MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 3, Chapter 1: Geology, hydrogeology and ground conditions

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Glossary

Term	Meaning
400 kV grid connection cables	Cables that will connect the proposed onshore substations to the existing National Grid Penwortham substation.
400 kV grid connection cable corridor	The corridor within which the 400 kV grid connection cables will be located.
Applicants	Morgan Offshore Wind Limited (Morgan OWL) and Morecambe Offshore Windfarm Ltd (Morecambe OWL).
Baseline	The status of the environment without the Transmission Assets in place.
Code of Construction Practice	A document detailing the overarching principles of construction, contractor protocols, construction-related environmental management measures, pollution prevention measures, the selection of appropriate construction techniques and monitoring processes.
Commitment	This term is used interchangeably with mitigation and enhancement measures. The purpose of commitments is to avoid, prevent, reduce or, if possible, offset significant adverse environmental effects. Primary and tertiary commitments are taken into account and embedded within the assessment set out in the ES.
Cumulative Effects	The combined effect of the Transmission Assets in combination with the effects from other proposed developments, on the same receptor or resource.
Development Consent Order	An order made under the Planning Act 2008, as amended, granting development consent.
Effect	The term used to express the consequence of an impact. The significance of effect is determined by correlating magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
EIA Scoping Report	A report setting out the proposed scope of the Environmental Impact Assessment process. The Transmission Assets Scoping Report was submitted to The Planning Inspectorate (on behalf of the Secretary of State) for the Morgan and Morecambe Offshore Windfarms Transmission Assets in October 2022.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process.
Generation Assets	The generation assets associated with the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm include the offshore wind turbines, inter-array cables, offshore substation platforms and platform link (interconnector) cables to connect offshore substations.
Geological Conservation Review site	Sites that form the basis of statutory geological and geomorphological site conservation in Britain. These sites have been defined through the Geological Conservation Review Series and have features of interest

Term	Meaning
	and importance at localities already notified or being considered for notification as Sites of Special Scientific Interest.
Inter-related Effects	Inter-related effects arise where an impact acts on a receptor repeatedly over time to produce a potential additive effect or where a number of separate impacts, such as noise and habitat loss, affect a single receptor.
Intertidal Infrastructure Area	The temporary and permanent areas between MLWS and MHWS.
Landfall	The area in which the offshore export cables make landfall (come on shore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area at Lytham St. Annes between Mean Low Water Springs and the transition joint bays inclusive of all construction works, including the offshore and onshore cable routes, intertidal working area and landfall compound(s).
Local Geodiversity Site	Local Geodiversity Sites are the most important places for geology and geomorphology outside statutorily protected land such as Sites of Special Scientific Interest.
Maximum design scenario	The realistic worst case scenario, selected on a topic-specific and impact specific basis, from a range of potential parameters for the Transmission Assets.
Morecambe OWL	Morecambe Offshore Windfarm Limited is a joint venture between Zero-E Offshore Wind S.L.U. (Spain) (a Cobra group company) and Flotation Energy Ltd.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore and onshore infrastructure connecting the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm to the national grid. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds. Also referred to in this report as the Transmission Assets, for ease of reading.
Morgan OWL	Morgan Offshore Wind Limited is a joint venture between bp Alternative Energy investments Ltd. and Energie Baden-Württemberg AG (EnBW).
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substations.
Onshore export cable corridor	The corridor within which the onshore export cables will be located.
Onshore Infrastructure Area	The area within the Transmission Assets Order Limits landward of Mean High Water Springs. Comprising the offshore export cables from Mean High Water Springs to the transition joint bays, onshore export cables, onshore substations and 400 kV grid connection cables, and associated temporary and permanent infrastructure including temporary and permanent compound areas and accesses. Those parts of the Transmission Assets Order Limits proposed only for ecological mitigation/biodiversity benefit are excluded from this area.
Onshore substations	The onshore substations will include a substation for the Morgan Offshore Wind Project: Transmission Assets and a substation for the Morecambe Offshore Windfarm: Transmission Assets. These will each comprise a compound containing the electrical components for transforming the power supplied from the generation assets to 400 kV

Term	Meaning
	and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid.
Preliminary Environmental Information Report	A report that provides preliminary environmental information in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. This is information that enables consultees to understand the likely significant environmental effects of a project and which helps to inform consultation responses.
Principal Aquifer	A geological unit that provides a significant quantity of water that can support water supply and/or provide water to rivers, lakes and wetlands (baseflow) on a strategic scale. These aquifers are highly permeable and provide a high level of groundwater storage.
Scoping Opinion	Sets out the Planning Inspectorate's response (on behalf of the Secretary of State) to the Scoping Report prepared by the Applicants. The Scoping Opinion contains the range of issues that the Planning Inspectorate, in consultation with statutory stakeholders, has identified should be considered within the Environmental Impact Assessment process.
Secondary A aquifers	A geological unit that provides modest groundwater that can support local water supplies and may form an important source of water to rivers.
Secondary B aquifers	A geological unit that is dominated by low permeability layers that may store and yield limited amounts of groundwater.
Secondary undifferentiated aquifer	Where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type, but generally have only a minor resource value.
Source Protection Zone	Groundwater catchment areas defined by travel time around important potable groundwater abstraction sites to safeguard drinking water quality. Certain land-uses are controlled or prohibited with certain source protection zone areas.
Study area	This is an area which is defined for each environmental topic which includes the Transmission Assets Order Limits as well as potential spatial and temporal considerations of the impacts on relevant receptors. The study area for each topic is intended to cover the area within which an impact can be reasonably expected.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
The Secretary of State for Energy Security and Net Zero	The decision maker with regards to the application for development consent for the Transmission Assets.
Transboundary effects	Effects from a project within one state that affect the environment of another state(s).
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above)
Transmission Assets Order Limits: Onshore	The area within which all components of the Transmission Assets landward of Mean High Water Springs will be located, including areas required on a temporary basis during construction and/or decommissioning (such as construction compounds).

Term	Meaning
	Also referred to in this report as the Onshore Order Limits, for ease of reading.
Unconfined aquifer	The upper surface of the aquifer (and water table) is open to the atmosphere either directly or through permeable overlying material.
Unproductive strata	Geological units that have negligible significance for water supply or baseflow to rivers, lakes and wetlands. They consist of bedrock or superficial deposits with a low permeability that naturally offer protection to any aquifers that may be present beneath.

Acronyms

Acronym	Meaning
BEIS	The former Department for Business, Energy & Industrial Strategy
Bgl	Below ground level
BGS	British Geological Survey
CEA	Cumulative Effects Assessment
CoCP	Code of Construction Practice
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
EIA	Environmental Impact Assessment
EnBW	Energie Baden-Württemberg AG
ES	Environmental Statement
GCR	Geological Conservation Review
HDD	Horizontal Directional Drilling
HSE	Health and Safety Executive
LGS	Local Geodiversity Site
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MMG	Mercia Mudstone Group
MSA	Mineral Safeguarding Area
NPPF	National Planning Policy Framework
NPS	National Policy Statement
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
PPP	Pollution Prevention Plan
SPZ	Source Protection Zone
SSC	Suspended Sediment Concentrations
SSSI	Site of Special Scientific Interest
UK	United Kingdom
UKCP	UK Climate Projections
UXO	Unexploded Ordnance
WFD	Water Framework Directive

Units

Unit	Description
GBq	Gigabecquerel
ha	Hectares
km	Kilometres
km^2	Kilometres squared
kV	Kilovolt
L/s	Litres per second
m	Metre
nm	Nautical mile
%	Percentage
m^2	Square metre

1 Geology, hydrogeology and ground conditions

1.1 Introduction

1.1.1.1 This chapter of the Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) undertaken for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. For ease of reference, the Morgan and Morecambe Offshore Wind Farms Transmission Assets are referred to in this chapter as the 'Transmission Assets'. This ES accompanies the application to the Planning Inspectorate for development consent for the Transmission Assets.

1.1.1.2 The purpose of the Transmission Assets is to connect the Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Windfarm: Generation Assets (referred to collectively as the 'Generation Assets') to the National Grid. A description of the Transmission Assets can be found in Volume 1, Chapter 3: Project description of the ES.

1.1.1.3 This chapter considers the likely impacts and effects of the Transmission Assets on geology, hydrogeology and ground conditions during the construction, operation and maintenance and decommissioning phases. Specifically, it relates to the intertidal and onshore elements of the Transmission Assets landward of Mean Low Water Springs (MLWS).

1.1.1.4 This ES chapter:

- identifies the key legislation, policy and guidance relevant to geology, hydrogeology and ground conditions;
- details the EIA scoping and consultation process undertaken for geology, hydrogeology and ground conditions;
- confirms the study area for the assessment, the methodology used to identify baseline environmental conditions and sets out the existing and future environmental baseline conditions, established from desk studies, surveys and consultation;
- identifies the scope of the assessment;
- details the mitigation and/or monitoring measures that are proposed to prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process;
- defines the project design parameters used to inform the impact assessment;
- identifies the impact assessment methodology and presents an assessment of the likely impacts and effects in relation to the construction, operation and maintenance and decommissioning phases of the Transmission Assets on geology, hydrogeology and ground conditions (and, where relevant, the impacts and effects of geology, hydrogeology and ground conditions on the Transmission Assets); and
- identifies any cumulative, transboundary and/or inter-related effects in relation to the construction, operation and maintenance and

decommissioning phases of the Transmission Assets on geology, hydrogeology and ground conditions.

1.1.1.5 The assessment presented is informed by the following technical chapters and should be read in conjunction with:

- Volume 3, Chapter 2: Hydrology and flood risk of the ES; and
- Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES.

1.1.1.6 This chapter also draws upon additional information to support the assessment contained within:

- Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES,
- Volume 3, Annex 2.1: Water Framework Directive surface and groundwater assessment of the ES; and
- Volume 3, Annex 2.2: Surface water abstraction licences, discharge consents and pollution incidents of the ES.

1.2 Legislation, policy and guidance

1.2.1 Legislation

1.2.1.1 Volume 1, Chapter 2: Policy and legislative context of the ES sets out the key legislation in relation to the Transmission Assets. This section summarises the key legislation relevant to geology, hydrogeology and ground conditions relevant to the construction, operation and maintenance and decommissioning of the Transmission Assets.

Water Resources Act 1991

1.2.1.2 The Water Resources Act 1991 (Chapter 57 Part III) principally relates to the protection of controlled water (i.e., rivers, lakes, canals and groundwater) from pollution. It sets out the responsibilities of the Environment Agency in relation to water pollution, resource management, flood defence, fisheries and, in some areas, navigation. It also regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwater.

The Environmental Protection Act 1990

1.2.1.3 The Environmental Protection Act 1990 set out a regime for prescribing limits on the release of substances to the environment. The Environmental Protection Act was amended by the Environment Act 1995 making provision for a risk-based framework for the identification, assessment and management of contaminated land within the United Kingdom (UK). These provisions came into effect in April 2000.

1.2.1.4 Part IIA (Contaminated Land) of the Environmental Protection Act was added by the Environment Act 1995 and defines a means of identifying contaminated land for its remediation. Part IIA is implemented through the Contaminated Land (England) Regulations 2006.

1.2.1.5 The Part IIA regime is aimed at ensuring that actions taken with respect to contaminated land are directed by a technically well-founded assessment of risk that considers the 'source-pathway-receptor' scenario (contaminant linkage). Under Part IIA, contaminated land is defined as:

'…any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.'

(section 78A, Part IIA, Environmental Pollution Act).

1.2.1.6 'Significant harm' is defined according to a risk-based approach and must be the result of pollutant linkages.

1.2.1.7 A contaminant source, pathway and receptor must be present to complete the pollutant linkage and for a potentially significant risk to exist. As such, the presence of contamination in itself does not necessarily indicate a need for remedial action. Accordingly, a site can only be considered 'contaminated' when a risk to the environment including property, or human health is present due to the presence of a 'source-pathway-receptor' linkage. In such circumstances and where there is a significant risk posed to human health and/or the environment, the Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (Department for Environment, Food and Rural Affairs (Defra), 2012) states that the enforcing authority must '*ensure that remediation achieves a standard sufficient to ensure that the land no longer poses sufficient risk to qualify as contaminated land'*. This means that the approach to remediating a site is dictated by the site's proposed end use.

The Contaminated Land (England) Regulations 2006

1.2.1.8 As set out above, these regulations make provision for a contaminated land regime in England, in accordance with Part IIA of the Environmental Protection Act 1990, which includes actions for the remediation of such land. These regulations (and the accompanying Part 2A Contaminated Land Statutory Guidance (Defra, 2012) introduced four possible grounds under which land can be classified as contaminated. These grounds are:

- significant harm is being caused to a human, or relevant non-human, receptor;
- there is a significant possibility of significant harm being caused to a human, or relevant non-human, receptor;
- significant pollution of controlled waters is being caused; and/or
- there is a significant possibility of significant pollution of controlled waters being caused.

The Environment Act 2021

1.2.1.9 The Environment Act 2021 gives a legal framework for environmental governance in the UK and brings in measures for improvement of the environment in relation to waste, resource efficiency, air quality, water, nature and biodiversity, and conservation.

1.2.1.10 Part 5 - Water, of the Environment Act 2021 includes provision for regulations to be made about the substances that should be taken into account when assessing the chemical status of surface or groundwater and specifying standards in relation to water quality.

Environmental Damage (Prevention and Remediation) (England) Regulations 2015

1.2.1.11 The aim of the Environmental Damage Regulations is to prevent and remedy damage to land, water and biodiversity.

Groundwater (England and Wales) Regulations 2009

1.2.1.12 The Groundwater Regulations 2009 transpose the provisions of the European Union Groundwater Directive 2006/118/EC into law in England. Although the Directive no longer has effect in the UK, the regulations remain in place to provide a comprehensive and risk-based approach to pollution prevention, in relation to groundwater contamination.

The Water Supply (Water Quality) Regulations 2016 and 2018

1.2.1.13 The quality of public drinking water supplies in England is regulated by the Water Supply (Water Quality) Regulations 2016 and the Water Supply (Water Quality) Regulations 2018. These regulations set standards for drinking water quality. Although standards are not specified for all chemical compounds in existence, the regulations do require that, in order to be regarded as ‘wholesome’, drinking water must not contain any substance at a level which would constitute a potential danger to human health (as well as meeting the other requirements of the regulations).

Environmental Permitting (England and Wales) Regulations 2016

1.2.1.14 These regulations revoke and replace the Environmental Permitting (England and Wales) Regulations 2010 and the Groundwater (England and Wales) Regulations 2009. These regulations control groundwater pollution, including from contaminated land sources.

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

1.2.1.15 These regulations were prepared to implement the European Union Water Framework Directive 2000/60/EC in England. Although the Directive no longer has effect in the UK, the regulations remain in place with the following environmental objectives.

- Prevention of deterioration of the status of surface water and groundwater.
- Achievement of objectives and standards for protected areas
- Protection, enhancement and restoration of each body of surface water with the aim of achieving good status for all water bodies by 2021. Where this is not possible and subject to the criteria set out in the Regulations, aim to achieve good status by 2027 or set an objective less stringent than good status.
- Protection and enhancement of each artificial or heavily modified water body with the aim of achieving good ecological potential and good surface water chemical status for heavily modified water bodies and artificial water bodies. Where this is not possible and subject to the criteria set out in the Regulations, aim to achieve good status or potential by 2027 or set an objective less stringent than good status or potential.
- Reversal of any significant and sustained upward trends in pollutant concentrations in groundwater.
- Aim progressively to reduce pollution from priority substances and aim to cease or phase out discharges of priority hazardous substances into surface waters.
- Progressively reduce the pollution of groundwater, prevent the input of hazardous substances and limit the entry of non-hazardous pollutants to groundwater.

The Construction (Design and Management) Regulations 2015

1.2.1.16 These regulations cover the management of health, safety and welfare when carrying out construction projects.

Control of Substances Hazardous to Health Regulations 2002

1.2.1.17 The Control of Substances Hazardous to Health regulations require the risks that arise from the use of hazardous substances to be assessed. This includes any arrangements to deal with accidents, incidents or emergencies e.g., as a result of significant spillages.

1.2.2 Planning policy context

1.2.2.1 The Transmission Assets will be located in English offshore waters (beyond 12 nautical miles (nm) from the English coast) and inshore waters (within 12 nm from the English coast), with the onshore infrastructure located wholly within England. As set out in Volume 1, Chapter 1: Introduction, of this ES, the Secretary of State for the Department for Business, Energy and Industrial Strategy (BEIS) (the department which preceded the Department for Energy Security and Net Zero) has directed that the Transmission Assets are to be treated as development for which development consent is required under section 35 of the Planning Act 2008, as amended.

National Policy Statements

1.2.2.2 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to offshore wind development and the Transmission Assets, specifically:

- Overarching NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero 2023a);
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero 2023b); and
- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero 2023c).

1.2.2.3 **Table 1.1** sets out a summary of the policies within these NPSs, relevant to geology, hydrogeology and ground conditions.

1.2.2.4 The policies within the current NPSs relevant to all topics in the ES can be viewed in the National Policy Statement tracker (document reference J26) and Planning Statement (document reference J28) submitted with the application for development consent.

Table 1.1: Summary of the NPS EN-1, NPS EN-3 and NPS EN-5 requirements relevant to this chapter

Summary of NPS provision	How and where considered in the ES
NPS EN-1 (DESNZ, 2023a)	
The ES shall clearly set out any effects on internationally, nationally and locally designated sites of geological conservation importance [paragraph 5.4.17 of NPS EN-1].	The effects of the Transmission Assets on sites of geological conservation importance are considered in **section 1.11.2** of this chapter.
The applicant should show how the project has taken advantage of opportunities to conserve and enhance geological conservation interest [paragraph 5.4.19 of NPS EN-1].	Mitigation measures relating to geology, hydrogeology and ground conditions are set out in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES).
Applicants should include appropriate avoidance, mitigation, compensation and enhancement measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: • during construction, they will seek to ensure that activities will be confined to the minimum areas required for the works • the timing of construction has been planned to avoid or limit disturbance … [paragraph 5.4.35, NPS EN-1].	
To further minimise any adverse impacts on geodiversity, where appropriate applicants are encouraged to produce and implement a Geodiversity Management Strategy to preserve and enhance access to geological interest features, as part of relevant development proposals [paragraph 5.4.38 of NPS EN-1].	Features of geological interest have largely been avoided through the site selection process and refinement and through the use of trenchless techniques. The effects of the Transmission Assets on sites of geological conservation importance are considered in **section 1.11.2** of this chapter. No significant effects are predicted as any sites designated for their geological

Summary of NPS provision	How and where considered in the ES
	interest would be protected through the use of trenchless techniques. Therefore, on this basis a Geodiversity Management Strategy is not required.
The benefits of nationally significant low carbon energy infrastructure development may include benefits for biodiversity and geological conservation interests and these benefits may outweigh harm to these interests. The Secretary of State may take account of any such net benefit in cases where it can be demonstrated. [paragraph 5.4.41 of NPS EN-1].	Predicted effects on designated sites have been taken into account in the site selection process and are considered in **section 1.11.2.** While no beneficial effects are considered likely, the assessment concludes that there will be no significant adverse effects on designated sites.
As a general principle, and subject to the specific policies below, development should, in line with the mitigation hierarchy, aim to avoid significant harm to biodiversity and geological conservation interests, including through consideration of reasonable alternatives (as set out in Section 4.3 above). Where significant harm cannot be avoided, impacts should be mitigated and as a last resort, appropriate compensation measures should be sought. [paragraph 5.4.42 of NPS EN-1].	The mitigation hierarchy has been applied in this case. Where possible, likely significant effects on designated sites have been taken into account in the site selection process through avoidance. Where this is not possible, the design process has sought to avoid or reduce effects. Details of the mitigation and design measures are outlined in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES). This is reflected in the assessment set out at **section 1.11.2**. Biodiversity is considered in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES.
Development proposals provide many opportunities for building-in beneficial biodiversity or geological features as part of good design. The Secretary of State should give appropriate weight to environmental and biodiversity enhancements, although any weight given to gains provided to meet a legal requirement (for example under the Environment Act 2021) is likely to be limited. [paragraph 5.4.46 of NPS EN-1].	Predicted effects on designated sites have been taken into account in the site selection process and are considered in **section 1.11.2.** While no beneficial effects are considered likely, the assessment concludes that there will be no significant adverse effects on designated sites.
In taking decisions, the Secretary of State should ensure that appropriate weight is attached to designated sites of international, national, and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment. [paragraph 5.4.48 of NPS EN-1].	Features of geological interest have largely been avoided through the site selection process and refinement and through the use of trenchless techniques. The effects of the Transmission Assets on sites of geological conservation importance are considered in **section 1.11.2** of this chapter. No significant effects are predicted as any sites designated for their geological interest would be protected through the use of trenchless techniques.
The Secretary of State should use requirements and/or planning obligations to mitigate the harmful aspects of the development and, where possible, to ensure the conservation and enhancement of the site's biodiversity or geological interest. [paragraph 5.4.50 of NPS EN-1].	There will be no adverse impacts on Sites of Special Scientific Interest (SSSIs) designated for geodiversity. This is discussed further in **section 1.11.2.6**.
The Secretary of State should give due consideration to regional or local designations. However, given the need for new nationally significant infrastructure, these designations should not be used in themselves to	There will be no significant adverse effects on regional or local sites designated for geodiversity. This is discussed further in **section 1.11.2.6**.

Summary of NPS provision	How and where considered in the ES
refuse development consent. [paragraph 5.4.52 of NPS EN-1].	
For developments on previously developed land, applicants should ensure that they have considered the risk posed by contamination [paragraph 5.11.8 of NPS EN-1].	The risks posed by land contamination are considered in the assessment summarised in **section 1.6.6** and **section 1.11** of this chapter, with further details of baseline conditions provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.
Applicants are encouraged to develop and implement a Soil Management Plan which could help minimise potential land contamination. The sustainable reuse of soils needs to be carefully considered in line with good practice guidance where large quantities of soils are surplus to requirements or are affected by contamination [paragraph 5.11.14 of NPS EN-1].	An Outline Soil Management Plan (document reference J1.7) has been prepared and is submitted with the application, as set out in **section 1.8**.
Applicants should ensure that a site is suitable for its proposed use, taking account of ground conditions and any risks arising from land instability and contamination [paragraph 5.11.17 of NPS EN-1].	A preliminary risk assessment is provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. Effects associated with existing contamination are considered in **sections 1.11.3**, **1.11.7** and **1.11.10**. This demonstrates that the site is suitable, with the proposed mitigation in place.
For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination, and where contamination is present, applicants should consider opportunities for remediation where possible. It is important to do this as early as possible as part of engagement with the relevant bodies before the official pre-application stage [paragraph 5.11.18 of NPS EN-1].	A preliminary risk assessment is provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. A ground investigation will be completed with an assessment of the potential risks arising from any contamination identified and a remediation strategy prepared as necessary as set out in **section 1.8**.
Applicants should safeguard any mineral resources on the proposed site as far as possible, taking into account the long-term potential of the land use after any future decommissioning has taken place [paragraph 5.11.19 of NPS EN-1].	The design of the Transmission Assets has aimed to avoid significant harm to mineral resources, where possible. The approach to site selection and consideration of alternatives is set out in Volume 1, Chapter 4: Site selection and consideration of alternatives of the ES. Effects on mineral resources are considered in **section 1.11.11**.
Where a proposed development has an impact upon a Mineral Safeguarding Area (MSA), the Secretary of State should ensure that appropriate mitigation measures have been put in place to safeguard mineral resources [paragraph 5.11.28 of NPS EN-1].	Where possible, the design has avoided MSAs. The impact on MSAs is considered in **section 1.11.11**.
Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment, and how this might change due to the impact of climate change on rainfall patterns and consequently water availability across the water environment, as part of the	Impacts in terms of groundwater are considered within **sections 1.11.3, 1.11.4, 1.11.5, 1.11.6** and **1.11.8**. Impacts in terms of surface water are considered within Volume 3, Chapter 2: Hydrology and flood risk of the ES.

Summary of NPS provision	How and where considered in the ES
ES or equivalent (see Section 4.3 and 4.10) [paragraph 5.16.3 of NPS EN-1].	
Applicants are encouraged to consider protective measures to control the risk of pollution to groundwater beyond those outlined in River Basin Management Plans and Groundwater Protection Zones – this could include, for example, the use of protective barriers [paragraph 5.16.6 of NPS EN-1].	Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as part of the application for development consent (document reference J1.4).
The ES should describe: • the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges; • existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies); • existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and • any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions • how climate change could impact any of the above in the future • any cumulative effects [paragraph 5.16.7 of NPS EN-1].	Hydrogeological resources, groundwater abstractions and SPZs are identified in **section 1.6.5** of this chapter and in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. Impacts in terms of the environmental objectives of the Water Framework Directive are set out in Volume 3, Annex 2.1: Water Framework Directive surface and groundwater assessment of the ES. Changes arising from climate change are considered in **section 1.6.9**. A cumulative effects assessment is provided in **section 1.13**. Details of impacts on surface water receptors are set out in Volume 3, Chapter 2: Hydrology and flood risk of the ES. Discharges are assessed within Annex 2.2: Surface water abstraction licences, discharge consents and pollution incidents of the ES.
The Secretary of State should consider whether mitigation measures are needed over and above any which may form part of the project application. A construction management plan may help codify mitigation at that stage [paragraph 5.16.8 of NPS EN-1].	Mitigation measures relating to geology, hydrogeology and ground conditions are set out in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES).
The risk of impacts on the water environment can be reduced through careful design to facilitate adherence to good pollution control practice. For example, designated areas for storage and unloading, with appropriate drainage facilities, should be clearly marked [paragraph 5.16.9 of NPS EN-1].	Measures are provided within the Outline Operational Drainage Management Plan provided as part of the application for development consent (document reference J10). Further details are provided in **section 1.8**. Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as part of the application for development consent (document reference J1.4).
The Secretary of State will need to give impacts on the water environment more weight where a project would have an adverse effect on the achievement of the	Mitigation measures relating to geology, hydrogeology and ground conditions are set out in **section 1.8** of this chapter and the

Summary of NPS provision	How and where considered in the ES
environmental objectives established under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Controlled waters include all watercourses, lakes, lochs, coastal waters, and water contained in underground strata [paragraph 5.16.12 of NPS EN-1].	Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES). Details of impacts in terms of the Water Framework Directive are set out in Volume 3, Annex 2.1: Water Framework Directive surface water and groundwater assessment of the ES.
The Secretary of State must also consider duties under other legislation including duties under the Environment Act 2021 in relation to environmental targets and have regard to the policies set out in the Government's Environmental Improvement Plan 2023 [paragraph 5.16.13 of NPS-EN 1].	Legislation is discussed in **section 1.2.1**. A key policy associated with Goal 10 Enhancing beauty, heritage and engagement with the natural environment is to reinforce the natural, geological and cultural heritage of our landscapes. Designated sites notified on the basis of geological and geomorphological interest are identified in **Table 1.6.** There will be no significant effects on geodiversity as discussed in **section 1.11.2.**
The Secretary of State should consider proposals to mitigate adverse effects on the water environment and any enhancement measures put forward by the applicant and whether appropriate requirements should be attached to any development consent and/or planning obligations are necessary [paragraph 5.16.16 of NPS EN-1].	Mitigation measures relating to geology, hydrogeology and ground conditions are set out in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES).
The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Protected Areas (MPAs). These could include Marine Conservation Zones (MCZs), HRA Sites including Special Areas of Conservation and Special Protection Areas with marine features, Ramsar Sites, Sites of Community Importance, and SSSIs with marine features. Applicants should also identity any effects on the special character of Heritage Coasts [paragraph 5.6.13 of NPS-EN-1].	Features of geological interest have largely been avoided through the site selection process and refinement and through the use of trenchless techniques. The effects of the Transmission Assets on sites of geological conservation importance are considered in **section 1.11.2** of this chapter. No significant effects are predicted as any sites designated for their geological interest would be protected through the use of trenchless techniques.
Where possible, applicants are encouraged to manage surface water during construction by treating surface water runoff from exposed topsoil prior to discharging and to limit the discharge of suspended solids e.g. from car parks or other areas of hard standing, during operation [paragraph 5.16.5].	Measures are provided within the Outline Operational Drainage Management Plan provided as part of the application for development consent (document reference J10). Further details are provided in **section 1.8**. Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as part of the application for development consent (document reference J1.4).
NPS EN-3	
No requirements specifically applicable to geology, hydrogeology and ground conditions chapter.	
NPS EN-5	
No requirements specifically applicable to geology, hydrogeology and ground conditions chapter.	

The National Planning Policy Framework

1.2.2.5 The National Planning Policy Framework (NPPF) was published in 2012 and updated in 2018, 2019, 2021 and 2023 (Department for Levelling Up, Housing and Communities, 2023). The NPPF sets out the Government's planning policies for England.

1.2.2.6 The Government has published proposed reforms to the NPPF for consultation on 30 July 2024, with the consultation period ending on 24 September 2024 (Ministry of Housing, Communities and Local Government, 2024). Following consultation, the NPPF will be updated.

1.2.2.7 **Table 1.2** sets out a summary of the NPPF policies relevant to this chapter.

Table 1.2: Summary of NPPF requirements relevant to this chapter

Paragraph No.	Key provisions	How and where considered in the ES
180	'*Planning policies and decisions should contribute to and enhance the natural and local environment by:* • *protecting and enhancing sites of geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);* • *preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of pollution or land instability. Development should, wherever possible, help to improve local environmental conditions; and* • *remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate*.'	Designated sites notified on the basis of geological and geomorphological interest are identified in **Table 1.6** of this chapter and described in **section 1.6.2** of this chapter. Impacts on those features are assessed in **section 1.11.2** of this chapter. No significant effects are identified.
189	'*Planning policies and decisions should ensure that:* *a. a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);* *b. 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* c. *adequate site investigation information, prepared by a competent person, is available to inform these assessments*.'	Historical activities, including but not limited to, quarrying and mining, and ground conditions are identified in **section 1.6.6** of this chapter. Effects on groundwater are considered in **section 1.11** of this chapter. Details from the contaminated land register have been sought through consultation with the local authorities detailed in **Table 1.4** and discussed in **paragraph 1.6.6.7**. A preliminary risk assessment is provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. A ground investigation will be completed with an assessment of the potential risks arising from any contamination identified and a remediation strategy prepared as necessary, see **section 1.8**.
190	'*Where a site is affected by contamination or land stability issues, responsibility for securing a*	

Paragraph No.	Key provisions	How and where considered in the ES
	safe development rests with the developer and/or landowner.'	
218	*Local planning authorities should not normally permit other development proposals in Mineral Safeguarding Areas if it might constrain potential future use for mineral working.*	The impact on MSAs is considered in **section 1.11.11**.

1.2.2.8 The consultation draft NPPF includes similar provisions as the designated NPPF. There are no material updates for geology, hydrogeology and ground conditions.

1.2.2.9 The Planning Practice Guidance (PPG) supports the NPPF and provides guidance across a range of topic areas.

1.2.2.10 Paragraph 001 of the PPG in the section relating to 'Minerals' (Ministry of Housing, Communities and Local Government and Department for Levelling Up, Housing and Communities, 2014) confirms that minerals can only be worked where they naturally occur and therefore it is necessary to protect minerals from non-minerals development.

1.2.2.11 Paragraph 018 of the PPG in the section in relation to the 'Natural environment' (Ministry of Housing, Communities and Local Government and Department for Levelling Up, Housing and Communities, 2024) sets out that information on geodiversity impacts and opportunities should inform all stages of development.

Local planning policy

1.2.2.12 The onshore and intertidal elements of the Transmission Assets are located within the administrative areas of Fylde Council, Blackpool Council, South Ribble Borough Council and Preston City Council (and Lancashire County Council at the County level).

1.2.2.13 The relevant local planning policies applicable to geology, hydrology and ground conditions based on the extent of the study area for this assessment are summarised in **Table 1.3**.

Table 1.3: Summary of local planning policy relevant to this chapter

Policy	Key provisions	How and where considered in the ES
Adopted Fylde Local Plan to 2032 (incorporating Partial Review) (Adopted December 2021) (Fylde Council, 2021).		
Non-strategic Policy GD9 – Contaminated Land	'*There will be a presumption in favour of the re-development of previously developed land. Previously developed land can be subject to contamination. However, development will be encouraged on contaminated previously developed land subject to all of the following criteria being met:* *a) Applicants will be required to provide evidence of a satisfactory site investigation and show that*	Local authorities were contacted regarding records within the contaminated land register has been undertaken and responses received. Details of ground conditions are provided in **section 1.6.6** of this chapter. Reported incidences of contaminated land within the study

Policy	Key provisions	How and where considered in the ES
	any proposed remedial works are adequate to deal with any identified hazards, including the risk to human health and controlled waters from land contamination. Any remedial work should be undertaken to the satisfaction of the local authority, ahead of the commencement of development; *b) Development should not have an adverse impact on the stability of surrounding areas; and* *c) Applicants will be required to provide details of remedial and mitigation measures to protect the high levels of biodiversity value on contaminated land and to protect conservation and heritage assets on the site.*'	area have been characterised and assessed within **paragraph 1.6.6.7**. A ground investigation will be completed with an assessment of the potential risks arising from any contamination identified and a remediation strategy prepared as necessary, see **section 1.8**. Any mitigation measures in relation to biodiversity and heritage are set out in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES and Volume 3, Chapter 5: Historic environment of the ES respectively.
Strategic Policy ENV2 - Biodiversity	'*The Council is committed to ensuring the protection and enhancement of Fylde's geological assets and interests. In order to do this, the Council will have regard to the following hierarchy of conservation sites when making planning decisions, according to their designation:* *ii) Sites of Special Scientific Interest (SSSI)* *iii) Local Geodiversity Sites…*'	Where possible, likely significant effects on designated sites have been taken into account in the site selection process through avoidance. Where this is not possible, the design process has sought to avoid or reduce effects. Details of the mitigation and design measures are outlined in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES). This is reflected in the assessment set out at **section 1.11.2**. No significant effects are identified.
	'*Geodiversity relates to rocks, minerals, fossils, soils, landforms and natural processes, and these play a major role in defining landscapes. The diversity of England's geodiversity has produced a wide range of landforms and soil types. Measures should be taken to avoid and, where appropriate, mitigate any negative effect of development on geodiversity. The Lytham Coastal Changes SSSI relates to geodiversity and there is one Local Geodiversity Site in Fylde, relating to the stretch of sand dunes from Starr Gate to the coastguard station (north of St Anne's, opposite the runway to Blackpool Airport), which includes the Starr Hills Local Nature Reserve.*'	
Strategic Policy CL1 – Flood Alleviation, Water Quality And Water Efficiency	'*Planning decisions should follow the sequential, risk-based approach to the location of development, as required by the Framework.* *All new development is required to minimise flood risk impacts on the environment, retain water quality and water efficiency, and mitigate against the likely effects of climate change on present and future generations.* *This will be achieved by…* *…g) Ensuring that new development does not adversely affect the quality of surface and groundwater resources in Source Protection Zones and where possible contributes towards improving it.*	Measures are provided within the Outline Operational Drainage Management Plan provided as part of the application for development consent (document reference J10). Further details are provided in **section 1.8**. Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as part of the application for development consent (document reference J1.4).

Policy	Key provisions	How and where considered in the ES
	h) Ensuring there is no risk of pollution to controlled waters from land contamination on previously developed sites.'	
Strategic Policy DLF1 - Development Locations for Fylde	'*Development will not be permitted which would prevent or undermine the operation of existing land uses, including hazardous installations and the ethylene pipeline and Mineral Safeguarding Areas, or prejudice airport safety at Blackpool Airport or at Warton Aerodrome*.'	The design of the Transmission Assets has taken into account key existing land uses, including Blackpool Airport. The impact on MSAs is considered in **section 1.11.11**.
Blackpool Local Plan Part 1: Core Strategy 2012-2027 (Blackpool Council, 2016).		
Policy CS6 – Green Infrastructure	'*International, national and local sites of geological conservation importance will be protected having regard to the hierarchy of designated sites and the potential for appropriate mitigation*.'	The location of nationally and regionally important sites are set out in **section 1.6.2** of this chapter. The potential impacts to these sites of geological interest are set out in **section 1.11.2** of this chapter and mitigation measures are set out in **section 1.8**.
South Ribble Local Plan 2012-2026 (South Ribble Borough Council, 2015).		
Policy G8 – Green infrastructure and networks – Future Provision	'*All developments should provide…* *…b) Conservation of important environmental assets, natural resources, biodiversity and geodiversity*.'	Where possible, likely significant effects on designated sites have been taken into account in the site selection process through avoidance. Where this is not possible, the design process has sought to avoid or reduce effects. Details of the mitigation and design measures are outlined in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES). This is reflected in the assessment set out at **section 1.11.2**. No significant effects are identified.
Policy G16 – Biodiversity and Nature Conservation	Regard will be had to protecting and safeguarding all designated sites of international, national, regional, county and local level importance including all Sites of Special Scientific Interest and Geological Heritage Sites.	
Policy G14 - Unstable or contaminated land	'*There will be a presumption in favour of the redevelopment of previously developed land. Previously developed land can be unstable and subject to contamination. However, development will be encouraged on unstable or contaminated brownfield land subject to the following:* *a) Applicants will be required to provide evidence of a satisfactory site investigation and show that any proposed remedial works are adequate to deal with any identified hazards*.'	Local authorities were contacted regarding records within the contaminated land register has been undertaken and responses received. Details of ground conditions are provided in **section 1.6.6** of this chapter. Reported incidences of contaminated land within the study area have been characterised and assessed within **paragraph 1.6.6.7**. A ground investigation will be completed with an assessment of the potential risks arising from any contamination identified and a remediation strategy prepared as necessary, see **section 1.8**.

Policy	Key provisions	How and where considered in the ES
The Preston Local Plan 2012-26 (Site Allocations and DPD (Preston City Council, 2015).		
Policy EN10 - Biodiversity and nature conservation	In Preston, Biodiversity and Ecological Network resources will be protected, conserved, restored and enhanced: Priority will be given to protecting and safeguarding all designated sites of international, national, regional, county and local level importance including all sites of special scientific interest and geological heritage sites.	No internationally designated sites relevant to this topic have been identified. The locations of nationally and regionally important sites, including geological heritage sites are set out **section 1.6.2** of this chapter. Details of the mitigation and design measures are outlined in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES). This is reflected in the assessment set out at **section 1.11.2.** No significant effects are identified.
Policy EN7 - Land Quality	'*New development should demonstrate that:* *a) any existing contamination of the land will be addressed by appropriate mitigation measures to ensure that the site is suitable for the proposed use and that there is no unacceptable risk of pollution within the site or in the surrounding area;* *b) the proposed development will not cause the land to become contaminated, to the detriment of future use or restoration of the site or so that it would cause pollution in the surrounding area.*'	Local authorities were contacted regarding records within the contaminated land register has been undertaken and responses received. Details of ground conditions are provided in **section 1.6.6** of this chapter. Reported incidences of contaminated land within the study area have been characterised and assessed within **section 1.6.6.7**. A ground investigation will be completed with an assessment of the potential risks arising from any contamination identified and a remediation strategy prepared as necessary, see **section 1.8**.
Central Lancashire Adopted Core Strategy – Local Development Framework (2012)		
Policy 22: Biodiversity and Geodiversity	'*Conserve, protect and seek opportunities to enhance and manage the biological and geological assets of the area, through the following measures…* *…(c) Safeguarding geological assets that are of strategic and local importance.*'	No internationally designated sites relevant to this topic have been identified. The locations of nationally and regionally important sites, including geological heritage sites are set out **section 1.6.2** of this chapter. Details of the mitigation and design measures are outlined in **section 1.8** of this chapter and the Commitments Register (Volume 1, Annex 5.3: Commitments Register of the ES). This is reflected in the assessment set out at **section 1.11.2.** No significant effects are identified.

Policy	Key provisions	How and where considered in the ES
Strategic Objective 22	*'To encourage the generation and use of energy from renewable and low carbon sources.'*	The purpose of the Transmission Assets is to enable the development of the Morgan and Morecambe offshore wind farms. Further details of the overarching policy context are set out in Volume 1, Chapter 2: Policy and legislation context of the ES.
Joint Lancashire Minerals and Waste Local Plan: Site Allocation and Development Management Policies (Blackpool Council, Blackburn with Darwen Council and Lancashire County Council, 2013)		
Policy DM1 - Management of Waste and Extraction of Minerals	'*To achieve the Spatial Vision, and to provide for the level of need and spatial distribution for the provision of minerals and waste treatment and disposal as set out in the Core Strategy, developments will be supported in accordance with the site specific policies contained within this plan for:* • *Safeguarding of mineral resources...*'	The impact on MSAs is considered in **section 1.11.11**.
Policy M2 - Safeguarding minerals	'*Within the Plan area, Mineral Safeguarding Areas have been delineated on the Policies Map around all deposits of:* • *Limestone* • *Sand and gravel* • *Gritstone (sandstone)* • *Shallow coal* • *Brickshales* • *Salt* *Within these mineral safeguarding areas identified, planning permission will not be supported for any form of development that is incompatible by reason of scale, proximity and permanence with working the minerals, unless the applicant can demonstrate to the satisfaction of the local planning authority that:* • *The mineral concerned is no longer of any value or has been fully extracted.* • *The full extent of the mineral can be extracted satisfactorily prior to the incompatible development taking place.* • *The incompatible development is of a temporary nature and can be completed and the site returned to its original condition prior to the minerals being worked.* • *There is an overarching need for the incompatible development that outweighs the need to avoid the sterilisation of the mineral resource.* • *That prior extraction of minerals is not feasible due to the depth of the deposit.*	

Policy	Key provisions	How and where considered in the ES
	• *Extraction would lead to land stability problems*.'	

1.2.3 Relevant guidance

1.2.3.1 Relevant guidance used to inform this chapter includes the following.

- British Standard requirements for the 'Investigation of potentially contaminated sites - Code of practice' (ref. BS10175:2011+A2:2017).
- British Standard requirements for the 'Code of practice for ground investigations' (ref. BS5930:2015+A1:2020).
- The Environment Agency's approach to groundwater protection, version 1.2 (Environment Agency, 2018).
- Construction Industry Research and Information Association (CIRIA) Document C649: Control of water pollution from linear construction projects. Site guide (CIRIA, 2006a).
- CIRIA Document C648: Control of water pollution from linear construction projects. Technical guidance (CIRIA, 2006b).
- CIRIA Document C665: Assessing Risks Posed by Hazardous Ground Gases to Buildings (CIRIA, 2007).
- Defra Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (Defra, 2012).
- CIRIA Document C552 – Contaminated Land Risk Assessment: A Guide to Good Practice (CIRIA, 2001a).
- CIRIA Document C532 – Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors (CIRIA, 2001b).
- Land Contamination: Risk Management (LCRM) (Environment Agency, 2020).

1.3 Consultation and engagement

1.3.1 Scoping

1.3.1.1 On 28 October 2022, the Applicants submitted a Scoping Report to the Planning Inspectorate, which described the scope and methodology for the technical studies being undertaken to provide an assessment of any likely significant effects for the construction, operation and maintenance and decommissioning phases of the Transmission Assets. It also described those topics or sub-topics which are proposed to be scoped out of the EIA process and provided justification as to why the Transmission Assets would not have the potential to give rise to significant environmental effects in these areas.

1.3.1.2 Following consultation with the appropriate statutory bodies, the Planning Inspectorate (on behalf of the Secretary of State) provided a Scoping Opinion on 8 December 2022.

1.3.2 Statutory consultation responses

1.3.2.1 The preliminary findings of the EIA process were published in the Preliminary Environmental Information Report (PEIR) in October 2023. The PEIR was prepared to provide the basis for formal consultation under the Planning Act 2008. This included consultation with statutory and no-statutory bodies under sections 42 and 47 of the Planning Act 2008.

1.3.3 Summary of consultation responses received

1.3.3.1 A summary of the key items raised specific to geology, hydrogeology and ground conditions is presented in **Table 1.4**, together with how these have been considered in the production of this chapter. It should however be noted that formal responses are provided for all consultation responses received and can be accessed in the Consultation Report (document reference E1).

Table 1.4: Summary of key consultation comments raised during consultation activities undertaken for the Transmission Assets relevant to geology, hydrogeology and ground conditions

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
December 2022	Planning Inspectorate (Scoping)	No specific evidence is provided to indicate that the operation and physical presence of the transmission assets would not lead to effects on groundwater flows, for example drainage resulting in an altering of flow pathways and available groundwater volume. The ES should consider impacts on groundwater levels and flow unless it can be evidenced that such effects would not lead to a significant effect. Evidence should ideally include reference to existing case study information.	An assessment of the effects posed by the Transmission Assets on the groundwater regime is given in **section 1.11**.
December 2022	Planning Inspectorate (Scoping)	As per the above comment, the potential for alterations to flow pathways as a result of the physical presence of the Proposed Development has the potential to impact groundwater levels and subsequently surface water which is fed by groundwater sources. The Scoping Report does not provide sufficient information to enable the Inspectorate to agree to scope this matter out of further assessment. Table 6.2 also notes that impacts on surface water are to be considered in the hydrology chapter, however, lists surface water quantity and quality within the hydrogeology chapter. The ES should clearly state where effects are to be assessed and provide a justification where a single receptor (for example surface water) is assessed in two separate chapters.	An assessment of the effects posed by the Transmission Assets on the groundwater regime is given in **section 1.11**. This includes consideration of effects on existing linkages and pathways. This includes groundwater-dependent receptors. Surface water quantity and quality is considered in Volume 3, Chapter 2: Hydrology and flood risk of the ES.
December 2022	Planning Inspectorate (Scoping)	Based on the information provided within the Scoping Report detailing that maintenance works would be limited in duration and that limited quantities of potentially polluting substances would be required, the Inspectorate is in agreement that an assessment of accidental release of polluting substances during operation and maintenance works can be scoped out of the assessment. The ES should however detail any operational controls on maintenance works, for example an Operational Management Plan.	Noted. Details of the measures proposed to control impacts are set out in **Table 1.18** . Operation and maintenance activities are described within Volume 1, Chapter 3: Project Description of the ES.
December 2022	Planning Inspectorate (Scoping)	Heat generation during construction and decommissioning - As the cables will not be operational during the construction and decommissioning phases, the Inspectorate is in agreement than an assessment of heat generation can be scoped out of the ES for these phases.	Noted. Heat generation by the cables during the operational phase is considered in **section 1.11.12.**

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
December 2022	Planning Inspectorate (Scoping)	The assessment of designated sites should also consider Lytham Coastal Changes Site of Special Scientific Interest.	Characterisation of all SSSIs present within the study area is set out in **section 1.6.2.** The assessment for relevant sites, including Lytham Coastal Changes SSSI, is provided in **section 1.11.2.** It has however, been concluded that there will be no impact on Lytham Coastal Changes SSSI, which lies outside the Transmission Assets Order Limits.
December 2022	Planning Inspectorate (Scoping)	Table 6.2 indicates that receptors will be identified using desk-based analysis. The ES should consider whether a field (walkover) survey should be undertaken, as this is likely to provide further details and updates to third party data.	The work undertaken for the ES has been based primarily on desk-based resources, which provide considerable information regarding existing conditions. This has been supplemented with site-specific ground investigation information, where available. Details of the baseline work undertaken are provided in **section 1.6** of this chapter.
December 2022	Planning Inspectorate (Scoping)	The Scoping Report does not refer to the potential for damage to new and existing infrastructure from potentially contaminated land, water, or ground gas. The ES should describe any design measures required to manage this issue.	The potential for mobilisation of existing contamination is considered within **section 1.11**. The work undertaken to date has identified existing areas of contamination and these have been taken into account, where practicable, in the site selection process. Details of the measures proposed to avoid and reduce impacts are set out in **section 1.8**.
December 2022	Planning Inspectorate (Scoping)	The Scoping Report does not refer to the potential for the presence of Unexploded Ordnance (UXO) within the onshore study area. The ES should provide desk study information including a risk assessment to inform the ES.	The risk associated with existing UXO is identified within **paragraphs 1.6.6.24** and **1.6.6.25**
December 2022	Natural England (Scoping)	<u>Water Quality</u> Increases in suspended sediment concentrations (SSC) during construction and operation (e.g., future dredging works) have the potential to smother sensitive habitats. The ES should include information on the sediment quality and potential for any effects on water quality through suspension of	The impact of increased sediment in surface water is considered in Volume 3, Chapter 2: Hydrology and flood risk of the ES for onshore receptors.

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		contaminated sediments. The EIA should also consider whether increased SSC resulting are likely to impact upon the interest features and supporting habitats of the designated sites. The ES should consider whether there will be an increase in the pollution risk as a result of the construction or operation of the development.	An assessment of the pollution risk posed by the Transmission Assets on the groundwater regime is set out in **section 1.11**.
December 2022	Environment Agency (Scoping)	Please be aware that the total catchment (Zone 3) extends further south than shown and borders the Ribble estuary.	Noted. SPZs are described in **section 1.6.5** of this chapter and impacts posed by the Transmission Assets are assessed in **section 1.11**.
December 2022	Historic England (Scoping)	Table 6.2 impacts on geology and hydrogeology – changes in groundwater levels can also impact on buried and waterlogged archaeological assets, including the dewatering of organic deposits leading to deterioration and loss of heritage assets. Furthermore, the heat output from cables can lead to drying out and deterioration of surrounding deposits which may include unknown buried archaeological assets. It is also vital to make sure the transmission cables will not suffer from bentonite slurry leakage which can contaminate surrounding archaeological deposits. The potential impact and mitigation of risk will need to be included in the WSI.	Archaeological assets are characterised and discussed within Volume 3, Chapter 5: Historic environment of the ES and the Outline Onshore and Intertidal Written Scheme of Investigation (document reference J9). Dewatering activities will be short term and localised as described in **section 1.11.4**. Details of controls on bentonite use are set out in the Outline Bentonite Breakout Plan provided as part of the application for development consent (document reference J1.13).
December 2022	United Utilities Water Ltd (Scoping)	Requested consideration of the SPZ that underlies the project, as this is used for water abstraction purposes. As a nationally and regionally significant scheme, the applicants should follow 'The Environment Agency's approach to groundwater protection' (hereafter referred to as 'the Environment Agency's approach') in relation to protection of drinking water supply from United Utilities' groundwater abstractions.	SPZs are described in **section 1.6.5** of this chapter and impacts posed by the Transmission Assets are assessed in **section 1.11**. The characterisation of risks posed to groundwater discussed within **section 1.11** of this chapter follows guidance given in the Environment Agency guidance (Environment Agency, 2018).
June 2023	Blackpool Council (data request)	Contaminated land register. There is no land in the Borough of Blackpool that is registered under part 2A of the Environmental Protection Act 1990.	No action required.

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		Private water supplies. There is one known private water supply located at the Metropole Hotel, Blackpool.	This lies outside the study area (see **section 1.4**) and therefore is not considered further.
June 2023	Fylde Council (data request)	Contaminated land register. There is one site in the contaminated land register - Thames Street.	This is described and assessed within **paragraph 1.6.6.7**.
		Private water supplies. There is one known private water supply known as 'The Bush, Pool Lane, Warton'.	This lies outside the study area outlined in **section 1.4** and therefore is not considered further.
June 2023	South Ribble Borough Council (data request)	Contaminated land register. There is no land in the same designated area for South Ribble Borough Council that is designated as contaminated land.	No action required.
		Private water supplies. There are no known private water supplies in the designated area for South Ribble Borough Council.	No action required.
N/A	Preston City Council (data request)	Contaminated land register. No response received.	No action required.
		Private water supplies. No response received.	No action required.
June 2023	Environment Agency (data request)	Licensed water abstractions. Details of 12 licensed abstractions within the study area.	All data relevant to the study area are provided within **section 1.6**.
		Consented discharges. None.	
		Data on the national monitoring network. None.	
		Historic or authorised landfills. Details of 23 historical or authorised landfill sites (of which six fall within the Onshore Order Limits).	
		Environmental pollution incidents. Details of 536 recorded environmental pollution incidents within the study area.	
		Industrial waste sites. Details of 18 waste management licences.	
		Sites with current exemption. Details of 315 registered waste exemptions within the study area.	

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
November 2023	Natural England (Section 42)	Further evidence required to determine presence of deep peaty soils. Natural England advises that either further information is provided to demonstrate the extent of deep peat in the area of the cable route, or that the proposed developments are amended to avoid any work within these particular areas.	Peaty soils are considered within Volume 3, Chapter 6: Land use and recreation of the ES.
November 2023	Natural England (Section 42)	Consider changes to the water table at Lytham St Annes Dunes SSSI.	The impact of changes in water levels at Lytham St Annes Dunes SSSI is considered within **section 1.11.9**.
November 2023	Natural England (Section 42)	The proposed development description – does not provide detail as to what is happening at Fairhaven (adjacent to RSPB Fairhaven Lakes). Part of this area falls within the geological site – Lytham Coastal Changes SSSI. Provide further detail for this area in the submitted ES.	Characterisation of all SSSIs present within the study area is set out in **section 1.6.2.** The assessment for relevant sites, including Lytham Coastal Changes SSSI, is provided in **section 1.11.2.** It has however, been concluded that there will be no impact on Lytham Coastal Changes SSSI, which lies outside the Transmission Assets Order Limits. The section of the Transmission Assets Order Limits adjacent to RSPB Fairhaven Lakes is proposed for ornithological mitigation. Refer to Volume 3, Chapter 4: Onshore and intertidal ornithology of the ES for further details.
November 2023	Natural England (Section 42)	As the proposed cabling route falls within an area of deep peaty soils, Natural England advises that the developer provides information detailing the presence or absence of peat along the cable route. Natural England do not support the principle of developing on peat. Peat is an irreplaceable asset that once gone is lost for ever and can never be restored to sequester carbon which is difficult to justify in a climate emergency.	Peaty soils are considered within Volume 3, Chapter 6: Land use and recreation of the ES.

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		Natural England therefore advises that either further information is provided to demonstrate the extent of deep peat in these areas or that the proposed developments are amended to avoid any work within these particular areas.	
November 2023	Natural England (Section 42)	One of main justifications of having less significant impact on ecological receptors is the use of Horizontal Directional Drilling (HDD) or alternative trenchless techniques, however no evidence is provided within the report why this approach is less intrusive and will have less impact. Further evidence should be provided regarding this approach, to set out why using these techniques will have less of an impact including description, predicted noise levels, operation, and methodology.	The impact on the groundwater levels, flow or quality at Lytham St Annes Dunes SSSI is considered within **section 1.11.9** Impacts on ecologically designated sites (at the dunes and the River Ribble) are considered in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES.
November 2023	Natural England (Section 42)	There is a lack of consideration of other impacts to Lytham St Annes Dunes SSSI, particularly with regards to changes to the water table. Depending on the depth of cable installation the impacts of HDD on the dune water table (i.e., the cable resulting in the dune slacks becoming drier changing the species composition) should be considered. The effects of surface water run-off should also be considered. Consider changes to the water table at Lytham St Annes Dunes SSSI.	Potential impacts on the groundwater water levels within the superficial deposit aquifer unit are provided within **section 1.11.4.** Further consideration of the impact the changes in water levels may have on the Lytham St. Annes Dunes SSSI is considered within **section 1.11.9**.
November 2023	United Utilities	The application boundary for the transmission assets extends to include sandstone rock, designated as a groundwater source protection zone (SPZ 3). These are used for the abstraction of water for public water supply purposes. We request that the approach to the assessment of the impact on the groundwater environment is considered and agreed with United Utilities.	SPZs are described in **section 1.6.5** of this chapter and impacts posed by the Transmission Assets are assessed in **section 1.11**.
November 2023	United Utilities	As a nationally and regionally significant scheme, the applicants should follow 'The Environment Agency's approach to groundwater protection' 1 (hereafter referred to as 'the Environment Agency's approach') in relation to protection of drinking water supply from United Utilities' groundwater abstractions.	The characterisation of risks posed to groundwater discussed within **section 1.11** of this chapter follows guidance given in the Environment Agency guidance (Environment Agency, 2018).

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
November 2023	United Utilities	Where the proposed development impacts on a sensitive location within a SPZ, relating to a drinking water abstraction resource (including those not currently in use for public water supply purposes but may need to be activated in the future), United Utilities may require a 'Hydrogeological Risk Assessment' for the specific borehole abstraction and intersection with the cable route. This risk assessment should form part of the Environmental Statement and identify the pollution and ground disturbance impacts on the SPZ and set out pollution prevention mitigation measures that will be needed, both during construction and during the operational life of the proposed development. The risk assessment should fully consider any related development activities and mitigation.	SPZs are described in **section 1.6.5** of this chapter and impacts posed by the Transmission Assets are assessed in **section 1.11**.
November 2023	United Utilities	Storage of hazardous Substances The risks posed by storage and distribution of fuels, chemicals and wastes from the proposed development, should also be assessed for the risk to groundwater abstractions (Environment Agency Position Statement Section D). Confirmation is sought that no storage facilities are proposed within the Groundwater SPZs. Following confirmation from the applicants as to whether the high voltage cables will be filled with fluid, we will require an assessment of the hazards these substances pose to the environment, during installation and maintenance, and following any chemical alteration due high-voltage use.	Change in groundwater quality through accidental release or spillage of potentially polluting substances is assessed in **section 1.11.8** in terms of the most sensitive receptor (the shallow sand and gravel aquifer). The groundwater SPZ relates to abstraction from the Permo-Triassic sandstone principal aquifer and in line is protected by a thick sequence of low permeability deposits.
November 2023	United Utilities	Significant earthworks and excavations The risks posed within a SPZ, by removing Made Ground/Topsoil and Superficial Deposits from an area up to 120m wide during cable laying operations piling towards Rockhead, or by the tunnelling of the River Ribble should be considered. If these create significant new pathways to the aquifer, a Hydrogeological Risk Assessment may be required for the relevant section of the cable route.	Details of the measures proposed to avoid and reduce impacts are set out in **section 1.8**.
November 2023	United Utilities	Groundwater Control Short term dewatering or longer term Groundwater Control may pose a risk of contaminant movement towards aquifer Rockhead, particularly where	Subject to landowner approval, at detailed design stage, hydrogeological risk assessment(s) will be undertaken at St Annes Old Links Golf Club, if

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		superficial deposits are shallow, or granular. A desk study should be targeted on proposed areas of tunnelling and the crossings of soft and compressible deposits, sensitive to changes in groundwater levels. Assurance is sought that granular and permeable Artificial and Superficial Deposits do not provide pollutant pathways to the aquifer, for surface contamination. In particular, that Ground Investigation data indicates that Glacial Clay provides adequate protective cover over the abstracted aquifers.	necessary. This would inform a detailed site specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI and the St Annes Old Links Golf Course. Full details of the measures proposed are set out in **section 1.8**.
November 2023	United Utilities	Construction Environmental Management Plan The applicants should follow best practise in their use and storage of fuels, oils, chemicals and other wastes, to remove the risk of causing pollution during construction and operation of the scheme. This should be included in a Construction Environmental Management Plan (CEMP). This will need to be specific to the environmental setting of the area and should fully reflect the implications of a location within a SPZ.	Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as part of the application for development consent (document reference J1.4). This forms an annex to the Outline Code of Construction Practice (CoCP) (document reference J1).
November 2023	United Utilities	Contaminated Land United Utilities requests that the assessment of potential environmental impact from contamination fully considers the impact on our assets, water resources and water quality as a result of construction of the proposed development.	A preliminary risk assessment is provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. A ground investigation will be completed with an assessment of the potential risks arising from any contamination identified and a remediation strategy prepared as necessary as set out in **section 1.8**.
November 2023	Lancashire County Council	Policy The application should demonstrate that the proposed development will fully comply with the requirements of all relevant national and local planning policy.	Details of the overarching policy context are set out in Volume 1, Chapter 2: Policy and legislation context of the ES. National and local policy relevant to geology, hydrogeology and ground conditions is set out in **section 1.2** of this chapter. Further details of policy compliance can be found in the Planning Statement (document reference J28).

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
November 2023	Canal and River Trust	<u>Underground Cabling</u> We would expect any waterway crossing (pipes, cables etc) to be installed under the waterway and cross perpendicular to the waterway. We would normally expect such crossings to be constructed via trenchless techniques and the crown of the crossing would need to be at least 3.5m below hard bed level of the waterway to ensure any settlement does not impact the waterway. However, this could crossing require a greater depth, depending on the results of the borehole/geotechnical information provided. This would mean that the launch and reception pits would be set well away from the waterway to allow the HDD to achieve the required depth. The route and depth of any such crossing, method statements, construction techniques and associated ground investigations will need to be approved by the Trust's geotechnical specialists, all via the CoP process.	All Environment Agency main rivers would be crossed using trenchless techniques, as set out in **section 1.8** and in Volume 1, Annex 3.2: Onshore crossing schedule of the ES. Any works that affect Canal and River Trust waterways or land will comply with the Canal & River Trust 'Code of Practice for Works affecting the Canal & River Trust'. Further details of all commitments are provided in **section 1.8**. Impacts on all watercourses in terms of water quality are considered in Volume 3, Chapter 2: Hydrology and flood risk of the ES. Impacts on the watercourses as ecological receptors are set out in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES. Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as part of the application for development consent (document reference J1.4). This forms an annex to the Outline CoCP (document reference J1).
November 2023	Canal and River Trust	<u>Pollution prevention</u> The canal/brook should be considered as a sensitive receptor as a watercourse. A robust and comprehensive Construction Environment Management Plan (CEMP) would be required to include aspects of how materials, fuels, chemicals and wastes will be stored and where; measures for the prevention of dust generation and windblown litter and debris; measures to prevent run off into the canal and culverts (e.g. of silt water, contaminated water, fuels and chemicals); pollution response emergency procedures and details of any planned water abstractions and/or discharges from or which may impact upon our waterways. Stockpiles must be kept away from the waterway and drainage Systems to reduce potential sediment ladened runoff entering the waterways. Silt curtains should also be used to stop surface water runoff. Where the works require stripping topsoil and removing vegetation, such as grass, silt curtains should be kept in place to protect against surface water runoff until sufficient vegetation has grown back on the reinstated topsoil to stabilise the soil and to act as a natural buffer. Site excavations will likely need to be dewatered, these cannot be discharged to the canal/brook without our consent. Discharges to land will need to be kept away from waterways.	

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
November 2023	National Farmers Union	Heat Dissipation – Heat dissipation, which can impact the land for the lifetime of the project, is a concern among farmers affected by the scheme. Please can you confirm the measures taken to reduce the impact of heat dissipation on the scheme.	Heat generation by the cables during the operational phase is considered in **section 1.11.12.**
November 2023	Environment Agency (National Infrastructure Team)	Groundwater: The impacts of the proposals on groundwater-dependant habitats of Lytham St Annes dunes SSSI have not been assessed.	The impact on Lytham St Annes Dunes SSSI is considered within **section 1.11.9**.
November 2023	Environment Agency (National Infrastructure Team)	Issue Lack of clarity regarding where details of permanent pollution measures (ie interceptors) at the substations will be included. The Outline Operational Onshore Substation Drainage Management Plans will consider drainage from a flood risk perspective but there is no mention as to whether these would also detail permanent pollution prevention at these sites. Impact Risk of pollution to the aquatic environment arising from uncontained incidents (e.g. fire breakout) from substation sites. Solution Provide clarity as to how details regarding permanent pollution measures will be considered and covered.	Measures are provided within the Outline Operational Drainage Management Plan provided as part of the application for development consent (document reference J10). Further details are provided in **section 1.8**.
November 2023	Environment Agency (National Infrastructure Team)	Issue The section describing HDD does not include clarity regarding which document will consider the management of effluent arising from HDD (potential contamination with soil conditioners etc), or from any subsequent dewatering activity. Impact Lack of clarity may result in pollution risk to the aquatic environment.	Details regarding the trenchless techniques proposed are provided within Volume 1, Chapter 3: Project description of the ES and in Volume 1, Annex 3.2: Onshore crossing schedule of the ES. Details of controls on bentonite use are set out in the Outline Bentonite Breakout Plan provided as part of the application for development consent (document reference J1.13). Pollution prevention measures are provided within the Outline Pollution Prevention Plan provided as

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		Solution If no such effluent is expected then this should also be clearly stated.	part of the application for development consent (document reference J1.4). This forms an annex to the Outline CoCP (document reference J1).
November 2023	Environment Agency (National Infrastructure Team)	Issue No reference to the presence of emergency spill kits. Impact Risk of pollution to the aquatic environment. Solution Ensure that either the Onshore Pollution Prevention Plan or the Spillage and Emergency Response Plan mentions the requirement for emergency spill kits to be provided.	An Outline Spillage and Emergency Response Plan is provided as part of the application for development consent (document reference J1.8). This forms an annex to the Outline CoCP (document reference J1).
November 2023	Environment Agency (National Infrastructure Team)	Issue Unknown geophysical conditions with the potential for unexpected boulders in the underlying Glacial Till under the River Ribble could result in the HDD process to stop or loose direction. Impact Lost circulation could result in drilling muds discharged via river bottom sediments into the River Ribble. Solution Complete geophysical surveys to understand the relationship of the stratigraphy to be penetrated. (NB previous surveys associated with previous pipeline activity may be available to supplement new research).	Details regarding the trenchless techniques proposed are provided within Volume 1, Chapter 3: Project description of the ES and in Volume 1, Annex 3.2: Onshore crossing schedule of the ES. Where areas of potentially significant contamination (e.g. landfills) cannot be avoided within the Transmission Assets Order Limits, ground investigation or other appropriate measures (e.g. use Personal Protective Equipment and/or hazard signage) will be implemented to mitigate potential impacts to, or effects on sensitive receptors. Where ground investigation identifies potential risks to sensitive receptors from contamination, a remediation strategy would be prepared in consultation with the Environment Agency. Details of the measures proposed are set out in **section 1.8**.
November 2023	Environment Agency (National Infrastructure Team)	Issue In the area to the north of the River Ribble continuous landfilling has taken place either with or without containment and/or significant capping. Waste types may have included Low Level Radioactive Waste, therefore detailed and specific investigation and appropriate HSE should be employed as	

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		stated, further investigation from historical nuclear disposal may also be necessary. The proximity of landfills to where the cable is proposed to cross the river provides a risk of contaminated groundwater connecting via the bore to the surface waters in the river, depending on the system to be utilised to undertake the drilling. Impact A pathway could be established between contaminated groundwaters and surface waters of the River Ribble. Solution Where HDD is proposed especially on or about the River Ribble, consideration in respect of the 'set back' of the drill pad entry spot should be considered further. The high permeability of shallow formations adjacent to the River corridor may require that the points of penetration and egress are previously treated by cementing with grout to form an impermeable base to aid controlled circulation within the proposed bore. This again to prevent possible contamination	
November 2023	Environment Agency (National Infrastructure Team)	Impact Ground conditions are currently an unknown risk. Thus establishing appropriate mitigation is not possible at this time and the environment is at risk. Solution Code of construction practice will include '…details of appropriate studies (e.g., Site Investigations) proposed to be undertaken where major HDDs (or other trenchless methodologies) are proposed, during the detailed design stage to confirm ground conditions.	A preliminary risk assessment is provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. Effects associated with existing contamination are considered in **sections 1.11.3**, **1.11.7** and **1.11.10**. An Outline Contaminated Land and Groundwater Discovery Strategy has been submitted with the application for development consent (document reference J1.14), to identify any suspected areas of contamination and any remedial measures which may be required. Further details are provided in **section 1.8.**

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
November 2023	Environment Agency (National Infrastructure Team)	Issue A current licensed abstraction has been omitted: 2671353003. ROYAL LYTHAM AND ST ANNES GOLF CLUB LAND HOLDINGS LIMITED (Also not listed in table 1.3 of Volume 3 annex 1.1. Spatially it is close to GWA_03 and 05) Impact Not considered further in document. Solution Include abstraction and update document as required.	Details of abstraction within the study area are set out in **section 1.6.5**. The abstraction highlighted in this response is not located within the study area.
November 2023	Environment Agency (National Infrastructure Team)	Issue Groundwater flow direction is stated as being orientated to the north east. This is almost certainly incorrect and will be towards the Ribble. Impact Likely inaccurate conceptualisation may have affect subsequent assessment of impact of works on abstractions/groundwater dependent features. Solution Update report to include that the base/natural flow direction is to the Ribble in that part of the aquifer. Then consider any changes needed elsewhere in document.	The groundwater flow this relates to is within the sandstone Principal aquifer of the Sherwood Sandstone Group. The groundwater flow within the superficial aquifer will be towards the River Ribble. This is discussed in **Table 1.12** and **Table 1.14**.
November 2023	Environment Agency (National Infrastructure Team)	Issue This is not considered correct. Lytham St. Anne's Dunes SSSI itself will be groundwater dependent. The citation states: 'The series of exceptionally large and extensive dune slacks on either side of Clifton Drive North support a wide range of species which vary according to the depth of water and degree of moisture retention in relation to the water table.' Impact	The impact on Lytham St Annes Dunes SSSI is considered within **section 1.11.9**.

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		Potential impacts on this feature have not been considered or subsequently mitigated. Solution Regard this feature as being groundwater dependent and consider further. Include ref to Section 1.9.9 in Table 1.25.	
November 2023	Environment Agency (National Infrastructure Team)	Issue Groundwater Dependent Terrestrial Ecosystem (GWDTE) Test for both quantitative and chemical tests. The SSSI at Lytham St Annes is groundwater dependent and will interact with the groundwater. Table 1.11 has scoped these aspects out. Volume 3, Chapter 1: Geology, Hydrogeology and ground conditions had also overlooked the groundwater interaction of the SSSI. Impact Potential adverse WFD impacts. Solution Consider impacts and potential mitigation options for the SSSI at Lytham St Annes.	The impact on Lytham St Annes Dunes SSSI is considered within **section 1.11.9**.
November 2023	Environment Agency (National Infrastructure Team)	An Outline Onshore Pollution Prevention Plan will form part of the Outline Code of Construction Practice, which will be prepared and submitted with the application for development consent. Onshore Pollution Prevention Plan s) will be developed in accordance with the Outline Onshore Pollution Prevention Plan and will include details of emergency spill procedures. Good practice guidance detailed in the Environment Agency's Pollution Prevention Guidance notes (including Pollution Prevention Guidance notes 01, 05, 08 and 21) will be followed where appropriate, or the latest relevant available guidance. Issue Pollution prevention risks have yet to be fully addressed. Impact	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT04).

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		There remains a risk of detrimental impact on the aquatic environment. Solution Outline onshore pollution prevention plan to be secured in the Development Consent Order (DCO) submission.	
November 2023	Environment Agency (National Infrastructure Team)	Issue It is unclear how the choice of a minimum vertical clearance of 2m between the hard bed of watercourses and any flood defences has been derived and this may not be sufficient in some instances. Impact Geomorphologically active rivers, together with the impact of increased peak river flows can result in erosion and bed incision and subsequent exposure of infrastructure. Solution Demonstrate an understanding of channel morphology and bed material to inform HDD strategies.	It is noted within the Defra document Exempt flood risk activities: environmental permits (Section 3) (Defra, 2020) that service crossings are to be at least 1.5 m below the riverbed along its whole length. We have used the guidance to inform the depth of trenchless techniques below the hard bed of watercourses and any flood defences.
November 2023	Environment Agency (National Infrastructure Team)	A Contaminated Land and Groundwater Discovery Strategy will be prepared to identify any suspected areas of contamination and any remedial measures which may be required. The strategy will also identify the construction protocol for discovery of any currently unknown contamination and any remedial measures that may be required. Issue Measures required to manage contaminated land and groundwater have yet to be fully addressed. Impact Risk of pollution to ground and surface water. Solution Outline Contaminated Land and Groundwater Discovery Strategy to be to be secured through DCO requirement.	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT 30).

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
November 2023	Environment Agency (National Infrastructure Team)	An Outline Code of Construction Practice (CoCP) will be prepared and submitted with the application for development consent. CoCP(s) will be developed in accordance with the outline CoCP. The CoCP will include measures to maintain and address: - pollution prevention; - geology and ground conditions; - soil management; and - bentonite breakout plan. Issue Measures required to manage environmental risks have yet to be fully addressed. Impact Risk to the environment. Solution Outline versions of various Plans to manage environmental risks to be appended to Outline CoCP and secured in the DCO submission.	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT35).
November 2023	Environment Agency (National Infrastructure Team)	Where the onshore export cable corridor or 400 kV grid connection cable corridor crosses sites of particular sensitivity (e.g. embanked Environment Agency surface watercourses, Sites of Special Scientific Interest or groundwater inner Source Protection Zones) a hydrogeological risk assessment will be undertaken to inform a site-specific crossing method statement which will also be agreed with the relevant authorities prior to construction. Issue Measures to manage hydrogeological risk have yet to be fully developed, and relevant locations have yet to be identified. Impact Risk to the environment.	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT41).

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		Solution Secure through DCO requirement.	
November 2023	Environment Agency (National Infrastructure Team)	An Outline Code of Construction Practice (CoCP) will be prepared and submitted with the application for development consent. CoCP(s) will be developed in accordance with the outline CoCP. Where required, trenched techniques may be used for minor ditches or smaller watercourses that are frequently dry. In these cases, measures will be implemented to protect water quality and flow and these will be detailed within the outline CoCP. Issue Measures to protect water quality and flow during trenched crossing of minor watercourses have yet to be fully developed. Impact Risk to the environment. Solution Measures to be included in Outline CoCP and secured in the DCO submission.	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT86).
November 2023	Environment Agency (National Infrastructure Team)	The Outline Code of Construction practice (CoCP) will be submitted as part of the application for the development consent. CoCP(s) will be developed in accordance with the outline CoCP. The outline CoCP will include details of appropriate studies (e.g. Site Investigations) proposed to be undertaken where major HDDs (or other trenchless methodologies) are proposed, during the detailed design stage to confirm ground conditions. Issue Detailed understanding of localised ground conditions has yet to be completed. Impact Unknown ground conditions may impact on HDD activity resulting in detrimental impacts on the environment. Solution	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT94).

Date	Consultee and type of response	Comment raised	Response to comment raised and/or where considered in this chapter
		Secure through DCO requirement.	
November 2023	Environment Agency (National Infrastructure Team)	Where suspected contamination is present and piling is proposed, where required a detailed piling risk assessment will be developed prior to the commencement of construction. Consultation with the Environment Agency will be sought. Issue Relevant locations, and measures required to prevent pollution of controlled waters have yet to be fully developed. Impact Potential for groundwaters pollution pathways to be created. Solution Secure through DCO requirement.	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT103).
November 2023	Environment Agency (National Infrastructure Team)	Where the onshore export cable corridor and/or 400 kV grid connection corridor crosses sites of particular sensitivity, which cannot be avoided and has the potential to impact protected species populations, a mitigation strategy will be devised and agreed with relevant stakeholders. Issue Measures to protect water quality and flow during trenched crossing of minor watercourses have yet to be fully developed. Impact Risk of impact on sensitive species or habitats. Solution An Outline Mitigation Strategy to be included in DCO submission.	This commitment remains in place. Details of the measures proposed are set out in **section 1.8** (see CoT41).

1.4 Study area

1.4.1.1 This section defines the areas within which geology, hydrology and ground conditions receptors may be affected by the Transmission Assets. The study area for this assessment extends to an area of 1 km around those parts of the Transmission Assets Order Limits that fall within the scope of this chapter (landward of MLWS), including the following.

- The Transmission Assets Order Limits: Onshore. The area within which all components of the Transmission Assets landward of Mean High Water Springs will be located, including areas required on a temporary basis during construction and/or decommissioning (such as construction compounds). Also referred to in this report as the Onshore Order Limits, for ease of reading.
- The Intertidal Infrastructure Area. This includes all elements of the Transmission Assets landward of MLWS where construction, operation and maintenance and decommissioning activity will occur.

1.4.1.2 The study area of 1 km buffer around these areas is shown on Figure 1.1 (see Volume 3: Figures). This buffer is based on professional judgement and environmental data screening distances.

1.5 Baseline methodology

1.5.1 Methodology for baseline studies

Desk studies

1.5.1.1 A comprehensive desk-based review was undertaken to inform the baseline for geology, hydrogeology and ground conditions. The existing studies and datasets referred to as part of the desk-based review are summarised in **Table 1.5**.

Table 1.5: Summary of desk study sources

Title	Source	Year	Author	Notes
GeoIndex Onshore	British Geological Survey (BGS) Map Viewers	-	BGS	Informs the geological setting.
Sheet 75: Preston (Bedrock and Superficial), 1:50,000 Scale.	BGS Map Viewers	2012	BGS	Informs the geological setting.
Geology of the country around Preston: Explanation of sheet 75.	BGS Memoir Portal	1978	BGS (Price *et al.*, 1978)	Informs the geological setting.
Sheet 74: Southport (Solid alongside Drift), 1:50,000 Scale.	BGS Map Viewers	1998	BGS	Informs the geological setting.

Title	Source	Year	Author	Notes
The geology of Southport and Formby: Explanation of sheets 74 and 83.	BGS Memoir Portal	1948	BGS (Wray *et al.,* 1948)	Informs the geological setting.
Geology of the country around Blackpool. Explanation of sheet 66.	BGS Memoir Portal	1990	BGS (Wilson and Evans, 1990).	Informs the geological setting.
Protected Sites (Sites of Scientific Interest, Special Areas of Conservation, Special Protection Areas, Ramsar)	Magic Maps; and Groundsure Enviro-Geo Insights Report	-	Natural England, Joint Nature Conservation Committee	Consideration of ecological receptors.
Geological Conservation Review (GCR) sites	Geological Conservation Review. CSV Database	2019	Joint Nature Conservation Committee	Consideration of geological receptors.
Notified Local Geodiversity Sites in Lancashire	GeoLancashire Database	-	GeoLancashire	Consideration of geological receptors.
Mineral resource map for Lancashire	BGS onshore mineral resource maps		McEvoy *et al.* (2006).	Consideration of mineral resources.
Aquifer designation – Bedrock and Superficial Deposits; Groundwater vulnerability; Groundwater safeguard zones Source Protection Zones.	Magic Maps	-	Defra	Informs the hydrogeological setting and consideration of groundwater receptors.
Source Protection Zones	Magic Maps and Data Services Portal	-	Defra	Consideration of groundwater receptors.
The physical properties of major aquifers in England and Wales	NERC Open Research Archive (NORA)	1997	British Geological Survey (Allen *et al.*, 1997)	Informs the hydrogeological setting.
The physical properties of minor aquifers in England and Wales	NERC Open Research Archive (NORA)	1997	British Geological Survey (Jones *et al.*, 1997).	Informs the hydrogeological setting.
Mineral Safeguarding Areas in Lancashire	MARIO – Maps and Related Information Online	-	Lancashire County Council	Consideration of mineral resources.
Water Framework Directive (WFD) groundwater bodies (Cycle 3 – 2019)	Catchment Data Explorer	-	Environment Agency	Informs the hydrogeological setting and consideration of groundwater receptors.

Title	Source	Year	Author	Notes
WFD river water bodies (Cycle 3 – 2019)	Catchment Data Explorer	-	Environment Agency	Informs the hydrological setting and consideration of surface water receptors.
Groundwater and surface water quality	Water Quality Archive	-	Defra	Informs the hydrogeological/hydrological setting.
Main Rivers in England	Statutory Main River Map	-	Environment Agency	Informs the hydrological setting and consideration of surface water receptors.
Groundsure Enviro-Insights Report including historical maps and aerial photography	Groundsure	2023	Produced by Groundsure based on dataset sets relevant to the Environment and Ground Conditions.	Informs baseline ground conditions and consideration of contamination sources and sensitive receptors.

1.5.1.2 This desk-based review is underpinned by the information and assessments provided in the Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.5.1.3 Local authorities were contacted regarding records within the contaminated land register has been undertaken and responses received. Details of ground conditions are provided in **section 1.6.6** of this chapter.

1.5.1.4 Geological conditions have been determined from mapped British Geological Survey (BGS) data. This has been augmented with local geological records provided by the BGS. Regionally important and locally important geological and geomorphological sites have been identified, where present.

1.5.1.5 Aquifer units in the bedrock geology and superficial deposits have been identified from information provided by the Environment Agency. Water Framework Directive (WFD) waterbodies (groundwater and surface water) have been identified and their status determined. Groundwater dependent receptors have then been identified through a review of Ordnance Survey mapping and consultation. These include, where relevant, groundwater abstractions (licensed sources and private water supplies); groundwater SPZs; and groundwater dependant ecological sites, such as watercourses, pond, lakes and springs.

1.5.1.6 Ground conditions have been identified using the information provided in a Groundsure Enviro-Geo Insights report. Features detailed within the Groundsure Enviro-Geo Insights report relevant to geology, hydrogeology and ground conditions include:

- historical land use (Ordnance Survey mapping and aerial photography);
- current and historical waste and landfill sites;
- current and historical industrial land use (Ordnance Survey mapping and aerial photography);
- hydrogeology (including aquifers, groundwater abstractions and SPZs);

- groundwater flooding;
- pollution incidents;
- discharge consents;
- abstraction licenses;
- environmental designations;
- natural ground subsidence; and
- mining, ground workings and natural cavities.

1.5.1.7 A qualitative ground condition constraints assessment has been undertaken to evaluate this data and presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

Site-specific surveys

1.5.1.8 Ground investigation was undertaken at the St Annes Old Links golf course and on the beach adjacent to Lytham St. Annes SSSI. This information has primarily been used to confirm the conditions identified during the desk study and inform the assessment relating to impacts on Lytham St Annes SSSI. It is considered that desk study data is sufficient to establish baseline conditions and inform the assessment pertinent to the remainder of the study area.

1.6 Baseline environment

1.6.1 Desk study

1.6.1.1 Information on geology, hydrogeology and ground conditions within the study area was collected through a detailed review of existing studies and datasets. These are summarised at **Table 1.5**.

1.6.1.2 The key datasets obtained are presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES and summarised in **section 1.5** above.

1.6.2 Designated sites

1.6.2.1 All sites within the study area designated for their geological or geodiversity value, and their qualifying interest features (forming the basis of which the designation is made) that could be affected by the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are set out in **Table 1.6**. Designated sites are also presented on Figures contained in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.6.2.2 This chapter assesses those groundwater-dependent ecologically designated sites that have not been scoped out within **Table 1.17**. The Lytham St Annes Dunes SSSI identified within **Table 1.6** is considered such a site. Remaining sites designated for their ecological and nature conservation value are not considered to be groundwater-dependent, as well as located within areas of

potential contamination and/or in areas of potential disturbance. These are considered in Volume 3, Chapter 3: Onshore ecology and nature conservation of this ES.

Table 1.6: Designated sites and relevant qualifying interests

Designated site	Distance to the Transmission Assets (nearest point)	Relevant qualifying interest
Lytham St. Annes Dunes SSSI	0 m (Within Onshore Order Limits)	This is listed as a biological SSSI (it is primarily designated for ecological and habitat interest). It is noted, however, that this site is cited as one of the best examples of a calcareous dune system remaining in Lancashire (as reflected in its local designations below).
Lytham St. Annes – Starr Hills Dunes Local Geodiversity Site (LGS) for Lancashire	0 m (Within Onshore Order Limits)	Coastal Dunes: Rare dune system. (Covers the same site as Lytham St. Annes Dunes SSSI, although boundary of the LGS is slightly smaller).
Lytham St. Annes. GCR site.	Closest site c. 155 m south of the Onshore Order Limits.	This GCR site is also designated as Lytham Coastal Changes SSSI. The Lytham St Annes GCR site presents an example of coastal Quaternary Geology. It includes a group of four separate sites within the town of Lytham St. Annes (at Fairhaven Dunes, Main Drain and Lytham Dock, Witch Wood and Government Offices) that provide the basic stratigraphical record of coastline changes represented by alternating organic and inorganic deposits.
Lytham Coastal Changes SSSI.	Closest site c. 155 m south of the Onshore Order Limits.	Geological SSSI. A group of four separate sites within the town of Lytham St. Annes (at Fairhaven Dunes, Main Drain and Lytham Dock, Witch Wood and Government Offices) that provide the basic stratigraphical record of coastline changes. The geological interest is preserved in sediments beneath the topsoil and sand dunes of the area and provides a record of sea-level changes which occurred during the Holocene.

1.6.3 Hydrology and topography

1.6.3.1 The section of the study area to the north of the River Ribble is located within the Ribble management catchment, whilst land to the south is located within the Douglas management catchment. Both management catchments are located within the wider north west river basin district.

1.6.3.2 The study area includes several Environment Agency Main Rivers and ordinary watercourses. These watercourses are designated WFD water bodies and include:

- Moss Sluice (also known as Liggard Brook) (Ref. GB112071065650);
- Main Drain (Ribble) (Ref. GB112071065651);
- Wrea Brook (Ref. GB112071065680);

- Dow Brook (Ref. GB112071065670);
- Mersey Mouth (Ref. GB641211630001);
- Ribble Estuary (Ref. GB531207112400);
- Deepdale Brook (Ref. GB112071065460); and
- Savick Brook (Ref. GB112071065470).

1.6.3.3 These WFD water bodies are all considered to be heavily modified and all have been classified with a WFD status of 'moderate ecological potential' in the most recent classification cycle (Cycle 3, 2022).

1.6.3.4 Ordnance Survey mapping also identifies land drains, streams and small ponds within the low-lying catchment of each of these WFD water bodies. The study area includes a high density of small, isolated ponds reflecting the local geology.

1.6.3.5 Further information on surface watercourses can be found within Volume 3, Chapter 2: Hydrology and flood risk of the ES and Volume 3, Annex 2.1: Water Framework Directive surface water and groundwater assessment of the ES.

1.6.3.6 The landfall for the Transmission Assets is located on the northern, coastal margin of the Ribble Estuary. Inland of the coast, the topography in the vicinity of the onshore export cable corridor crosses low-lying land (typically less than 15 m above ordnance datum) that is flat or gently undulating. Land rises gently to the north east, reaching elevations of approximately 50 m above ordnance datum. A topographic divide runs east to west towards the north of the study area. This divide defines the boundary between the catchment of the River Ribble and the River Wyre to the north.

1.6.3.7 The onshore export cable corridor and 400 kV grid connection cable corridor cross the small catchments of Liggard Brook, Wrea Brook, Dow Brook, Deepdale Brook and Savick Brook, which all flow southward to the River Ribble. To the north of the topographic divide, the Hillylaid Pool, Thistleton Brook, Lords Brook, Woodplumton Brook and the Barton (Westfield) Brook flow in a north/north westerly direction to their confluence with the River Wyre. The tidal River Ribble bisects the 400 kV grid connection cable corridor. Land then gently rises to the south east into the catchment of the River Douglas. This are shown in Figure 2.2 (Volume 3, figures).

1.6.4 Geology

1.6.4.1 The geology of the study area is dominated by a thick sequence of unconsolidated, superficial deposits that conceal the underlying bedrock. The superficial deposits exceed 30 m in thickness within the study area, as shown in geological cross-sections on Sheet 74: Southport (BGS, 1989) and Sheet 75: Preston (BGS, 2012).

1.6.4.2 The regional geological sequence is summarised in **Table 1.7** and presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

Superficial deposits

Glacial Till and Glaciofluvial Deposits

1.6.4.3 The surface superficial deposits within the study area are dominated by a Glacial Till deposits. Glacial till is an unconsolidated deposit that predominately comprises cohesive clays with some interspersed sands and gravel horizons. BGS regional mapping shows Glacial Till at the ground surface across the eastern half of the onshore export cable corridor and to the north and south of the onshore substations and 400 kV grid connection cable corridor in the east. The geological cross section provided on BGS Sheet 74 for Southport (BGS, 1989) and BGS Sheet 75 for Preston (BGS, 2012) shows that the Glacial Till can be thick, typically being 20 m to 30 m in the Lytham St. Annes area.

1.6.4.4 The Glacial Till in the local area has been divided into a cohesive 'upper boulder clay' and 'lower boulder clay'. These boulder clay horizons are separated by the granular 'middle sand' horizon. Boulder clay is the historical term for Glacial Till, reflecting the fact this clay-rich unit commonly contains large pebbles and boulders. Around Preston the upper boulder clay is between approximately 5 m to 15 m thick. It is generally a reddish or reddish brown slightly sandy clay with many boulders. The middle sand is typically thin. The thickness of the lower boulder clay is not reported in BGS geological memoirs for Sheet 74 or Sheet 75.

1.6.4.5 Small areas of Glaciofluvial Deposits are found in association with the Glacial Till. These granular glacial deposits are of very localised extent in central and northern parts of study area. These deposits are described as sand and gravel deposits interspersed with finer grained layers and/or lenses of clay, silt and organic material.

Blown Sand Deposits

1.6.4.6 In the landfall area and the area immediately inland from the landfall (north of the Ribble Estuary), surface superficial deposits are dominated by Blown Sand. These unconsolidated, granular, deposits form naturally unstable dunes at the coast. These dunes become progressively stabilised by vegetation inland until they ultimately thin out upon peat, alluvium or Glacial Till (Wray *et al.,* 1948). It is these blown sand deposits (between MHWS and Blackpool Airport) that are the basis of the designation of geological and geomorphological protected sites within the study area (See **Table 1.6**).

1.6.4.7 As shown on the geological cross section shown on Sheet 74 for Southport (BGS, 1989), the blown sand deposits are only 2.5 m and 4 m thick (Wilson and Evans, 1990) and overlie thin peat deposits, tidal saltmarsh deposit or Glacial Till.

Table 1.7: Regional geology and hydrogeological classification within the study area

Era	Formation	Description	Thickness	Aquifer designation (Environment Agency)	BGS hydrogeological description
Superficial deposits					
Quaternary	Tidal Flat Deposits	Mud flat and sand flat deposits. Unconsolidated sediment, mainly mud and/or sand.	Not defined	Unproductive Strata	Not described.
	Peat	Anaerobic, waterlogged deposits of organic matter which has been partially carbonised.	Not defined	Unproductive Strata	
	Blown Sands	Aeolian deposits of fine to medium grained sands.	Not defined	Secondary A	
	Glacial Till (Devensian, diamicton)	Unconsolidated mixed deposit consisting of a clay, sand, gravel, and boulders.	Not defined	Secondary Undifferentiated	
	Glaciofluvial Deposits	Unconsolidated material by glacial river waters. Consists of boulders, gravel, sand, silt and clay.	Not defined	Secondary A	
	Saltmarsh Deposits	Fine-grained deposits of sand and mud with sporadic shelly layers and rhizoliths.	Not defined	Unproductive Strata	
	Alluvium	Sorted/semi-sorted clay, silt, sand and gravel deposited by a river, stream.	Not defined	Unproductive Strata	
	Head Deposits	Poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep. Can comprise gravel, sand and/or clay.	Not defined	Secondary Undifferentiated	

Era	Formation	Description	Thickness	Aquifer designation (Environment Agency)	BGS hydrogeological description
	Tidal River or Creek Deposits	Predominantly silts and clays but may also contain muds, sands, gravels and peat.	Not defined	Unproductive Strata	
Bedrock geology					
Triassic	Sidmouth Mudstone Formation	Breckells Mudstone Member Mudstone, reddish-brown, structureless, commonly brecciated, with common halite and gypsum.	(Mercia Mudstone Group (MMG) up to 1,350 m)	Secondary B	MMG: Low productivity aquifer. Yields below 0.5 litres per second (L/s). Quality can be highly mineralised.
		Kirkham Mudstone Member (Sidmouth Mudstone Formation: Dominantly red-brown mudstone and siltstone with common grey-green reduction patches and spots).	(MMG up to 1,350 m)	Secondary B	
		Singleton Mudstone Member: Halite and mudstone.	(MMG up to 1,350 m)	Secondary B	
	Tarporley Siltstone Formation	Interbedded siltstones, mudstones and sandstones in approximately equal proportions.	c. 20-60 m	Secondary B	
Permo-Triassic	Sherwood Sandstone Group	Sandstone, red-brown to yellow, generally pebble-free, fine- to medium-grained, cross-stratified.	Can be > 1,500 m	Principal	Highly productive aquifer. Principal aquifer measuring approximately 600 m thick and producing yields of 125 L/s. Water quality hard but otherwise good. Can become saline when confined by MMG.

Tidal Flat Deposits

1.6.4.8 BGS mapping shows a significant extent of comparatively thick Tidal Flat Deposits in two areas within the study area:

- the western end of the onshore export cable corridor where they outcrop along the coast and extend inland. Becoming concealed beneath blown sand deposits; and
- to the north and south of the River Ribble where it bisects the 400 kV grid connection cable corridor.

1.6.4.9 The Tidal Flat Deposits are typically dominated by muds and sand of a marine or estuarine origin. These deposits are commonly overlain by thinner layers of Saltmarsh Deposits or Tidal River/Creek Deposits.

Peat deposits

1.6.4.10 Organic peat deposits are a notable feature of the superficial deposits in the study area. They are particularly common in the west where they form a thin layer overlying Tidal Flat Deposits or Glacial Till and are commonly found beneath the blown sand. BGS mapping does not suggest the onshore or intertidal elements of the Transmission Assets are underlain by significant areas of peat deposits. However, peaty soils are likely to be present in the area.

Other minor deposits

1.6.4.11 Other superficial deposits are present within the study area but are of very limited spatial extent. Saltmarsh deposits and 'Tidal River or Creek Deposits' are associated with the tidal areas of the River Ribble and Ribble Estuary. Freshwater alluvium is found inland from the coast and is associated with inland surface water catchments described in **section 1.6.3**. Alluvium is a mixed deposit that is constrained to narrow strips along certain watercourses.

Bedrock

1.6.4.12 Bedrock underlying the landfall and the onshore export cable corridor is dominated by red mudstones of the Sidmouth Mudstone Formation of the MMG. The 400 kV grid connection cable corridor at the eastern end of the study area is underlain by bedrock comprising undifferentiated sandstones of the Sherwood Sandstone Group. The boundary between these key bedrock units is typically marked by geological faulting.

Local geological records

1.6.4.13 The expected geological sequence within the study area has been corroborated using borehole records from the BGS GeoIndex onshore platform. Geological logs for the identified boreholes have been identified within the study area and are provided in Appendix B of Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the

ES. The boreholes are also shown in figures contained within Volume 3, Annex 1.1.

1.6.4.14 The local geological sequence across the study area determined from these records is summarised in **Table 1.7**. These records generally confirm the expected geology, although they also demonstrate the following elements.

- Thick, near surface, sand and gravel deposits between landfall and Lytham Moss, often with a shallow and thin intervening peat horizon. These deposits are interpreted as blown sand and possible middle sands of the Glacial Till. These deposits extend further east than shown on BGS mapping but do become progressively confined by overlying clay-rich Glacial Till.
- Central and eastern sections of the onshore export cable corridor are dominated by clay-rich boulder clay at the surface and at depth.
- Presence of a surface or near surface sand and gravel horizon in the eastern part of the study area, around the onshore substations and the 400 kV grid connection cable corridor.
- A thick superficial sequence across the study area with a lower clay-rich 'boulder clay' layer above the bedrock.

Mineral Safeguarding Areas

1.6.4.15 The mineral planning policy for Lancashire is outlined in the Joint Lancashire Minerals and Waste Local Plan, Site Allocation and Development Management Policies (Blackpool Council, Blackburn with Darwen Borough Council and Lancashire County Council, 2013). Policy M2 specifically relates to the safeguarding of valuable mineral resources through the delineation of MSAs around deposits of:

- limestone;
- sand and gravel;
- gritstone (sandstone);
- shallow coal;
- brickshales; and
- salt.

1.6.4.16 A review of MSAs present shows they principally reflect the surface distribution of the Tidal Flat Deposits as shown on BGS mapping, with some small areas of Glaciofluvial Deposits and Head Deposits included. Given that underlying documents offer limited insight into the MSAs and the limited amount of viable mineral resource contained in Tidal Flat Deposits, it is considered these MSAs relate to underlying sand and gravel deposits shown to be present in the local geological records. The MSAs do not include surface extent of the Glacial Till or peat shown on BGS mapping. The blown sand deposits in the Blackpool and Lytham St. Annes area are also not identified as an MSA, as they are already sterilised beneath existing development in these areas.

1.6.4.17 The onshore export cable corridor crosses approximately 4.5 km of safeguarded mineral resource. The permanent elements of the onshore substations are situated generally outside of the MSAs (with the exception of a negligible overlap with the Morecambe onshore substation). The working compounds for the onshore substations would occupy approximately 4.25 ha of the MSA during the construction phase only.

1.6.4.18 The 400 kV grid connection cable corridor is situated above a large MSA, except where Glacial Till is present, south of the River Ribble around the existing National Grid Penwortham substation. The cable corridor would therefore cross approximately 13 km of safeguarded mineral resource. This MSA is extensive and occupies an area of approximately 950 hectares in total.

1.6.5 Hydrogeology

Aquifer units

1.6.5.1 Geological units are subdivided into the following aquifer units of differing importance by the Environment Agency.

- Principal Aquifer – a geological unit that provides a significant quantity of water that can support water supply and/or provide water to rivers, lakes and wetlands (baseflow) on a strategic scale. These aquifers are highly permeable and provide a high level of groundwater storage.
- Secondary A Aquifer – a geological unit that provides modest amounts of water, but the nature of the rock or the aquifer's structure limits their use. They support water supplies at a local scale rather than strategic scale (such as for private supplies) and remain important for rivers, wetlands and lakes.
- Secondary B Aquifer – dominated by lower permeability layers that may store and yield limited amounts of groundwater.
- Secondary (Undifferentiated) Aquifer – where it is not possible to apply either a secondary a or b definition because of the variable characteristics of the rock type, but generally have only a minor resource value.
- Unproductive Strata – geological units that have negligible significance for water supply or baseflow to rivers, lakes and wetlands. They consist of bedrock or superficial deposits with a low permeability that naturally offer protection to any aquifers that may be present beneath.

1.6.5.2 Aquifer classifications for geology in the study area are summarised in **Table 1.7** and shown on Figure 1.3 and 1.4 in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. **Table 1.7** also provides the hydrogeological description for each bedrock geological unit as provided by the BGS.

Superficial deposits

1.6.5.3 The blown sand deposits at the western end of the study area are designated as a Secondary A aquifer. As shown in **Table 1.7**, these granular surface deposits are commonly underlain by sand and gravel deposits that may be attributed to the middle sand of the Glacial Till. Together, these deposits form a locally important groundwater resource from which modest abstractions are made, typically for spray irrigation. Groundwater discharge from these shallow deposits is likely to contribute to flow in surface watercourses and other groundwater dependent features where present.

1.6.5.4 The sand and gravel deposits (middle sand) identified in the west of the study area do not appear to be designated as an aquifer unit by the Environment Agency. However, as seen at the western end of the study area, these deposits do appear to be able to support modest groundwater abstractions.

1.6.5.5 Much of the central area of the study area is underlain by clay-rich Glacial Till which is classified as a Secondary (undifferentiated) aquifer unit. The presence of groundwater in this clay-rich, low permeability material is restricted to localised granular lenses or layers. These granular deposits do not typically form significant groundwater bodies and the Glacial Till is not considered to be of significant resource value in the study area.

1.6.5.6 The granular Glaciofluvial Deposits found in association with the Glacial Till in the west, can form locally important groundwater bodies and are classified as a Secondary A aquifer unit. However, these deposits are of very localised extent in the study area and will not form significant groundwater bodies.

1.6.5.7 The Tidal Flat Deposits and peat are designated as unproductive strata and are not important from a groundwater perspective.

Bedrock

1.6.5.8 The majority of the study area is underlain by bedrock comprising the red mudstones of the MMG. These units are designated as a Secondary B aquifer and are of little groundwater resource value given that:

- groundwater is uncommon within these mudstones units; and
- the bedrock concealed beneath a thick sequence of low permeability Glacial Till.

1.6.5.9 The eastern end of the study area is underlain by bedrock comprising sandstones of the Sherwood Sandstone Group. These sandstone units are designated as a Principal aquifer and are exploited for water supply in the local area. This bedrock aquifer is also concealed beneath a thick sequence of superficial deposits, that include Glacial Till and Tidal Flat Deposits. These clay-rich deposits of low permeability separate the bedrock aquifer from shallow groundwater in the near surface deposits (where present) and groundwater dependent features at the surface (e.g., watercourses, springs and ponds).

Groundwater occurrence across the study area

1.6.5.10 The presence of groundwater across the study area has been determined from the borehole records taken from the BGS GeoIndex Onshore platform, as described in **section 1.6.4**, and abstraction data from the Groundsure Enviro-Geo Insights Report. Groundwater occurrence is described in the summary of baseline conditions provided in **Table 1.14.**

1.6.5.11 The near-surface granular superficial deposits in the west and east of the study area have been shown to contain groundwater. In the west, the blown sand deposits and middle sand deposits form a locally important aquifer that is used for water supply. There is no evidence of significant groundwater occurrence or abstraction in the Glacial Till that dominates the central section of the study area.

1.6.5.12 There is an absence of boreholes installed in the red mudstones of the MMG. This is consistent with the absence of groundwater resources within this geological unit.

1.6.5.13 There is groundwater within the sandstone aquifer of the Sherwood Sandstone Group. Abstractions used for water supply have been installed in this unit within the study area and the wider area. Details of these abstractions are provided in **Table 1.9**.

Water Framework Directive groundwater bodies

1.6.5.14 The study area crosses two WFD groundwater bodies defined for the Water Framework Directive. These groundwater bodies and their chemical and quantitative status (classified as good or poor) are summarised in **Table 1.8**.

Table 1.8: Summary of WFD groundwater bodies within the study area

Ref.	Name	Position in study area	Overall status*	Quantitative status*	Chemical status*
GB 41202G912700	West Lancashire Quaternary Sand and Gravel Aquifers Water Body	Coastline/landfall up to Freckleton. Western and central section.	Good	Good	Good
GB 41201G100500	Fylde Permo-Triassic Sandstone Aquifers Water Body	Eastern end of study area, comprising the 400 kV grid connection cable corridor to National Grid Penwortham substation.	Poor	Poor	Good

* WFD groundwater body status determined for Cycle 3 (2019)

1.6.5.15 The West Lancashire Quaternary Sand and Gravel Aquifers Water Body has good overall status. This water body comprises the blown sand and middle sand aquifer identified across the eastern half of the study area.

1.6.5.16 The Fylde Permo-Triassic Sandstone Aquifers Water Body has poor overall status. This relates to the quantitative status of this water body which is classified as poor with respect to its water balance. The reasons for not achieving good status are not defined on the Environment Agency catchment

explorer platform but are assumed to relate to abstraction from the sandstone principal bedrock aquifer in this area.

Groundwater abstraction

Licensed abstractions

1.6.5.17 A total of nine licensed groundwater abstractions have been identified within the study area. The location and details of these abstractions are provided in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES. Of the nine identified, only three licensed abstractions are currently active. Key details of those active abstractions and their location in relation to the Transmission Assets Order Limits are provided in **Table 1.9.**

Table 1.9: Summary of active licensed abstractions

Ref.*	Site name	Distance from Transmission Assets Order Limits	Aquifer unit	Details	Qualitative risk assessment#
GWA_01	The St Annes Old Links Golf Club Ltd	0 m (within the Onshore Order Limits)	Superficial deposits (Secondary A)	Within study area and the Onshore Order Limits near landfall. Golf club borehole for spray irrigation.	High
GWA_20	Penwortham Golf Club	980 m north west	Superficial deposits (Secondary A)	Golf club borehole for spray irrigation. North east of the 400 kV grid connection cable corridor, towards River Ribble.	Low
GWA_24	Penwortham Golf Club Ltd	980 m north west	Superficial deposits (Secondary A)		Low

* Ref. denotes the reference on Figure 1.3 and 1.4 in Volume 3, Annex 1.1: Phase 1 Geo-Environmental Preliminary Risk Assessment; # denotes the qualitative risk associated with construction activities, most notably dewatering. This has been estimated using Sichardt Equation for a well sorted sand aquifer.

1.6.5.18 One active abstraction is identified in the western end of the study area and located within the Onshore Order Limits, namely GWA_01. This licence authorises the abstraction of groundwater for spray irrigation at a local golf club. The review of local geological records indicates that the licensed abstraction will draw groundwater from the near-surface, granular aquifer formed by blown sand and middle sand deposits.

1.6.5.19 There are no licensed groundwater abstractions within the central section of the study area. This reflects the dominance of low permeability clay-rich Glacial Till in this area.

1.6.5.20 There are two active licensed abstractions at the eastern end of the study area. Both abstractions are located outside of the Onshore Order Limits but within the study area and relate to spray irrigation for a golf club. The aquifer from which they abstract groundwater is uncertain, but both are modest abstractions that could be supported by near surface sand deposits if present.

1.6.5.21 The remaining licensed abstractions at the eastern end of study area are historical and relate to waste management/disposal and dewatering.

Private groundwater supply sources

1.6.5.22 Given the presence of a shallow granular aquifer at the eastern and western end of the study area, there is some potential for rural properties to utilise small private water supplies that do not require an abstraction licence. Based on the information provided to date, including consultation with local authorities, no records of private water supplies have been identified within the study area. These are not therefore considered further at this stage.

Source Protection Zones

1.6.5.23 Groundwater supply sources are afforded protection by the Environment Agency through the delineation of SPZs. SPZs define the level of risk to the supply source from contamination. Three zones are defined below.

- Inner Protection (SPZ1) – 50 day travel time of pollutant to the source of abstraction or a default 50 m minimum radius.
- Outer Protection Zone (SPZ2) – 400 day travel time of pollutant to source of abstraction. This zone has a 250 or 500 m minimum radius around the source depending on the amount of water taken.
- Total Catchment (SPZ3) – The area around a supply source within which all the groundwater ends up at the abstraction point. This could extend some distance from the source point.

1.6.5.24 SPZs are used to protect groundwater from different activities through the planning process, as described in the Environment Agency's approach to groundwater protection (Environment Agency, 2018).

1.6.5.25 SPZs have been defined for a number of sources situated more than 4 km north east of the study area and are shown in Figure 1.3 of Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment. Although the sources are relatively distant from the Onshore Order Limits and Intertidal Infrastructure Area, the total catchment zone (known as SPZ 3) for those abstraction boreholes crosses the 400 kV grid connection cable corridor along the northern bank of the River Ribble. This relates to abstraction from the Permo-Triassic sandstone principal aquifer the flow direction in which is indicated to be to the north east at the points of abstraction.

Groundwater-dependent features

1.6.5.26 Groundwater-dependent features can include surface watercourses, ponds and lakes, springs and wetlands that receive a component of groundwater discharge from underlying aquifers. Ordnance Survey mapping has been reviewed to identify these features within the study area.

1.6.5.27 Between the landfall and the B5261 (Queensway), current land use is dominated by designated geological/ecological sites, a golf course and Blackpool Airport. The Lytham St Annes Dunes SSSI citation states that the

dunes support a wide range of species which vary according to the depth of water and degree of moisture retention in relation to the water table.

1.6.5.28 East of the B5261 (Queensway), the onshore export cable corridor crosses many land drains and small watercourses that drain the catchments of the small WFD water bodies that discharge to the River Ribble. This area is also characterised by the presence of many small, isolated ponds. There is little evidence of springs or groundwater-fed wetlands in this area.

1.6.5.29 In the east, the onshore substations and the 400 kV grid connection cable corridor are situated on areas of drained marsh. The 400 kV grid connection cable corridor and onshore substation sites in this area cross many land drains and small watercourses. There is very little evidence of springs or groundwater-fed wetlands in this area. Some ponds are present close to the onshore substation sites. However, both substations are adjacent to Savick Brook and situated on top of a mixture of tidal flat deposits and clay rich glacial till which is pockmarked by ponds from old clay pits. Therefore, it is unlikely that these have a material groundwater component.

1.6.5.30 For groundwater discharge to be important, the land drains and watercourses must be in continuity with nationally or locally important aquifers. Within the majority of the Onshore Order Limits, land drains, watercourses and small ponds are indicated to be underlain by clay rich deposits of Glacial Till or Tidal Flat Deposits. These geological units do not contain significant groundwater and therefore do not contribute significantly to surface flows and vice versa. This is evidenced by the large number of small, isolated ponds across the study area and the limited presence of shallow groundwater abstractions, reflecting the low permeability of the underlying superficial geology.

1.6.5.31 Groundwater-dependent features are therefore not considered particularly sensitive receptors across most of the study area, with the exception of Lytham St Annes Dunes SSSI.

1.6.6 Potential sources of contamination

1.6.6.1 Activities that may represent potential risk to land quality or groundwater quality, as presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES, are described below. This annex shows the feature identifications and their spatial representation.

Quarrying and mining

1.6.6.2 The Groundsure Enviro-Insights Report has provided a review of the following:

- surface ground workings from a review of the historic mapping; and
- location of ‘British Pits (BritPits)’ which are closed or active surface and underground mineral workings obtained from records of the BGS.

1.6.6.3 Many surface ground workings have been identified within the study area, with some located within the Onshore Order Limits. However, these features are typically very small and almost exclusively relate to ponds. Small ponds

are a common feature in the undeveloped parts of the study area and reflect the low permeability Glacial Till that dominate the surface geology.

1.6.6.4 There are 19 BritPits identified within the study area. BritPits identified within the Onshore Order Limits are limited to one located within an area proposed for use as biodiversity net gain enhancement and/or mitigation and a second associated with a former foreshore sand working on the beach at Lytham St Annes. These are shown within Figure 1.6 presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.6.6.5 The BritPits are typically recorded as being former clay or shale workings and they typically correlate with small surface ground workings of small spatial extent. Two of the BritPits relate to sites identified as historical landfills in other datasets reviewed.

1.6.6.6 It is noted that an application for an extension/continuation of the former sand working at the beach was submitted in 2022. This application has not progressed at this stage.

Designated contaminated land

1.6.6.7 Consultation with Fylde Brough Council has identified one site on the contaminated land register that falls within the study area. This site is located off Thames Street located adjacent to the Onshore Order Limits. The site is a former builder's yard contaminated with asbestos. Planning (reference 20/0357) was granted 30 July 2021 to develop the site as a residential caravan park. This area will not be disturbed during the construction, operation, maintenance or decommissioning phases of the Transmission Assets and is not considered further.

Landfill sites and licensed waste sites

1.6.6.8 A total of 23 active and historical landfill sites have been identified in the study area and these are summarised in **Table 1.10.** These are based on the information provided in the Groundsure Enviro-Geo Insights report and are shown within Figure 1.5 presented in Volume 3, Annex 1.1: Phase 1 Geo-Environmental Preliminary Risk Assessment of the ES.

Table 1.10: Active or historical landfills within the study area

RPS ID	Site name and status	Waste type accepted	Description
LF_01	Refuse Tip: Historical	Unknown	Unknown waste type but only c. 0.007 km^2 and situated adjacent to the Onshore Order Limits and near the landfall.
LF_02	Clifton Drive North, Near Blackpool Airport, Lytham, St. Annes: Historical	Unknown	Unknown waste covering area of c. 0.002 km^2 and located within the Onshore Order Limits.
LF_03	Leach Lodge Farm, Leach Lane, Blackpool Road North, St Annes: Historical	Industrial, Commercial	Possible biodegradable waste mass, located across the Onshore Order Limits.

RPS ID	Site name and status	Waste type accepted	Description
LF_04	Snowdon Road, St Annes, Fylde: Historical	Inert, Commercial, Household	Contains potentially biodegradable 'household' waste. Located within the Onshore Order Limits.
LF_05	Refuse Destructor (B): Historical	Unknown	Unknown waste type but only c. 0.003 km^2 and located within the Onshore Order Limits.
LF_06	Blackpool Airport, Common Edge Road, Lytham, Blackpool: Historical	Inert, Household	Contains potentially biodegradable 'household' waste. Located across and adjacent to the Onshore Order Limits.
LF_07	Midgeland Farm, Midgeland Road, Marton, Blackpool, Lancashire: Historical	Inert, Industrial, Commercial, Household	Possible biodegradable waste mass, but historical site situated on mudstone bedrock of the MMG and Glacial Till. Located c. 300 m north of the Onshore Order Limits (north of the onshore export cable corridor).
LF_08	Westby Landfill Site, Annas Road, FY4 5JY: Active or recent	Waste Landfilling Inert, Special, Industrial, Commercial, Household	Active landfill adjacent to the Onshore Order Limits accepting potentially biodegradable household waste.
LF_09	Land off Saltcotes Road, Land off Saltcotes Road, Ballam Road, Lytham, Lancashire - Historical	Inert	Historical landfill located c. 470 m south of the Onshore Order Limits. Only inert waste and measuring c. 0.02 km^2 in size.
LF_10	Saltcotes, Lytham Hall Park, Saltcoates Road, Lytham, Lancashire: Historical	Inert, Industrial, Commercial, Household, Liquid sludge	Historical landfill located c. 110 m south of the Onshore Order Limits. Contains potentially biodegradable 'household' waste.
LF_11	Lidum Park Industrial Estate, Boundary Road, Lytham, FY8 5LT: Historical	Unknown	Located c. 800 m south of the Onshore Order Limits. Only measuring c. 0.002 km^2 in size but unknown waste received.
LF_12	Moss Side Lane, Moss Side: Historical	Inert	Historical landfill located c. 640 m north of the Onshore Order Limits. Very small (c. 0.002 km^2) and receiving inert waste.
LF_14	Grange Farm, Lytham Road, Freckleton: Active or Recent	Co-Disposal Landfill Site	Active landfill located c.790 m south of the Onshore Order Limits.
LF_15	Grange Farm No 2, Freckleton: Historical	Inert, Industrial, Household, Liquid sludge	Historical landfill which accepted biodegradable waste c.620 m south of the Onshore Order Limits.
LF_16	Clifton Marsh Landfill, Preston New Road, Freckleton, Preston, Lancashire, PR4 1HN - Active or recent	Unknown	Large (c. 1.0 km^2), active landfill stretching across northern bank of River Ribble, adjacent to the Onshore Order Limits. Waste type unknown excluding low level radioactive waste

RPS ID	Site name and status	Waste type accepted	Description
			declared through radioactive substance authorisation (RS_01).
LF_17	Clifton Marsh Landfill Site, Lytham Road, Clifton: Active or Recent	Co-Disposal Landfill Site. Inert, Industrial, Commercial, Liquid Sludge	As LF_16.
LF_19	Clifton Marsh Landfill Site, Lytham Road, Clifton: Historical	Unknown	Historical landfill only measuring c. 0.002 km^2 in size located c. 650 m from the Onshore Order Limits. Waste type unknown.
LF_21	Lea Marsh, Preston: Historical	Inert, Industrial	Sizable (c. 0.26 km^2) historical landfill located across and adjacent to the Onshore Order Limits near the River Ribble.
LF_22	Refuse Tip	Unknown	Unknown waste type but only c. 0.003 km^2 and located adjacent to the Onshore Order Limits near River Ribble.
LF_23	Refuse Tip	Unknown	As LF_22.
LF_24	Refuse Tip	Unknown	As LF_22.
LF_25	Refuse Tip	Unknown	As LF_22.
LF_26	Refuse Tip	Unknown	As LF_22.

* Ref. denotes the reference on Figure 1.3 and 1.4 in Volume 3, Annex 1.1: Phase 1 Geo-Environmental Preliminary Risk Assessment.

1.6.6.9 The historical and active landfills sites that are of greatest significance to the Transmission Assets in terms of groundwater and land quality are in two key areas. At the eastern end of Blackpool Airport, in the western end of the study area, several historical landfill sites are shown to cross the onshore export cable corridor (most notably LF_06 and LF_03). Also, at the eastern end of the study area, active or historical landfill sites lie along the northern bank of the River Ribble adjacent to the Onshore Order Limits. One such site (LF_21) crosses almost the entire width of the 400 kV grid connection corridor.

1.6.6.10 A total of 20 licensed waste sites (a permitted waste activity including waste disposal) have been identified within the study area none of which are within the Onshore Order Limits or Intertidal Infrastructure Area. Most licensed waste sites within the study area are associated with active or historical landfill sites and operations.

1.6.6.11 Only five licensed waste sites are not associated with active or historical landfills (namely WS_05, WS_06 and WS_07, and WS_17 and WS_18). WS_05 is associated with an agricultural anaerobic digestor, WS_06 and WS_07 are associated with a waste electrical and electronic equipment treatment facility. WS_17 and WS_18 are agricultural composting facilities. Composting of organic matter presents a low risk of contamination especially when associated with an established agricultural property.

Fuel stations, garages and hazardous waste storage sites

1.6.6.12 One historical petrol station (FS_08) and seven historical; and operational garages have been identified in the study area. Of these eight features, four are located adjacent to the Onshore Order Limits (FS_05 to FS_08). The operational status of the petrol station and garages was determined through the use of satellite imagery and Google maps.

1.6.6.13 FS_01 to FS_03 are considered low risk due to their distance outside of the Onshore Order Limits or Intertidal Infrastructure Area and the prevalence of Glacial Till in the area which acts as the low conductivity barrier between the underlying aquifer and any potential contamination. Similarly, FS_04 to FS_07 are considered low to moderate for this reason despite being located adjacent or in close proximity to the Onshore Order Limits. FS_08 is considered a potentially significant source of contamination due to its historical use as a petrol depot associated with the Preston Docks on the northern bank of the River Ribble as well as being located adjacent to the Onshore Order Limits. In addition, the historical depot is situated above the Sherwood Sandstone Group which is a primary aquifer. However, local geological records indicate the presence of Glacial Till above the underlying aquifer which will again provide a hydrogeological barrier between any potential contamination and the underlying groundwater source.

Other recent and historical land uses

1.6.6.14 Five licensed industrial activities deemed to be higher risk have been identified in the study area, none of which are located within the Onshore Order Limits or Intertidal Infrastructure Area. Four of the six activities (IA_01 and IA_03 to IA_05) are associated with the active Clifton Marsh landfill site and the remaining activity (IA_06) associated with intensive farming practices. All are located south of the Onshore Order Limits.

1.6.6.15 This area is underlain by Tidal Flat Deposits and Glacial Till. These units do act as a hydrogeological barrier to downward movement of contamination. As indicated for the active and historical landfills sites, these licensed industrial activities do still represent a potential risk to soil quality and groundwater quality in the near surface sand and gravel deposits shown to be present on local geological records. Risks are qualitatively assessed with the Conceptual Site Model provided within Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.6.6.16 Many other recent land uses have been identified within the study area. Recent or current land uses include, but are not limited to, sewage works, gas governor and radar station. Recent industrial land use data were screened to identify those land uses that represent a higher risk in terms of soil or groundwater contamination. The most notable land uses include Blackpool Airport, St. Annes radar station and more general slurry beds and lagoons and pumping stations.

1.6.6.17 Historical land uses in the study area include railway sidings, a fire station, refuse heaps and petrol depots. These historical features were generally identified from OS mapping and are often old and are considered to represent a relatively low soils or groundwater contamination risk in regard to

the Transmission Assets. As historical OS mapping was not considered a complete record of these features and in the absence of environmental chemical data pertaining to soils and groundwater, an Outline Contaminated Land and Groundwater Discovery Strategy has been prepared to identify the construction protocol for discovery of any currently unknown contamination and any remedial measures that may be required (document reference J1.14). Further details are provided in **section 1.8**.

Pollution incidents

1.6.6.18 Ten recorded pollution incidents of severity category 2 (significant) have been identified within the study area (refer to Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES for pollution incident categories). Three of these are located within the Onshore Order Limits and two adjacent to the Onshore Order Limits. No category 1 (major) pollution incidents were recorded in the study area. Category 3 and 4 pollution incidents were screened out of the assessment due to the minimal risk they pose to ground conditions associated with the Transmission Assets.

1.6.6.19 All pollution incidents are considered low risk, apart from PI_09 (sludge pollution of water environment). This is based on their location outside of the Onshore Order Limits and Intertidal Infrastructure Area or having a notification date over 10 years old. PI_09 is ranked low to moderate risk in terms of a contaminant source due to its proximity to key proposed infrastructure areas; namely the onshore substations and the 400 kV grid connection cable corridor.

Licensed discharges to groundwater

1.6.6.20 Groundsure geospatial data records reported no licensed discharges to groundwater within the study area.

Radioactive substance authorisations

1.6.6.21 One radioactive substance authorisation has been identified within the study area south of the Onshore Order Limits. That authorisation is associated with the Engineered Phase 4 of the Clifton Marsh landfill site and has been effective since 2015.

1.6.6.22 Low level radioactive waste is defined by the UK Radioactive Waste Authority as '*waste that contains relatively low levels of radioactivity, not exceeding 4 gigabecquerel (GBq) per tonne of alpha activity, or 12 GBq per tonne of beta/gamma activity'* (UK Radioactive Waste Inventory, 2024). It is noted that the Environment Agency Decision Notice for the application to dispose low level radioactive waste in Phase 4 of the Clifton Marsh Landfill Site (dated 14 August 2012) stated the following.

- Low level radioactive waste disposal at Grange Farm and Clifton Marsh commenced in 1974, through authorisations granted originally to British Nuclear Fuels Ltd. in respect of their sites at Capenhurst and Springfields.

- Phase 4 of the Clifton Marsh Landfill was designed as a containment landfill to meet Environment Agency guidance.
- The older phases of the Clifton Marsh landfill do not have any engineered, low permeability liner to inhibit the passage of leachate to groundwater. However, leachate entry into the aquifer below phases 1 – 3 is partly hindered due to a 'pseudo-liner' of low permeability sewage sludges deposited at the base of each phase prior to commencement of disposals.

1.6.6.23 This suggests that historical landfills in this area are unlikely to be lined and may be in continuity with the saturated sand and gravel deposits identified in the local geological records for the eastern part of the study area. Furthermore, the water quality in that aquifer unit may be impacted by waste disposal.

Unexploded ordnance

1.6.6.24 CIRIA Report C681 (CIRIA, 2009) outlines recommendations for dealing with the potential risk associated with the legacy of Unexploded Ordnance Risk, largely relating to WWII bombing and military sites.

1.6.6.25 A detailed UXO desk study (EOD Contracts Ltd, 2024) completed for Transmission Assets identified a number of UXO contamination indicators as follows.

- Bomb strikes were recorded near the site.
- Recorded bomb damage on Blackpool Airport.
- Military usage noted near the western/middle/eastern parts of the site.
- The site was not used in the production of explosives munitions however a Chemical Warfare site was noted north of the site.

1.6.6.26 The risk level in four key areas was determined as medium and the remaining part of the site as low.

1.6.6.27 The recommendations made within the UXO desk study for both the medium and low risk areas will be adhered to during construction.

1.6.7 Site-specific ground investigation

1.6.7.1 Two ground investigations have been completed at the landfall and these are reported within the following documents:

- Fugro, Intertidal Survey - Morgan, Ground investigation Report (GIR) Factual Account, F216874-Morgan 02, 20 December 2023 (Fugro, 2023).
- Central Alliance - Morgan St Annes Ground Investigation, 2372506-FAC-01, May 24 (Central Alliance, 2024).

1.6.7.2 A summary of these investigations is presented below.

Central Alliance, 2024

1.6.7.3 The scope of the investigation included:

- one cable percussion drilling sampled borehole with Rotary core drilling follow-on to a depth of 30 m below ground level (bgl);
- geotechnical laboratory testing;
- chemical laboratory testing; and
- four groundwater/ground gas monitoring occasions at weekly intervals.

Ground conditions

1.6.7.4 A thin horizon of Made Ground (0.2 m thickness) is underlain by Blown Sands and possibly middle sands of the Glacial Till (with a 4.5 m thickness of intervening Peat and Alluvium) to a depth of 14.0 m, underlain in turn by cohesive Glacial Till to a depth of 30.4 m and Mercia Mudstone to an unproven depth of 39.0 m. A general description of the strata is provided as follows:

- blown sands - comprising loose and medium dense fine to medium sand;
- peat - amorphous and pseudo fibrous peat;
- alluvium - soft silty clay;
- glacial till - brown clay with increasing gravel and cobble content with depth. Gravel and cobbles of mudstone and siltstone; and
- mercia mudstone - weak and very weak reddish brown and greenish grey mudstone. Weathered upper horizon (1.9 m thickness) of very stiff reddish brown clay.

1.6.7.5 A groundwater strike (where groundwater is encountered during drilling) was recorded at 1.0 m bgl rising to 0.73 m bgl after 20 minutes.

Geotechnical laboratory testing

1.6.7.6 Laboratory testing included particle size distribution tests. **Table 1.11** presents results for samples obtained within the sand deposits.

Table 1.11: Particle size distribution

Borehole and sample depth (m)	Clay/Silt (%)	Sand (%)	Gravel (%)	Cobbles (%)
CP+RC 2.00 – 2.45	1	99 Fine – 45 Medium – 54 Coarse - 0	0	1
CP+RC 11.00 – 11.50	10	89 Fine – 41 Medium – 47 Coarse - 1	1 Fine – 1 Medium – 0 Coarse - 0	0

Borehole and sample depth (m)	Clay/Silt (%)	Sand (%)	Gravel (%)	Cobbles (%)
CP+RC 13.00 – 13.50	10	88 Fine – 51 Medium – 35 Coarse - 2	2 Fine – 2 Medium – 0 Coarse - 0	0

Groundwater monitoring

1.6.7.7 **Table 1.12** presents the groundwater monitoring results.

Table 1.12: Groundwater monitoring

Date	Borehole level (mAOD)	Water depth (m bgl)	Base depth (m bgl)	Water level (mAOD)
30 November 2023	9.93	0.53	29.72	9.40
07 December 2023	9.93	0.21	29.72	9.72
14 December 2023	9.93	0.00	29.72	9.93
21 December 2023	9.93	0.00	29.72	9.93

Fugro, 2023

1.6.7.8 The scope of the investigation included:

- three cable percussion boreholes;
- three dynamic sampling boreholes;
- seventeen cone penetration testing boreholes;
- geotechnical laboratory testing; and
- chemical laboratory testing.

Ground conditions

1.6.7.9 Based on exploratory hole locations A1_CP01 and A2_CP01B Blown Sands and possibly middle sands of the Glacial Till were encountered to depths of 14.5 m and 15.0 m, underlain by cohesive Glacial Till to a maximum unproven depth of 21 m. A general description of the strata is provided as follows.

- Blown sands - comprising medium dense (sometimes loose, dense and very dense) fine to coarse sand with variable gravel and cobble content of mixed lithologies.
- Glacial till - brown slightly sand slightly gravelly clay. Gravel and cobbles of mixed lithologies.

Geotechnical laboratory testing

1.6.7.10 Laboratory testing included particle size distribution tests and **Table 1.13** presents the results for samples obtained within the sand and gravel aquifer.

Table 1.13: Particle size distribution

Borehole and sample depth (m)	Clay/Silt (%)	Sand (%)	Gravel (%)	Cobbles (%)
A2_CP01 8.00 – 8.20	2.9	54.9	42.2	0.0
A2_CP01B 1.20 – 1.65	0.4	99.3	0.3	0.0
A2_CP01B 2.50 – 2.80	0.2	99.8	0	0.0
A2_CP01B 4.50 – 4.80	0.3	58.8	28.4	12.5
A2_CP01B 6.00 – 6.45	9.3	56.9	33.8	0.0
A2_CP01B 9.00 – 9.45	1.0	54.0	45.0	0.0
A2_CP01B 11.00 – 11.30	0.9	95.3	3.8	0.0
A2_CP01B 13.00 – 13.30	0.9	86.6	12.5	0.0

1.6.8 Conceptual site model and summary baseline conditions

1.6.8.1 Generally, the study area is underlain by a thick sequence of superficial deposits characterised by blown sand deposits at the landfall, Tidal Flat Deposits and Glacial Till. Peat deposits are present at the western end of the study area and further minor deposits include head, Alluvium and River Terrace Deposits. BGS records indicate the superficial deposits are of >20 m (typically > 30 m) in thickness. They constitute Unproductive strata, Secondary A aquifers and Secondary Undifferentiated aquifers. One active groundwater abstraction licence is located within the Onshore Order Limits which authorises the abstraction of groundwater for spray irrigation at a local golf club.

1.6.8.2 Bedrock comprises the MMG in the west which is classed as a Secondary B aquifer and the Sherwood Sandstone Group in the east which is classed as a Principal aquifer.

1.6.8.3 The hydrogeological model is summarised within **Table 1.14**.

1.6.8.4 There are multiple watercourses within the study area, which include the River Ribble, Moss Sluice, Dow Brook and Mill Brook.

1.6.8.5 A number of potential sources of contamination have been identified from historical and current land uses including Blackpool Airport, sewage works, gas works, fuel depot, radar station, railway sidings, refuse heaps, and active and historical landfills.

1.6.8.6 There are currently no known active pollutant linkages within the Intertidal Infrastructure Area or Onshore Order Limits, however, a number of potential pollutant linkages may become active upon development and this is presented in detail within the Conceptual Site Model presented within Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

Table 1.14: Summary baseline hydrogeological model

Location	Description	Local geological sequence	Aquifer units	Hydrogeological conceptual model
Landfall: MHWS to A584.	The western, coastal end of the study area. Situated on the Ribble Estuary, west of the A584 and between MHWS tide and the transition joint bays at or near Blackpool Airport.	The surface sequence of superficial deposits comprises blown sand (dunes and littoral sediments) and Tidal Flat Deposits up to 21 m depth. Depth to bedrock is not proven. Bedrock is expected to comprise mudstones of the MMG.	**Superficial Deposits** Unproductive strata (saline). **Bedrock** Secondary B.	Saline water is expected in the saturated coastal sand and gravel deposits. Freshwater may be encountered if a lens forms above the saline water where dunes extend above MHWS. No abstractions or SPZs.
Landfall and onshore export cable corridor: A584 to A583.	Western part of the study area extending from the transition joint bays, across the A584, up to the end of blown sand deposits at B5261 (Queensway).	Borehole logs demonstrate a surface sequence of superficial deposits more than 30 m thick. That sequence comprises: 2.5 m to 3.8 m of blown sand deposits. 1.7 m to 1.8 m of peat. 0 m to 2.8 m of Boulder Clay (Glacial Till) that is typically a grey clay. 3.7 m to 9.9 m of sand that is thickest near coastline. A lower Glacial Till of unproven thickness but with a depth of up to 32.3 m and is typically a reddish-brown clay. Mudstones of MMG present at a depth of approx. 32 m.	**Superficial Deposits** Secondary A (blown sand and middle sand). **Bedrock** Secondary B (MMG).	Shallow groundwater is expected near surface sand and gravel deposits (blown sands and middle sand) as evidenced by shallow groundwater abstractions in the study area. Those shallow aquifers will be characterised by intergranular groundwater flow that is orientated toward: the coastline; local surface water courses; and/or shallow (active) abstraction boreholes. No groundwater of significance is present in the MMG bedrock that is located at depth beneath the surface granular aquifer and Glacial Till. There are no SPZs in this section of the study area.
Onshore export cable corridor: A583 to Freckleton/Hall Cross onshore export cable corridor.	Central section that extends from the end of blown sand deposits at B5261 (Queensway) up to Kirkham Road at Freckleton in the east.	**Superficial Deposits** **Western end** More than 30 m of superficial deposits are proven and comprise: 3.5 – 8.8 m surface clay and peat (Tidal Flat Deposits or Glacial Till).	**Superficial Deposits** **Western end** Dominated by unproductive strata of the Tidal Flat Deposits and peat. Although this has	**Western end** Shallow groundwater has been shown to be present in sand and gravel deposits underlying the surface Tidal Flat Deposits or Glacial Till. That groundwater is perched on the Glacial Till. Intergranular flow in this superficial aquifer, will be

Location	Description	Local geological sequence	Aquifer units	Hydrogeological conceptual model
		Up to or greater than 10 m of sand and gravel (middle sand). Brown clay (Glacial Till). **Central and eastern section** Proven depth of superficial deposits between 30.5 m to 43.9 m. Sequence dominated by Glacial Till comprising: 18-22 m of surface Glacial Till. Thin band of sand (middle sand). Brown Glacial Till at depth. **Bedrock** SD43SW12 (in centre of section) red marls and sandstones of the MMG at 43.9 metres below ground level. SD43SW61 (in east) red sandstones of Sherwood Sandstone Group at 30 metres below ground level.	been shown to be underlain by saturated sands and gravel. **Central and eastern section** Dominated by Secondary Undifferentiated (Glacial Till and head), with small, localised areas of Secondary A (GFD and alluvium) **Bedrock** Secondary B (MMG)	orientated towards local surface watercourses (where in continuity with aquifer); or shallow (active) abstraction boreholes. No groundwater of significance is present in the MMG bedrock located at depth. **Central and eastern section** Superficial deposits that are dominated by low permeability, cohesive Glacial Till. Localised groundwater will be restricted to granular bands within the Glacial Till. This groundwater is not considered to be of resource value and has limited lateral connectivity with surface receptors. This section of the study area is largely underlain by mudstones of MMG with no groundwater of significance. In the east, the Principal aquifer of the Sherwood Sandstone Group has been identified but is concealed and protected the thick overlying sequence of low permeability Glacial Till.
Freckleton/Hall Cross onshore export cable corridor, onshore substations and 400 kV grid connection cable corridor as far as A584	Situated immediately east of Kirkham Road near Freckleton. Comprises the low-lying, largely agricultural land between the A584 and A583, around Newton-with-Scale. Situated to the north of the River Ribble.	Underlain by a thick sequence of superficial deposits (22.7 m to more than 30.7 m). This sequence typically comprises a surface horizon of sand or gravel deposits (6.1 to 15.1 m), which can be overlain by a thin layer of clay (Tidal Flat Deposits or Glacial Till). These granular deposits overly brown, Glacial Till that is typically between 7.5 m and 17 m thick.	**Superficial Deposits** Unproductive Strata (Tidal Flat Deposits) Secondary Undifferentiated (Glacial till in north) with small, localised areas of Secondary A It is noted however that a saturated, near surface sand and gravel deposits	**Superficial Deposits** A shallow groundwater body is expected to present in the granular sand and gravel deposits. Lateral, intergranular flow is expected in that aquifer unit that will be orientated towards local surface watercourses (where in continuity with aquifer) possibly including the River Ribble. This near-surface aquifer is expected to be hydraulically separated from the underlying bedrock by the presence of low permeability Glacial Till.

Location	Description	Local geological sequence	Aquifer units	Hydrogeological conceptual model
	Includes the footprint of the onshore substations.	The superficial deposits conceal red sandstones of Sherwood Sandstone Group bedrock at depth. In the north west the Sherwood Sandstone Group is located at depth of approximately 30 m, decreasing to 22.7 m in the south east toward the River Ribble.	have been identified north of the River Ribble (presumed Glacial Till) **Bedrock** Principal aquifer (Sherwood Sandstone Group)	No active abstraction sources that that utilise this shallow aquifer have been identified. **Bedrock** The Sherwood Sandstone Group Principal aquifer is present at depth. Groundwater flow directions in that aquifer is uncertain but SPZs suggest it will be affected by local licensed abstraction to the north and north east of the Onshore Order Limits. The bedrock aquifer is likely to be hydraulically separated from shallow groundwater the low permeability Glacial Till and Tidal Flat Deposits.
400 kV grid connection cable corridor: A584 to Penwortham	The grid connection cable route crosses Clifton Marsh and traverses the River Ribble.	The geological sequence is consistent with that seen for the onshore substations, with a thick sequence of superficial deposits concealing bedrock. Superficial deposit typically include a near surface sand unit (13 m to 18 m) although this can be reduced by surface clays that are presumed to be Tidal Flat Deposits. These deposits are underlain by a thick sequence clay deposits typically referred to as boulder clay (i.e., Glacial Till). Bedrock is encountered at a depth of between 22.3 m and 41 m. Bedrock comprises red sandstones of the Sherwood Sandstone Group. There is no local geological data available for the study area south of the River Ribble. It is reasonable	**Superficial Deposits** Unproductive strata of the Tidal Flat Deposits across majority of the area. Secondary (undifferentiated) aquifer (Glacial Till) in the south west around Penwortham. It is noted however that a saturated, near surface sand and gravel deposits have been identified north of the River Ribble (presumed Glacial Till) **Bedrock** Principal aquifer of the Sherwood Sandstone Group.	**Superficial Deposits** As in the onshore substations, a shallow groundwater body is expected to be present in the granular sand and gravel deposits. Lateral, intergranular flow is expected in that aquifer unit that will be orientated towards local surface watercourses (where in continuity with aquifer) possibly including the River Ribble. This near-surface aquifer is expected to be hydraulically separated for the underlying bedrock by the presence of low permeability Glacial Till. No active abstraction sources that that utilise this shallow aquifer have been identified. **Bedrock** The Sherwood Sandstone Group Principal aquifer is present at depth. Groundwater flow directions in that aquifer is uncertain but will be affected by local licensed abstraction, most notably at the

Location	Description	Local geological sequence	Aquifer units	Hydrogeological conceptual model
		to assume the geology will be similar to that observed north of the River Ribble given their proximity and similarity of historical depositional environments.		Springfields nuclear licensed site. The bedrock aquifer is likely to be hydraulically separated from shallow groundwater the low permeability Glacial Till and Tidal Flat Deposits.

* The local geological sequence has been determined using the data from named ‘Key Boreholes’ identified on BGS GeoIndex Onshore platform and site-specific ground investigation at the landfall. Those borehole logs are provided in Annex 1.1: Phase 1 Geo-Environmental Preliminary Risk Assessment and Annex 1.2: Dewatering Impact on Lytham St Annes SSSI of the ES. The geological units are assigned are based on author interpretation.

1.6.9 Future baseline conditions

1.6.9.1 The baseline conditions associated with geology, hydrogeology and ground conditions are not subject to significant change in future. Little change is expected with regards to the following.

- Geology:
  - designated and non-designated sites and features of geological or geomorphological significance.
- Hydrogeology:
  - groundwater bodies/aquifer units;
  - groundwater levels and groundwater flow patterns;
  - groundwater recharge rates;
  - groundwater quality and the level of groundwater abstraction; and
  - groundwater discharge to groundwater dependent receptors.
- Ground conditions:
  - areas of potentially contaminated land/groundwater relating to historical or recent land-use; and
  - operation of permitted landfill sites/waste facilities.

1.6.9.2 Climate change represents the most likely mechanism that could potentially result in measurable changes to hydrogeology, through changes to the amount and distribution of recharge to aquifers. The Meteorological Office provide UK Climate Projections (UKCP), the most recent being for 2018 (UKCP18). The projected climate change impacts on rainfall and river flow for this area of England could involve decreasing summer rainfall and increasing winter rainfall, resulting in more severe low flow events in rivers and high peak river flows.

1.6.10 Key receptors

1.6.10.1 **Table 1.15** identifies the receptors identified as part of baseline environment that have been taken forward into the assessment. The impacts on individual receptors are discussed in **section 1.11**.

Table 1.15: Key receptors taken forward to assessment

Receptor type	Description
Geology	
Geological or geomorphological features of national or international importance.	Geological or geomorphological sites that have been designated at a national level. This includes SSSIs and GCR sites.
Geological or geomorphological features of local importance.	Geological or geomorphological sites that have been designated at the local level. This includes LGSs (formerly regionally important geological sites).
Hydrogeology	
Groundwater in superficial deposits Secondary A aquifer unit.	A secondary aquifer unit providing a locally important water resource and/or groundwater dependent sites of local importance. This aquifer unit has been shown to extend further east than is shown on BGS mapping. A similar aquifer has also been identified in the western end of the study area.
Groundwater in bedrock Principal aquifer unit.	Principal aquifer providing locally important water resource and/or supporting a groundwater dependent site of national importance or a river ecosystem. This aquifer is formed of sandstones of the Sherwood Sandstone Group at the eastern end of the study area. This bedrock aquifer is concealed beneath a thick sequence of superficial deposits.
Licensed abstractions.	Groundwater abstraction above 20 m^3/day that has an abstraction licence issued by the Environment Agency.
Groundwater dependent receptors.	Surface watercourses, lakes/ponds, springs and wetlands that are supported by discharge from an underlying aquifer unit. A protected ecological site that has designated features that are supported by discharge from an underlying aquifer unit.
Minerals safeguarded sites.	Sites designated by Lancashire County Council through the minerals planning process.
Human health	
Humans	Construction workers or others that may be affected by existing contamination or ground gas arising from natural sources.
Property	
Buildings	Any structure or erection, and any part of a building including any part below ground level, but does not include plant or machinery comprised in a building.

1.6.10.2 No private water supplies have been identified during consultation with the local planning authorities. These have not therefore been taken through to assessment. If currently unknown private water supplies are identified prior to construction, continued water supply will be managed through the CoCP.

1.6.10.3 Where groundwater provides base flow to surface waters the impact assessment is on the aquifer units. Surface water receptors are presented within Volume 3, Chapter 2: Hydrology and flood risk of the ES.

1.7 Scope of the assessment

1.7.1.1 The scope of this ES has been developed in consultation with relevant statutory and non-statutory consultees as detailed in **Table 1.4**.

1.7.1.2 Taking into account the scoping and consultation process, **Table 1.16** summarises the issues considered as part of this assessment.

Table 1.16: Impacts considered within this assessment

Activity	Impacts scoped into the assessment
Construction phase	
Construction of the onshore and intertidal elements of the Transmission Assets, including excavation of cable trenches, HDD or other trenchless techniques and construction of substation foundations.	The impact of partial or total loss of or damage to designated geological and geomorphological sites.
	The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units.
	The impact of reduced groundwater quantity or quality in aquifer units, on protected groundwater abstractions (licensed or non-licensed) and/or change in groundwater resources status.
	The impact of existing contamination to human receptors.
	The impact of a deterioration in groundwater quality through the accidental spillage/release of potentially polluting substances.
	The impact of changes in groundwater levels, flow or quality on other sensitive groundwater dependent sites, including surface waters fed by groundwater.
	The impact of ground gas generation on human health and other environmental receptors.
	Sterilisation of safeguarded mineral resources.
Operation and maintenance phase	
Operation of the onshore and intertidal elements of the Transmission Assets, including access for maintenance. Permanent management of drainage and runoff from substation sites.	The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units.
	The impact of reduced groundwater quantity or quality in aquifer units, on protected groundwater abstractions (licensed or non-licensed) and/or change in groundwater resources status.
	The impact of changes in groundwater levels, flow or quality on other sensitive groundwater dependent sites, including surface waters fed by groundwater.
	The impact of ground gas generation on human health and other receptors (property).
	The impact of heat generated by the onshore export cables on groundwater quality, during the operation and maintenance phase.
Decommissioning phase	
Decommissioning of the onshore and intertidal elements of the Transmission Assets, including removal and	The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units.
	The impact of reduced groundwater quantity or quality in aquifer units, on protected groundwater abstractions (licensed or non-licensed) and/or change in groundwater resources status.
	The impact of a deterioration in groundwater quality through the accidental spillage/release of potentially polluting substances.

Activity	Impacts scoped into the assessment
decommissioning activity.	The impact of changes in groundwater levels, flow or quality on other sensitive groundwater dependent sites, including surface waters fed by groundwater.
	The impact of ground gas generation on human health and other environmental receptors.

1.7.1.3 Impacts that are not likely to result in significant effects have been scoped out of the assessment. A summary of the impacts scoped out, together with justification for scoping them out and whether the approach has been agreed with key stakeholders through either scoping or consultation (see **Table 1.4**), is presented in **Table 1.17**.

Table 1.17: Impacts scoped out of the assessment

Impacts	Justification
The impact of accidental spillages/contaminant release on the quality of groundwater ground receptors during operation and maintenance of the onshore elements of the Transmission Assets.	Activities associated with the operation and maintenance of the onshore and intertidal elements of the Transmission Assets are unlikely to require the transport or storage of harmful substances. Therefore, the potential impact of spills/contaminant releases on the quality of groundwater receptors during operation and maintenance of the onshore elements of the Transmission Assets is unlikely to result in significant effects and has been scoped out of the assessment for geology, hydrogeology and ground conditions. The Planning Inspectorate confirmed in their Scoping Opinion that this matter can be scoped out of the assessment, subject to the ES detailing any operational controls, such as through an Outline Pollution Prevention Plan (document reference J1.4). Details of such controls are provided in the Outline Operational Drainage Management Plan (document reference J10).
Heat generation during construction and decommissioning.	The Planning Inspectorate confirmed in their Scoping Opinion that, as the cables will not be operational during the construction and decommissioning phases, an assessment of heat generation can be scoped out for these phases.
The impact of ground contamination on the Ribble Estuary SSSI and the Ribble and Alt Estuaries SPA during construction.	These ecologically designated sites are located within the study area at the location of the landfall. No potentially significant sources of contamination have been identified within this area. Furthermore, groundwater quality at this location is to be of limited resource potential as it will be tidally influenced and subject to saline intrusion.

1.8 Measures adopted as part of the Transmission Assets (Commitments)

1.8.1.1 For the purposes of the EIA process, the term ‘Measures adopted as part of the Transmission Assets’ is used to include the following types of mitigation measures (adapted from IEMA, 2016). These measures are set out in Volume 1, Annex 5.3: Commitments Register of the ES.

- Embedded mitigation. This includes the following:
  - Primary (inherent) mitigation - measures included as part of the project design. IEMA describes these as ‘modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project and do not require additional action to be taken’. This includes modifications arising through the

iterative design process. These measures will be secured through the consent itself through the description of the project and the parameters secured in the DCO and/or marine licences. For example, a reduction in footprint or height.

  - Tertiary (inexorable) mitigation. IEMA describes these as '*actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects*'. It may be helpful to secure such measures through a CoCP or similar.

- Secondary (foreseeable) mitigation. IEMA describes these as '*actions that will require further activity in order to achieve the anticipated outcome'*. These include measures required to reduce the significance of environmental effects (such as lighting limits) and may be secured through environmental management plan.

1.8.1.2 In addition, where relevant, measures have been identified that may result in enhancement of environmental conditions. Such measures are clearly identified within Volume 1, Annex 5.3: Commitments Register of the ES.

1.8.1.3 Embedded measures that will form part of the final design (and/or are established legislative requirements/good practice) have been taken into account as part of the initial assessment presented in **section 1.9** below (i.e., the initial determination of impact magnitude and significance of effects assumes implementation of these measures). This ensures that the measures to which the Applicants are committed are taken into account in the assessment of effects.

1.8.1.4 Where an assessment identifies likely significant adverse effects, further or secondary mitigation measures may be applied. These are measures that could further prevent, reduce and, where possible, offset these effects. They are defined by IEMA as actions that will require further activity in order to achieve the anticipated outcome and may be imposed as part of the planning consent, or through inclusion in the ES (referred to as secondary mitigation measures in IEMA, 2016). For further or secondary measures both pre-mitigation and residual effects are presented.

Table 1.18: Measures (commitments) adopted as part of the Transmission Assets

Commitment number	Measure adopted	How the measure will be secured
Embedded measures		
CoT02	The following features will be crossed by trenchless techniques, as set out in the Onshore Crossing Schedule submitted as part of the application for development consent: • A, B and Classified unnumbered roads (known as C roads) (including the Preston Western Distributor Road, A582 South Ribble Western Distributor Upgrade and M55 Heyhouses Link Road; excluding Leech Lane); • All Environment Agency Main Rivers, including: Moss Sluice, east of Midgeland Road along Pegs Lane; Savick Brook, south of A583; Wrea Brook southeast of Cartmell Lane; Dow Brook east of Lower Lane between the A584 and the A583; Middle Pool north of Lund Way; and • All Network Rail crossings, including along the line which runs between Blackpool North and Preston, south of Cartmell Lane; and at the Network Rail crossing along the line which runs to Blackpool North, south east of Squires Gate, parallel to the A584.	DCO Schedules 2A & 2B, Requirement 5(2) (Detailed design parameters onshore); DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT04	An Outline Pollution Prevention Plan (PPP) forms part of the Outline Code of Construction Practice submitted with the application for development consent. Detailed PPP(s) will be developed in accordance with the Outline PPP and includes details of emergency spill procedures. Good practice guidance detailed in the Environment Agency's Pollution Prevention Guidance notes (including Pollution Prevention Guidance notes 01, 05, 08 and 21) will be followed where appropriate, or the latest relevant available guidance.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT05	During construction of piled foundations the following guidance will be used: Land Contamination Risk Management (LCRM) (July 2023) and Managing and reducing land contamination: guiding principles (GPLC), or latest relevant available guidance, where appropriate.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT09	The Outline Code of Construction Practice (CoCP) has been submitted as part of the application for development consent. Detailed CoCP(s) will be developed in accordance with the outline CoCP. The Outline CoCP includes information about drainage during construction.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT10	Where trenchless techniques are proposed for Environment Agency Main Rivers, the following distances will be used: • 8 m from the bank of the Environment Agency Main River or landward toe of any associated flood defence structure;	DCO Schedules 2A & 2B, Requirement 8 (CoCP); DCO Schedule 10, Part 9

Commitment number	Measure adopted	How the measure will be secured
	• 16 m from tidal Environment Agency Main Rivers or the landward toe of any flood defences, where the Main River is a sea defence structure; and • a minimum of 2 m vertical clearance will be maintained below the hard bed of all Environment Agency Main Rivers, including the landward toe of any associated flood defences. Final vertical clearance depths beneath Environment Agency Main Rivers will be identified during detailed design stage, in consultation with the Environment Agency, to ensure the export cables remain buried for the operational lifetime of the project.	
CoT11	An Outline Operational Drainage Management Plan for the substation sites has been prepared and submitted with the application for development consent. The Plan will include measures to ensure that existing land drainage is reinstated and/or maintained. This will include measures to limit discharge rates and attenuate flows to maintain greenfield runoff rates at the onshore substations. It will also include measures to control surface water runoff, including measures to prevent flooding of the working areas or offsite and to ensure any runoff is treated appropriately. Detailed Operational Drainage Management Plan(s) will be developed in accordance with the Outline Operational Drainage Management Plan and in line with the latest relevant drainage guidance notes in consultation with the Environment Agency and the Lead Local Flood Authority (Lancashire County Council).	DCO Schedules 2A & 2B, Requirement 20 (Outline Operational Drainage Management Plan)
CoT29	Appropriate Personal Protective Equipment will be used and relevant good working practices applied to avoid potential risk to human health including from any potential ground contamination, in line with relevant available guidance.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT30	An Outline Contaminated Land and Groundwater Discovery Strategy, as part of the Outline CoCP has been submitted with the application for development consent, to identify any suspected areas of contamination and any remedial measures which may be required. Detailed strategies will identify the construction protocol for discovery of any currently unknown contamination and any remedial measures that may be required.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT35	An Outline Code of Construction Practice (CoCP) has been prepared and submitted with the application for development consent. Detailed CoCP(s) will be developed in accordance with the Outline CoCP. The Outline CoCP includes measures to maintain and address: • flood protection and control measures; • water environment and drainage; • pollution prevention;	DCO Schedules 2A & 2B, Requirement 8 (CoCP)

Commitment number	Measure adopted	How the measure will be secured
	• geology and ground conditions; • ecology and nature conservation (including protected species and invasive species); • historic environment; • soil management; • traffic and transport; • noise management measures; • air quality and dust management; • landscape and visual; • recreation; and • bentonite breakout.	
CoT36	Onshore Decommissioning Plan(s) will be developed prior to decommissioning. The Onshore Decommissioning Plan(s) will include provisions for the removal of all onshore above ground infrastructure and the decommissioning of below ground infrastructure (if and where relevant and practicable), and details relevant to flood risk, pollution prevention and avoidance of ground disturbance. The Onshore Decommissioning Plan(s) will be in line with the latest relevant available guidance.	DCO Schedules 2A & 2B, Requirement 22 (Onshore decommissioning)
CoT44	The Project Description (Volume 1, Chapter 3 of the Environmental Statement) sets out that the installation of the offshore export cables under Lytham St Annes SSSI and the St Annes Old Links Golf Course will be undertaken by direct pipe trenchless installation technique. The exit pits associated with the direct pipe installation will be at least 100 m seaward of the western boundary of the SSSI.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT81	An Outline Soil Management Plan has been prepared as part of the Outline CoCP and submitted as part of the application for development consent. The detailed CoCP(s) will be developed in accordance with the outline CoCP. Detailed Soil Management Plan(s) will be developed in order to characterise and manage soil materials during construction. Soil types would be determined via site-specific survey work.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT86	An Outline Code of Construction Practice (CoCP) will be prepared and submitted with the application for development consent. Detailed CoCP(s) will be developed in accordance with the Outline CoCP. Where required, trenched techniques may be used for minor ditches or smaller watercourses that are frequently dry. In these cases, measures will be implemented to protect water quality and flow and these will be detailed within the Outline CoCP.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)

Commitment number	Measure adopted	How the measure will be secured
CoT90	The Project Description (Volume 1, Chapter 3 of the Environmental Statement) sets out that the installation of the 400kV Grid Connection Cable Corridor beneath the River Ribble will be undertaken by direct pipe or micro tunnel trenchless installation techniques.	DCO Schedules 2A & 2B, Requirement 5(3) (Detailed design parameters onshore); and Requirement 8 (CoCP)
CoT94	The Outline Code of Construction practice (CoCP) has been submitted as part of the application for development consent. Detailed CoCP(s) will be developed in accordance with the outline CoCP. The outline CoCP details appropriate studies (e.g. Site Investigations) proposed to be undertaken where major HDDs (or other trenchless techniques) are proposed, during the detailed design stage to confirm ground conditions.	DCO Schedules 2A & 2B, Requirement 8 (Code of Construction Practice)
Secondary measures		
CoT41	Where the onshore export cable corridor or 400 kV grid connection cable corridor crosses sites of particular sensitivity (e.g. embanked Environment Agency surface watercourses, Sites of Special Scientific Interest or groundwater inner Source Protection Zones) hydrogeological risk assessment(s) will be undertaken to inform a site-specific crossing method statement(s) where required. These will be agreed with the relevant stakeholders prior to construction.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT101	Where high concentrations of peat are identified, these will be avoided where practicably possible for the placement of the plant and infrastructure to avoid the possibility of ground gas build up. Where this is not possible, further investigation and appropriate monitoring will be identified undertaken, if necessary.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT103	Where suspected contamination is present and piling is proposed, where required detailed piling risk assessment(s) will be developed prior to the commencement of the relevant stage of works. Consultation with the Environment Agency will be sought.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT118	Where areas of potentially significant contamination (e.g. landfills) cannot be avoided within the Transmission Assets Order Limits, ground investigation or other appropriate measures (e.g. use Personal Protective Equipment and/or hazard signage) will be implemented to mitigate potential impacts to, or effects on sensitive receptors. Where ground investigation identifies potential risks to sensitive receptors from contamination, a remediation strategy would be prepared in consultation with the Environment Agency.	DCO Schedules 2A & 2B, Requirement 8 (CoCP)
CoT119	Subject to landowner approval, at detailed design stage, hydrogeological risk assessment(s) will be undertaken at St Annes Old Links Golf Club (abstraction borehole ref: GWA_01), if necessary. The	DCO Schedules 2A & 2B, Requirement 8 (CoCP)

Commitment number	Measure adopted	How the measure will be secured
	hydrogeological risk assessment(s) would be informed by ground investigation information, where relevant and practicable. If undertaken, the risk assessment(s) will inform a detailed site specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI and the St Annes Old Links Golf Course.	
CoT128	At detailed design stage, hydrogeological risk assessment(s) will be undertaken in relation to the crossing of Lytham St Annes SSSI to mitigate potential impacts to the hydrologically dependant surface water features of the sand dune system. The hydrogeological risk assessment(s) will be informed by ground investigation information, where necessary and practicable. These assessment(s) will used to inform the detailed site specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI.	DCO Schedules 2A & 2B, Requirement 12 (Ecological Management Plan)

1.9 Key parameters for assessment

1.9.1 Maximum design scenario

1.9.1.1 The maximum design scenarios (MDS) identified in **Table 1.19** have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the ES. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g., different infrastructure layout), to that assessed here be taken forward in the final design.

Table 1.19: Maximum design scenario considered for the assessment of impacts

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Loss of, or damage to, designated geological and geomorphological sites.	✓	×	×	**Construction phase: Landfall** The offshore export cables between the transition joint bay working area within Blackpool Airport and the beach will be installed using the direct pipe trenchless technique for a maximum length of 1,500 m. It is anticipated the direct pipe exit will be 100 m from the boundary of Lytham St Annes Dunes SSSI. • Entry pits for the direct pipe will be situated within the transition joint bay area within Blackpool Airport: The maximum number of entry pits will be six, with a maximum direct drill entry pit area of 450 m^2 per circuit with a depth of 6 m. The total duration of entry pit works which is included within the overall transition joint bay construction works is 29 months assuming a sequential construction scenario. • Exit pits on the beach: The maximum number of exit pits will be six, with a maximum area of drill exit pit of 875 m^2 per circuit, with a depth of 3 m. The maximum cofferdam area dimensions per pit is 75 m^2 (15 m x5 m). The total duration of exit pit works on the beach is 2 weeks per circuit. • For the offshore export cable installation between exit pits and MLWS, the burial at the of the offshore export cables seaward of the direct pipe exit pits will via open trenching. The maximum number of trenches will be six. The maximum width of the stepped trench is 10 m at the top and 3 m at the bottom and are each 3 m deep. The maximum length per trench is 300 m with a maximum working area each side of the trench of 25 m. • The open trench will transition to a beach trencher, this will be 3 m wide and up to 1,250 m long, the trench will be contained within a working corridor with a 50 m width. • Cable pull in and burial will take up to six weeks per circuit and the maximum total duration of cable pull in and burial is 36 weeks assuming a sequential construction scenario. • There will be up to four compounds required west of the transition joint bays to MLWS: – Compound 1 (welfare): 300 m^2 to be active for 36 weeks; – Compound 2: 2,500 m^2 to be active for 48 weeks; – Compound 3: 510 m^2 to be active for 48 weeks; and – Compound 4: 600 m^2 to be active for 36 months (in a sequential construction scenario).	Direct pipe will be used to install the landfall beneath the railway line, the A584 Clifton Drive North and at Lytham St. Annes Dunes SSSI. For the onshore cable corridor, open cut represents the largest physical impact and greatest area of land disturbance/impact on mineral resources compared to HDD beneath a feature. As such, where options remain, open cut trenching represents the MDS. In terms of duration, the MDS is represented by sequential construction of the Morgan Offshore Wind Project Transmission Assets and the Morecambe Offshore Windfarm Transmission Assets (rather than concurrent construction), as this represents the longest overall period. The MDS is represented by the largest permanent footprint for the onshore substations, which

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• There will be two transition joint bay compounds (10,000 m2 for Morgan and 10,000 m2 for Morecambe) within Blackpool Airport to facilitate construction works, to be active for up to 29 months over a 45 month period. – Maximum working area of the transition joint bay: 4,900 m^2 for Morgan and 2,800 m^2 for Morecambe **Construction phase: onshore export cables** • The maximum number of trenches will be six, with a target trench depth of 1.8 m. • Onshore export cable construction corridors width 100 m, with a length of up to 17 km. Width will include two haul roads. There will be up to 110 joint bays and 110 link boxes, with 1,000 m^3 and 8 m^3 of material excavated for each joint bay and link box respectively. • There will be up to ten construction compounds along the onshore export cable corridor. During a sequential construction compounds will be present for 66 months with the following attributes: – 2 type A compounds, a maximum total area of 26,500 m^2; – 6 type B compounds a maximum total area of 79,500 m^2; and – 2 type C compounds a maximum total area of 17,500 m2. • The maximum number of HDD locations is 120. Each major HDD location will have a compound, measuring up to 100 m x 50 m. Drilling mud will be stored and used at these compounds. **Construction phase: onshore substations** • The combined permanent footprint of the Morecambe onshore substation and Morgan onshore substation 223,500 m^2, including eight main buildings, with two access roads at 15 m width (each) and temporary substation compound. • The area of temporary compounds (combined) includes working and laydown areas (excludes permanent substation footprint) is 122,500 m^2 (additional to permanent footprint). Duration: enabling works 12 months, main construction 54 months, testing/commissioning 21 months (sequential construction scenario). **Construction phase: 400 kV grid connection cable**	represents the largest physical impact and greatest area of land disturbance and the greatest risk of impact to groundwater. Micro-tunnelling is considered to represent the MDS for the River Ribble due to the depth of the entry/exit pits.

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Open cut trenching: The maximum number of trenches will be four, with a target trench depth of 1.8 m. The width of the permanent cable corridor is 50 m. There will be a total of 60 joint bays and 60 link boxes. • The working area will include a construction corridor width of 76 m (which includes two haul roads), with a length of up to 13 km. Duration of installation of up to 66 months (sequential construction scenario). • There will be a maximum of 46 HDD crossings (excluding the Ribble Estuary crossing) and the HDD compound locations will be 100 m x 50 m. • Trenchless technologies will be used to cross the River Ribble. Micro-tunnelling is considered to represent the MDS due to the depth of the entry/exit pits. The temporary compound at the launch/exit (two compounds) area would be a maximum of 75 m x 400 m. There will be a maximum of four tunnels/bores over a distance of up to 650 m. The depth of the launch and receiver pits would be a maximum of 45 m. • There will be up to eight construction compounds along the 400 kV grid connection cable corridor. During a sequential construction compounds will be present for 66 months with the following attributes: – 2 type A compounds, a maximum total area of 26,270 m2; – 4 type B compounds a maximum total area of 52,540 m2; and – 2 type C compounds a maximum total area of 17,500 m2. • Duration of installation is up to 66 months (sequential).	
The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units.	✓	✓	✓	As per detailed construction elements above **Construction: all elements** • Construction compounds will be prepared by removing and storing topsoil and subsoil and then constructing hardstanding areas using clean crushed stone. • Temporary dewatering of export trenches, joint bays and link boxes will be required where shallow groundwater is encountered. **Operation and maintenance phase** • Maintenance to the onshore export cable and the 400 kV grid connection cable will be undertaken only as required. Corrective activities will be limited.	As per impact above.
The impact of reduced groundwater quantity or quality in aquifer	✓	✓	✓		

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
units, on protected groundwater abstractions (licensed or non-licensed) and/or change in groundwater resources status.				• The onshore export cable, the 400 kV grid connection cable and the onshore substations will be monitored remotely but will involve regular visits. • Permanent footprint of the onshore substations 223,500 m^2. **Decommissioning phase** Decommissioning is likely to operate within the parameters identified for construction (i.e., any activities are likely to occur within construction working areas and to require no greater amount or duration of activity than assessed for construction).	
The impact of changes in groundwater levels, flow or quality on other sensitive groundwater dependent sites, including surface waters fed by groundwater.	✓	✓	✓		
The impact of ground gas generation on human health and other environmental receptors.	✓	✓	✓		
The impact of existing contamination to human receptors.	✓	×	×	As per detailed construction elements above **Construction: all elements** • Construction compounds will be prepared by removing and storing topsoil and subsoil and then constructing hardstanding areas using clean crushed stone. • Temporary dewatering of export trenches, joint bays and link boxes will be required where shallow groundwater is encountered.	As above.

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Decommissioning phase Decommissioning is likely to operate within the parameters identified for construction (i.e., any activities are likely to occur within construction working areas and to require no greater amount or duration of activity than assessed for construction).	
The impact of a deterioration in groundwater quality through the accidental spillage/release of potentially polluting substances.	✓	×	✓	As per detailed construction elements above **Construction: all elements** • Construction compounds will be prepared by removing and storing topsoil and subsoil and then constructing hardstanding areas using clean crushed stone. • Temporary dewatering of export trenches, joint bays and link boxes will be required where shallow groundwater is encountered.	As above.
Sterilisation of safeguarded mineral resources.	✓	×	×	As per detailed construction elements above **Construction: all elements** • Construction compounds will be prepared by removing and storing topsoil and subsoil and then constructing hardstanding areas using clean crushed stone. • Temporary dewatering of export trenches, joint bays and link boxes will be required where shallow groundwater is encountered.	Only the construction of permanent elements of the Transmission Assets are likely to affect the sterilisation of minerals resources. Temporary construction compounds will not result in sterilisation.
The impact of heat generated by the onshore export cables on groundwater quality, during the operation and maintenance phase.	×	✓	×	**Onshore export cables** • Maximum number of cables: 18 • Maximum number cable circuits: 6 • Target trench depth: 1.8 m • Maximum voltage: 275 kV • Typical permanent cable corridor width 70 m with a length of up to 17 km	Maximum number of cables will result in greatest potential for heat generation and larger permanent cable corridor width (and therefore larger area potentially impacted).

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				400 kV grid connection cable • Maximum number of cables: 12 • Maximum number cable circuits: 4 • Target trench depth: 1.8 m • Maximum voltage: 400 kV • Permanent corridor width of 50 m, with a length of up to 13 km	

[a] C=construction, O=operation and maintenance, D=decommissioning

1.10 Assessment methodology

1.10.1 Overview

1.10.1.1 The approach to determining the significance of effects is a two-stage process that involves defining the magnitude of the impact and the sensitivity of the receptor. This section describes the criteria applied in this chapter to assign values to the magnitude of impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on relevant guidance, including the Design Manual for Roads and Bridges (DMRB) methodology (Highways England *et al.,* 2020) where appropriate as described in further detail in Volume 1, Chapter 5: Environmental assessment methodology of the ES. The definitions specified for geology within the DMRB are used as a basis for defining mineral resources.

1.10.2 Receptor sensitivity/value

1.10.2.1 The criteria for defining the sensitivity of geology, hydrogeology or ground conditions receptors in this chapter are outlined in **Table 1.20** below.

Table 1.20: Sensitivity criteria

Sensitivity	Definition and examples
Very High	Very high importance and rarity, international scale and very limited potential for substitution. **Geology** UNESCO World Heritage Sites, UNESCO Global Geoparks and GCR where citations indicate features of international importance. Geology meeting international designation citation criteria which is not designated as such. **Hydrogeology** Principal aquifer providing a nationally important water resource and/or supporting a groundwater dependant site protected under international/EC legislation. Groundwater within an inner source protection zone (SPZ1). **Contamination: Human health** Very high sensitivity land use such as residential or allotments.
High	High importance and rarity, national scale and limited potential for substitution. **Geology** Geological site of national importance (e.g., GCR or SSSI or NNR). Geology meeting national designation citation criteria but which is not designated as such. **Hydrogeology** Principal aquifer providing locally important water resource and/or supporting a groundwater dependent site of national importance or a river ecosystem. Groundwater supports a Groundwater Dependent Terrestrial Ecosystem defined for the WFD. Groundwater within an outer source protection zone (SPZ2). **Contamination: Human health** High sensitivity land use such as public open space.

Sensitivity	Definition and examples
Medium	High or medium importance and rarity, regional scale, limited potential for substitution. **Geology** Geological site of regional importance (e.g., LGS, LNR). Geology meeting regional designation citation criteria which is not designated as such. Regionally or locally designated mineral resources (by mineral planning authorities). **Hydrogeology** Secondary aquifer unit providing a locally important water resource and/or groundwater dependent features or sites of local importance. Groundwater within the total catchment source protection zone (SPZ3). **Contamination: Human health** Medium sensitivity land use such as commercial or industrial.
Low	Low or medium importance and rarity, local scale. **Geology** Non-designated geological features of local interest (e.g., non-designated geological exposure, former quarries/mining sites, cuttings etc). **Hydrogeology** Secondary aquifer unit of providing water resource of limited local importance with little connection to surface water. **Contamination: Human health** Low sensitivity land use such as highways and rail.
Negligible	Very low importance and rarity, local scale. **Geology** No geological exposures, little/no local interest. **Hydrogeology** Unproductive strata. **Contamination: Human health** Undeveloped surplus land/no sensitive land use proposed.

1.10.3 Magnitude of impact

1.10.3.1 In determining impact magnitude, the impact duration and the nature of the impact has been taken into account. The following definitions from the DMRB (LA104 and LA113) have been used in the assessment.

- Temporal scale.
  - Short Term: A period of months, up to one year.
  - Medium Term: A period of more than one year, up to five years.
  - Long Term: A period of greater than five years.
- Geographical scale: whether the effect would be experienced at the local, regional or national level.
- Adverse or Beneficial: whether the nature of the effect increases or decreases potential contamination risks to sensitive receptors.

- Temporary: effects that persist for a limited period only (due for example, to particular activities taking place for a short period of time).
- Permanent: effects that result from an irreversible change to the baseline environment (e.g., land-take) or which persist for the foreseeable future.
- Reversible/irreversible effect: effects can be reversed by mitigation measures or by natural environmental recovery within reasonable timescales (e.g., 5 to 10 years following cessation of construction).

1.10.3.2 The criteria for defining magnitude in this chapter are outlined in **Table 1.21** below.

Table 1.21: Magnitude of impact criteria

Magnitude of impact		Definition
High	Adverse	**Geology** A large change from baseline conditions, which results in the large-scale loss or deterioration in condition of the geological feature, site or resource affected. The impact is typically of wide spatial extent, permanent duration and irreversible. **Hydrogeology** A large change from baseline conditions in an aquifer unit, which results in severe deterioration of groundwater quality, groundwater levels, groundwater flow and/or resource utility, for example. • A deterioration in overall WFD status for a groundwater body. • Rendering the groundwater in an aquifer unit non-potable through the introduction of hazardous substances into groundwater, failure against prescribed concentrations for pollutants (i.e., statutory Drinking Water Standards), or reduction in resource availability. • Rendering existing groundwater sources of supply (borehole, well or spring) non-viable. • Cause a large impact on groundwater dependent watercourse in terms of flow, overall WFD status of the water body or failure against statutory Environmental Quality Standards. • Cause statutory monitoring targets for ecological sites to be failed. These impacts are likely to be of wide spatial extent, of permanent duration and of low reversibility. **Human health** Significant contamination identified. Contamination levels significantly exceed background levels and relevant screening with potential for significant harm to human health. Contamination heavily restricts future use of land.
	Beneficial	**Geology** A large change from baseline conditions, which results in major improvement in the condition of the geological feature or site affected. The impact will be of wide extent and permanent in nature. **Hydrogeology** A large change from baseline conditions in an aquifer unit, which results in significant improvement in groundwater quality, groundwater levels, groundwater flow and/or resource utility, for example. • An improvement in the overall WFD status for a groundwater body.

Magnitude of impact		Definition
		• Rendering a previously contaminated aquifer potable or increasing resource availability. • Rendering existing groundwater sources of supply viable. • Cause a large beneficial impact on a groundwater dependent receptor (e.g., watercourse in terms of flow, or water quality, or WFD status; achieving statutory monitoring targets for ecological site) (Environment Agency, 2022). These impacts are likely to be of wide spatial extent and of permanent duration.
Medium	Adverse	**Geology** A moderate change from baseline conditions, which results in the loss or deterioration in condition of part of the geological feature, site or resource affected. The impact is typically of local to wide spatial extent, moderate to long duration and of low reversibility. **Hydrogeology** A moderate change from baseline conditions in an aquifer unit, which results in the deterioration of groundwater quality, groundwater levels, groundwater flow and/or resource utility, for example. • A deterioration in WFD criteria for certain parameters, although the overall WFD status may not change. • A deterioration in groundwater quality in an aquifer and/or possible failure against certain prescribed concentrations (i.e., statutory Drinking Water Standards). • Deterioration in quality, quantity, or reliability of groundwater source of supply (borehole, well or spring). • Cause a moderate impact on groundwater dependent watercourse in terms of flows, or WFD status or failure relative to statutory Environmental Quality Standards. • Cause statutory monitoring targets for ecological site to be failed. These impacts are likely to be of local to wide spatial extent, or of moderate to long duration and/or of low reversibility. **Human health** Contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria. Significant contamination can be present. Control/remediation measures are required to reduce risks to human health/make land suitable for intended use.
	Beneficial	**Geology** A moderate change from baseline conditions, which results in improvement in the condition of part of the geological feature or site affected. The impact is typically of local to wide spatial extent, moderate to long duration and of low reversibility. **Hydrogeology** A moderate change from baseline conditions in an aquifer unit, which results in the improvement in groundwater quality, groundwater levels, groundwater flow and/or resource utility. These impacts are likely to be of local to wide spatial extent, of moderate to long duration.
Low	Adverse	**Geology** Some measurable change from baseline conditions, which results in a small deterioration in condition of part of the geological feature, site or resource affected.

Magnitude of impact		Definition
		The impact is typically of limited spatial extent and may be of short duration and/or reversible. **Hydrogeology** Some measurable change from baseline condition, which results in a small deterioration of groundwater quality, groundwater levels, groundwater flow and/or resource utility but does not change its regulatory status (e.g., overall WFD status) or utility of resource given the impacts are small, likely to be of limited spatial extent, or of short duration and/or reversible. **Human health** Contaminant concentrations are below relevant screening criteria, Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health.
	Beneficial	**Geology** Some measurable change from baseline conditions, which results in a small improvement in condition of part of the geological feature, site or resource affected. The impact is typically of limited spatial extent and may be of short duration and/or reversible. **Hydrogeology** Some measurable change from baseline condition, which results in a small improvement of groundwater quality, groundwater levels, groundwater flow and/or resource utility. This may result in measurable effects on groundwater dependent receptors. These impacts are likely to be of limited spatial extent, or short duration and/or reversible.
Negligible	Adverse or beneficial	**Geology** A small measurable change from baseline conditions, but no material change to the status or condition of the geological feature, site or resource affected. **Hydrogeology** A small measurable change from baseline condition, but no change in the status of groundwater quality, quantity or flow within the aquifer unit affected or its utility. A small measurable change from baseline condition, but no change in the status of groundwater dependent receptor affected (e.g., river, stream, borehole, well, spring or wetland) and their utility. Very minor benefit to, or positive addition of one or more characteristics, features or elements. **Human health** Contaminant concentrations substantially below levels outlined in relevant screening criteria. No requirement for control measures to reduce risks to human health/make land suitable for intended use.
No change		No change from baseline conditions. No measurable impact either adverse or beneficial.

1.10.4 Significance of effect

1.10.4.1 The significance of the effect upon geology, hydrogeology and ground conditions has been determined by taking into account the sensitivity of the receptor and the magnitude of the impact. The method employed for this

assessment is presented in **Table 1.22**. Where a range of significance levels is presented, the final assessment for each effect is based upon expert professional judgement.

1.10.4.2 In all cases, the evaluation of receptor sensitivity, impact magnitude and significance of effect has been informed by expert professional judgement and is underpinned by narrative to explain the conclusions reached.

1.10.4.3 For the purpose of this assessment, any effects with a significance level of minor or less are not considered to be significant in terms of the EIA Regulations.

Table 1.22: Assessment matrix

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

1.10.4.4 Where the magnitude of impact is 'no change', no effect would arise.

1.10.4.5 The definitions for significance of effect levels are described as follows.

- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category. Effects upon human receptors may also be attributed this level of significance.
- Moderate: These beneficial or adverse effects have the potential to be important and may influence the key decision-making process. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse or beneficial effect on a particular resource or receptor.
- Minor: These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
- Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

1.10.5 Assumptions and limitations of the assessment

1.10.5.1 The assessment of effects has been determined primarily from a desk-based review of available information, supplemented by site-specific site investigations where available. This is considered to provide a robust basis for EIA.

1.10.5.2 The zone of influence assessed within **section 1.11.9** uses empirically derived relationships. It utilises information based on limited ground investigation data with no direct data currently available pertaining to the ground conditions beneath the Lytham St Annes Dunes SSSI, especially the groundwater regime and its variability which is likely to be seasonal.

1.11 Assessment of effects

1.11.1 Introduction

1.11.1.1 The impacts arising from the construction, operation and maintenance and decommissioning phases of the Transmission Assets on geology, hydrogeology and ground conditions have been assessed. The impacts arising from each phase are listed in **Table 1.26** along with the MDS against which each impact has been assessed.

1.11.1.2 A description of the likely effect on geology, hydrogeology and ground conditions receptors caused by each identified impact is given below.

1.11.2 The impact of partial loss or damage to designated geological or geomorphological sites

1.11.2.1 Designated sites of geological and geomorphological interest identified within the Onshore Order Limits include:

- Lytham St. Anne's Dunes SSSI, designated at the national level; and
- Lytham St. Anne's – Starr Hills Dunes LGS for Lancashire – Starr Hills Dunes LGS, designated at the local level (Lancashire).

1.11.2.2 These sites overlap with each other and are located above MHWS between the A584 and the railway between Lytham St. Annes and Blackpool.

1.11.2.3 The Lytham Coastal Changes SSSI and Lytham St. Anne's GCR site lie outside of the Onshore Order Limits. These sites include multiple land parcels, the closest of which falls within the study area and is approximately 155 m south of the Onshore Order Limits (see Figure 1.1 of Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES). There will be no intrusive works, excavation or the use of any potentially polluting materials close to the Lytham Coastal Changes SSSI. There will no impact in terms of loss of damage to this site.

1.11.2.4 No designated sites of geological and geomorphological interest have been within the Intertidal Infrastructure Area.

Construction phase

Sensitivity of the receptor

1.11.2.5 The dunes at Starr Hills are one of the best examples of a calcareous dune system remaining in Lancashire. The site still shows classic features of dune formation and ecological succession, including the widest range of foredune, yellow dune, dune grassland, acid dune grassland, dune scrub and dune slack habitats found anywhere along the Fylde Coast. Given the small size of the site and the rarity of the dune formation, it cannot be readily restored or substituted. The sensitivity of the SSSI is high. The Starr Hills LGS is a site of local importance and would therefore typically have a sensitivity of medium. However, given this designation overlaps with the national level SSSI designation, the overall sensitivity is considered to be **high**.

Magnitude of impact

1.11.2.6 As set out in Volume 1, Chapter 3: Project description of the ES, the offshore export cables will be installed beneath the dunes by direct pipe from the transition joint bays to Lytham St Annes beach (see **Table 1.19**). Further information regarding the installation methodology for direct pipe is detailed within Volume 1, Chapter 3: Project description of the ES. The direct pipe will pass beneath the sand dunes at Lytham St. Annes Dunes SSSI and the Starr Hills LGS, as secured by (see **Table 1.18**). Utilising direct pipe allows the offshore export cables to be installed with minimal disruption to the designated sites. There will be no open trenching through the designated sites and all construction compounds and transition joint bays will be located outside of the Lytham St. Annes Dunes SSSI and the Starr Hills LGS.

1.11.2.7 The magnitude of impact is therefore considered to be **negligible**.

1.11.2.8 The impact in terms of groundwater dependent receptors is set out in **section 1.11.9**.

Significance of the effect

1.11.2.9 Overall, the sensitivity of the receptor is **high** and the magnitude of the impact is **negligible**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

1.11.3 The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units

1.11.3.1 Recent or historical land uses have the potential to result in localised areas of soil or groundwater contamination. That contamination is subject to potential mobilisation if disturbed. The mobilisation of contamination may result in an adverse impact on underlying aquifers, in terms of their WFD status and/or general potability. Those effects can be direct or may arise from the creation of new pathways, through excavation, piling or HDD (or other trenchless techniques). An adverse impact on groundwater quality also represents a potential risk to groundwater abstractions. As described in **section 1.6.8** the

following areas have been identified within the Onshore Order Limits and/or Intertidal, Infrastructure Area where high risk activities and land uses have been identified.

Landfall and onshore export cable corridor near Blackpool Airport

1.11.3.2 At the western end of the study area, the installation of the offshore export cables by direct pipe (MDS, see **Table 1.19**) will require the creation of construction compounds. Transition joint bays will be constructed to join the onshore export cables to the offshore export cables. Compounds have been sited, where possible, to avoid key constraints in and around the landfall area. Exit pits will require the use of cofferdams on the beach. There is, however, potential to disturb existing ground/groundwater contamination associated with current and historical potentially contaminative land use in this area. Higher risk potentially contaminative land uses include:

- Blackpool Airport;
- fire station;
- railway sidings;
- refuse destructor/refuse heap;
- garages;
- gas works; and
- active and historical landfills (most notably Blackpool Airport landfill and Westby landfill).

1.11.3.3 A full list of potentially contaminative land uses and figures are presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.11.3.4 The WFD status of the Secondary A superficial deposit (Blown Sands) aquifer in this part of the study area is currently good. Water quality could be affected by any excavations, construction of haul roads or compounds.

400 kV grid connection cable corridor

1.11.3.5 The 400 kV grid connection cable corridor crosses the area around Clifton Marsh and the River Ribble. This highly developed area extends along the Onshore Order Limits north of the River Ribble. Potentially significant contaminative land uses identified in this area include:

- active and historical landfills (most notably Clifton Marsh landfill and Grange Farm landfill);
- multiple licensed wastes sites associated with the landfills;
- a large sewage works;
- gas governor;
- five historical garages/fuel stations sites (F2_04 to FS_08) on the A584 and A583; and

- a number of pollution incidents that historically affected water quality.

1.11.3.6 A full list of potentially contaminative land uses and figures are presented in Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.11.3.7 Either direct pipe or micro-tunnelling will be used for crossing beneath the River Ribble. These techniques have similar parameters but micro-tunnelling has been identified as the MDS for this impact due to the depth of entry/exit pits (see **Table 1.19**). HDD (or other trenchless techniques) may be used at identified locations beneath the developed area and other crossing locations. All have the potential to disturb any existing areas of ground/groundwater contamination.

1.11.3.8 Water quality in the underlying sand and gravel aquifer could also be affected by mobilisation during construction of temporary haul roads, excavations or compounds.

1.11.3.9 The water quality in the surface aquifer in this area is not known, although it may be affected by contamination from the historical landfills immediately north of the River Ribble.

Other areas

1.11.3.10 Outside of these two key areas, several areas of existing contamination are present in isolation. Although several further current and/or historical potential sources of contamination have been identified within other areas of the Onshore Order Limits, these are not considered likely to be significant for the transmission Assets given their nature, location and/or extent. All existing features presenting a potential contamination risk are presented in Figure 1.5 of Volume 3, Annex 1.1: Phase 1 geo-environmental preliminary risk assessment of the ES.

1.11.3.11 The onshore substations could potentially require deep piled foundations. The construction of piled foundations could potentially create new migration pathways connecting surface contamination sources and the underlying bedrock Principal aquifer at depth. However, it is noted that high risk potentially significant sources of contamination have not been identified in these areas.

Construction phase

Sensitivity of receptor

Landfall and onshore export cable corridor near Blackpool Airport

1.11.3.12 The shallow Secondary A superficial deposit (Blown Sands) aquifer at the western end of the study area is a locally important groundwater resource that is currently of good WFD chemical and quantitative status. The sensitivity of this receptor is **medium**.

400 kV grid connection cable corridor and other areas

1.11.3.13 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is also locally important and with good WFD chemical and quantitative status. The sensitivity of this receptor is therefore **medium**.

1.11.3.14 The Principal bedrock aquifer in the eastern part of the study area is of high importance. The aquifer has been shown to be of good WFD chemical status although its WFD quantitative status is poor as a result of abstraction. The sensitivity of this receptor is **high.**

Magnitude of impact

Landfall and onshore export cable corridor near Blackpool Airport

1.11.3.15 The use of open cut trenching and direct pipe, with some areas of HDD (or other trenchless techniques) has the potential to disturb existing ground/groundwater contamination associated with current and historical land use and may create a potential pathway that could allow the migration of contaminated groundwater outside of its current area of impact. The excavation and dewatering of direct pipe entry/exit pits, transition joint bays and the construction of temporary infrastructure also have the potential to mobilise soil or groundwater contamination associated with the potential contaminant sources including the airport and historical landfills.

1.11.3.16 This mobilisation of contamination could result in a change from baseline conditions in the aquifer units, for example a deterioration in overall WFD status for a groundwater body.

1.11.3.17 The presence or severity of any contamination in these areas is not fully determined. Appropriate further studies (e.g., site investigations) are proposed to be undertaken where major trenchless crossings are proposed, during the detailed design stage to confirm ground conditions (CoT94).

1.11.3.18 An Outline Contaminated Land and Groundwater Discovery Strategy has been submitted with the application for development consent (document reference J1.14), to identify any suspected areas of contamination and any remedial measures which may be required. Detailed strategies will identify the construction protocol for discovery of any currently unknown contamination and any remedial measures that may be required.

1.11.3.19 Based on the available information, the magnitude of impact is likely to be up to medium.

400 kV grid connection cable corridor

1.11.3.20 Open cut trenching, the use of direct pipe beneath the River Ribble and HDD (or other trenchless techniques) in the wider area, the excavation and dewatering of joint bays or link boxes and the construction of temporary infrastructure have the potential to have direct, long term impacts on any site or activity crossed by the 400 kV grid connection cables and temporary infrastructure.

1.11.3.21 During the construction of the entry and exits pits associated with the River Ribble Crossing, which may be up to 45 m in depth (micro-tunnelling), it is expected that some dewatering would be required.

1.11.3.22 Though the entry pits are located outside the Lea Marsh landfill mapped boundaries there is potential for these works to mobilise contaminants associated/contained within it (where groundwater/leachate within the feature is in continuity with the surrounding aquifer units). Dewatering in terms of reduction in groundwater levels is discussed within **section 1.11.4.**

1.11.3.23 Given the density of high risk potentially contaminative land uses identified in this area, this could result in a major change from baseline conditions in the aquifer unit, for example:

- a deterioration in overall WFD status for a groundwater body; and
- rendering the groundwater in an aquifer unit non-potable through the introduction of hazardous substances into groundwater or failure against prescribed concentrations for pollutants (i.e., statutory Drinking Water Standards).

1.11.3.24 The micro-tunnelling entry/exit pit shafts will extend a maximum of 45 m which will likely coincide with bedrock of the Sherwood Sandstone Group.

1.11.3.25 The superficial sand and gravel aquifer unit is expected to be hydraulically separated from the underlying bedrock by the presence of low permeability Glacial Till.

1.11.3.26 The presence or severity of any contamination in these areas is not fully determined. Appropriate further studies (e.g., site investigations) are proposed to be undertaken where major trenchless crossings are proposed, during the detailed design stage to confirm ground conditions (CoT94).

1.11.3.27 An Outline Contaminated Land and Groundwater Discovery Strategy has been submitted with the application for development consent (document reference J1.14), to identify any suspected areas of contamination and any remedial measures which may be required. Detailed strategies will identify the construction protocol for discovery of any currently unknown contamination and any remedial measures that may be required.

1.11.3.28 The magnitude of impact is likely to be up to **medium**.

Other areas

1.11.3.29 Piling may be used as the foundation solution for large structures at the onshore substations.

1.11.3.30 Given the onshore permanent substations are not located within an area of high risk potentially contaminative land uses, and with the Contaminated Land and Groundwater Discovery Strategy in place in terms of any currently unknown contamination, the magnitude of the construction impact is likely to be up to **low**.

Significance of effect

Landfall and onshore export cable corridor near Blackpool Airport

1.11.3.31 Overall, the sensitivity of the Secondary A superficial deposit (Blown Sands) aquifer is **medium** and the magnitude of the impact is **medium**. The effect will, therefore, be of **moderate adverse** significance, which is significant.

400 kV grid connection cable corridor and other areas

1.11.3.32 Overall, the sensitivity of the sand and gravel aquifer is **medium** and the magnitude of the impact is **medium**. The effect will, therefore, be of **moderate adverse** significance, which is significant.

1.11.3.33 Overall, the sensitivity of the bedrock aquifer is **high** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

Further mitigation and residual effects

1.11.3.34 Where the onshore export cable corridor or 400 kV grid connection cable corridor crosses sites of particular sensitivity (e.g. embanked Environment Agency surface watercourses, SSSIs or groundwater inner SPZs) hydrogeological risk assessment(s) will be undertaken to inform a site-specific crossing method statement(s) where required. These will be agreed with the relevant stakeholders prior to construction (CoT41).

1.11.3.35 Subject to landowner approval, at detailed design stage, hydrogeological risk assessment(s) will be undertaken at St Annes Old Links Golf Club, if necessary. The hydrogeological risk assessment(s) would be informed by ground investigation information, where relevant and practicable. If undertaken, the risk assessment(s) will inform a detailed site-specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI and the St Annes Old Links Golf Course (CoT119).

1.11.3.36 Where areas of potentially significant contamination (e.g. landfills) cannot be avoided within the Transmission Assets Order Limits, ground investigation or other appropriate measures (e.g. use Personal Protective Equipment and/or hazard signage) will be implemented to mitigate potential impacts to, or effects on sensitive receptors. Where ground investigation identifies potential risks to sensitive receptors from contamination, a remediation strategy would be prepared in consultation with the Environment Agency (CoT118).

1.11.3.37 Through the application of mitigation measures the magnitude of the impact on the aquifer units would be reduced to **low** (superficial deposit aquifers) and **negligible** (Principal bedrock aquifer). The sensitivity of the receptor is **medium** (superficial deposits aquifer) and **high** (Principal bedrock aquifer). The residual effect would be of **minor adverse** significance, which is not significant.

Operation and maintenance phase

Sensitivity of receptors – all areas

1.11.3.38 The shallow, Secondary A superficial deposit (Blown Sands) aquifer at the west end of the study area is a locally important groundwater resource that is currently of good chemical and quantitative status. The sensitivity of this receptor is **medium**.

1.11.3.39 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is also locally important and with good chemical and quantitative status. The sensitivity of this receptor is also therefore **medium**.

Magnitude of impacts – all areas

1.11.3.40 Activity at the landfall and along the onshore export cable corridor and 400 kV grid connection cable corridor during the operation and maintenance phase will be limited. This will involve infrequent on-site inspections of the cables and corrective maintenance activities. The cables will be continuously monitored remotely.

1.11.3.41 The onshore substations will be unmanned: the onshore infrastructure will be continuously monitored remotely, and there will be operation and maintenance staff visiting the onshore substations to undertake preventative and corrective works on a regular basis (no less than every six months).

1.11.3.42 Once constructed, no activities are likely during operation that have the potential to result in additional mobilisation of any pre-existing contamination.

1.11.3.43 The magnitude of impact during the operation and maintenance phase will therefore be **negligible** for all areas.

Significance of effect – all areas

1.11.3.44 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **negligible**. The effect will, therefore, be of **negligible adverse** significance, which is not significant.

Decommissioning phase

1.11.3.45 During decommissioning, it is expected that the onshore export cables will be left *in-situ* to minimise the environmental disturbance during decommissioning. The cable ends will be cut, sealed and securely buried as a precautionary measure.

1.11.3.46 Joint bays and link boxes will be removed only if it is feasible with minimal environmental disturbance or if their removal is required to return the land to its current use.

1.11.3.47 Decommissioning of the onshore substations will be reviewed in discussion with the transmission system operator and appropriate regulators in the light of any other existing or proposed future use of the onshore substations

1.11.3.48 An Onshore Decommissioning Plan will be developed (CoT36, as in **Table 1.18**) prior to decommissioning in a timely manner. The Onshore Decommissioning Plan will include provisions for the removal of all onshore above ground infrastructure and the decommissioning of below ground infrastructure and details relevant to pollution prevention and avoidance of ground disturbance. The Onshore Decommissioning Plan will be in line with the latest relevant available guidance.

Sensitivity of receptor – all areas

1.11.3.49 The shallow, Secondary A superficial deposit (Blown Sands) aquifer at the west end of the study area is a locally important groundwater resource that is currently of good chemical and quantitative status. The sensitivity of this receptor is **medium**.

1.11.3.50 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is also locally important and with good chemical and quantitative status. The sensitivity of this receptor is therefore **medium**.

Magnitude of impact – all areas

1.11.3.51 Activity at the landfall and along the onshore export cable corridor and 400 kV grid connection cable corridor during the decommissioning phase will be equal to or less than that described for the construction phase. The onshore substations will require a greater level of decommissioning activity due to the scale and operation of the plant.

1.11.3.52 The magnitude of impact during the decommissioning phase will therefore be equal to or less than that reported for the construction phase. With the Onshore Decommissioning Plan (CoT36) in place, the magnitude of impact is anticipated to be **low** in all areas.

Significance of effect – all areas

1.11.3.53 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

1.11.4 The impact on groundwater levels in aquifer units: Superficial deposit Secondary A aquifer unit

1.11.4.1 The onshore export cable corridor extending from the landfall to the B5261 (Queensway), crosses the shallow Secondary A superficial deposit (Blown Sands) aquifer. The locally important aquifer unit extends along the coastline, beneath Blackpool and Lytham St. Annes. Local geological records confirm the presence and lateral extent of the Secondary A superficial deposit (Blown Sands) aquifer unit. In the west, this aquifer often extends to a depth of more than 10 m where it appears to combine with underlying sand of gravel deposits (possibly middle sands of the Glacial Till).

1.11.4.2 The WFD status for this groundwater body has been shown to be good, for both chemical and quantitative quality. Local records also show the aquifer

extending further east than aquifer designation maps, becoming overlain by a progressively thicker layer of clay deposits/boulder clay. These clay deposits appear to be between 18 to 22 m thick over much of the central and west section of the onshore export cable corridor and will essentially isolate the sand and gravel aquifer from surface activities.

1.11.4.3 Local geological records have also shown the presence of an extensive, shallow sand and gravel unit within the onshore substation and 400 kV grid connection cable corridor (in the eastern part of the study area). These deposits appear to form a laterally extensive aquifer unit, although they are not identified as an aquifer on Environment Agency designation maps. The water quality in these deposits is not known, although reporting suggests they may be affected by leachate from historical landfills identified immediately north of the River Ribble in the 400 kV grid connection cable corridor.

1.11.4.4 These shallow aquifers in the west and east, do support small, licensed abstractions within or near the study area (see **section 1.6.5**).

1.11.4.5 The following activities have the potential to impact groundwater levels within the superficial deposits aquifer unit.

Dewatering

1.11.4.6 The construction of entry/exit pits, transition joint bays, onshore export cables, 400 kV grid connection cables and associated joint bays or link boxes will require dry excavations. Groundwater dewatering of open trenches and excavations may therefore be required through pumping. The groundwater removed by dewatering will be discharged to local surface watercourses or spread to ground away from the excavations. This will be undertaken in accordance with measures agreed through the CoCP (CoT35) and Outline Pollution Prevention Plan (document reference J1.4) (CoT04).

1.11.4.7 Dewatering in the vicinity of unconfined aquifer units will result in:

- groundwater levels being locally reduced by up to 6 m near the transition joint bays (and 13 m for the entry/exit pits associated with the micro-tunnelling technique beneath the River Ribble) within the trenches and excavations; and
- change in local groundwater flow directions, which will become oriented towards the dewatering activities.

1.11.4.8 Groundwater levels will recover after construction assuming that the excavated materials are used as backfill and are not subject to artificial compaction. This will be controlled through the CoCP and the Surface Water and Groundwater Management Plan. An Outline CoCP (document reference J1) is provided, together with an Outline Surface Water and Groundwater Management Plan (document reference J1.9) as part of the application for development consent.

1.11.4.9 Impacts in relation to the Lytham St. Annes Dunes SSSI are set out in **section 1.11.9**

Foundations

1.11.4.10 Construction of the onshore substations will require both a temporary construction compound and a permanent operational footprint for each substation. The permanent footprint will include both permeable and non-permeable areas. The non-permeable parts of the onshore substation footprints will introduce new areas of hardstanding. This will affect the infiltration of rainwater to ground and hence recharge to underlying aquifer units.

1.11.4.11 Foundations required for the onshore substations may also intercept groundwater causing localised impacts on flow and levels.

Horizontal directional drilling

1.11.4.12 Direct pipe (see **Table 1.19**) drilling techniques will be employed at the landfall, with HDD (or other trenchless techniques) used, where required, to cross roads, rivers and sensitive utility assets. Micro-tunnelling (MDS, see **Table 1.19**) is to be used beneath the River Ribble. These techniques may have the potential to intercept shallow groundwater causing localised impacts on flow and levels.

Construction phase

Sensitivity of the receptor

1.11.4.13 The shallow, Secondary A superficial deposit (Blown Sands) aquifer at the western end of the study area is a locally important groundwater resource that is currently of good WFD chemical and quantitative status. The sensitivity of this receptor is **medium**.

1.11.4.14 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is also locally important and with good WFD chemical and quantitative status. The sensitivity of this receptor is therefore **medium**.

Magnitude of impact

Dewatering

1.11.4.15 The dewatering of open cut trenches and excavations will have a direct impact on shallow groundwater levels and flow. That impact will be short term and localised in nature. The magnitude of this impact on groundwater quantity will be **low**.

Foundations

1.11.4.16 The onshore substations are partly located on the Secondary A superficial deposit aquifer, their construction may affect recharge to the Secondary A superficial deposit aquifer. The magnitude of this impact on the aquifer and on groundwater levels or flow is likely to be **low**.

Horizontal directional drilling

1.11.4.17 HDD (or other trenchless techniques) will be used to install the Transmission Assets along the length of the route particularly beneath key constraints. These techniques may have the potential to intercept shallow groundwater causing localised impacts on flow and levels anticipated to be short term. The magnitude of impact is **low**.

Significance of the effect

Dewatering

1.11.4.18 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

Foundations

1.11.4.19 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be **minor adverse** significance, which is not significant.

Horizontal directional drilling

1.11.4.20 The sensitivity of the receptor is **medium** and the magnitude of impact of drilling works is **low**. The effect will, therefore, be **minor adverse** significance, which is not significant.

Operation and maintenance phase

1.11.4.21 During the operation and maintenance phase, the only impact on groundwater levels in the Secondary A superficial deposit aquifer unit will be from the ongoing presence of foundations at the onshore substations.

Sensitivity of receptor

1.11.4.22 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is locally important and with good WFD chemical and quantitative status. The sensitivity of this receptor is therefore **medium**.

Magnitude of impact

1.11.4.23 As the onshore substations are partly located on the Secondary A superficial deposit aquifer, their continued operation may affect recharge to the Secondary A superficial deposit aquifer. With measures set out in the Outline Operational Drainage Management Plan (CoT11) in place the magnitude of this impact on the aquifer and on groundwater levels or flow will be **negligible**.

Significance of effect

1.11.4.24 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **negligible**. The effect will, therefore, be of **negligible adverse** significance, which is not significant.

Decommissioning phase

1.11.4.25 A description of the decommissioning phase activities is provided in paragraphs **1.11.3.45** to **1.11.3.48**.

Sensitivity of receptor

1.11.4.26 The shallow, Secondary A superficial deposit aquifer at the western end of the study area is a locally important groundwater resource that is currently of good chemical and quantitative status. The sensitivity of this receptor is **medium**.

1.11.4.27 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is also locally important and with good chemical and quantitative status. The sensitivity of this receptor is therefore **medium**.

Magnitude of impact

1.11.4.28 Activity at the landfall and along the onshore export cable corridor and 400 kV grid connection cable corridor during the decommissioning phase will be equal to or less than that described for the construction phase.

1.11.4.29 The onshore substations will require a greater level of decommissioning activity than the cable routes.

1.11.4.30 The magnitude of impact during the decommissioning phase will therefore be less than or equal to that reported for the construction phase. With the Onshore Decommissioning Plan in place, the magnitude of impact is anticipated to be **low** in all areas.

Significance of effect

1.11.4.31 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

1.11.5 The impact of reduced groundwater levels in aquifer units: Bedrock Principal aquifer unit

1.11.5.1 The bedrock Principal aquifer of the Sherwood Sandstone Group underlies much of the area affected by the onshore substations and the 400 kV grid connection cable corridor. This Principal aquifer is overlain by a thick sequence of superficial deposits, primarily Glacial Till. Local geological records show the depth to top of the bedrock ranges from approximately 20 m to 40 m. A lower, clay-rich unit in the Glacial Till (typically between 7.5 m and 17 m), separates the bedrock from near surface sand and gravels

identified at the eastern end of the study area. This clay-rich 'boulder clay' is of low permeability and has three functions:

- forms the base to the overlying surface sand and gravel aquifer, that contains groundwater;
- confines the groundwater in the underlying bedrock aquifer; and
- forms a barrier that protects the groundwater in the deep bedrock aquifer from surface aquifers or surface activities.

1.11.5.2 The impacts of dewatering and foundation construction on the near surface Secondary A superficial deposit aquifer have been assessed in **section 1.11.4**.

Construction phase

Sensitivity of receptor

1.11.5.3 The Principal bedrock aquifer is of high importance. The aquifer has been shown to be of good WFD chemical status although its WFD quantitative status is poor as a result of abstraction. The sensitivity of this receptor is **high**.

Magnitude of impact

1.11.5.4 The clay-rich Glacial Till (boulder clay) that separates the surface aquifer and bedrock aquifer will afford protection to the bedrock aquifer from surface activities. As a result of this barrier, there will be no impact arising from surface dewatering. It is likely that the onshore substation foundations would be above this level (this will be confirmed at detailed design stage).

1.11.5.5 The pit shafts will extend a maximum of 45 m which will likely coincide with bedrock of the Sherwood Sandstone Group.

1.11.5.6 During the construction of the start and exit pits/shafts associated with the River Ribble Crossing, particularly where required to be excavated to their maximum depths of 45 m for the proposed micro-tunnelling technique, it is expected that dewatering of the shafts and, potentially, the surrounding ground would be required (approximately 13 m depth).

1.11.5.7 The superficial sand and gravel aquifer unit is expected to be hydraulically separated from the underlying bedrock by the presence of low permeability Glacial Till. This will be confirmed through ground investigation as described in **paragraph 1.11.3.17** secured by CoT94.

1.11.5.8 Groundwater levels will recover after construction assuming that the excavated materials are used as backfill and are not subject to artificial compaction. This will be controlled through the CoCP and the Surface Water and Groundwater Management Plan. An Outline CoCP (document reference J1) is provided, together with an Outline Surface Water and Groundwater Management Plan (document reference J1.9) as part of the application for development consent. The magnitude of construction impact is likely to be **low**.

Significance of effect

1.11.5.9 Overall, the sensitivity of the receptor is **high** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

Decommissioning phase

1.11.5.10 A description of the decommissioning phase activities is provided in paragraphs **1.11.3.45** to **1.11.3.48**.

Sensitivity of receptor

1.11.5.11 The Principal aquifer is of high importance. The aquifer has been shown to be of good WFD chemical status although its WFD quantitative status is poor, as a result of abstraction. The sensitivity of this receptor is **high**.

Magnitude of impact

1.11.5.12 Activity at the landfall and along the onshore export cable corridor and 400 kV grid connection cable corridor during the decommissioning phase will be at surface level. The onshore substations will require a greater level of decommissioning activity and foundations will be removed and land restored to its previous use (or other agreed land use).

1.11.5.13 This clay-rich Glacial Till (boulder clay) that separates the surface aquifer and bedrock aquifer will afford protection to the bedrock aquifer from shallow surface activities. As a result of this barrier, there will be no change on the Principal aquifer arising from decommissioning. The magnitude of decommissioning impact is likely to be **no change**.

Significance of effect

1.11.5.14 Overall, the sensitivity of the receptor is **high** and the magnitude of the impact is **no change**. There will therefore be **no effect**, which is not significant.

1.11.6 The impact of reduced groundwater levels or quality in aquifer units: Impact on existing groundwater abstractions

1.11.6.1 The construction, operation and maintenance, and decommissioning of the Transmission Assets have the potential to have a direct impact on groundwater abstractions. Groundwater dewatering, new pathway creation, accidental releases of hazardous substances and/or the mobilisation of contamination all have the potential affect groundwater supply sources situated near or down hydraulic gradient from the Transmission Assets.

Licensed groundwater abstractions

1.11.6.2 Details of the three active groundwater abstraction licenses identified in the study area are summarised in **Table 1.9**. These licensed abstractions abstract groundwater from the shallow sand and gravel aquifer.

Construction phase

Sensitivity of receptor

1.11.6.3 The active licensed groundwater abstractions are of local importance given they are abstracted from a secondary aquifer unit providing a locally important water resource. The sensitivity of this receptor is **medium**.

Magnitude of impact

Licensed groundwater abstractions

1.11.6.4 As set out in **Table 1.9**, licensed abstraction GWA_01 is located within Onshore Order Limits near Blackpool Airport. It is possible that the construction of the landfall and onshore export cable corridor could impact the abstraction borehole. The magnitude of this construction impact has the potential to be short term and up to **high**.

1.11.6.5 The other active boreholes drawing water from shallow sand and gravel deposits are located at considerable distance from the proposed onshore infrastructure. The magnitude of this construction impact is **no change**.

Significance of effect

Licensed groundwater abstractions

1.11.6.6 Overall, the sensitivity of the GWA_01 is **medium** and the magnitude of the impact is up to **high**. The effect will, therefore, be of **major adverse** significance, which is significant.

1.11.6.7 For the other boreholes drawing groundwater from shallow sand and gravel deposits, the sensitivity of the receptor is **medium** and there will be **no change** in terms of magnitude of impact. There will therefore be **no effect** which is not significant.

Further mitigation and residual effects

Licensed abstraction sources

1.11.6.8 Subject to landowner approval, at detailed design stage, hydrogeological risk assessment(s) will be undertaken at St Annes Old Links Golf Club (abstraction borehole ref: GWA_01), if necessary. The hydrogeological risk assessment(s) would be informed by ground investigation information, where relevant and practicable. If undertaken, the risk assessment(s) will inform a detailed site-specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI and the St Annes Old Links Golf Course (CoT119).

1.11.6.9 Where the onshore export cable corridor or 400 kV grid connection cable corridor crosses sites of particular sensitivity (including SPZs) hydrogeological risk assessment(s) will be undertaken to inform a site-specific crossing method statement(s) where required. These will be agreed with the relevant stakeholders prior to construction (CoT41).

1.11.6.10 With suitable measures in place, water supply will be provided during construction. Through the application of mitigation measures the sensitivity of the receptor is **medium** and the magnitude of the impact on GWA_01 could be reduced to **low**. The residual effect would be of **minor adverse** significance, which is not significant.

Operation and maintenance phase

Sensitivity of receptor

1.11.6.11 Active licensed groundwater abstractions are considered to be of local importance. The sensitivity of these receptors is **medium**.

Magnitude of impact

Licensed groundwater abstractions

1.11.6.12 It is expected that any affected groundwater levels will have recovered by the operational phase. Given that the excavated materials will be used to backfill the trenches, the impact on level and flow is expected to be small. There is unlikely to be a significant measurable change in levels or quality, and the resource status should not be affected. The magnitude of the impact on GWA_01 will be **low**.

1.11.6.13 All other active boreholes drawing water from shallow sand and gravel deposits are located at considerable distance from the proposed position of Transmission Assets. The risk to these boreholes is considered low. The magnitude of this operational impact is **negligible**.

Significance of effect

Licensed groundwater abstractions

1.11.6.14 Overall, the sensitivity of the GWA_01 is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

1.11.6.15 The magnitude of the sensitivity of the other boreholes is **medium** and the impact is **negligible**. The effect will, therefore, be of **negligible** significance, which is not significant.

Decommissioning phase

Sensitivity of receptor

1.11.6.16 Active licensed groundwater abstractions are of local importance. The sensitivity of this receptor is **medium**.

Magnitude of impact

Licensed groundwater abstractions

1.11.6.17 Any temporary dewatering required for the removal of joint bays and link boxes will be localised and temporary. The magnitude of the impact on GWA_01 is therefore considered to be **low**.

1.11.6.18 All other active boreholes drawing water from shallow sand and gravel deposits are located at considerable distance from the Onshore Order Limits and Intertidal Infrastructure Area. The magnitude of this construction impact is **negligible**.

Significance of effect

Licensed groundwater abstractions

1.11.6.19 Overall, the sensitivity of GWA_01 is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

1.11.6.20 The magnitude of the sensitivity of the other boreholes is **medium** and the impact is **negligible**. The effect will, therefore, be of **negligible** significance, which is not significant.

1.11.7 The impact of existing contamination to human receptors

1.11.7.1 As set out in **section 1.11.3**, areas of potential contamination are present within the study area. Higher risk sites include historical landfill sites located within Blackpool Airport and north of the River Ribble Crossing.

1.11.7.2 In addition, there is potential for unexpected contamination to be encountered during construction.

Construction and decommissioning phases

Sensitivity of receptor

1.11.7.3 For this assessment the potential impact on human health for construction workers, maintenance workers and adjacent site users has been considered. The sensitivity of this receptor is **high**.

Magnitude of impact

1.11.7.4 All construction works will be undertaken in accordance with the CoCP, which will include details of protective measures for construction workers with regards to ground contamination. Appropriate Personal Protective Equipment will be used, and relevant good working practices applied to avoid potential risk to human health (construction workers and adjacent off site users) including from any potential ground contamination, in line with relevant available guidance (CoT29).

1.11.7.5 In addition, a Land and Groundwater Contamination Discovery Strategy as secured by CoT30 has been prepared to outline the procedure for

construction workers to follow in the event that previously unidentified contamination is encountered during the construction phase. Any construction activities in the area of this material should cease until an appropriate plan for assessment and, where necessary, remediation of the material has been put in place.

1.11.7.6 With effective good practice measures in place, the risks will be controlled and the magnitude of impact will be **negligible**.

Significance of effect

1.11.7.7 Overall, the sensitivity of the receptor is **high** and the magnitude of impact on other boreholes is **negligible**. The effect will, therefore, be of **minor adverse** significance which is not significant.

Operation and maintenance phase

Sensitivity of receptor

1.11.7.8 For this assessment the potential impact on human health for end site users has been considered. The sensitivity of this receptor is **medium**.

Magnitude of impact

1.11.7.9 In line with mitigation presented within **section 1.8**, a ground investigation will be completed within areas where potentially significant sources of contamination have been identified within the Onshore Order Limits. Where ground investigation identifies potential risks to sensitive receptors from any contamination identified, then a remediation strategy would be prepared and remediation and/or mitigation measures will be implemented in accordance with the strategy.

Significance of effect

1.11.7.10 Overall, the sensitivity of the receptor is **medium** and the magnitude of impact is **negligible**. The effect will, therefore, be of **negligible** significance which is not significant.

1.11.8 Change in groundwater quality through the accidental release or spillage of potentially polluting substances

1.11.8.1 Potentially polluting substances will be stored, handled and used during the construction phase and decommissioning phase. Notable substances include fuels, lubricants and hydraulic oils associated with plant and machinery. Other substances such as foul water generated from welfare facilities will also require appropriate management. As outlined above, measures will be implemented through the CoCP and Pollution Prevention Plan to ensure all controlled water receptors are protected during the proposed construction and decommissioning works, as set out in **section 1.8**.

1.11.8.2 Impacts during decommissioning will be controlled through the Onshore Decommissioning Plan.

Construction and decommissioning phases

Sensitivity of receptor

1.11.8.3 The shallow, Secondary A superficial deposit aquifer at the western end of the study area is a locally important groundwater resource that is currently of good chemical and quantitative status. The sensitivity of this receptor is **medium**.

1.11.8.4 For this assessment, it is assumed that the sand and gravel aquifer identified in the 400 kV grid connection cable corridor and onshore substations is also locally important and with good WFD chemical and quantitative status. The sensitivity of this receptor is therefore **medium**.

Magnitude of impact

1.11.8.5 Following adoption of the measures outlined in the CoCP and Onshore Decommissioning Plan, the likelihood of any accidental release will be minimised. The scale and duration of the release will also be reduced. The potential for the release to occur in the most sensitive area (e.g., excavation areas) would be minimised. The magnitude of the construction and decommissioning impact will be short term and **low**.

Significance of effect

1.11.8.6 Overall, the sensitivity of both the Secondary A superficial deposit aquifer and the sand and gravel aquifer is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

1.11.9 The impact of changes in groundwater levels, flow or quality on other sensitive groundwater dependent sites, including surface waters fed by groundwater (groundwater-dependent receptors)

1.11.9.1 As set out in **section 1.6.5**, groundwater-dependent features can include surface watercourses, ponds and lakes, springs and wetlands that receive a component of groundwater discharge from underlying aquifers.

1.11.9.2 Between the landfall and the B5261 (Queensway) current land use is dominated by designated geological sites, a golf course and Blackpool Airport. The Lytham St Annes Dunes SSSI citation states that the dunes support a wide range of species which vary according to the depth of water and degree of moisture retention in relation to the water table.

1.11.9.3 The nearest borehole to the Lytham St Annes Dunes SSSI (approximately 475 m east), located on the fringe of St Annes Old Links golf course, recorded the geology as blown sand deposits (and middle sand) extending to a depth of approximately 14.0 m which in turn are underlain by a thickness of approximately 16.4 m of cohesive Glacial Till. Shallow groundwater is expected within the near surface sand and gravel deposits (Blown Sands and middle sand) as evidenced by a shallow groundwater strike recorded at 1 m depth.

1.11.9.4 Improved land drainage in the overlapping and adjoining St Annes Old Links golf course and increased evapotranspiration associated with scrub and the use of abstracted groundwater on the greens and fairways are likely to have played a part in drawing down the water table at this location.

1.11.9.5 The baseline environment at the Lytham St Annes Dunes SSSI may be considered non-static due to the natural state of dune succession and ecological colonisation, and the changes in land management practice.

1.11.9.6 As set out in **paragraphs 1.11.4.6** to **1.11.4.8** dewatering will result in a change in groundwater level within the cable trenches and excavations, although levels are expected to recover following construction.

1.11.9.7 East of the B5261 (Queensway), the onshore export cable corridor crosses many land drains, and small watercourses that drain the catchments of the small WFD water bodies that discharge to the River Ribble. This area is also characterised by the presence of many small, isolated ponds. There is little evidence of springs or groundwater-fed wetlands in this area.

1.11.9.8 In the east, the onshore substations and the 400 kV grid connection cable corridor are situated on areas of drained marsh. The cable corridor and onshore substations in this area cross many land drains and small watercourses. There is very little evidence of springs or groundwater-fed wetlands in this area.

1.11.9.9 For groundwater discharge to be important, the land drains and watercourses must be in continuity with locally important surface aquifers. Within the majority of the Onshore Order Limits, land drains, watercourses and small ponds are underlain by clay rich deposits of Glacial Till or Tidal Flat Deposits. These geological units do not contain significant groundwater and do not contribute significantly to surface flows. This is supported by the large number of small, isolated ponds across the study area and absence of abstractions, which reflect the low permeability of the underlying geology.

1.11.9.10 The impact of the Transmission Assets on existing abstractions is considered in **section 1.11.6**.

1.11.9.11 The River Ribble is a key ecological receptor. It is noted that a number of existing contamination sources, including landfill sites, are located close to the River Ribble. Further consideration of effects in relation to surface water is provided in Volume 3, Chapter 2: Hydrology and flood risk of the ES. Details of effects on ecological receptors are considered in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES.

1.11.9.12 The key groundwater dependent receptor relevant to this chapter is the Lytham St Annes Dunes SSSI.

1.11.9.13 In order to mitigate against direct impact on the SSSI a trenchless installation technique (direct pipe) will drill underground from the landfall compound (located at Blackpool Airport) under the SSSI and will exit on North Beach at Lytham St. Annes at or around MHWS. As part of these works, direct pipe entry pits of up to 4 m depth will be excavated for six pipe alignment entry points. These excavations will require dewatering to ensure they remain stable. The below assessment is based on the requirement to dewater the excavations through well point abstraction which is considered a worst case.

1.11.9.14 In order to assess the impact of the proposed dewatering the calculation of an approximate zone of influence is made using ground investigation data provided in **section 1.6.7.**

1.11.9.15 Hazen's method has been used to estimate the permeability for soil samples using PSD data for samples of Blown Sands detailed in **Table 1.11** and **Table 1.13**.

1.11.9.16 Hazen's method (CIRIA, 2016) relates to permeability k (in m/s) to the D10 particle size (in mm):

$$k = 0.01 \times (\mathrm{D}_{10})^2$$

1.11.9.17 The data indicates permeability values for the Blown Sands ranging from 3.97 x 10^{-5} m/s to 4.00 x 10^{-4} m/s. The geometric mean of the permeability values for the Blown Sands is 1.01 x 10-4 m/s.

1.11.9.18 This is consistent with literature values for a clean sand (mid range value of 1.00 x 10-4 (Freeze and Cherry, 1979).

1.11.9.19 The zone of influence within the superficial unconfined aquifer likely to be generated by the proposed dewatering can be calculated using Sichardt's equation:

$$R = 3000s\sqrt{\mathrm{Ksat}}$$

R = radius of influence (m)

Ksat = saturated hydraulic conductivity (m/s)

s = drawdown in the borehole

1.11.9.20 Using the geometric mean permeability value of 1.01 x 10^{-4} m/s and a drawdown value of 1 m a radius of influence of 30 m is calculated.

1.11.9.21 The drawdown in the dewatering boreholes is currently unknown. However, a value of 4 m is used given the relatively shallow excavations for the direct pipe entry pits. Based on this and using the above equation a radius of influence of 120 m is calculated.

1.11.9.22 Using a 'factor of safety' of double, a 240 m zone of influence is well within the total distance from the direct pipe entry pits to the SSSI (measured at approximately 600 m).

1.11.9.23 It is worth noting that the benefit of the cofferdam construction at the direct pipe pits in reducing the zone of influence has not been considered which offers an additional level of conservatism.

1.11.9.24 Further details of effects on ecological receptors are considered in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES.

Construction phase

Sensitivity of receptor

1.11.9.25 The sensitivity of the Lytham St Annes Dunes SSSI receptor is **high**.

Magnitude of impact

1.11.9.26 Cables will be installed underground beneath the Lytham St. Annes Dunes SSSI from the transition joint bays located in Blackpool Airport to exit pits located on North Beach at Lytham St. Annes.

1.11.9.27 Saline water is expected in the saturated coastal sand and gravel deposits where the direct pipe will exit at or around MHWS. Freshwater may be encountered if a lens forms above the saline water where the dunes extend above MHWS. Review of the dewatering required to be undertaken in relation to the entry pit excavation within Blackpool Airport indicates that the SSSI is located outside the predicted zone of influence.

1.11.9.28 Dewatering is not therefore likely to result in impacts to the SSSI. The magnitude of impact on the hydrogeological regime and consequently Lytham St Annes Dunes SSSI is considered short term and **low**.

1.11.9.29 The cable duct could be installed within an impermeable zone which, if present within the sand and gravel deposits, may impact the hydrogeology of the SSSI. This risk is low but, if it occurred, could result in a **high** magnitude of impact.

Significance of effect

1.11.9.30 Overall, the sensitivity of the SSSI is **high** and the magnitude of the impact is up to **high**. The effect will, therefore, be of **major adverse** significance, which is significant.

Further mitigation and residual effects

1.11.9.31 Subject to landowner approval, at detailed design stage, hydrogeological risk assessment(s) will be undertaken at St Annes Old Links Golf Club (abstraction borehole ref: GWA_01), if necessary. The hydrogeological risk assessment(s) would be informed by ground investigation information, where relevant and practicable. If undertaken, the risk assessment(s) will inform a detailed site specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI and the St Annes Old Links Golf Course (CoT119).

1.11.9.32 At detailed design stage, hydrogeological risk assessment(s) will be undertaken in relation to the crossing of Lytham St Annes SSSI to mitigate potential impacts to the hydrologically dependant surface water features of the sand dune system. The hydrogeological risk assessment(s) will be informed by ground investigation information, where necessary and practicable. These assessment(s) will used to inform the detailed site specific crossing design for the installation of the offshore export cables beneath Lytham St Annes SSSI (CoT128).

1.11.9.33 With the above measures in place, the magnitude of impact would be no greater than **low**, resulting in a **minor adverse** effect which is not significant.

Operation and maintenance phase

Sensitivity of receptor

1.11.9.34 The sensitivity of the Lytham St Anne's Dunes SSSI receptor is **high**.

Magnitude of impact

1.11.9.35 Once installed, the continued presence of the cables within the sand and gravel deposits would be no greater than assessed for the construction phase. No new impacts would occur at this stage. The magnitude of impact would therefore be **no change**.

Significance of effect

1.11.9.36 Overall, the sensitivity of the SSSI is **high** and the magnitude of the impact is **no change**. The effect will, therefore, be of **no effect** significance, which is not significant.

1.11.10 The impact of ground gas generation on human health and other receptors

1.11.10.1 Peat is a partially decomposed mass of vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps. BGS mapping shows peat and/or peaty soils to be present within the study area. Peat has the potential to generate ground gases that could represent a risk to human health or buildings principally during the construction and decommissioning phases. Local geological records have shown a thin horizon of peat (1.7 m to 1.8 m) to be present below the blown sand that underlies Blackpool and Lytham St. Annes. The peat extends east of Blackpool Airport but is generally indicated to be absent from the majority of the onshore export cable corridor, the onshore substations and the 400 kV grid connection cable corridor.

1.11.10.2 Landfills within and in close proximity to the Transmission Assets also have the potential to generate landfill gas which has the potential to ingress into buildings which could accumulate and represent an inhalation risk to human health and/or explosive risk to human health and buildings.

Construction phase

Sensitivity of receptor

1.11.10.3 For this assessment the potential impact on human health or construction workers has been considered. The sensitivity of this receptor is **high**.

Magnitude of impact

1.11.10.4 The peat identified at the west end of the study area is thin and potentially discontinuous. The gas generating potential of this material is not therefore considered to be high, although gas ingress into open cut trenches and

excavation could occur locally. The magnitude of the construction impact is **medium**.

1.11.10.5 Landfills are located at the western end of the study area particularly around Blackpool Airport, and on the northern bank of the River Ribble at the eastern end of the study area. The generation of landfill gas may be high and has the potential to ingress into open cut trenches and excavations. The magnitude of the construction impact has the potential to be long term and **medium** to **high**.

Significance of effect

1.11.10.6 Overall, the sensitivity of the receptor is **high** and the magnitude of the impact is at worst **medium** to **high**. The effect will, therefore, be of **moderate** to **major adverse** significance, which is significant.

Further mitigation and residual effects

1.11.10.7 Where high concentrations of peat are identified these, will be avoided where practicably possible for the placement of the plant and infrastructure to avoid the possibility of ground gas build up. Where this is not possible, further investigation and appropriate monitoring will be identified undertaken, if necessary (CoT101).

1.11.10.8 Where areas of potentially significant contamination (e.g. landfills) cannot be avoided within the Transmission Assets Order Limits, ground investigation or other appropriate measures (e.g. use Personal Protective Equipment and/or hazard signage) will be implemented to mitigate potential impacts to, or effects on sensitive receptors. Where ground investigation identifies potential risks to sensitive receptors from contamination, a remediation strategy would be prepared in consultation with the Environment Agency (CoT118).

1.11.10.9 Through the application of mitigation measures the magnitude of the impact on human health can be reduced to **low** and the sensitivity of the receptor is **high**. The residual effect will be of **minor adverse** significance, which is not significant.

Operation and maintenance phase

1.11.10.10 No further disturbance of peat will be required during the operation and maintenance phase.

Sensitivity of receptor

1.11.10.11 For this assessment the potential impact on human health or maintenance workers has been considered. The sensitivity of this receptor is **high**.

Magnitude of impact

1.11.10.12 Operation will require remote surveillance monitoring of the onshore infrastructure and some site visits. No further disturbance of peat will be required. The magnitude of the impact is **negligible**.

Significance of effect

1.11.10.13 Overall, the sensitivity of the receptor is **high** and the magnitude of the impact at worst is **negligible**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

Decommissioning phase

Sensitivity of receptor

1.11.10.14 For this assessment the potential impact on human health or construction workers has been considered. The sensitivity of this receptor is **high**.

Magnitude of impact

1.11.10.15 The peat identified at the western end of the study area is thin and potentially discontinuous. The gas generating potential of this material is not therefore considered to be high, although gas ingress into open excavation could occur locally during decommissioning of the Transmission Assets, most notably entry/exit shafts, joint bays and link boxes. The extent of work required during decommissioning is equal to or less than during the construction phase. The magnitude of the impact is likely to be **low**.

Significance of effect

1.11.10.16 Overall, the sensitivity of the receptor is **high** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

Further mitigation and residual effects

1.11.10.17 Given that the effect is not predicted to be significant, further mitigation is not strictly required. Nevertheless, the impact could be reduced further through the adoption of similar measures to those implemented during the construction phase.

1.11.11 Sterilisation of safeguarded mineral resources

1.11.11.1 Mineral resources are geological deposits of economic importance within the county (e.g., for construction, manufacturing and other purposes). Minerals can only be extracted (or 'worked') where they naturally occur. Sterilisation of mineral resources occurs when that resource can no longer be worked due to the presence of non-mineral development. The Onshore Order Limits cross MSAs defined by Lancashire County Council. It is noted, however, that the designated MSAs principally relate to the distribution of Tidal Flat Deposits as opposed to blown sand or other sand and gravel deposits shown to be present within the study area.

Construction phase

Sensitivity of the receptor

1.11.11.2 The MSAs appear to relate to the distribution of Tidal Flat Deposits as opposed to blown sand or other sand or gravel deposits shown to be present within the study area. It is also noted that there is considerable extent of this safeguarded resource within Lancashire. Notwithstanding these observations, a safeguarded mineral resource is of local importance and the sensitivity of this receptor is **medium**.

Magnitude of impact

1.11.11.3 The permanent elements of the onshore infrastructure are considered in this section as the temporary works in areas required only for construction would not sterilise the mineral resource.

1.11.11.4 The onshore export cable corridor crosses approximately 4.5 km of safeguarded mineral resource. Given a total permanent width for the six cable trenches of 70 m, this could equate to up to 31.5 ha of the MSA affected.

1.11.11.5 The permanent onshore substations are situated generally outside of the MSAs (with the exception of a negligible overlap with the Morecambe onshore substation).

1.11.11.6 The 400 kV grid connection cable corridor is situated above an MSA over much of its area. The 400 kV grid connection cable corridor will potentially extend approximately 13 km between the onshore substations and Penwortham National Grid substation. Given the total permanent width of the four connection cable trenches of 50 m, this equates to an area of approximately 65 ha, equivalent to approximately 7% of the MSA (which has a total area of approximately 950 ha).

1.11.11.7 The magnitude of this impact is direct and long term and given the width of the permanent cable trenches and that the onshore substation sites are primarily situated outside of the MSAs is considered **low**.

Significance of the effect

1.11.11.8 Overall, the sensitivity of the receptor is **medium** and the magnitude of the impact is **low**. The effect will, therefore, be of **minor adverse** significance, which is not significant.

Operation and maintenance and decommissioning phases

1.11.11.9 Once constructed, there would be no further impact on the MSAs. All decommissioning activities will be undertaken within the area used for construction.

1.11.12 The impact of heat generated by the onshore export cables on groundwater quality

1.11.12.1 Underground cables, such as the onshore export cables and the 400 kV grid connection cables, generate heat that dissipates naturally to the surrounding ground during power transmission.

1.11.12.2 The levels of heat loss and dissipation of heat through the soil can only be determined once further details of the cable voltage, soil structure (including its thermal properties) and the final engineering design are known. This will include consideration of the cable depth (in terms of the receptor that may be affected).

1.11.12.3 However, the onshore cables themselves will consist of copper or aluminium conductors wrapped with various materials for insulation, protection, and sealing. Once installed, the electrical cables must be suitably spaced out in order to minimise the mutual heating effect of one cable circuit on another, this enables the cables to effectively carry the large power volumes required without overheating and damaging the cable.

1.11.12.4 It is therefore likely that any heat dissipation will be localised and confined to the areas immediately surrounding the onshore cables. On this basis, it is unlikely that there will be any impact on the quality or temperature of groundwater at its point of abstraction during operation. This impact is therefore excluded from further consideration.

1.11.13 Future monitoring

1.11.13.1 **Table 1.23** below outlines the proposed monitoring commitments.

Table 1.23: Monitoring commitments

Commitment number	Measure adopted	How the measure will be secured
101	Where high concentrations of peat are identified these, will be avoided where practicably possible for the placement of the plant and infrastructure to avoid the possibility of ground gas build up. Where this is not possible, further investigation and appropriate monitoring will be identified undertaken, if necessary.	DCO Schedules 2A & 2B, Requirement 8 (Code of Construction Practice)

1.11.13.2 The effects on geology, hydrogeology and ground conditions as a result of the construction, operation and maintenance and decommissioning phases of the Transmission Assets are predicted not to be significant. Based on the predicted impacts it is concluded that no specific monitoring to test the predictions made within the impact assessment is required.

1.12 Cumulative effect assessment methodology

1.12.1 Introduction

1.12.1.1 The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Transmission Assets together with other projects and

plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

1.12.1.2 The geology, hydrogeology and ground conditions CEA methodology has followed the methodology set out in Volume 1, Chapter 5: Environmental assessment methodology of the ES. As part of the assessment, all projects and plans considered alongside the Transmission Assets have been allocated into 'tiers' reflecting their current stage within the planning and development process.

- Tier 1
  - Under construction.
  - Permitted application.
  - Submitted application.
  - Those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact.
- Tier 2
  - Scoping report has been submitted.
- Tier 3
  - Scoping report has not been submitted.
  - Identified in the relevant Development Plan.
  - Identified in other plans and programmes.

1.12.1.3 This tiered approach is adopted to provide a clear assessment of the Transmission Assets alongside other projects, plans and activities.

1.12.1.4 A total of 55 Tier 1 projects located within the study area have been scoped in for review. Some of these projects represent a potential constraint to be considered in terms of the construction of onshore and intertidal elements of the Transmission Assets given their position within the Onshore Order Limits and/or Intertidal Infrastructure Area and would need to be considered as part of detailed design. However, of these 55 projects only five are scoped into the CEA for consideration for geology, hydrogeology and ground conditions. This is based on the size of the development, their proximity to identified sensitive receptors and the nature of the proposed development i.e., likely extent of ground disturbance during the construction phase. Those five projects are outlined in **Table 1.24**. All other projects (including Tier 3 projects) are screened out given they are unlikely to have the potential to result in significant cumulative effects for this topic based on the aforementioned criteria and the assumed mitigation and control measures that will be in place for the prevention of pollution to human health and/or the environment.

Table 1.24: List of other projects, plans and activities considered within the CEA

Project/Plan	Status	Distance from the Transmission Assets	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Outline residential application comprising of a 3 storey building for up to 38 apartments (17/0299)	Permitted and under construction	430 m south of the Onshore Order Limits	38 assisted flats and 33 car parking spaces. Flats would include: - 1 Bed Flats with footprint of 48.36m^2 - 2 Bed flats with footprint of 72.54m^2.	Under construction	Not provided	Construction phase – Yes Operational phase - Yes
Mixed use development, phase 1 of the Blackpool Enterprise Zone.	Permitted	320 m south of the Onshore Order Limits	Outline planning application with all matters reserved for: Reconfiguration of Common Edge Road to create a new point of access into the Enterprise Zone and provision of new spine road from this access point to Amy Johnson Way; Erection of up to 35,000sqm of business, industrial and storage and warehousing uses (Classes E(g), B2 and B8); Erection of up to 275sqm retail floorspace (Class E(a)); Erection of up to 275sqm cafe floorspace (Class E(b)); Highways works including reconfiguration of the junction of Common Edge Road and School Road; Associated infrastructure including drainage works, electric vehicle charging hub, substations, car parking and landscaping; Demolition of a single storey building at Collins Park and no. 2 School Road.	Not provided	Not provided	Construction phase – Yes Operational phase - Yes

Project/Plan	Status	Distance from the Transmission Assets	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Residential application comprising 40 self-contained apartments	Pending	800 m north of the Onshore Order Limits	Erection of part 4, 5 & 6 storey building comprising of 40 self-contained apartments with associated cycle/waste storage, and provision of 45 car parking spaces with access from Harrowside West, following demolition of existing hotel.	Not provided	Not provided	Construction phase – Yes Operational phase - Yes
Hybrid planning application relating to enterprise zone development	Pending	220 m north of the Onshore Order Limits	Hybrid planning application relating to enterprise zone development consisting of full application the construction of new access roads, existing highways improvement works and drainage works; and outline planning application for the construction of 5 no. Hangars, a commercial unit (class b2 / e(g)) and car parking, alongside associated infrastructure works.	Not provided	Not provided	Construction phase – Yes Operational phase - Yes

Project/Plan	Status	Distance from the Transmission Assets	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Dry ski slope, mountain bike track, creation of leisure lake.	Permitted	Adjacent to Onshore Order Limits	Erection of dry ski slope and mountain bike track, creation of leisure lake and siting of up to 13 lodges to be occupied by young people in the services of Pioneer Tec together with associated development (06/2023/0245).	Not provided	Not provided	Construction phase – Yes Operational phase - Yes

1.12.2 Scope of cumulative effects assessment

1.12.2.1 The impacts identified in **Table 1.25** have been selected as those having the potential to result in the greatest cumulative effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been based on the Project Design Envelope set out in Volume 1, Chapter 3: Project description of the ES as well as the information available on other projects and plans.

Table 1.25: Scope of assessment of cumulative effects

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
Change in groundwater quality or quantity in superficial deposit Secondary A aquifer unit. Change in groundwater levels, flow or quality on other sensitive groundwater dependent sites.	✓	X	✓	Maximum design scenario as described for the Transmission Assets **Table 1.19** assessed cumulatively with the following other projects/plans: **Tier 1 Projects** Defined within **Table 1.24.** – Construction works will occur concurrently with the Transmission Assets. – The magnitude of the operation and maintenance phase and decommissioning phase impacts on the Transmission Assets will be smaller than construction phase impacts.	The Tier 1 leisure development is located on the banks of the River Ribble and crosses the 400 kV grid connection cable corridor at the River Ribble Crossing location. It is located upon a number of historical landfills. The area is underlain by Tidal Flat Deposits classified as unproductive strata and not therefore not significant in terms of groundwater resource potential. This development is therefore not considered further. The remaining Tier 1 developments are located around Blackpool Airport within an area of potentially contaminative land use including Blackpool Airport itself and historical landfills. The area is underlain by Blown Sands designated a Secondary A aquifer and includes the Lytham St Annes Dunes SSSI. For the CEA it is assumed that: • Baseline conditions will be shared for all projects. • Outcome of the CEA will be greatest when projects are constructed concurrently. • The magnitude of impacts expected for the construction phase of the Tier 1 developments should not result in significant effects given each respective planning permission will require: – consideration of potential impacts on groundwater quantity and quality through dewatering options, foundation design and discharges of runoff in the construction and operation phase; and – a full assessment of risk associated with ground conditions, which will include remediation measures in order to manage those risks if required, and the development of a land and groundwater contamination discovery strategy. – Implementation of control measures within a CoCP to minimise any new contamination i.e. accidental spills/leaks.

[a] C=construction, O=operation and maintenance, D=decommissioning

1.13 Cumulative effects assessment

1.13.1 Introduction

1.13.1.1 A description of the significance of cumulative effects upon geology, hydrogeology and hydrogeology receptors arising from each identified impact is given below.

1.13.2 Change in groundwater quality or quantity in superficial deposit Secondary A aquifer unit

Tier 1 developments: Construction phase

Sensitivity of the receptor

1.13.2.1 The Tier 1 developments are underlain by the shallow, Secondary A aquifer at the west end of the study area which is a locally important groundwater resource that is currently of good WFD chemical and quantitative status. The sensitivity of the receptor is **medium**.

1.13.2.2 The sensitivity of the Lytham St Annes Dunes SSSI as a groundwater dependent receptor is **high**.

Magnitude of impact

Dewatering

1.13.2.3 Dewatering may be expected for the developments, given their location above the superficial geology of Blown Sands. Where dewatering of deep excavations is required, either for basements or as part of foundation solutions, there is potential for greater drawdown of the water table or lowering of the water table for extended duration impacting the SSSI. The closest project to the Lytham St Annes Dunes SSSI is approximately 865 m south.

1.13.2.4 The cumulative impact is predicted to be of localised spatial extent and short term duration. The magnitude is likely, therefore, to be **low**.

1.13.2.5 Any dewatering is not expected to have a direct impact on groundwater quality in the shallow aquifer. The cumulative impact is predicted to have a magnitude that is **negligible**.

Significance of effect

Dewatering

1.13.2.6 Overall, the magnitude of the cumulative impact is **negligible** to **low** and the sensitivity of the receptor is **medium** to **high**. The cumulative effect will, therefore, be of **negligible** or **minor adverse** significance, which is not significant.

Decommissioning phase

1.13.2.7 There will be no decommissioning of the Tier 1 developments. For the purpose of decommissioning, it is therefore assumed that the cumulative effects will be same as for construction of the Transmission Assets outlined in **paragraph 1.13.2.6**.

1.14 Transboundary effects

1.14.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to geology, hydrogeology and ground conditions from the Transmission Assets upon the interests of other states.

1.15 Inter-related effects

1.15.1.1 Inter-relationships are the impacts and associated effects of different aspects of the Transmission Assets on the same receptor. These are as follows.

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Transmission Assets (construction, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor group than if just one phase were assessed in isolation.
- Receptor led effects: Assessment of the scope for all relevant effects across multiple topics to interact, spatially and temporally, to create inter-related effects on a receptor.

1.15.1.2 This chapter assesses the significance of effects on geology, hydrogeology and ground conditions. This includes consideration of the potential for groundwater dependant receptors to be present, based on the findings of the following chapters:

- Volume 3, Chapter 2: Hydrology and flood risk of the ES; and
- Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES.

1.15.1.3 Effects on the surface water are assessed within Volume 3, Chapter 2: Hydrology and flood risk of the ES. Effects on agricultural land use are assessed in Volume 3, Chapter 6: Land use and recreation of the ES. The generation of construction dust is assessed in Volume 3, Chapter 9: Air quality of the ES.

1.15.1.4 Further details of inter-related effects are provided in Volume 4, Chapter 3: Inter-relationships of the ES.

1.16 Summary of impacts, mitigation measures and monitoring

1.16.1.1 Information on geology, hydrogeology and ground conditions within the study area was collected through desktop review and consultation.

1.16.1.2 **Table 1.26** presents a summary of the potential impacts, measures adopted as part of the Transmission Assets and residual effects in respect to geology,

hydrogeology and ground conditions. Overall, it is concluded that there will be no significant effects arising from the Transmission Assets during the construction, operation and maintenance or decommissioning phases, with all mitigation in place.

1.16.1.3 **Table 1.27** presents a summary of the potential cumulative impacts, mitigation measures and residual effects. Overall, it is concluded that there will be no significant cumulative effects from the Transmission Assets alongside other projects/plans.

Table 1.26: Summary of environmental effects, mitigation and monitoring

Description of impact	Phase[a]			Commitment number	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
The impact of partial loss or damage to designated geological or geomorphological sites	✓	×	×	CoT44.	C: Negligible	C: High	C: Minor adverse	Not required	C: Minor adverse	None
The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units: Landfall and onshore export cable corridor near Blackpool Airport.	✓	✓	✓	CoT30, CoT35, CoT44, CoT90, CoT94. CoT36	C: Medium O: Negligible D: Low	C: Medium O: Medium D: Medium	C: Moderate adverse O: Negligible adverse D: Minor adverse	CoT41 and CoT118.	C: Minor adverse O: Negligible adverse D: Minor adverse	None
The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units: 400 kV grid connection cable corridor	✓	✓	✓	CoT10, CoT30, CoT35, CoT44, CoT90, CoT94. CoT36	C: Medium O: Negligible D: Low	C: Medium O: Medium D: Medium	C: Moderate adverse O: Negligible adverse D: Minor adverse	CoT41.	C: Minor adverse O: Negligible adverse D: Minor adverse	None
The impact of mobilisation of existing areas of contamination causing a deterioration of groundwater quality in underlying aquifer units: Other areas	✓	✓	✓	CoT30, CoT35, CoT44, CoT90, CoT94. CoT36	C: Low O: Negligible D: Low	C: High O: Medium D: Medium	C: Minor adverse O: Negligible adverse D: Minor adverse	CoT103.	C: Minor adverse O: Negligible adverse D: Minor adverse	None
The impact on groundwater levels in aquifer units: Superficial deposit	✓	×	×	CoT04, CoT09, CoT30, CoT35.	C: Low	C: Medium	C: Minor adverse	Not required	C: Minor adverse	None

Description of impact	Phase[a]			Commitment number	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
Secondary A aquifer unit: Dewatering				CoT36.						
The impact on groundwater levels in aquifer units: Superficial deposit Secondary A aquifer unit: Foundations	✓	✓	✓	CoT04,CoT05, CoT09, CoT30, CoT35. CoT36.	C: Low O: Negligible D: Low	C: Medium O: Medium D: Medium	C: Minor adverse O: Negligible D: Minor adverse	Not required	C: Minor adverse O: Negligible D: Minor adverse	None
The impact on groundwater levels in aquifer units: Superficial deposit Secondary A aquifer unit Discharges to ground	✓	✓	✓	CoT04, CoT09, CoT30, CoT35. CoT36.	C: Low D: Low	C: Medium D: Medium	C: Minor adverse D: Minor adverse	Not required	C: Minor adverse O: Negligible D: Minor adverse	None
The impact on groundwater levels in aquifer units: Superficial deposit Secondary A aquifer unit: HDD	✓	×	×	CoT04, CoT09, CoT30, CoT35. CoT36.	C: Low	C: Medium	C: Minor adverse	Not required	C: Minor adverse	None
The impact of reduced groundwater quantity in aquifer units: Bedrock Principal aquifer unit	✓	✓	✓	CoT90, CoT09, CoT11, CoT30, CoT35. CoT36.	C: Low D: No change	C: High D: High	C: Minor adverse D: No effect	Not required	C: Minor adverse O: No effect D: Minor adverse	None
The impact of reduced groundwater quantity or quality in aquifer units: Impact on existing groundwater abstractions: Licensed Abstraction GWA_01	✓	✓	✓	CoT09, CoT30, CoT35.	C: High O: Low D: Low	C: Medium O: Medium D: Medium	C: Major adverse O: Minor adverse D: Minor adverse	CoT41. CoT119	C: Minor adverse O: Minor adverse	Yes

Description of impact	Phase[a]			Commitment number	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
									D: Minor adverse	
The impact of reduced groundwater quantity or quality in aquifer units: Impact on existing groundwater abstractions Other Licensed Abstractions	✓	✓	✓	CoT09, CoT30, CoT35.	C: No change O: Negligible D: Negligible	C: Medium O: Medium D: Medium	C: No effect O: Negligible D: Negligible	None	C: Minor adverse O: Negligible D: Negligible	None
The impact of existing contamination to human receptors	✓	✓	✓	CoT29, CoT30, CoT35, CoT44, CoT90, CoT94. CoT36	C: Negligible O: Negligible D: Negligible	C: High O: Medium D: High	C: Minor adverse O: Negligible D: Minor adverse	Not required	C: Minor adverse O: Negligible D: Minor adverse	None
Change in groundwater quality through the accidental release or spillage of potentially polluting substances	✓	✗	✓	CoT04, CoT35. CoT36.	C: Low D: Low	C: Medium D: Medium	C: Minor adverse O:No Effect D: Minor adverse	Not required	C: Minor adverse D: Minor adverse	None
The impact of changes in groundwater levels, flow or quality on other sensitive groundwater dependent sites	✓	✓	✗	CoT41.	C: High O: No change D: High	C: High O: High D: High	C: Major adverse O: No effect D: Major adverse	CoT119 CoT128	C: Minor adverse O: No effect D: Minor adverse	None
The impact of ground gas generation on human health and other environmental receptors	✓	✓	✓	CoT29, CoT35. CoT36.	C: Medium to High O: Negligible D: Low	C: High O: High D: High	C: Moderate to Major adverse O: Minor adverse	CoT101 CoT118	C: Minor adverse O: Minor adverse	Yes (Gas monitoring)

Description of impact	Phase[a]			Commitment number	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
							D: Minor adverse		D: Minor adverse	
Sterilisation of safeguarded mineral resources	✓	×	×	None	C: Low	C: Medium	C: Minor adverse	Not required	C: Minor adverse	None

[a] C=construction, O=operation and maintenance, D=decommissioning

Table 1.27: Summary of cumulative environmental effects, mitigation and monitoring

Description of effect	Phase[a]			Commitment number	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
Tier 1										
Change in groundwater quality or quantity in superficial deposit Secondary A aquifer unit: Dewatering	✓	×	×	None	C: Low or negligible	C: Medium	C: Minor adverse or negligible	Not required	C: Minor adverse or negligible	None
Change in groundwater quality or quantity in superficial deposit Secondary A aquifer unit: Foundations	✓	✓	✓	None	C: Negligible O: Low D: Negligible	C: Medium O: Medium D: Medium	C: Negligible O: Minor adverse D: Negligible	Not required	C: Negligible O: Minor adverse D: Negligible	None
Change in groundwater quality or quantity in superficial deposit Secondary A aquifer unit: Discharge to ground	✓	✓	✓	None	C: Low O: Low D: Low	C: Medium O: Medium D: Medium	C: Minor adverse O: Minor adverse D: Minor adverse	Not required	C: Minor adverse O: Minor adverse D: Minor adverse	None

[a] C=construction, O=operation and maintenance, D=decommissioning

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