



East Anglia ONE North Offshore Windfarm

Appendix 18.3

Land Quality Preliminary Risk Assessment (PRA)

Environmental Statement Volume 3

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Glossary of Acronyms

AONB	Area of Outstanding Natural Beauty
Bgm ⁻³	Becquerels per cubic metre
BGS	British Geological Survey
CDM	Construction Design and Management
CIRIA	Construction Industry Research and Information Association
CoCP	Outline Code of Construction Practice
CL:AIRE	Contaminated Land: Application in Real Environments
CSM	Conceptual Site Model
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
HDD	Horizontal Directional Drilling
MMP	Materials Management Plan
NVZ	Nitrate Vulnerable Zones
OCoCP	Outline Code of Construction Practice
OS	Ordnance Survey
PCOC	Potential Contaminant of Concern
PHE	Public Health England
PPE	Personal protective equipment
PRA	Preliminary Risk Assessment
RPE	Respiratory Protective Equipment
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest

Glossary of Terminology

Applicant	East Anglia ONE North Limited.
Cable sealing end compound	A compound which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
Cable sealing end (with circuit breaker) compound	A compound (which includes a circuit breaker) which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
Construction consolidation sites	Compounds which will contain laydown, storage and work areas for onshore construction works. The HDD construction compound will also be referred to as a construction consolidation site.
Development area	The area comprising the onshore development area and the offshore development area (described as the 'order limits' within the Development Consent Order).
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia ONE North windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive, as defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017 and regulation 18 of the Conservation of Offshore Marine Habitats and Species Regulations 2017. These include candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
HDD temporary working area	Temporary compounds which will contain laydown, storage and work areas for HDD drilling works.
Jointing Bay	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land and connect to the onshore cables.
Link boxes	Underground chambers within the onshore cable route housing electrical earthing links.
Mitigation areas	Areas captured within the onshore development area specifically for mitigating expected or anticipated impacts.

National electricity grid	The high voltage electricity transmission network in England and Wales owned and maintained by National Grid Electricity Transmission
National Grid infrastructure	A National Grid substation, cable sealing end compounds, cable sealing end (with circuit breaker) compound, underground cabling and National Grid overhead line realignment works to facilitate connection to the national electricity grid, all of which will be consented as part of the proposed East Anglia ONE North project Development Consent Order but will be National Grid owned assets.
National Grid overhead line realignment works	Works required to upgrade the existing electricity pylons and overhead lines (including cable sealing end compounds and cable sealing end (with circuit breaker) compound) to transport electricity from the National Grid substation to the national electricity grid.
National Grid overhead line realignment works area	The proposed area for National Grid overhead line realignment works.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia ONE North project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia ONE North project Development Consent Order.
National Grid substation location	The proposed location of the National Grid substation.
Natura 2000 site	A site forming part of the network of sites made up of Special Areas of Conservation and Special Protection Areas designated respectively under the Habitats Directive and Birds Directive.
Onshore cable corridor	The corridor within which the onshore cable route will be located
Onshore cable route	This is the construction swathe within the onshore cable corridor which would contain onshore cables as well as temporary ground required for construction which includes cable trenches, haul road and spoil storage areas.
Onshore cables	The cables which would bring electricity from landfall to the onshore substation. The onshore cable is comprised of up to six power cables (which may be laid directly within a trench, or laid in cable ducts or protective covers), up to two fibre optic cables and up to two distributed temperature sensing cables.
Onshore development area	The area in which the landfall, onshore cable corridor, onshore substation, landscaping and ecological mitigation areas, temporary construction facilities (such as access roads and construction consolidation sites), and the National Grid Infrastructure will be located.
Onshore infrastructure	The combined name for all of the onshore infrastructure associated with the proposed East Anglia ONE North project from landfall to the connection to the national electricity grid.
Onshore preparation works	Activities to be undertaken prior to formal commencement of onshore construction such as pre-planting of landscaping works, archaeological investigations, environmental and engineering surveys, diversion and laying of services, and highway alterations.

Onshore substation	The East Anglia ONE North substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia ONE North project.
Transition Bay	Underground structures at the landfall that house the joints between the offshore export cables and the onshore cables.

18.3 Land Quality Phase 1 Preliminary Risk Assessment

18.1 Introduction

18.1.1 Scope

1. This appendix to **Chapter 18 Ground Conditions and Contamination** is a Phase 1 Land Quality Preliminary Risk Assessment (PRA), created in support of the Environmental Impact assessment (EIA) for the onshore development area and infrastructure associated with the proposed East Anglia ONE North project.

18.1.2 Proposed East Anglia ONE North Project

2. The onshore elements of the proposed East Anglia ONE North project will consist of a landfall with a transmission bay. Onshore cables will be connected underground to an onshore substation which will in turn connect into the national electricity grid via new transmission infrastructure owned and operated by National Grid.

18.1.3 Key Objectives

3. The objectives of the PRA, in the context of the proposed East Anglia ONE North project, are to:
 - Identify (as far as reasonably possible) any potential sources of contamination within the study area (**section 18.1.5**) that may represent an unacceptable risk to the key receptors identified for the site; and
 - Identify any proposed actions to be taken to further investigate or mitigate the risk identified.

18.1.4 Methodology

4. The PRA has been completed in general accordance with the approach recommended in Contaminated Land Report 11 (Defra and Environment Agency, 2004).
5. The PRA is a desk-based study and forms the initial step in the assessment of potentially contaminated land. It proceeds, if required, to intrusive investigation, risk assessment, options appraisal, remedial design, implementation planning and completion reporting.
6. The main purpose of the PRA is to identify whether there are potentially unacceptable risks to human health or the environment posed by the onshore

development area and the immediate surroundings, which warrant further investigation.

7. The following desk-based information sources have been reviewed:
- Envirocheck Report comprising historical maps, environmental sensitivity data and Local Authority permitting records;
 - British Geological Survey (BGS) Onshore GeoIndex web portal¹; and
 - Environmental records from the Environment Agency on historical and permitted landfills.

18.1.5 Study Area

8. The study area for the PRA is based on the onshore development area, as shown in **Figure 18.1**. This comprised the following areas:
- Landfall;
 - Onshore Cable Corridor;
 - Onshore substation and National Grid infrastructure; and
 - A 1 km buffer was considered around the onshore development area.
9. These areas are shown within **Figure 18.1**.

18.1.6 Report Format

10. This report presents the finding of the PRA and comprises the following sections:
- **Section 18.2** Site Location and Land Use;
 - **Section 18.3** Environmental Setting;
 - **Section 18.4** Regulatory Information;
 - **Section 18.5** Preliminary Conceptual Site Model;
 - **Section 18.6** Conclusions; and
 - **Section 18.7** Recommendation and Next Steps.

18.2 Site Location and Land Use

18.2.1 Current Land Use

11. The onshore development area is located between the landfall north of Thorpeness and extends westwards to the small village of Friston. Villages, individual isolated properties and farms have been excluded from the onshore development area. However, the following settlements occur within 1 km of the

¹ <http://mapapps2.bgs.ac.uk/geoindex/home.html>

onshore development area: Leiston, Friston, Aldringham, Knodishall, Friston, Coldfair Green, Thorpeness and Sizewell.

12. A detailed description of the current land use can be found in **Chapter 21 Land Use**.

18.2.2 Historical Land Use

13. The site history was established from a review of historical maps dating from 1882 – 2018. This was done to establish and identify potential sources of contaminated land. The results of this review are presented in **Table A18.1**.
14. Note that historical Ordnance Survey (OS) mapping often contains omissions for national security purposes. The East of England has been heavily used for military installations (such as airfields) which are often missing from the historical maps.

Table A18.1 Key Historical Map Information

Historical map dates	Land use	Location
Landfall		
1882	Agricultural land present across the onshore development area	Majority of the landfall
1951 - 1957	Building demolished Thorpeness common	South-east corner of the landfall
1951 - 1957	Tramway	South-east corner of the landfall.
1927 - 1957	Ted's Barn	Eastern edge of the landfall.
1927 - 2018	Wind pump	Eastern edge of the landfall.
Onshore Cable Corridor		
1882	Agricultural land present across the site	Majority of onshore cable corridor.
1882	Roads	'A' roads have been present in the onshore cable corridor since 1882.
1882	Former sand and clay pits	Former sand and clay pits were present in the onshore cable corridor and adjacent to the area since 1882.
1882 - 1976	Railway	The former Aldeburgh branch railway crossed the onshore cable corridor.
1951-1957	Buildings demolished	Adjacent to the onshore cable corridor.
1882 - 1927	Brick Works	250 m from onshore cable corridor.

Historical map dates	Land use	Location
1958 -1976	Nuclear Power Station	Sizewell Power station constructed 500 m from north-eastern corner of the onshore cable corridor.
1958 -1976	Sewage works	Sewage works constructed at Sizewell Power station 500 m from north-eastern corner of the onshore cable corridor.
1971	Power lines towers	Adjacent to northern boundary of the onshore cable corridor.
Onshore Substation and National Grid Substation		
1882	Agricultural land present across the site	Majority of the substation location.
1882	Road	A road has been present in the substation location since 1882.
1882 - 1971	Sand pit	Western most corner of the substation location.
1882 - 1971	Sand pit	Adjacent to south-eastern boundary of the substation location/
1971	Power lines towers	Adjacent to northern boundary of the substation location.

18.3 Environmental Setting

18.3.1 Geological Conditions

18.3.1.1 Geology

15. Information on geological conditions at the site has been collated from the British Geological Survey (BGS) datasets including 1:50,000 scale geological mapping. The anticipated geological sequence, as shown on the BGS online viewer, is outlined in **Table A18.2** and **Table A18.3**. A map of the bedrock geology of the onshore development area has been produced (**Figure 18.2**) and a map of the superficial geology for the onshore development area has also been produced (**Figure 18.3**).

Table A18.2 Summary of Anticipated Superficial and Bedrock Geology

Stratum	Unit Name	Description
Superficial deposits	Alluvium	Clay, silt, sand and gravel.
	Till – Diamicton	Variable lithology, usually sandy, silty clay with pebbles, but can contain gravel-rich, or laminated sand layers; varied colour and consistency.
	Till – Lowestoft formation	Sands and gravels, Clay and silts, and sands.

Stratum	Unit Name	Description
Bedrock	Crag Group	Sands

Table A18.3 Summary of BGS Borehole Records

Borehole Number	Location	Date	Depth (m)	Description
Landfall				
BGS ID: 567573:BGS Reference: TM46SE38	Within 250 m (BNG: 646270, 260600)	N/A	0 to 12.5	Quaternary, Norwich Crag Formation, Chillesford Sand Member SAND, dark yellowish orange, moderately to well sorted, fine-to medium-grained, with sporadic thin greyish orange silty clay layers up to 20 mm thick. Bedding horizontal or gently inclined.
			12.5 to 37.8	Red Crag Formation SAND, shelly greyish orange to dark yellowish orange, olive grey from 26.2 m, poorly sorted, fine-to coarse-grained, shells finely commented, contains small iron rimmed silty clay pellets. Bedding dips up to 20° in sets up to 0.7 m thick, although more gently inclined in places. From 30.0 m, some more horizontally bedded thin clays, commonly with numerous fine sand laminae.
			37.8 to 44.6	Red Crag Formation CLAYS with fine sand laminae, interbedded with fine sands and medium shelly sands. Small scale loading structures occur within the laminated deposits.
			44.6 to 50.9	SANDS, shelly, olive grey, poorly sorted, fine-to coarse-grained; shells finely comminuted with rare sub-entire gastropods and mollusc valves. Includes clay lumps and phosphatic pebbles in basal 0.2 m. Bedding generally indistinct with gently inclined layers.
			50.9 to 51.1	Eocene London Clay Formation CLAY, silty.
BGS ID: 567602:BGS Reference: TM46SE67	Centre of landfall area (BNG: 647470, 260530)	1921	0 to 13.7	Groundwater level: 10.13 m bgl. Groundwater utilised in the summer months May to September only.
BGS ID: 567603 : BGS	Within 100 m of landfall area	1935	0 to 12.2	Groundwater level: 9.75 m bgl.

Borehole Number	Location	Date	Depth (m)	Description
Reference: TM46SE68				
Onshore Cable Corridor				
BGS ID: 567606 : BGS Reference: TM46SE71	Within 100 m of onshore cable corridor area (BNG: 646890, 261180)	1972	0 to 44 m	Borehole has a steel casing with a P.V.C installed. Borehole only within the Crag formation and no chalk identified within the depth range.
BGS ID: 567574 : BGS Reference: TM46SE39	Within 100 m of onshore cable corridor area (BNG: 647050, 261280)	N/A	0 to 4.5	Quaternary Pebbly sand
			4.5 to 12	Norwich Crag Formation Chillesford Sand Member SAND, dark yellowish orange to greyish orange, moderately sorted dominantly fine-grained. Cross-stratified in sets up to 0.3 m thick with forest dips up to 30°
			12 to 48.6	SAND, shelly, decalcified in the upper 2 m, poorly sorted, fine-to coarse-grained, Shells dominantly finely comminuted. Generally cross-stratified, with sets rarely exceeding 0.2 m thick, forest dip up to 30° but generally less than 10°.
			48.6 to 51.8	CLAYs with fine sand and silt laminae interbedded with fine- and medium-grained sands and shelly sands up to 0.1 m thick. Load structures are common, the bedding is generally horizontal.
BGS ID: 567572 : BGS Reference: TM46SE37	Within centre of onshore cable corridor area	N/A	0 to 1.7	Quaternary Gravel, sandy
			1.7 to 22.6	Norwich Crag Formation Chillesford Sand Member SAND, dark yellowish orange, variably silty, well sorted medium-to fine-grained, shelly from 3.2 to 3.4 m. Contained sporadic silty clay intraclasts and layers. Bedding mainly gently inclined.
			22.6 to 42.2	Red Crag Formation SAND, shelly, dark yellowish orange, becoming olive grey from about 31.0 m, poorly sorted, fine-to coarse-grained. Shells finely comminuted. Contains several silty clays up to

Borehole Number	Location	Date	Depth (m)	Description
				0.2 m thick between 22.8 and 26.2 m, some of which contain fine sand laminae 1-2 mm thick. Bedding, gently inclined. Also cross-strata dipping at 15 - 20°.
			42.2 to 42.8	Red Crag Formation SAND, shelly, very silty, olive grey. Complete mollusc valves, Horizontal bedding
			42.8 to 49.2	Red Crag Formation CLAYS, with fine sand laminae, interbedded with fine-to medium-grained sands and shelly sands up to 0.2 m thick; small-scale loading structures. Bedding horizontal.
			49.2 to 56.9	Red Crag Formation SAND, shelly, olive grey, poorly sorted, shell mainly finely comminuted. Much of the deposit is strongly cemented from 53.4 m. Rare thin silty clays. Gently inclined cross-stratification.
			56.9 to 58.2	Eocene London Clay Formation CLAY, olive grey with thin (20 mm) silty layers from 57.8 m.
BGS ID: 567605:BGS Reference: TM46SE70	Within 100 m of onshore cable corridor area (BNG: 647500, 262300)	N/A		Groundwater level: 10.67 m bgl.
BGS ID: 567532 : BGS Reference: TM46SW36	Within 250 m of onshore cable corridor area (BNG: 644900, 261220)	1972	51 m	Borehole has a steel casing with a P.V.C installed.
BGS ID: 567535 : BGS Reference: TM46SW39	Within 250 m of onshore cable corridor area (BNG 644230,260750)	1982	0 to 10 m	Groundwater pumping rate 12 l/s (3 days) then 9 l/sec.
Onshore Substation and National Grid Substation				
BGS ID: 1135367 : BGS Reference: TM46SW40	With 100 m of substation(s) area (BNG: 641500, 260500)	1980	N/A	Craig Aquifer unconfined. Average pumping rate 8.5 l/s (48 hour test).
BGS ID: 567527 :	With 100 m of substation(s)	N/A		Groundwater level: 6.4 m bgl.

Borehole Number	Location	Date	Depth (m)	Description
BGS Reference: TM46SW31	area (BNG 641250,260650)			

18.3.1.2 Mining and Mineral Extractions

16. The onshore development area is not located within an area that might be affected by coal mining activity.
17. There are no BGS recorded mineral sites within the onshore substation location.
18. **Table A18.4** lists the BGS mineral sites identified within the onshore development area and within a 250m buffer of these areas. The minerals sites identified were a mixture of sand, gravel and clay pits, all within the Crag formation, extracted by opencast methods and have now ceased operating.

Table A18.4 BGS Recorded Mineral Sites

Name	Status	Location
Thorpe Sand Pit	Opencast – ceased operation	Landfall
Sizewell Farm Sand Pit	Opencast – ceased operation	Onshore cable corridor
Pebble Cottage Pit	Opencast – ceased operation	Onshore cable corridor
Sizewell Cottage Sand Pit	Opencast – ceased operation	Onshore cable corridor
Manor Farm Clay Pit	Opencast – ceased operation	Onshore cable corridor
Bull's Hall Clay Pit	Opencast – ceased operation	Onshore cable corridor
Billeaford Hall Sand Pit	Opencast – ceased operation	Onshore cable corridor- within 250 m
Fitche's Lane Pit	Opencast – ceased operation	Onshore cable corridor
Leiston Brick Works	Opencast – ceased operation	Onshore cable corridor- within 250 m
Crown Cottages Pit	Opencast – ceased operation	Onshore cable corridor- within 250 m
Knodishall Hall Sand Pit	Opencast – ceased operation	Onshore cable corridor- within 250 m
Nuttery Lane Pit	Opencast – ceased operation	Onshore cable corridor- within 250 m
Aldringham Pit	Opencast – ceased operation	Onshore cable corridor- within 250 m
Friston House Clay Pit	Opencast – ceased operation	Substation – within 250 m

18.3.1.3 Radon Gas

19. The presence of radon gas is assessed in the UK according to the number of homes likely to be above the Action Level (200 becquerels per cubic metre (Bq m⁻³)). Under the building regulations the requirement for protection measures (described in Building Research Establishment, 2015) in the construction of new buildings, conversions or extensions is dependent on Radon Potential.
20. The Radon Potential dataset is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland, created jointly by Public Health England (PHE) and the BGS using long-term radon measurements made in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland (without affecting householders' confidentiality), combined with geological map data.
21. PHE recommends that radon levels should be reduced in homes where the annual average is at or above 200Bq m³. This is termed the Radon Action Level.
22. BGS data indicate that the onshore development area is located within a lower probability radon area (less than 1% of homes above the Action Level) therefore no protective measures are required.

18.3.2 Groundwater

18.3.2.1 Hydrogeology

23. Hydrogeological information has been collated from the Envirocheck data. Superficial and bedrock strata are classified by the Environment Agency according to their resource value and vulnerability as shown in **Table A18.5** and shown on **Figure 18.2**.
24. The Environment Agency's groundwater vulnerability data indicates parts of all aspects (landfall location, cable corridor and substations) of the onshore development area are designated as having a high groundwater vulnerability (overlying a permeable aquifer). This indicates soils which may be able to transmit a wide range of pollutants into any groundwater stored in strata beneath them. This designation is based on limited information and so a worst-case groundwater vulnerability classification is assigned. The superficial deposits are classified as predominately Secondary Undifferentiated Aquifer, with areas classified as Secondary A, Secondary B, and as unproductive strata. Where present low permeability strata are likely to minimise the flow of contamination and therefore provide a degree of protection to underlying water resources. However, the extent of low permeability strata is limited and as such will only provide protection to a small area of the proposed construction activity.

Table A18.5 Environment Agency Groundwater Classifications

Criteria	Strata	Classification	Description
Aquifer Classification	Superficial Deposits	Secondary Aquifer - Undifferentiated	Principal aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage.
		Secondary Aquifer - A	Secondary A aquifers contain permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
		Secondary Aquifer - B	Secondary B aquifers may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
		Unproductive Strata	Secondary B aquifers may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
	Bedrock	Principle	Secondary Undifferentiated aquifers have not been categorised as A or B due to their variable characteristics

25. BGS flood risk information indicates that the onshore substation, National Grid infrastructure and landfall location are located within areas of limited potential for groundwater flooding at the surface and basements. Most of the onshore cable corridor is also located within areas of limited potential for groundwater flooding. However, there are some areas with potential for groundwater flooding at the surface and basements within the onshore development area.

18.3.2.2 Groundwater Abstractions

26. There are three groundwater abstractions identified within the study area. The former Suffolk Coastal District Council was contacted in June 2018 and an official environmental information request was made. From this search, a total of 20 groundwater and surface water private water supplies were identified within the onshore development area and a 1km buffer. Further requests for private water supply information were made to East Suffolk Council and the Environment Agency in 2019 and a total of 20 private abstractions were identified in the onshore study area. Only three abstractions were identified within 250 m of the onshore development area.

18.3.2.2.1 Groundwater Source Protection Zones

27. There are two Groundwater Source Protection Zones (SPZs) identified within the onshore development area. These are the Leiston (AN307) and Coldfair Green (ANO34) public water supply abstractions.
28. SPZs are defined around public water supply abstraction boreholes used for potable water supply, to delineate the area where release of a contaminant into the aquifer could impact on the abstraction. There are three types of SPZ:

- The Inner Zone (Zone 1) is the most sensitive and some activities with the potential to pollute groundwater are restricted in this area;
- The Outer Zone (Zone 2) is less sensitive, and there are fewer restrictions; and
- Outside Zone 2 is the Total Catchment (Zone 3), which indicates the recharge area that contributes to that water supply.

29. The Environment Agency has published SPZs for public water supplies and other significant sources. For potable abstractions without published SPZs there is a default Inner Zone of 50m radius, and an Outer Zone of 250m or 500m radius (depending on the size of the abstraction).

18.3.3 Surface Water

18.3.3.1 Hydrology and Drainage

30. Surface water catchment data was obtained from the EnviroCheck Report. The onshore development area and a 1km buffer zone are located within the Suffolk Coastal Catchment area. The surface water bodies identified include: the coastal fridge, Hundred River, Leiston Beck, Friston watercourse with several smaller, unnamed rivers discharging out into the Suffolk Coast.

18.3.3.2 Surface Water Abstractions

31. There are no licensed surface water abstractions within the onshore development area.

18.3.4 Sensitive Land Uses

32. Environmentally sensitive receptors have been mapped within the onshore development area, as shown in **Figure 18.5**. The following environmentally sensitive areas are located within the onshore development area:

- Ancient woodland;
- Special Sites of Scientific Interest (SSSI);
- Nitrate Vulnerable Zones (NVZs);
- Environmentally sensitive areas; and
- An Area of Outstanding Natural Beauty (AONB)

33. Environment Agency data for drinking water safeguard zones was reviewed along with the Envirocheck Report. This identified two NVZs. The S661 Leiston Beck NVZ was identified as occurring within the onshore cable corridor in the north-east corner and is within 1 km of landfall location. This zone occurs >1 km from the onshore substation and National Grid infrastructure. The S412 Formus

NVZ does not occur within the Refined Areas of Search however, is located within 500 m west of the onshore substation and National Grid infrastructure and is within 1 km of the cable corridor.

34. The Leiston – Aldeburgh SSSI is adjacent to the onshore cable corridor and is within 1 km of the onshore substation and National Grid infrastructure.

18.4 Regulatory Information

35. Records held by regulatory bodies with regard to discharge consents, pollution incidents to controlled waters, substantiated pollution incidents, permitted and historical landfills, waste management sites, Local Authority Pollution Prevention and Control authorisations, Hazardous substances consents and handling notifications, Prosecutions relating to Authorised Processes, Prosecutions Incidents to Controlled Waters, Licensed radioactive substances, Fuel sites and Contemporary Trade Directory records (active and former) were reviewed and relevant entries are described in **Table A18.6**.

Table A18.6 Summary of Regulatory Records

Environmental Record	Onshore development area	0-250m	Description
Landfall			
Discharge Consent	0	1	The nearest discharge consent is located approximately 230 m north of the north-east corner of the landfall onshore development area and relates to a soakaway associated with a private dwelling, which was issued in 1988 and revoked in 1998. There are nine other discharge consents within 1 km of the landfall onshore development area. These all relate to a Sewage Treatment works operated by Anglian Water Service located approximately 400 m from the south-west corner.
Pollution Incident to controlled waters	0	0	There is one pollution incident within 1 km of the landfall onshore development area. This relates to a Category 3 - minor incident associated with an unknown pollutant. This incident is located at the Sewage Treatment works operated by Anglian Water Service located approximately 400 m from the south-west corner of the landfall onshore development area.
Substantiated Pollution Incidents	0	0	None within 1km of the landfall onshore development area.
Registered landfill, historic landfill or other waste disposal sites	0	0	There is one registered landfill site located approximately 400 m from the south-west corner of the landfall onshore development area.

Environmental Record	Onshore development area	0-250m	Description
Licensed waste management facilities (transfer, treatment and disposal sites)	0	0	None within 1 km of the landfall onshore development area.
Integrated Pollution Prevention and Control authorisations	0	0	None within 1 km of the landfall onshore development area.
Local Authority Pollution Prevention and Control authorisations	0	0	None within 1 km of the landfall onshore development area.
Hazardous substances consents and handling notifications	0	0	None within 1 km of the landfall onshore development area.
Prosecutions relating to Authorised Processes	0	0	None within 1 km of the landfall onshore development area.
Prosecutions Incidents to Controlled Waters	0	0	None within 1 km of the landfall onshore development area.
Licensed radioactive substances	0	0	None within 1 km of the landfall onshore development area.
Fuel sites	0	0	None within 1 km of the landfall onshore development area.
Contemporary Trade Directory records (active and former)	0	0	None within 1 km of the landfall onshore development area.
Onshore Cable Corridor			
Discharge Consent	0	0	There are 11 discharge consents within 1 km of the onshore cable corridor onshore development area. These relate to Coldfair Green surface water discharge consents from water company discharge effluents and a Sewage Treatment works operated by Anglian Water Service located approximately 400 m from the south-west corner.

Environmental Record	Onshore development area	0-250m	Description
Pollution Incident to controlled waters	2	0	Two pollution incidents to controlled waters have occurred on the boundary of the onshore cable corridor onshore development area.
Substantiated Pollution Incidents	0	0	None within 1 km of the onshore cable corridor onshore development area.
Registered landfill, historic landfill or other waste disposal sites	1	0	<p>There is one registered waste management facility.</p> <p>The Registered Landfill Site is recorded at Home Farm, Sizewell. The licence was granted by the Environment Agency (907/01/16/04) to a license holder Ogilvie and has since been surrendered. The waste types accepted are not recorded. This landfill was within the onshore cable route, although the landfill boundary is not known. Historical maps of the area only show the BGS recorded mineral sites at this approximate location. Sand and gravel pits have been present on the site from 1892. Between 1958 and 1976 the BGS registered mineral sites appears to have been infilled and the ground level in this area was altered.</p> <p>There is one further registered landfill site located approximately 700 m from the south of the eastern end of the onshore cable corridor onshore development area.</p>
Licensed waste management facilities (transfer, treatment and disposal sites)	1	0	The onsite waste management facility relates to a scrap metal recycling facility license now expired. There are two areas of historic landfilling in Coldfair green 1 km from the onshore cable corridor onshore development area.
Integrated Pollution Prevention and Control authorisations	0	0	None within 1 km of the onshore cable corridor onshore development area.
Local Authority Pollution Prevention and Control authorisations	0	1	One pollution prevention control authorisation is located within 250m. This is a laundrette providing dry cleaning services. There are no other pollution prevention authorisations within 1 km of the onshore cable corridor onshore development area.
Hazardous substances consents and handling notifications	0	0	None within 1 km of the onshore cable corridor onshore development area.
Prosecutions relating to Authorised Processes	0	0	None within 1 km of the onshore cable corridor onshore development area.

Environmental Record	Onshore development area	0-250m	Description
Prosecutions Incidents to Controlled Waters	0	0	None within 1 km of the onshore cable corridor onshore development area.
Licensed radioactive substances	0	0	EDF Energy (Sizewell B) hold licenses for the keeping and use of radioactive material within 1 km of the Onshore development area. EDF Energy (Sizewell B) and Magnox Limited (Sizewell A) hold licences for the disposal of radioactive waste.
Fuel sites	0	0	There is one fuel station entry within 1 km of the onshore cable corridor onshore development area and this relates to the filling station at Coldfair Green.
Contemporary Trade Directory records (active and former)	0	6	<p>No contemporary trade directory entries have been identified with the onshore cable corridor onshore development area.</p> <p>The following contemporary trade activities were identified within 1 km of the onshore cable corridor onshore development area:</p> <ul style="list-style-type: none"> Food production – manufacturing Furniture manufacturing Engineering works Garage services Car dealerships Petrol filling stations Laundries and laundrettes Dry cleaning services Domestic and commercial cleaning services Carpet and furniture cleaners Builders merchants
Onshore Substation and National Grid Substation			
Discharge Consent	0	3	There are three discharge consents within 250 m of the Substation locations within the Onshore development area. The closest consent is located approximately 20 m to the site boundary in the centre of the search area. These consents relate to domestic sewage discharges to freshwater streams.
Pollution Incident to controlled waters	0	1	There is one pollution incident to controlled waters located within 250 m of the substation onshore development area. This was a Category 3 – Minor Incident related to Oil (Kerosene fuel oil) discharged to groundwater and occurred in 1997.

Environmental Record	Onshore development area	0-250m	Description
Substantiated Pollution Incidents	0	0	None within 1 km of the substation onshore development area.
Registered landfill, historic landfill or other waste disposal sites	0	0	None within 1 km of the substation onshore development area
Licensed waste management facilities (transfer, treatment and disposal sites)	0	0	None within 1 km of the substation onshore development area
Integrated Pollution Prevention and Control authorisations	0	0	There is one Integrated Pollution Prevention and Control authorisation within 1 km of the substation onshore development area. This is located approximal 700 m north-west of the substation onshore development area, at Redhouse Farm. This relates to intensive poultry farming operation at this location.
Local Authority Pollution Prevention and Control authorisations	0	0	None within 1 km of the substation onshore development area.
Hazardous substances consents and handling notifications	0	0	None within 1 km of the substation onshore development area.
Prosecutions relating to Authorised Processes	0	0	None within 1 km of the substation onshore development area.
Prosecutions Incidents to Controlled Waters	0	0	None within 1 km of the substation onshore development area.
Licensed radioactive substances	0	0	None within 1 km of the substation onshore development area.
Fuel sites	0	0	None within 1 km of the substation onshore development area.
Contemporary Trade Directory records (active and former)	0	0	None within 1 km of the substation onshore development area.

18.5 Preliminary Conceptual Site Model and Qualitative Risk Assessment

18.5.1 Conceptual Site Model

18.5.1.1 Preliminary Conceptual Site Model

36. Current guidance recommends that a Conceptual Site Model (CSM) is formulated based on the information available. As more information becomes available the CSM is updated. The CSM is limited, at this stage, to identification and assessment of potential sources, potential receptors and anticipated pathways to those receptors, identified as a result of desk-based research.
37. For contamination within soil or water to pose a risk, a feasible pollutant linkage must be established. A pollutant linkage consists of three parts:
- A source of contamination in or on the land;
 - A viable pathway by which the contaminant is able to cause harm (or which presents a significant possibility of such harm being caused); and
 - A receptor which is sensitive to impact from the contamination.
38. Where all three of these are present, a feasible pollutant linkage exists.

18.5.1.2 Potential Sources of Ground Contamination

39. Contamination sources can include neighbouring land uses and historical activities within the onshore development area and in its surroundings. From the desk-based information and the findings of the site walkover, potential sources of contamination have been identified within the onshore development area and include:
- Agricultural land which can be associated with some contaminative activities including use/storage of pesticides and herbicides and burial of wastes (including asbestos); and
 - A number of historical clay and shale pits and sand and gravel pits present in various locations within the onshore development area have been infilled, and may contain unknown and potentially contaminated fill material.
40. In addition to the sources identified above the following potential sources of contamination have been identified within 500m of the onshore development area:
- Sizewell Nuclear Power Station;
 - Historic Landfill and sewage treatment works;
 - Areas of artificial land; and
 - Petrol Filling station.

18.5.1.3 Identified Receptors

41. Based on the current and proposed use of the site, it is considered that the likely receptors will be:
- Future end users (farm workers) of the site during the operational phase of the proposed East Anglia ONE North project when land is largely returned to its former use through dermal contact, ingestion and inhalation (with the exception of the substation sites, the end use of the land will not change as a result of the development);
 - Construction and maintenance personnel involved in excavation (e.g. cable installation, substation construction and reinstatement of services) through dermal contact, ingestion and inhalation;
 - Shallow groundwater (Secondary A, B, and Undifferentiated Aquifers) below the proposed development, the quality of the water may be affected by the leaching and disturbance of soil borne contaminants. This includes private licenced and unlicensed groundwater abstractions;
 - Deep groundwater (Principal aquifer) is present beneath superficial deposits beneath the survey area. It might be affected by direct disturbance (i.e. directional drilling) or leaching and groundwater migration where connectivity to the localised shallow aquifers exists. This includes Groundwater SPZs; and
 - Surface freshwater bodies (various rivers, streams, ditches, ponds, lakes and a canal) through leaching of any soil borne contaminants, inflow of contaminated groundwater or direct entry by runoff.

18.5.2 Qualitative Risk Assessment

42. **Table A18.7** presents the qualitative risk assessment.

Table A18.7 Preliminary Conceptual Model and Qualitative Risk Assessment

Land use	Pathway	Receptor	Qualitative Assessment Discussion of Pollutant Linkages and Risk Management
Source Within the Onshore Development Area			
Made Ground, infill material and former quarries and pits.	Dermal Exposure, Inhalation, Ingestion	Human Health (Construction Workers)	<p>The majority of the onshore development area crosses agricultural land, where significant sources of contamination are not anticipated. There is however, a small risk of encountering buried asbestos or agrochemicals.</p> <p>Areas of likely Made Ground have however been identified within the onshore development area. These include areas of former pits, building structures, roadways, dismantled railway and dismantled tram tracks. These areas should be avoided during the placement and selection of the cable corridor and any associated structures.</p> <p>Where contaminated materials are encountered these should be segregated and assessed for their suitability for re-use or disposal off site.</p> <p>Where practical, trenchless crossing techniques (e.g. Horizontal Directional Drilling (HDD)) could be used to avoid significantly contaminated areas.</p> <p>Potential contaminants of concern (PCOC) could be present in the onshore development area and could represent an unacceptable risk to construction workers. However, these areas appear to be localised and it is likely that short term risks associated with construction could be managed through the use of personal protective equipment (PPE) and appropriate working practices.</p> <p>The potential risk from exiting pollution linkages is considered to be low.</p>
	Leaching, Groundwater migration	Groundwater	<p>The underlying geology comprises mainly of sands and gravels, which are highly permeable materials. The Secondary aquifers are considered to be linked to the underlying Principal aquifer.</p> <p>There is the potential for contaminants of concern such as hydrocarbons and metals to leach from the Made Ground and migrate in groundwater and impact groundwater resources.</p> <p>Leaching/migration of contaminants can result in impacts to sensitive water resources.</p> <p>Several SPZs will be crossed by or lie adjacent to the onshore development area. The abstractions related to these zones are not considered to be at risk from the general cable construction works.</p>

Land use	Pathway	Receptor	Qualitative Assessment Discussion of Pollutant Linkages and Risk Management
			<p>However, where deeper trenchless crossing techniques (e.g. HDD) are to be undertaken the risk to the SPZs should be considered further.</p> <p>Landfall occurs >1km from all SPZs and is considered not to have likely pollutant linkages exist or develop during works. The cable corridor onshore development area is considered to not have migration pathways via a single aquifer strata. The substations would be located 1.9 to 2km from the inner zone however works will occur within a source protection zone.</p> <p>Investigation should be carried out to ensure there is a sufficient thickness of impermeable deposits to protect the underlying aquifer. Where the potential trenchless crossing techniques (e.g. HDD) exceed the depth of drift deposits, or comes close to the base, mitigation measures should be set in place to protect the aquifer, prevent the creation of a temporary or permanent pathway for groundwater migration (and prevent a pollution incident from the disturbance of sediments or accidental spillage or leakage of drilling fluids.</p> <p>If any unexpected contamination is encountered during trenching operations this should be further investigated.</p> <p>The potential risk from existing pollution linkages is considered to be low.</p>
		Surface waters	<p>The presence of the till in many locations throughout the onshore development area should significantly delay the potential migration of any contaminants encountered or disturbed. Where superficial deposits are not present or highly permeable there is increased migration potential.</p> <p>Watercourses crossed by the project may be in close connection with groundwater, and where this groundwater supports potable abstractions, contamination entering the watercourse may be drawn to the abstraction points. PCOC could therefore represent an unacceptable risk to controlled waters from leaching or groundwater transport.</p> <p>The potential risk from exiting pollution linkages is considered to be low.</p>

Land use	Pathway	Receptor	Qualitative Assessment Discussion of Pollutant Linkages and Risk Management
	Direct Entry	Surface Waters/ Marine Environment	<p>The onshore development area largely comprised of agricultural land therefore significant areas of contamination are not expected.</p> <p>Appropriate control/mitigation measures should be put in place by the contractor during construction works to prevent migration of contaminated sediments or materials into controlled waters.</p> <p>The potential risk from this pollutant linkage is considered to be low.</p>
	Gas migration through permeable strata	Human Health (Future Site Users)	<p>There is the potential for gas generation and migration into the onshore development area within the permeable strata present.</p> <p>Any confined spaces, manholes or pits should be constructed away from potential contamination risk areas to prevent the risk of maintenance contractors entering an area subject to potential gas build up.</p> <p>The potential risk from this pollutant linkage is considered to be high.</p>
Source Within 250 m of the Onshore Development Area			
Historic landfill and former quarries.	Gas migration through permeable strata	Human Health (Future Site Users)	<p>There is the potential for gas generation and migration into the onshore development area within the permeable strata.</p> <p>Any confined spaces, manholes or pits should be constructed away from potential contamination risk areas to prevent the risk of maintenance contractors entering an area subject to potential gas build up.</p> <p>The potential risk from this pollutant linkage is considered to be low.</p>

18.5.3 Uncertainties in the Conceptual Site Model

43. At this stage in the process there are a number of uncertainties associated with the preliminary CSM, specifically associated with defining the potential sources and the respective pathways as summarised below:
- The presence, magnitude and extent of the PCOC needs to be established to determine risks to human health, controlled waters and property;
 - The mobility of contaminants needs to be established to determine risks to controlled waters; and
 - The geology and hydrogeological regime at the site needs to be established to determine the potential for contaminant migration, including ground gas.

18.6 Conclusions

44. A desk-based assessment of contamination risks has been undertaken for the proposed East Anglia ONE North project. A number of localised potential sources of contamination have been identified within or near the onshore development area. The potential risk posed by the off-site sources is only likely to be realised where the contamination sources co-exist with the more permeable superficial deposits. Therefore, for the off-site sources, no further action would be required in areas where the potential sources and permeable strata do not co-exist.
45. Should the works within the onshore development area cross a zone of permeable material that co-exists with an area of potential contamination, there may be a risk of encountering impacted groundwater, or ground gas migration. Precautions should be taken to ensure that a further pathway for contaminant migration to controlled waters is not created and that the risk to future workers and construction workers is mitigated or managed by gas monitoring while working in confined spaces or siting jointing pits away from potential risk areas.
46. As part of the cable installation process, trenchless crossing techniques and HDD may be required. This could include several trenchless crossing locations above SPZs. Trenchless crossings work in these locations should ensure that a sufficient thickness of glacial material, or adequate groundwater protection measures, are present to prevent migration of contaminants into the protected principal aquifer beneath.

18.7 Recommendation and Next Steps

47. Protocols for dealing with unexpected contamination should be set in place prior to construction to ensure that procedures are known and agreed with the regulators should contaminated materials be encountered. This protocol should include consideration for dealing with substances which contain asbestos.

48. Should any existing buildings or structures require removal as part of the proposed East Anglia ONE North project, a pre-demolition asbestos survey should be carried out, in accordance with the Control of Asbestos Regulations (2012). If asbestos containing materials are identified, they should then be removed and disposed of in an appropriate manner and to the satisfaction of the Regulating Authority. No buildings within the onshore development area have, to date, been identified as requiring demolition.

18.7.1 Soil Management

49. In terms of managing the movement and reuse of materials, reference should be made to the CL:AIRE Code of Practice (CL:AIRE 2011). The definition of waste: Development Industry Code of Practice. The code is aligned with CLR11 (Defra and Environment Agency 2004) where land is either contaminated or suspected of being contaminated. It must be noted that there is no similar published framework available for cases where land is not suspected of being contaminated. The code does, however adopt a similar approach for the latter scenario, whereby a Design Statement is required (where a remediation strategy would otherwise be necessary).
50. Firstly, it must be determined whether the soils to be excavated on-site are a waste material or not. This depends on a range of factors set out in Environment Agency and CL:AIRE guidance, principally:
- Suitability of material for use (without any further treatment);
 - Certainty of use within the design; and
 - Quantity of material.
51. To demonstrate that the criteria have been satisfied, a Materials Management Plan (MMP) must be prepared, which will ultimately form part of a wider design statement. The MMP will include an auditable tracking system and make allowance for contingency arrangements, e.g. discovery of unexpected soil materials on-site.
52. If it is envisaged that the use of materials will occur in excess of one year from being stockpiled or stored on-site a time limit must be agreed with the Environment Agency. The decision relating to the length of storage will be made within the context of the extant planning permission or agreed programme of works. It is likely that supporting information will be requested by the Environment Agency. Such information may include site plans, cross sections and information regarding stockpile management issues, such as control of dust, suspended solids and runoff.

18.7.2 Waste Management

53. Any material excavated and requiring disposal off site will need to be characterised and disposed of in accordance with the Landfill Regulations 2002 (as amended) and the Hazardous Waste Regulations 2005, where applicable. Any material classified as hazardous waste will require pre-treatment prior to disposal to either reduce the volume of hazardous waste requiring disposal or to reduce the hazardous nature of the material.
54. Any soils imported to the site will need to be tested and verified to ensure that they do not pose a risk to human health or controlled waters and that they are suitable for their intended use. They will also need to be accompanied by all relevant Duty of Care documentation.

18.7.3 Construction Health and Safety

55. Risks to construction workers may be controlled through good site practice and hygiene in addition to the use of appropriate Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE), where necessary.
56. Method statements and risk assessments should be developed for all site works to aid identification of such risks and appropriate risk avoidance and reduction measures. The works should be undertaken in accordance with the requirements of the Construction (Design and Management) (CDM) Regulations 2015 where appropriate, as detailed in the Outline Code of Construction Practice (OCoCP) submitted with this DCO application.

18.7.4 Pollution Prevention

57. During the construction phase, contractors and designers should ensure that sound environmental practices are adopted and followed including relevant best practice guidance from the Defra and Environment Agency's Pollution prevention for business (Defra, 2016), and construction best practice documents published by the Construction Industry Research and Information Association (CIRIA).
58. Care should be taken during construction to prevent uncontrolled run-off that may contain suspended solids or leaked fuels in order to mitigate pollution of adjacent surface waters. A CoCP will be developed pre-construction; this will include protocol for dealing with spillages and leaks of fuel and oils.
59. The storage of oils and fuels should be in a designated area, stored in bunds with 110% capacity, which will effectively capture any spills or leaks. Any temporary compounds should be located as far away from watercourses as possible.

60. Consideration should be given to the control and management of excavated sediments during any works in or around the various drains and dykes crossing the site. Control mechanisms and best practice are detailed in the OCoCP submitted with this application. Any excavated materials should be appropriately stored and segregated according to type to mitigate any potential pollution incidents.

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