VikingLink

nationalgrid

UK Onshore Scheme

Environmental Statement

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Chapter 18

Geology & Hydrogeology (Proposed Converter Station)

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Environmental Statement Volume 2			
ES Reference	**Chapter**	**Chapter Title**	
ES-2-A.01	Ch01	Introduction	
ES-2-A.02	Ch02	Development of the UK Onshore Scheme	
ES-2-A.03	Ch03	The UK Onshore Scheme	
ES-2-A.04	Ch04	Environmental Impact Assessment Methods	
ES-2-B.01	Ch05	The Proposed Underground DC Cable	
ES-2-B.02	Ch06	Intertidal Zone	
ES-2-B.03	Ch07	Geology & Hydrogeology	
ES-2-B.04	Ch08	Water Resources & Hydrology	
ES-2-B.05	Ch09	Agriculture & Soils	
ES-2-B.06	Ch10	Ecology	
ES-2-B.07	Ch11	Landscape & Visual Amenity	
ES-2-B.08	Ch12	Archaeology & Cultural Heritage	
ES-2-B.09	Ch13	Socio-economics & Tourism	
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ES-2-B.12	Ch16	Register of Mitigation	
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ES-2-C.03	Ch19	Water Resources & Hydrology	
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ES-2-C.05	Ch21	Ecology	
ES-2-C.06	Ch22	Landscape & Visual Amenity	
ES-2-C.07	Ch23	Archaeology & Cultural Heritage	
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Appendix 18.2 Preliminary Ground Investigation Report (Proposed Converter Station Site)

Appendix 18.3 Preliminary Ground Investigation Report (Permanent Access Road)

Appendix 18.4 Unexploded Ordnance Desk Study and Risk Assessment

Glossary & Abbreviations

Glossary of Terms	
Term	**Meaning**
Alternating Current (AC)	Electric power transmission in which the voltage varies in a sinusoidal fashion. This is the most common form of electricity transmission and distribution.
base scheme design	The design of the UK Onshore Scheme for the purposes of the planning application.
connection point	The existing Bicker Fen 400 kV Substation; the point on the National Electricity Transmission System (NETS) where Viking Link connects.
the Contractor	Party or parties responsible for the detailed design and construction UK Onshore Scheme.
converter station	Facility containing specialist equipment (some indoors and some potentially outdoors) for the purposes of converting electricity from AC to DC or DC to AC.
converter station site	The proposed site occupying approx. 30 ha containing the converter station and associated landscaping, drainage as well as land required for construction.
converter station zone	The proposed zone occupying approx. 8 ha containing the converter station buildings, outdoor electrical equipment and hardstandings within a security fence.
detailed scheme design	The design of the Scheme developed by the Contractor within the Limits of Deviation (AC and DC cables) and Rochdale Envelope (converter station).
Direct Current (DC)	Electric power transmission in which the voltage is continuous. This is most commonly used for long distance point to point transmission.
Limits of Deviation	These define the maximum extents of the corridor for which planning permission is sought and within which proposed DC and AC cable routes may be installed.
the Project	Viking Link, from the connection point at Revsing Substation in Denmark to the connection Bicker Fen Substation in Great Britain).
Rochdale Envelope	This defines the parameters of the proposed converter station for which planning permission is sought including its location, layout and dimensions.
the Scheme	UK Onshore Scheme from MLWS to the connection point comprising underground AC and DC cables, converter station and access road.
Temporary Construction Compound	Compound used by the Contractor for siting of offices, welfare facilities, storage and laydown.
Temporary Construction Facilities	All areas used for temporary construction requirements including compounds, working areas.
Temporary Works Area	Larger working area located on or adjacent to the working width used where construction activities requires a larger area for example at trenchless crossings.

Glossary of Terms	
Term	**Meaning**
trenchless methods	Cable installation methods used to cross obstacles such as roads or watercourses and ensure less disturbance at the ground surface.
working width (AC cables)	The 50 m wide working corridor required for the installation of underground AC cables.
working width (DC cables)	The 30 m wide working corridor required for the installation of underground DC cables.

List of Abbreviation	
Abbreviation	**Meaning**
AC	Alternating Current
ACEC	Aggressive Chemical Environment for Concrete
BGS	British Geological Survey
BRE	Building Research Establishment
BS	British Standard
CDM	Construction Design Management
CEMP	Construction Environmental Management Plan
CLEA	Contaminated Land Exposure Assessment
COSHH	Control of Substances Hazardous to Health
CPP	Construction Phase Plan
CS	Characteristic Situation
DC	Direct Current
DS	Design Sulfate
EA	Environment Agency
eDNA	Environmental Deoxyribonucleic Acid
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERP	Environmental Response Plan
ES	Environmental Statement
ESG	Environmental Scientific Group
EQS	Environmental Quality standard
GAC	Generic Assessment Criteria
GEL	Geotechnical Engineering Limited
GQRA	Generic Quantitative Risk assessment
GSV	Gas Screening Value

List of Abbreviation	
Abbreviation	**Meaning**
H&SP	Health and Safety Plan
IDB	Internal Drainage Board
IPPC	Integrated Pollution Control
Km	Kilometre
kV	Kilovolt
LGS	Local Geological Sites
LoD	Limit of Deviation
M	Meter
m bgl	Metres Below Ground Level
MCA	Mineral Consultation Areas
MSA	Mineral Safeguarding Areas
NGVL	National Grid Viking Link
NVZ	Nitrate Vulnerable Zone
OEL	Occupational Exposure Limit
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PPE	Personal Protective Equipment
SHDC	South Holland District Council
SPZ	Source Protection Zone
SSSI	Sites of Special Scientific Interest
SVOC	Semi Volatile Organic Compound
SWMP	Site Waste Management Plan
TCA	Temporary Construction Areas
TCC	Temporary Construction Compounds
TPH	Total Petroleum Hydrocarbon
UK	United Kingdom
UKSO	UK Soil Observatory
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria

1 Introduction

1.1 Introduction

1.1.1 This chapter has been prepared by AECOM. It reports the results of baseline studies and the assessment of the potential impacts of the proposed converter station (including the proposed Alternating Current (AC) cable route and proposed permanent access road) on Geology and Hydrogeology. Table 18.1 below sets out the structure of the Environmental Statement (ES) with respect to Geology and Hydrogeology.

1.1.2 Impacts on Geology and Hydrogeology are interrelated with impacts on Water Resources and Hydrology (*ES-2-C.03, Volume 2, Chapter 19)*, Agriculture and Soils (*ES-2-C.04, Volume 2, Chapter 20*) and Ecology (*ES-2-C.05, Volume 2, Chapter 21)*.

Table 18.1 Environmental Statement: Geology and Hydrogeology

ES Reference	ES Volume	ES Chapter	Content
ES-2-B.03	2	07	Main Report: Proposed Underground DC Cable
ES-2-C.02	**2**	**18**	**Main Report: Proposed Converter Station**
ES-3-B.01	3	07	Figures: Proposed Underground DC Cable
ES-3-C.01	3	18	Figures: Proposed Converter Station
ES-4-B.03	4	07	Technical Appendices: Proposed Underground DC Cable
ES-4-C.02	4	18	Technical Appendices: Proposed Converter Station

1.2 Chapter Structure

1.2.1 The remainder of this chapter is structured as follows:

- Section 2. Approach to Assessment. Sets out the discipline specific approach to the assessment in accordance with relevant guidance.
- Section 3. Basis of Assessment. Sets out the key assumptions which have been made in undertaking the impact assessment.
- Section 4. Planning Policy and Legislative Considerations. Provides a summary of the key points of planning policy and legislation which have been considered as part of the assessment.
- Section 5. Baseline Conditions. Reports the results of desktop and field studies undertaken to establish existing conditions.

- Section 6. Potential Impacts. Identifies the potential impacts on geology and hydrogeology which may occur as result of construction and operation.
- Section 7. Mitigation. Identifies the mitigation which is proposed including measures which are incorporated into the siting, design and construction of the proposed converter station.
- Section 8. Residual Effects. Reports the residual effects which remain taking into account proposed mitigation and identifies whether these are significant or not.
- Section 9. Cumulative Effects. Identifies the inter-project cumulative effects which may occur in combination with other developments.
- Section 10. Summary of Assessment. Provides a summary of the key findings of the impact assessment.

1.2.2 The baseline conditions detailed in Section 5 have been established utilising the sources of information listed in Section 11 of this chapter.

2 Approach to Assessment

2.1 Introduction

2.1.1 This section describes the approach to the identification and assessment of impacts resulting from the construction and operation of the UK Onshore Scheme converter station on Geology and Hydrogeology.

2.2 Summary of Consultation

Scoping Opinion Review

2.2.1 Table 18.2 summarises the issues raised in the scoping opinion in relation to Geology and Hydrogeology and outlines how these have been addressed.

Table 18.2 Scoping opinion (Geology and Hydrogeology)

Consultee	Summary of Comment	How and where addressed
Boston Borough Council (BBC)	Requested that the ES should positively acknowledge potential environmental effects on land drainage regimes.	Whilst there is overlap with hydrogeology, the effects on land drainage regimes will be considered and assessed within *ES-2-C.03, Volume 2, Chapter 19: Water Resources and Hydrology.*
Environment Agency (EA)	The EA requested that private groundwater abstractions be considered in the assessment as well as licensed groundwater abstractions.	Groundwater abstraction records identified within a defined zone of influence will be reported on within the baseline conditions against which potential positive or negative environmental effects will be assessed using the geology and hydrogeology methodology that is presented in this section.

Additional Consultation

2.2.2 Table 18.3 summarises additional consultation undertaken with relevant statutory and non-statutory consultees in relation to Geology and Hydrogeology and outlines how and where this has been addressed.

Table 18.3 Additional consultation (Geology and Hydrogeology)		
Consultee	**Nature of additional consultation**	**How and where addressed**
BBC	A meeting (3rd August 2016) to discuss ground conditions and to introduce the scope of future ground investigation.	Baseline ground conditions information is reported in Section 5.
BBC	Request made for information on private groundwater abstraction licenses made in September 2016. BBC advised that no records held in September 2016.	Baseline groundwater abstraction information is reported in Section 5.
EA	The EA were contacted in December 2015 and again in January 2016 to request data on consented discharges to controlled waters and groundwater levels for the area around the converter station site at the southern end of the proposed underground cable route. A response was received on 16th February 2016 (reference CCN/2015/560) and 23rd March 2016 (reference CCN/2015/1609).	Baseline groundwater abstraction information is reported in Section 5.
EA	The EA were contacted on the 10th October 2016 to request data on private and commercial groundwater abstractions for the area around the converter station site. A response was received on the 23rd November 2016 (reference CCN/2016/25333) and 30th January 2017 (reference CCN/2017/34554)	Baseline groundwater abstraction information is reported in Section 5.
Greater Lincolnshire Nature Partnership Geodiversity Group	A request was made for information on Local Geological Sites in February 2016 and records were provided back within the same month.	Baseline information on geological sites is reported in Section 5.
South Holland District Council (SHDC)	Request made for information on private groundwater abstraction licenses made to SHDC in September 2016. Data was provided in November 2016.	Baseline groundwater abstraction information is reported in Section 5

2.3 Scope of Assessment

Aspects to be assessed

2.3.1 The following specific topic areas have been assessed.

- Geology;
- Hydrogeology;
- Mineral Resources;
- Geological Designated Sites; and
- Soil and Groundwater Contamination.

Spatial Scope

2.3.2 The assessment has considered potential direct and indirect impacts associated with the Limits of Deviation. The Zone of Influence is based on the application boundary for the UK Onshore Scheme plus a 250 m buffer. For groundwater abstractions a 500 m buffer has been adopted.

2.3.3 The Zone of Influence for geology and hydrology is illustrated in Figure 18.1.

Temporal Scope

2.3.4 In assessing the effects, the likely duration of effect has been considered as either:

- Temporary impacts – construction phase comprising the groundworks for AC cable installation and the construction of the proposed converter station; and
- Longer term, operational and permanent impacts – operational phase and beyond.

2.3.5 The majority of impacts on Geology and Hydrogeology are likely to arise during the construction phase and are anticipated to be localised, with notable exceptions being where mineral resources are lost or sterilised and where impacts may be more permanent.

2.3.6 The routine operation of the Scheme is not likely to have any significant effects on the underlying geology and groundwater under normal operating conditions. Any contamination encountered during construction would be expected to be removed, treated and/or mitigated as part of the construction.

2.4 Identification of Baseline Conditions

Desk Studies

2.4.1 A number of desktop sources of information have been used to establish the baseline conditions of the Zone of Influence. In particular the sources referred to, which are presented in Section 11 have been referenced to establish the geological and hydrogeological setting, the potential for significant soil or groundwater contamination, the extent of mineral resources and the presence of geologically designated sites.

Field Studies

2.4.2 Intrusive ground investigation has been undertaken to inform the design of the UK Onshore Scheme and further information on these is provided in Section 5.

2.5 Assessment Guidance

Impact Assessment

2.5.1 The assessment of the significance of the potential effects on geology is based on guidance provided in Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11 (Ref: 18-1). The potential effects on groundwater have been assessed in a qualitative manner. The assessment of importance, magnitude and significance of predicted effects is based on DMRB HD45/09, Part 10 (Ref: 18-2). There is no specific guidance in relation to assessing the impact of interconnectors on Geology and Hydrogeology therefore DMRB has been used as it is considered to be the most appropriate methodology because it is designed for assessing the effects of linear schemes. It is also a well-established and tested methodology, familiar to statutory consultees.

Contaminated Land Risk Assessment

2.5.2 The potential effects upon the UK Onshore Scheme from contaminated soils, groundwater and ground gas have been identified. The impacts associated with contaminated land are generally assessed by means of a source/hazard-pathway-receptor methodology in accordance with EA (2004), 'Contaminated Land Report (CLR11) Model Procedures for the Management of Land Contamination' (Ref: 18-3) and British Standard BS10175, (2011+A1 2013) 'Investigation of Potentially Contaminated Sites - Code of Practice' (Ref: 18-4), where the following definitions apply:

- Source/hazard: a hazardous substance that has the potential to cause adverse impacts to a receptor;
- Receptor: a target that may be affected by contamination; examples include human occupants/users of the site, water resources or structures; and
- Pathway: a route whereby a hazardous substance may come into contact with the receptor: examples include ingestion of contaminated soil and leaching of contaminants from soil into water resources.

2.5.3 For contamination to result in a significant potential impact, it must be demonstrated that there is an identifiable source of contamination (be it an on-site or off-site source), potential sensitive receptors and potential pathways through which the former may affect the latter. The assessment has considered both the impacts of existing contamination on the Scheme, and the potential for the proposed converter station, permanent access road and AC cable route to impact upon land quality.

2.5.4 Receptor sensitivity to potential contaminated land has been defined in Table 18.4. This is a qualitative measure that is considered relevant as a means of defining the types and sensitivities of different receptors that may be impacted upon during construction and operation, where in the presence of known or potential contaminated soil or groundwater.

2.6 Impact Assessment Criteria

Sensitivity of Receptors

2.6.1 The sensitivity of a receptor reflects the quality of the receptor and its ability to absorb an impact without perceptible change. Sensitivity is defined in Table 18.4.

Table 18.4 Sensitivity criteria (Geology and Hydrogeology)

Sensitivity	Description	Examples
Very High	Attribute has a high quality and rarity on a regional or national scale	Principal aquifer providing a regionally important resource Groundwater supporting a site protected under European and UK habitat legislation Groundwater source protection zone (SPZ) 1 Presence of significant mineral reserves and within a Mineral Consultation Area (MCA) or Mineral Safeguarding Area (MSA) Internationally or nationally important geological/geomorphological features
	Other Sensitive receptors susceptible to soil or groundwater contamination	Residential areas, schools, play areas directly adjacent to construction works Construction and maintenance workers Internationally and nationally designated ecological sites directly adjacent to construction works Surface water features deemed to be of very high quality/value
High	Attribute has a high quality and rarity on a local scale	Principal Aquifer Secondary A aquifer providing locally important resource or supporting river ecosystem Groundwater SPZ 2 or 3 Within a MCA or MSA Regionally important geological/ geomorphological features
	Other Sensitive receptors susceptible to soil or groundwater contamination	Residential areas, schools or play areas within 250 m of construction works Allotments, arable farmland, livestock, market gardens Regionally important ecological sites Surface water features deemed to be of high quality/value

Table 18.4 Sensitivity criteria (Geology and Hydrogeology)		
Sensitivity	**Description**	**Examples**
Medium	Attribute has a medium quality and rarity on a local scale	Secondary A and B Aquifers Secondary A aquifer providing source of water for agricultural or industrial use with limited connectivity with surface water features Some mineral potential but not within a MCA or MSA Locally important geological/geomorphological features.
	Other Sensitive receptors susceptible to soil or groundwater contamination	Commercial land use or open space (excluding school playing fields and play areas) adjacent to construction works. Surface water feature deemed to be of medium quality/value. Locally important ecological sites.
Low	Attribute has a low quality or rarity on a local scale	Secondary B Aquifers. Secondary B aquifer providing source of water for agricultural or industrial use with limited connectivity with surface water features. Geology or geomorphology of less than local importance. Limited potential for mineral reserves and site not within a Mineral Consultation or Safeguarding Area.
	Other Sensitive receptors susceptible to soil or groundwater contamination	Commercial land use or open space (excluding school playing fields and play areas) within 250 m of construction works. Residential areas, schools or play areas present > 250 m of construction works. Surface water feature deemed to be of low quality/ value.
Negligible	Attribute has a negligible quality or rarity on a local scale	Unproductive groundwater strata. No mineral extraction potential. No geological or geomorphological features of interest.
	Other Sensitive receptors susceptible to soil or groundwater contamination	No developed land uses other than transport infrastructure within 250 m. Surface water feature deemed to be of negligible quality/value.

Magnitude of Impacts

2.6.2 The magnitude of a potential impact considers the scale of the predicted change to the baseline condition taking into account its duration (i.e. the magnitude may be moderated by the effects being temporary rather than permanent, short term rather than long term). Definitions for effect

magnitude are described in Table 18.5. It is unlikely that any effects on geology and soils would be beneficial, so the examples of magnitude all relate to adverse effects.

Table 18.5 Impact magnitude criteria (Geology and Hydrogeology)

Magnitude	Description	Examples
High	Total loss or major alteration to key features of the baseline conditions such that post development character/composition of baseline condition will be fundamentally changed	Pollution of potable sources of water abstraction. Loss of, or extensive change to, an aquifer or groundwater supported designated wetland. Loss of, or extensive change to, nationally important geological/ geomorphological features.
Medium	Loss or alteration to one or more key features of the baseline conditions such that post development character/composition of baseline condition will be materially changed	Partial loss or change to an aquifer. Partial loss of the integrity of groundwater supported designated wetlands. Permanent loss of regionally important geological features or substantial changes to nationally important geological/ geomorphological features.
Low	Results in some measurable change in attributes quality or vulnerability compared to baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character/composition of baseline condition will be similar to the pre-development situation	Measurable effect on aquifer but of limited size or proportion, which does not lead to a reduction in the aquifer status; Minor effects on groundwater supported wetlands; and, Minor changes to regionally important geological/ geomorphological features or small changes to nationally important geological/ geomorphological features.
Negligible	Very little change from baseline conditions. Change is barely distinguishable, approximating to a “no change” situation	No measurable effect upon groundwater, or geology/geomorphology.

Assessing the Significance of Effects

2.6.3 The significance of a potential effect is derived from both the sensitivity of the feature and the magnitude of the effect, and can be then determined using the matrix presented in Table 18.6. Effects can be beneficial, adverse or negligible and their significance major, moderate, minor or negligible. Any effect predicted to be Minor is considered to be 'Not Significant'. Effects assessed as moderate or major are considered to be 'Significant'.

Table 18.6 Assessment of significance (Geology and Hydrogeology)					
Magnitude of impact	Sensitivity of receptor				
	Very High	High	Medium	Low	Negligible
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

2.7 Contaminated Land Risk Assessment

2.7.1 The effects of contamination have been identified by a qualitative assessment using the aforementioned source-pathway-receptor approach to determine the potential risks posed to construction workers, buildings/infrastructure, adjacent properties, the general public and maintenance workers. This will consider the likelihood of a source posing a risk to any given receptor.

2.7.2 The potential significance of these effects has been assessed using Tables 18.7 and 18.8 which are taken from National House Building Council (NHBC), EA and Chartered Institute of Environmental Health (CIEH) 'Guidance for the Safe Development of Housing on Land Affected by Contamination' R&D Publication 66' (Ref: 18-05). These classifications can apply to a broad range of scenarios. It should be noted that the categories of pollution incident have no relation to the categories of significant possibility of significant harm to human health or significant possibility of significant pollution of controlled waters in respect of the Part 2A Statutory Guidance (Ref: 18-6).

Table 18.7 Consequence classification (contaminated land assessment)	
Consequence	Description
Severe	Highly elevated concentrations likely to result in "significant harm" to human health as defined by the Environmental Protection Act (EPA) (1990), Part 2A (Ref: 18-06), if exposure occurs. Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A (Ref: 18-6) if exposure occurs. Equivalent to EA Category 2 pollution incident including significant effect on water

Table 18.7 Consequence classification (contaminated land assessment)	
Consequence	**Description**
	quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health unlikely to lead to "significant harm". Equivalent to EA Category 3 pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structure and services.

Table 18.8 Probability classification (contaminated land assessment)	
Probability	**Description**
High Likelihood	There is a pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. It is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.
Unlikely	There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

2.7.3 A consideration of the magnitude of consequence in relation to contaminated land, and probability will define the level of risk as shown in the table below (Table 18.9) (reproduced from Ref: 18-5).

Table 18.9 Classification of risk from soil and groundwater contamination				
Probability	Consequence			
	Severe	Medium	Mild	Minor
High likelihood	Very high risk	High risk	Moderate risk	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

2.7.4 The EIA Regulations require the likely significant effects to be identified. The classification of significance is explained in Table 18.10, however, in simple terms effects predicted to be 'major' or 'moderate' are considered to be 'significant' whilst effects predicted to be 'minor' or 'neutral' are considered to be 'not significant'.

Table 18.10 Explanation of significance classifications		
Classification	General Description	Significant?
Major (adverse or beneficial)	A large and/or detrimental change to a valuable/sensitive receptor; likely or apparent exceeding of accepted (often legal) threshold or a major departure from national targets. A large and beneficial change, resulting in improvements to baseline conditions whereby previously poor conditions are replaced by compliance with accepted (often legal) thresholds or a major contribution is made to national targets.	Yes
Major (adverse or beneficial) (continued…)	These are effects which may represent key factors in the decision making process. Potentially associated with sites and features of national importance or likely to be important considerations at a regional or district scale. Major effects may relate to impacts on resources or features which are rare and cannot be relocated, or if lost, cannot be replaced.	Yes

Table 18.10 Explanation of significance classifications		
Classification	**General Description**	**Significant?**
Moderate (adverse or beneficial)	A medium scale change which, although not beyond an accepted (often legal) threshold, is still considered to be generally unacceptable, unless balanced out by other significant positive benefits of the development. Likely to relate to departure from relevant planning policy, rather than legal compliance. A positive moderate effect is a medium scale change that is significant in that the baseline conditions are improved to the extent that guideline targets are contributed to. These effects, if adverse, are likely to be important at a local or district scale and on their own could have a material influence on decision making.	Yes
Minor (adverse or beneficial)	A small change that, whilst adverse, does not exceed accepted thresholds, legal or guideline standards. Unlikely to be a departure from planning policy. A small positive change, but not one that is likely to be a key factor in the overall balance of issues. These effects may be raised as local issues but are typically unlikely to be critical in the decision making process.	No
Negligible	A very small change that is so small and unimportant that it is considered acceptable to disregard. Effects which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error, these effects are unlikely to influence decision making, irrespective of other effects.	No

3 Basis of Assessment

3.1 Overview

3.1.1 A full description of the construction, operation and decommissioning of the proposed converter station zone, proposed permanent access road and proposed AC cable route between the proposed converter station zone and the existing Bicker Fen Substation is discussed within *ES-2-C.01, Volume 2 Chapter 17: The Proposed Converter Station* of this ES. The following points are considered to be of particular relevance to the Geology and Hydrogeology assessment:

- Earthworks required to create a raised development platform for the converter station zone;
- Earthworks seeking to minimise the need to dispose of surplus excavated materials from the site and also the need to import materials to site, wherever possible;
- A shallow foundation solution in conjunction with ground improvement or deeper piled foundations may be required for the proposed converter station zone depending on the findings of detailed ground investigation;
- Construction platforms and areas of hardstanding will be founded on compacted granular fill over natural ground, following a topsoil strip;
- The proposed converter station site will include an approximate 2 hectare temporary construction compound;
- Standard open cut trenching techniques will be used for the proposed AC cable installation wherever possible, although some trenchless installation will be required;
- The AC cable route will have a maximum 50 m working width;
- There will be up to two separate AC cable trenches, each containing up to three cables;
- The AC cable route trenches will be typically 1.5 m deep and 1 m wide;
- The trenches will be backfilled as much as practicable with excavated material except for 75 mm of cement bound sand which will form the base of the trench, onto which the cables are laid and also the surround for the cables;
- Connection works are required within the existing Bicker Fen Substation footprint where the proposed AC cable route connects to the existing electricity supply. Below ground construction works at the connection point within the existing substation are expected to be minimal and may include as an example extending the existing concrete slab to support the installation of new electrical switch bays.
- The level of the proposed permanent access road will be 2.7 m AOD upon completion and some cut and fill earthworks will be required to achieve this; and
- As part of the AC cable installation there is also a requirement for temporary construction facilities to be established including:
  - Temporary Construction Compounds (TCC) for the storage of plant and material as well as site offices and welfare facilities for staff;

- Temporary Construction Area (TCA) where the proposed AC cable working width may need to be extended beyond 50 m, for example at water crossings; and
- Access including formation of new bell mouth junctions and upgrades to existing roads as well as the establishment of temporary accesses to the proposed AC cable working width.

3.2 Any other assumptions

3.2.1 The Geology and Hydrogeology impact assessment has been based upon details of the UK Onshore Scheme, provided by National Grid Viking Link Limited (NGVL) at the time of the assessment. Some reliance is placed on third party data and reports within the assessment. It has been assumed that third party data is accurate and a true reflection of what it is indicating. Unless stated otherwise, AECOM has not independently verified the data presented within third party reports.

3.2.2 The Baseline Conditions section of this chapter includes an interpretation of the ground conditions encountered during two phases of preliminary ground investigation carried out at the proposed converter station site in September 2016 and along the proposed permanent access road in March 2017. The scope of the ground investigation was determined based on desk study information which revealed that the proposed converter station site and proposed permanent access road had undergone very little by way of development and had predominantly been used, historically and currently, for agricultural activities. Given the 'Greenfield' nature of the land, significant variations in ground conditions are considered to be limited, however the potential for some heterogeneity exists between the exploratory locations.

3.2.3 For any decommissioning impacts, these are assumed to be similar to the construction (temporary) impacts defined in the assessment.

4 Planning Policy and Legislative Considerations

4.1 National Legislation

4.1.1 The following EU Directives and UK Acts are considered to be the key legislative drivers for the Geology and Hydrogeology topic including dealing with risks to human health and the environment from ground conditions:

- The Water Framework Directive (2000/60/EC) (Ref: 18-7);
- The Groundwater Directive (2006/118/EC) (Ref: 18-8);
- The Environmental Quality Standards (EQS) Directive (2008/105/EC) (Ref: 18-9);
- The Environmental Liability Directive (2004/35/EC) (Ref: 18-10);
- The Environment Act 1995 (Ref: 18-11)
- The Environmental Protection Act (EPA) 1990 and Part 2A (the Contaminated Land Regime) (Ref: 18-6);
- The Water Resources Act 1991 (Ref: 18-12);
- The Water Act 2003 (Ref: 18-13);
- The Building Act 1984 (Ref: 18-14); and
- The Town and Country Planning Act 1990 (Ref: 18-15).

4.1.2 Current legislation relating to contaminated land in the UK is contained within Part 2A of the EPA (1990) (Ref: 18-6), which was inserted by Section 57 of the Environment Act 1995 (Ref: 18-11) and by Section 86 of the Water Act 2003 (Ref: 18-13), and elaborated within the Contaminated Land (England) Regulations 2006 [S.I. 2006/1380] (amended 2012 [S.I. 2012/263]) (Ref: 18-16). Under Part 2A, sites are identified as 'contaminated land' if they are: causing harm, if there is a significant possibility of significant harm, or if the site is causing, or could cause, pollution of controlled waters (i.e. both surface and groundwater).

4.1.3 The Water Act 2003 introduced a revision to the wording of the EPA, which requires that if a site is causing or could cause significant pollution of controlled waters it may be determined as contaminated land. Once a site is determined to be ‘contaminated land’ then remediation is required to render significant pollutant linkages insignificant (i.e. the source-pathway-receptor relationships that are associated with significant harm to human health and/or significant pollution of controlled waters), subject to a test of reasonableness. The Water Resources Act 1991 provides statutory protection for controlled waters (i.e. streams, rivers, canals, marine environment and groundwater) and makes it an offence to discharge to controlled waters without the permission or consent of the regulators of these areas.

4.1.4 The Building Act 1984 and in particular the associated Building Regulations & c (Amendment) Regulations 2015 (Ref: 18-17) are key when considering structural and design aspects of a development in terms of the geotechnical properties of the ground. The Building Act 1984 requires that buildings are constructed so that ground movement caused by swelling, shrinkage, freezing, landslip or subsidence of the sub-soils will not impair the stability of any part of the building.

4.2 National Planning Policy

National Planning Policy Framework (2012)

4.2.1 National planning policy is established within the National Planning Policy Framework (NPPF) (Ref: 18-18). Paragraph 109 of the NPPF states that: "The planning system should contribute to and enhance the natural and local environment by:

- Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability; and
- Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."

4.2.2 Paragraph 110 requires that plans should aim to minimise pollution and other adverse effects on the local and natural environment.

4.2.3 Paragraph 111 states that planning policies and decisions should encourage:

- "the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value."

4.2.4 Paragraph 120 advises that where a site is affected by contamination or stability issues, it is the responsibility of the developer or landowner to secure a safe development. Further to this, paragraph 121 advises that planning policies and decisions should ensure that:

- "the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
- adequate site investigation information, prepared by a competent person is presented."

4.3 Regional Planning Policy

Lincolnshire County Council 'Core Strategy and Development Management Policies Lincolnshire Minerals and Waste Local Plan (Adopted 1st June 2016)

4.3.1 The Core Strategy and Development Management Policies (Ref: 18-19) document replaces the Lincolnshire Minerals Local Plan (1991) and most of the policies in the Lincolnshire Waste Local

Plan (2006) (Ref: 18-20) with the exception of Policies WLP2 Household Waste Recycling Centres, WLP6 Materials Recovery Facilities and WLP12 Energy from Waste of that document. The document includes the vision, objectives, spatial strategy and development management policies for minerals and waste development in Lincolnshire over the period to the end of 2031. Whilst the Scheme does not relate to either of these types of development, the following policy is considered relevant to geology and hydrogeology:

- Policy M11 Safeguarding of Mineral Resources states that: "Applications for non-minerals development in a minerals safeguarding area must be accompanied by a Minerals Assessment. Planning permission will be granted for development within a Minerals Safeguarding Area provided that it would not sterilise mineral resources within the Mineral Safeguarding Areas or prevent future minerals extraction on neighbouring land."
- Policy M12 Safeguarding of Existing Mineral Sites and Associated Minerals Infrastructure states that "Mineral sites (excluding dormant sites) and associated infrastructure that supports the supply of minerals in the county will be safeguarded against development that would unnecessarily sterilise sites and infrastructure or prejudice or jeopardise their use by creating incompatible land uses nearby".

4.4 Local Planning Policy

Boston Borough Council Local Plan (Adopted April 1999, saved policies)

4.4.1 The BBC Local Plan (1999) (Ref: 18-21) is the development plan for the borough. The Local Plan consists of a series of documents which set out the spatial vision for BBC, the strategy for delivery of this vision and contains detailed policies and guidance for managing development in the borough and development sites where change are anticipated. This Local Plan is applicable to the approximate northern half of the AC cable route; an area extending approximately 550 m to the south of Bicker Fen Substation.

4.4.2 There are two policies with particular reference to geology and hydrogeology:

- Policy G4 Safeguarding the Water Environment states that: "Planning permission will not be granted for developments which will have an adverse effect on the water environment, or the quality of surface or groundwater."
- Policy G8 Air and Soil Resources states that: "Planning permission will not be granted for developments which will have an adverse effect on the quality of air or soil such as to lead to:

  1) harm to local living or working conditions or the operation of nearby land uses;

  2) harm to the natural flora and fauna of interest in the locality; or

  3) added constraints on future developments in the area."

South Holland District Council Local Plan (Adopted July 2006, saved policies)

4.4.3 The SHDC Local Plan (Ref: 18-22) published in July 2006, provides a comprehensive statement of the Council's planning policies for the development and use of land in the District until 2021. This Local Plan is applicable to the southern half of the AC cable route, the proposed converter

station and the proposed permanent access road. There are two policies of relevance to geology and hydrogeology:

- Policy SG4 Development in the Countryside states that: “Planning permission will only be granted for development in the open countryside which is essential in the proposed location and cannot reasonably be accommodated within defined settlement limits. Development proposals that would result in an unacceptable impact upon the landscape character of an area, either individually or cumulatively, will only be permitted where:

  1) the need for the development in that location outweighs its impact; and

  2) no other site or solution exists to accommodate the proposed development.”

- Policy SG13 Pollution and Contamination states that: “Planning permission will only be granted for development proposals which:

  1) do not cause unacceptable levels of pollution of surrounding land by noise, light, toxic or offensive odour, airborne pollutants or by the release of waste products; and

  2) provide, as necessary, appropriate treatment of land to clean up pollution and contamination.”

5 Baseline Conditions

5.1 Study Area

5.1.1 The proposed converter station site is centred on Ordnance Survey (OS) National Grid reference TF187 373 and is illustrated in Figure 18.1 which is presented in *ES-2-C.01, Volume 3, Chapter 18: Geology and Hydrogeology*. The proposed converter station site lies to the south/south west of Bicker Fen Substation by approximately 1.1 km and is located within SHDC's area. The proposed permanent access road is also within SHDC's area. The proposed AC cable route is located within both SHDC and BBC's area.

5.1.2 The proposed AC cables and temporary construction facilities include Limits of Deviation (LoD). The LoD are based on an extended area, typically 50 m either side of a maximum 50m working width of the AC cables (or other temporary working area). However, the LoD have been widened along the proposed AC cable route to manage uncertainty surrounding the entry to the Bicker Fen 400kV Substation and due to the surrounding land drainage in this area.

5.1.3 The Zone of Influence for this assessment comprises the proposed AC cable working width including the LoD, the proposed converter station site and the proposed permanent access road as well as a 250 m buffer extending out from the limits of these areas. For groundwater abstractions and discharges to groundwater, the assessment considers a 500 m buffer. The Zone of Influence is shown on Figure 18.1 which is presented in *ES-2-C.02, Volume 3, Chapter 18: Geology and Hydrogeology*.

5.1.4 Whilst the baseline conditions focus on the geological and hydrogeological setting, it also considers the wider environment in terms of identifying potential receptors that could be impacted upon by any existing or resulting soil and/or groundwater contamination. There is therefore some reference made to hydrological and ecological features in this section which are discussed in more detail within *ES-2-C.03, Volume 2, Chapter 19: Water Resources and Hydrology and ES-2-C.05, Volume 2, Chapter 21: Ecology*.

5.1.5 In accordance with the assessment methodology outlined in Section 2, potential impacts on geological and hydrogeological features and resources (receptors) are assessed through impact assessment to determine significant effects. Potential significant effects associated with existing, and potential future, soil and groundwater contamination have been determined through the application of a risk-based assessment approach. The baseline conditions section has been structured into five main sub sections. These comprise the geological setting and sensitivity, the hydrogeological setting and sensitivity, underground structures, unexploded ordnance and then a section on potential soil and groundwater contamination. Where applicable this heading structure has continued into Section 6, so that it is clear where the two assessment approaches have been applied.

5.2 Geological Setting and Sensitivity

Published Geology

5.2.1 The geology throughout the Zone of Influence has been determined by making reference to the British Geological Survey's (BGS) 1:50,000 scale geological map of Boston – Sheet 128 (Solid and Drift) (Ref: 18-23), the AECOM Geology and Hydrogeology Desk Study report (October 2016) (Ref: 18-24) and historic BGS borehole information available for the area (Ref: 18-25). The AECOM Geology and Hydrogeology Desk Study report is presented in *ES-4-C.02, Volume 4, Chapter 18: Geology and Hydrogeology* as Appendix 18.1.

5.2.2 The available mapping indicates that the Zone of Influence is underlain by Quaternary superficial deposits comprising the Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits) which are old marine deposits that typically comprise clay and silt. These are underlain by glacial deposits of Till (Boulder Clay). The solid geology is of Jurassic age and indicated to be the Oxford Clay Formation comprising typically mudstones of the Ancholme Group.

5.2.3 The Zone of Influence is within the Fenlands and has a characteristically flat topography.

5.2.4 There are no BGS borehole records present within the proposed converter station site or the proposed permanent access road Zone of Influence (Ref: 18-25). There is one BGS borehole record (reference TF13NE10, dated 5th June 1963) available within the proposed AC cable route Zone of Influence (within the working width). This borehole is located to the east of Vicarage Drove, approximately 75 m north of the northern extent of the proposed AC cable route. The geological sequence encountered broadly confirms the published geological mapping for the area and is summarised as follows:

- Topsoil: identified from ground level to 0.4 metres below ground level (m bgl);
- Soft grey and brown silty clay identified from 0.4 m bgl to 2.74 m bgl;
- Soft peat identified from 2.74 m bgl to 3.05 m bgl;
- Very stiff grey clay with traces of chalk identified from 3.05 m bgl to 4.57 m bgl; and
- Hard dark grey clay: identified from 4.57 m bgl to 12.19 m bgl (end of borehole – full thickness not proven).

5.2.5 The very stiff and hard clay is interpreted by AECOM to be representative of Till (Boulder Clay), with the overlying superficial deposits typical of the Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits). A groundwater strike was recorded during the drilling of borehole TF13NE10 and this was at 2.74 m bgl within the inferred Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits).

Ground Investigation

Proposed Converter Station Site Preliminary Ground Investigation (September 2016)

5.2.6 A preliminary ground investigation was undertaken in September 2016 on the proposed converter station site by Environmental Scientifics Group Limited (ESG) on behalf of NGVL (Ref: 18-26). The ground investigation was designed and managed by AECOM and the findings are presented

in a Preliminary Ground Investigation Report that was prepared by AECOM in March 2017 (Ref: 18-27) and which is included in *ES-4-C.02, Volume 4, Chapter 18: Geology and Hydrogeology* as Appendix 18.2.

5.2.7 In total three exploratory borehole locations (designated BH01 (CS1), BH02 (CS1) and BH03 (CS1)) were completed across the proposed converter station site to a maximum depth of 12 m bgl. The exploratory borehole locations are indicated in Figure 18-2 which is presented in *ES-3-C.01, Volume 3, Chapter 18: Geology and Hydrogeology*.

5.2.8 The sequence of strata encountered supports the published geology. The Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits) were proven overlying Till (Boulder Clay). The Oxford Clay Formation is mapped to be the solid geology across the proposed converter station site, although this was not encountered as part of the preliminary ground investigation due to the depth limitations of the investigation. No Made Ground was encountered at any borehole location during the ground investigation.

5.2.9 A summary of the ground conditions encountered through ground investigation completed at the proposed converter station site is provided in Table 18.11.

Table 18.11 Proposed converter station site: summary of ground conditions (GI, Sept 2016)

Strata	Name[2]	Description/Presence	Depth Range to Top (m bgl)	Proven Thickness (m)
Topsoil	-	-	0	0.3
Superficial Geology	Barroway Drove Beds (Marine Deposits/ Tidal Flat Deposits)	Soft to firm, dark brown or orange-brown, mottled grey, sandy clay with loose and very loose orange-brown, medium sand present in BH01 (CS1) and BH02 (CS1). BH01 and BH03 contained a 0.1 m and 1.6 m thick organic rich horizon of organic clay, respectively.	0.3	2.3 to 2.9
	Till (Boulder Clay)[1]	Firm to stiff, brown grey, slightly sandy gravelly clay. Gravel was noted to be fine and medium, occasionally coarse, of mainly chalk and quartzite. Within these deposits ESG recorded 'Probable Glaciolacustrine Deposits', which are defined as typically laminated silts and clays deposited in glacier formed lakes. Laminated deposits were encountered from between 7 m and 9 m depth up to a maximum proven thickness of 4.8 m in BH02 (CS1).	2.6 – 3.2	6.8 – 9.4

Table 18.11 Proposed converter station site: summary of ground conditions (GI, Sept 2016)				
Strata	Name[2]	Description/Presence	Depth Range to Top (m bgl)	Proven Thickness (m)
Solid Geology	Oxford Clay Formation (Ancholme Group)	Not encountered during investigation.	-	-

[1] Not fully penetrated;
[2] AECOM interpretation based on published geology and recorded field observations; and
m bgl - metres below ground level.

Proposed Permanent Access Road Preliminary Ground Investigation (February/March 2016)

5.2.10 A preliminary ground investigation was concluded in February and March 2017 that included the proposed permanent access road. This investigation was undertaken by Geotechnical Engineering Limited (GEL) on behalf of NGVL (Ref: 18-28). The ground investigation was designed and managed by AECOM and the findings are presented in a Preliminary Ground Investigation Report that was prepared by AECOM in June 2017 (Ref: 18-29). The AECOM report was structured to include standalone technical appendices for the specific features targeted by the ground investigation. The results of the ground investigation in relation to the proposed permanent access road are included in *ES-4-C.02, Volume 4, Chapter 18: Geology and Hydrogeology* as Appendix 18.3.

5.2.11 In total five boreholes (designated HR-BH001, HR-BH002A, HR-BH003 to HR-BH005) and five trial pits (designated HR-TP001 to HR-TP005) were completed across the proposed permanent access road to a maximum depth of 15.5 m bgl. The exploratory borehole locations are indicated in Figure 18.3 which is presented in *ES-2-C.02, Volume 3, Chapter 18: Geology and Hydrogeology*.

5.2.12 The sequence of strata encountered supports the published geology and ground conditions encountered during the proposed converter station site ground investigation. A summary of the ground conditions encountered during the ground investigation undertaken along the proposed permanent access road is provided in Table 18.12.

Table 18.12 Proposed permanent access road: summary of ground conditions (GI, Mar 2017)				
Strata	Name [2]	Description/Presence [4]	Depth Range to Top (m bgl)	Proven Thickness (m)
Made Ground [1]	-	Very soft or firm to stiff brown/grey sandy, gravelly, silty clay with the sand,	0.00	0.20 - 1.20

Table 18.12 Proposed permanent access road: summary of ground conditions (GI, Mar 2017)				
Strata	Name [2]	Description/Presence [4]	Depth Range to Top (m bgl)	Proven Thickness (m)
		gravel and silt fractions found in varying proportions. The gravel comprised brick, sandstone, quartzite and flint Organic material and frequent rootlets also noted with occasional cobbles of brick and sandstone. Metal fragments identified within HR-TP001 Land drains were encountered at 1 m bgl within HR-TP002 and HR-TP003		
Natural Superficial Deposits	Barroway Drove Beds (Marine Deposits/ Tidal Flat Deposits) [3]	Interbedded very soft to stiff silty and/or sandy clays, clayey silts, clayey or silty sands with occasional gravel often with decomposed rootlets and pockets of organic clay. Very soft organic sandy or silty clays and spongy or plastic peat	0.20 - 1.20	2.40 - 5.50 [4]
	Till (Boulder Clay)	Firm to very stiff, rarely fissured light grey or dark grey/blue grey, mottled orange sandy gravelly clay with frequent pockets of orange silt and sand. Gravel is chalk, flint, limestone, mudstone, quartzite and sandstone. Rare cobbles of mudstone and chalk Light grey shelly limestone band in HR-BH004	2.40 - 5.70	0.20 - 11.15 [4]
Solid Geology	Oxford Clay Formation (Ancholme Group)	Extremely weak grey shelly mudstone	15.35	0.15 [4]

[1] Made ground is defined as materials that contained anthropogenic material or where it was underlain by material that contained anthropogenic material;

[2] AECOM's interpretation based on published geology and recorded field observations;

[3] Where no Made Ground is encountered at the surface, it is acknowledged that the upper most section of the natural deposits will have been subject to potential reworking/soil structure improvements and also the potential addition of nutrients and other elements associated with agricultural activity; and

[4] Not fully penetrated.

Geotechnical Hazards

5.2.13 Table 18.13 summarises the potential geotechnical hazards identified within the Zone of Influence from the Landmark Envirocheck® Report obtained (Ref: 18-30).

Table 18.13 Potential geotechnical hazards

Hazard Type	Receptor Hazard Potential
Non Coal Mining Areas	No Hazard
Potential for Collapsible Ground Stability Hazards	No Hazard
Compressible Ground Stability	Moderate
Ground Dissolution Stability	No Hazard
Landslide Ground Stability	Very Low
Running Sand Ground Stability	Moderate
Shrinking or Swelling Clay Ground Stability	Low
Radon Affected Areas	No, as less than 1% of homes are above action level
Radon Protection Measures	None required

Geological Designations

5.2.1 There are no Local Geological Sites (LGS) or geologically designated Sites of Special Scientific Interest (SSSI) present within the Zone of Influence (Ref: 18-24).

Mineral Sites and Designations

5.2.2 There are no former/current mineral extraction sites, MCA or MSA at, or within close proximity, to the Zone of Influence (Ref: 18-24).

5.3 Hydrogeological Setting and Sensitivity

Aquifer Designations

5.3.1 The EA aquifer mapping shows both the superficial geology beneath the Zone of Influence to be designated as Unproductive Strata (Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits)) and Secondary Undifferentiated (Till (Boulder Clay)) (Ref: 18-30). The solid geology is designated as Unproductive Strata (Oxford Clay Formation). Unproductive Strata are described by the EA as rock layers, or drift deposits, with low permeability that have only negligible significance for water supply or river base flow. Secondary Undifferentiated aquifers are assigned

by the EA in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Groundwater Levels

5.3.2 The EA were contacted in January 2016 to request data on groundwater levels for the Zone of Influence. Of the data provided by the EA; none was found to fall within the Zone of Influence (Ref: 18-31).

Proposed Converter Station Site Preliminary Ground Investigation (September 2016)

5.3.3 During the preliminary ground investigation undertaken within the proposed converter station site, groundwater strikes were recorded in all three boreholes at depths generally ranging between 2.50 m bgl and 3.70 m bgl; corresponding with the interface between the Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits) and the Till (Boulder Clay). A deeper strike was also recorded in BH02 (CS1) at 7.15 m bgl within the Boulder Clay (Ref: 18-27). The groundwater strikes were typically described by the Lead Driller as 'minor seepages'.

5.3.4 Groundwater monitoring was undertaken as part of the preliminary ground investigation on the proposed converter station site on the 3rd, 17th and 31st October 2016 within the three boreholes located on the site. The depth to groundwater was found to range between 0.58 m bgl and 2.53 m bgl within the Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits) (Ref: 18-27).

5.3.5 An additional groundwater monitoring event was undertaken on 9th May 2017 as part of the proposed permanent access road preliminary ground investigation (Ref: 18-29). The depth to groundwater was found to range between 1.06 m bgl and 2.17 m bgl within the Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits).

5.3.6 A summary of the October 2016 and May 2017 groundwater monitoring data is provided in Table 18.14.

Table 18.14 Summary of 2016 groundwater monitoring data

Exploratory Hole	Date	Groundwater Level (m bgl)	Groundwater Level (mAOD)	Strata
BH01 (CS1)	19/09/2016	2.3	-0.03	Barroway Drove Beds (Marine Deposits/ Tidal Flats Deposits)
	03/10/2016	2.44	-0.17	
	17/10/2016	2.53	-0.26	
	30/10/2016	0.92	1.35	
	09/05/2017	2.17	0.11	
BH02 (CS1)	19/09/2016	1.9	0.08	

Table 18.14 Summary of 2016 groundwater monitoring data				
Exploratory Hole	Date	Groundwater Level (m bgl)	Groundwater Level (mAOD)	Strata
	03/10/2016	1.95	0.03	
	17/10/2016	1.91	0.07	
	30/10/2016	1.10	0.88	
	09/05/2017	1.64	0.34	
BH03 (CS1)	19/09/2016	0.85	0.57	
	03/10/2016	0.98	0.44	
	17/10/2016	0.58	0.84	
	30/10/2016	0.58	0.84	
	09/05/2017	1.06	0.37	

m bgl – metres below ground level; and
mAOD – metres Above Ordnance Datum.

Proposed Permanent Access Road Preliminary Ground Investigation (February/March 2017)

5.3.7 Groundwater strikes were recorded within the Barroway Drove Beds (within both clay and sand layers) at HR-BH001 and HR-BH005. The groundwater strikes were recorded at 2.0 m bgl (rising to 1.98 m bgl) and 3.00 m bgl (rising to 2.15 m bgl), respectively. Groundwater was not encountered prior to use of water flush during drilling within the remainder of the borehole locations. Groundwater seepages were recorded within all five of the trial pit locations between 0.3 m bgl and 3.1 m bgl (but these were predominately encountered within the range of 1.1 to 1.5 m bgl). The groundwater within the trial pits was also encountered within the Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits) with the exception of an initial seepage at HR-TP003. This was detected directly below the land drain encountered at this location, in material described as Made Ground due to the presence of the land drain pipe. However, given the absence of any other anthropogenic material at this location these appear more representative of reworked Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits). The seepages within the trial pits occurred within both clay and peat layers.

5.3.8 Groundwater monitoring was undertaken on the proposed permanent access road on the 8th May 2017 within the three monitoring installations (HR-BH001, HR-BH002A and HR-BH003). The depth to groundwater level was recorded at 1.11 m bgl in HR-BH001, 3.41 m bgl in HR-BH002(A) and 2.41 m bgl in HR-BH003 which all lie within the Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits) (Ref: 18-29).

Groundwater Abstractions

5.3.9 The Zone of Influence is not located within a groundwater SPZ and there are no SPZ identified within the Zone of Influence (Ref: 18-29 and 18-32).

5.3.10 The EA were contacted in October 2016 to request data on private and commercial groundwater abstractions within the Zone of Influence and a response was received on the 23rd November 2016 (Ref: 18-33). In addition a request was made for information on private groundwater abstraction licenses to BBC and SHDC in September 2016 and data was provided from BCC and SHDC in September and November 2016, respectively (Ref 18-34). The information provided by the EA and the Local Planning Authorities showed there are currently no private or commercial groundwater abstraction licences within the Zone of Influence.

Groundwater Flooding

5.3.11 The BGS Groundwater Flooding Susceptibility map provided in the Landmark Envirocheck® Report obtained shows that the Zone of Influence is not in an area at risk from groundwater flooding (Ref: 18-30). In addition, Section 8.3 of the SHDC Strategic Flood Risk Assessment dated 2010 states that "there are no reports of groundwater flooding occurring in the District. This issue is therefore taken as having no strategic significance in relation to flood risk" (Ref: 18-35). The BBC Strategic Flood Risk Assessment dated 2010 (Ref: 18-36) also states that flooding from groundwater is of no relevance in the Boston area. Further discussion on flood risk is contained within *ES-2-C.03, Volume 2, Chapter 19: Water Resources and hydrology.*

5.3.12 The EA website indicates that the Zone of Influence is located in a Nitrate Vulnerable Zone (NVZ), which is defined by the EA as a "designated area of land draining into waters polluted by nitrates from agriculture" (Ref: 18-32).

Groundwater Sensitivity

5.3.13 Groundwater sensitivity is considered based on the aquifer designation and its resource value as defined by the criteria in Table 18.2. The groundwater within the Zone of Influence is considered to be of negligible sensitivity.

5.4 Underground Structures

Proposed Converter Station Site and Proposed Permanent Access Road

5.4.1 Based on a review of the underground assets information provided in the utility search report (Ref: 18-31), no underground cables or pipelines associated with supplying water, electricity, gas or telecommunications have been identified on the proposed converter station site.

5.4.2 An Openreach British Telecommunications cable, an Anglian Water pipe and a Western Power Distribution electricity cable are located adjacent south, 10 m south and 60 m south of the proposed converter station site running in a north-west to south-east orientation. These three utilities also cross the northern extent of the proposed permanent access road. In addition, a second Anglian Water pipe running from north to south is shown to underlie the northern extent of the proposed permanent access road (a section of approximately 320 m).

5.4.3 Land drains are also known to exist at the proposed converter station site and they are expected to cross parts of the proposed permanent access road. Whilst land drains are an underground asset, they are important in terms of controlling near surface drainage and are therefore afforded a medium sensitivity.

5.4.4 There is also the limited potential for hard standing, buried structures or below ground obstructions associated with the existing array of buildings in the central part of the southern proposed converter station site boundary to be present.

Proposed AC Cable Route

5.4.5 The following underground assets have been identified within the proposed AC cable route Zone of Influence (Ref: 18-37):

5.4.6 An Anglian Water pipe crosses the northern extents of the proposed AC cable route at the point where the proposed AC cable route would enter the eastern side of the existing Bicker Fen Substation.

5.4.7 A British Telecommunications cable is located approximately 140 m north-west of the northern extent of the proposed AC cable route centre line which runs parallel to the western side of the existing Bicker Fen Substation.

5.4.8 A Western Power Distribution electricity cable lies approximately 220 m north-west of the northern extent of the proposed AC cable route centre line which runs parallel to the western side of the existing substation.

5.4.9 In addition to the stated underground utilities, the potential also exists for a network of agricultural land drains relating to the agricultural fields, crossing and adjacent to the proposed AC cable route. Land drains are important in terms of controlling drainage and are therefore afforded a medium sensitivity

5.5 Unexploded Ordnance Potential

5.5.1 Zetica Limited were commissioned by NGVL to undertake an unexploded ordnance (UXO) desk study which included the Zone of Influence (Ref: 18-38). Zetica were then requested to undertake a UXO risk assessment (Ref: 18-39). The desk study report and subsequent risk assessment report are included as Appendix 18.4 in *ES-2-C.02, Volume 4, Chapter 18: Geology and Hydrogeology*. The assessment identified that there is no evidence of significant UXO potential within the Zone of Influence.

5.6 Soil and Groundwater Contamination Potential

Historical Land Use

5.6.1 Historical OS maps supplied as part of the Landmark Envirocheck® Report obtained (Ref: 18-40) dating back to 1888 have been reviewed in order to identify potentially contaminative historical land uses.

Proposed Converter Station Site

5.6.2 Since publication of the 1889 OS map there has been little by way of development on and around the proposed converter station site. The current layout of the proposed converter station site has existed since at least 1973; and prior to this its main discernible features were that the site was split into eight, and then five areas. A small building is shown on the 1905 plan in the centre of the southern field boundary, which increased to the size of the existing array of buildings present today from around 1973. Currently the building area appears to be used for general storage of agricultural equipment. The surrounding area has historically, and continues to be, characterised by agricultural land use.

Proposed Permanent Access Road

5.6.3 The historical OS maps show that the alignment of the proposed permanent access road and the surrounding area has comprised predominantly agricultural fields since at least 1888. The only notable changes are as follows:

- The 1985 map shows that a track had been constructed in a north to south orientation from the southern boundary of the proposed converter station site towards a railway line located approximately 580 m to the south. The track underlies the northern extent of the proposed permanent access road (a section of approximately 480 m) and divides two agricultural fields.
- A small cluster of buildings (residential or farm buildings) are shown to be present on historical mapping between 1888 and 1956, approximately 480 m south of the proposed converter station site (close to the southern extent of the existing track). These buildings are shown to have been cleared by the 1985 OS map.

Proposed AC Cable Route

5.6.4 The available OS maps dated between 1888 and 2006 show that there has been no notable development on or around the proposed AC cable route. Land uses between these periods are shown to comprise open arable fields with the exception of a road named Vicarage Drove located at the northern extent of the proposed AC cable route.

5.6.5 The most recent OS map from 2016 shows the existing Bicker Fen Substation present at the northern extent of the proposed AC cable route. Five wind turbines are also labelled within the proposed AC cable route Zone of Influence.

5.6.6 No significant contamination potential has been identified at the proposed converter station site, the proposed permanent access road or the proposed AC cable route based on mapped historical land use.

Current Land Uses

5.6.7 Current OS Mapping (Ref: 18-40) and aerial imagery (Ref: 18-41) have been reviewed alongside observations from various site visits undertaken during the course of the project in order to identify the present land uses within the Zone of Influence.

Proposed Converter Station Site

5.6.8 The proposed converter station site is bounded to the north by the Mill Drain which is maintained by the Black Sluice Internal Drainage Board (IDB). Branches of the Mill Drain also bound the proposed converter station site to the west and south. Middle Fen Drove Drain (IDB drain) borders the north-east corner of the proposed converter station site connecting to the Mill Drain. North Ing Drove (road) lies to the immediate south. The field is currently used to farm arable crops. The surrounding area is characterised by agricultural land use.

Proposed Permanent Access Road

5.6.9 The proposed permanent access road (approximately 2.8 km long) will connect the proposed converter station to the existing highway network (A52). Current land use along the alignment is characterised by open agricultural fields. A railway line is located to the south of the alignment (approximately 50 m to the south at its closest point) and Hammond Beck (which is orientated north-east to south-west) dissects the approximate mid-point of the alignment.

Proposed AC Cable Route

5.6.10 The proposed AC cable route currently comprises open agricultural fields. It crosses Middle Fen Drove Drain at its southern limits, Boundary Drain West which runs in a west to east orientation at the approximate mid-point between the proposed converter station site and the existing Bicker Fen Substation and Vicarage Drove Drain which runs parallel to Vicarage Drove road which bounds the substation to the east and south. It also crosses four other unnamed drains.

Regulated Activities and Data

5.6.11 The Landmark Envirocheck® Report (Ref: 18-30) has identified one discharge consent within the Zone of Influence. This consent is located approximately 250 m south east of the proposed converter station site and 240 m north of the proposed permanent access road (at its closest point). This relates to trade discharge (agricultural) to groundwater.

5.6.12 The Landmark Envirocheck® Report (Ref: 18-30) records no pollution incidents to controlled water within the Zone of Influence.

5.6.13 There are no Integrated Pollution Control (IPPC) processes, hazardous substance consents or fuel station entries located within the Zone of Influence (Ref: 18-30).

5.6.14 The EA published landfill mapping does not identify any historic or current landfill sites on, or within the Zone of Influence (Ref: 18-32).

5.6.15 There are no current or preferred waste management sites identified in the Lincolnshire County Council Core Strategy and Development Management Policies Lincolnshire Minerals and Waste Local Plan (Ref: 18-19) within the Zone of Influence.

5.6.16 There are no areas within or adjacent to the Zone of Influence that are classified as ‘Contaminated Land’ under Part 2a of the Environmental Protection Act 1990 (Ref: 18-6).

Ground Investigation – Soil and Groundwater Chemical Analysis

Proposed Converter Station Site Preliminary Ground Investigation (September 2016)

5.6.17 As part of the September 2016 preliminary ground investigation on the proposed converter station site (Ref: 18-26), soil and groundwater samples were collected in order to provide a quantified measure of baseline soil and groundwater quality at the proposed converter station site. A total of five soil samples from between 0.4 m and 2.0 m bgl were analysed for a range of determinands including metals, inorganic compounds (cyanide, nitrate and sulphur compounds), speciated polycyclic aromatic hydrocarbons (PAH), total hydrocarbons, total phenols, volatile organic compounds (VOC) and semi volatile organic compounds (SVOC). In addition, three soil samples from between 1.0 m and 3.0 m bgl were submitted for soil leachate testing for a similar range of determinands, although due to the soil leachate preparation methods total hydrocarbons, SVOC and VOC were not analysed.

5.6.18 A total of three groundwater samples were collected from monitoring well installations and subsequently analysed for a range of determinands including metals, inorganic compounds, PAH, total hydrocarbons, total phenols, organochlorine and organophosphorus pesticides and herbicides.

5.6.19 To provide some context to the measured concentrations within the soils and groundwater sampled, a generic quantitative risk assessment (GQRA) was undertaken by AECOM as part of the preliminary ground investigation interpretive report (Ref: 18-27).

Summary of Soil Results

5.6.20 The assessment of the soil samples recovered from the ground investigation was based on screening maximum soil concentrations for a range of determinands against soil Generic Assessment Criteria (GAC) that are published for numerous potential contaminants by both regulatory and industry recognised bodies. Where GAC have not been published, AECOM has derived its own GAC values using industry recommended and accepted methods. GAC were selected for a residential with plant uptake scenario to provide an initial conservative screen and because this was considered to be sufficiently protective to any residents located directly adjacent to the proposed converter station site.

5.6.21 All of the determinands tested were found to be below the adopted screening criteria and it was therefore concluded by AECOM that there was no appreciable significant risk from the soil samples tested to the human health of future end users or directly neighbouring site users (Ref: 18-27).

Summary of Soil Leachate and Groundwater Results

5.6.22 To assess the baseline groundwater quality and any potential risks to groundwater or surface water, a comparison of maximum concentrations recorded in groundwater and soil leachate, against published limits was undertaken. Published Environmental Quality Standards (EQS - freshwaters) were used where available (Ref: 18-29) to reflect that surface waters are more

sensitive to pollution in the area. Screening for the protection of drinking water was not undertaken given that the proposed converter station site and surrounding area is not within an SPZ and the superficial and bedrock geology are classified as Unproductive Strata by the EA. Furthermore groundwater is not abstracted locally within the Zone of Influence. A summary of the findings of the screening assessment is provided as follows:

- The screening assessment identified that there were no phenols, pesticides or herbicides detected greater than the limit of detection of the test method adopted, within groundwater and/or the soil leachate samples analysed.
- With the exception of pyrene, all PAH were detected at concentrations below the limit of detection of the test method within the groundwater samples taken. As pyrene was only detected marginally greater than the limit of detection of the test method, it was not considered to be at a concentration that would pose a viable risk to surface waters.
- The PAH fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene and benzo(g,h,i)perylene, were detected within the soil leachate tested and found to be in excess of their adopted screening values. However, AECOM concluded that the lack of these PAH in the groundwater was sufficient to show that no impact was occurring to groundwater and hence the level of future risk was unlikely to be significant.
- Total petroleum hydrocarbons were analysed in the groundwater samples taken from all three boreholes within the proposed converter station site. Although detected within the groundwater, there was no visual or olfactory evidence of contamination and the concentrations were only marginally above (same order of magnitude) the detection limit of the adopted test method.
- The metals nickel, cadmium, copper, zinc and boron were detected in the groundwater and soil leachate samples at concentrations greater than their respective adopted screening values. In addition, lead, iron and mercury were detected at leachable concentrations above the adopted screening values in soil leachate samples tested only. However, given the agricultural nature of the surrounding area, and the lack of potential contaminative sources identified, AECOM concluded that these concentrations are most likely to reflect background concentrations within the groundwater as a result of either weathering of the natural geology, or the widespread agricultural activities undertaken in the area. The concentrations of metals recorded in the soils were noted to be similar and within the ranges of those recorded as background concentrations in the area by the UK Soil Observatory (UKSO) (Ref: 18-27).
- Ammoniacal Nitrogen was detected in the groundwater samples and soil leachate samples at concentrations greater than the adopted screening values. It was acknowledged that with the agricultural history and current use of the proposed converter station site, the presence of ammonia/ammoniacal nitrogen within the groundwater would not be unexpected.
- Marginally elevated sulphur concentrations were detected in groundwater and soil leachate when compared to the adopted screening value. The marginally elevated concentrations in groundwater were considered by AECOM to be commensurate with natural background levels associated with natural weathering of the geology in the area.

5.6.23 The use of the EQS are considered conservative given that the guidance concentrations are applicable to the concentration in the receiving surface water body, i.e. after dilution. Soil leachate concentrations would also undergo additional dilution upon infiltration into groundwater during migration to the surface water body. Additionally, the Part 2A statutory guidance (Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance April, 2012) (Ref: 18-6) notes that normal levels of contaminants in soil should not be considered to cause land to qualify as contaminated land, unless there is a particular reason to consider otherwise.

5.6.24 Based on the assessment completed by AECOM it was concluded that the baseline groundwater conditions encountered were consistent with those that might be generally considered to be natural background concentrations. There is not considered to be any appreciable significant contamination within the groundwater beneath the proposed converter station site which may pose a risk to surface water quality during the construction phase (Ref: 18-27).

Ground Gas Assessment

5.6.25 Three ground gas monitoring visits were undertaken in October 2016 by ESG during the preliminary ground investigation (Ref: 18-26). Concentrations of carbon dioxide, carbon monoxide, methane, oxygen, hydrogen sulphide and gas flow were measured in the three boreholes with response zones screened in the deeper superficial geology. Atmospheric pressure readings between the events ranged from 1014 millibar (mb) to 1028 mb. The ground gas monitoring data was assessed by AECOM in their interpretive report (Ref: 18-27).

5.6.26 No methane was detected during any of the monitoring visits. Carbon dioxide was recorded at a maximum concentration of 4.9 percentage volume (% v/v). Carbon monoxide was detected during the first two visits from BH03 (CS1) at concentrations of 3.7 parts per million (ppm) and 3.9 ppm, respectively. No obvious source for the presence of the carbon monoxide was identified by AECOM, however, it was the borehole location out of the three locations that was closest to the farm lane and used for farm traffic. Hydrogen sulphide was detected on one occasion (during the initial visit) in BH02 (CS1). Oxygen concentrations were within the range of between 18.2 % to 21.6 % volume and only negligible gas flow was recorded (maximum 0.3 litres/hour)

5.6.27 AECOM assessed the ground gas results in accordance with BS 8485 (2015) 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' (Ref: 18-42) and CIRIA guidance document C665 (2007) 'Assessing risks posed by hazardous gasses to buildings' (Ref: 18-43). This guidance uses Gas Screening Values (GSV) to assess the risks to humans, buildings and development from methane and carbon dioxide and also takes into account gas flow rates.

5.6.28 The proposed converter station site was assessed to fall within a Characteristic Situation 1 very low risk classification. However, it was noted that the exploratory borehole records indicated that there is evidence of organic clay within the Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits); notably in BH01 and BH03 where a 0.1 m and 1.6 m thick horizon of organic clay was recorded respectively. The response zone (the slotted section of standpipe) in the monitoring

installations targeted the deeper superficial geology and so did not intercept these soil horizons. It was therefore recommended that the classification be elevated to Characteristic Situation 2 to account for this, and in recognition of there only having been a limited amount of monitoring undertaken at this time.

5.6.29 Ref 18-42 supports this judgement by stating that a Characteristic Situation 2 classification is typical for areas underlain by natural soil with high organic content. This is also supported by Figure 2 of the CL:AIRE Research Bulletin titled 'A Pragmatic Approach to Ground Gas Risk Assessment' (Ref: 18-44). This provides an alternative approach to ground gas assessment. This guidance states that alluvial soils and well decomposed peaty soils have been found to not generate sufficient hazardous gas flows that exceed Characteristic Situation 2 as defined in BS 8485: 2007 (Ref: 18-41).

Proposed Permanent Access Road Preliminary Ground Investigation (February/March 2016)

5.6.30 The findings of the targeted ground investigation undertaken along the proposed permanent access road are included in *ES-2-C.02, Volume 4, Chapter 18: Geology and Hydrogeology* as Appendix 18.2. A summary of the contamination assessments is provided as follows:

- A total of fourteen soil samples collected from the ten exploratory hole positions (depths ranging between 0.1 and 2.2 m bgl) were chemically analysed for a suite of metals, inorganic parameters, speciated PAH, speciated TPH (12 samples) and total phenols. Selected soil samples were also tested for a suite of VOC and SVOC, herbicides, pesticides and screened for asbestos containing material;
- Three soil samples collected from exploratory hole positions HR-BH005, HR-BH003, HR-TP005 were also submitted for soil leachability analysis. The analytical suite comprised metals, inorganics and speciated PAH;
- The soils data was screened against GAC for a residential with plant uptake scenario and the soil leachate data was screened against controlled waters GAC derived primarily from EQS guidance values;
- The human health risk assessment concluded that that there is no appreciable significant risk from the soil samples tested based on the proposed end use of a permanent access road from the A52 to the proposed converter station; and
- The controlled waters risk assessment concluded that the soil baseline conditions are broadly consistent with natural background concentrations with only minor and localised exceptions of soil leachate values that do not appear to be representative of the general conditions along the proposed permanent access road. There is not considered to be a significant risk from soil contamination to groundwater. A programme of groundwater quality monitoring is being implemented at the time of writing and this will be reported under separate cover and will serve to establish pre-construction baseline conditions against which future construction and post construction monitoring can be compared against.

Conceptual Site Model

5.6.31 The topography, geology, hydrogeology and hydrology of the site are the main factors that influence the way in which potential contaminants in the soil or groundwater can be transported on or off site, and the ways in which contamination can affect different receptors. Potential receptors are first summarised in this section, and where applicable references are made to other relevant chapters within this Environmental Statement. Potential sources and pathways linking any sources to the defined receptors are then identified.

Receptors to Soil and Groundwater Contamination

Groundwater

5.6.32 The superficial and solid geology underlying the Zone of Influence are classified as Unproductive Strata by the EA and there are currently no private or commercial groundwater abstraction licences within the Zone of Influence.

Water Resources and Hydrology - Proposed Converter Station Site

5.6.33 A summary of potential hydrological receptors identified within the Zone of Influence is provided below and further details are presented in *ES-2-C.03, Volume 2, Chapter 21: Water Resources and Hydrology*.

5.6.34 The proposed converter station site is bounded to the north, north-east, south and west by existing IDB drains (Mill Drain and Middle Fen Drove Drain). There are no other significant surface water bodies within the proposed converter station site Zone of Influence, however there are a network of smaller drains dividing the adjacent fields (Ref: 18-27).

5.6.35 The South Forty Foot Drain is part of a major river network, and runs from north east to south west, approximately 660 m to the west of the proposed converter station site (Ref: 18-27). The Landmark Envirocheck® Report (Ref: 18-30) states that the South Forty Foot Drain has a General Quality Assessment grade of C (fairly good) as designated by the EA in 2000.

5.6.36 Hammond Beck is also located approximately 560 m south east of the proposed converter station site at its closest point, and runs from north east to south west. There is no water quality data available for this water feature provided in the Landmark Envirocheck® Report (Ref: 18-30).

5.6.37 The closest licensed surface water abstraction is located approximately 700 m to the south and relates to abstraction for spray irrigation use from a tributary of Hammond Beck (Ref: 18-30, Ref: 18-31).

Water Resources and Hydrology - Proposed Permanent Access Road

5.6.38 The proposed permanent access road crosses Hammond Beck. The alignment also runs parallel to, and crosses at two points, existing drains including the Old Pump Drain and Gibbet Fen Drain which connect to the Hammond Beck.

5.6.39 The closest licensed surface water abstraction is located approximately 240 m to the south of the western section of the proposed permanent access road and relates to abstraction for spray irrigation use from a tributary of the Hammond Beck (as referred to above) (Ref: 18-30 and 18-31).

Water Resources and Hydrology - Proposed AC Cable Route

5.6.40 The proposed AC cable route crosses three IDB drains; Middle Fen Drove Drain at the cables southern extent, Boundary Drain West in the centre and Vicarage Drove Drain at the northern extent. A network of smaller drains divide the agricultural fields crossed by the proposed AC cable route.

5.6.41 There are no licensed surface water abstractions within the Zone of Influence of the proposed AC cable route (Ref: 18-30).

Sensitive Sites

5.6.42 A summary of designated environmentally sensitive receptors identified within the proposed converter station, the proposed AC cable route and the proposed permanent access road Zone of Influence is provided below and further details a presented in *ES-2-C.05, Volume 2, Chapter 23: Ecology.*

5.6.43 There are no statutory designated ecological sites or heritage assets present within the Zone of influence for Geology and Hydrogeology (Ref: 18-27).

5.6.44 The nearest designated ecological site is South Forty Foot Drain Local Wildlife Site which is approximately 650 m to the west of the proposed converter station at its closest point (Ref: 18-27).

5.6.45 Two outlier badger holes were recorded on the western boundary of the proposed converter station site and one outlier hole on the northern boundary. A positive result for great crested newts Environmental Deoxyribonucleic Acid (eDNA) was returned for the western boundary ditch (Ref: 18-27).

Human Receptors

5.6.46 Potential human receptors identified within the Zone of Influence are summarised as follows:

- Residential property (The Old Barn) located approximately 150 m south east of the proposed converter station site;
- Employees working at Bicker Fen Substation located adjacent to the northern extent of the proposed AC cable route;
- Potential farm workers associated with the agricultural fields adjacent to the proposed converter station, the proposed permanent access road and the proposed AC cable route; and

- Construction and future maintenance workers.

Buildings and Infrastructure

5.6.47 The closest building to the proposed converter station site is approximately 150 m south east and is unlikely to be affected. The closest building to the proposed AC cable route is the Bicker Fen Substation into which the AC cable route connects. There are no buildings located within the Zone of Influence of the proposed permanent access road, west of the A52.

5.6.48 In terms of future excavations, the Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits) are recorded at the proposed converter station site as being very loose and loose (where the principle constituent is granular) and typically very soft, locally soft (where the principle constituent is fine (i.e. silt or clay). Based on this, there may be a requirement to provide temporary support for site excavations during construction.

5.6.49 The ground investigations completed to date on the proposed converter station site have indicated that for concrete specified at depth (e.g. piles), and for preliminary design purposes, a design classification of DS-3 and ACEC (Aggressive Chemical Environment for Concrete) class of AC-3 would be required. In terms of shallower materials, and due to anticipated ground disturbance (e.g. either associated with pile caps/beams or shallow foundations where ground improvement has taken place), a DS-5/AC-5 classification would be required. This initial assessment is considered to be a conservative level of assessment with a view to further refinement taking place during the detailed design.

5.6.50 The ground investigations completed to date along the proposed permanent access road has indicated that for concrete specified at depth (e.g. piles for the bridge foundations), and for preliminary design purposes, a design classification of DS-2 and ACEC class of AC-2 would be required. In terms of shallower materials, and due to anticipated ground disturbance (e.g. either associated with pile caps/beams or shallow foundations where ground improvement has taken place), a DS-4/AC-4 was assessed for any permanent shallow structures. As with the proposed converter site this initial assessment is considered to be a conservative level of assessment with a view to further refinement taking place during the detailed design.

5.6.51 The outcome of a preliminary ground gas assessment at the proposed converter station site has indicated that a Characteristic Situation 2 would apply, which means that some low level ground gas protection may be required for new development.

Potential Receptors Summary

5.6.52 The site-specific receptors were identified based on the proposed land-use as well as the environmental setting of the Zone of Influence. Table 18.15 presents the identified potentially sensitive receptors that will be considered within the geology and hydrogeology assessment.

Table 18.15 Summary of potentially sensitive receptors	
Identified Receptor	**Receptor Sensitivity**
Human health – contractors carrying out construction works	Very High
Human health – Agricultural and employment activity within 250 m of proposed construction works.	Low
Human health – Neighbouring residential properties (The Old Barn, Residential)	High
Human health – Proposed converter station end users	High
Groundwater - Unproductive Strata and Secondary Undifferentiated	Negligible
Surface water features (proposed converter station site) - Mill Drain on the northern, southern and western boundaries, Middle Fen Drove Drain to the north-east.	High
Surface water features (proposed permanent access road) - Old Pump Drain, Hammond Beck, Gibbet Fen Drain and other unnamed drains crossed or adjacent to the proposed permanent access road.	High
Surface water features (proposed AC cable route) – Mill Drain, unnamed IDB drain, Vicarage Drove Drain and other unnamed drains crossed or adjacent to the proposed AC cable route.	High
Proposed utilities and infrastructure both on–site and in close proximity (e.g. foundations, utilities)	Low

Potential Sources of Contamination

5.6.53 Based on the historical and current land uses in the Zone of Influence, and the findings of the preliminary ground investigations, no significant sources of soil or groundwater contamination have been identified. A low ground-gas risk has been assessed for future buildings on the proposed converter station site based on the available data and no evidence of elevated UXO potential has been found within the Zone of Influence.

Potential Pathways

5.6.54 The human health exposure pathways that are considered viable based on the proposed land use and UK guidance (CLEA) are listed below:

- Dermal contact with soil, dust and groundwater;
- Ingestion of soil attached to grown produce (proposed AC cable route only);
- Ingestion of soil, dust and groundwater;
- Inhalation of dust;
- Inhalation of vapours (from soils and groundwater); and
- Inhalation of ground-gas in confined spaces and future buildings.

5.6.55 The controlled waters pathways considered viable are as follows:

- Vertical and lateral migration of leachate through the unsaturated soils to groundwater;
- Vertical and lateral groundwater migration; and
- Surface water run-off.

Conceptual Site Model Summary

5.6.56 In the absence of any significant sources of soil and/or groundwater contamination, there are not perceived to be any soil or groundwater contamination risks associated with the baseline conditions that might significantly impact upon future development. There is the potential for slightly elevated naturally occurring ground gas and also elevated sulphate in groundwater that may influence the specification of materials during the detailed design stages.

6 Potential Impacts

6.1 Temporary Construction Impacts

6.1.1 A number of activities will occur at the site during the construction phase that have the potential to interact with the underlying geology and hydrogeology. These have been identified as:

- Soil stripping;
- Cut and fill earthworks;
- Excavations for proposed AC cable route trenching, trenchless cable installation techniques, foundations, connection works within the existing Bicker Fen Substation, drainage and utilities;
- Dewatering of excavations;
- Excavated materials management and soil storage; and
- Establishment of temporary construction compounds and the storage of hazardous materials within them for use in construction e.g. fuels and oils.

6.1.2 There will be one large temporary construction compound at the proposed converter station site and this will be located in the south east corner. A smaller construction compound, for localised storage of materials and plant, will be located at the northern extent of the proposed AC cable route, adjacent east of Vicarage Drove. There will also be a construction compound adjacent to the proposed permanent access road junction with the A52.

Geological Setting

Materials Management

6.1.3 The scope of the works within the proposed converter station zone includes for the re-profiling of the site to achieve a development platform that is 2.9 m above ordnance datum (AOD) for the proposed converter station zone. Based on existing levels, re-profiling of the site is estimated to require up to 1 metre of fill in places to achieve this. It is estimated that approximately 61,000 cubic metres of excavated soils/materials will be required to create the development platform and of this volume approximately 40,000 cubic metres is estimated to be available from within the proposed converter station site boundary (eastern area).

6.1.4 The adopted foundation solution for the proposed converter station zone will be subject to the findings of more detailed ground investigations. At this stage either a shallow foundation solution, in conjunction with ground improvement, or deeper piling is expected to be adopted. The construction of foundations, service trenches and drainage features, as well as the more general re-profiling discussed, will also generate arisings requiring subsequent management.

6.1.5 The construction of the AC cable route will require up to two separate trenches, with each trench accommodating up to three cables. Open cut installation will be adopted wherever feasible but it

is envisaged that the application of trenchless installation techniques (e.g. horizontal directional drilling, auger boring or micro boring) will be required in some locations, particularly where the proposed AC cable route crosses the Black Sluice IDB drains e.g. the Middle Fen Drove Drain, Boundary Drain West and Vicarage Drove Drain.

6.1.6 There is expected to be a surplus of excavated materials following cable installation due to the use of cement bound sand as the founding bed, and surrounds, to the cables when laid in open cut, or from the generation of spoil from the application of trenchless techniques. These materials will either need to be managed on site, managed off site or disposed of off-site.

Ground Stability

6.1.7 Earthworks including excavations and foundations, together with dewatering, could adversely affect ground stability and, subsequently, any proposed and surrounding structures through uncontrolled settlement. There may be a requirement to provide temporary support for site excavations. Such support may include benching of excavations, shoring or the construction of retaining walls (e.g. sheet piles) or struts to mitigate the risk of settlement or excessive spalling. It is expected that the need for such control would be established during detailed design and where specified and implemented correctly, would be sufficient to mitigate any residual effects. With reference to the methodology in Tables 18.2, 18.3 and 18.4, it is considered that any settlement of land would represent a low magnitude of change to land stability, which is of low sensitivity given the general absence of development that might be affected. Therefore, it is assessed that the construction activities would result in an effect of **negligible significance** on land stability.

Geological Site Designations

6.1.8 There are no geologically designated sites identified within the Zone of Influence, therefore a negligible sensitivity and magnitude has been identified in this regard. This results in an overall pre-mitigation effect upon designated geological sites during the construction phase that is considered to be of **negligible significance**.

Mineral Site Designations

6.1.9 There are no designated minerals sites, mineral safeguarding or mineral consultation areas within the Zone of Influence, and hence no potential for severance or sterilisation of local, regional or nationally significant mineral reserves. A negligible sensitivity and magnitude has therefore been identified, which results in an overall pre-mitigation effect upon mineral resources that is considered to be of **negligible significance**.

Hydrogeological Setting

Aquifer Permeability

6.1.10 Re-profiling of the site, will in places increase the landform height which may result in increased loading and localised decreased permeability of the underlying ground conditions. Similarly any ground improvement adopted to support a shallow foundation solution for the proposed converter station zone or associated with any connection works within the Bicker Fen 400 kV Substation may have a similar effect on the permeability of the ground conditions. However, there are no sensitive groundwater abstractions identified in the baseline review that could be affected by a localised reduction in permeability, and there is no suggestion that the area is currently prone to groundwater flooding (Ref. 18-35 and Ref. 18-36). A negligible sensitivity and low magnitude has been identified, which results in an overall pre-mitigation effect upon the underlying aquifer, and its permeability status, that is considered to be of **negligible significance**.

Dewatering and Drainage

6.1.11 Dewatering of excavations may be required which will generate a quantity of groundwater that will need to be managed and discharged appropriately from site. An abstraction licence is required when extracting more than twenty cubic metres/day. Where discharges from site are uncontrolled this could result in pollution of the receiving waters, which may impact on surface water quality. If too much water is discharged, or the discharge rate is too high in the absence of sufficient controls, the capacity of the receiving surface water environment could be exceeded which may cause flooding off site in the wider area. The discharge of groundwater will require an environmental permit from the EA as well as consent from the IDB when discharging to an IDB maintained water course or drain.

6.1.12 There are no sensitive groundwater abstractions identified in the baseline review that could be affected by dewatering activities and it is expected that discharges will be required to be managed in accordance with permitting and dewatering requirements. A negligible sensitivity and low magnitude has therefore been identified. This results in an overall pre-mitigation effect upon the aquifer and its permeability status that is of **negligible significance**. The potential impact associated with dewatering activities on surface waters is considered further in *ES-2-C.03, Volume 2, Chapter 19: Water Resources & Hydrology*.

Underground Structures

6.1.13 It is anticipated that land drains will be present in agricultural land within the Zone of Influence and the potential exists for these to be temporarily severed as a result of open cut trench excavations for the proposed AC cable route, trenchless starter pits and earthworks or foundation excavations for the proposed converter station site. On this basis the sensitivity of the existing land drains are considered to be medium with a medium potential magnitude of impact. This results in an overall pre-mitigation effect upon the unproductive aquifer that is of **moderate significance**.

6.1.14 Given the low groundwater sensitivity environment and absence of any groundwater abstractions within the Zone of Influence, the proposed converter station zone, proposed AC cable route, the connection works within the existing Bicker Fen Substation, and proposed permanent access road are considered likely to have an overall **negligible significance** on the hydrogeological conditions at the site.

6.1.15 Potential impacts to groundwater quality from construction activities are considered below.

Soil and Groundwater Contamination

6.1.16 Current guidance and best practice for the assessment of soil and groundwater contamination is based on risk assessment rather than impact assessment as discussed in Section 2. A qualitative risk assessment for soil and groundwater contamination has been undertaken for the construction and operational phases. The risk assessment is pre-mitigation and where a significant risk remains, mitigation measures are then recommended in Section 7.

6.1.17 The potential effects associated with soil and groundwater contamination have been defined based on the likely sources and level of contamination across the proposed converter station site, proposed AC cable route and proposed permanent access road; the sensitivity of the receptors and the consequence of the effect resulting from an interaction between the source and the receptor, via a pathway. In addition, consideration has also been given to how construction activities could have the potential to cause soil and groundwater contamination through the use of hazardous materials, and the approach to excavated materials management. The assessment methodology adopted for these aspects is defined in Tables 18.7, 18.8 and 18.9 in Section 2.

6.1.18 Desk study and ground investigation has not identified a significant potential for soil and groundwater contamination within the proposed converter station site, proposed AC cable route or proposed permanent access road which suggests that there is a low potential for chemically unacceptable soils or groundwater to be encountered during the construction phase. Whilst ground investigation has not been completed for the proposed AC cable route, the proposed AC cable route crosses similar agricultural land with no discernible historical land uses identified that could have given rise to significant soil or groundwater contamination.

6.1.19 In the absence of any significant existing sources of soil or groundwater contamination, there are no significant source-pathway-receptor linkages based on current conditions except for those that may influence the specification of materials during detailed design e.g. concrete for foundations and ground gas mitigation in buildings. Therefore, the main potential sources of contamination considered in the assessment are considered to be fuels and chemicals that may be introduced during the construction (and operation) of the proposed converter station site.

Construction Workers – Human Health

6.1.20 The handling of excavated soils, construction materials and the use of construction machinery all include the potential to introduce hazardous materials and potential impacts to construction

workers. Construction workers have the potential to come into contact with fuels and other chemicals during construction activities, posing a potential risk to human health through dermal contact, ingestion and inhalation. There is also a limited potential for ground gas to emanate from the known organic deposits present within the Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits), which may preferentially accumulate in excavations or poorly ventilated confined spaces, where construction workers could be required to work.

6.1.21 Prior to construction activities taking place it is contingent on the appointed Contractor that risk assessments will be undertaken in full accordance with the Health and Safety at Work Act (Ref: 18-45) to restrict and manage any potential exposure to harmful substances. Potential impacts specific to construction workers are expected to be mitigated through the appropriate specification and use of Personal Protective Equipment (PPE) and the implementation of site controls and procedures in accordance with the Principal Contractor's Construction Phase Plan, as required under the Construction Design and Management (CDM) Regulations 2015 (Ref: 18-46).

6.1.22 Construction workers are considered to have a very high sensitivity due to the potential for exposure to hazardous materials which if not controlled may occur through dermal contact, inadvertent ingestion or inhalation. The probability of significant harm occurring to human health is defined as low taking into consideration the adoption of standard PPE and site controls which are a prerequisite to construction. The potential consequence classification is considered mild. The potential effects upon construction workers would be limited for the duration of the construction phase activities. As such, the overall pre-mitigation classification of risk upon health of construction workers during the construction phase is considered to be **low**.

Neighbouring Site Users, Occupiers and the General Public – Human Health

6.1.23 Neighbouring site users, occupiers and the general public immediately adjacent to, or in proximity to the proposed construction activities, could be impacted upon. Contaminated soils encountered during earthworks including the creation of stockpiled materials, may be exposed to wind and rain which may increase dispersal through the spread of soil dust in air and/or soil in uncontrolled run off, in the absence of mitigation.

6.1.24 The absence of a significant potential for existing soil contamination suggests that it is unlikely that significant impacts on neighbouring human health would occur from any uncontrolled releases of soil-derived dusts or run off. However, it is possible that construction works could introduce contaminants into the environment through accidental release. In the event that soil derived dusts and/or run-off do migrate to affect neighbouring properties and their occupants, this would be a short-term impact.

6.1.25 Neighbouring residential and commercial human receptors identified within the baseline Zone of Influence are assigned a high and low sensitivity, respectively. This considers relative exposure duration between a resident (continuous) and an employee (working hours), together with the proximity of each type of receptor from the construction works. The consequence of effects on

human health resulting from exposure to soil dusts and/or uncontrolled run off is defined as minor with a probability of it occurring being low. As such, provided good construction practices are adopted, the overall pre-mitigation risk from the uncontrolled release of potentially contaminated soil-derived dust or run off upon the health of neighbouring site users, occupiers and the general public during the construction phase is considered to **very low**.

Groundwater and Surface Water

6.1.26 Hazardous materials will be introduced and stored on-site during construction, in the form of diesel fuel, oils, chemicals and solvents, as well as construction materials such as cement and bentonite. Chemicals and solvents might include detergents, degreasers, paints, thinners, firefighting fluids, resins and glues. Improper handling and use of hazardous materials has the potential to introduce contaminants into underlying soils and groundwater which may in turn result in impacts to surface water courses through groundwater migration or uncontrolled run off. Leakages/spillages from materials and fuel storage areas or from the incorrect disposal of waste or surplus material, could also impact on the underlying ground and hydrogeological conditions which would affect the groundwater resource potential.

6.1.27 The increased use of water during construction works, e.g. for dust suppression, wheel washing, drilling or dewatering may lead to increased potential for contaminated water to be generated and increased surface water run-off. This poses a risk to the underlying Unproductive Strata and to nearby surface water features (Mill Drain that bounds the proposed converter station site to the north and west) that may interact with groundwater.

6.1.28 Where trenchless techniques are undertaken, potential impacts may arise through the inaccurate design depth, whereby excavations or drilling may create pathways for drilling fluids, or other fluids used during construction, to reach groundwater receptors. Where crossing water courses or drains, drilling too shallow could create a contamination pathway to sensitive surface water receptors, should a break out of drilling fluids, or other fluids used during construction, occur through the bed of the watercourse. This is of particular relevance when working within loose granular deposits.

6.1.29 The potential impact on groundwater as a supply resource has been assessed. The assessment presented in this section considers the potential consequences of the above potential impacts to the underlying groundwater quality (assessed as a receptor of negligible sensitivity). The assessment also considers adjacent surface water features (which are classified as high sensitivity receptors) that may receive groundwater. The potential consequence of effect is assessed to be Mild with a probability of it occurring low. The overall pre-mitigation risk is therefore assessed to be **low**.

6.2 Longer Term, Operational and Permanent Impacts

Geological Setting

6.2.1 There are not expected to be any longer term, operational or permanent impacts on geology resulting from the operation of the proposed converter station or proposed permanent access road.

Hydrogeological Setting

6.2.2 Within the proposed converter station site, surface water drainage infrastructure will be designed to incorporate Sustainable Drainage System (SuDS) components. Drainage will be attenuated in an attenuation pond approximately 10,600m^2 in area and located in the south west corner of the proposed converter station site. Concrete or stone gabion structures will be used at outfalls, where required, to prevent erosion of the drain banks. The potential for surface water to therefore infiltrate into the ground will be reduced once the proposed converter station site is operational.

6.2.3 Along the proposed AC cable route and permanent access road, post construction drainage will be installed to ensure that any new drainage installed along the proposed AC cable easement or proposed permanent access road is incorporated into the existing drainage system and the long-term integrity of the wider land drainage system is maintained.

6.2.4 In view of the proposed drainage solutions, no potential operational effects on hydrogeological conditions associated within the proposed converter station site, proposed AC cable route or proposed permanent access have been identified.

Soil and Groundwater Contamination

6.2.5 During the operation of the proposed converter station site minor quantities of fuels and other chemicals would be stored and used in the proposed converter station zone. Requirements for fuel/chemical storage will typically comprise oil for the transformers, possibly a small amount of sulphur hexafluoride gas for the 400 kV switchgear circuit breaker, ethylene glycol, silicon oils for insulation, diesel for the back-up generator and fire-fighting fluids.

6.2.6 In the event of an uncontrolled release of such materials, either from storage areas or during handling within the proposed converter station zone, contamination of the ground may occur. The magnitude of impact will depend on the type of material released, as well as the quantity and timing of the release and the sensitivity of the receiving environment. The nearest receptors will be direct employees involved with dealing with the uncontrolled release, groundwater contained within the underlying aquifer and the Mill Drain. The greatest potential effects would arise from large-scale, uncontained releases of materials, which have a high environmental toxicity and which are resistant to degradation (such as diesel oil).

Future Employees and Site Maintenance Workers

6.2.7 During normal operation there would be approximately six personnel on the proposed converter station site daily and during routine maintenance operations there would be more personnel on site. Ground cover within the proposed converter station zone will comprise predominantly hardstanding or gravel surfacing. In the event of an uncontrolled release, the potential exists for personnel in the proposed converter station zone to be exposed to potentially hazardous materials through dermal contact, ingestion and/or inhalation pathways.

6.2.8 The probability of an uncontrolled release occurring which would result in significant harm to human health is considered to be low since it is expected that bulk fuel and other chemicals will be stored in accordance with the relevant EA Pollution Prevention Guidance (withdrawn but widely considered good practice) notes and relevant storage regulations. It is also considered that the site will operate to an accredited environmental management standard where potential leaks and/or spills are minimised, but if they do occur are identified and remediated promptly by personnel present on site.

6.2.9 Boreholes BH01 and BH03 installed during the preliminary ground investigation at the proposed converter station site contained between 0.1 m and 1.6 m of organic-rich clay within the Barroway Drove Beds (Ref: 18-26). This material has been identified as a potential limited source of ground gas. The Preliminary Ground Investigation Report (Ref: 18-27) included a ground-gas risk assessment which identified an overall low risk driven by elevated carbon dioxide concentrations. The assessment concluded that based on the ground gas data obtained during the preliminary ground investigation, basic ground-gas protection measures would be required in new buildings. This is subject to further ground gas monitoring and detailed design to confirm the level of mitigation required. For carbon dioxide there is no risk of flammability, however, there is a risk of asphyxiation to site operatives, particularly if working in confined spaces. In the absence of mitigation the probability of a pollutant linkage is assessed as **low**.

6.2.10 The proposed converter station end users (employees and site maintenance workers) are considered to be of high sensitivity. The probability of exposure to hazardous materials and ground gas is defined as low and the consequence of these effects is assessed as mild. As such, the overall pre-mitigation risk is considered to be **low**.

6.2.11 Future users of the proposed permanent access road would be transient in nature and therefore unlikely to interact with the underlying ground conditions or hydrogeology in any way.

Groundwater and Surface Water

6.2.12 Within the proposed converter station zone, operations will be contained with no uncontrolled discharges to land, surface water or groundwater. Chemical substances and hazardous materials will be stored in accordance with EA guidance and applicable storage regulations and it is assumed that accredited operational and environmental management standards will be employed for activities undertaken during the operational stage. On this basis the probability of the

proposed development converter station impacting on groundwater or surface water that interacts with groundwater is defined as low for routine operations.

6.2.13 The consequence of a pollution incident to the Unproductive and Secondary Undifferentiated strata (classified as a negligible sensitivity receptor) is considered to be minor. As such, the overall pre-mitigation risk from a pollution event occurring during routine operations is considered to be **very low**.

6.2.14 The Mill Drain is considered to be a receptor of medium sensitivity and therefore the consequence of a potential pollution incident is assessed as mild. Therefore, the resulting pre-mitigation level of risk to surface water quality is considered to be **low**.

6.2.15 The foundations associated with the proposed converter station may provide a preferential pathway for contaminants to migrate to non-contaminated soils and subsequently into groundwater throughout the operational period. However, the results of the 2016 preliminary ground investigation did not identify elevated concentrations of organic or inorganic chemical parameters in soil and no Made Ground was encountered, therefore the probability of an ongoing pollution pathway being created is considered to be unlikely. In addition, any contamination encountered during construction would be expected to be removed, treated and/or mitigated as part of the construction process. Taking into consideration the negligible sensitivity of the aquifer (Unproductive and Secondary Undifferentiated), the resultant risk is assessed to be **very low**.

Proposed Buildings and Below Ground Infrastructure

6.2.16 Certain organic contaminants in soil or groundwater (hydrocarbons and solvents) can permeate through or corrode pipe work and possibly contaminate water supplies. Plastic water supply pipes can be at risk of attack from oils and phenols. Additionally, concrete infrastructure can be subject to attack from acids and high sulphate concentrations in soils.

6.2.17 Total petroleum hydrocarbons were detected within the soil and groundwater samples tested during the 2016 ground investigation, however there was no evidence of visual or olfactory contamination and the concentrations were only marginally above (same order of magnitude) the detection limit of the method. Concentrations of total phenol and volatile/semi-volatile organic compounds (tested in soil samples only) were recorded below the detection limit of the method. The probability of potable water pipes being impacted by potential organic contaminants is therefore considered to be unlikely.

6.2.18 In terms of potential degradation of buried concrete from the ground conditions, risks to the proposed development will be adequately mitigated through the adoption of an appropriate design of concrete class that will be specified in accordance with the Building Research Establishment (BRE) Special Digest 1 (Ref: 18-47) and based on ground investigation. It is therefore considered that the probability of degradation of concrete infrastructure is unlikely.

6.2.19 The proposed buildings and below ground services are considered to be receptors of low sensitivity and the consequence of effects are considered minor. As such, the overall pre-level of risk to proposed buildings and below ground infrastructure is considered to be v**ery low**.

6.3 Decommissioning Impacts

6.3.1 Decommissioning impacts are assumed to be similar and no worse than as the temporary impacts defined in Section 6.1.

7 Mitigation

7.1 Design Mitigation

Proposed Converter Station

7.1.1 When the proposed converter station is complete and operational, the single phase power transformers will be located within bunding to contain potential oil leaks. Within the drainage system the use of oil-water interceptors will be incorporated to separate out free product in the unlikely event that such products are released. Where ethylene glycol is used as a coolant in cooling fans, control measures will also include pipe collars or double integrity pipework.

7.1.2 Requirements for fuel/chemical storage will typically comprise oil for the transformers, a small amount of sulphur hexafluoride gas for the 400 kV switchgear circuit breaker, ethylene glycol, silicon oils for insulation, diesel for the back-up generator and fire-fighting fluids. Chemical substances and hazardous materials will be stored in accordance with EA Pollution Prevention Guidance (withdrawn but widely considered good practice) (Ref: 18-48) and applicable storage regulations and it is assumed that accredited operational and environmental management standards will be employed for these activities.

7.1.3 Further ground investigation will be undertaken as part of design development. The outcomes of these further studies will inform the final adopted foundation solutions, the cut/fill extents, dewatering strategies, the extent to which excavation support is required and also the extent to which ground gas mitigation is required.

7.1.4 Materials used in buildings and infrastructure would be specified accordingly, taking due account of the ground conditions such as elevated sulphate or ground gases. The assessment methodology set out in BRE Special Digest 1 (2005) (Ref: 18-47) will be adopted to determine the appropriate concrete classification. The ground investigations completed at the proposed converter station zone to date have indicated for concrete specified at depth (e.g. piles), and for preliminary design purposes, a design classification of DS-3 and ACEC (Aggressive Chemical Environment for Concrete) class of AC-3. In terms of shallower material, due to anticipated ground disturbance (e.g. either associated with pile caps/beams or shallow foundations where ground improvement has taken place), a DS-5/AC-5 classification is identified. This initial assessment was considered to be a conservative level of assessment with a view to further refinement taking place during the detailed design.

7.1.5 The ground investigations completed to date along the proposed permanent access road have indicated that for concrete specified at depth (e.g. piles for the bridge foundations), and for preliminary design purposes, a design classification of DS-2 and ACEC class of AC-2 would be required. In terms of shallower materials, and due to anticipated ground disturbance (e.g. either associated with pile caps/beams or shallow foundations where ground improvement has taken

place), a DS-4/AC-4 was assessed for any permanent shallow structures. As with the proposed converter site this initial assessment is considered to be a conservative level of assessment with a view to further refinement taking place during the detailed design.

7.1.6 Available ground gas results for the proposed converter station site have been assessed in accordance with BS 8485 (2015) (Ref: 18-42) and CIRIA guidance document C665 (2007) (Ref: 18-43). The outcome of this initial assessment suggests that some low level ground gas mitigation may be required, e.g. gas impermeable membrane, as part of construction. This is to be subject to further design refinement based on more site specific data obtained during future ground investigation studies.

7.1.7 No potentially significant impacts during construction or operation have been identified, which is a reflection on the limited sensitivity of the geological and hydrogeological setting and the low potential for existing soil and/or groundwater contamination to impact upon the development of the proposed converter station site and proposed permanent access road. Notwithstanding the limited sensitivity identified, the potential for construction activities to have some measureable impact upon the geological and hydrogeological setting is possible, in the absence of appropriate levels of control. Furthermore there is the potential for unexpected soil and/or groundwater to be encountered, recognising the inherent limitations of ground investigation compared to the extent of excavation works undertaken during construction. Mitigating controls that will be adopted during construction that influence how construction interacts with the geological and hydrogeological environment are set out in Section 7.2.

Proposed AC Cable Route

7.1.8 Further ground investigation will be undertaken during design development. This information will inform how the proposed AC cable route will be constructed and the extent to which excavation support is required and the depth the proposed AC cables will be placed, taking due account of any minimum vertical clearances specified by stakeholders, for example, the IDB and the presence of land drains. It is assumed that where excavation support is deemed to be necessary, as defined by prior ground investigation, this will be adopted during construction.

7.1.9 No potentially significant impacts during construction or operation have been identified, which is a reflection on the limited sensitivity of the geological and hydrogeological setting and the low potential for existing soil and/or groundwater contamination to impact upon the development of the proposed AC cable route. Notwithstanding the limited sensitivity identified, the potential for construction activities to have some measureable impact upon the geological and hydrogeological setting is possible, in the absence of appropriate levels of control. Furthermore there is the potential for unexpected soil and/or groundwater to be encountered, recognising the inherent limitations of ground investigation compared to the extent of excavation works undertaken during construction. Mitigating controls that will be adopted during construction that influence how construction interacts with the geological and hydrogeological environment are set out in Section 7.2.

7.2 Construction Mitigation

Legislation and Regulations

7.2.1 A significant amount of legislation bears relevance to construction work and its actual and potential interactions with ground conditions. A Construction Environmental Management Plan (CEMP) will be developed that will contain measures to ensure compliance with relevant standards and legislation. The CEMP will set out the environmental mitigation requirements and also the project level expectations on how the proposed converter station site, proposed AC cable route and the proposed permanent access road will be constructed.

Excavated Materials Management

7.2.2 Prior to construction, a strategy will be prepared, which will set out how the earthworks stage of the construction phase will be undertaken. Where necessary the strategy will consider what excavated materials can be reused, or are required within the development, and what materials are surplus and require either disposal or onward management to ensure appropriate re-use. The strategy will also define whether any geotechnical improvement may be required, prior to re-use or disposal.

7.2.3 To minimise the effects on soil resources during any earthworks, including materials management following foundation construction, high standards of soil handling and management will be employed with a view to minimising where possible the double handling of soils and the extent to which exposed soils will be left vulnerable to erosional processes. An outline soil handling and storage protocol will be prepared further details of which are provided in *ES-2-C.04, Volume 2, Chapter 20: Agriculture and Soils.*

7.2.4 The re-use of excavated materials during construction will be governed by either a Materials Management Plan developed in accordance with the CL:AIRE Code of Practice (Ref. 18-49), an environmental permit or a relevant exemption. The CL:AIRE Code of Practice is a voluntary framework for excavated materials management and re-use. Following this framework results in a level of information being generated that is sufficient to demonstrate to any regulator that excavated material has been re-used appropriately and is suitable for its intended use. It demonstrates that unsuitable material or waste has not been used in the development. The Materials Management Plan details the procedures and measures that will be taken to classify, track, store, reuse and dispose of all excavated materials that will be encountered during the development works.

7.2.5 The disposal of soil waste, contaminated or otherwise to landfill sites would be best mitigated by minimisation of the overall quantities of waste generated during construction and by ensuring that excavated material consigned to landfill cannot, as an alternative, be put to use either on site or on other sites.

7.2.6 Where there is a requirement to dispose of surplus excavated materials off site as waste, the material will be characterised to determine firstly whether it is Hazardous or Non-Hazardous waste in accordance with the EA's Technical Guidance WM3 (Ref: 18-50) and then once this is

established the appropriate disposal facility will be determined through Waste Acceptance Criteria (WAC) analysis, as required.

Groundwater and Dewatering

7.2.7 During the completed ground investigations, groundwater strikes and seepages were predominantly encountered within the Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits); generally below 2 m bgl in the boreholes and predominately between 1.1 m bgl and 1.5 m bgl in the proposed permanent access road trial pits.

7.2.8 Standing groundwater levels recorded during the three groundwater monitoring visits in October 2016 typically varied from approximately 0.5 to 2.5 m bgl across the proposed converter station site. Due to shallow groundwater it is expected that groundwater controls will need to be adopted during construction. The water quality testing undertaken as part of the 2016 ground investigation suggests that pre-treatment due to chemical contamination of the groundwater is unlikely to be required prior to disposal.

7.2.9 If groundwater is not adequately controlled then excavations may flood or become unstable, and the efficiency of construction operations will be impacted. Where the volume of groundwater requiring dewatering exceeds twenty cubic metres a day then an abstraction permit will be obtained from the EA. Consents will also be obtained where discharging to watercourses including IDB managed water courses or public sewer.

7.2.10 The adopted dewatering techniques will be appropriate to the type of excavation and hydrogeological conditions. The hydraulic conductivity of the ground within each excavation or trench section will be considered to establish the required abstraction volume to achieve the necessary drawdown of groundwater levels. The type of dewatering undertaken may include the use of cut off walls, sump dewatering and potentially well point dewatering with some provision for attenuation capacity to allow for water treatment and/or settlement prior to final discharge.

7.2.11 Based on EA guidance and given the Unproductive and Secondary A status of the aquifer, and absence of groundwater abstractions in the Zone of Influence, there is not expected to be a formal requirement to monitor the wider effects of dewatering (Ref: 18-51). The inclusion of attenuating capacity for dewatering will ensure that discharge rates are controlled and this will effectively mitigate against the capacity of the receiving surface water environment being exceeded.

Land Drains

7.2.12 Pre-construction surveys to identify land drains will be carried out to inform the detailed design, which would seek to avoid or re-instate any land drains affected. Temporary drainage will be installed to maintain the integrity of the existing land drainage systems and to manage drainage and ground conditions during construction.

Soil and Groundwater Pollution Control Mitigation

7.2.13 Measures contained within the CEMP would be designed to limit the potential for dispersal and accidental releases of potential contaminants, soil derived dusts and uncontrolled run-off to occur during construction. For example the CEMP will set out how material is to excavated and stockpiled to minimise the potential for run-off, soil degradation or wind dispersal of dusts. The use of biodegradable netting and the binding of the surface through temporary grass seeding will be specified together with dampening procedures during dry weather. Sheeting may be used if any material is identified to be hazardous with a view to limited water ingress and potential leachate generation. Soil storage and handling areas will be defined prior to construction commencing. In the event of uncontrolled releases occurring, the CEMP and the Contractor's own method statements contained in their Construction Phase Plan (CPP) would also set out the measures required to ensure that the extent and impact of any such releases are contained and ultimately remediated.

7.2.14 A Pollution Response Plan will be in place prior to the commencement of construction works. The plan will outline key pollution mitigation measures to be adopted including a Control of Substances Hazardous to Health (COSHH)/fuel inventory and key contacts to be notified in the event of a significant pollution incident, which may subsequently lead to the contamination of controlled waters or soils. All bulk fuel and COSHH items will be stored in accordance with the relevant EA Pollution Prevention Guidance notes and storage regulations. Tanks and dispensing pumps will be locked when not in use to prevent unauthorised access.

7.2.15 Any hazardous materials will be stored in designated locations with specific measures to prevent leakage and the release of their contents. This will include a requirement to position storage areas at least 50 m away from surface water features/drains, on an impermeable base with an impermeable bund that has no outflow and is of adequate capacity to contain at least 110 % of the contents. Valves and trigger guns will be protected from vandalism and kept locked when not in use.

7.2.16 Only well maintained plant will be used during construction to minimise the potential for accidental pollution from leaking machinery or damaged equipment. Static machinery and plant are expected to be stored in hard standing areas when not in use and, where necessary, to make use of drip trays beneath oil tanks/engines/gearboxes/hydraulics. Spill response kits containing equipment that is appropriate to the types and quantities of materials being used and stored during construction will be maintained on site for the duration of the works.

7.2.17 The CEMP will establish procedures for dealing with unexpected soil or groundwater contamination that may be encountered. This would typically require affected works to stop to enable appropriate people to be notified, and further characterisation and risk assessment to be undertaken, before remediation or mitigation proposals are agreed with all required stakeholders.

7.2.18 Potential impacts specific to construction workers during site preparation and construction would be mitigated by the following measures and through working in accordance with CIRIA C692 3rd Edition 'Environmental Good Practice On Site' (2010) (Ref: 18-52).

- measures to minimise dust generation;
- provision of PPE, such as gloves, barrier cream, overalls etc. to minimise direct contact with soils;
- provision of adequate hygiene facilities and clean welfare facilities for all construction site workers;
- monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces, i.e. to suitably trained personnel only, and use of specialist PPE, where necessary; and
- preparation and adoption of a site and task specific health and safety plan.

8 Residual Effects

8.1 Temporary Construction Effects

8.1.1 Following the implementation of mitigation measures, it is anticipated that all construction effects will be reduced so that residual effects are **negligible** for geological and hydrogeological receptors and **very low** and **low** for receptors affected by soil and/or groundwater contamination. As a result no significant effects are expected to occur.

8.2 Longer Term, Operational and Permanent Effects

8.2.1 Following the implementation of mitigation measures, it is anticipated that all effects associated with the complete and operational proposed converter station site, proposed AC cable route and proposed permanent access will be reduced so that residual effects are **negligible** for geological and hydrogeological receptors and **very low** for receptors affected by soil and/or groundwater contamination.

8.3 Decommissioning Effects

8.3.1 Decommissioning effects are assumed to be the similar and no worse than the temporary effects defined in Section 8.1.

9 Cumulative Effects

9.1 Inter-project Effects

9.1.1 No development sites have been identified within the Zone of Influence of the proposed converter station site, the proposed AC cable route or the proposed permanent access road which could have the potential to result in cumulative effects on Geology & Hydrogeology. Further details on cumulative effects and in-combination effects are provided in *ES-2-C11, Volume 2, Chapter 28: Cumulative Effects*.

9.2 Intra-project Effects

9.2.1 Intra-project effects occurring as a result of the proposed underground DC cable route construction (Route Section 4) in combination with the proposed converter station have also been considered. The potential common shared receptors identified in this chapter and in *ES-2-B0.3, Volume 2, Chapter 07: Geology &Hydrogeology (Proposed Underground DC Cable)* are ground stability, construction workers, neighbouring site users, groundwater and surface water features.

9.2.2 Potential impacts that could occur during the construction phase of the proposed underground DC cable route in the vicinity of the proposed converter station have been identified as; changes to settlement of land as a result of trench excavations and dewatering, potential for exposure of construction workers to hazardous materials, exposure of site neighbours to construction generated dust and reduction to groundwater and surface water quality due to uncontrolled releases of pollutants (i.e. from the temporary construction compound or from drilling fluids).

9.2.3 However, following the implementation of mitigation measures during the construction phase of proposed underground DC cable route the residual effects have been assessed in *ES-2-B0.3, Volume 2, Chapter 07: Geology &Hydrogeology (Proposed Underground DC Cable)* as **negligible** for geological and hydrogeological receptors and **very low** and **low** for receptors affected by soil and/or groundwater contamination. In addition, potential impacts will be moderated by the phasing of construction; major earthworks for the proposed converter station are likely to occur well in advance of the proposed underground DC cable route. Once the proposed underground DC cable route has been completed, no longer term, operation and permanent impacts have been identified. Therefore, it is considered that the residual intra-project effects on Geology and Hydrogeology will be of **negligible** significance.

10 Summary of Assessment

10.1 Summary

Overview of Baseline Conditions

10.1.1 The superficial geology comprises the Barroway Drove Beds (Marine Deposits/Tidal Flat Deposits), overlying Till (Boulder Clay). The solid geology is indicated to be the Oxford Clay Formation.

10.1.2 The EA aquifer mapping shows both the superficial geology beneath the Zone of Influence to be designated as Unproductive Strata (Barroway Drove Beds (Marine Deposits/Tidal Flats Deposits)) and Secondary Undifferentiated (Till (Boulder Clay)) (Ref: 18-30). The solid geology is designated as Unproductive Strata (Oxford Clay Formation).

10.1.3 There are no MSA, LGS or geologically designated SSSI within the Zone of Influence.

10.1.4 A preliminary ground investigation was carried out by AECOM at the proposed converter station site in September 2016 and along the proposed permanent access road in March 2017 to obtain geotechnical and geo-environmental information.

10.1.5 The soil chemical results from both ground investigations showed that concentrations of tested determinands were below the relevant human health screening criteria which indicated the soils sampled would not pose a significant risk to human health when considered within a residential context (conservatively assumed for screening purposes).

10.1.6 Groundwater samples recovered at the proposed converter station site in 2016 indicated that the metals (nickel, cadmium, copper, zinc and boron), ammonia/ammoniacal nitrogen, and to a lesser extent sulphur, were recorded greater that the adopted screening values.

10.1.7 The assessment of soil leachate samples from the proposed permanent access road and converter station site concluded that the soil baseline conditions were broadly consistent with natural background concentrations with only minor and localised exceptions along the proposed permanent access road where localised soil leachate values did not appear to be representative of wider conditions.

10.1.8 The risk assessment concluded that given the nature of the surrounding area, these concentrations were most likely to be reflective of background concentrations within the groundwater as a result of the natural geology, and the widespread agricultural activities undertaken in the area.

10.1.9 A programme of groundwater quality monitoring was being implemented at the time of writing and this will be reported under separate cover and will serve to establish pre-construction baseline conditions against which future construction and post construction monitoring can be compared against.

10.1.10 Based on the findings of the ground-gas risk assessment undertaken at the proposed converter station site, there is a potential low risk associated with potentially harmful ground gases within the future proposed buildings and structures. However, nominal gas protection measures are recommended to comply with a Characteristic Situation 2; although this will be subject to further assessment during detailed design.

10.1.11 The findings of a UXO desk study undertaken in June 2016 identified that there is no evidence of UXO potential within the Zone of Influence.

10.1.12 In overall terms the geological and hydrogeological setting is of limited sensitivity.

Overview of Residual Effects

10.1.13 Following the implementation of mitigation measures described, it is anticipated that construction residual effects will be reduced to negligible for geological and hydrogeological receptors and very low and low for receptors affected by soil and/or groundwater contamination. Therefore, no significant effects to geology and hydrogeology are expected throughout the construction works associated with the proposed converter station, the proposed permanent access road and the proposed AC cable route and the connection works within the existing Bicker Fen Substation, provided the mitigation outlined is adopted. Key elements of the mitigation for geology and hydrogeology concerns the effective and efficient management of excavated materials through the development of a materials management strategy, controls on how construction materials are handled and stored to prevent uncontrolled releases to ground and the design of earthworks, foundations, ground gas mitigation and the AC cable trench and trenchless installation locations.

10.1.14 The residual effects associated with the completed and operational proposed converter station, proposed permanent access and proposed AC cable route are anticipated to be negligible based on the site complying with storage regulations for hazardous materials and implementing operational and environmental procedures and controls to limit the potential for uncontrolled releases to occur to ground. Therefore, no significant effects to geology and hydrogeology are expected once the proposed converter station, proposed permanent access road and proposed AC cable route is completed.

Table 18.16 presents a summary of the residual effects of the proposed converter station on geology and hydrogeology.

Residual Effects in South Holland District Council

10.1.15 Following the implementation of mitigation measures, it is anticipated that all construction effects will be reduced so that residual effects are negligible for geological and hydrogeological receptors and very low and low for receptors affected by soil and/or groundwater contamination.

10.1.16 Following the implementation of mitigation measures, it is anticipated that all effects associated with the complete and operational proposed converter station site, proposed AC cable route and proposed permanent access will be reduced so that residual effects are negligible for geological

and hydrogeological receptors and very low for receptors affected by soil and/or groundwater contamination.

Residual Effects in Boston Borough Council

10.1.17 Following the implementation of mitigation measures, it is anticipated that all construction effects will be reduced so that residual effects are negligible for geological and hydrogeological receptors and very low and low for receptors affected by soil and/or groundwater contamination.

10.1.18 Following the implementation of mitigation measures, it is anticipated that all effects associated with the complete and operational proposed converter station site, proposed AC cable route including the connection works within the existing Bicker Fen Substation, and proposed permanent access will be reduced so that residual effects are negligible for geological and hydrogeological receptors and very low for receptors affected by soil and/or groundwater contamination.

Table 18.16 Summary of assessment: Geology and Hydrogeology				
Description of Receptor	**Value / Sensitivity**	**Description of Residual Effect**	**Significance**	**Significant**
Construction				
Geological Setting – ground instability (buildings and infrastructure)	Low	The residual effect is of negligible significance as construction activity e.g. excavations and dewatering resulting in ground instability is unlikely to take place adjacent to existing development, with exception to Bicker Fen Substation, where engineering controls are to be included in the design.	Negligible	No
Geological setting - geologically designated sites and mineral sites, safeguarding or consultation areas	Negligible	The residual effect is of negligible significance as there are no geologically designated sites or mineral sites, safeguarding or consultation areas.	Negligible	No
Hydrogeological setting – aquifer permeability	Negligible	The residual effect of any reduced permeability due to increased land form height, or through ground improvement, is assessed to be of negligible significance as the aquifer is not an overly sensitive receptor given its Unproductive status and the absence of any groundwater abstractions.	Negligible	No
Hydrogeological setting – groundwater abstractions	Negligible	The residual effect of dewatering activities and the drawdown of the groundwater table on groundwater abstraction is of negligible significance as there are no groundwater abstractions identified within the Zone of Influence.	Negligible	No

Table 18.16 Summary of assessment: Geology and Hydrogeology				
Description of Receptor	**Value / Sensitivity**	**Description of Residual Effect**	**Significance**	**Significant**
Hydrogeological setting – disruption to network of land drains	Moderate	Severance, or disruption, of the land drain network, local to the construction works could impact on land drainage resulting in reduced drainage potential. This will be mitigated through pre-construction survey, temporary drainage during construction and re-instatement or diversion of any affected land drains upon completion.	Negligible	No
Human health – contractors carrying out construction works	Very High	Construction workers have the potential to come into contact with fuels and other chemicals during construction activities but through the application of measures contained in the CEMP and the Principal Contractor's Construction Phase Plan, together with consideration of the measures in CIRIA C692 (Ref: 18-51), a low risk has been assessed.	Low Risk	No
Human health – Neighbouring residential properties within 250 m of construction works.	High	Surrounding residents and workers may be exposed to construction generated soil dust or run off if not controlled. Measures contained within the CEMP with regards to soils handling and storage would control the impact resulting in a low and very low risk to these receptors.	Low Risk	No
Human health – Neighbouring commercial human receptors within 250 m of construction works.	Low		Very Low Risk	No

Table 18.16 Summary of assessment: Geology and Hydrogeology				
Description of Receptor	**Value / Sensitivity**	**Description of Residual Effect**	**Significance**	**Significant**
Groundwater (Unproductive Strata)	Negligible	Reduction in groundwater quality from the uncontrolled release of pollutants, uncontrolled discharges of drilling fluids during trenchless installation of the AC cables, potential break out of fluids into surface watercourses, and potential accidental release of hazardous materials to groundwater during construction. The impact will be controlled through appropriate hazardous materials storage and handling, pollution response and environmental management; the principles of which will be set out in the CEMP.	Low Risk	No
Surface water features	High	Reduction in surface water quality due to impacted groundwater migration and/or surface water run-off resulting from uncontrolled release of pollutants. The impact will be controlled through appropriate hazardous materials storage and handling, pollution response and environmental management; the principles of which will be set out in the CEMP.	Low Risk	No
Completed and Operational				
Geological setting - geologically designated sites and mineral sites, safeguarding or consultation areas	Negligible	There are not expected to be any significant residual effects on geology once operational	Negligible	No
Hydrological setting – aquifer permeability and groundwater abstractions	Negligible	There are not expected to be any significant residual effects on the hydrogeological setting once operational	Negligible	No

Table 18.16 Summary of assessment: Geology and Hydrogeology				
Description of Receptor	**Value / Sensitivity**	**Description of Residual Effect**	**Significance**	**Significant**
Human health – Proposed converter station end users	High	Future site users / maintenance workers have the potential to come into contact with fuels and other chemicals or be exposed to ground-gas during operation of the proposed converter station but these will be controlled through operational and environmental management procedures, pollution incident response planning and design mitigation e.g. ground gas protection and materials storage.	Very Low	No
Groundwater (Unproductive Strata)	Negligible	There is the potential for a reduction in groundwater quality from the uncontrolled release of pollutants without controls. Once operational the potential impact would be controlled through operational and environmental management procedures, pollution incident response planning and design mitigation e.g. design of materials storage in accordance with storage regulations and EA guidance.	Negligible	No
Surface water features	Medium	Reduction in surface water quality due to impacted groundwater migration and/or surface water run-off resulting from uncontrolled release of pollutants. Once operational the potential impact would be controlled through operational and environmental management procedures, pollution incident response planning and design mitigation e.g. design of materials storage in accordance with storage regulations and EA guidance.	Negligible	No

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