DOGGER BANK
TEESSIDE A & B

March
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Environmental Statement Chapter 24 Appendix A Land Quality Phase 1 Desk Study

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Cover photograph: Indicative image showing installation of meteorological mast within the Dogger Bank Zone

Land Quality Phase I Desk Study

Dogger Bank Teesside A & B

Forewind

15 January 2014

Final Report v2

9W7904

Royal HaskoningDHV

Enhancing Society Together

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Royal HaskoningDHV

SUMMARY

Royal HaskoningDHV have been commissioned by Forewind to conduct a Land Quality Assessment (Preliminary Risk Assessment) in connection with the onshore components of the Dogger Bank Teesside A & B Grid connection.

The onshore works are described as all infrastructure required landward of the Mean High Water Mark (MHWM) to distribute the electricity generated by the offshore wind turbines to the electricity transmission system.

A preliminary risk assessment has been undertaken to identify whether or not there are potentially unacceptable risks to human health or the environment posed to or by onshore development works, which warrant further investigation.

The majority of the project boundary (shown on **Figure 2.1**) is underlain by superficial deposits comprising Till. The nature and thickness of the clay represents a significant barrier for the vertical and / or horizontal migration of contaminants. Some small areas in the west of the project area (west of Lackenby) are underlain by outcrops of Glaciofluvial Deposits and Glaciolacustrine Deposits. It is likely that this material is highly permeable and will permit the transmission of contaminants. The entire extent of the study area is underlain by the Redcar Mudstone Formation.

A number of historical potentially contaminative land uses have been identified within the project boundary. Many industrial land uses can store and use various potentially contaminative materials and products. GIS data from Envirocheck (November 2012) on manufacturing, industrial and public land uses has identified a number of sites with potential activities that may represent a significant source of contamination.

Contamination sources can include neighbouring land uses and historical activities both on and off the site. Within this assessment a number of features have been identified to represent a potential risk and therefore are included within the conceptual site model.

Contamination is described within Part2A of The Environment Act 1990 as a substance or substances that can be introduced to the land where they would not normally be. These substances are often associated with industrial processes or activities that have now ceased, but where remnant waste products or residues may present a hazard to the general environment.

In accordance with the above approach, a conceptual model of the site has been produced and a risk assessment undertaken to assess the potential for source-pathway-receptor linkages to occur at the site as a result of the proposed onshore infrastructure.

Based on the data assessment presented in this report a number of potential pollutant linkages may be present in relation to the proposed onshore infrastructure. These potential pollutant linkages vary in risk and require varying degrees of further work.

It is considered that the sources classified as Very Low Risk require no further work.

All of the sources classified as Low risk should be investigated further if located within the final alignment of the cable route, the converter station site footprint or within a distance that contaminants could migrate from. It is recommended that this is done by

contacting the site operators to understand if there has been any record of breakdown or contamination event. Further information that would be useful in understanding the risks include maintenance records, installation records and where relevant decommissioning dates. It is likely that if these facilities have been well maintained and pollution events have been recorded, that these sources will not require any further consideration.

All of the sources with risk ratings of Moderate/Low and Moderate will require further investigation if located within the final alignment of the cable route, the converter station site footprint or within an influencing distance. Considering the industrial nature and likely licenced activities undertaken at these sites, it is likely that there are records detailing the more specific land uses. Records may also exist for previous ground investigation and risk assessment that may help in understanding the risks form these land uses. If such information is not available, further site investigation may be required.

Any excavated material should be handled, managed and disposed of in accordance with current waste management guidance and legislation and detailed in a Site Waste Management Plan or Materials Management Plan.

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1 INTRODUCTION

Royal HaskoningDHV have been commissioned by Forewind to conduct a Land Quality Assessment (Preliminary Risk Assessment) in connection with the onshore infrastructure of Dogger Bank Teesside A & B.

Key Objectives

The primary objective of this Preliminary Risk Assessment (PRA) is to undertake an assessment of the potential risks to human health and controlled waters[1].

This document has been prepared for the sole benefit of Forewind Ltd. Limitations are described in **Appendix E**.

Report Format

This report presents the findings of the PRA. The report comprises the following principal sections:

- **Section 2 –** Development Description;
- **Section 3** – Site Location, Land Use and Environmental Setting;
- **Section 4** – Preliminary Conceptual Site Model and Risk Evaluation; and
- **Section 5** – Conclusions and Recommendations.

Methodology

The PRA has been completed in general accordance with the recommended approach in Contaminated Land Report 11 (DEFRA, Environment Agency (2004) Model procedures for the Management of Contaminated Land, R & D Publication CLR11) and CIRIA 552 (2001), Contaminated Land Risk Assessment, A Guide to Good Practice.

The PRA is a desk based study and forms the initial step in the assessment of potentially contaminated land and precedes, if required, subsequent intrusive investigation, risk assessment, options appraisal, remedial design, implementation planning and completion reporting.

The main purpose of the PRA is to identify whether or not there are potentially unacceptable risks to human health or the environment posed by the site and the proposed onshore development works, which warrant further investigation. The following desk-based information sources have been reviewed in undertaking the PRA:

- GIS Envirocheck Data comprising historical maps, environmental sensitivity data and permitting records;
- British Geological Survey (BGS) Online Geology Viewer and BGS 1:50,000 Guisborough solid and drift map 1998;

[1] The Preliminary Risk Assessment (PRA) has been completed in accordance with the recommended approach in Contaminated Land Report 11, (*DEFRA, Environment Agency (2004). Model procedures for the Management of Contaminated Land, R & D Publication CLR11).*

- Consultation with Tees Valley RIGS Group regarding Regionally Important Geological and Geomorphological Sites (RIGS);
- Redcar and Cleveland Borough Council Draft Local Plan Policies Map (September 2013);
- Historical borehole logs for the surrounding area from the BGS historical borehole database;
- Environment Agency website 'What's in my Backyard'[2]; and
- Multi Agency Geographic Information for the Countryside (MAGIC)[3].

For the purpose of this assessment the following terminology has been used to describe the development and study areas under consideration:

- Project Boundary – refers to the land within the planning boundary within which permanent and temporary works may be undertaken. The project boundary area is shown on all drawings.
- Study area – this refers to the land within the project boundary and a 500m buffer around the project boundary within which data searches have been undertaken.

[2] http://www.environment-agency.gov.uk/homeandleisure/37793.aspx
[3] http://magic.defra.gov.uk/

2 DEVELOPMENT DESCRIPTION

Dogger Bank Teesside is Forewind's second stage of development of the Dogger Bank Zone. Teesside Projects A & B will each have a maximum installed capacity of 1.2GW.

Dogger Bank Teesside A & B will connect into an existing National Grid substation at Lackenby, near Redcar and the cables are anticipated to come onshore between Redcar and Marske-by-the-Sea. Dogger Bank Teesside A is located within the eastern part of Tranche B, with a size of 560km^2 and with closest point from shore at 196km and Dogger Bank Teesside B which straddles Tranche A and Tranche B, with the majority of the project located in Tranche B. It is 593km^2 and is 165km from shore at its closest point.

The onshore infrastructure for Dogger Bank Teesside A & B will comprise the following:

- A preferred landfall location between Redcar and Marske-by-the-Sea;
- Two buried High Voltage Direct Current (HVDC) cable systems (one per project);
- Two converter station site and associated development (converting High Voltage Direct Current (HVDC) to High Voltage Alternating Current (HVAC); and
- Two buried HVAC cable systems (one per project) connecting to existing National Grid substation at Lackenby.

The onshore Project Boundary is shown on **Figure 2.1**. This encompasses the cable corridors, convertor stations and construction compounds required to construct the onshore components.

2.1 Onshore Transition Pit

An onshore transition pit will be required close to the shoreline. This allows each offshore export cable to be jointed to an onshore cable which is then connected to the onshore converter station site (the onshore cable route).

The transition pit size and design will be determined through detailed design. The pit will be located below ground level and will need to be accessible throughout the life time of the project and as such the immediate area around it is likely to have restricted access. It is assumed that the maximum depth of excavation for the transition pit is 2m below ground level.

2.2 Cable System

2.2.1 Cable Components

Dogger Bank Teesside A & B comprises two buried HVDC cable systems, one for each project. In addition, there are two HVAC cable systems, one for each project. A cable system is the installed infrastructure in a single trench, including cables, safety markers, fibre optics, jointing pits, ducts and any other material other than natural vegetation surrounding the underground cables. The chosen cable route is likely to be approximately 9km long.

Cables will be buried in one trench which is anticipated to be around 1.5m wide and approximately 1.5m deep, with an indicative working width during construction of up to 39m wide.

During the construction phase in areas where trenching is proposed the material for backfilling around the cable will require demonstration that it is suitable for use as per the Contaminated Land: Applications in Real Environments (CL:AIRE) Development Industry Code of Practice.

2.2.2 Cable Installation Techniques

The two main cable construction techniques proposed are trenching and horizontal direction drill (HDD). HDD will be used to cross significant obstacles such as rivers, streams and major roads where trenching cannot be achieved. During HDD tunnels are bored under the structure and the cables pulled through the underlying geology.

2.3 Onshore Converter Station Site

Forewind has accepted a grid connection offer made by National Grid to connect 2 GW of the Dogger Bank Teesside project into the existing Lackenby substation, to the south west of the Wilton Complex (Chemical Works). Two new converter station site will be constructed which represent the main permanent, visible, aspect of the onshore project infrastructure.

The design and layout of the new converter station site has been progressed in parallel with the development process. The final locations have taken into consideration feasibility studies on land availability, environmental and technical constraints; and landowner negotiations. The locations of the onshore converter station site are shown on **Figure 2.1**.

The converter station site is required to be accessed by operational and maintenance personnel on an intermittent basis and will incorporate a cover of hard standing.

3 LAND QUALITY AND ENVIRONMENTAL SENSITIVITY

This section summarises the environmental setting for the project to the support the development of the conceptual site model (CSM) identifying potential sources, pathways and receptors of contamination. The Geological Online Viewer provided by the British Geological Survey[4] has been reviewed and the findings summarised below.

3.1 Geology

The superficial deposits overlay the solid geology which is described below. The units identified are shown on **Figure 3.1** and **Figure 3.2** and described below.

3.1.1 Superficial Geology

The majority of the project boundary is underlain by superficial deposits comprising Till as shown on Figure 3.1 Superficial Geology. The Till is described as a group of sediments laid down by the direct action of glacial ice with variable lithology, usually sandy, silty clay with pebbles, but can contain gravel-rich, or laminated sand layers; and of varied colour and consistency. Borehole records[5] in the area indicate the Till to be approximately 10m in thickness and comprising predominantly of clay. The clayey nature and thickness of the clay represents a significant barrier for the vertical migration of contaminants. Borehole locations are shown on **Figure 3.1**.

An outcrop of Glaciofluvial Deposits is shown underlying the project boundary around Yearby and Lackenby. Glaciofluvial Deposits are described as sand gravel formed up to 2 million years ago in the Quaternary Period when the local environment was dominated by ice age conditions. These are likely to be permeable and may permit the vertical migration of contaminants.

The north western corner of the project boundary in the vicinity of Grangetown is underlain by Glaciolacustrine Deposits. Glaciolacustrine Deposits are described as clay and silt. Again the Superficial Deposits formed up to 2 million years ago in the Quaternary Period when the local environment was dominated by ice age conditions. These are likely to be permeable and unlikely to retard the vertical migration of contaminants.

Outside of the project boundary other superficial deposits are present. These are described below;

Tidal Flat Deposits

Tidal Flat Deposits are shown to the north of the project boundary. These are described as consolidated soft silty clay, with layers of sand, gravel and peat. These are likely to be permeable in nature and have the capacity to hold groundwater and transmit contaminants. The general permeability is dependent on the local composition.

[4] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

[5] http://mapapps.bgs.ac.uk/boreholescans/boreholescans.html. Copies of a selection of representative Borehole Record sheets are included in **Appendix B** – Borehole Record Sheets and the locations shown on **Figure 3.1**

Blown Sand
Outcrops of Blown Sand deposits are shown to be present adjacent to the eastern extent of the project boundary along the coastline. Blown Sand deposits are described as pale brown, fine-grained and uncemented. It is likely that this material is highly permeable and will permit the transmission of contaminants.

3.1.2 Solid Geology

The entire extent of the project boundary is underlain by the Redcar Mudstone Formation as shown on **Figure 3.2** Bedrock Geology. The Redcar Mudstone Formation is described as predominantly grey, well bedded, laminated, marine calcareous mudstone and silty mudstone over 200m in thickness.

3.1.3 Geological Sites of Special Scientific Interest

A desk based review identified one (RIGS) known as Red Howles and one geological Site of Special Scientific Interest (SSSI), known as Redcar Rocks, located 150m and 2km to the north of the project boundary, respectively. The location of the designated sites is shown on **Figure 3.6**.

Red Howles is located on the foreshore between the high and low mean water mark, north of the landfall, at National Grid Reference NZ6266-2374 and NZ6273-2377 to NZ6277-2374. This site was officially designated in December 2012 and is shown on the Redcar and Cleveland Borough Council Draft Local Plan Policies Map, September 2013. A meeting was held with the Tees Valley RIGS Group on the 26th November 2013 to discuss the sensitivity of this area.

Red Howles forms part of the Redcar Rocks succession and comprises calcareous shales from the oldest part of the Jurassic era. The site is designated as regionally important for its index fossils, its depiction of the environment in which the rocks were formed and evidence of anticlinal folding.

Redcar Rocks, 2km to the north, are hailed as one of the finest exposures of Lower Lias rocks (within the Lower Jurassic era) in north east England comprising abundant bivalve and ammonite fossils.

3.2 Hydrogeology

The majority of the project boundary is underlain by strata designated as being an unproductive aquifer (refer to **Table 3.1**). However the Glaciofluvial Deposits underlying the project boundary around Yearby and Lackenby and the Glaciolacustrine deposits underlying the project boundary in around Grangetown are considered to be a Secondary A aquifers.

Table 3.1 Summary of Underlying Geology and Aquifer Properties

	Stratum	Aquifer properties	Groundwater vulnerability
Drift	Till	Defined as unproductive strata. Deposits are low permeability, with negligible significance for water supply or base flow to rivers.	None
	Glaciofluvial and Glaciolacustrine deposits	Defined by the Environment Agency as Secondary A aquifer. Deposits with permeable layers with the capability to support water supplies at a local rather than strategic scale and provide an important source of base flow to rivers.	Minor Aquifer Low
Solid	Redcar Mudstone Formation	Secondary A - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers	N/A

The groundwater sensitivity within the project boundary is dictated by the presence of the Glacial Till Deposits described above which are not expected to hold considerable quantities of water and are likely, where clay is dominant, to significantly retard the transmission of mobile contaminants. Evidence from borehole records indicates that the Till is of a clayey composition and of considerable thickness. Where the project boundary is underlain by Till, groundwater is not considered to be a sensitive receptor.

Where the Glacial Till is replaced by the Glaciofluvial and lacustrine deposits (ie, Till is not present), in the west of the project boundary around Yearby, Lackenby and Grangetown, as shown on **Figure 3.3** Groundwater Vulnerability, the groundwater is considered to be a sensitive receptor.

There are no Source Protection Zones (SPZ) within the study area.

3.3 Hydrology

A single watercourse within the study area appears in the Local River Basin Management Plan (Roger Dikes). This is considered to be a moderately sensitive receptor.

The following surface water features have also been identified within the study area.

- Long Beck;
- Kettle Beck; and
- Surface Water Drains

All of these features are relatively small and likely to have very localised catchments. There are sensitive to only very localised sources of contamination. As such the sensitivity of these surface water features is considered to be low.

The site is not within an area subject to flooding from rivers or sea without defences with the exception of land on the seaward side of the flood defences that borders the beach at the landfall.

3.4 Current Industrial Land Use

Many industrial land uses can store and use various potentially contaminative materials and products. GIS data from Envirocheck on manufacturing, industrial and public land uses has been screened to identify potential activities that may represent a significant source of contamination. The data has been screened to identify those land uses that are significant geographically and are likely to form a potentially significant source of contamination. A full list of the manufacturing, public and commercial activities identified in the GIS is provided in Table 3.2.1 in **Appendix C**.

To screen the data for its geographic significance, the following assumptions have been made:

- Where industrial and commercial land uses are situated within the project boundary, these are considered significant in the context of the CSM and have been discussed further; and
- Where potential industrial land uses are situated either within the project boundary or within the study area and are within an area of Glaciofluvial sand and gravel or Glaciolacustrine sand, clay or silt, these are considered significant in the context of the conceptual site model and have been discussed further.

Following the above screening exercise the remaining land uses have been further screened based upon; the likely activities undertaken and the potential for these activities to represent a significant source of contamination.

Following both the above screening exercises, none of the remaining industrial and commercial land uses are considered further in the conceptual site model.

3.5 Historical Potential Sources of Contamination

A GIS database of Historical Data provided by Envirocheck has been used to identify potential historical sources of contamination. This data has been corroborated with 1:10,000 scale Ordnance Survey Historical Mapping. A number of historical potentially contaminative land uses have been identified within the project boundary. A table including all of the Historical Potential Sources identified within the Envirocheck GIS database is included in Table 3.2.3 in **Appendix C**.

The data has been screened to identify those historical land uses that are significant geographically and for their likely significance as sources of contamination.

To screen the data for its geographic significance, the following assumptions have been made:

- Where industrial and commercial land uses are situated within the project boundary, these are considered significant in the context of the CSM and have been discussed further; and
- Where potential industrial land uses are situated either within the project boundary or within study area and are within an area of Glaciofluvial sand and gravel or Glaciolacustrine sand, clay or silt, these are considered significant in the context of the CSM and have been discussed further.

Following the above screening exercise the remaining land uses have been further screened based upon;

- The likely activities undertaken and the potential for these activities to represent a significant source of contamination; and
- The age of the source and subsequent likely standard of working practices and context of environmental legislation is considered.

Following both the above screening exercises, the remaining industrial and commercial land uses have been listed in **Table 3.2** and are considered further in the CSM. These potential sources are shown on **Figure 3.4**.

Table 3.2 Historic Potentially Contaminative Sites

GIS Source ID	Historical Land Use	Date first shown on maps	Underlying Superficial Geology	Likely Contaminants	Potential Hazard
Within Project boundary					
006	Electrical Sub Station	1983	Till	Hydrocarbons, PCB's	Low
057	Mineral railway	1895	Glaciofluvial deposits, Devensian - sand and gravel	Hydrocarbons, PAHs, PCB's, Metals	Low
085	Railways	1857	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
086	Railways	1895	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
087	Railways	1920	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
088	Railways	1938	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
089	Railways	1953	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
090	Railways	1994	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
091	Railways	1938	Till	Hydrocarbons, PAHs,	Low

GIS Source ID	Historical Land Use	Date first shown on maps	Underlying Superficial Geology	Likely Contaminants	Potential Hazard
				PCB's, Metals	
092	Railways	1953	Till	Hydrocarbons, PAHs, PCB's, Metals	Low
093	Electricity production & distribution [inc large transformers]	1992	Glaciolacustrine deposits, Devensian - clay and silt	Hydrocarbons, PCB's	Low to Medium
100	Factory or works - use not specified	1992	Glaciolacustrine deposits, Devensian - clay and silt	Hydrocarbons, PAHs, Metals, Asbestos	Medium to High
101	Factory or works - use not specified	1992	Till	Hydrocarbons, PAHs, Metals, Asbestos	Medium
102	Factory or works - use not specified	1992	Till	Hydrocarbons, PAHs, Metals, Asbestos	Medium
113	Historic landfill (CLE141)	1984	Till	Various	Medium*
114	Historic landfill (CLE165)	19/4/86-15/4/88	Till	Various	Medium*
115	Historic landfill (CLE ST16)	1984	Till	Various	Medium*
117, 118	Licensed landfill (Wilton Perimeter Mounds)	1954	Till	Various	Medium
Outside the Project boundary					
001	Quarrying of sand & clay, operation of sand & gravel pits	1895	Glaciofluvial deposits, Devensian - sand and gravel	Hydrocarbons, Other	Medium
111	Historic landfill	Unknown	Glaciolacustrine deposits, Devensian - clay and silt	Various	Medium
119, 120	Historic landfill (Wilton Perimeter Mounds)	1954	Glaciolacustrine deposits, Devensian - clay and silt	Various	Medium

*Reduced potential hazard based on information provided by Local Authority detailed in Section 3.2.5

3.6 Landfill Sites

GIS data from Envirocheck and review of the Environment Agency website[6] identify three historic landfills within the project boundary. Consultation in October 2012 with Redcar & Cleveland Borough Council provided detailed information on these and is provided below. The location of the landfills within the project boundary are shown on **Figure 3.6**.

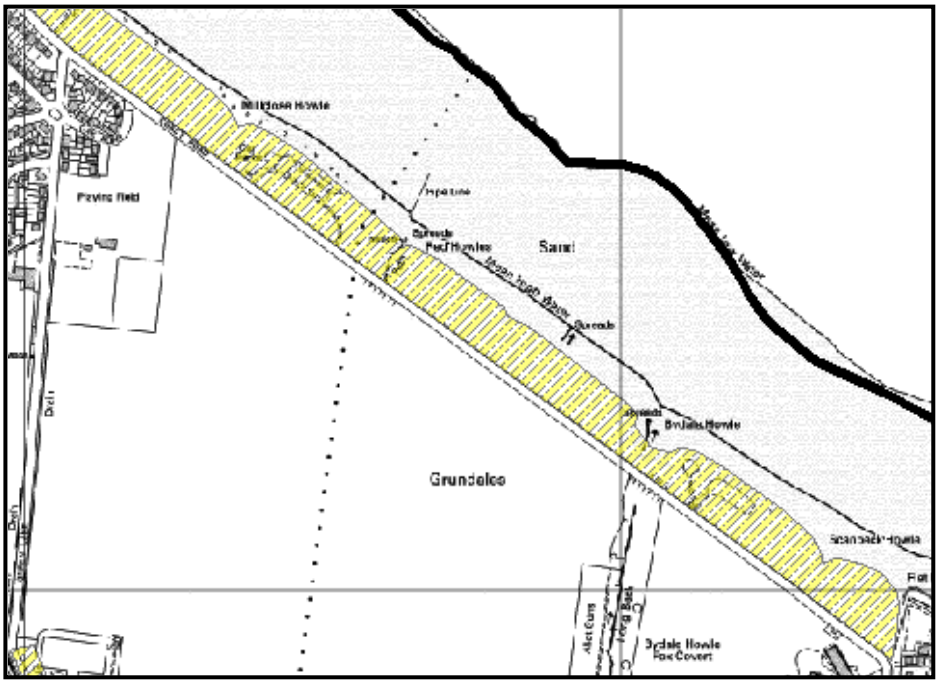
[6] http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=waste

CLE 141, Coastal Protection Works. The Stray, Redcar, Cleveland, NZ 613 162

- Operator - Langbaurgh Borough Council Engineer; and
- Permitted Wastes - Wastes from the construction industry

This licence was issued to Langbaurgh Borough Council Engineers in April 1984 and permitted the deposit of waste from the construction industry. The licence was returned to the Agency in December 1990. The Environment Agency has no gas monitoring results for this site. The landfill site CLE141 is shown on **Plate 1** below.

Plate 1 CLE 141, Coastal Protection Works

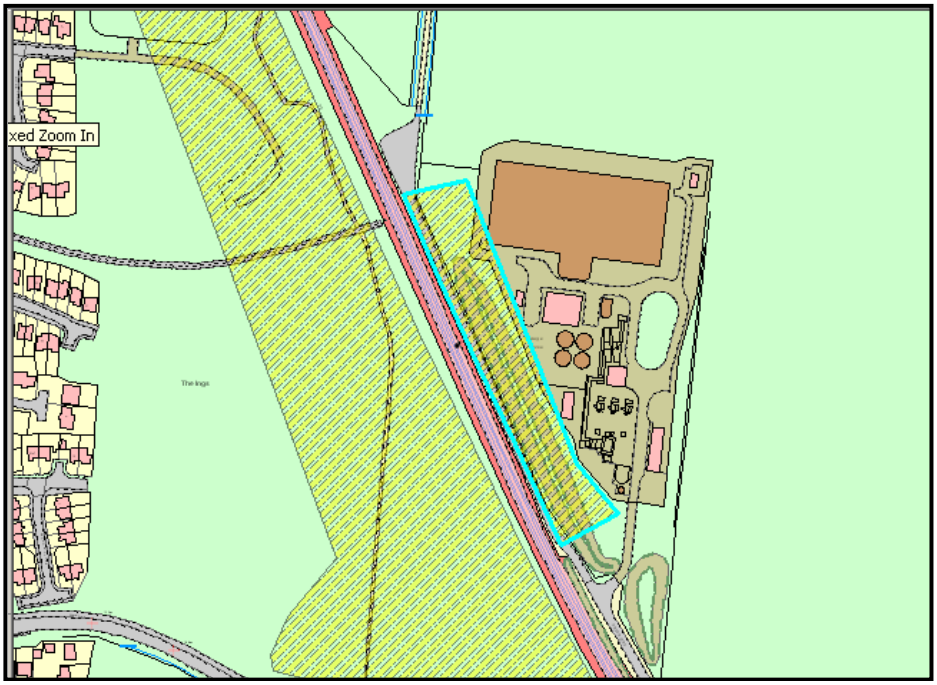


CLE ST16 Marske Treatment Works, Green Lane, Marske, North Yorkshire NZ 621 227

- Operator - Northumbrian Water Authority; and
- Permitted Wastes - Wastes from the construction industry

This licence was issued to Northumbrian Water Authority in August 1984 and permitted the deposit of waste from the construction industry. The licence was subsequently returned to the Agency on completion of operations. The Agency has no monitoring records from this site. The landfill site CLEST16 is shown on **Plate 2**.

Plate 2 CLEST16, Merske Treatment Works

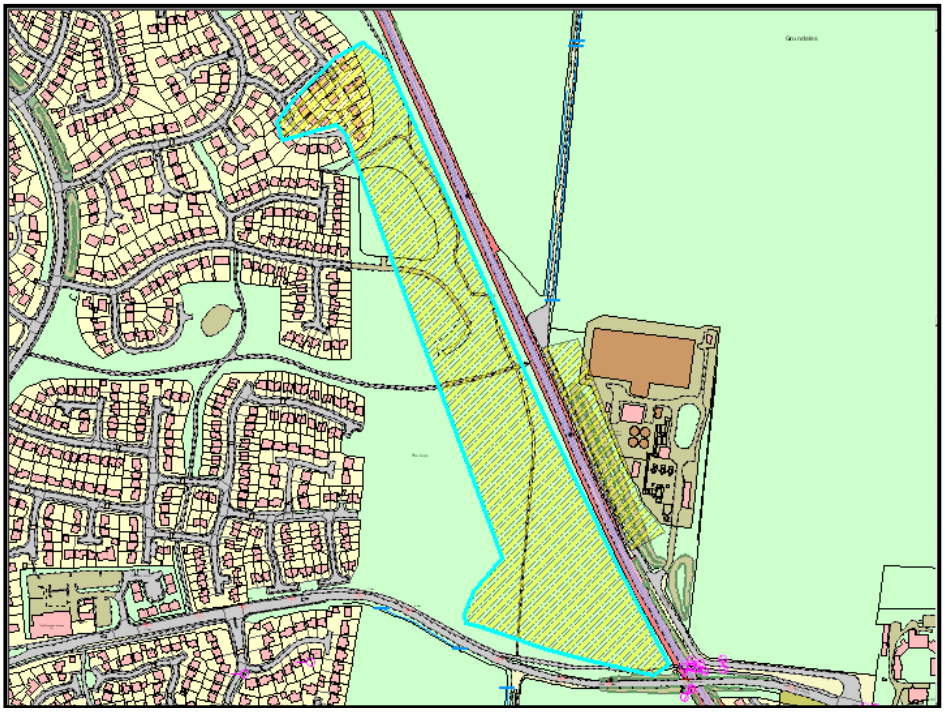


CLE 165, The Ings Residential Development, NZ 619 227

- Operator- Moorhead Sutton & Laing;
- Life of site- 19/4/86-15/4/88;
- Wastes -General Household skip waste and construction industry waste; and
- Other Points- only wastes deposited were from site operations.

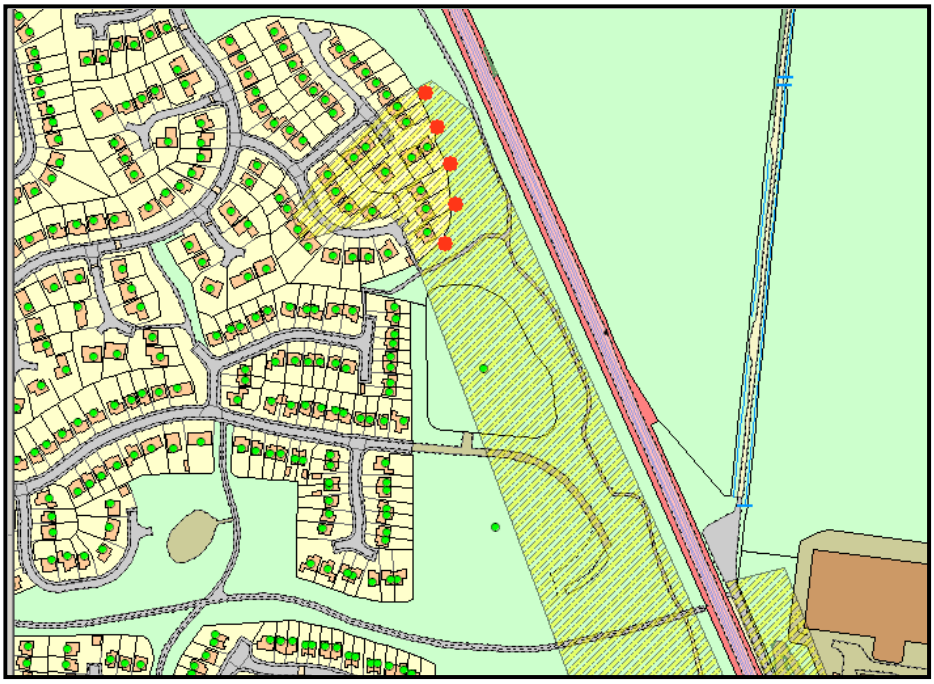
This licence was issued to Leech Holmes Ltd in November 1989 and permitted the deposit of waste from the construction industry and general household waste. However, only materials arising from on-site excavations were deposited. Operations at this site ceased in November 1989 and the licence was subsequently returned to the Agency. The Agency does not have any records of gas monitoring at this site. The landfill site CLEST16 is shown on **Plate 3**.

Plate 3 CLEST16, Ings Residential Development



The Local Authority (2011-2012) has carried out limited hand augered gas sampling (3 rounds) at locations shown on the map below. The nature of the arisings were clayey sandy soil with stones, and Pulverised Fuel Ash (PFA). Results to date indicate no flow and no landfill gas generation, and show Gas Characteristic Situation 1. The hand auger locations are shown on **Plate 4**.

Plate 4 Hand Auger Locations



Historical Potential Source – 111, 119, 120

A number of historic landfills are shown on the Environment Agency website in the proximity of the Wilton Chemical Works in the West of the project boundary. These are marked as Wilton Perimeter Mounds. It is likely that these were constructed from locally won surplus material from the Wilton works. These may contain contaminated soils and construction waste including asbestos.

No further information is available on the permitted wastes at this time.

Due to the nature of the waste deposited in all of the landfills discussed above, some biodegradable material may have been deposited within these landfills. Therefore, the possibility of landfill gas generation/ migration should not be excluded.

3.7 Licenced Landfills

Historical Potential Source – 117, 118

A number of historic landfills are shown on the Environment Agency website in the proximity of the Wilton Chemical Works in the West of the project boundary. These are marked as Wilton Perimeter Mounds. It is likely that these were constructed from locally won surplus material from the Wilton works. These may contain contaminated soils and construction waste including asbestos.

Again, due to the nature of the waste deposited in all of the landfills discussed above, some biodegradable material may have been deposited within these landfills. Therefore, the possibility of landfill gas generation/ migration should not be excluded at this stage.

3.8 Sensitive Land Use

The Multi Agency Geographic Information for the Countryside tool (MAGIC) and the RCBC Draft Local Plan Policies Map (September, 2013) have been reviewed for Statutory[7] and non-Statutory[8] sensitive land uses within the study area.

There are no statutory land use designations identified within the study area with the exception of a Local Wildlife Site (LWS). The LWS is shown adjacent to and extending into the study area along the eastern boundary as shown on **Figure 3.7** Sensitive Land Uses as presented within **Appendix A**.

There are three non-statutory designations within the study area for:

- A Community Forest;
- Red Howles Regionally Important Geological Site; and
- An Objective 2 Area designated by the Department for Business, Enterprise and Regulatory Reform.

[7]http://magic.defra.gov.uk/website/magic/opener.htm?startTopic=magotherrural&xygridref=459556,521505&startScale=45920
[8]http://magic.defra.gov.uk/website/magic/opener.htm?startTopic=magstatrural&xygridref=459556,521505&startScale=45920

Neither of the Community Forest or the Objective 2 Area land uses are considered to be significantly sensitive in terms of Land Quality Risk Assessment when the footprint of the project infrastructure is considered against the size of the designated land uses. However if any project infrastructure is situated within any forested area then an ecological risk assessment should be undertaken.

The Red Howles RIG site is considered to be a sensitive area which lies approximately 150m north of the project boundary at the landfall, but within the 500m study area buffer. The site will be affected by direct impact and disturbance, refer to Section 3.1.3 for details of the designation.

4 PRELIMINARY CONCEPTUAL SITE MODEL AND RISK EVALUATION

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 harm' may be caused or significant pollution of controlled waters is being or is likely to be caused, and a pathway which connects the two. Should any element of this contaminant linkage not be present (or be severed) then the land may not be regarded as contaminated land, as defined in Part 2A of the Environmental Protection Act 1990.

Contamination is described within Part2A as a substance or substances that can be introduced to the land where they would not normally be. These substances are often associated with industrial processes or activities that have now ceased, but where remnant waste products or residues may present a hazard to the general environment.

In accordance with the above approach, a conceptual model of the site has been produced and a risk assessment undertaken to assess the potential for source-pathway-receptor linkages to occur at the site as a result of the proposed development.

As more information becomes available the conceptual model should be updated. The conceptual model is limited at this stage to the identification and assessment of potential sources, potential receptors, and the anticipated pathways to those receptors identified as result of the documentary research.

4.1 Potential Sources

Contamination sources can include neighbouring land uses and historical activities both on and off the site. Within this assessment and based on the discussions in Section 3.2.2 and 3.2.3 all of the features listed in **Table 3.1** and **Table 3.2** have been identified to represent a potential risk and therefore are included within the conceptual site model. Identified sources include the following:

- Railways;
- Hospitals;
- Sewage Works;
- Electrical Sub Stations;
- Tanks;
- Factories;
- Landfills; and
- Quarries.

4.2 Potential Pathways

Direct contact – ingestion and physical contact with contaminants which are present at or near the surface. This pathway is viable during the construction phase (cable trenching etc.) and at the eventual converter station site locations where access and maintenance is required. During the construction phase and where cable trenching is proposed the material used for backfilling around the cable will need to be proven suitable for use as per the Contaminated Land: Applications in Real Environments (CL:AIRE) Development Industry Code of Practice.

- Any risks of exposure to construction workers should be mitigated through Personal Protective Equipment (PPE). Exposure during the operation phase at the converter station site is significantly reduced due to the design including concrete hardstanding at the converter stations sites and the infrequent and short time, workers are likely to be on-site.
- ***Inhalation*** – from airborne particles, ground gasses and vapours that may be present. This pathway is viable at the eventual converter station site locations where access and maintenance is required. However likelihood of exposure is significantly reduced due to the designed concrete hardstanding at the converter station sites. In areas where the cable trenching is to occur, backfilling will be with clean material. Any risks of exposure to construction workers will be mitigated through PPE.
- ***Permeable ground*** – As discussed in Section 3.1, the sections of the project boundary that are not underlain by Glacial Till may allow contaminants (if present) to migrate to surface water and off-site groundwater where in continuity.
- ***Deep groundwater*** – the bedrock aquifer beneath main project boundary is classed as a Secondary A Aquifer of intermediate vulnerability, and may allow contaminants (if present) to migrate to surface water, off-site groundwater and water abstractions where in continuity.
- ***Surface water*** – The site comprises a number of small, localised drainage ditches and dykes. These may transmit contaminants laterally across the project boundary.
- ***Drains and Underground Services (including the buried cable systems proposed as part of this development) –*** without mitigation, permeable gravel surrounds of cable systems and ducting may allow the lateral migration of contamination.

4.3 Potential Receptors

- ***Human health (construction workers)*** - Construction workers are considered to be a sensitive receptor due to the close proximity in which they are required to work with the soils. However, this assessment is for long term health risks and further assessment is required by the contractor[9]. Special attention and planning will be required where construction activities occur in the proximity of landfill sites.
- ***Human health (future site users / land owners) –*** Future site users / land owners will only have access to the cable route post construction, therefore, assuming that the soils are placed appropriately during construction works, the risk to human health is not considered to be significant.
- ***Human health (converter station site operators) -*** The converter station site are required to be accessed by operational and maintenance personnel. However the facilities will incorporate a cover of hard standing and will only be accessed intermittently, therefore, assuming that the soils are placed appropriately during construction works, the risk to human health is not considered to be significant.
- ***Shallow and Deep groundwater*** - The bedrock aquifer beneath the main study area is classed as a Secondary A of intermediate vulnerability. The parts of the

[9] In this document the assessment of risk to human health from potential contaminants of concern is based on long term rather than short term exposure, the latter being more typical of that experienced by construction workers. It is generally considered that the potential risk to construction workers can be mitigated / managed through appropriate working practices and personal protective equipment. Relevant information should be made available to the contractor undertaking the works such that they are able to make their own assessment of risks, and develop appropriate methods of working

study area where the superficial geology is not Glacial Till the shallow and deep aquifers are considered to be sensitive receptors.

- ***Sensitive geological features* –** The Red Howles RIG site is considered to be a highly sensitive receptor that would be affected by direct impact or disturbance at the surface. The RIG site lies approximately 150m outside of the project boundary and is unlikely to be directly affected by the development works. As such the development is not considered to pose a risk to this receptor and is not discussed further.
- ***Local drainage ditches and dykes*** - The Rogers Dike is a water body identified in the regional catchment management plan and is considered to be a moderately sensitive receptor.
- **Project Infrastructure (Buildings, Structures and Construction Materials) –** The proposed cabling and associated infrastructure are considered to be moderately sensitive. Where interactions with any identified potential source is likely, consideration of the impact is required.

Table 4.1 Summary of Conceptual Site Model

Sources	Pathways	Receptors						
		Surface water (Local Drainage Ditches and Dykes)	Groundwater (Shallow and Deep)	Human health			Sensitive Ecological Receptors (i.e. Flora and fauna)	Structures and buildings
				Construction Workers	Future Site Users / Land Owners	Convertor Station Site Operatives		
Contaminated Soil / Groundwater / Ground Gas from Identified historical and present land uses	Direct Contact	No	No	Yes	No	No	No	Yes
	Inhalation	No	No	Yes	No	No	No	Yes
	Permeable Ground	Yes	Yes	Yes	No	No	No	Yes
	Groundwater	Yes	Yes	Yes	No	No	No	Yes
	Surface Water	Yes	Yes	Yes	No	No	No	Yes
	Drains and Underground Services	Yes	Yes	Yes	No	No	No	Yes

4.4 Risk Evaluation

4.4.1 Methodology

The risk evaluation methodology is a qualitative assessment and is based on CIRIA C552 'Contaminated Land Risk Assessment'. The process involves the classification of the following:

- Magnitude of the potential consequence which takes into account both the potential severity of the hazard and the sensitivity of the receptor; and
- The magnitude of the probability (likelihood) which takes into account both the presence of the hazard and the receptor and the integrity of the pathway.

The resultant risk categories are shown in **Table 4.2**.

Table 4.2 Contamination Risk Categories

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	**Very High Risk**	**High Risk**	**Moderate Risk**	Moderate / Low Risk
	Likely	**High Risk**	**Moderate Risk**	Moderate / Low Risk	Low Risk
	Low Likelihood	**Moderate Risk**	Moderate / Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

Within this assessment the terminology presented in **Table 4.3** has been used.

Table 4.3 Contamination Risk Rating Terminology

Risk rating	Description
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard or there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term
Moderate Risk	It is possible that, harm could arise to a designated receptor from an identified hazard. However it is either relatively unlikely that any such harm would be severe, or if any harm were to occur, it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that at worst this harm if realised would at worst normally be mild
Very Low Risk	There is a low probability that harm could arise to a receptor, in the event of such being realised it is not likely to be severe

4.4.2 Risk Evaluation Assumptions

Based on the following assumptions all of the sources identified in Section 3.2.2 and 3.2.3 have been assessed as to the viable pollutant linkages that may be associated. These pollutant linkages are then assessed for the likely significance and risk.

Assumptions from the CSM carried forward to the risk assessment.

- Human health (Future Users/ Land Owners) is not considered to be a significant receptor due to the negligible exposure potential;
- Project infrastructure placed in areas of the potential sources of contamination identified in Section 3 may expose construction workers to contamination, appropriate assessment and mitigation will be required;
- Groundwater is not considered to be a significant receptor where the underlying superficial geology is Glacial Till;
- Groundwater is considered a sensitive receptor where the superficial deposits of glaciofluvial or glaciolacustrine are present, however it should be noted there are no groundwater abstractions for drinking water purposes;
- Surface waters are considered to be a potential pathway for contaminant migration and mitigation techniques will be implemented (such as Horizontal Directional Drilling and good site working practices) to ensure that these receptors are not exposed to contaminative activities;
- Project infrastructure placed in areas of the potential sources of contamination identified in Section 3 may be susceptible to aggressive ground conditions and appropriate assessment and mitigation will be required;
- Sensitive locally important geological features will be affected by direct impact or disturbance from both permanent and temporary works but are currently outside of the project boundary area and therefore are not at risk;
- Where cabling passes through any in areas of the potential sources of contamination identified in Section 3 appropriate mitigation must be used to ensure that the gravel surrounds will not permit the lateral migration of contaminants; and
- Where cable trenching passes through any of the potential sources of contamination identified in Section 3 all backfilling and spoil material will require demonstration that it is suitable for use as per the Contaminated Land: Applications in Real Environments (CL:AIRE) Development Industry Code of Practice.

4.4.3 Risk Evaluation Summary

The full risk evaluation of all identified sources of contamination and viable contaminant linkages is presented in **Appendix D**. **Table 4.4** overleaf summarises those viable linkages with a risk classification greater than low.

Table 4.4 Viable Pollutant Linkages

Source ID	Land Use	Pathway	Receptor	Consequence of Risk being realised (Severity)	Probability of Risk being realised (likelihood)	Risk Classification	Risk Management	Residual Risk
100	Factory or works - use not specified large transformers	Shallow Groundwater	Shallow and deep aquifers	Medium	Likely	Moderate / Low Risk	Further information should be gathered into the specific history of this facility including maintenance and monitoring activities	Moderate / Low Risk
101, 102, S13	Factory or works - use not specified	Shallow Groundwater	Shallow and deep aquifers	Medium	Unlikely	Moderate / Low Risk	Further information should be gathered into the specific history of this facility including maintenance and monitoring activities	Moderate / Low Risk
111, 113, 114, 115, 119, 120	Historic landfill	Shallow Groundwater	Shallow and deep aquifers	Medium	Unlikely	Moderate / Low Risk	Further information should be gathered into the specific history of this facility including maintenance and monitoring activities	Moderate / Low Risk
		Dermal Exposure / Inhalation	Construction Workers	Medium	Likely	Moderate / Low Risk	Appropriate Personal Protective Equipment PPE and Risk Assessments. Where possible Horizontal Directional Drilling (HDD) should be used to avoid contaminated areas	Moderate / Low Risk
117, 118	Licenced landfill	Shallow Groundwater	Shallow and deep aquifers	Medium	Unlikely	Moderate / Low Risk	Further information should be gathered into the specific history of this facility including maintenance and monitoring activities	Moderate / Low Risk
		Dermal Exposure / Inhalation	Construction Workers	Medium	Likely	Moderate / Low Risk	Appropriate Personal Protective Equipment PPE and Risk Assessments. Where possible Horizontal Directional Drilling (HDD) should be used to avoid contaminated areas	Moderate / Low Risk

5 CONCLUSIONS AND RECOMMENDATIONS

Based on the data assessment presented in this report a number of potential pollutant linkages may be present in relation to the proposed onshore infrastructure for Dogger Bank Teesside A & B.

It is considered that the sources classified as Very Low Risk require no further work.

All of the sources classified as Low Risk should be investigated further if located within the final alignment of the cable route, the converter station site footprint or within a distance that contaminants could migrate from. It is recommended that this is done by contacting the site operators to understand if there has been any record of breakdown or contamination event. Further information that would be useful in understanding the risks include maintenance records, installation records and where relevant decommissioning dates. It is likely that if these facilities have been well maintained and pollution events have been recorded, that these sources will not require any further consideration.

All of the sources with risk ratings of Moderate/Low and Moderate will require further investigation if located within the final alignment of the cable route, the converter station site footprints or within an influencing distance. Considering the industrial nature and likely licenced activities undertaken at these sites, it is likely that there are records detailing the more specific land uses. Records may also exist for previous ground investigation and risk assessment that may help in understanding the risks form these land uses. If such information is not available, further site investigation may be required.

Any excavated material should be handled, managed and disposed of in accordance with current waste management guidance and legislation and detailed in a Site Waste Management Plan or Materials Management Plan.

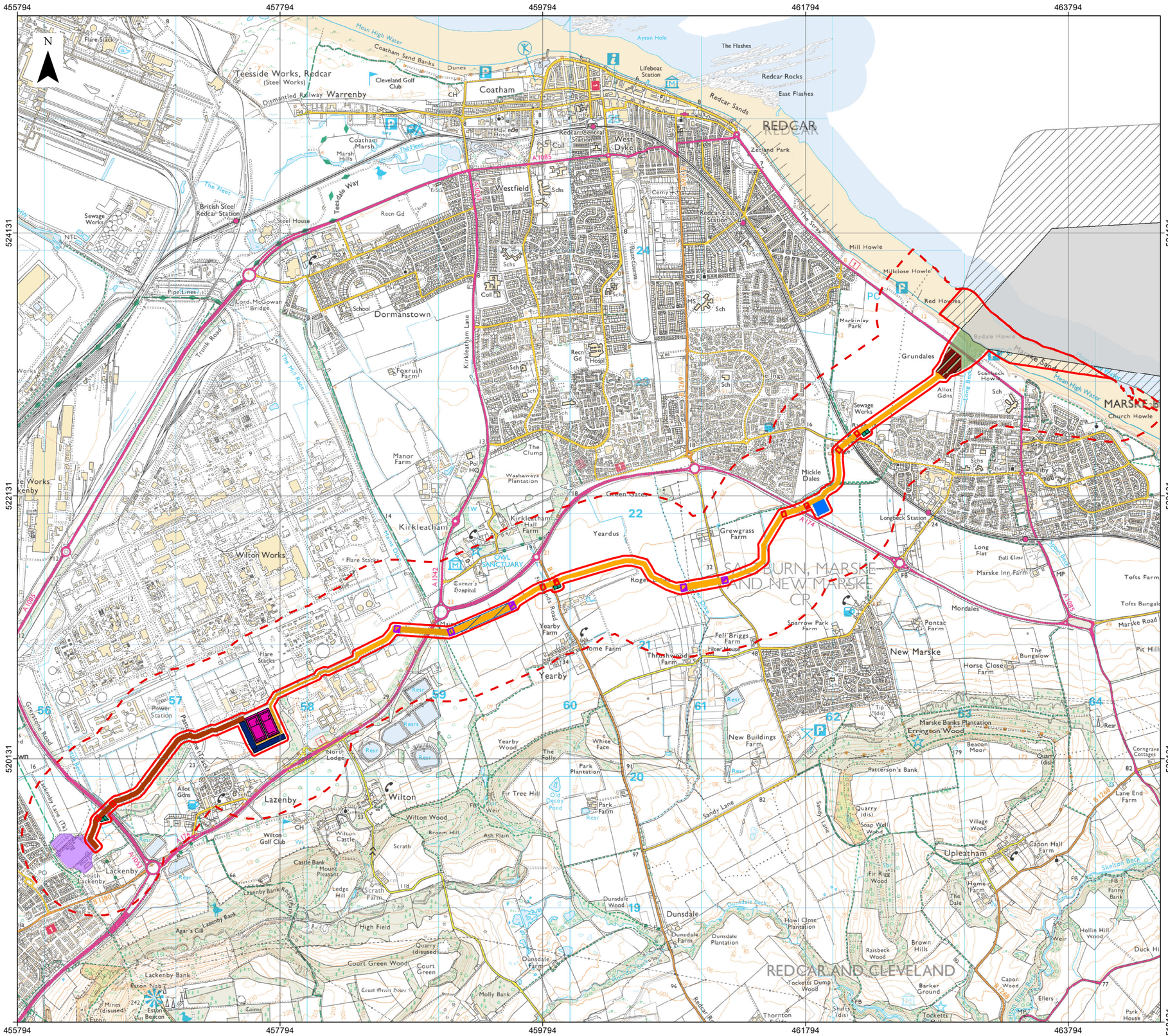
5.1 Recommendations

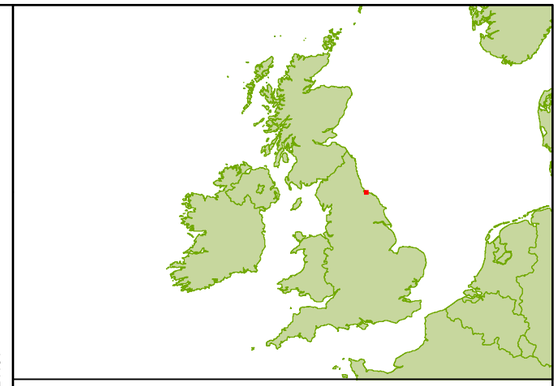
Recommendations for managing risks associated with land quality and materials management are presented in **Table 5.1**.

Table 5.1 Recommendations

Aspect of Scheme	Concern	Recommendation
Construction Phase Health and Safety - potential exposure of construction workers to contaminants in soil or water and gas risk including but not limited to confined spaces.	Compliance with Health and Safety Legislation including the Health and Safety at Work Act 1974 and Construction (Design & Management) Regulations 2007	• Good site practice and hygiene in addition to the use of appropriate Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE), where necessary. • Method statements and risk assessments should be developed for all site works to aid identification of such risks (including gas risk) and appropriate risk avoidance and reduction measures. The works should be undertaken in accordance with the requirements of the Construction (Design & Management) Regulations 2007 where appropriate.
Materials Reuse	Compliance with the CL:AIRE Code of Practice entitled 'The definition of waste: Development Industry Code of Practice'.	• Complete a Materials Reuse Risk Assessment. • Use the results of the Materials Reuse Risk Assessment to complete a Materials Management Plan. • Complete a Site Waste Management Plan.
Disposal of unsuitable materials and importation of clean fill	Compliance with waste management legislation including the Landfill Regulations 2002 (as amended) and the Hazardous Waste Regulations 2005	• Waste should be disposed of in-line with the waste hierarchy. • Characterisation of any material excavated and disposal off site of any materials demonstrated not to be suitable for reuse. • Pre-treatment prior to disposal to either reduce the volume of hazardous waste requiring disposal or to reduce the hazardous nature of the material. • Testing and verification of any soils imported to the site to ensure that they do not pose a risk to human health or controlled waters. They will also need to be accompanied by all relevant Duty of Care documentation.
Control of groundwater. Potential for environmentally damaging materials or fuels to pollute controlled waters (surface water and groundwater) during construction phase.	Best practice for construction site management. Avoidance of pollution incidents.	• If dewatering of excavations is undertaken as part of the proposed scheme these should be contained and disposed of appropriately. • Best practice guidance should be followed (for example, Pollution Prevention Guidance Note (PPG) 5: Works in, near or liable to affect watercourses and PPG6: Working at construction and demolition sites).

Appendix A - Figures





LEGEND

- Study Area
- Dogger Bank Teesside A & B Project
- Dogger Bank Teesside A & B offshore cable
- Offshore temporary works area
- Cable landfall envelope
- Landfall horizontal directional drill compound and joint transition bay
- Direct current cable route (agricultural setting, 36m working width)
- Direct current cable route (industrial setting, 18m working width)
- Alternating current cable route (39m working
- Minor horizontal directional drill entry or exit locations (1,200m²)
- Major horizontal directional drill entry or exit locations (2,000m²)
- HDD or open trench to be confirmed
- Primary construction compound (10,000m²- 5,000m² per project)
- Intermediate construction compound (784m²)
- Converter stations (one per project)
- Converter station construction compounds (10,000m², one per project)
- Lackenby 400kV substation

0 0.5 1
Kilometres

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PROJECT TITLE

DOGGER BANK TEESSIDE A & B

DRAWING TITLE

Figure 2.1: Dogger BankTeesside A and B Onshore Study Area

VER	DATE	REMARKS	Drawn	Checked
2	06/12/2012	Draft	LW	DW
3	15/01/2013	Submit PEI3	LW	DW
4	21/01/2014	Pre-DCO submission review	LW	DW

DRAWING NUMBER:

9W7904_Fig2.1

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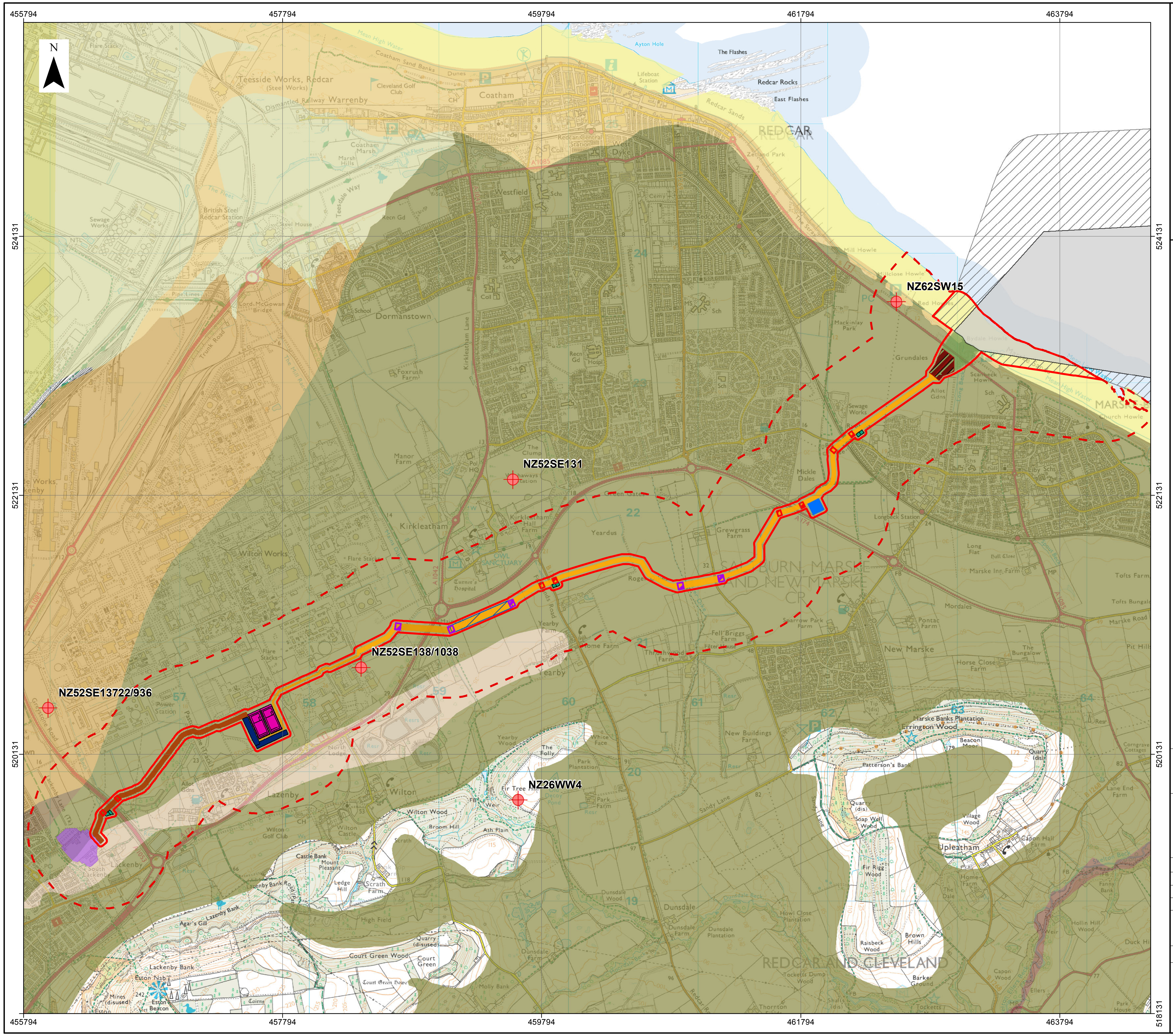

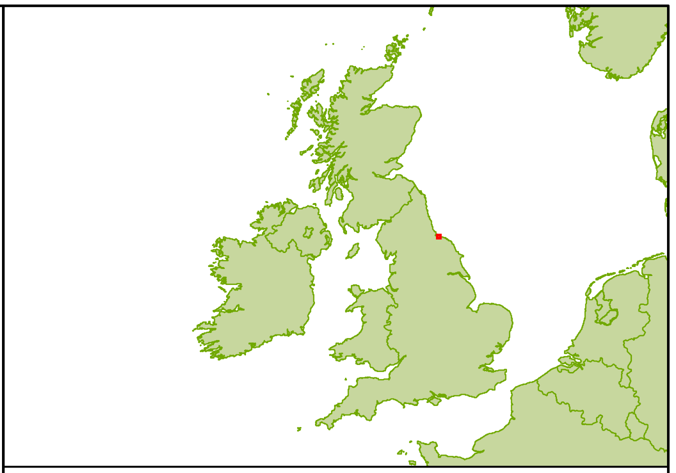

LEGEND

- ▭ Study Area
- 🟥 Dogger Bank Teesside A & B Project Boundary
- ⬜ Dogger Bank Teesside A & B offshore cable corridor
- ▨ Offshore temporary works area
- 🟩 Cable landfall envelope
- ▨ Landfall horizontal directional drill compound and joint transition bay
- 🟧 Direct current cable route (agricultural setting, 36m working width)
- 🟧 Direct current cable route (industrial setting, 18m working width)
- 🟫 Alternating current cable route (39m working width)
- ▨ Minor horizontal directional drill entry or exit locations (1,200m²)
- ▨ Major horizontal directional drill entry or exit locations (2,000m²)
- ▨ HDD or open trench to be confirmed
- 🟦 Primary construction compound (10,000m²- 5,000m² per project)
- 🟩 Intermediate construction compound (784m²)
- 🟪 Converter stations (one per project)
- 🟦 Converter station construction compounds (10,000m², one per project)
- 🟪 Lackenby 400kV substation

Superficial Geology

- 🟫 Alluvium - CLAY, SILT, SAND AND GRAVEL
- 🟨 Beach and Tidal Flat Deposits (Undifferentiated) - SAND
- 🟨 Blown Sand - SAND
- ⬜ Glaciofluvial Deposits, Devensian - SAND AND GRAVEL
- 🟫 Glaciolacustrine Deposits, Devensian - SAND
- 🟧 Glaciolacustrine Deposits, Devensian - CLAY AND SILT
- ⬜ Tidal Flat Deposits - SAND AND SILT
- 🟨 Tidal Flat Deposits - SAND, SILT AND CLAY
- 🟫 Till, Devensian - DIAMICTON
- ⊕ Borehole

0 0.5 1
Kilometres

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BGS: Derived from 1: 50 000 scale BGS Digital Data, British Geological Survey - NERC

PROJECT TITLE

DOGGER BANK TEESSIDE A & B

DRAWING TITLE

Figure 3.1: Superficial Geology

VER	DATE	REMARKS	Drawn	Checked
2	06/12/2012	Draft	LW	DW
3	15/01/2013	Submit PEI3	LW	DW
4	21/01/2014	Pre-DCO submission review	LW	DW

DRAWING NUMBER:
9W7904_Fig3.1

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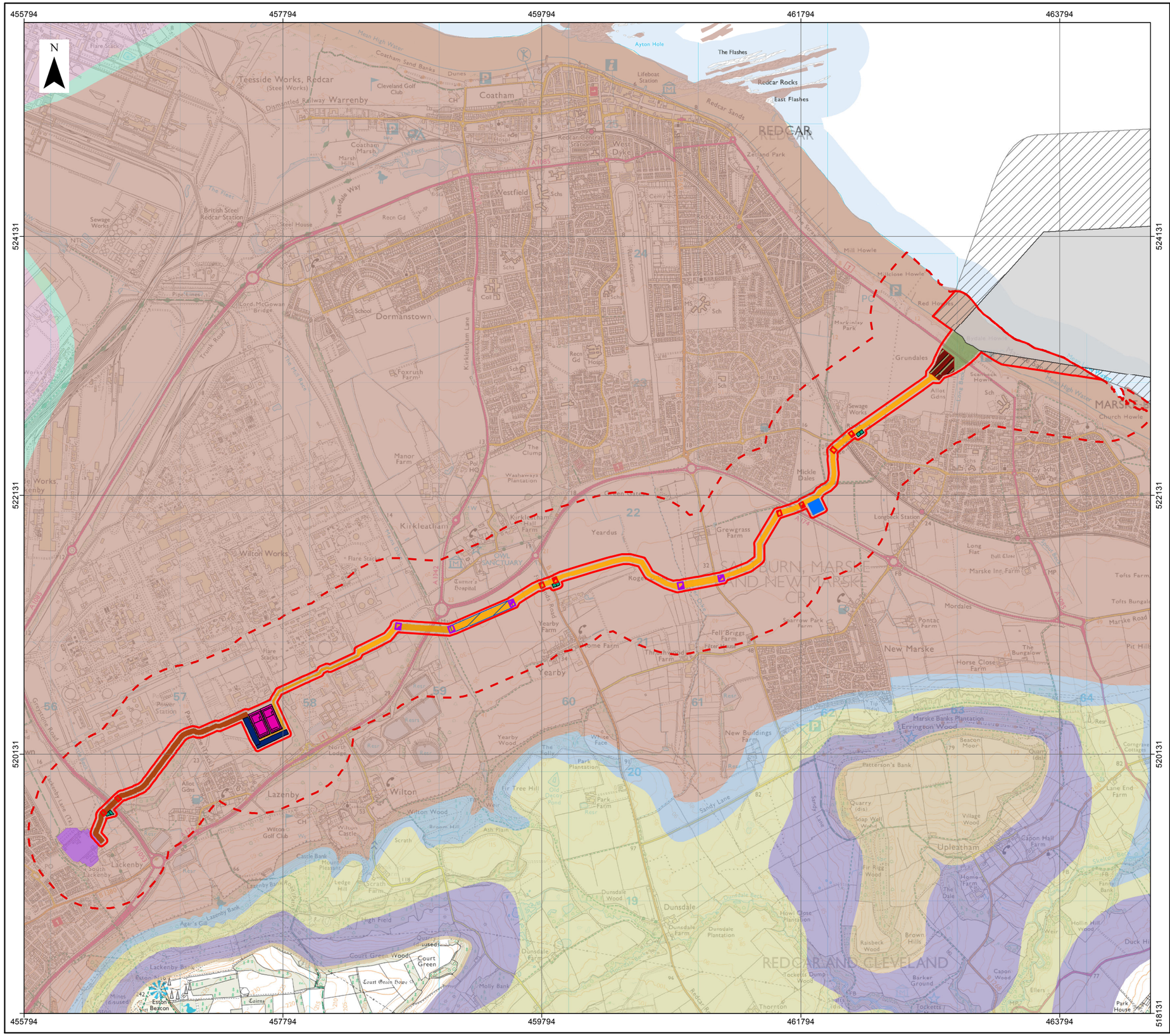

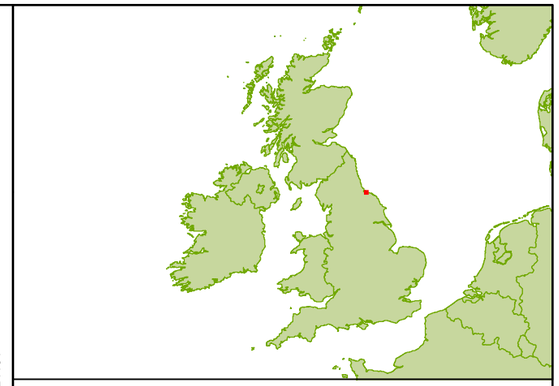

LEGEND

- Study Area
- Dogger Bank Teesside A & B Project Boundary
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- Intermediate construction compound (784m²)
- Converter stations (one per project)
- Converter station construction compounds (10,000m², one per project)
- Lackenby 400kV substation

ROCK_NAME

- Cleveland Ironstone Formation
- Dogger Formation
- Mercia Mudstone Group
- Penarth Group
- Redcar Mudstone Formation
- Saltwick Formation
- Staithes Sandstone Formation
- Whitby Mudstone Formation

0 0.5 1
Kilometres

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BGS: Derived from 1: 50 000 scale BGS Digital Data, British Geological Survey - NERC

PROJECT TITLE

DOGGER BANK TEESSIDE A & B

DRAWING TITLE

Figure 3.2: Bedrock Geology

VER	DATE	REMARKS	Drawn	Checked
2	06/12/2012	Draft	LW	DW
3	15/01/2013	Submit PEI3	LW	DW
4	21/01/2014	Pre-DCO submission review	LW	DW

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