the existing land use and tourism and recreation features within the area of the onshore grid connection between Weybourne and Salle has been collected from site visits, maps, and local data sources. Public meetings were held in the villages of Bodham, Saxthorpe/ Corpusty and Cawston as part of the Scoping stage of the EIA to establish information relating to the local community interests. The baseline conditions have therefore been established through desktop studies and consultation. The potential effects of the proposed grid connection have been identified and assessed and, where relevant, mitigation measures have been identified.

12.2.3 Impact identification, significance levels and mitigation

Potential impacts occurring from the onshore grid connection have been identified and assessed, taking into account both the sensitivity of economic, recreational and tourism features of the area and the likely magnitude of effects. Where potentially significant effects are predicted appropriate mitigation is proposed.

The significance level (negligible, minor, moderate, major adverse or beneficial) of identified impacts are shown in **bold** in this section and are considered to be the **residual** impact following successful implementation of the cited mitigation measures, good construction or operational practice or relevant regulations and guidelines. Reference should be made to Section 4.5 for further clarification and Table 4.4 for definitions of significance levels.

12.3 Existing Environment

12.3.1 Land use

General study area

The proposed site of the grid connection is located between the coastal village of Weybourne and an existing substation at Salle, near Cawston. The route is located almost entirely within private agricultural land, with the exception of several areas of woodland, a railway, a holiday park, and locations where it crosses the road network and is therefore owned and maintained by the Highways Authority, in this case Norfolk County Council.

The proposed grid connection cable route begins at the Muckleburgh Collection museum in Weybourne and then passes in a southerly direction about 200m west of the villages of Weybourne and Lower Bodham, through the Kelling Heath Holiday Park (discussed further below). It then continues approximately 300m to the east of Baconsthorpe and through a gap between the two parts of Plumstead. The route passes 400m west of the village of Little Barningham, then bypasses Saxthorpe/Corpusty to the east by approximately 1km, and after passing Cawston about 400m to the east, it finally reaches the substation at Salle (which is located between Cawston and Salle).

The predominant land use of the proposed route is cultivated agricultural land, with occasional fields under pasture. Some exceptions to this include the locations where the route passes across or through the road network; the location where the route crosses the North Norfolk Railway (Poppy Line); and the crossing of the River Bure. The route also passes through several areas of woodland at Kelling Heath/Hundred Acre Woods, Carman's Belt, Baconsthorpe Wood and a woodland strip east of Salle Park. The woodland at Kelling Heath/Hundred Acre Woods is an operational holiday park and a County Wildlife Site.

Fields are generally separated by hedgerows with occasional trees. Watercourses and surface water features (i.e. ponds) are present along parts of the study area, but in general are fairly limited (refer to Section 8: 'Geology, Hydrogeology, Hydrology and Land Quality'.

In areas of proposed directional drilling

In certain locations, it has been assessed that an open-trench cable installation method would not be suitable, for example when crossing certain woodlands, railways and larger watercourses. The characteristics of the land uses within these particular areas are discussed in more detail below.

- **Kelling Heath/Hundred Acre Woods and Poppy Line Railway**

  The proposed cable route passes through the 'Cromer Ridge' at a point where the ridge comprises of a large woodland known as Kelling Heath and Hundred Acre Woods. The Poppy Line Railway also runs along the northern side of the woodland.

  The North Norfolk 'Poppy Line' Railway offers a round trip through an area of North Norfolk designated as being an Area of Outstanding Natural Beauty (AONB). To the south are wooded hills and the Norfolk beauty spots of Kelling Heath and Sheringham Park. To the east of the proposed crossing point is Weybourne Station, located about 900m south of Weybourne (see **Plate 12.1**). This consists of a historically preserved country station, built in 1900, which also houses a locomotive shed together with a carriage maintenance and restoration centre. The station is frequently used by walkers visiting Sheringham Park, or for walkers who wish to walk back to Sheringham along the coast. (source: www.nnrailway.co.uk/weybourne_station.htm).

  The Kelling Heath Holiday Park is a 250 acre park set amongst woodland and open heathland, close to the North Norfolk coastline at Weybourne. Kelling Heath provides more than 400 luxury caravan holiday homes and timber lodges for private owners, and hires out 40 lodges /caravan holiday homes for short breaks or longer holiday. There are also 300 pitches for the owners of touring caravans, motor-homes and tents. There is a network of footpaths around the park. The key tourism and recreational interests at the site relate to the presence of significant habitats of the woodlands (source: www. kellingheath.co.uk/).

- **Baconsthorpe Wood**

  The woodland is located north of Baconsthorpe village and to the north-east of the ruins of Baconsthorpe Castle.

- **River Bure**

  The route passes across the River Bure and associated woodland on south side (see **Plate 12.2**). The River Bure is one of the major rivers flowing through the Norfolk Broads and is an Environment Agency Main River (refer to Section 8: 'Geology, Hydrogeology, Hydrology and Land Quality' for further details).

- **Woodland East of Salle Park**

  Salle Park is a landscaped park and woodland approximately 75 hectares in size, with a formal topiary garden beside a Manor House. The study area crosses a narrow belt of the woodland with associated watercourses at the eastern limit of Salle Park.

Plate 12.1 Weybourne Station and the Poppy Line railway

Plate 12.2 The River Bure

In the area of the proposed substation

The current land use at the area of the proposed substation is arable, with some parts currently under agricultural set-aside. The site is bound to the north by the B1145 road and to the west by the existing EDFE Salle substation. Marriott's Way (a permissive path and an off-road cycle route) passes approximately 50m to the south of the site. There are no tourism or local community interests directly located on the site of the proposed substation.

12.3.2 Socioeconomic description

For each district or region a description of key socioeconomic indicators and features of their economy is given in comparison to national statistics. These data have been obtained from Demographic Information Note 3/97 (www.norfolk.gov.uk).

North Norfolk district

North Norfolk region covers an area of 98,600 hectares in area with a coastline of 68km. 80.37% of the area is agricultural land, 9.2% is urban land and 10.1% is other non-agricultural land. The built environment consists of seven towns and a large number of hamlets and villages. The population of the largest town, North Walsham, was estimated at nearly 11,500 in mid 1997. With its attractive coast and countryside, North Norfolk is a popular destination for holidays and day trips. The area boasts a number of attractions and leisure opportunities for visitors and residents.

Broadland district

Broadland is in Norfolk and includes the northern suburbs of Norwich and the rural areas to the north and east of the city. The Broadland region covers an area of 55215 hectares and includes the parishes of Drayton, Gt & Little Plumstead, Hellesdon, Horsford, Horsham & Newton St Faith, Old Catton, Postwick, Rackheath, Spixworth, Sprowston, Taverham and Thorpe St Andrew. The district has a population of 121,100 and includes the northern suburbs of Norwich and the rural areas to the north and east of the city. Broadland includes several market towns including Aylsham and Acle and numerous villages.

Norfolk county

The population of Norfolk is now estimated to be 829,000 (compared with 824,000 in the 2001 Census). The area of Norfolk is 537,085 hectares and the population density is 1.54 persons per hectare (the tenth lowest in England). Norfolk has a relatively elderly age profile – compared with England and Wales it has higher proportions of people aged 50-54 and over, and lower proportions in all the younger age groups. 38% of the County's population live in the three major built up areas of Norwich, Great Yarmouth and King's Lynn. A further 18% live in market towns, 40% live in parishes with a population of over 300, and the remaining 4% live in parishes with a population lower than 300 (www.norfolk.gov.uk).

East of England region

The East of England region covers an area of 19,120 km^2 and consists of the counties of Bedfordshire, Essex, Cambridgeshire, Hertfordshire, Norfolk and Suffolk. The majority of its land is less than 60m above ordinance datum with much of the fens and central lowlands being at or below sea level.

The region's population is approaching 5.5 million. The main population centres are Peterborough, Norwich and Cambridge.

The population of each of the Norfolk districts and each of the Counties within the East of England Region are provided within **Table 12.1**.

Table 12.1 Populations in East of England Region and Norfolk counties & districts 2005

Norfolk County		**East of England Region**	
Districts	**Population**	**Counties**	**Population**
Breckland	127,100	Bedfordshire	397,700
Broadland	121,100	Cambridgeshire	588,900
Great Yarmouth	92,500	Essex	1,340,000
Kings Lynn & West Norfolk	140,400	Hertfordshire	1,048,200
North Norfolk	100,200	Norfolk	824,200
Norwich	127,600	Suffolk	692,100
South Norfolk	115,300		

(source: www.nomisweb.co.uk)

12.3.3 Local community consultation

The proposed onshore grid connection passes through the parishes of Weybourne, Bodham, Baconsthorpe, Matlaske, Plumstead, Little Barningham, Itteringham, Corpusty and Saxthorpe, Oulton, Heydon and Cawston.

The local communities of North Norfolk and the Broadland district have been extensively consulted throughout the EIA process, as discussed in Section 4: 'Legislative Context and the EIA Process' through consultation with the local parish councils and public exhibitions in order to obtain information on any issues of concern in relation to the onshore grid connection.

Three public exhibitions were held between 24 and 26 October 2006 in Bodham, Saxthorpe/Corpusty and in Cawston as part of the EIA consultation process. These exhibitions were held to ensure that local people were aware of the proposal and to note and respond its issues and concerns raised.

The exhibitions were advertised widely in the local press and posters were put up in libraries, schools, public notice boards. Amongst the invitees and attendees were representatives from several parish councils, Norfolk County Council Highways officers, North Norfolk District Council and Broadland District Council councillors and officers, landowners and other local people.

A total of 114 visitors attended the exhibitions, of which 38 returned a questionnaire. Information packs were issued to all attendees, which included a copy of the poster panels displayed in relation to the grid connection project. Attendees at each exhibition are summarised below:

- Bodham: 57.
- Saxthorpe/ Corpusty: 32.
- Cawston: 25.

Plate 12.3 Public exhibition at the Corpusty and Saxthorpe Centre

Chart 12.1 summarises the results of two of the questions included on the public exhibition questionnaires. 89% of the exhibition visitors were in favour of wind farm being built off the coast of Sheringham. The main benefits listed by attendees included:

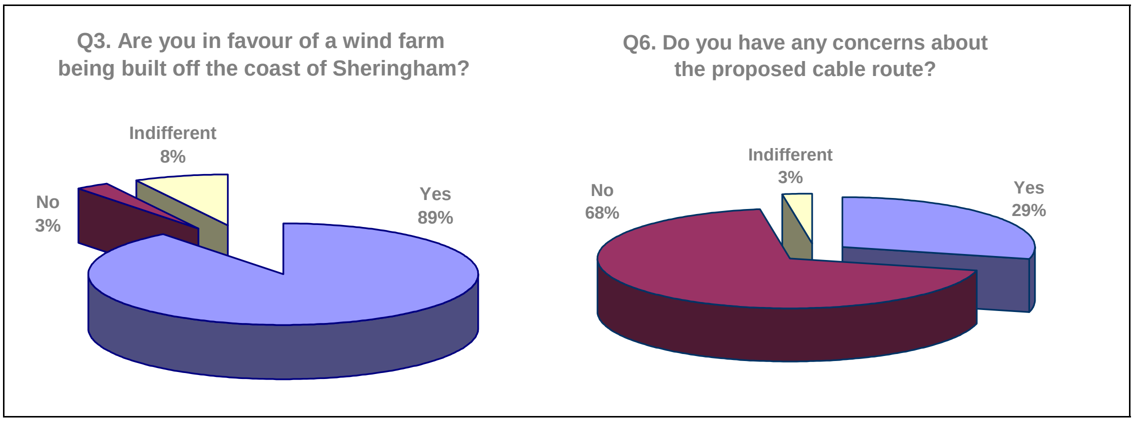
- Eco-friendly, cheaper, renewable energy, resulting in reduction of carbon emissions and greenhouse effect, and of benefit to future generations.
- May result if fewer power stations, including nuclear.
- Less reliance on gas, oil, coal and nuclear.
- More consistent supply of electricity.
- Onshore works may result in improved road construction following reinstatement.
- May provide local employment.
- Could become a tourist attraction.

68% reported that they had no concerns in relation to the proposed onshore cable connection; however 29% of the visitors did express concerns over some particular aspects.

The main areas of concern in relation to the proposed onshore grid connection are listed below, however it should be noted that the majority relate to the possibility of routing the cable along the local road network, which was still under consideration at the time of the public exhibitions:

- Traffic disruption if cables routed along the local road network.
- Use of unsuitable minor roads as temporary diversions if roads require closure.
- Possible conflict with agricultural activities also generating short term heavy traffic movements.
- Quality of road reinstatements.
- Proximity of trees in relation to the proposed road route.
- Specific concerns relating to the use of the railway bridge at Weybourne Station and closure of Sandy Hill Lane.

Chart 12.1 Public exhibition questionnaire analysis extract

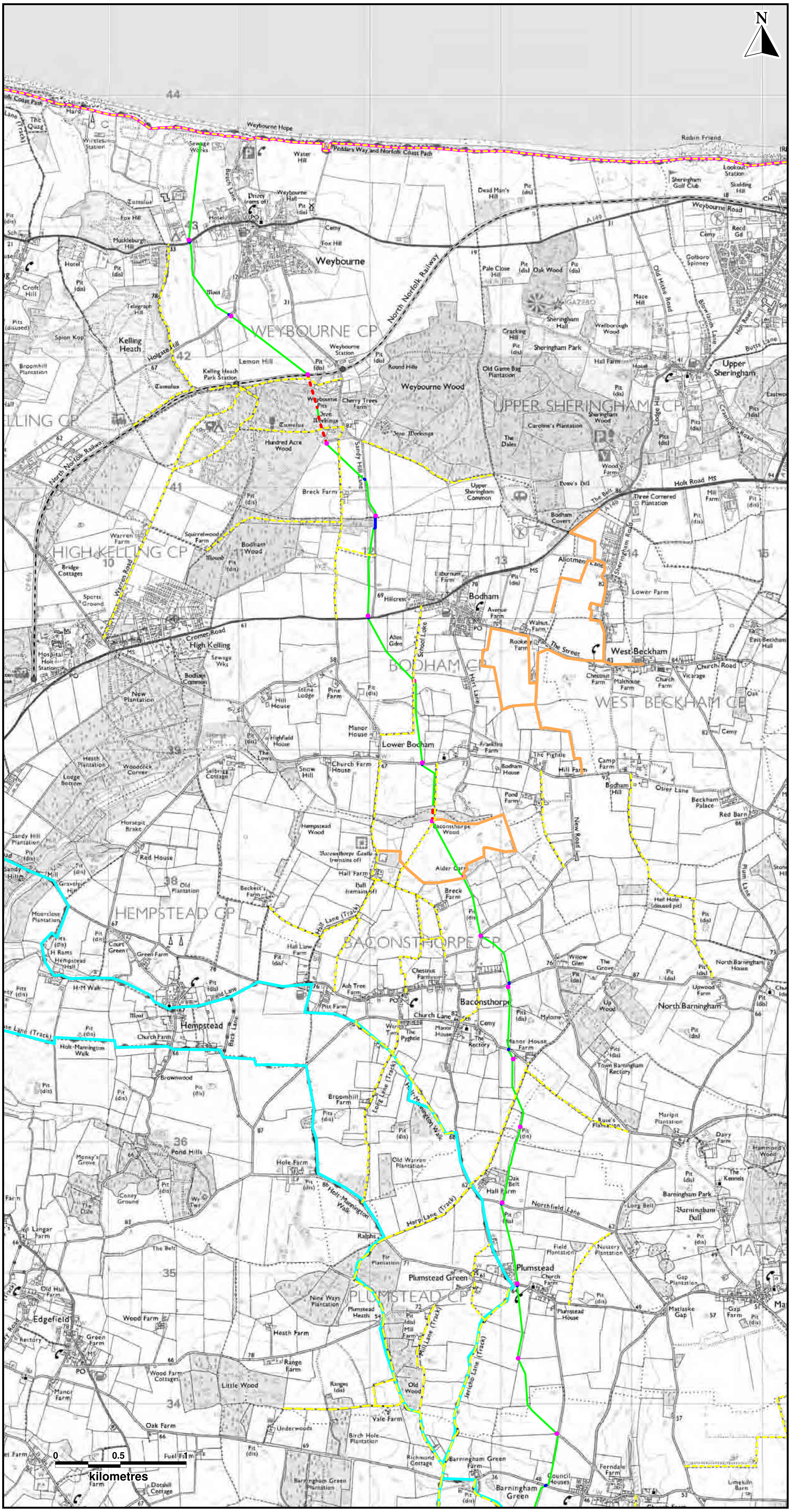


12.3.4 Public Rights of Way

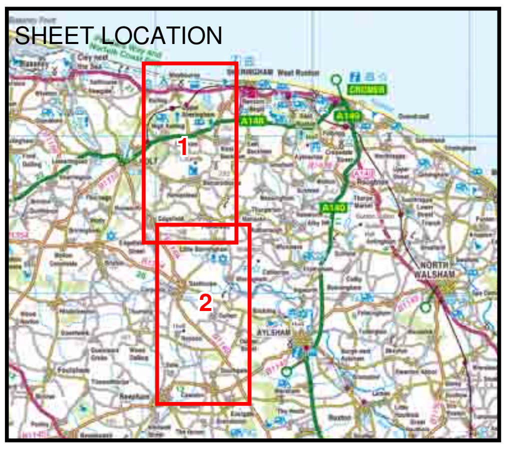
The proposed cable route passes across or adjacent to several Public Rights of Way (PRoW), which include Footpaths and Bridleways.

In addition, Norfolk County Council (NCC) promotes several Circular Walks, Long Distance Paths, and Bridle/Cycle routes on their website (www.countrysideaccess.norfolk.gov.uk); and DEFRA promote several Permissive Paths in the region. A permissive path is a path where landowners have agreed with DEFRA to give walkers or riders access.

The locations where the proposed onshore grid connection is located in proximity to any Public Rights of Way, permissive paths or NCC promoted walks is summarised in **Table 12.1** and shown on **Figure 12.1**.



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor

Substation

- Total extent of proposed substation

Public Access Routes

- Public Footpath
- Public Bridleway
- National Trail
- Circular Path
- Permissive Path

Title:
PUBLIC ACCESS

SHEET 1 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

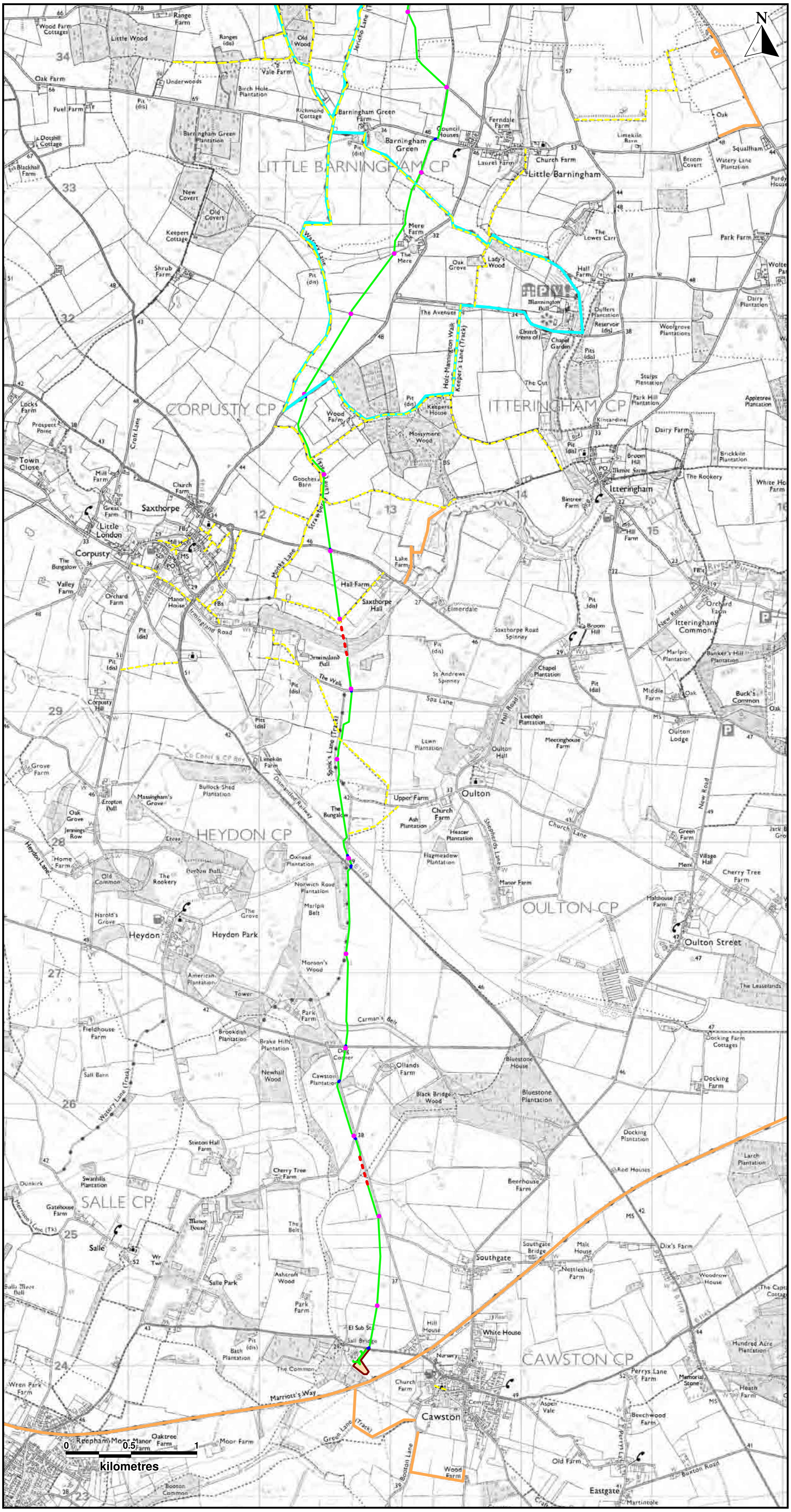
Client:
SCIRA OFFSHORE ENERGY LTD.

Date:
AUGUST 2007

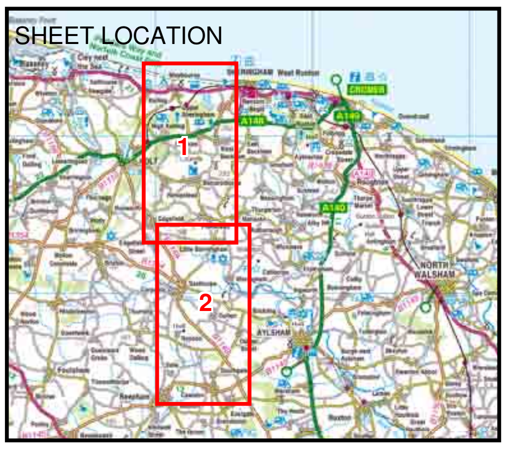
Scale:
NTS

Figure:
FIGURE 12.1 (1 of 2)

ROYAL HASKONING



SHEET LOCATION



LEGEND:

Proposed Onshore Grid Connection

Cable System

- Open trenching in agricultural land
- Open trenching across or within Highway
- Directional drilling
- Likely location of jointing pits and cross-bonding pits
- Open trenching construction corridor

Substation

- Total extent of proposed substation

Public Access Routes

- Public Footpath
- Public Bridleway
- National Trail
- Circular Path
- Permissive Path

Title:
PUBLIC ACCESS

SHEET 2 OF 2

Project:
SHERINGHAM SHOAL OFFSHORE WIND FARM - ONSHORE GRID CONNECTION

Client:
SCIRA OFFSHORE ENERGY LTD.

Date:	Scale:
AUGUST 2007	NTS

Figure:
FIGURE 12.1 (2 of 2)

ROYAL HASKONING

Table 12.1 Public Rights of Way, promoted walks and permissive paths located along the onshore grid connection study area

Relation with Route	Path Type	Grid Ref	Cable installation method at location
Adjacent	Public Footpath and National Trail (Norfolk Coast Path and Peddar's Way)	TG10774371	Not directly affected by application
Crossing	Public Footpath	TG11534183	Directional drilling
Crossing	Public Footpath	TG11654145	Directional drilling
Crossing	Public Footpath	TG11774123	Open trenching
Crossing	Public Footpath	TG12004048	Open trenching
Crossing and adjacent	Public Footpath	TG12333953	Open trenching
Crossing and adjacent	Public Footpath	TG12503882 -TG12483845	Open trenching (adjacent) and directional drilling (crossing)
Crossing	Permissive Path (Baconsthorpe Castle)	TG12723803	Open trenching
Crossing	Public Footpath	TG13123635	Open trenching
Crossing	Public Bridleway / Holt to Mannington Circular Path	TG13183303	Open trenching
Crossing	Holt to Mannington Circular Path	TG12353141	Open trenching
Adjacent	Public Bridleway	TG12263115-TG12473064	Open trenching
Crossing	Public Footpath	TG12413092	Open trenching
Crossing	Public Footpath	TG12493062	Open trenching
Crossing	Public Footpath	TG12622968	Directional Drilling
Crossing	Public Footpath	TG12622877	Open trenching
Adjacent	Permissive Path and Cycleway (Marriott's Way)	TG23802386 at nearest point	Proposed substation located approx. 50m to north of Marriott's Way

The Norfolk Coast Path and the Peddars' Way combine as one of Britain's newer National Trails. The Peddars Way runs from Knettishall Heath in Suffolk to Holme-next-the-Sea on the north Norfolk coast where it joins the Norfolk Coast Path running from Hunstanton along the coast to Cromer. The National Trail totals some 150km (93 miles) and is jointly promoted and funded by the Natural England and Norfolk and Suffolk County Councils and maintained by the two Councils in their respective counties. A National Trail Manager employed by Norfolk County Council co-ordinates the overall management of the route. The proposed landfall and cable route crossing the low cliff at Weybourne, included in the application to DBERR, would require the crossing of the National Trail. The onshore cable included in this application would not cross the trail, but would be located in close proximity to it.

Norfolk County Council actively promotes two of paths on its website: the Circular Path from Holt to Mannington, and the Norfolk Coastal Path. Some parts of the Holt to Mannington Circular Walk are Public Footpath. Marriott's Way is a disused railway line mostly owned by the County Council (with some sections owned by Broadland District Council). The route is not a public right of way but is promoted as a permissive path for walkers, horse riders and cyclists. The route extends 34km (21 miles) from Aylesham to Norwich. Most of the route follows the path of a disused railway, passing through typical lowland arable fields, woods and water meadows near to the River Wensum, before going on to the slightly higher and drier lands beyond Reepham.

In summary, the proposed route corridor crosses 12 Public Rights of Way (11 Public Footpaths and one Public Bridleway) and other frequently used routes in the study area comprising the Holt-Mannington Circular Walk and the Baconsthorpe Castle Walk. In some cases, the route runs adjacent to a path but this may still require a closure or diversion of the path (discussed later within Section 12.4.3). In addition, the proposed works would be in close proximity to the Norfolk Coast Path (National Trail and Public Footpath) and the Marriott's Way.

12.3.5 Tourism and recreation

North Norfolk district

Tourism and recreation have a very important role in the economy of North Norfolk. There are around 45 miles of coastline, with long sandy beaches, flint pebble banks and salt marshes, stretching from Horsey to Holkham beach. The rich architectural heritage of 81 Conservation Areas, over 2,200 Listed Buildings and 100 Scheduled Monuments, is set in countryside ideal for cycling, walking, bird watching or just relaxing.

Based on the 2003 North Norfolk (Economic Impact on Tourism) Summary Report, the money spent by tourists in North Norfolk amounted to £357,111,000 in 2003. Another report prepared for the North Norfolk Council, in 2005, showed that 84% of the jobs in the area are provided directly as a result of visitor spend activity, with the remainder being supported indirectly through tourism business linkages, and through the resultant expenditure of employees on local goods and services. North Norfolk is one of the most distinctive and diverse tourism districts within the East of England region, with the main appeal being in regards to the District's unique environmental assets.

Table 12.2 North Norfolk regional tourism statistics

Indicator	Value
Staying visitors (per annum)	959,700
Staying visitor spend (£ per annum)	£133,612,000
Day visitors per annum	8,548,368
Day visitor spend (£ per annum)	£223,498,035
Supported by tourism total business turnover (£ per annum)	£415,522,000
Supported by tourism total full-time equivalent jobs	9,995

(Source: 2003 Summary Report www.north-norfolk.gov.uk)

Broadland district

In Broadland District, tourism is playing an increasingly important role in the economy. The features which make the district attractive to visitors include the world famous Broads, and some of Britain's finest wetland with some 200km of navigable waterways. The western part of the district is characterised by gentle rolling landscapes and many unspoilt villages, with picturesque flint cottages, churches and houses.

In 2005, 2800 people (7% of the Broadland labour market) were employed in tourism related industries (www.nomisweb.co.uk).

Features within the study area

There are a number of tourist and recreation features within the immediate study area. These include:

- Beach (including main public access point at Beach Lane car park, Weybourne).
- Railways (Poppy Line Railway and Weybourne Station).
- Caravan and camping sites (including Kelling Heath Holiday Park, Fox Hills Caravan Park, Breck Farm Camping and Caravanning, and the Woodlands Caravan Park).
- Woodland areas (for example Kelling Heath / Hundred Acre Woods, Baconsthorpe, Salle Park).
- Rivers (River Bure).
- Museums (Muckleburgh Collection, Weybourne).
- Country parks and open access (Sheringham Park (National Trust), trails within Hundred Acre Wood, Kelling Heath, Mossymere Wood).
- Public access (including Public Rights of Way, Marriott's Way, Norfolk Coast Path and other circular and permitted paths outlined within Section 12.3.3).
- Baconsthorpe Wood and Baconsthorpe Castle.

Within the wider study area other attractions include:

- Blakeney and Cley to the west of Weybourne are centres for wildlife and a focus for bird watchers.
- Sheringham, Cromer and Holt all attract high numbers of visitors. Sheringham and Cromer are both popular seaside resorts, with European Blue Flag status.
- Blickling Hall, Sheringham Hall and Mannington Hall properties.
- Pettitts Animal Adventure Park, Reedham.
- Priory Maze and Gardens, Sheringham.

12.4 Impacts During Construction

12.4.1 Impact to agricultural activities

Cable system

During the installation of the cable system, disruption to agricultural activities would inevitably occur. As discussed in Section 3: 'Project Details', the duration of the overall programme is dependant on final timing of the construction sequence and the number of gangs working at any one time, which would not be determined until the detailed design stage. In summary however, it is envisaged that the construction of the cable system would take between 18 months and two years, although the duration of construction at each location would be of a relatively short duration.

In relation to agricultural practices, the main period of disruption would relate to the cable excavation, ducting and reinstatement phase of works. For one construction gang working at any one time, it is estimated that approximately 200m of trench could be completed per week, per gang (i.e. approximately 5 weeks for each 1km). This phase would prevent the farmer from using any of the land within the 20m working corridor for the period of the construction works, and would most likely impact upon any crops for a period of time prior to and following the construction phase, depending on the season during which the works take place. The cable route has been designed to track along field boundaries wherever feasible and to limit any unworkably small areas of land being "cut-off", to restrict the impact to the working corridor only, as far as possible.

The subsequent elements of the construction phase involving cable jointing and cross-bonding would be carried out as a separate stage. The cable system has been designed to locate the jointing positions on field boundaries, therefore the level of disruption to agricultural activities would be of lower significance, however there is still likely to be some disruption in the immediate areas of works.

Other elements of the construction phase resulting in disruption to farming activities would relate to the site preparation works (for example preparation of haul roads) and the need to share access points onto the Highway. As discussed within Section 3: 'Project Details', care would be taken at all times to ensure the protection the topsoil.

Following the construction phase all land would be reinstated to its former use to allow for previous agricultural practices to continue. Consultation with landowners and tenants would be ongoing during the site planning and construction stage in order to minimise any impacts further.

Mitigation – Agricultural activities during construction
• Ongoing consultation during site planning and construction phase. • Considerate use of shared access points in agreement with landowner. • Storage and protection of top-soil during construction phase. • Full reinstatement on completion of works.

Given the temporary and short-term nature of the works, the limited area of affected land, and the outlined mitigation measures, the impact is anticipated to be of **negligible** significance.

New substation

The construction of Scira's proposed substation adjacent to the existing EDFE substation at Salle, near Cawston, would impact upon the current agricultural land use at this location. The site is currently under arable cultivation, with some areas of set-aside. The proposed site area, which would be permanently taken out of agricultural production, is 2.15 acres.

During the construction phase, the works would be fenced and no additional compound would be required within adjacent agricultural land. The site has been designed to ensure that the remaining parts of the field are workable during both construction and operational phases.

The substation would result in an existing farm access off the B1145 road into the woodland behind the substation being cut-off. However, alternative access routes and points are available to the west of the existing EDFE substation, and also further to the east, therefore the disruption is not considered to be significant.

As with the cable system installation phase, consultation with the landowner would be ongoing during the detailed design and construction phase to ensure that impacts to agricultural activities adjacent to the proposed site are not adversely affected.

The construction of the proposed substation would have a **minor adverse impact** on agricultural practices, due to the permanent loss of a relatively small area of agricultural land and a farm access track.

12.4.2 Impacts on the road network and users

As outlined within Section 3: 'Project Details', the proposed onshore cable route would need to cross the road network in 21 locations. One of these locations (adjacent to Bodham Wood along Sandy Hill Lane), would also require trenching in the road carriageway for approximately 92m. For all of these locations, with the exception of the A148 Cromer-Holt road and the B1149, the roads would need to be closed and suitable diversions planned whilst the cable trenching, ducting, and reinstatement phase is carried out. It has been assessed that one-way traffic could be maintained during the installation across the A149 and B1149 if some degree of temporary road widening (with full reinstatement following construction) takes place on one road verge.

The expected duration of these road crossing works are also given within Section 3 and range between one and three shifts per crossing, with the exception of the location along Sandy Hill Lane where the cable would be installed within the carriageway, which would take between three and six shifts.

Initial discussions have been carried out with the Norfolk County Council Highways Authority to establish the preferred timing for these works. This would be discussed and agreed further during the detailed design and site planning stage, however where required and necessary, works will be timed either outside of the key tourism seasons or during night-time in order to minimise impact to road users during these periods (refer to Section 3 for detail on specific restrictions and timing). Any closures would also have consideration to any major events occurring in the area, bank holidays and school holidays. Any diversions would also be carefully planned to minimise duration and inconvenience to road users, in consultation with the Highways Authority.

In addition to road closures and diversions relating to specific crossing points, the construction of the onshore grid connection (including the proposed substation at Salle) would also result in increased numbers of Heavy Goods Vehicles (HGVs) and other construction traffic. Further information relating to the estimated types, numbers and durations are provided within Section 3: 'Project Details'. Detailed consultation will take place with the Norfolk County Council Highways Authority in order to plan and agree suitable construction traffic routes and any appropriate restrictions and measures, in order to minimise the impact to local community, tourists, visitors and other road users.

It is considered likely that there could be some disruption to road users due to increased traffic levels, delays and other inconvenience. The main receptors would be the local community, who are likely to be negatively impacted by road closures and diversions and general construction traffic.

The disruption to the road network during construction could also potentially cause some negative impacts on tourism in the region due to the increase in traffic caused by construction vehicles, along with road diversions and closures which may cause disruption to the large number of tourists travelling within the area, many of whom use caravans or motor-homes.

The following mitigation measures will be implemented to reduce impact to the local road network during construction. Additional measures relating to noise and vibration levels and dust and air quality, along with specific mitigation measures, are discussed separately in Sections 10 and 11 respectively.

Mitigation – Road network during construction
• Road closures for the 21 road crossings will be planned in consultation with the Highways Authority and will avoid the main tourist seasons and other key periods where required and appropriate, following an assessment of each road crossing. Where necessary, works will take place at night. • Consultation will take place with the Highways Authority to ensure the most suitable diversion routes are selected. • All work within the Highway will be fully reinstated on completion. • Routes for construction traffic will be discussed and agreed with the Highways Authority and any required restrictions relating to timing and working hours complied with. This may include specific requirements for movements of any significant construction plant. • Construction traffic movements will, when possible, be scheduled to avoid the peak traffic periods at the beginning and end of the day, and other sensitive periods, in order to minimise disturbance to local traffic. • Wheel washing will be carried out where required to ensure that local roads are kept clear of mud and debris.

Mitigation – Road network during construction
• Ongoing consultation with the local community, via parish councils, will take place to keep them informed of the construction phase and any planned impact to the local road networks. Residents in the immediate area of any works would also be informed of the construction programme. • Designers and contractors will comply with their relevant duties under the Construction (Design and Management) Regulations 2007, and the Health and Safety at Work Act 1974.

Given the above mitigation measures, and considering the temporary nature of the construction phase, the residual impact of the development on users of the local road is assessed to be **minor adverse** during certain stages of the construction phase requiring high levels of traffic movements, for example during directional drills and during excavation and export of spoil at the Salle substation. During the remaining period, the impact is considered to be **negligible**.

12.4.3 Impact to footpaths and other public access

During the construction of the cable system, temporary closure and diversion of several Public Rights of Way or other public access paths will be necessary.

11 Public Footpaths and one Bridleway are directly crossed by the cable route, however three of the footpaths would be directionally drilled, therefore the need for a temporary closure during drilling would need to be assessed and agreed with Norfolk County Council (NCC). One NCC promoted walk (the Holt-Mannington Circular Path) and one 'permissive path' (the Baconsthorpe Castle walk) would also need to be crossed. The need for closure of any other paths which are located adjacent or close to the proposed construction corridor would also require confirmation from NCC.

The Norfolk Coast Path would also require temporary closure during the installation of the cable system across the low cliff top at Weybourne, however this is covered as part of the Offshore Wind Farm Environmental Statement (Scira, 2006) and application to DBERR.

The public access paths affected can be viewed on **Figure 12.2**. Although the closures would be temporary and short-term in nature, they are likely to cause some disruption to the local community and tourists who use these paths for horse-riding, cycling and walking. Diversions would need to be put in place and well publicised to minimise the inconvenience caused to walkers, cyclists and horse-riders.

Although no direct impact would occur, the construction of the proposed Scira substation at Salle would be visible from some parts of the Marriott's Way; however this is confined to a very short section where the topography of the footpath and the footpath is at level. Elsewhere, the Marriott's Way is either located in a cutting or on an embankment with existing tree screening. The construction site would be securely fenced to ensure there was no danger to the public. If a hoarding type security fence is installed, there would also be no views into the construction site from the Marriott's Way.

The following mitigation will be undertaken to minimise this potential impact.

Mitigation – Footpaths and other public access during construction
• Liaison with Norfolk County Council Highways Authority to identify suitable diversion routes and plan appropriate closures. • Good communication with local community to inform of Public Rights of Way closures, to avoid inconvenience. • Minimise duration of closures wherever possible, with consideration to public safety at all times. • Reinstatement of all features immediately following construction phase. • Secure fencing of the proposed substation site to prevent access from Marriott's Way. • Designers and contractors will comply with their relevant duties under the Construction (Design and Management) Regulations 2007, and the Health and Safety at Work Act 1974.

Given that the closure or diversions of these paths or public rights of way will be temporary and short term, and given the implementation of the mitigation described above, the impact significance is likely to be **negligible**. The potential impact to users of the Marriott's Way during the construction of the Salle substation is also considered to be **negligible**.

12.4.4 Areas of specific tourism and recreational value

There are several locations along the route which have been identified as locations of particular value to the tourism and recreational resource of the region, which could potentially be adversely affected by the onshore grid connection. These are listed below and discussed in turn:

- The Muckleburgh Collection museum, Weybourne.
- The Poppy Line (North Norfolk Railway) and Kelling Heath/Hundred Acre Wood (Kelling Heath Holiday Park).
- Marriott's Way (discussed already in Section 12.4.3 above).

The Muckleburgh Collection

The proposed wind farm export cable comes ashore at the Muckleburgh Collection museum in Weybourne. The impact assessment of the wind farm, export cables, landing point, crossing of the shingle ridge and low cliffs (including the Norfolk Coast Path) and construction of a jointing pit is covered within the current application to DBERR and accompanying Environmental Statement (Scira, 2006). The scope of this application covers the buried cable route from the jointing pit, in a southerly direction towards the A149 road across the museum land.

The installation of the buried trench across the museum would take place during winter months (October to February) in order to avoid the main tourist season at the Muckleburgh Collation museum. Following installation, the land would be reinstated to its former condition. Therefore, **no impact** is envisaged to the operation of the museum during the construction period, and no additional mitigation measures are considered necessary.

Poppy Line Railway and Kelling Heath Holiday Park

The impact of the proposed cable on these two significant features has been minimised by the proposal to directionally drill across the railway and woodland ridge in two hits, as described in Section 3: 'Project Details'. The site in question has several environmental sensitivities and is enjoyed by tourists and local people alike. By drilling underneath, the disturbance to these areas is minimised and means that these amenities can still be enjoyed during the construction period.

As outlined in detail in Section 3, the proposed drill would need to occur in two hits due to the terrain and overall drill length, and would take approximately four weeks to complete. The main drilling equipment would be located in the field to the south of Kelling Heath Holiday Park and the field to the north of the railway and holiday park. A smaller construction area, with less equipment, would be required in a wide grass strip (a firebreak) within the holiday park in order to receive the drills.

The characteristics of the drilling process would mean that the quantity of excavated solid material and drilling mud would exit at the central working area located in the firebreak into the containment areas. This would require regular off-site disposal, using the main Kelling Heath Holiday Park access road and could therefore temporarily affect the amenity value of parts of the holiday park.

The working area within the firebreak would also be visible to the holiday park users, as it is located off the main access road into the site. The walking track which utilises the firebreak would need to be temporarily closed off during the works.

The main drilling rig site to the north of the railway and park would also be visible to users of the Poppy Line railway during the construction period.

Impacts relating to noise and vibration levels and dust and air quality, along with specific mitigation measures, are discussed separately in Sections 10 and 11 respectively.

The following measures will be adopted to minimise impacts to the holiday park and railway users.

Mitigation – Kelling Heath holiday park and Poppy Line during construction
• Works will be timed to avoid the main holiday season wherever feasible in discussion with Kelling Heath Holiday Park and NNDC before the commencement of development. • Ongoing consultation would be carried out with the owners and operators of both the holiday park and the railway to ensure that impacts are minimised wherever possible. • The directional drill working areas would be fenced during the construction period. • Opportunities to screen the firebreak construction area from the holiday park access road would be assessed during the detailed design, with consideration of any construction access needs. • Any tracks requiring diversion within the holiday park would be clearly signposted. • Following the construction phase the land will be fully reinstated to its former condition. • Construction traffic will be routed in liaison with Norfolk County Council Highways Authority as already noted for the general cable construction phase. • Designers and contractors will comply with their relevant duties under the Construction (Design and Management) Regulations 2007, and the Health and Safety at Work Act 1974.

The design of the proposed directional drill across the Cromer Ridge and the implementation of the outlined mitigation measures will ensure that the potential environmental impact to users or both the Poppy Line railway and the Kelling Heath Holiday Park will be of short-term (four week) duration and of **negligible** significance. If construction works cannot be timed to avoid the key tourist season, a short-term **minor adverse impact** is envisaged.

12.4.5 Regional and local economy

The construction phase has the potential to generate local employment and local spend. Employment may result directly from the construction activities or indirectly from suppliers and sub-contractors in the region. Local companies, contractors and suppliers shall be given a full and fair opportunity to tender for work where they are capable of demonstrating a combination of competence, expertise, quality, prices and delivery that provides overall value comparable to other suppliers. Local spend would result from workers spending wages in the local economy. The construction phase is likely to have an overall a duration of between one and two years. The numbers of workers would be dependant upon the Contractor selected and so cannot be estimated at this stage.

Where appropriate, Scira or their Contractors may source materials and labour from the local area. Workers brought in from out of town will be utilising local hotels, B&Bs, shops and restaurants, which would generate local spend. It is not possible to estimate the local spend, and the actual beneficial effects for the local economy at this stage.

Overall, a **minor beneficial impact** on the regional and local economy is envisaged during the construction phase.

12.4.6 Cumulative impacts

As outlined in Section 3: ‘Project Details’, EDFE would also need to undertake additional work at the existing Salle substation, with a likely duration of 14 months. This would comprise seven months of civil works and eight months of electrical works, with a one month overlap. It is not yet known whether this work would coincide with the cable and substation work required by Scira.

The EDFE work would involve significant earth movements resulting in a large number of heavy vehicle trips to remove waste soil. There would also be movements of personnel vehicles, occasional cranes, tele-handlers and tippers. The total number of vehicle movements is not known, but these are likely to be concentrated in the seven months of civil work.

Potential cumulative impacts are possible to the main receptors already discussed, which include the local community, the local road network (and its users) and users of the Marriott’s Way.

Should the Scira and EDFE work coincide, the cumulative impact to these would be greater, mainly relating to higher frequency of vehicle movements with knock-on effects including increased congestion and disturbance and possibly increased noise and dust levels (discussed in Sections 10 and 11 respectively). In the case that the construction periods do not overlap, the receptors identified would be subject to a longer overall period of disruption.

Scira will liaise with EDFE with the aim of timing the coordination of works to minimise increased disruption wherever feasible. This may include measures such as staggering significant vehicle movements to ensure that these do not occur on the same days.

Overall, it is not considered that the cumulative impact would increase the actual impact levels already identified.

12.5 Impacts During Operation

With the exception of the cross-bonding pits (or pillars), once operational, the cable system between Weybourne to Salle would be buried. All land would be fully reinstated and there would be no impact to existing land use practices.

The operation of Scira's new substation proposed at Salle would also not impact upon the local community or any features of tourism or recreational significance. Agricultural land use would be able to continue in the area surrounding the site.

Overall, **no impact** is envisaged to current land uses, the local community, or tourism or recreation receptors during the operation of the onshore grid connection.

12.6 Summary

The assessment of impact on the local community, land use, tourism and recreation has involved thorough consultation with the local community, including three public exhibitions, and the collation of other information on any features located in the study area. The proposed route runs almost entirely through private agricultural land. Exceptions to this include the 21 locations where the route crosses the road network; several locations where the route cross Public Rights of Way and other public access points; several areas of woodland; a river and a holiday park.

The construction of the onshore cable system will cause some disruption to farming activities relating to the 20m working corridor becoming unworkable. The cable route has been designed to follow field boundaries to minimise disruption outside of the working corridor. Mitigation, including ongoing consultation with farmers, full reinstatement of the land and considerate storage of equipment, would result in the residual impact on land use being reduced to a **negligible** level.

Users of the local road network would experience some disruption and inconvenience due to general construction traffic and the temporary closure and diversion during the required Highway crossing points. Mitigation including ongoing consultation with the Highways Authority at Norfolk County Council, sensitive timing and good construction practice would ensure that the residual impact would only be of **minor adverse** significance. The installation of the route would require the temporary closure or disruption of several Public Rights of Way or frequently used paths and disturbance to users of the Marriott's Way. Mitigation would limit the impact to a **negligible** level.

Specific tourism and recreational features likely to be impacted by the construction of the cable route are the Muckleburgh Collection Museum; the Poppy Line Railway; and Kelling Heath Holiday Park. Works within the Muckleburgh Collection museum will be timed during the winter closure period therefore **no impact** would occur. The route would be directionally drilled under the Poppy Line and Kelling Heath Holiday Park; however works would be carried out within a firebreak in the woods. This disturbance would be minimised by sensitive timing of works, fencing of the construction area and good construction practices. If the proposed drill at Kelling Heath is carried out during the main tourism season, the impact is assessed to be **minor adverse**; if construction avoids the main tourism season then the impact is assessed to be **negligible**.

The proposed new substation installation is located on private agricultural land, which Scira intend to purchase. This would result in the permanent loss of approximately 2.15 acres of agricultural land, including a farm access track. The construction of the new substation has therefore been assessed to have a **minor adverse** impact on agricultural practices.

Works required inside the existing substation by EDFE could potentially be carried out at the same time as the construction of the Scira substation, which would result in increased levels of disruption to the receptors already discussed. If the works are not timed together, this would extend the period of disruption. It has been assessed that these potential cumulative impacts would not result in any increase in the levels of impact significance already identified. Scira would however aim to liaise with EDFE to time and execute the works in a sensitive and co-ordinated manner wherever feasible.

The regional economy may benefit from the proposed development due to the increase in local spend from construction workers in the area. Where possible Scira will source materials and labour from the area. Local companies and contractors will be given the opportunity to tender for work relating to the development. The overall impact is likely to be **minor beneficial**.

With the exception of cross bonding pits, once the cable is installed it will be buried; therefore it will not impact on the local community or any features of tourism or recreation. The operational phase of the proposed onshore grid connection will therefore have **no impact** on the land use, local community, tourism or recreation during operation.

12.7 References

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Planning Policy Guidance Note 17: Planning for Open Space, Sport and Recreation

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Planning Policy Statement 1: Delivering Sustainable Development

East of England Regional Assembly 2004
Regional Spatial Strategy (RSS) documents for the East Of England

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ROYAL HASKONING

Sheringham Shoal Offshore Wind Farm
Onshore Grid Connection
Environmental Statement

Scira Offshore Energy Limited
August 2007
9R8482

SECTION 13

SUMMARY AND CONCLUSIONS

13 SUMMARY AND CONCLUSIONS

13.1 Introduction

Scira Offshore Energy Ltd. (Scira) is proposing to construct and operate an offshore wind farm, known as Sheringham Shoal, offshore from the coastal town of Sheringham, on the north Norfolk coast. The application for environmental and other consents required for the wind farm is currently being determined by the Department for Business, Enterprise & Regulatory Reform (DBERR).

An onshore grid connection would be required in order to connect the wind farm to the national electricity distribution grid. It is proposed that this would comprise of approximately 21.3km of underground cabling between the coastal town of Weybourne and an existing substation at Salle, near Cawston. In addition a new substation would be required adjacent to the existing substation, in order to accommodate the additional capacity from the offshore wind farm.

This section provides a summary of the proposed **onshore grid connection project**, the consent requirements, and the findings of the Environmental Impact Assessment (EIA) process.

Mitigation measures and monitoring proposals that have been committed to by Scira are also provided.

Figure 13.1 provides an overview map of the offshore wind farm location, the export cables and the landfall point at Weybourne (all part of the application to DBERR); along with the area of the proposed onshore grid connection, for which this Environmental Statement has been prepared.

Figure 13.1 Offshore Wind Farm and Onshore Grid Connection Site Overview

13.2 Project Details

13.2.1 The cable system

The onshore grid connection would consist of an underground 132kV cable system of 21.3km length running between the Muckleburgh Collection museum at Weybourne and an existing substation, owned and operated by Electricite de France Energy (EDFE) at Salle, near Cawston.

From the Muckleburgh Collection, the cable route heads south-east to cross the Poppy Line railway and Kelling Heath/Hundred Acre Woods, and then south in the vicinity of Bodham, Lower Bodham, Baconsthorpe, Plumstead, Little Barningham, Saxthorpe, Oulton and Cawston, before connecting at the Salle substation. The route is located almost entirely within private agricultural land, with the exception of locations where it crosses the Public Highway, Public Rights of Way, the Poppy Line Railway, the River Bure, several woodlands, the Kelling Heath Holiday Park and the Muckleburgh Collection museum.

The grid connection would require two circuits, each consisting of three 132kV cables. Fibre optic cables required for the transmittal of information between the wind farm and the substation would also be needed. The cables would be installed in ducts. For the most part of the route, it is proposed that the cable ducts are installed by a method of open-cut trenching. The trenches would be up to 2.2m in width and approximately 1.6m depth. The exception to this is in four locations, where directional drilling is proposed in order to prevent and minimise any impact to surface features. These locations are: Kelling Heath Holiday Park and the Poppy Line Railway; Baconsthorpe Wood; the River Bure; and a Woodland to the East of Salle Park.

The duration of the cable system construction period would be dependant upon a number of factors, and it is estimated that the complete construction would take between 18 months and two years. However, construction at each location along the route will be limited in duration. During the construction period, some disruption to the local road network is envisaged due to the increased numbers of construction related vehicles, including Heavy Goods Vehicles (HGVs) and slow-moving low-loader vehicles. The bulk of the traffic movements would relate to site staff and wagons required for the import and export of soil, spoil and materials. In addition, where the route crosses the Public Highway (21 locations) short-term temporary closures and diversions would be required, however these would be timed carefully in liaison with the Highways Authority (Norfolk County Council) to minimise disruption to road users. Any closures and traffic management schemes are likely to be in the order of days, rather than a longer time period.

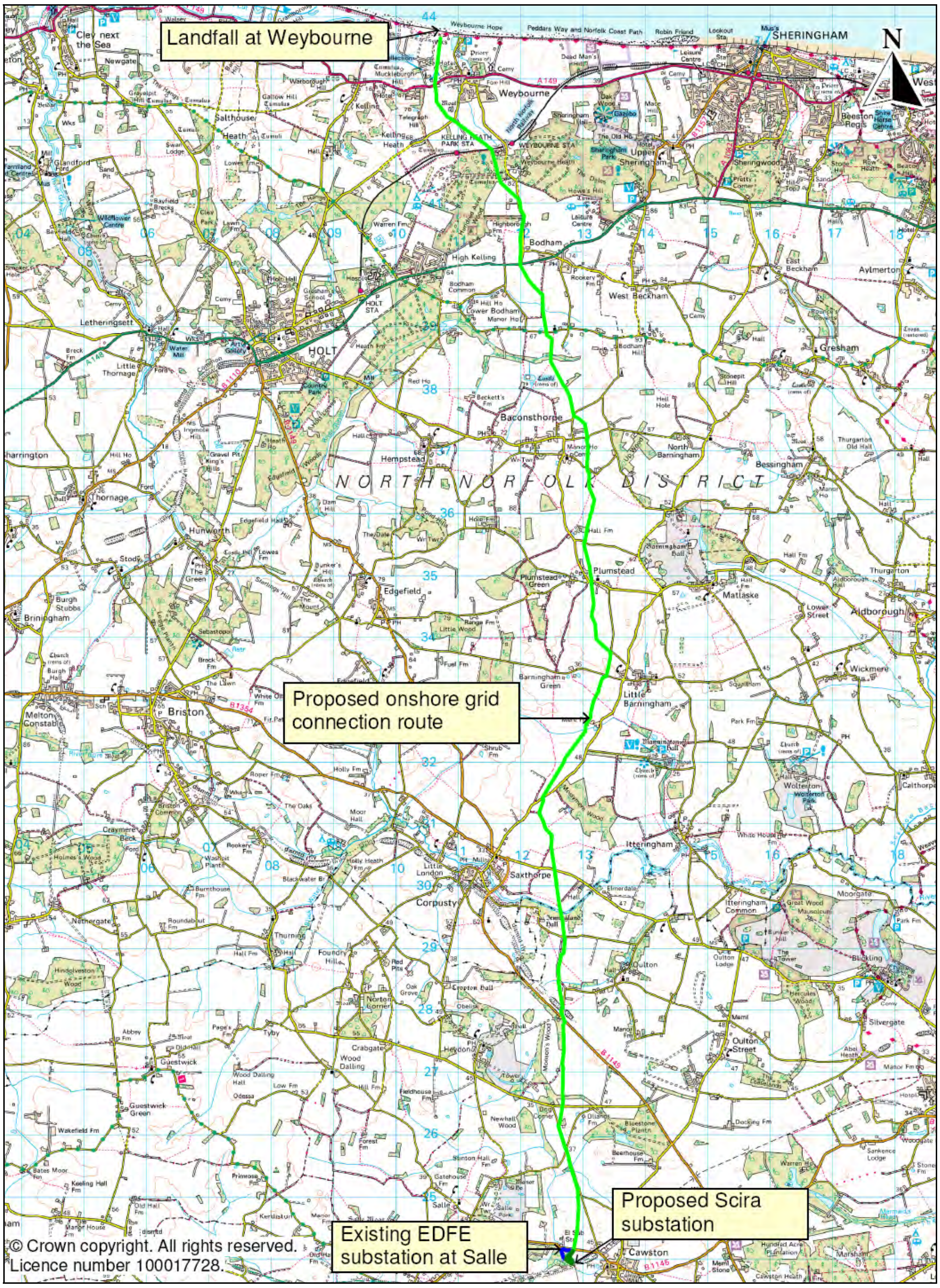
Following the construction phase, the cable system would be buried and the land reinstated to its former condition. The exception to this is in locations where the cables would need to be jointed together and cross-bonded. In these locations, permanent access is needed to the cross-bonding, therefore these would be installed in either buried pits, with a visible manhole and marker post, or above ground ‘pillars’.

Once operational, maintenance would be carried out on a five-yearly basis. In the unlikely event that there is any failure of cables, the fault would be located and the cables either repaired or replaced.

A Decommissioning Plan for the offshore wind farm would include consideration of the onshore grid connection. At the decommissioning stage, Scira would evaluate whether the cable system could be used for another purpose, however at this stage, it is considered likely that the buried cable system would be isolated, left *in-situ* and notified as such. Any above ground elements (i.e. the cross bonding pits or pillars) would be removed to a sufficient level beneath the surface to allow normal land use to continue.

An overview of the proposed route alignment for the cable system is given in **Figure 13.2**.

Figure 13.2 Proposed onshore grid connection overview



13.2.2 The substation

The proposed location for the new substation lies adjacent to the south-east boundary of the existing EDFE Salle substation. Scira's new substation would house equipment necessary to connect the offshore wind farm to the electricity grid network and would include a new control building to house the control and switching equipment and an ancillary building. The outdoor electrical equipment will comprise reactors and a series of capacitors.

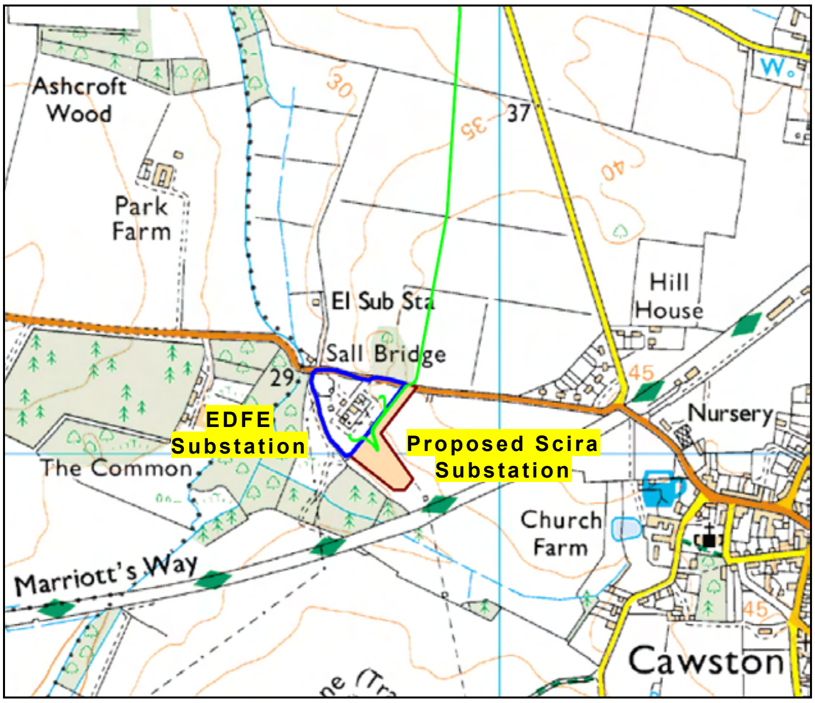
It has been estimated that construction of the Scira substation would take between 15 and 18 months. During this period there would be increased numbers of HGVs and other heavy and slow moving equipment which would need to be delivered to the site.

During operation, the substation would not be permanently manned. Routine inspections and maintenance work would be required on the GIS switchgear, capacitors, and oil filled reactors. The maintenance would be carried out on an annual basis and would only require a site visit by a transit type vehicle. Any major equipment failure necessitating removal would require the use of suitable mobile cranes.

The programme for decommissioning would be outlined in detail later within the project lifetime. The disposal of all materials would be in accordance with the legislation and regulations in use at the time. The buildings may be retained and converted for other usage if agreed with the relevant parties.

The location of the proposed substation in relation to the existing EDFE substation is shown on **Figure 13.3**.

Figure 13.3 Location of existing EDFE substation and proposed Scira substation at Salle, near Cawston



13.2.3 EDFE works

In order to make the connection, EDFE would also need to install additional infrastructure within their substation compound. Although designs are not finalised, the works are likely to need to include: two external steel gantries either side of the existing pylon on the south-eastern boundary; additional external switching and connection apparatus; potentially the extension of an existing building to house control, protection and metering equipment; and retaining walls, fencing, shingle paths, associated earthworks and embankments. It has been estimated that civil works would take approximately seven months and electrical works approximately eight months, with the first month overlapping with the civils stage. This would give an overall construction period of approximately 14 months.

This work would be carried out by EDFE. The work has been considered as part of this ES in order to provide the 'whole picture' and assess any possible cumulative impacts, where relevant for the Salle substations.

13.3 Consenting Requirements

The onshore grid connection project is subject to an Environmental Impact Assessment (EIA) in accordance with the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999.

EIA is a process of identifying and assessing the potential impacts (adverse and beneficial) that are likely to occur during the life-cycle of a project (i.e. from the planning of the design through to construction, operation and eventual decommissioning). The Environmental Statement (ES) is the report that describes the proposed onshore grid connection project and documents the findings and recommendations of the EIA process.

The ES accompanies applications being made by Scira Offshore Energy Ltd. to North Norfolk District Council and Broadland District Council for planning permission under the Town and Country Planning Act (England and Wales) 1990.

In addition to the requirement for planning consent and EIA, a series of other consents and permissions are required, including:

- Notifications under the New Roads and Street Works Act 1991 (NRSWA) in relation to any temporary road closures or diversions. In addition to construction access planning with Norfolk County Council Highways Authority.
- Temporary Closure Notices for Public Rights of Way crossings.
- Gas main crossing - authorisation and approval of method statements from National Grid UK.
- Consent under Land Drainage Act 1991 from Environment Agency for River Bure crossing and from Internal Drainage Board (IDB) for watercourse to east of Salle Park.
- Railway crossings - confirmation and approval of method statement from North Norfolk Railway Plc.

- Natural England licensing with respect to great crested newts.
- Compliance with Landfill Regulations 2002 (as amended) and the Hazardous Waste Regulations 2005 for the disposal of any excavated materials.
- Discharge consents – for any discharges of foul or surface water for the substation is required.

13.4 The Need for Renewable Energy

The central aim of the UK Government's energy policy is to establish a supply of energy that is diverse, sustainable and secure and is offered at competitive prices. Key to this goal is a 60% reduction of CO_2 emissions by 2050. The development of renewable energy plays a key role in the Government's strategy for carbon reduction. In 2000, the Government proposed an initial ten year strategy, which included a target to generate 10% of the UK's electricity from renewable sources by 2010. Revised targets have proposed that 15% of the UK electricity supply should come from renewable sources by 2015, with an aspiration of 20% by 2020.

The Government's targets for renewable energy will help the UK to meet its international obligations, but also obtain greater security of energy supply. The construction of wind farms, (both on- and offshore) is expected to be the largest contributor to the renewable energy sector and wind energy will provide the greatest contribution to Government targets of all the renewable energy technologies.

It is proposed that the Sheringham Shoal offshore wind farm would have an installed capacity of up to 315MW. Based on a specialist assessment of the wind resource, it has been estimated that this would equate to the production of approximately 1.0 TeraWatt hours (TWh) of electricity per year (Garrad Hassan, 2006). Although domestic energy use only accounts for part of the country's energy needs, it is useful to consider that this would be enough to supply electricity to over 210,000 households [1].

The wind farm is expected to be operational by 2011 and would therefore contribute to the UK Government's target of 15% energy supply by renewable energy sources by 2015. This 15% target is expected to require the generation of 57.45TWh per year [2]. Therefore, once operational, the proposed wind farm would contribute 1.74% of the total amount of renewable energy required to meet this 15% target. In addition, the wind farm would help the UK move towards its goals by reducing emissions of CO_2 by approximately 34,400 kilotonnes (kt) over its 40 year lifetime [3].

[1] Calculation based on an average UK household energy consumption of 4,700KWh, based upon Digest of UK Energy Statistics 2005, cited by BWEA www.bwea.com/edu/calcs/html.

[2] Based upon total projected electricity generation for 2015 of 365TWh estimate based on a prediction favourable to coal, contained within the Energy Review 'The Energy Challenge', Annex C (DTI, 2006).

[3] Calculation based on BWEA 2007, based on avoided emissions from coal powered plants (www.bwea.com.edu/calcs.html).

13.5 Summary of Environmental Impacts

13.5.1 The Environmental Impact Assessment process

The EIA has been prepared in accordance with Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999.

A Scoping Report was prepared setting out the proposed scope of the EIA to be carried out. This was submitted to North Norfolk District Council and Broadland District Council who consulted various consultees and confirmed that the proposed scope of the EIA was satisfactory and attached consultee responses for consideration in the EIA.

The EIA has involved a detailed route selection process, which has considered numerous alternative options before selecting the preferred option, with consideration to environmental, technical, financial and risk factors. Thorough consultation has been carried out with statutory and non-statutory consultees as well as the local community in order to obtain any relevant information and data and to determine any issues or concerns to inform the assessment.

Impact identification and evaluation was carried out via a number of methods and techniques including data collation and literature review, consultation, reference to relevant guidance and standards, original data collection and analysis, as well as experience of similar schemes. Details of the assessment methodology and data sources are provided for each parameter in the relevant section. In order to provide a consistent framework for considering and evaluating impacts, significance levels have been assigned to each impact. The assigned definitions are set out **Table 13.1**.

Table 13.1 Terminology for Classifying Environmental Impacts

Impact Significance	Definition
No impact	There is an absence of one or more of the following: impact source, pathway or receptor.
Negligible	The impact is not of concern.
Minor adverse	The impact is undesirable but of limited concern.
Moderate adverse	The impact gives rise to some concern but is likely to be tolerable (depending on the scale and duration).
Major adverse	The impact gives rise to serious concern; it should be considered as severe.
Minor beneficial	The impact is of minor significance but has some environmental benefit.
Moderate beneficial	The impact provides some gain to the environment.
Major beneficial	The impact provides a significant positive gain.

To assess the significance of an impact, it is necessary to identify the magnitude of the effect and also the sensitivity of the receptor. The resulting significance is a balance of the two. A number of criteria are utilised to determine these two factors during the assessment of significance, and include:

- Magnitude of the impact (local/strategic).

- Spatial extent of the impact (small scale/large scale).
- Duration of the impact (short term/long term).
- Reversibility of the impact (including species or habitat recoverability).
- Conservation or protected status.
- Probability of occurrence of the impact.
- Confidence in the impact prediction.
- The margins by which set values are exceeded (e.g. noise standards).

Where potentially significant adverse impacts are identified, mitigation measures have been outlined, either as part of the design, or as a measure implemented during construction or operational phases. Scira has agreed to these mitigation measures and they are therefore expressed as commitments. The level of significance assigned to an impact in this Environmental Statement is the **residual** impact, following successful implementation of the stated mitigation methods, good construction or operational practice or relevant regulations and guidelines, and is emboldened in each section.

Following planning consent, an Environmental Action Plan (EAP) would be prepared to ensure that the mitigation measures committed to as part of the Environmental Statement and best practice are implemented correctly on site and as part of the construction contract.

The following sections summarise the potential environmental impacts associated with the construction and operation of the onshore grid connection project. The following environmental parameters have been assessed:

- Nature conservation and ecology.
- Archaeology and cultural heritage.
- Geology, hydrogeology, hydrology and land quality.
- Landscape and visual character.
- Noise and vibration.
- Dust and air quality.
- Land use, local community, tourism and recreation.

The EIA has addressed the potential impact of the proposed onshore grid connection based on a realistic worse-case scenario, relevant to each environmental parameter.

Cumulative impacts relating to the works required by EDFE inside the Salle substation have been assessed and described, where relevant. A description of the mitigation measures that will be committed to by Scira are listed for each environmental parameter, such that environmental impacts can be avoided, reduced or minimised.

For a full description of the impacts and measures outlined, reference should be made to the detailed assessments included in ES Sections 6 to 12.

13.5.2 Nature conservation and ecology

The cable route and substation site identification process has avoided any impact to international, European and national nature conservation sites in the general study area. There would also be **no impact** to any woodland sites listed on Natural England's Ancient Woodland Inventory or any Roadside Nature Reserves. The majority of County Wildlife Sites are also avoided.

The utilisation of directional drill techniques has prevented or minimised impact to several sites of nature conservation importance and habitats of ecological interest, including woodland and aquatic features at Kelling Heath and Hundred Acre Woods (a County Wildlife Site), Baconsthorpe Wood, the River Bure and a woodland to the east of Salle Park.

Cable routing has been aligned to utilise any existing gaps in hedgerows, as well as avoiding individual trees along field boundaries wherever possible. Further mitigation measures, including full reinstatement, will ensure that the residual impact to hedgerow habitat and scattered trees would be of a short-term and **minor adverse impact** level.

The majority of woodlands which are crossed by the cable route would be directionally drilled with the exception of a belt of woodland known as Carman's Belt (a County Wildlife Site), and a disused railway lined with trees and scrub, both in the Heydon area. Minimisation of the working corridor, careful alignment to avoid sizeable or noteworthy trees and full reinstatement, would ensure that the residual effect to these woodlands would be **negligible.**

Likewise, the crossing of several small drainage channels utilising open-cut trenching techniques would be carefully managed to ensure that there would be **no impact** once reinstatement has occurred. The impact to grassland habitat along the cable corridor would be **negligible** and limited to areas of grassland within the Muckleburgh Collection museum and field margins. The new substation would result in the permanent loss of a small area of arable habitat, of no ecological significance.

No evidence of badgers were recorded along the route corridor, therefore **no impact** is envisaged. Water vole and otter are present along the River Bure and its floodplain; however there would be **no impact** to these species as the area is to be directionally drilled. Mitigation would be incorporated to ensure that there would be **no impact** to breeding birds, or the known population of great crested newts in the study area during the construction phase. In addition, **no impact** to any potential bat roost sites or habitat suitable for supporting white-clawed crayfish would occur. Based on the management and minimisation of impacts to woodland, grassland and wetland habitats, impacts to any reptiles or diverse invertebrate assemblages present would be **negligible**. Badger and water vole surveys would be carried out nearer to the construction period to re-confirm the results and incorporate any additional mitigation which may be necessary.

Mitigation measures to avoid, reduce and minimise significant adverse impacts, along with good construction practice, are summarised in the table below.

Mitigation – Nature conservation and ecology during construction
General: • Workforce briefings on sensitive habitats and associated species. • Reduce 20m working corridor at hedgerow breaches, sensitive grassland habitat, and open-cut woodland and ditch crossings, where possible by removing storage areas (i.e. 10m of the working width). • Clear demarcation of working areas and no storage of equipment or material in proximity to sensitive habitats, including trees. • Careful separation of topsoil and subsoil (and channel substrate at ditch crossings) and full reinstatement following construction phase, with consideration of the appropriate species composition. • The directional drill working area within the Kelling Heath Park and Hundred Acre Woods County Wildlife Site will be carefully managed to prevent and minimise any impact to the value of the site. • Open-trenching within Carman's Belt and the disused railway in the Heydon area will be carefully aligned and minimised (hand-dig potentially required to avoid or minimise impact to trees in certain parts).
Drainage channels: • Installation of temporary vehicle crossing points to minimise impact to bank habitats and channel features.
Badgers: • Secure fencing of Salle and Cable compounds to prevent injury to foraging badgers. • Ramped egress at end of open trenches left over night to allow trapped animals to escape. • Sensitive fencing of cable corridor to avoid severance of badger foraging habitat. • Re-survey prior to construction to re-confirm results.
Water vole: • Re-survey of open-cut ditch crossings prior to construction to re-confirm results.
Breeding birds: • Time trenching work in Mere Farm outside bird breeding season (March to August). • Scrub clearance prior to breeding season (if construction planned between March to August).
Great crested newts: • Finalisation and implementation of mitigation strategy will be carried out in three locations; including installation of newt-proof fencing. • Application for licence for development from Natural England.

Once the onshore grid connection is operational, there would be **no impact** upon any of the nature conservation or ecological receptors identified.

13.5.3 Archaeology and cultural heritage

The route of the proposed buried cable connection between Weybourne and Salle has been designed in order to avoid any identified sites of archaeological or cultural heritage importance *in situ,* wherever feasible. However, where this has not been possible, the potential impact of the development on archaeological and cultural heritage resources has been assessed and a programme of mitigation to ensure that the archaeological resource is properly recorded has been suggested.

The majority of Listed Buildings are over 50m from the proposed route, with the exception of Eagle Lodge North (30m from construction corridor; 38m from trench) and

Eagle Lodge South (38m from construction corridor, 43m from trench). The two identified Scheduled Monuments are located 70m and 190m from the proposed route. Although no impact is envisaged, additional mitigation to ensure that the sites are not accidentally damaged during the construction phase have been outlined in order to ensure that there would be **no impact**.

The proposed cable route crosses a narrow plantation belt, known as ‘Carman’s Belt’, which is within the Heydon Hall Grade II* Registered Park and Garden. The route has been located adjacent to an existing overhead line crossing, where there are no significant trees, in order to minimise impact. Further mitigation, including minimising the working width and adopting additional precautionary measures to ensure there is no accidental damage, would ensure that the impact to the Registered Park would be **negligible**. There would be **no impact** to the value of the Mannington Hall Grade II Registered Park during construction.

There are several locations where the proposed route passes through sites listed on the NHER database. These include: a World War II training area at Muckleburgh; a belt of ancient iron-working pits at Kelling Heath; earthworks within Baconsthorpe Wood; Roman cropmarks in the area of Mere Farm, near Barningham; Medieval cropmarks at Weybourne; Bronze Age cropmarks at Cawston; as well as several undated cropmarks elsewhere along the route and findspots ranging from several periods, generally located in the Weybourne, Baconsthorpe, Mere Farm, Saxthorpe and Cawston areas.

In these areas, the construction of the cable system could potentially result in irreversible damage, disturbance and loss of archaeological remains. In order to minimise the potential impact, a detailed mitigation strategy will be agreed and implemented in consultation with Norfolk Landscape Archaeology in order to record any archaeological remains, prior to development commencing. The level of mitigation will be dependant on the value of the feature and the likely level of disturbance, and is likely to range from an archaeological watching brief during construction, to more intensive archaeological excavation. Given the incorporation of a suitable mitigation strategy; and the routing of cable connection to avoid significant finds and features, wherever possible; the residual impact to other archaeological sites has been assessed to be **minor adverse**.

A previous archaeological watching brief in the area of the proposed workings at Salle substation has proved negative in finding archaeological remains. However, to take into account the potential for unknown archaeological remains at this site, the impact has been deemed to be **negligible**.

Mitigation – archaeology and cultural heritage during construction
<u>Scheduled Monuments</u> • Notify construction personnel of Scheduled Monument status. • Fenced construction to ensure no storage of machinery or equipment in vicinity of Scheduled Monuments.

Mitigation – archaeology and cultural heritage during construction
<u>Listed Buildings</u> • Notify HGV driving personnel of Listed Building status to avoid accidental damage. • Location of the cable trench on the opposite side of the access track to increase distance between excavations and the Listed Buildings. • Reduction of working widths in the area of Listed Buildings (and storage areas/compounds to be sited away from these features).
<u>Heydon Hall Registered Park</u> General mitigation • Working areas and storage sites will be clearly demarcated in the general area of Heydon Hall Registered Park, particularly along the boundary of Norwich Road Plantation to ensure there is no risk of accidental damage to the park. Carman's Belt crossing: • A construction method statement will be compiled and conveyed to the construction team. • The working area through Carman's Belt would be adapted in order to minimise the width required. No materials, equipment or vehicles would be stored within the plantation belt. • A replanting scheme will compensate for any disturbance to the woodland at this location.
<u>Other archaeological sites</u> All archaeological sites which cannot be preserved *in situ* will be properly recorded; and an Archaeological Mitigation Strategy will be devised by Norfolk Landscape Archaeology. This could potentially involve the following measures: • Minimisation of working widths within sensitive areas. • Minimisation of stripped working area, utilising geo-textile grids (or similar) to preserve underlying features, where appropriate. • Archaeological evaluation, including field-walking, geophysical survey, targeted trial-trenching. • Archaeological excavation to record significant remains that cannot be preserved *in situ.* • Archaeological watching brief.

During the operational phase, during normal operations there would be no ground disturbance. If any elements of the onshore grid connection do require replacement, any excavations would be in the area of previously disturbed ground. Therefore there would be **no impact** to archaeological and cultural heritage features during operation.

13.5.4 Geology, hydrogeology, hydrology and land quality

The route of the cable system crosses 14 watercourses, including one Main River (the River Bure) and one watercourse managed by the regional Internal Drainage Board; both of these watercourses are to be directionally drilled. The remaining 12 crossings are generally minor drainage channels and several are dry. The main hydrological impacts of the project are associated with direct interference to local watercourses and increased sedimentation/soil erosion associated with earthworks and excavation.

Historically, the predominant land use across the study area has been agriculture, with scattered settlements, from the 1800's to the present day. This has resulted in few potentially contaminative uses of the land being identified (such as pits, quarries and landfill sites). The development of a Conceptual Site Model (CSM) has identified the following potential environmental risks associated with the proposals:

- Risks to surface waters are considered to be medium.

- Risks to shallow groundwater are considered to be low to medium.
- Risks to site workers, future site users and neighbouring properties and land use are considered to be low.
- Risks to ecological receptors are considered to be low to negligible.
- Risks to buildings and structures are considered to be negligible.

Based on the findings of this risk assessment and the application of the mitigation measures and good practice approaches outlined below, the impacts of the development with respect to geology, hydrogeology, hydrology and land quality have been identified as **negligible** with the exception of the potential impacts of directional drilling on construction workers and controlled waters, should any contamination be encountered, which were assessed as **minor adverse** impacts.

Mitigation – geology, hydrogeology, hydrology and land quality during construction
General • Adherence to Pollution Prevention Guidance (PPG) notes and British Standards.
Good construction practice • Minimise volume and length of time that excavations are kept open. Reinstatement using appropriate fill materials. • Good site practice, hygiene and use of appropriate personal protective equipment (PPE) and / or respiratory protective equipment to protect site workers. • Defined construction areas.
Unexpected sources of pollution • Consultation of environmental professionals if unexpected sources of pollution are encountered and excavation work in accordance with a pre-agreed method statement.
Specific measures during open trench cable system installation Surface water crossings (dam and pipe; dam and pump; or open trench): • Construct dams to prevent sediment and other pollutants from entering the waterbody. • Use sufficient pumps and screen pump intakes. Prevent streambed scour at discharge. • Monitor dam and pumps to ensure proper operation. • Complete instream construction activities within 24 hours. • Separate and store topsoil, subsoil and substrate and reinstate soil structure. • Replant disturbed riparian areas with grasses, legumes or native plant species. Soil erosion and runoff: • Where practically possible, avoid undertaking construction during/following wet weather. • Where significant runoff problems are anticipated, utilise sediment traps and silt fences. • Stabilised construction vehicle entrances with tire wash provisions. Landfill at Saxthorpe: • Gain and assess further information related to landfill site, produce risk assessment. • Consultation with the Environment Agency and incorporation of suitable mitigation. Excavated materials: • Minimise volume of materials excavated. Characterise and segregate excavated materials. • Off-site disposal in accordance with the Landfill Regulations 2002 (as amended). • Storage of excavated materials to prevent cross-contamination and leaching contaminants. • Testing of imported fill material.
Specific measures during directional drill cable system installation Controlled waters: • Dewatering in accordance with a method statement. • Measures to prevent contamination of surface or ground waters with Bentonite clay.

13.5.5 Landscape and visual character

The landscape and visual character section and Section 2: 'Site Selection and Consideration of Alternatives' has identified the approach that has been adopted in the route planning for the grid connection cables and the site planning and design of the substation at Salle. Landscape considerations including the protection of landscape character, physical features and visual characteristics have been an inherent part of the process including the selection of options. The mitigation of landscape effects has been 'built-in' to the application proposals when this has been enabled by engineering considerations. Consequently, where the assessment has identified impacts, few opportunities for further mitigation have been identified for reporting in the ES.

The assessment has drawn on the extensive use of high-resolution aerial photography and field-walking to build up a full understanding of the context of the development both of the cable route and the substation at Salle. Reference to countryside character assessments and consultation with planning officers has also informed the process and made a sufficiently robust basis for the assessment.

For the cable route the main effects that have been identified concern the construction phase. A degree of mitigation is available through the management of the project programme. The effects (on landscape character and views) are of short duration. Few permanent effects in respect of landscape features were identified. Overall **no major effects** have been predicted.

The construction phase of the work on the Scira substation was assessed as having a potentially greater impact on the local landscape than the operational phase and found to be incapable of mitigation. This is offset by the relatively short duration.

Mitigation – landscape and visual character during construction
<u>Landscape features during cable system construction</u> • Undertake detailed tree survey prior to construction to list vegetation removed at field and hedge breaches. • Produce method statements for work near trees categories A and B in BS 5837:2005. • Undertake construction in accordance with BS 5837:2005. • Immediately prior to construction install protective measures as BS 5837:2005. • Restore field boundary structures including banks and fencing to match existing. • Restore hedgerow breaches through replacement planting of native species. • Transplant suitable semi-mature trees in plantations where coincident with corridor (woodland Heydon Estate north of directional drill location 4). • Restore ground surface to existing profiles including drains and ditches.
<u>Landscape views during substation construction</u> • Minimise contract duration overall subject to engineering constraints. • Minimise interval between construction operations. • Plan construction to occur in quieter seasons if other constraints permit. • Plan construction access routes to minimise distance on minor roads.

In the case of operational phase of the substation, the key effect identified was the potential change in views for the travelling public and for the occupants of a small number of dwellings near to the site. Despite the size of the proposed building the topography and existing vegetation substantially contain the site. This is amplified by the integral mitigation measures of landscape and building design. Tree planting forms part of the development and within fifteen to twenty years will substantially marry the north and east site boundaries with the woodland on the valley floor.

The cumulative effects associated with work in the existing EDFE substation have been examined. It was found that the application proposals for the new substation integrate and assimilate the whole and have the beneficial side-effect of screening the existing equipment and structures. These are higher than the structures in the proposed substation.

It has been assessed that the completed development of the substation entails **negligible** effects on landscape features. The assessment concludes that it would not be prominent in views and over time would be assimilated into the landscape and so have only **moderate adverse visual effects**.

13.5.6 Noise and vibration

An assessment has been made of potential construction noise levels arising as a result of the construction of the cable system. Predictions of construction noise levels affecting the closest potentially noise sensitive receptors to the cable route have been carried out based on the guidance contained in British Standard 5228: Part 1: 1997 "Noise and vibration control on construction and open sites" and using noise levels typical of such construction operations. The assessment has considered potentially noise sensitive buildings within a 300m zone either side of the proposed construction route.

The assessment has shown that at certain locations the construction activities come to within 10m of residential properties, leading to unacceptable day time noise levels of up to 85 dB L_{Aeq}, as assessed against an acceptable noise limit of 70 dB L_{Aeq}. Approximately 190 residential properties would be affected by noise during the construction period, with unacceptable day time noise levels predicted to occur for approximately 15 properties; major adverse impacts predicted for approximately 44 properties; substantial adverse impacts predicted for approximately 32 properties (plus an additional 18 static caravans); moderate adverse impacts predicted for approximately 14 properties (plus an additional eight static caravans); minor adverse impacts predicted for approximately 26 properties; and negligible adverse impacts are predicted for approximately 32 properties.

Night time activities involving the operation of pumps are predicted to give rise to unacceptable noise levels of greater than 45 dB L_{Aeq} for all properties within a 300m study area.

Mitigation in the form of the application of current best practice working methods, the use of low noise technology equipment where available and, where necessary, the use of physical screening, will ensure that noise levels are reduced such that no more than a **minor adverse impact** occurs. Where this is not possible, the effective and timely use of a public relations strategy should ensure that *subjective perception* of noise (that might otherwise quantitatively be assessed as being of moderate adverse significance) is reduced to a **minor adverse** significance. Controls on the speed and times of operations of construction-related traffic will ensure that impacts from these activities are only of **minor adverse** significance.

Mitigation – noise and vibration during construction
• Working hours restrictions suitable to the daily activities of the local residents. • The contractor will apply the principles of Best Practicable Means (BPM), as defined in BS 5228: Part 1: 1997, to all elements of the construction works. • Site compounds will, where possible be located as far from potentially noise sensitive receptors as possible. • Activity in and around the compounds will be restricted to day time working hours and the principles of BPM will be applied to the construction and operation of the compounds as well as to the general construction activities. • Where generators for power are required these will be sited as afar from noise sensitive receptors as possible and so that buildings or natural features provide screening. • Where *unacceptable* noise levels in excess of 70 dB LAeq during the day, or 45 dB L_{Aeq} at night, impact upon residential properties physical mitigation may be required physical mitigation might be required. • Mitigation of adverse impacts from construction-related noise by the enforcement of construction-traffic speed limits will be carried out through built-up areas. • Contractor will ensure that HGVs do not travel on local roads before or after the general construction activities and do not stand idling or queuing outside residential properties. • Timely and 'honest' public relations will be undertaken to reduce the adverse perception regarding construction noise. • Letter drops will be carried out for those properties that might be adversely affected by the works (potentially, all residential properties within 300m of the construction works). • The use of the modern and quiet equipment, plus physical screening, as mentioned previously.

The substation construction activities are at sufficient distance from residential properties such that day time noise levels are potentially of only **minor adverse** significance. Night time noise levels might be of major adverse significance, but the implementation of suitable mitigation should ensure that this is reduced such that **no impact** is caused.

It is possible that the cable laying activities and new substation construction may overlap with the works that EDFE plan to carry out to the existing substation at Salle. Full details of the proposed activities and vehicle numbers are not yet known, however it is known that construction activities will occur during the daytime and will involve offsite removal of large amounts of soil. Presuming the EDFE construction activities will give rise to similar noise levels as Scira's substation construction, the unmitigated impacts would be approximately 3 dB higher, approximately 56 dB L_{Aeq}, and would therefore be of potentially substantial adverse significance. Mitigation as already discussed would potentially reduce this noise level to 46 dB L_{Aeq}, below the day time impact criterion level of 50 dB L_{Aeq} and reduce the adverse impacts to a **minor adverse** level.

The cumulative effect of both developments will cause road vehicle noise impacts to be **moderate** to **major**. The application of suitable mitigation measures, as previously discussed, may reduce the adverse impacts to **minor** or **moderate**.

During operation of the cable and substation, no further noise impacts are predicted. Any significant maintenance work will use the mitigation measures described above to ensure that the noise impact is **negligible**.

13.5.7 Dust and air quality

Exceedences of UK air quality objectives are not predicted in the area proposed for the onshore grid connection. Local background concentrations of NO_2 and PM_{10} are below air quality objectives for 2007 and 2010.

Identification of haul routes, likely access points, and diversion routes to be used during road closures, would be agreed with NNDC and BDC following consent. Therefore the impact of emissions from on road vehicles associated with installation of the onshore cable can not be assessed at this time. Emissions from NRMM used during construction are predicted to have a minor adverse impact on air quality. Implementation of the proposed mitigation measures will reduce the impact from NRMM on air quality to **negligible**.

In assessing the impact of construction dust emissions a number of factors were considered including the magnitude, special extent, duration, and reversibility of the impact. The probability of occurrence of the impact was also considered. The air quality assessment has reported that construction emissions are predicted to have a short term moderate adverse impact on sensitive receptors within 200m of construction activities. However the successful implementation of proposed mitigation measures will reduce the impact of construction emissions on sensitive receptors near the cable route to short term, **minor adverse** significance. Following the mitigation methods outlined below, the construction of the substation is likely to cause a **minor adverse** impact on air quality. It is therefore not necessary to undertake monitoring of dust during the construction phase.

Mitigation – dust and air quality during construction
Emissions from non road mobile machinery • All NRMM shall use fuel equivalent to ultra low sulphur diesel (fuel meeting the specification within EN590:2004) where possible. • All NRMM shall comply with either the current or previous EU Directive Staged Emission Standards (97/68/EC, 2002/88/EC, 2004/26/EC). • All NRMM shall be fitted with Diesel Particulate Filters (DPF) conforming to a defined and demonstrated filtration efficiency (load/duty cycle permitting). • The ongoing conformity of plant retrofitted with DPF, to a defined performance standard, shall be ensured through a programme of on-site checks. • Implementation of energy conservation measures and maintenance of equipment to ensure efficient energy consumption.
Dust • A Code of Construction Practice (COCP) will be implemented as outlined in the GLA and London Councils Best Practice Guidance. This will incorporate dust minimisation and management techniques. • The approach shall follow Best Practice Guidance on the control of dust emissions from medium risk construction activities.

Following completion of the onshore grid connection and substation, there will be **no impact** during operation on local air quality.

13.5.8 Land use, local community, tourism and recreation

The assessment of impact on the local community, land use, tourism and recreation has involved thorough consultation with the local community, including three public exhibitions, and the collation of other information on any features located in the study area. The proposed route runs almost entirely through private agricultural land. Exceptions to this include the locations where the route crosses the road network; locations where the route cross Public Rights of Way and other public access points; several areas of woodland; a river and a holiday park.

The construction of the onshore cable system will cause some disruption to farming activities relating to the 20m working corridor becoming unworkable. The cable route has been designed to follow field boundaries to minimise disruption outside of the working corridor, and mitigating activities will reduced this impact to a **negligible** level.

Users of the local road network would experience some disruption and inconvenience due to general construction traffic and the temporary closure and diversion during the required Highway crossing points. Mitigation including ongoing consultation with the Highways Authority at Norfolk County Council, sensitive timing and good construction practice would ensure that the residual impact would only be of **minor adverse** significance during periods of high traffic movement, and **negligible** at other times.

The installation of the route would require the temporary closure or disruption of several Public Rights of Way or frequently used paths and disturbance to users of the Marriott's Way. Mitigation would limit the impact to a **negligible** level.

Specific tourism and recreational features likely to be impacted by the construction of the cable route are the Muckleburgh Collection Museum; the Poppy Line Railway; and Kelling Heath Holiday Park. Works within the Muckleburgh Collection museum will be timed during the winter closure period therefore **no impact** would occur. The route would be directionally drilled under the Poppy Line and Kelling Heath Holiday Park; however works would be carried out within a firebreak in the woods. This disturbance would be minimised by sensitive timing of works, fencing of the construction area and good construction practices. If the proposed drill at Kelling Heath is carried out during the main tourism season, the impact is assessed to be short term **minor adverse**; if construction avoids the main tourism season then the impact is assessed to be **negligible**.

The proposed new substation installation is located on private agricultural land. This would result in the permanent loss of approximately 2.15 acres of agricultural land, including a farm access track. The construction of the new substation will therefore have a **minor adverse** impact on agricultural practices.

If works inside the existing EDFE substation are carried out at the same time as the construction of the Scira substation, this may result in increased levels of disruption to the receptors already discussed. If the works are not timed together, this would extend the period of disruption. Scira would aim to liaise with EDFE to time and execute the works in a sensitive and co-ordinated manner wherever feasible; and the works would not result in any significant increase in the level of impact already described.

The regional economy may benefit from the proposed development due to the increase in local spend from construction workers in the area. Where possible Scira will source materials and labour from the area. Local companies and contractors will be given the opportunity to tender for work relating to the development. The overall impact is likely to be **minor beneficial**.

Mitigation –land use, local community, tourism and recreation during construction
General • Designers and contractors will comply with their relevant duties under the Construction (Design and Management) Regulations 2007, and the Health and Safety at Work Act 1974. • Ongoing consultation will take place with Norfolk County Council, landowners, tourism operators and the local community during site planning and construction phase. • Duration of public rights of way and highway closures will be minimised. • Full reinstatement of ground surface after works are carried out.
Agricultural activities • Considerate use of shared access points in agreement with landowner. • Storage and protection of top-soil during construction phase. • Full reinstatement on completion of works.
Road Network • Routes for construction traffic will be discussed and agreed with the Highways Authority and any required restrictions relating to timing and working hours complied with. This may include specific requirements for movements of any significant construction plant. • Construction traffic movements will, when possible, be scheduled to avoid the peak traffic periods at the beginning and end of the day, and other sensitive periods, in order to minimise disturbance to local traffic. • Wheel washing will be carried out where required to ensure that local roads are kept clear of mud and debris.
Footpaths and other public access • Good communication with local community to inform of Public Rights of Way closures. • Secure fencing of the proposed substation site to prevent access from Marriott's Way.
Kelling Heath Holiday Park and Poppy Line • The directional drill working areas would be fenced during the construction period. • Opportunities to screen the firebreak construction area from the holiday park access road would be assessed during the detailed design, with consideration of any construction access needs. • Any tracks requiring diversion within the holiday park would be clearly signposted.

With the exception of cross bonding pits, once the cable is installed it will be buried; therefore it will not impact on the local community or any features of tourism or recreation. The operational phase of the proposed onshore grid connection will therefore have **no impact** on the land use, local community, tourism or recreation.

13.6 Conclusions

In order to identify the proposed route of the cable system, Scira has progressed a detailed and iterative process, taking into account environmental, technical, financial and risk considerations at each stage. This process has been carried out by Scira with the support of a team of environmental and technical specialists. An almost limitless number of route options and combinations are theoretically possible in order to connect the proposed Sheringham Shoal offshore wind farm to the grid, however Scira are confident that the process which has been adopted has taken due account of all environmental and technical consideration in order to propose a buried grid connection route with minimal impact to the environment. The location, layout and design of the proposed substation at Salle has also been carried out in a way to minimise effects on the landscape and visual character of the surrounding area, as well as other environmental receptors.

A thorough Environmental Impact Assessment (EIA) of the proposed onshore grid connection has been carried out which has involved detailed surveys, studies and assessments to assess any effects to the natural, physical and man-made environment. This has also involved thorough consultation with statutory and non-statutory organisations, as well as the local community, throughout the EIA process. Overall, given the successful implementation of the stated mitigation measures as committed to by Scira, it is predicted that the onshore grid connection project would have no long-term unacceptable or significant impacts.

Following planning consent, an Environmental Action Plan (EAP) will be prepared to ensure that the mitigation measures committed to by Scira as part of the Environmental Statement and best practice are implemented correctly on site and as part of the construction contract.

The project is an essential part of the overall Sheringham Shoal Offshore Wind Farm, and would therefore make a significant contribution to both regional and national renewable energy targets and CO_2 emission reductions.

13.7 References

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