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Yorkshire Green Energy Enablement (GREEN) Project

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10. Geology and Hydrogeology

10.1 Introduction

10.1.1 This chapter presents the assessment of the likely significant effects of the Yorkshire Green Energy Enablement (GREEN) Project (referred to as the Project or Yorkshire GREEN throughout the ES) with respect to Geology and Hydrogeology, including groundwater, land contamination and ground instability receptors (for example human health and buildings). It should be read in conjunction with the Project description provided in **Chapter 3: Description of the Project, Document 5.2.3, Volume 5** and with respect to relevant parts of the following chapters:

- **Chapter 8: Biodiversity, Document 5.2.8, Volume 5**;
- **Chapter 9: Hydrology, Document 5.2.9, Volume 5**;
- **Chapter 11: Agriculture and Soils, Document 5.2.11, Volume 5;** and
- **Chapter 13: Air Quality, Document 5.2.13, Volume 5**.

10.1.2 This chapter describes the:

- legislation, policy and technical guidance that has informed the assessment (**Section 10.2**);
- consultation and engagement that has been undertaken and how comments from consultees relating to geology and hydrogeology have been addressed (**Section 10.3**);
- methods used for baseline data gathering (**Section 10.4**);
- overall baseline (**Section 10.5**);
- embedded environmental measures relevant to geology and hydrogeology (**Section 10.6**);
- scope of the assessment for geology and hydrogeology (**Section 10.7**);
- methods used for the assessment (**Section 10.8**);
- assessment of geology and hydrogeology effects (**Section 10.9**);
- assessment of cumulative effects (**Section 10.10**); and
- summary of the significance conclusions (**Section 10.11**).

Project overview

10.1.3 Project is divided into six sections for ease of reference as indicated in **Figure 1.2, Document 5.4.1, Volume 5**. The Project will comprise both new infrastructure and works to existing transmission infrastructure and facilities as follows.

- Section A (Osbaldwick Substation): Minor works at the existing Osbaldwick Substation comprising the installation of a new circuit breaker and isolator along with

associated cabling, removal and replacement of one gantry and works to one existing pylon. All substation works would be within existing operational land.

- Section B (North west of York Area): Works would comprise:
  - Reconductoring of 2.4km of the 400kv Norton to Osbaldwick (2TW/YR) overhead line and replacement of one pylon on this overhead line.
  - The new 400kv YN overhead line (2.8km), north of the proposed Overton Substation.
  - The new Shipton North and South 400kv cable sealing end compounds (csecs) and 230m of cabling to facilitate the connection of the new YN 400kv overhead line with the existing Norton to Osbaldwick YR overhead line.
  - A new substation (Overton 400kv/275kv Substation) approximately 1km south of Shipton by Beningbrough.
  - Two new sections of 275kv overhead line which would connect into Overton Substation from the south (the 2.1km XC overhead line to the south-west and the 1.5km SP overhead line to the south-east).
  - Works to 5km of the existing XCP Poppleton to Monk Fryston overhead line between Moor Monkton in the west and Skelton in the east comprising a mixture of decommissioning, replacement and realignment. To the south and south-east of Moor Monkton the existing overhead line would be realigned up to 230m south from the current overhead line and the closest pylon to Moor Monkton (340m south-east) would be permanently removed. A 2.35km section of this existing overhead line permanently removed between the East Coast Mainline (ECML) Railway and Woodhouse Farm to the north of Overton.
- Section C (Moor Monkton to Tadcaster): Works proposed to the existing 275kV Poppleton to Monk Fryston (XC) overhead line comprise replacing existing overhead line conductors, replacement of pylon fittings, strengthening of steelwork and works to pylon foundations.
- Section D (Tadcaster Area): Two new CSECs (Tadcaster East and West 275kV CSECs) and approximately 350m of cable would be installed approximately 3km south-west of Tadcaster and north-east of the A64/A659 junction where two existing overhead lines meet. One pylon on the existing 275kV Tadcaster Tee to Knaresborough (XD) overhead line would be replaced.
- Section E (Tadcaster to Monk Fryston): Works proposed to the existing 275kV Poppleton to Monk Fryston (XC) overhead line would comprise replacing existing overhead line conductors, replacement of pylon fittings, strengthening of steelwork and works to pylon foundations.
- Section F (Monk Fryston Area): A new substation would be constructed to the east of the existing Monk Fryston Substation which is located approximately 2km south-west of the village of Monk Fryston and located off Rawfield Lane, south of the A63. A 1.45km section of the 275kV Poppleton to Monk Fryston (XC) overhead line to the west of the existing Monk Fryston Substation and south of Pollums House Farm would be realigned to connect to the proposed Monk Fryston Substation. East of the existing Monk Fryston Substation the existing 4YS 400kV
  Monk Fryston to Eggborough overhead line, which currently connects to the existing substation, would be reconfigured to connect to the proposed Monk Fryston Substation.

Limitations and assumptions

10.1.4 The limitations that have affected the preparation of this chapter are:

- The assessment is based on desk study and walkover information, supported by intrusive ground investigation data from a limited number of positions where necessary for the current stage of engineering design (specifically at the proposed new Monk Fryston Substation, Shipton CSECs and new Overton Substation sites). Where ground investigation information is not available, 'reasonable worst-case' assumptions regarding the likely ground conditions have been made when assessing the effects of the Project, informed by the desk study and walkover information. This is in line with the approach agreed with the Planning Inspectorate through the Scoping Report.
- Limited information regarding private groundwater supplies. Enquiries have been made of the Local Planning Authorities (Harrogate Borough Council, Hambleton District Council, City of York Council, Leeds City Council and Selby District Council) and records have been used as available/provided. However, the completeness and accuracy of this information is limited to that of the source records held by the local authorities.
- Limitations regarding the accuracy of the locations of licensed groundwater abstractions. The Environment Agency provides positions at an accuracy that varies from an eight-figure grid reference to a 12-figure grid reference, depending on the abstraction. As a result, distances quoted to abstractions may vary in accuracy correspondingly.
- Where baseline desk study data is available from regularly updated open access government sources (for example, groundwater Source Protection Zones), the data used is current as of June 2022. Where baseline desk study data is available from other sources (for example, data from commercial providers), the data used is current as of June 2021. This data currency is considered sufficient given the nature of the records and usual planning timescales.

10.2 Relevant legislation, planning policy and technical guidance

10.2.1 This section identifies the legislation, planning policy and technical guidance that has informed the assessment of effects with respect to geology and hydrogeology. Further information on policies relevant to the Project is provided in **Chapter 5: Legislation and Policy Overview, Document 5.2.5, Volume 5**.

Legislation

10.2.2 A summary of the relevant legislation is given in **Table 10.1**

Table 10.1 – Legislation relevant to the geology and hydrogeology assessment

Legislation	Legislative context
The Environmental Protection Act (EPA) 1990 – Part 2A (Contaminated Land)[1]	Provides key definitions and the overall legislative framework for assessment relating to the contamination of land and Controlled Waters. Part 2A of the EPA provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment.
The Contaminated Land (England) Regulations 2006[2] (which consolidate the provisions of the Contaminated Land (England) Regulations 2000 and subsequent amendments), as amended by the Contaminated Land (England) (Amendment) Regulations 2012[3]	Relates primarily to Special Sites as defined in the regulations.
Environmental Protection Act (EPA) 1990: Part 2A Contaminated Land Statutory Guidance[4]	Provides information on how to implement Part 2A of the EPA in England. It also defines relevant ecological receptors requiring consideration as part of Part 2A contaminated land assessments, which are restricted to sites with recognised ecological status (e.g. Sites of Special Scientific Interest, Ramsar sites, national nature reserves).
The Environmental Damage (Prevention and Remediation) (England) Regulations 2015[5]	Requirement to ensure that the Project will not cause damage to ecosystems, Controlled Waters or land.

[1] UK Government (1990). *The Environmental Protection Act (EPA) 1990* [online]. Available at https://www.legislation.gov.uk/ukpga/1990/43/contents [Accessed 24 June 2021].
[2] UK Government (2006). *The Contaminated Land (England) Regulations 2006 (SI 2006/1380)*. [online] Available at https://www.legislation.gov.uk/uksi/2006/1380/contents/made [Accessed 24 June 2021].
[3] UK Government (2012). *The Contaminated Land (England) Regulations 2012 (SI 2012/263)*. [online] Available at https://www.legislation.gov.uk/uksi/2012/263/made [Accessed 24 June 2021].
[4] DEFRA (2015), Environmental Protection Act (EPA) 1990: Part 2A Contaminated Land Statutory Guidance. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223705/pb13735cont-land-guidance.pdf [Accessed 28 June 2022].
[5] UK Government (2015). *The Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (SI 2015/810)*. [online] Available at https://www.legislation.gov.uk/uksi/2015/810/contents [Accessed July 2022].

Legislation	Legislative context
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[6]	Provides legislative context for compliance with the Water Framework Directive (WFD).
The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015[7]	Provides water classification and compliance framework and numerical standards.
The Water Supply (Water Quality) Regulations 2016	Primarily relates to water quality for human use/consumption (include drinking water standards).

Planning policy

10.2.4 A summary of the current relevant national and local planning policy is given in **Table 10.2**. In September 2021, the Department of Business, Energy and Industrial Strategy (BEIS) consulted upon a review of energy National Policy Statements (NPS) with consultation closing on 29 November 2021. The energy NPS were reviewed to reflect the policies and broader strategic approach set out in the Energy white paper and ensure a planning framework was in place to support the infrastructure requirement for the transition to net zero. The changes set out in the draft NPS EN-1 and NPS EN-5 provide greater detail regarding Geology and Hydrogeology, but do not change the fundamental requirements of the current published NPSs in relation to this aspect area.

Table 10.2 – Planning policy relevant to the geology and hydrogeology assessment

Policy	Policy context	Where addressed in this Chapter
National planning policy		
Overarching National Policy Statement for Energy (EN-1)[8,]	Section 4.10: Pollution Control and other environmental regulatory regimes. States that proposals should be considered within the context of existing pollution control regimes.	**Section 10.9** includes land contamination assessments. The assessments of effects in **Section 10.9** are consistent with existing pollution control regimes (e.g. discharge consents).

[6] UK Government (2017). *The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 ((SI2017/407).* [online] Available at https://www.legislation.gov.uk/uksi/2017/407/contents/made [Accessed July 2022].
[7] UK Government (2015). *The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (SI 2015/1623).* Available at https://www.legislation.gov.uk/uksi/2015/1623/resources (Accessed July 2021)
[8] Department of Energy and Climate Change (2011) *Overarching National Policy Statement for Energy (EN-1)*. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf [Accessed 28 June 2022].

Policy	Policy context	Where addressed in this Chapter
	Policy 5.3: Biodiversity and Geological Conservation. States that the application should clearly set out any effects on designated sites of geological conservation importance, including Regionally Important Geological Sites (RIGS). Development should aim to avoid significant harm to biodiversity and geological conservation interests; where this is not possible then appropriate compensation measures should be sought. Sites of Special Scientific Interest (SSSIs) should be given a high degree of protection. The applicant should show how the Project has taken advantage of opportunities to conserve and enhance geological conservation interests.	**Section 10.7** explains that effects on geological conservation assets are scoped out of the assessment due to the absence of receptors.
	Section 5.10: Land Use For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination. .	**Section 10.9** includes land contamination assessments. The assessments of effects in **Section 10.9** are consistent with existing pollution control regimes (e.g. discharge consents).
	Policy 5.15: Water Quality and Resources Indicates that assessments should consider the physical and chemical characteristics of groundwater and its importance as a resource, with reference to abstractions, discharges and drinking water Source Protections Zones (SPZ).	The assessment system in **Section 10.8**, as applied in **Section 10.9**, considers the physical and chemical characteristics of groundwater, with reference to abstractions, discharges and SPZ.

Policy	Policy context	Where addressed in this Chapter
National Policy Statement for Electricity Networks Infrastructure (EN-5)[9]	Section 2.2: Factors influencing Site Selection by Applicants Paragraph 2.2.6 requires that new electricity infrastructure proposals should have regard to the conservation of geological features of special interest. Section 2.7 Biodiversity and Geological Conservation This section does not highlight any specific considerations relating to geological conservation. Section 2.8 Landscape and Visual Paragraph 2.8.9 specifically highlights the relevance of effects on soils and geology in relation to undergrounding as a technology option.	**Section 10.7** explains that geological conservation effects are scoped out of the assessment due to an absence of receptors. **Section 10.9** considers the effects of proposed underground cables on Geology & Hydrogeology receptors.
National Planning Policy Framework (NPPF)[10]	Paragraph 174 specifies that planning policies and decisions should contribute to the protection and enhancement of sites of geological value. It also states that these policies and decisions should prevent development contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil pollution, water pollution or land instability. Finally, paragraph 174 notes that policies and decisions should contribute to the remediation and mitigation of contaminated and unstable land, where appropriate.	**Section 10.9** assesses the effects of the Project in relation to contamination and land instability, as relevant to the scope of this Chapter.

[9] Department of Energy and Climate Change (2011) *National Policy Statement for Electricity Networks Infrastructure (EN-5)*. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37050/1942-national-policy-statement-electricity-networks.pdf [Accessed 28 June 2022].
[10] Ministry of Housing, Communities & Local Government (2021). *National Planning Policy Framework*. [online] Available at: National Planning Policy Framework (publishing.service.gov.uk) [Accessed 28 July 2021].

Policy	Policy context	Where addressed in this Chapter
	Paragraph 183 specifies that planning policies and decisions should ensure that a site is suitable for its proposed use, taking account of land instability and contamination.	
Local planning policy		
Harrogate District Local Plan, 2014 - 2035[11]	Policy NE2: Water Quality Water quality assurance should be delivered through appropriate risk assessments of surface and groundwater systems. Policy NE3: Protecting the Natural Environment Consideration must be given to the protection of natural environments, including geology, from the risks posed by construction works. Policy NE9: Unstable and Contaminated Land Risks posed by unstable and contaminated land are to be assessed prior to development to ensure safe working/living conditions to future land users.	**Section 10.9** assesses all relevant effects that are covered by policies NE2, NE2 and NE9.
Hambleton Local Plan -, 2022[12]	Policy E3: The Natural Environment Protection of local geological sites, subject to suitable assessment of any proposals that may affect these sites and consideration of the mitigation hierarchy ('avoidance-reduction-compensation' in order of preference). Policy RM5: Ground Contamination and Groundwater Pollution	**Section 10.7** explains that risks to protected geology are scoped out of the assessment due to an absence of receptors. **Section 10.9** provides assessments of the effects of the Project in relation to

[11] Harrogate Borough Council (2020). *Harrogate district Local Plan 2014-2035*. [online] Available at https://www.harrogate.gov.uk/planning-policy-guidance/harrogate-district-local-plan-2014-2035 [Accessed 28 July 2021].
[12] Hambleton District Council (2022). *Hambleton Local Plan.* [online] Available at https://www.hambleton.gov.uk/downloads/file/2745/hambleton-local-plan-final-february-2022 [Accessed 1 July 2022].

Policy	Policy context	Where addressed in this Chapter
	This policy relates to ground contamination and groundwater pollution. It provides a thorough description of how best practice in ground and groundwater contamination risk assessment and remediation process is to be implemented through local planning. It also specifies that development activities should not introduce significant contamination to the ground or groundwater, with particular reference to work within Groundwater Source Protection Zones.	ground contamination and groundwater pollution.
Saved Policies of the York Local Plan, 2005[13]	Policy NE3: Water Protection Specifies the requirement for the effects of proposed developments on underground water supplies to be considered, and for development proposals to minimise any such effects. Policy GP6: Contaminated Land Specifies the requirement for suitable contaminated land assessments in support of planning applications, and the implementation of contaminated land risk assessment and remediation good practice through the local planning system.	**Section 10.9** provides an assessment of the effects of the Project on underground water supplies (aquifers) and an assessment of effects relating to land contamination.
City of York draft Local Plan– Publication Draft, 2018[14]	Policy GI2: Biodiversity and Access to Nature Development should ensure retention, enhancement and management of features of	**Section 10.7** explains that geological conservation effects are scoped out of the assessment due to an absence of receptors.

[13] City of York Council (2005). *City of York Draft Local Plan Incorporating the 4th Set of Changes (April 2005).* [online] Available at https://www.york.gov.uk/CurrentLocalPlan [Accessed 28 July 2021].
[14] City of York Council (2005). *City of York Local Plan Publication Draft (Regulation 19 Consultation) (February 2018)*. [online] Available at https://www.york.gov.uk/downloads/download/581/local-plan-publication-draft-2018-consultation [Accessed 28 July 2021].

Policy	Policy context	Where addressed in this Chapter
	geological interest, where appropriate. Policy ENV3: Land Contamination Development proposals should be accompanied by appropriate land contamination risk assessments. Where contamination risks are identified, remedial measures will be required to deal with contamination. Policy ENV5: Sustainable Drainage Sustainable drainage systems shall be designed to prevent an unacceptable risk of contamination of groundwater. Paragraph 12.1: Notes the requirement for land instability to be considered when determining the suitability of proposed new development.	**Section 10.9** provides an assessment of land contamination and ground instability effects and consideration of the risks of new proposed drainage to groundwater receptors.
Leeds Core Strategy, 2019[15]	Policy G8: Protection of Important Species and Habitats Protection of species and habitats, including sites of geological importance.	**Section 10.7** explains that geological conservation effects are scoped out of the assessment due to an absence of receptors.
Saved Policies of the Selby District Local Plan,2005[16]	Policy ENV2: Environmental Pollution and Contaminated Land Contaminated land should be assessed to investigate potential implications for future occupants. Groundwater stored in aquifers is abstracted as potable water so quality and quantity need to be assessed prior to and during developments.	**Section 10.9** provides assessments of the effects of the Project in relation to land contamination and aquifers. **Section 10.7** explains that there are no geologically sensitive receptors that may be affected by the Project.

[15] Leeds City Council (2019). *Leeds City Council Core Strategy Local Plan*. [online] Available at https://www.leeds.gov.uk/planning/planning-policy/adopted-local-plan/core-strategy-introduction [Accessed 28 July 2021].
[16] Selby District Council (2005). *Saved Policies of the Selby District Local Plan (2005)*. [online] Available at https://www.selby.gov.uk/selby-district-local-plan-sdlp-2005 [Accessed 28 July 2021].

Policy	Policy context	Where addressed in this Chapter
	Policy ENV9: Sites of Importance for Nature Conservation Geologically sensitive sites will be protected and where there is an alternative option it shall be chosen over the sensitive site.	
Selby District Core Strategy Local Plan, 2013	Section 7 explains that the District contains significant groundwater supplies within bedrock aquifers. It notes that, in places, protective drift cover is missing making the aquifer very susceptible to contamination and that, correspondingly, consideration must be given to the protection of water quality and prevention of pollution to the ground water supply.	**Section 10.9** provides assessments of the effects of the Project in relation to aquifers.
	Policy SP15 (Sustainable Development and Climate Change) notes that development proposals should minimise the risks of subsidence and instability, and exploit opportunities for the reclamation of contaminated land. Policy SP18 (Protecting and Enhancing the Environment) notes the requirement to retain, protect and enhance features of geological interest.	**Section 10.9** assesses the effects of the Project in relation to contamination and land instability, as relevant to the scope of this Chapter. **Section 10.7** explains consultation undertaken with the Coal Authority in relation to ground subsidence. **Section 10.7** explains that there are no geologically sensitive receptors that may be affected by the Project.

Technical guidance

10.2.5 A large volume of technical guidance is available in relation to geology and hydrogeology. A summary of that which is most pertinent to the assessment undertaken in **Section 10.9** is provided in **Table 10.3**.

Table 10.3 – Technical guidance relevant to the geology and hydrogeology assessment

Technical guidance document	Context
Environment Agency (2020) Land Contamination Risk Management[17]	Overarching technical guidance for land contamination risk assessments.
CIRIA (2007) Assessing risks posed by hazardous ground gases to buildings (CIRIA publication 665)[18]	Technical guidance on ground gas risk assessment.
CIRIA (2001) Contaminated Land Risk Assessment: A Guide to Good Practice (CIRIA publication 552)[19]	Guidance on land contamination risk assessment principles.
Environment Agency (2017) Groundwater Protection guidance[20]	Collection of guidance documents covering groundwater permissions, risk assessments and controls.
CIRIA (2006) Control of water pollution from linear construction projects (CIRIA publication 648)[21]	Technical guidance on practical considerations and measures for protecting groundwater and surface water during the construction of linear infrastructure projects.

10.3 Consultation and engagement

Overview

10.3.1 The assessment has been informed by consultation responses received within the Scoping Opinion and in response to Statutory Consultation. An overview of the approach to consultation is provided in **Chapter 4: Approach to Preparing the ES, Volume 5, Document 5.2.4**.

Scoping opinion

10.3.2 A Scoping Opinion was adopted by the Secretary of State, administered by the Planning Inspectorate, on 28 April 2021 (**Appendix 5.3.4A, Document 5.3.4A**). A summary of the relevant responses received in the Scoping Opinion in relation to Geology and Hydrogeology and confirmation of how these have been addressed within the assessment is presented in **Table 10.4**.

[17] Environment Agency, (2020). *Land Contamination: risk management*. [online] Available at: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm [Accessed June 2021].
[18] Construction Industry Research and Information Association (CIRIA), (2007). *Assessing risks posed by hazardous ground gases to buildings (C665)*. CIRIA; London.
[19] Construction Industry Research and Information Association (CIRIA), (2001). *Contaminated Land Risk Assessment: A Guide to Good Practice (C552)*. CIRIA; London.
[20] Environment Agency, (2017). *Groundwater Protection*. [online] Available at: https://www.gov.uk/government/collections/groundwater-protection [Accessed June 2021].
[21] Construction Industry Research and Information Association (CIRIA), (2006). *Control of water pollution from linear construction projects (C648).* CIRIA; London.

Table 10.4 – Summary of EIA Scoping Opinion responses for geology and hydrogeology

Consultee	Consideration	How Addressed in this ES
Planning Inspectorate/Environment Agency	The Study Area contains groundwater Source Protection Zones (SPZ 1, 2 and 3). The appropriateness of development in the most sensitive locations (for example avoidance by design) should be considered, and suitable protection measures should be incorporated.	The embedded measures that are described in **Table 10.9** will minimise the risk of contaminants being released to groundwater. Design mitigation has been incorporated to minimise construction works in SPZ1 (as described in **Section 10.9**). Dewatering of abstracted bedrock aquifers is not required (see **Section 10.9** which provides a detailed explanation). Potential physical and chemical effects on SPZ are assessed in **Section 10.9** (Effects GH2A/B, GH3, GH4 and GH5), accounting for the design mitigation and embedded measures.
Planning Inspectorate/Environment Agency	The effects of piled foundations on groundwater, and potential inter-topic effects on surface water (hydrology) should be considered or justification should be provided as to why they would not give rise to likely significant effects.	The potential effects of piling on groundwater are assessed in **Section 10.9** Any piling works would be subject to confirmatory foundation risk assessments, in line with Environment Agency guidance on the protection of groundwater, as part of the detailed engineering design process (post-consent). This will be secured through the **Construction Code of Practice (CoCP) (Appendix 3B, Document 5.3.3B),** as an embedded measure (see **Table 10.9**). Inter-topic effects on surface water receptors are considered in **Chapter 9: Hydrology (Document 5.2.9)**.
Planning Inspectorate	The potential for major accidents associated with asbestos in the ground or unexploded ordnance (UXO) should be considered.	The embedded environmental measures (**Table 10.9**) will ensure that the identification and management of any suspected asbestos finds accords with legislation and good practice. The risks associated with asbestos

Consultee	Consideration	How Addressed in this ES
		contamination in soils are assessed in **Section 10.9**. UXO is considered to primarily be a construction safety risk. National Grid Electricity Transmission Plc (National Grid) commissioned a UXO report for the proposed Overton and Monk Fryston Substation sites and proposed new pylons and temporary structures (see **Appendix 10C[22], Document 5.3.10C, Volume 5**) and is in the process of preparing this for the remainder of the route. For both substation sites, the UXO hazard is assessed in the UXO reports as 'unlikely' (the lowest possible category) and the UXO specialists advise that no further action is required (above and beyond ordinary vigilance). For the proposed new pylons and temporary structures, the UXO risk is assessed as 'low' by the UXO reports.
Environment Agency	Dewatering impacts should be considered with particular regard to dewatering within an SPZ. The effects of both abstraction and discharge should be considered.	The potential effects are assessed in **Section 10.9**.
Environment Agency	Consideration should be given to the potential for disruption of groundwater flow and potential for artesian groundwater.	The potential effects are assessed in **Section 10.9** (Effect GH11).
Environment Agency	The water quality effects of SuDS (Sustainable Drainage Systems) or other drainage on groundwater receptors should be considered.	The potential water quality effects of drainage systems on groundwater receptors are assessed in **Section 10.9** (see Effect GH11).
North Yorkshire County Council	North Yorkshire CC confirms that the development does not fall within the exemption criteria for the Joint Plan as no mention	A Minerals Resource Assessment is provided in **Document 7.10, Volume 7**.

[22] These reports show provisional design information as of the date that they were prepared. Whilst this information is outdated, the content in relation to UXO remains valid.

Consultee	Consideration	How Addressed in this ES
	is made of the potential impact of the development on mineral resources in the Scoping Report and therefore it does not take into account the safeguarding issues arising from the Minerals and Waste Joint Plan. Consequently, the recommendation is that the applicant be advised to undertake a mineral resource assessment in order to establish whether there is any scope to make appropriate use, within the development, of the mineral resources existing at the site; and, includes that assessment as part of any planning application submission.	

Statutory Consultation

10.3.3 Statutory Consultation took place between 28 October and 9 December 2021 in accordance with section 42 of the Planning Act 2008. Prescribed and non-prescribed consultees and members of the public were included in the consultation. Various methods of consultation and engagement were used in accordance with the Statement of Community Consultation (SoCC) including letters, website, public exhibitions, publicity and advertising in newspapers and webinar briefings.

10.3.4 National Grid prepared a Preliminary Environmental Information Report (PEIR) which was publicised at this consultation stage and sought feedback on the environmental information presented in that report. Feedback received during statutory consultation was considered by National Grid and incorporated where relevant in the design of the Project.

10.3.5 A summary of the statutory consultation representations received (relevant to EIA) and National Grid's responses is provided in **Volume 6, Document 6.1** (**Consultation Report**). A summary of the main statutory consultation representations received from prescribed and non-prescribed bodies in relation to the geology and hydrogeology assessment are presented in **Table 10.5**.

Table 10.5 – Consultee comments and responses to PEIR

Consultee	Comments and consideration	How Addressed in this ES
Environment Agency	**Section 10.8** on addressing risks identified states that an outline CEMP will be the compliance mechanism for the measures	An Code of Construction Practice (CoCP) is provided as **Document 5.3.3B, Volume 5**.

Consultee	Comments and consideration	How Addressed in this ES
	identified. We could not see this document in the consultation.	
Environment Agency	In addition to the above, we advise that there is a potential risk of contamination to the water environment through the runoff of water from exposed soils during development. We therefore advise that appropriate management plans are provided to mitigate against this potential risk, including the submission of details of any protection measures (which could include silt traps or impermeable barriers).	Relevant measures are included in the Code of Construction Practice (CoCP), provided as **Document 5.5.3B, Volume 5.**
North Yorkshire County Council and Selby District Council	The ES will include consideration of precautionary groundwater monitoring procedures, along with an assessment of potential cumulative effects with other developments.	Any such monitoring requirements would depend on the piling technique and depths and would be specified as an output of the pre-construction piling risk assessment, in accordance with the embedded measures in **Table 10.9**.

10.3.6 Technical engagement with consultees in relation to Geology and Hydrogeology is primarily through the Scoping Opinion and section 42 Planning Act 2008 process. It has not been necessary to hold specific technical meetings or discussions in relation to Geology and Hydrogeology to date.

10.4 Data gathering methodology

Study Area

10.4.1 For the purpose of establishing the baseline conditions, the Study Area comprises the land within the Order Limits, as shown on **Figure 1.2**, **Document 5.4.1, Volume 5** plus a 250m buffer. Given the scale and nature of the Project, this is generally considered a robust yet proportionate approach. However, for hydrogeological baseline information (for example SPZ and water abstractions) the Study Area for baseline data collection has been extended to 500m from the Order Limits, due to the mobile nature of groundwater and the corresponding potential for the Project to affect receptors at a greater distance.

10.4.2 The 250m and 500m Study Areas are shown on **Figures 10.1** - **10.4, Document 5.4.10, Volume 5**.

Data sources

10.4.3 A summary of the organisations that have supplied data, together with the nature of that data, is outlined in **Table 10.6.**

Table 10.6 – Data sources used to inform the geology and hydrogeology assessment

Organisation	Data Source[1]	Data Provided
Selby District Council	Council records	Private water supply locations.
Leeds City Council	Council records	Private water supply abstractions (nil return i.e. no data held).
Environment Agency	Environment Agency records	Discharge permits, pollution incidents, water abstraction licences, WFD programme of measures for relevant waterbodies.
Environment Agency	Open Water Quality Archive (WIMS)	Groundwater quality monitoring data.
British Geological Survey (BGS)	BGS	1:50,000 scale geological mapping.
BGS	BGS	Historical borehole records, publicly available from the BGS online viewer[23].
BGS	BGS	Aquifer designation data.
BGS	BGS GeoSure data	Natural geohazards risk mapping (collapsible ground, compressible ground, landslides, running sand, shrink-swell, and soluble rocks).
Government open source	.gov.uk	Historical landfills, authorised landfills, groundwater SPZs.
Landmark Information Group Ltd	Ordnance Survey County and National Grid Series historical mapping	1:10,000 and 1:10,560 scale historical mapping, in GIS format.
Landmark Information Group Ltd	Landmark Information Group[2]	Contaminated Land Register entries, pollution prevention and control records, enforcement and prohibition notices, prosecutions relating to Controlled Waters, prosecutions in relation to authorised processes, substantiated pollution incident register entries, registered radioactive substance sites, licensed waste management facilities, registered waste transfer sites, registered waste treatment or disposal sites, hazardous substance sites (COMAH, NIHHS), contemporary trade directory entries, fuel station entries.

[23] British Geological Survey (2021) *Geology of Britain viewer (classic).*

Organisation	Data Source[1]	Data Provided
Public Health England	Radon records	Publicly available online radon risk mapping[24].
Socotec (work undertaken on behalf of National Grid)	N/A, proprietary data collected on behalf of National Grid.	Ground investigation data, obtained in 2022 (**Appendix 5.3.10E, Document 5.3.10, Volume 5**)**.**

[1] Nil return data sources searched in relation to geological SSSI and locally designated geological sites within the Study Area not listed, as these were considered at scoping and the potential effects scoped out correspondingly.

[2] Landmark Information Group provides a database of environmental information sourced through agreements with a number of suppliers. A full list is available on request.

Survey work

10.4.4 To support the Geology and Hydrogeology assessment, targeted walkover inspections have been undertaken at the following locations:

- The Shipton North and South CSEC sites (refer **Figure 3.2, Volume 5, Document 5.4.3**). This location was selected because it involves a number of closely concentrated proposed construction elements that will involve ground disturbance (including underground cabling) and is close to a groundwater abstraction (circa 50m north of the Order Limits at Newlands Farm).
- Overton Substation and the proposed new section of the XC 275kV overhead line connecting into the substation from the south-west (locations of proposed pylons XC417 to XC420) (refer **Figure 3.2, Volume 5, Document 5.4.3**). This location was selected in order to get a general characterisation of the construction of new pylons across agricultural land in the area, and to give information on the substation site.
- The field containing existing pylon XC428T (which will be dismantled as part of the Project), located immediately to the south-east of Moor Monkton (refer **Figure 3.3, Volume 5, Document 5.4.3)**. This provided general characterisation in relation to pylon removal works on agricultural land in the area.
- Tadcaster Area (refer **Figure 3.4, Volume 5, Document 5.4.3**). The field containing the proposed CSECs and underground cable. This location was selected due to the nature of the proposed infrastructure and previous land use including quarrying (discussed further in **Section 10.5**).

10.4.5 These locations were selected based on the nature of the proposed construction activities (for example, construction activities that involve ground disturbance) and the sensitivity of the locations (for example, proximity to groundwater abstractions), as well as access constraints and previous land uses.

10.4.6 The walkover surveys were carried out on 24 June 2021 and 19 July 2022, with survey records provided in **Appendix 10A, Document 5.3.10, Volume 5**.

[24] Public Health England (2021). *UK Maps of Radon*. [online] Available at [redacted] (Accessed 28 July 2021).

10.5 Overall baseline

10.5.1 The description of the baseline conditions is presented first on a generalised 'Project-wide' basis, explaining each aspect of the baseline (such aquifers and landfills) at this level of detail. This is then followed by additional specific detail on three Focus Areas where new infrastructure is proposed and the nature of the Project is likely to involve greater ground disturbance and therefore the baseline geological and hydrogeological conditions are of greater relevance (see **Chapter 3 Description of the Project, Document 5.2.3, Volume 5** for additional detail). The Focus Areas comprise Sections B (North-west of York Area), D (Tadcaster Area) and F (Monk Fryston Area), as these areas comprise the locations of new infrastructure and construction compounds.

10.5.2 Outside these three Focus Areas, the Project primarily involves modifications to existing pylons and overhead lines (approximately 65% of the Project length consists of this activity) (Sections C Moor Monkton to Tadcaster and Section E Tadcaster to Monk Fryston), as well as near surface works involving minimal ground disturbance at Osbaldwick Substation (new circuit breaker and isolator) (Section A: Osbaldwick Substation).

Current baseline

General description (route wide)

Solid geology

10.5.3 The Order Limits extend for approximately 35km (north-south) and display variable geology. The solid geology of the 500m Study Area (the Order Limits plus 500m buffer) can generally be split into two distinct parts (north and south), which contain different geological units. The geological boundary between these two parts intersects the Order Limits approximately 2.3km north of Tadcaster town centre, at the approximate position of existing pylon XC467 (**Figure 3.3, Document 5.4.3**). To the north of this, the 500m Study Area (including Osbaldwick Substation which is remote from the rest of the Order Limits) is mapped as being underlain by deposits of the Sherwood Sandstone Group (sandstone with subordinate mudstone). The south of the 500m Study Area is mapped as being primarily underlain by Zechstein Group limestone and dolostone (interbedded with mudstones, sandstones and siltstones) of the Cadeby and Brotherton Formations, with less frequent occurrences of the Roxby Formation (calcareous mudstone).

10.5.4 The north of the 500m Study Area contains a number of south-west to north-east trending faults. This regional faulting alignment is also present in the south of the 500m Study Area, although the geological structure in this area also includes more complex localised faulting.

10.5.5 The solid geology, as described above, is shown on **Figure 10.1, Document 5.4.10, Volume 5**.

Superficial geology

10.5.6 To the north of the approximate location of existing pylon XC445 (**Figure 3.3, Document 5.4.3**), the mapped superficial geology within the 500m Study Area is primarily deposits of the Alne Glaciolacustrine Formation, described by the BGS as generally comprising "*laminated clay with silt (varved) and subordinate fine-grained sand beds, plus a little marginal sand and gravel*". Much less prevalently, sporadic

deposits of the Breighton Sand Formation (clayey to silty sand with basal peat), Sutton Sand Formation (sand), unnamed glaciofluvial sand deposits, and the Vale of York Formation (Glacial Till) are present. Alluvium is recorded to be present along the alignment of watercourses (particularly the River Ouse).

10.5.7 From the approximate location of existing pylon XC445 southwards to where the A659 crosses the Order Limits (circa 175m south-west of existing pylon XC472, **Figure 3.3, Document 5.4.3**), the superficial deposits are mapped to primarily consist of Glacial Till (Vale of York Formation), with occasional granular (gravelly sand and clayey gravelly sand) glacial deposits of the York Moraine Member, and also deposits of alluvium (for example, along the River Wharfe).

10.5.8 To the south of the point at which the A659 crosses the Order Limits (**Figure 3.4, Document 5.4.3**) to the southern terminus of the 500m Study Area at Monk Fryston (**Figure 3.6, Document 5.4.3**), the coverage of superficial deposits is mapped as being more sporadic, with substantial areas recorded to be devoid of superficial cover. Where superficial deposits are present, these are primarily Glacial Till deposits of the Harrogate Till Formation (sandy gravelly clay). Small, localised, areas of granular superficial deposits (glaciofluvial/lacustrine sand and gravels) are also present, as are small deposits of Head (variable clay, silt, sand and gravel) and alluvium (again generally along river channels, and in some locations accompanied by river terrace gravels).

10.5.9 Two superficial deposit types are mapped by the BGS as being present within the 500m Study Area around Osbaldwick Substation (**Figure 3.1, Document 5.4.3**), which is remote from the remainder of the Order Limits. These are the Alne Glaciolacustrine Formation (which underlies the majority of the 500m Study Area in this location, including the northern c. two thirds of the Order Limits) and the York Moraine Member (which underlies the southern one third of the Order Limits).

10.5.10 The superficial geology, as described above, is shown on **Figure 10.2, Document 5, Volume 5.4.10**.

Aquifers

10.5.11 Both the sandstones in the northern part of the 500m Study Area and the limestones/dolostones in the southern part are classified as Principal Aquifers. As a result, the majority of the 500m Study Area has a bedrock Principal Aquifer designation, with the only exception being relatively small areas where the sub-cropping/outcropping geology is calcareous mudstone (Secondary B Aquifer). The bedrock aquifer designations are shown on **Figure 10.4, Document 5.4.10, Volume 5**.

10.5.12 The sandstone aquifer in the northern part of the Study Area generally benefits from a superficial cover of clay and silt of the Alne Glaciolacustrine Formation (to the north of the approximate location of existing pylon XC445) and sandy gravelly clay of the Vale of York Formation (to the south of the approximate location of existing pylon XC445, but to the north of where the A659 crosses the Order Limits). The Alne Glaciolacustrine Formation is classified as Unproductive Strata, meaning that it has low permeability and negligible significance for water supply or river base flow. The Vale of York Formation is classified as a Secondary Undifferentiated aquifer, which is likely reflective of the potential for localised water-bearing horizons within a variable material of generally relatively low permeability.

10.5.13 Whilst extensively prevalent, these lower permeability superficial deposits are not ubiquitous overlying the sandstone, and in places sporadic granular superficial deposits

are present that are generally classified as Secondary A Aquifers. These include the Breighton Sand Formation (clayey to silty sand with basal peat), Sutton Sand Formation (sand), and unnamed glaciofluvial sand deposits. The York Moraine Member is variably classified as a Secondary Undifferentiated or Secondary A Aquifer, depending on its local composition.

10.5.14 The limestone/dolostone aquifers in the southern part of the 500m Study Area (to the south of where the A659 crosses the Study Area) do not have the same extent or continuity of superficial cover as the sandstone aquifers in the north. The sporadic superficial deposits in this area are generally classified as Secondary Undifferentiated aquifers (for example, the Harrogate Till Formation, Head), with small areas designated as Secondary A Aquifers where glaciofluvial sand and gravel deposits are present.

10.5.15 Alluvium deposits, which are present sporadically throughout the 500m Study Area (generally following surface watercourses) are classified as Secondary A Aquifers. Such aquifers are defined by the Environment Agency as "*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers*".

Groundwater WFD status

10.5.16 The sandstones in the northern part of the 500m Study Area form part of the 'SUNO Sherwood Sandstone' groundwater body and the 'Wharfe and Lower Ouse Sherwood Sandstone' groundwater body, whilst the limestones/dolostones in the southern part of the 500m Study Area form part of either the 'Wharfe Magnesian Limestone' groundwater body or the 'Aire and Don Magnesian Limestone' groundwater bodies.

10.5.17 All four of these groundwater bodies were classified by the Environment Agency as having 'Poor' WFD status in 2019. In the cases of the SUNO Sherwood Sandstone and Aire and Don Magnesian Limestone groundwater bodies, the Environment Agency has published reasons[25] why these groundwater bodies have not achieved 'Good' status. In both cases, these relate to agricultural and nutrient management issues, as well as the effects of private sewage treatment. For the SUNO Sherwood Sandstone, there is also reference to poor pesticide management and the influence of natural conditions on groundwater quality.

10.5.18 The Environment Agency has provided details of the current Programme of Measures in relation to the status of the four WFD classified groundwater bodies that are described above (as of 2021). These primarily involve measures to minimise the impacts of agricultural activities on the aquifers, and measures in relation to the modification and enforcement of permits.

Groundwater SPZ and groundwater abstractions

10.5.19 There are several groundwater SPZs within the 500m Study Area, and within the Order Limits, most notably immediately to the west and south-west of Tadcaster (between existing pylons XC472 and XC490). These SPZs relate to licensed potable water abstractions, the closest of which are circa 400m east of the Order Limits (at Tower Brewery) and 240m south of the Order Limits (licensed to the University of Leeds). Further licensed potable water abstractions beyond the 500m Study Area may also be

[25] Environment Agency (2021). *Catchment Data Explorer (website)*. Data for specific aquifers in question. [online] Available at: Environment Agency - CDE - SUNO Sherwood Sandstone (data.gov.uk) and Environment Agency - CDE - Aire & Don Magnesian Limestone. (data.gov.uk) [Accessed 12 October 2022].

associated with these SPZs. The configuration of SPZs in this area is shown on **Figure 10.4, Document 5.4.10**. The intersection of SPZ1 (inner source protection zone) with the Order Limits is minimal, with the majority of the land within an SPZ that falls inside the Order Limits being either in SPZ2 (Outer Zone) or SPZ3 (Total Catchment).

10.5.20 In addition to the SPZ to the west and south-west of Tadcaster, there are also four small SPZ1 (Inner Zone) designations within the 500m Study Area. These are licensed abstractions that do not form public water supplies but have a potable element (for example licensed abstractions at farms) and are defined by the Environment Agency as a 50m SPZ1 radius in all cases, with no SPZ2 or SPZ3. These SPZs are shown on **Figure 10.4, Document 5.4.10**, and are at the following locations:

- Newlands Farm, 1.8km north-east of Shipton by Beningbrough;
- Oaklands Turkey Farm, 1km south of Moor Monkton;
- Healaugh Grange, 1.7km south-east of Bilton; and
- Milford Farm, 1.3km north-east of Ledsham.

10.5.21 There are also further groundwater abstractions within the 500m Study Area that do not have associated SPZs. This is because they are either licensed abstractions without a potable element or because they are private water abstractions that do not require licences (for example, because the daily abstracted volume is less than 20,000 litres). **Table 10.7** provides details of all currently known groundwater abstractions within the 500m Study Area[26].

Table 10.7 – Groundwater[27] Abstractions within the 500m Study Area

Licensee/ Owner	Use[28]	Stratum Abstracted[29]	Volume Abstracted (max permitted per day, in m^3)	SPZ Associated with Abstraction (Y/N)	Approximate Location
Rab	Agriculture, farming and domestic	Sherwood Sandstone	45	Y – SPZ1 only	Newlands Farm, 1.8km north-east of Shipton by Beningbrough.

[26] Private water abstraction data search responses have not been received from the following Local Planning Authorities: York City Council, Hambleton District Council, and Harrogate Borough Council.
[27] For private water supplies, the records do not indicate whether the abstraction is from surface water or groundwater. For the purpose of this chapter, all such abstractions have been assumed to be from groundwater, on a precautionary basis.
[28] Where 'unknown' is stated, this is because the data provider (Local Planning Authority) does not release this information.
[29] Where 'unknown' is stated, this is because the data provider (Local Planning Authority) does not release this information.

Licensee/ Owner	Use[28]	Stratum Abstracted[29]	Volume Abstracted (max permitted per day, in m^3)	SPZ Associated with Abstraction (Y/N)	Approximate Location
Bonsel	Amenity – make up or top up water	Sherwood Sandstone	137	N	400m south of Moor Monkton.
Oakland	Agriculture, farming and domestic	Sherwood Sandstone	240	Y – SPZ1 only	Oaklands Turkey Farm, 1km south of Moor Monkton.
Grange Farms	Agriculture, farming and domestic	Sherwood Sandstone	34.091	Y – SPZ1 only	1.7km south-east of Bilton.
Private water supply	Unknown	Unknown (assumed Sherwood Sandstone)	<20 per day.	N (although within SPZ for Grange Farms abstraction)	30m east of Grange Farms abstraction. Possibly a record of the same abstraction (for example, if abstracted volumes were originally below the licensing threshold and subsequently increased above it).
Coors Brewers	Breweries	Magnesian limestone	3,000	Y	Tower Brewery, 690m east of existing pylon XC473.
Coors Brewers	Breweries	Magnesian limestone	3,000	Y	Tower Brewery, 760m south-east of existing pylon XC473.
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Brick House Farm, 1km south-east of Tadcaster

Licensee/ Owner	Use[28]	Stratum Abstracted[29]	Volume Abstracted (max permitted per day, in m^3)	SPZ Associated with Abstraction (Y/N)	Approximate Location
					Grammar School.
University of Leeds	Drinking, cooking, sanitary and washing	Magnesian limestone	855	Y	1.5km south-west of Tadcaster Grammar School. Appears to be associated with an agricultural research facility.
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Peggy Ellerton Farm, 525m west of existing pylon XC488.
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Lowpark Farm, 210m east of existing pylon XC488.
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Approximately 250m west of existing pylon XC491.
WS Bayston and Son	Agriculture – spray irrigation	Magnesian limestone	1,228	N – assumed to be due to the absence of a potable use	Approximately 240m east of existing pylon XC501.
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Approximately 570m west of existing pylon XC504.
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Approximately 430m west of existing pylon XC508.
Private water supply	Unknown	Unknown (assumed	<20 per day	N	Approximately 300m east of

Licensee/ Owner	Use[28]	Stratum Abstracted[29]	Volume Abstracted (max permitted per day, in m^3)	SPZ Associated with Abstraction (Y/N)	Approximate Location
		Magnesian limestone)			existing pylon XC509.
W Chapman and Sons	Agriculture – spray irrigation	Magnesian limestone	1,000	N – assumed to be due to the absence of a potable use	Approximately 510m east of existing pylon XC509.
Milford Farm Produce	Agriculture, farming and domestic	Magnesian limestone	34m	Y – SPZ1 only.	1.3km north-east of Ledsham. 590m west of existing pylon XC519.
Lumby Garden Centre	Horticultural and nurseries (general use)	Magnesian limestone	22.73	N – assumed to be due to the absence of a potable use.	Approximately 340m west of existing pylon XC522T.
Lumby Garden Centre	Horticultural and nurseries (general use)	Magnesian limestone	22.73	N – assumed to be due to the absence of a potable use.	Approximately 330m west of existing pylon XC522T. (N.B. Different borehole from that listed above; not a duplicate record, despite identical details).
Private water supply	Unknown	Unknown (assumed Magnesian limestone)	<20 per day	N	Approximately 290m east of existing pylon XC509. Appears to be situated at Lumby Garden Centre.

Discharge consents

10.5.22 The Environment Agency reports that there are 27 registered water discharge consents within the 500m Study Area. These generally relate to wastewater treatment

facilities/pumping stations, together with a lesser number of permits relating to agricultural and other commercial premises. Details of the receiving water body (either groundwater or surface water) or the permitted discharge volumes are not provided. Of the 27 registered water discharge consents, two have registered co-ordinates within the Order Limits[30]. These are:

- Church Lane wastewater treatment, located approximately 50m north-west of existing pylon XC430; and
- Quarrybank wastewater treatment, located approximately 90m south-east of existing pylon XC521.

Natural geohazards

10.5.23 Hazard mapping produced by the BGS has been reviewed in relation to each of the following naturally occurring geological hazards: compressible ground, soluble rocks, collapsible deposits, shrink-swell potential, running sand, and landslides. Each of these six hazards is discussed in turn below. Due to the nature of the information (not hydrogeological or relevant to mobile contaminants), the baseline is described only for the 250m Study Area.

10.5.24 The Alne Glaciolacustrine Formation deposits (located to the north of existing pylon XC445) are recorded to have the potential for compressibility, as are the sporadic deposits of alluvium within the 250m Study Area. Otherwise, the BGS risk mapping indicates that significantly compressible natural strata are unlikely to be present.

10.5.25 Soluble rocks are recorded to be present for the extent of the 250m Study Area in which Permian limestones/dolostones and calcareous mudstone outcrop or sub-crop. The extent of these rocks is shown on **Figure 10.1, Document 5.4.10** (Sheets 4, 5 and 6) and covers all of the 250m Study Area to the south of a point 140m north-east of existing pylon XC467.

10.5.26 The BGS hazard mapping does not suggest the presence of collapsible deposits within the 250m Study Area, with the full 250m Study Area either falling into the hazard category in which such deposits are either “believed not to be present” or “unlikely to be present”.

10.5.27 In terms of shrink-swell potential, the BGS indicates that the Alne Glaciolacustrine Formation deposits may display a medium plasticity. This classification is also given to sporadic small areas elsewhere within the 250m Study Area (i.e. outside the area underlain by the Alne Glaciolacustrine Formation) although this is primarily underlain by deposits indicated by the BGS to have either low plasticity or to be non-plastic.

10.5.28 The small areas of alluvium within the 250m Study Area, which generally follow the routes of watercourses, are recorded to have the potential to display running sand conditions. This is also the case for the area recorded to be underlain by the Sutton Sand Formation in the general vicinity of existing pylons YR031 to 2TW169 (mapped

[30] For brevity, the 24 discharge consents outside the Order Limits are not listed. They consist of wastewater discharges undertaken by water companies, water/wastewater discharges from farming operations and other commercial premises, and water discharges from domestic premises (including farmhouses). The Environment Agency records do not specify whether the discharges are to surface water or groundwater, although it is considered likely that a proportion will be surface water discharges (based on their proximity to surface water features).

extent of the Sutton Sand Formation shown on **Figure 10.2, Document 5.4.10** (Sheets 1 and 2)).

10.5.29 The BGS landslide hazard mapping divides the hazard into three categories: slope instability problems are not likely; slope stability problems may be present; and slope stability problems are probably present. Almost all of the 250m Study Area falls within the category in which slope instability problems are defined as “not likely”, which is consistent with its relatively flat nature. None of the 250m Study Area falls within the category where slope stability problems are “probably present”. Very small, and localised, areas fall within the category in which slope stability problems “may be present” (locations shown and described in detail in **Section 10.9**).

Historical land use

10.5.30 A review of published historical mapping indicates that the previous land use within the 500m Study Area has been largely agricultural, together with the quarrying of limestone and small areas of sand and gravel. A particular intensity of historical limestone quarrying is noted within the 500m Study Area in the area around existing pylons XC473 to XC484 (former quarry locations in this area are shown on **Figure 10.3, Document 5.4.10**, specifically Sheet 4).

10.5.31 **Figure 10.3, Document 5.4.10** shows features noted/identified from this review that may have the potential to be associated with contamination (although in some cases, such as allotments and plantations, this risk is very low). These are generally associated with historical quarrying and clustered around the Tadcaster Area (Section D) and Monk Fryston Area (Section F). In many cases, these recorded historical uses correlate with artificial ground deposits recorded by the BGS on their 1:50,000 scale mapping.

10.5.32 The locations of these historical land uses, and the BGS recorded artificial ground extents, are shown on **Figure 10.3, Document 5.4.10**. Further detail/discussion of the historical land use relative to the three Focus Areas is provided in the descriptions of baseline conditions that are specific for these areas.

Landfills

10.5.33 There are three currently authorised landfills within the 500m Study Area.

- Smaws Quarry landfill. This landfill is located 520m north-west of existing pylon XC477. It is licensed to accept inert waste.
- Lodge Quarry landfill. This landfill is located 450m north of existing pylon 4YS029. The permit for the site is for the disposal of household, commercial and industrial waste and the site is recorded to be ‘in closure’ (i.e. implementing the landfill closure plan and associated monitoring and not accepting waste).
- Betteras Hill Quarry landfill. This landfill is located 780m east of existing pylon 4YS029. The waste type listed on the licence records is ‘A06: Other Wastes’. The licence is recorded to have expired.

10.5.34 None of these landfills are located within or immediately adjacent to the Order Limits.

10.5.35 There are three historical landfills within the 500m Study Area. These are:

- Mile Gap Quarry landfill, which is located approximately 440m north of the existing Monk Fryston Substation, immediately adjacent to (outside) the Order Limits. The waste types that were accepted at this landfill are not known/recorded. The landfill is

recorded to have first received waste in 1973. The date at which waste deposition ended is not known.Grimston Bar Borrow Pit, which is located approximately 100m south of the existing Osbaldwick Substation site. It is recorded to have been permitted to accept a large range of wastes, including inert, industrial, commercial, household, special and liquid waste. The landfill is recorded to have been operational between 1978 and 1986.

- Sherburn Quarry II landfill, which is located c.1.3km west of existing pylon XC510. This landfill is recorded to have accepted inert, industrial, commercial, household and sludge waste. The landfill is recorded to have been operational between 1980 and 1987.

Pollution Incidents

10.5.36 Excluding the area around Osbaldwick substation, the Environment Agency reports a total of 121 closed (historical) pollution incidents within the 500m Study Area, dating between November 2001 and February 2021. The following statistics are summarised from this information:

- 29 of the 121 incidents were recorded to have had no impact in relation to land or water.
- There were no Category 1 (major) or Category 2 (significant) pollution incidents in relation to water. There were a total of 22 Category 3 (minor) pollution incidents in relation to water, which included releases of sewage and oils. None of these incidents took place within the last 3 years.
- There was one Category 1 (major) pollution incident in relation to land. This took place approximately 200m south of the existing Monk Fryston Substation in 2004 and appears to relate to unauthorised waste activities involving tyres.
- There were 17 Category 2 (significant) pollution incidents in relation to land. All of these occurred over 15 years ago, and with the exception of one incident relating to inert clay and soil 210m north-east of existing pylon XC510, all relate to unauthorised waste management activities at a site approximately 25-50m to the east/north of existing pylon XC522T. This includes pollution incidents within the Order Limits and is discussed further in the subsequent specific baseline conditions description for the Monk Fryston Area (Area F).
- There were 56 Category 3 (minor) pollution incidents in relation to land. Of these, 2 are located within the Order Limits, with the details provided in **Table 10.8**.

Table 10.8 - Category 3 (minor) pollution incidents to land within the Order Limits

Location	Easting	Northing	Date	Cause	Pollutant
Pollums House Farm	447622	429843	10 November 2011	Not identified	Tyres and smoke
Pollums House Farm	447520	430000	2 August 2012	Burning of waste	Firefighting run-off and smoke

10.5.37 There are 75 recorded historical pollution incidents within 500m of the Order Limits at the Osbaldwick Substation site, only one of which is within the Order Limits. The incident within the Order Limits is recorded to have been a Category 3 (Minor) pollution incident to land that occurred in 2002 and involved the fly tipping of commercial waste. The remaining 74 historical pollution incidents were outside the Order Limits and occurred between July 2001 and September 2018. 72 of these incidents did not exceed Category 3 (Minor) in relation to effects on land or water. The remaining two were: a Category 2 (Significant) incident to land that occurred in March 2002 and involved fly tipping of asbestos 390m north of the Order Limits; and a Category 2 (Significant) incident to water that occurred in May 2002 and involved the release of sewage from a pumping station 400m north of the Order Limits. Given their nature, age and distance from the Order Limits, neither of these Category 2 pollution incidents are considered to have potential to have any current effect on the condition of the ground or groundwater within the Order Limits.

Landmark Information Group Records

10.5.38 As listed in **Table 10.6**, a number of geo-environmental data searches have been undertaken through the database of commercially available information held by Landmark Information Group.

10.5.39 The are no recorded Contaminated Land Register Entries, enforcement and prohibition notice records, records of prosecutions relating to Controlled Waters, prosecutions relating to authorised processes, registered radioactive substance sites, registered waste transfer sites, or hazardous substance sites (COMAH/NIHHS) within the 250m Study Area.

10.5.40 There are pollution prevention and control (PPC) records within the 250m Study Area at the following locations:

- Oaklands Turkey Farm, which has two PPC records, one of which is positioned approximately 475m south-west of existing pylon XCP0001T, and the second of which is positioned approximately 880m south-west of that pylon;
- agricultural activities 210m east of existing pylon XC437;
- quarry processes at Jackdaw Crag Quarry, 125m south-east of existing pylon XC481;
- odourising natural gas and liquified petroleum gas 280m south-west of existing pylon XC483; and
- respraying of road vehicles 450m north of the existing Osbaldwick Substation.

10.5.41 Other than Oaklands Turkey Farm, none of these PPC records are located within the Order Limits

10.5.42 There are two recorded fuel station sites within the 500m Study Area[31]. These are:

- Selby Fork Services, located approximately 550m north-west of existing pylon XC521. This record/site is recorded to be obsolete; and
- Hull Road Service Station, located approximately 375m south-west of Osbaldwick Substation.

[31] This use of 500m, rather than 250m, is considered applicable in relation to fuel stations, due to the potential relevance to background groundwater quality.

10.5.43 Neither of these fuel stations are located within the Order Limits.

10.5.44 There are a total of 42 trade directory entries within the 250m Study Area. These records are associated with current or recent businesses, with 16 recorded as active. Of these 16, four can be grouped as generally being associated with the car industry (garages, tyre dealers, engine reconditioning), with the remainder comprising:, a builders warehouse, electronic component manufacture and distribution, food manufacturing, gas suppliers (two trade directory entries), industrial instrument manufacturing, PVC-U product manufacturing, a machine shop, a manufacturer of welding and cutting equipment, a quarry (Jackdaw Crag Quarry), and two distribution companies.

10.5.45 Of the 16 active trade directory entries, 11 are situated at a trading estate immediately adjacent to and north-west of Osbaldwick Substation. No active trade directory database entries are located within the Order Limits.

10.5.46 There is one registered waste treatment site/waste management site within the 250m Study Area, at Jackdaw Crag Quarry (outside the Order Limits). However, the permit associated with this site is recorded to be lapsed/defunct/surrendered/expired.

North-west of York Area (Section B)

10.5.47 Further to the general 'route-wide' description of baseline conditions above, more detailed baseline information is presented below in relation to the North-West of York Area.

10.5.48 The baseline geological conditions at the proposed Shipton CSECs site (i.e. the location of the proposed CSECs, construction compounds, underground cables, new pylons and associated overhead line works – refer to **Figures 3.2, Document 5.4.3, Volume 5**) are generally recorded by the BGS to comprise natural superficial deposits of the Alne Glaciolacustrine Formation, overlying solid geology of the Sherwood Sandstone Group, although the southern part of this site is recorded to be underlain by the Sutton Sand Formation rather than the Alne Glaciolacustrine Formation (still overlying Sherwood Sandstone). The BGS indicates that, regionally, the Alne Glaciolacustrine deposits are up to 22m thick. A nearby historical borehole log, publicly available from the BGS, indicates that other than a 1.2m thick horizon described as "running sand" between 1.8m and 3.0m bgl, the Alne Glaciolacustrine Formation comprises clay to a depth of 14m bgl, overlying solid geology of sandstone and "marl". This borehole was situated 280m north of the Order Limits.

10.5.49 Ground investigation undertaken by Socotec in 2022, consisting of two boreholes to depths of c.23m at the proposed Shipton CSEC site (locations shown in **Appendix 10E, Document 5.3.10E**), shows some slight variation from the desk study information provided above. These boreholes recorded topsoil to depths of up to 0.8m, overlying Alne Glaciolacustrine Formation deposits to depths of around 9.5m to 10m. Around 5-6m of sand (logged by Socotec as the Sutton Sand Formation) is then recorded in both boreholes, underlain by further deposits of the Alne Glaciolacustrine Formation. These deposits continued until rockhead in one of the boreholes, with rock encountered at 22m and recorded to be mudstone of the Mercia Mudstone Group. This differs from the BGS records, which indicates the solid geology to be Sherwood Sandstone, although it is noted that Socotec's drilling extended only 0.95m into rock and that the Sherwood Sandstone does contain subordinate mudstone as well as a gradational boundary with the Mercia Mudstone, so the recorded mudstone is academic for the purpose of this EIA. Rock was not encountered in the second borehole, which instead found further

deposits of sand (logged as the Sutton Sand Formation) at around 20m to its termination at 22.6m depth.

10.5.50 Groundwater was struck during drilling in both boreholes at shallowest depths of around 9-9.5m, generally co-incident with the presence of the sand deposits.

10.5.51 Soil samples were taken from the topsoil (one sample from each borehole) and tested for a suite of contaminants including metals, asbestos, free cyanide, speciated phenols, speciated total petroleum hydrocarbons (TPH), BTEX (benzene, toluene, ethylbenzene and xylene), polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (VOC). The recorded contaminant concentrations were low and consistent with what would be expected of natural soils on agricultural land. PAH, free cyanide, speciated phenols and VOC concentrations were recorded to be below laboratory detection limits, no asbestos was recorded, and metals concentrations were generally low[32].

10.5.52 The historical land use at the proposed Shipton CSECs site is recorded to be agricultural, with the exception of an area formerly occupied by allotments in the south of this site. The allotments were removed over 100 years ago, after which their location became farmland.

10.5.53 A groundwater abstraction point is located 175m north of the Order Limits at Newlands Farm (see **Table 10.7**). This abstraction point only has a SPZ1, which extends to 125m from the Order Limits. The licensee is permitted to abstract up to $45m^3$ of groundwater per day from the Sherwood Sandstone for the purpose of agricultural, farming and domestic use.

10.5.54 Groundwater levels recorded on historical borehole logs in the vicinity of the proposed Shipton CSEC site indicate groundwater to be at around 11m bgl, within the superficial deposits.

10.5.55 The area around Overton Substation is generally underlain by the same published geology as the Shipton CSEC site (Sherwood Sandstone, primarily overlain by Alne Glaciolacustrine Formation). Ground investigation undertaken by Socotec in 2022 comprised 3 boreholes to depths of between 17m and 30m. The recorded ground conditions are topsoil to depths of up to 0.9m, overlying the Alne Formation to depths of around 10-17m, in turn overlying deposits of the Vale of York Formation (variable glacial deposits of gravelly sandy clay and sand) to weathered rockhead recorded at 25.5m depth. The weathered rock is recorded to be weathered sandstone of the Sherwood Sandstone. The shallowest groundwater strikes were recorded at around 5-6m depth.

10.5.56 Two soil samples were tested for contamination as part of the Socotec investigation, one from the topsoil and one from the shallow natural superficial deposits (taken at 0.5m depth). These were tested for a similar suite to the samples obtained from the Shipton CSEC site. The sample from the topsoil was also tested for leachable metals, anions (ammoniacal nitrogen, chloride, sulphate, fluoride), free and complex cyanide, and speciated phenols. The recorded contaminant concentrations were low and consistent with what would be expected of natural soils on agricultural land. Free cyanide, speciated phenols and VOC concentrations were recorded to be below laboratory detection limits, no asbestos was recorded, and metals and PAH

[32] Although there are no specific generic assessment criteria available for assessing soil contaminant concentrations for the development and operation of electricity infrastructure, for general context it is noted that all recorded contaminant concentrations are below the Chartered Institute of Environmental Health and Land Quality Management Ltd ‘Suitable for Use Levels’ for any form of public open space or private residential gardens.

concentrations were generally low[32]. Concentrations of leachable contaminants were recorded to be less than UK Drinking Water Standards and Environmental Quality Standards (or within the range of Environmental Quality Standards where they vary depending on the chemical characteristics of the receiving watercourse). The only exception to this is the recorded leachable iron concentration in the natural topsoil (1.98mg/l compared to a drinking water standard of 0.2mg/l).

10.5.57 The following specific aspects of the baseline are highlighted at and around Overton Substation:

- the presence of the following historical land use within the 500m Study Area (although none of this falls within the Order Limits): three sewage works, a quarry (referred to as a 'sand hole'), a gasometer, two gravel pits, a factory, and an unspecified 'works';
- the presence of railway land (the current East Coast Mainline Railway) within the Order Limits;
- the presence of a small area in which the BGS advises that slope instability problems may be present, immediately adjacent to the River Ouse;
- the presence of two historical Category 3 (minor) pollution incidents to land directly adjacent to (outside) the Order Limits:
  - 390m south-west of Overton Substation. This involved the fly tipping of electrical equipment in 2004; and
  - 1.4km south of Overton Substation. This involved the fly tipping of household waste in 2003.

10.5.58 These features are shown on **Figure 10.6**. It is also noted that the Overton Substation site lies within a low radon potential area.

10.5.59 In addition to the pollution incidents to land shown on **Figure 10.6**, there are also numerous historical Category 3 (minor) pollution incidents to water within the 500m Study Area near to the proposed Overton Substation (see **Figure 10.7**). The pollutants involved include oil, fuels and sewage. Whilst these may have affected shallow perched groundwater in the immediate vicinity at the time, the Principal Aquifer is likely to be protected from surface contamination by the low permeability superficial cover, and the incidents were Category 3 and all occurred over 7 years ago.

10.5.60 Publicly available historical borehole records held by the BGS indicate that groundwater levels are at approximately 8m bgl at the proposed Overton Substation.

Tadcaster Area (Section D)

10.5.61 The Tadcaster Area (Section D) is characterised by the presence of an unconfined bedrock Principal Aquifer (limestone and dolostone) which is shown to have sporadic (and commonly absent) superficial cover. This aquifer is abstracted locally for potable purposes and as a result the majority of the 500m Study Area, including most of the land within the Order Limits, at the Tadcaster Area (Section D) falls within either SPZ2 or SPZ3. Small areas are also within SPZ1, as shown on **Figure 10.4, Document 5.4.10.**

10.5.62 There is one private water abstraction within close proximity of the Order Limits, , at Brick House Farm (as previously noted in **Table 10.7**), located approximately 150m north-east of existing pylon XC481.

10.5.63 Borehole scans are available from the BGS from ground investigations undertaken during the construction of the A64, which crosses the Order Limits in an east-west orientation within the Tadcaster Area (Section D). Whilst there is a very large number of scans, random selection of several indicates that these generally found a thin layer of silty clay (for example, around 1-3m thick) with limestone fragments, overlying limestone deposits. The limestone is recorded to contain clay/silt infilled joints in its upper part and thin marl bands. In some cases, the silty clay layer is recorded to be absent and topsoil is directly underlain by rock.

10.5.64 Groundwater level data from the water abstraction borehole at Brick House Farm (recorded by the Environment Agency and available through the BGS online borehole scans service) indicates that, between the period 1979 and 2005, groundwater levels in this borehole were between approximately 37m and 44m bgl[33], which is between 9m and 16m above ordnance datum.

10.5.65 In addition to the general WFD status of the aquifer (Poor), groundwater quality data is available from the Environment Agency's WIMS service. The closest WIMS data point to the Tadcaster Area (Section D) is located at the Coors Breweries abstractions referred to in **Table 10.7**. A review of the recent WIMS data indicates that the groundwater has a hardness, conductivity and pH consistent with expectations for groundwater in carbonate aquifers. Contaminant levels generally appear to be relatively low, although it is noted that traces of trihalomethanes and the herbicide atrazine are consistently recorded, with the most recently recorded concentration of trihalomethanes (2022) being 0.76µg/l and the most recently recorded concentration of atrazine (2022) being 0.0087µg/l.

10.5.66 Historical land use features of potential relevance to land contamination assessments within the Tadcaster Area (Section D) include a relatively high intensity of historical quarrying. The extent of the recorded quarrying activities, and other previous land uses identified from a review of historical mapping, are shown on **Figure 10.10, Document 5.4.10** (with groundwater abstractions and selected proposed infrastructure elements shown for context).

10.5.67 Jackdaw Crag Quarry is present within the 500m Study Area, directly adjacent to (but outside) the Order Limits, 100m south of existing pylon XC481. This quarry is currently operational and the BGS records the presence of 'artificial ground' at and around it.

Monk Fryston Area (Section F)

10.5.68 The mapped solid geology within the 500m Study Area at the Monk Fryston Area primarily consists of Permian limestones and dolostones, with calcareous mudstones recorded to sub-crop in small areas in the north (to the north of existing pylon XC521) and east (to the east of the proposed Monk Fryston Substation). A mapped fault runs south-west to north-east across the north-west corner of the existing Monk Fryston Substation site. The superficial geology primarily consists of deposits of the Harrogate Till Formation. This superficial cover is sporadic within the 500m Study Area, but generally present within the Order Limits (see **Figure 10.2, Document 5.4.10**). Historical borehole scans available from the BGS from a location 340m west of existing

[33] For the source record, see: British Geological Survey (1979). BGS ID: 12826549 : BGS Reference: SE44SE402
British National Grid (27700) : 446450,441770. [online] Available at: [redacted] [Accessed 28 June 2022].

pylon XC522T (at Lumby Garden Centre) indicate the superficial cover in this location to consist of 7-8m of “clay and stones”, overlying limestone.

10.5.69 The limestones/dolostones are classified as a Principal Aquifer. There are no SPZs within the 500m Study Area, but there are a number of water abstractions without SPZs (either private water abstractions, or licensed abstractions with no potable use), which are described in **Table 10.7**.

10.5.70 Groundwater within the limestone/dolostone Principal Aquifer is recorded to be at approximately 30m bgl in the general vicinity, based on publicly available borehole logs held by the BGS[34].

10.5.71 There are a large number of recorded historical pollution incidents within the Order Limits in the north-west of the Monk Fryston Area (Section F), at the site of Pollums House Farm. These relate to unauthorised waste activities involving biodegradable waste and most occurred in either 2004 or 2005. These incidents are recorded to have had no impact on water but are designated as Category 2 (significant) or Category 3 (minor) in relation to land. The corrective/closure measures taken in relation to these incidents are not known, although all are noted to be ‘closed’ by the Environment Agency. These incidents were located approximately 300m east of three water abstractions at/near Lumby Garden Centre. The positions of the pollution incidents and the water abstractions are shown on **Figure 10.9, Document 5.4.10.**

10.5.72 There is also one recorded Category 1 (major) pollution incident in relation to land within the Monk Fryston Area (Section F). This took place 200m south of the existing Monk Fryston Substation in 2004 and relates to unauthorised waste activities involving tyres.

10.5.73 Similar to the Tadcaster Area (Section D), the Monk Fryston Area (Section F) appears to have a history of limestone quarrying. The locations of former quarries identified from a review of historical mapping, together with any other potential contaminative land uses identified from this review, are shown on **Figure 10.3, Document 5.4.10** (Sheet 6) (this includes the existing Monk Fryston Substation, which is recorded to be underlain by Made Ground). There are a total of 16 former quarries within the 500m Study Area at Monk Fryston, one of which is within the Order Limits (approximately 650m south east of the existing Monk Fryston Substation). Three of the quarries are recorded to have been used as landfills, as shown on **Figure 10.3, Document 5.4.10** (Sheet 6) (Mile Gap Quarry, Betteras Hill Quarry and Lodge Quarry, as listed previously in the ‘route wide’ description of landfills). These do not include the former quarry that intersects the Order Limits.

10.5.74 The proposed Monk Fryston Substation site (immediately adjacent to the east of the existing Monk Fryston Substation) is occupied by agricultural fields, but contains two earth bunds, one in the south-east of the site and one in the north. The south-western bund is around 6-7m in height and the northern bund around 3-4m in height. Ground investigation was undertaken by Socotec in 2022 on the bunds (4 hand dug pits to 1.2m depth) and in the remainder of the proposed substation site (2 boreholes to 20m depth), as well one borehole to 20m depth in the field that adjoins the south-east of the proposed substation site. The upper part of the northern bund, to 1.2m depth, was recorded to consist of cohesive Made Ground (sandy gravelly clay) with gravel of brick and limestone and cobbles of concrete. The upper part of the southern bund, to 1.2m depth, was found to contain similar material, but also containing fragments of glass, mudstone, siltstone and occasional wood. The ground conditions outside the bunds were recorded to comprise Made Ground/topsoil to around 0.3-0.6m depth (gravelly

[34] British Geological Survey (2021). *Geoindex Onshore*. [online]

sandy clay with rootlets and non-natural inclusions of gravel sized brick fragments), overlying cohesive natural superficial deposits of the Harrogate Till Formation to 3.7-6.4m depth. Rock was encountered at the base of the Harrogate Till. This was recorded to be limestone of the Brotherton Formation in the two boreholes within the proposed substation site and weathered mudstone (Roxby Formation) overlying limestone of the Brotherton Formation in the borehole located in the field adjacent to the south-east of the proposed substation site.

10.5.75 Perched groundwater strikes were recorded within the Harrogate Till at depths of 3.5-4.4m. Groundwater entries were not encountered during drilling within the limestone.

10.5.76 The Socotec ground investigation included testing of the following soil samples for contamination: two samples from the south-western bund, one sample from the northern bund, three samples from the area outside the bunds but still within the proposed substation site (two of which were from topsoil Made Ground and one from natural superficial deposits), and one sample from natural superficial deposits from the field adjacent to the south-east of the proposed substation site. All samples were tested for a suite of contaminants including metals, free cyanide, speciated phenols, speciated PAH, speciated TPH, BTEX, asbestos and VOC. The three samples from the area outside the bunds were also tested for polychlorinated biphenyls (PCBs). In addition, two of these samples as well as the three samples from the bunds were tested for leachable metals, anions (ammoniacal nitrogen, chloride, sulphate, fluoride), free and complex cyanide, and speciated phenols.

10.5.77 The contamination testing results record concentrations of VOC, free cyanide, speciated phenols, PCBs and BTEX to be below laboratory detection limits in the soils tested. Asbestos was not recorded in any of the seven samples. Concentrations of PAHs, speciated TPH and metals were all found to be low[35]. Concentrations of leachable contaminants were recorded to be less than UK Drinking Water Standards and Environmental Quality Standards (or within the range of Environmental Quality Standards where they vary depending on the chemical characteristics of the receiving watercourse). The only exception to this is one sample of topsoil Made Ground from the area outside the bunds (but still within the Order Limits), which recorded leachable iron at a concentration of 7.8mg/l (compared to a drinking water standard of 0.2mg/l).

10.5.78 The existing Monk Fryston Substation site (adjacent to the proposed new substation site) is known to contain asbestos containing materials. These are within cable wrap and other equipment, rather than within the soil, and would not be disturbed by the construction or operation of the Project.

10.5.79 Several small areas mapped by the BGS as potentially being affected by slope instability are present within the 250m Study Area at Monk Fryston. These are all outside the Order Limits.

10.5.80 The proposed Monk Fryston Substation is in a location in which there is elevated radon potential, being situated in a 1km x 1km grid square in which Public Health England (UK radon)[24] report that 1-3% of homes exceed the radon Action Level (200Bq/m^3).

[35] Although there are no specific generic assessment criteria available for assessing soil contaminant concentrations for the development and operation of electricity infrastructure, for general context it is noted that all recorded contaminant concentrations are below the Chartered Institute of Environmental Health and Land Quality Management Ltd ‘Suitable for Use Levels’ for any form of public open space or private residential gardens.

Future baseline

10.5.81 To assess the potential effects of the Project, it is necessary to predict how those conditions observed and recorded at the time of baseline data collection could change prior to the commencement of construction and during the Project's operational lifespan.

10.5.82 It is currently anticipated that construction would run from 2024 to 2028. Prior to and during that period, and for the operational lifespan of the Project (assumed to be 80 years), ground conditions in relation to geology or land contamination would not be expected to change substantively, assuming that any future activities would be permitted/controlled in accordance with current contaminated land legislation.

10.5.83 Hydrogeological conditions are more prone to change, and may be affected by the following:

- future provision of housing development – an increase in housing in the region has the potential to affect recharge to the aquifers and the demand for drinking water, which could affect future water resources and groundwater levels in aquifers;
- changes in the water supply and waste water infrastructure – leaking waste water infrastructure represents a potential diffuse source of nutrients (nitrogen and phosphorus), other contaminants (for example, heavy metals) and coliform bacteria to groundwater; and
- climate change – changes in rainfall may affect aquifer recharge, groundwater levels and flow gradients.

10.5.84 However, given the nature of the Project, it is not considered that any change in the baseline resulting from these factors would be likely to have a meaningful influence on the assessment of effects.

10.6 Embedded environmental measures

10.6.1 A range of environmental measures have been embedded into the Project and included in the **Embedded Measures Schedule, Appendix 3.3.3A, Document 5.3.3, volume 5**. **Table 10.9**, which outlines how these embedded measures will influence the Geology and Hydrogeology assessment. These measures accord with standard good construction practice.

Table 10.9 – Summary of the embedded environmental measures relevant to the Geology and Hydrogeology assessment

Receptor	Potential changes and effects	Embedded measures	Compliance mechanism
Construction			
Construction workers	Harm to human health resulting from exposure to contaminants or gases in the ground.	Compliance with relevant health and safety legislation, including measures specific to the risks of land contamination and ground gas. This will include the use of appropriate Personal Protective Equipment (PPE) and statutory health and safety compliance	CoCP (**Document 5.3.3B**) secured via DCO Requirement 5

Receptor	Potential changes and effects	Embedded measures	Compliance mechanism
		(for example, compliance with the Confined Spaces Regulations 1997[36] in relation to ground gas risks from working in trenches), to minimise the potential risks associated with encountering expected and/or unexpected contamination or ground gas. This embedded measure will include compliance with The Control of Asbestos Regulations 2012[37], CAR-SOIL 2012[38], and CIRIA 773[39], which will ensure that any unexpected asbestos finds are identified, assessed and dealt with correctly.	
Construction workers, adjacent site users, groundwater (aquifers)	Inadvertent exposure to contaminants in the ground, or release of contaminants from the ground to an aquifer due to unexpected ground conditions during construction.	Ground investigation and testing to be undertaken prior to construction to verify the anticipated ground conditions and minimise the risk, where further detail is needed[40]. Contingency procedures in the event that unexpected contamination is encountered during construction ('stop protocol', testing, risk assessment). Dust suppression and stockpile management (for example, sheeting) as necessary to minimise airborne emissions and/or leachate generation from soils affected by contamination, to be incorporated into the Dust Management Plan that is referred to in **Chapter 13: Air Quality**.	CoCP (**Document 5.3.3B**) secured via DCO Requirement 5 and Requirement 12 (draft DCO, **Volume 3, Document 3.1**).

[36] UK Government (1997). *The Confined Spaces Regulations 1997 (SI 1997/1713)*. [online] Available at https://www.legislation.gov.uk/uksi/1997/1713/contents/made [Accessed July 2021].
[37] UK Government (2012). *The Control of Asbestos Regulations 2012 (SI 2012/632). [online]* Available at https://www.legislation.gov.uk/uksi/2012/632/contents/made [Accessed August 2021].
[38] CL:AIRE (2016). Control of Asbestos Regulations 2012 Interpretation for Managing and Working with Asbestos in Soils in Construction and Demolition Materials.
[39] CIRIA (2014). Asbestos in soil and made ground: a guide to understanding and managing risks. CIRIA; London.
[40] Prior to construction commencing, it will be necessary to undertake ground investigations for both engineering and geo-environmental purposes. For most of the Order Limits, the ES has been produced in advance of the completion of this work, in accordance with the approach established through scoping. In areas where ground investigation information is already available, this has been considered in the preparation of this Chapter.

Receptor	Potential changes and effects	Embedded measures	Compliance mechanism
Groundwater	Deterioration of groundwater quality due to discharges from the Project (for example, water pumped from excavations during construction).	All discharges to be undertaken under best practice requirements, with appropriate pre-treatment (for example, de-silting) where required.	CoCP (**Document 5.3.3B**) secured via DCO Requirement 5.
Construction workers, groundwater (aquifers)	Contamination of groundwater, or harm to human health, resulting from the leakage or incorrect handling or storage of fuels and chemicals.	Correct environmental management, handling and storage of fuels and chemicals (for example, compliance with The Control of Pollution (Oil Storage) Regulations 2001[41] and Environment Agency guidance 'Protect groundwater and prevent groundwater pollution'[42]. Use of oil-water separators as necessary (for example, for drainage from refuelling areas). Collection of process water from the washout/cleaning of ready-mix concrete vehicles and equipment for treatment/disposal. Appropriate training of construction workers in the use and handling of chemicals. General construction site good environmental and waste management procedures (for example, regular vehicle checks, use of spill kits, correct waste storage and disposal).	CocP (**Document 5.3.3B**) secured via DCO Requirement 5.
Groundwater in SPZs	Contamination of potable water supplies.	Vehicle parking, fuel storage, de-icer storage, rock salt storage, and washout/cleaning of ready-mix concrete vehicles and equipment to be sited outside SPZ1, and outside SPZ2 where possible.	CoCP (**Document 5.3.3B**) secured via DCO Requirement 5.

[41] *Control of Pollution (Oil Storage) Regulations 2001 (SI 2001/2954)*. Available at https://www.legislation.gov.uk/uksi/2001/2954/contents/made (Accessed July 2021)
[42] Environment Agency (2017). *Protect groundwater and prevent groundwater pollution*. Available at https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwater-pollution/protect-groundwater-and-prevent-groundwater-pollution (Accessed July 2021)

Receptor	Potential changes and effects	Embedded measures	Compliance mechanism
		Application of salt grit (for example, to prevent access tracks freezing) to comply with recommended rates in CIRIA 648[21], with control of run-off during any application in SPZs.	
Groundwater	Contamination of groundwater due to piling activities.	Consideration of pile type (for example, driven versus bored) to minimise pollution risks. All piling activities to be conducted in line with a risk assessment prepared in accordance with Environment Agency guidance NC/99/73[43] and 'Piling into contaminated sites'[44].	CoCP (**Document 5.3.3B**) secured via DCO Requirement 5.
Operation			
Future maintenance workers, future land users (for example, once temporary land take is returned to other uses, such as agriculture), groundwater (aquifers)	Harm to human health or groundwater from herbicides, should vegetation control be required as part of operational maintenance. Harm to human health resulting from exposure to contaminants or gases in the ground.	Herbicides to be used in accordance with DEFRA Code of Practice for Using Plant Protection Products[45] and the Pant Protection Products (Sustainable Use) Regulations 2012[46]. Compliance with relevant health and safety legislation, including measures specific to the risks of land contamination and ground gas. This will include the use of appropriate PPE and statutory health and safety compliance (for example, compliance with the Confined Spaces Regulations 1997[36] in relation to ground gas risks from working in trenches), to minimise the potential risks associated with encountering expected and/or unexpected contamination or ground gas.	Appointed contractor Risk Assessment Method Statement(s)
Future maintenance	Harm to human health from	During the construction phase, all earthworks or material movements will be	CoCP (**Document**

[43] Environment Agency, (1999). *REP NC/99/73 Piling and penetrative ground improvement methods on land affected by contamination: guidance on pollution prevention*.
[44] Environment Agency (2002). *Piling into contaminated sites*. Environment Agency; Bristol.
[45] DEFRA, the Health and Safety Commission (HSC) and the National Assembly for Wales Environment, Planning and Countryside Department. (2006). *Code of Practice for Using Plant Protection Products*. [online] Available at: https://www.hse.gov.uk/pesticides/using-pesticides/codes-of-practice/code-of-practice-for-using-plant-protection-products.htm [Accessed 28 June 2022].
[46] *The Plant Protection Products (Sustainable Use) Regulations 2012 (SI 2012/1657*. [online] https://www.legislation.gov.uk/uksi/2012/1657/pdfs/uksi_20121657_en.pdf . [Accessed July 2022].

Receptor	Potential changes and effects	Embedded measures	Compliance mechanism
workers, future land users (for example, once temporary land take is returned to other uses, such as agriculture), groundwater (aquifers)	exposure to legacy ground contamination that has arisen from the Project, or the long-term release of such contamination to aquifers.	conducted under appropriate environmental permits, exemptions or in accordance with CL:AIRE 'The Definition of Waste: Development Industry Code of Practice'[47], which will ensure proper control on the chemical suitability of these materials.	**5.3.3B**) secured via DCO Requirement 5. Whilst this is an operational phase effect, the measures to prevent it should take place during the construction phase (to prevent legacy contamination occurring).

10.6.2 For the purpose of the assessment, it will be assumed that the detailed engineering design for the new infrastructure and structures that would be built as part of the Project would incorporate suitable consideration of ground instability risks and of any risks that may exist from chemically aggressive ground conditions, such that the new infrastructure and structures are not susceptible to significant effects resulting from ground instability or chemical damage of concrete. This is a fundamental engineering requirement and will be considered equivalent to an embedded environmental measure and incorporated into the CoCP (that is, an 'embedded engineering measure').

10.7 Scope of the assessment

The Project

10.7.1 All construction phase elements of the Project have been scoped into the assessment. However, the assessment is primarily focussed on those that will involve notable ground disturbance or fuel/chemical storage areas, specifically: new underground cables, substation construction, CSECs, construction compounds, and the installation of foundations for new pylons.

10.7.2 The operational phase involves the presence, operation and maintenance of the proposed infrastructure. In itself, the presence of the infrastructure has the potential to affect hydrogeology through the presence of impermeable surfaces and potential effects on groundwater flow pathways, so is considered in the assessment in this regard. Additionally, the following operational phase aspects may involve ground disturbance and/or the potential for exposure to ground gas, so are considered in the assessment:

- operational maintenance (possibility of sporadic ground disturbance for repairs or inspections);

[47] CL: AIRE, (2011). *The Definition of Waste: Development Industry Code of Practic*e. [online] Available at: [redacted] [Accessed 28 June 2022].

- operational access to new buildings, such as occasional manual access to substations (potential for exposure to ground gases, should these accumulate in indoor spaces);
- future land use within the Order Limits during the operational phase (for example, potential health risks if soils containing elevated contaminant levels were excavated during construction and then redeposited at shallow depths in areas of temporary land take that were then returned to agricultural use prior to the operational phase); and
- changes to infiltration and drainage resulting from the presence of new infrastructure.

10.7.3 The Project is expected to have a life span of approximately 80 years. If decommissioning is required at this point in time, then activities and effects associated with the decommissioning phase are expected to be of a similar or lesser level to those during the construction phase works, with a lesser duration of two years. Therefore, the likely significance of effects relating to the construction phase assessment will be applicable on a conservative basis to the decommissioning phase and decommissioning effects are not discussed further in this chapter.

10.7.4 The following potential effects are scoped out of the assessment:

- dewatering effects within the operational phase, as there would be no dewatering during this phase;
- ground instability effects on proposed structures. As previously explained, these are considered matters of engineering design;
- risk of damage to structures from vibrations caused by piling. This potential effect is assessed in **Chapter 14: Noise and Vibration, Document 5.2.14, Volume 5**;
- ground instability effects relating to historical coal mining (based on the coal mining setting within the Order Limits, and agreed with the Coal Authority); and
- effects on designated geological conservation sites, due to the absence of potential receptors.

Spatial scope

10.7.5 The spatial scope of the assessment of geology and hydrogeology effects covers the area of the Project contained within the Order Limits, together with the 250m/500m Zones of Influence (ZoIs) that have formed the basis of the Study Areas described in **Section 10.4**.

10.7.6 The Study Areas for the purpose of baseline data collection are set at 250m and 500m. However, when assessing the potential effects on receptors, the spatial scope is also relevant to each assessment. For example, effects on construction workers are only relevant within the Order Limits, whereas effects on groundwater receptors are relevant to the full 500m Study Area extent. This is described further, where necessary, within the assessments of likely significant effects in **Section 10.9**.

Temporal scope

10.7.7 The temporal scope of the assessment of geology and hydrogeology is consistent with the period over which the Project would be carried out, and therefore covers the period 2024 to 2028 (for construction) and thereafter (for operation). The duration of the

operational phase is not relevant to the assessment of effects in relation to geology and hydrogeology, so is considered on an indefinite basis.

Potential receptors

10.7.8 The principal geology and hydrogeology receptors that have been identified as being potentially subject to effects are summarised in **Table 10.10**.

Table 10.10 – Geology and hydrogeology receptors subject to potential effects

Receptor	Reason for consideration
Groundwater in aquifers	In accordance with the legislation, policy and guidance described in **Section 10.2**, designated aquifers should be considered receptors in relation to groundwater quality and quantity. As described in **Section 10.4**, the 500m Study Area contains various aquifers, including large sections underlain by Principal Aquifers (sandstone and limestone/dolostone).
Abstracted groundwater	Used for potable and other human uses (for example, irrigation). This is a relevant receptor in relation to groundwater quality and quantity. SPZs around groundwater abstractions are present at several locations within the 500m Study Area (as described in **Section 10.4**), including within the Order Limits.
Adjacent land users, construction workers and future land users[48]	Defined receptors in relation to potential human health risks from ground contamination and gas, in accordance with the legislation, policy and guidance described in **Section 10.2**.
Soil/land quality, including crops, livestock and landscaping schemes[49]	Defined receptors in accordance with the legislation, policy and guidance described in **Section 10.2**.

[48] Adjacent land users comprise people using land adjacent to active construction locations during the construction of the Project, who could be affected by soil contamination or gas/vapours mobilised by ground disturbance. Future land users include people who will use land that is temporarily used by the Project during construction but is returned to a different use once the project is operational. In both cases (adjacent and future land users), given the nature of the Study Area these are likely to primarily be agricultural workers and recreational users (for example, walkers). Future land users also include any workers involved in operating or maintaining the infrastructure during the operational phase.

[49] Soil and land quality receptors are only relevant to the Geology and Hydrogeology assessment insofar as is relevant to land contamination. Other effects in relation to these receptors fall under **Chapter 11**: **Agriculture and Soils, Document 5.2.11, Volume 5.**

Receptor	Reason for consideration
Existing structures for example, farm buildings and houses	Defined receptors in relation to the potential to be affected by ground gas migration risks, in accordance with the legislation, policy and guidance described in **Section 10.2**. They are also relevant receptors when considering potential ground instability effects.
Proposed structures involving accessible indoor spaces (for example, substations and compounds)	Defined receptors in relation to the potential to be affected by ground gas migration risks, in accordance with the legislation, policy and guidance described in **Section 10.2**.

Likely significant effects

10.7.9 The effects on geology and hydrogeology receptors which have the potential to be significant and have been taken forward for detailed assessment are summarised in **Table 10.11**.

Table 10.11 – Geology and hydrogeology potential effects

Receptor	Likely[1] significant effects
Construction	
Construction workers and adjacent land users (human health)	Harm to human health resulting from exposure to pre-existing soil contamination, including dust and vapours (Effect GH1[50]). The activity that may cause this effect is ground disturbance during construction. Explosion or asphyxiation as a result of ingress and accumulation of ground gas within enclosed spaces, including the risk that construction activities can cause gas migration to adjacent properties (Effect GH6). Construction exacerbating and/or being affected by naturally occurring geological hazards, such as unstable slopes, or by unstable areas of artificial ground, resulting in injury or other harm to health (Effect GH7).
Groundwater bodies (aquifers) and groundwater abstractions	Deterioration in the chemical quality of groundwater, caused by the mobilisation of pre-existing contamination (Effect GH2A). The activity that may cause this effect is ground disturbance during construction. Deterioration in chemical quality of groundwater due to the mobilisation of pre-existing contamination as a result of dewatering (Effect GH2B), for example the dewatering of trenches for new

[50] For consistency with the Scoping Report and Preliminary Environmental Information Report, and ease of reference in **Section 10.9** of this chapter, each potential effect is given a short-hand reference code (GH1, GH2A, GH2B, GH3, GH4, GH5, GH6, GH7, GH8, GH9, and GH10).

Receptor	Likely[1] significant effects
	underground cables, or the dewatering of foundation excavations for new structures. Deterioration in the chemical quality of groundwater due to the release of contamination by activities associated with the Project (for example, loss of fuels to an aquifer) (Effect GH3). Physical effects on groundwater such as depletion of the aquifer and increased solids/turbidity (Effect GH4). The activities that may cause this effect are ground disturbance during construction and/or dewatering. Physical and chemical effects on groundwater as a result of the discharge of groundwater arising from dewatering (Effect GH5).
Land	Deterioration in the chemical quality of land, caused by the mobilisation of pre-existing contamination (Effect GH2A). The activity that may cause this effect is ground disturbance during construction. Deterioration in the chemical quality of land due to the release of contamination by activities associated with the Project (for example, fuel spills) (Effect GH3).
Structures (for example, existing structures and temporary compounds)	Explosion or asphyxiation as a result of ingress and accumulation of ground gas within enclosed spaces, including the risk that construction activities can cause gas migration to adjacent properties (Effect GH6). The activity that may cause this effect is ground disturbance during construction. The risk of gas migration from existing ground gas sources to new enclosed spaces constructed as part of the Project (for example, temporary compounds) also forms part of potential effect GH6. Construction exacerbating and/or being affected by naturally occurring geological hazards, such as unstable slopes, or by unstable areas of artificial ground, resulting in injury or other harm to health (Effect GH7).
Operation	
Future site users (human health)	Exposure to residual soil contamination, for example: if soils containing elevated contaminant levels were excavated during construction and then redeposited at shallow depths in areas of temporary land take that were then returned to agriculture (Effect GH8). Exposure to soil contamination, dust or vapours. The activities that could cause this effect are the disturbance of ground during operational maintenance or the release of contaminants from

Receptor	Likely[1] significant effects
	maintenance activities (for example, herbicides if vegetation clearance is required for maintenance) (Effect GH9). Accumulation of ground gas within permanent structures, resulting in asphyxiation of occupants or explosion (Effect GH10) during periods of manual access to operate/maintain the infrastructure (for example, substations).
Groundwater bodies (aquifers) and groundwater abstractions	Changes to infiltration and effects on groundwater levels or quality as a result of the presence of new structures and surfaces (GH11).
Structures (for example, new substations)	Accumulation of ground gas within permanent structures, resulting in explosion (Effect GH10). This could occur if substations were to be sited on or near to gas generating land, without suitable gas barriers and sub-ventilation within the structure.

[1] In the context of this chapter, "likely significant effects" means potential risks that are not scoped out and require assessment. It does not imply any specific probability of an effect occurring. In accordance with topic-specific guidance and the assessment methodology provided in **Section 10.8**, the probability of an effect occurring is considered when assessing that effect, in **Section 10.9**.

10.8 Assessment methodology

10.8.1 The generic Project-wide approach to the assessment methodology is set out in **Chapter 4: Approach to Preparing the ES, Document 5.2.4, Volume 5**. However, whilst this has informed the approach that has been used in this geology and hydrogeology assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this geology and hydrogeology assessment.

10.8.2 The information regarding baseline conditions will be considered in the context of the Project (for example, the proposed infrastructure locations and proposed construction methods) to identify potential source-pathway-receptor linkages and inform a risk-based assessment of the effects of the Project. This approach accords with published guidance (for example, LCRM[51]), and will be transposed into an EIA classification as follows:

- For each potential effect, the receptor sensitivity and magnitude of effect will be assigned using **Table 10.12** and **Table 10.13**, which will then be combined to give an output using

[51] Environment Agency, (2020). *Land Contamination: risk management*. [online] Available at: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm [Accessed June 2021].

- Table 10.14.
- This output will then be adjusted for the probability of the effect occurring, to provide an overall assessment of significance (using **Table 10.15**).

10.8.3 This approach integrates the requirements from legislation and guidance for Geology and Hydrogeology effects to be assessed via a risk-based approach into the EIA methodology, and is an application of the methodology provided within CIRIA C552[19], which recommends considering potential effects as a function of 'consequence' (effectively the output of

10.8.5 Table 10.14) and the probability of the effect occurring (as achieved by **Table 10.15**).

10.8.6 The output of the assessment will be the level of effect determined from **Table 10.15**. This will classify each potential effect as either negligible, minor, moderate or major. However, it should be noted that the output of the assessment is a risk classification, rather than a predicted effect. For example, minor 'effects' in relation to health risks from exposure to soil contamination would reflect an assessment that there is a minor (not significant) risk of adverse health effects, rather than indicating that there is a predicted adverse effect that would be of a minor nature.

10.8.7 Where the outcome of the assessment is a moderate or major risk, then the effect (risk) will be considered significant, and mitigation would be required. Where the outcome is a minor or negligible risk, then the effect (risk) will be considered not significant, and mitigation would not ordinarily be required.

10.8.8 The potential effects will be assessed for both the construction and operational phases of the Project.

Table 10.12 - Receptor sensitivity

Sensitivity	Land contamination and ground instability criteria	Hydrogeological criteria
High	Human health risk, where receptor characteristics promote exposure and/or vulnerability to soil contamination or ground gas. Structures of high susceptibility to ground instability and/or high importance.	Groundwater that is used for human consumption, and/or is within geological units that display a high level of water storage and may support water supply and/or river base flow on a strategic scale. Includes all Principal Aquifers and SPZs.
Medium	Human health risk, where receptor characteristics limit exposure and/or vulnerability to soil contamination and ground gas. Soil/land: crops, livestock or plants in managed planting/landscaping schemes. Agricultural assets whose quality may be affected by exposure to contamination. Structures of medium susceptibility to ground instability and/or medium importance.	Groundwater that is not currently used for human consumption, but which is within Secondary Aquifers that display generally good chemical quality (for example, WFD Good chemical status) and/or groundwater quantities. Groundwater that is currently used for agricultural purposes (for example, field irrigation).
Low	Human health risk, where receptor characteristics significantly minimise exposure	Groundwater that is not currently used for human consumption and is within Secondary Aquifers that display poor chemical quality

Sensitivity	Land contamination and ground instability criteria	Hydrogeological criteria
	and/or vulnerability to soil contamination and ground gas. Structures of low susceptibility to ground instability and low importance.	(for example, WFD Poor chemical status) and groundwater quantities. Groundwater that is abstracted for low sensitivity industrial purposes (for example, cooling water).
Negligible	Land/soil: Phytotoxic effects on non-agricultural plants that are not part of managed planting/landscaping schemes.	Groundwater that does not contribute meaningfully towards river base flow and is not used, and does not have a potential to be used, for drinking water supply.

Table 10.13 - Magnitude of effect

Magnitude	Land contamination and ground instability criteria	Hydrogeological criteria
High	Short-term (acute) risk to human health. Ground instability resulting in direct harm to health (for example, severe injury or death), and/or resulting in severe structural damage to, or immediate collapse of, buildings or infrastructure.	Release of Priority Hazardous Substances or substances regulated under The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015[52] or the Water Supply (Water Quality) Regulations 2016 (**Table 10.1**) at concentrations that may present a direct/imminent risk to abstractions. Physical or chemical effects on an aquifer (such as changes in groundwater levels, flows or quality) that substantively restrict its viability as an abstractable resource and/or its WFD status.
Medium	Long-term (chronic) risk to human health. Death or major health effects on livestock or significant direct damage to crops or plants in a managed planting/landscaping	Release of Priority Hazardous Substances or substances regulated under The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015[52] of

[52] UK Government (2015). *The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.* [online] Available at https://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksiod_20151623_en_003.pdf [Accessed 28 June 2022].

Magnitude	Land contamination and ground instability criteria	Hydrogeological criteria
	scheme that is directly attributable to soil contamination. Ground instability that may cause structural damage gradually over time.	the Water Supply (Water Quality) Regulations 2018 (**Table 10.1**) at concentrations that exceed regulatory compliance criteria and may lead to substantial localised degradation in groundwater quality, but not present a direct/imminent risk to abstractions. Physical or chemical effects on an aquifer (such as changes in groundwater levels, flows or quality) that limit its effectiveness as a resource and may affect its status.
Low	Minor damage to crops or plants in a managed planting/landscaping scheme that is directly attributable to soil contamination.	Release of Priority Hazardous Substances or substances regulated under The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015[52] of the Water Supply (Water Quality) Regulations 2018 (**Table 10.1**) at concentrations that may lead to minor localised degradation in groundwater quality but have no significant potential to present a risk to abstractions. Reduction of groundwater levels/quantities or changes in groundwater flows, but with little effect on the use or status of the groundwater resource.
Negligible	No significant potential for adverse human health effects. No damage to crops, livestock or plants. No damage to structures from ground instability.	No/minimal measurable effect on groundwater levels, quantities, flows or chemical quality, or on the use or status of a groundwater resource.

Table 10.14 - Matrix to determine the level of effect on receptors (unadjusted for probability)

		Magnitude of Effect			
		High	**Medium**	**Low**	**Negligible**
Receptor Sensitivity	**High**	Major	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

Table 10.15 - Matrix to determine the level of effect (adjusted for probability)

		Probability of Effect Occurring [a]			
		High	**Medium**	**Low**	**Negligible**
Unadjusted Level of Effect (from Table 10.8)	**Major**	Major (Significant)	Major (Significant)	Moderate (Significant)	Negligible (Not significant)
	Moderate	Major (Significant)	Moderate (Significant)	Minor (Not significant)	Negligible (Not significant)
	Minor	Moderate (Significant)	Minor (Not significant)	Minor (Not significant)	Negligible (Not significant)
	Negligible	Negligible (Not Significant)	Negligible (Not significant)	Negligible (Not significant)	Negligible (Not significant)

[a] The probability assessment will be based on professional judgement and consideration of the specific circumstances relevant to the effect i.e. the nature of the source-pathway-receptor linkage and the likelihood of a significant risk to human health or any other relevant receptor.

Water Framework Directive (WFD) Assessment

10.8.9 The assessment provided in this chapter is also supported by a standalone WFD assessment in relation to hydrogeological receptors (hydrological receptors are covered as part of **Chapter 9: Hydrology, Document 5.4.9, Volume 5**). This approach is as specified in the Scoping Report. The WFD assessment is provided in **Appendix 5.3.10D, Document 5.3.10, Volume 5** and is consistent with and complementary to the assessment of hydrogeological effects provided in **Section 10.9**.

10.9 Assessment of geology and hydrogeology effects

Human health receptors (construction phase)

10.9.1 The human health receptors during the construction phase comprise construction workers and users of land adjacent to and within the Order Limits (for example, farm workers and recreational walkers). The potential effects in relation to these receptors are:

- harm to health resulting from the exposure to pre-existing soil contamination, including dust and vapours (Effect GH1); and
- harm to human health due to explosion or asphyxiation resulting from the ingress and accumulation of ground gas, including the risk that construction activities can cause gas migration to adjacent properties (Effect GH6).

10.9.2 In accordance with **Table 10.12**, these receptors are classified as having a **high** sensitivity.

Effect GH1: harm to health resulting from the exposure to pre-existing soil contamination, including dust and vapours

10.9.3 For Effect GH1 to occur, the Project would need to involve ground disturbance in locations affected by historical soil contamination. In most cases, the former use of land within the Order Limits is recorded to be entirely agricultural.

10.9.4 Agricultural land presents a relatively low contamination risk. However, the potential for contamination associated with historical agricultural activities still requires consideration. Potentially contaminative agricultural practices include the use and storage of fuels, the application of soil improvement agents (in some historical cases, these included sewage sludge and industrial by-products) and the use of pesticides/herbicides. They can also include burning, with the resulting ash potentially containing elevated contaminant concentrations (for example, heavy metals and polycyclic aromatic hydrocarbons). Unrecorded infilling of ponds and 'low points' can also be associated with historical agricultural land use. These risks are evident from the walkover inspections reported in **Appendix 10A, Document 5.3.10**; for example, evidence of localised tipping, previous burning and infilled ponds. It should be noted that none of these specific observations were in locations where the Project will involve ground disturbance.

10.9.5 Where the Project involves ground disturbance on land whose only former use is agricultural, the potential magnitude of effect from soil contamination resulting from agricultural land use is classified as **high** (for example, risk of unexpected contaminants, such as caches of old buried asbestos, that may present an acute health risk).

10.9.6 There is a low likelihood of such contamination being encountered during the construction of the Project. This is because agricultural land is typically underlain by uncontaminated natural soils, with any contamination typically small scale and localised. The Project will involve excavating relatively small areas of land, so the likelihood of encountering soil contamination is **low**.

10.9.7 Furthermore, embedded environmental measures (see **Table 10.9**) will mean that even in the unlikely event that localised contamination is identified in areas of proposed ground disturbance, it would not be expected to present a health risk to construction workers or adjacent land users. This is because all work will be done with the benefit of appropriate pre-construction (post-consent) ground investigations and under a suitable

'stop protocol' should unexpected/suspicious ground conditions be encountered, with precautionary appropriate PPE used for all work that involves ground disturbance, and good practice environmental dust control measures adopted throughout the works. Therefore, the probability criterion for Effect GH1 from construction work on land which is recorded to only have a former agricultural use is **negligible**. This results in an effect which is classified as negligible and **Not Significant**.

10.9.8 There are limited areas within the Order Limits where the recorded former land use is not entirely agricultural, and industrial land uses are recorded (see **Figure 10.3** (Sheets 1 to 7)). Outside of the three Focus Areas, these areas generally consist of moderate to low risk potentially contaminative uses, such as quarries and railway land (running lines; not depots or yards). Due to the minimal ground disturbance associated with the proposed construction works outside the Focus Areas, and limited/sporadic extent of historical non-agricultural land, it is considered that the assessment provided above in relation to agricultural land remains generally applicable i.e. with suitable embedded measures (see **Table 10.9**), Effect GH1 will be **negligible** and **Not Significant**.

10.9.9 Within the three Focus Areas, the proposed construction activities will involve greater ground disturbance, including the elements listed in **Table 10.16**. The potential for Effect GH1 at each of these Focus Areas is assessed in turn in the text following **Table 10.16**.

Table 10.16 - Proposed construction elements within the Focus Areas

Focus Area	Proposed construction activities[1]
North-west of York Area (Section B) (refer **Figure 3.2, Document 5.4.3**)	Shipton CSEC site (1.2km north-west of Shipton by Beningbrough): New 400kV underground cable (approximately 230m length), two CSECs, two construction compounds, new 400kV pylons (permanent), temporary structures, removal of pylons and modification of existing pylons. Various associated works, such as overhead line stringing, access tracks and scaffolds. Overton Substation: Proposed substation. Two construction compounds, and various associated works (such as access tracks and overhead works). Other land in the North-west of York Area: Construction of new permanent 400kV/275kV pylons, generally spaced at approximately 360m intervals. Removal of existing pylons, and construction of a temporary diversion. Various associated works, such as overhead line stringing, access tracks and scaffolds.
Tadcaster Area (Section D) (refer **Figure 3.4, Document 5.4.3**)	New 400kV underground cable (approximately 350m length), two cable sealing end compounds, one new pylon (permanent), two new temporary structures, one construction compound. Various associated works, such as overhead line stringing, access tracks, scaffolds, and the modification of existing pylons.
Monk Fryston Area (Section F) (refer **Figure 3.6, Document 5.4.3**)	Proposed substation and connecting gantries, five new permanent 275kV pylons, gantry connections to the substation, two new temporary structures. Various associated works, such as the

Focus Area	Proposed construction activities[1]
	removal of existing pylons, overhead line stringing, access tracks, scaffolds, and the modification of existing pylons.

[1] This is not intended to provide full detail on proposed construction activities, particularly where the degree of ground disturbance will be minimal (e.g. overhead works). For further and full details of the proposed construction activities, see **Chapter 3: Description of the Project, Document 5.2.3** and associated figures.

10.9.10 Within the North-west of York Area (Section B), there are small areas of recorded former industrial land use. However, these do not intersect the Order Limits in locations where construction activities require ground disturbance. An area of allotments was present over 100 years ago in the location of a proposed construction compound 240m south of existing pylon YR040T, but this is not considered likely to present a source of residual ground contamination over and above the general risk associated with agricultural land. The walkover observations reported in **Appendix 5.3.10A, Document 5.3.10, Volume 5** from this area are consistent with this assessment, as is the contamination testing data from ground investigations at the Shipton CSECs site and Overton Substation site (**Appendix 5.3.10E, Document 5.3.10, Volume 5**).

10.9.11 Within the Tadcaster Area (Section D), the proposed location of a section of the new 275kV underground cable, and part of the footprint of the eastern CSEC associated with this cable, are located on part of a backfilled former quarry. This configuration is shown on **Figure 10.10, Document 5.4.10, Volume 5**.

10.9.12 The section of the former quarry that intersects the proposed underground cable route and CSEC appears, based on historical mapping, to have been backfilled at some time between 1965 and 1989 (although parts of the quarry to the south of the A64 remain open/operational). The presence and nature of contamination within the backfilled quarry section will depend on the materials that were used to backfill the quarry, which are unknown. Typical contaminants in quarry fill materials from this time may generally include asbestos, polycyclic aromatic hydrocarbons, fuel hydrocarbons, and toxic metals. For the purpose of the assessment, it is assumed on a worst-case basis that contaminants of this nature may be present.

10.9.13 The receptors that may be affected by contamination, should it be exposed by construction works, would be construction workers and adjacent land users. This could be through skin contact with soil, inadvertent ingestion, and/or the inhalation of vapours and dust for construction workers, and primarily via the inhalation pathway for adjacent land users. In accordance with **Table 10.12**, these receptors are considered to have a **high** sensitivity. The magnitude of effect is assessed as **high** on a precautionary basis, due to the currently unknown nature of any contaminants in the ground. Due to the presence of gas pipes, the construction methodology for the underground cable in this location is likely to be HDD (although this is subject to detailed engineering design, post-consent). This reduces the amount of soil exposed, compared to for example an open cut cable installation[53]. In addition, the embedded measures in **Table 10.9** would be expected to substantially reduce the likelihood of significant adverse effects (health

[53] Notwithstanding this, should open cut be required, then the embedded measures would mean that the probability assessment provided would be unchanged from that for HDD.

risks), through prior characterisation by ground investigation, the adoption of suitable Health and Safety practices for the ground conditions to protect construction workers, and environmental management measures (for example, dust suppression). Allowing for these factors, the probability of the effect occurring is classified as **negligible**, resulting in an overall assessment of effects of negligible and **Not Significant.**

10.9.14 Within the Monk Fryston Area (Section F), the proposed works at the existing Monk Fryston Substation will primarily be overhead/above ground (for example, modifications to gantries). However, some ground disturbance will take place (for example, associated with minor demolition and access works, and with new foundations for busbars). This would be expected to disturb Made Ground, which may contain contaminants including those associated with historical substation use (e.g. PCBs). The magnitude of effect is assessed as **high** on a precautionary basis, as contaminant levels are not known. The receptor sensitivity (construction workers and adjacent land users) is **high**. The risk of exposure to contamination, or the mobilisation of airborne contamination that could affect adjacent land users, can be effectively controlled through prior characterisation/testing of the ground, followed by the adoption of suitable occupational Health and Safety and environmental management measures, in accordance with the embedded measures in **Table 10.9**. Therefore, the probability of the effect occurring is classified as **negligible**, resulting in an overall assessment of effects of negligible and **Not Significant**.

10.9.15 The proposed Monk Fryston Substation will be built adjacent to (and connect into) the existing Monk Fryston Substation. The previous use of this site is agricultural, with two bunds that appear to be formed from clay with inclusions of construction type waste, possibly generated during the construction of the adjacent substation. Initial ground investigations indicate that contaminant concentrations within the bunds are unlikely to present a potential risk to health. The available testing is only from the top 1.2m of the bunds and, subject to reprofiling requirements for construction it is expected that deeper, as yet untested, materials will be exposed during construction. Due to the potential risk of asbestos, the possible magnitude of effect is assessed as **high** on a precautionary basis. Through the application of the embedded measures (e.g. further ground investigation if deeper soils are to be disturbed, contamination watching brief during construction and so on), the probability of an adverse effect occurring is classified as **negligible.** Therefore, overall the effects are assessed as negligible and **Not Significant**.

10.9.16 The proposed construction of new pylon XC522, in the north-west of the Monk Fryston Area (Section F), is situated on land that is the location of numerous historical pollution incidents. These relate primarily to unauthorised waste activities involving biodegradable waste. As the incidents are closed and the site is not listed on the Contaminated Land Register, it is assumed that some form of corrective action took place, although details are not known. Therefore, there is the potential for source-pathway-receptor linkages in relation to any residual biodegradable waste deposits. The receptor sensitivity is **high**. Biodegradable wastes typically relate to either organic matter, such as manure, or household waste. In both cases, although an odour nuisance and potential gas generation risk, contaminant levels are typically low, so the magnitude of effect in relation to human health risks has been classified as **medium**. The probability of an adverse effect occurring is assessed as negligible, because:

- it would be expected that any significant contamination would have been addressed to enable the Environment Agency to close the original pollution incident (given that all of these pollution incidents are recorded by the Environment Agency to have a status of ‘closed’); and

- the embedded measures in **Table 10.9** (for example, ground investigation if considered necessary, use of suitable PPE, dust suppression and stop protocols for unexpected ground conditions) would minimise the potential for exposure.

10.9.17 Similar to the above, there is also one historical, closed, pollution incident relating the fly tipping of commercial waste within the Order Limits at Osbaldwick. This was a Category 3 (minor) incident that occurred in 2002. A proposed access track crosses its former location and the same assessment as that provided above (i.e. **high** sensitivity, **medium** magnitude and negligible probability) applies.

10.9.18 Therefore, allowing for the embedded measures, the effect is assessed as negligible and **Not Significant**. It is also noted that, although there is a former quarry within the Order Limits in the Monk Fryston area (as described in the baseline conditions description earlier) this is not in a location in which the construction of the Project will involve ground disturbance.

10.9.19 To summarise the assessment of Effect GH1:

- The majority of the land within the Order Limits is agricultural and appears to have been throughout its history (as far back as the earliest mapping revision available from Landmark Information Group, which varies throughout the Order Limits between 1850, 1893 and 1895).
- In a small number of locations within the Order Limits (shown on **Figure 10.3, Document 5.4.10, Volume 5**), industrial land use has taken place, although this is primarily quarrying and does not include uses that would be expected to present a high contamination risk.
- There is the potential for source-pathway-receptor linkages in relation to Effect GH1 associated within these areas, and in a location of several former pollution incidents at proposed pylon XC522, as well as a general low potential associated with the prevailing agricultural land use.
- These potential linkages have been assessed, with regard to the nature of construction activities in specific locations (particularly the three Focus Areas, where the proposed construction work involves more ground disturbance than elsewhere). The outcome of these assessments is that Effect GH1 is assessed as **negligible** (**Not Significant**)[54].

Effect GH6: Explosion or asphyxiation as a result of ingress and accumulation of ground gas into buildings and other enclosed spaces, including the risk that construction activities can cause gas migration to adjacent properties

10.9.20 During the construction phase, there will be occupied internal space at the temporary construction compound sites in the North-west of York Area (Shipton CSECs site and Overton Substation), Tadcaster Area, and the proposed Monk Fryston Substation site. For a ground gas ingress risk to be present at these sites, the compounds would need to be either situated on a source of ground gas, or to be affected by ground gas migration from gas sources within the Study Area.

[54] The output of the assessment is a risk classification, rather than a predicted effect. For example, a negligible classification means that there is a negligible/very low risk of significant harm to human health via Effect GH1. This is consistent with the requirements of legislation and guidance to assess land contamination through a risk-based approach.

10.9.21 The construction compounds are not directly located on sites that have previous land uses that would be expected to present a gas generation risk. In all instances, the former land use is recorded to be agricultural, other than the previously mentioned former allotments at the Shipton CSEC site. The mapped natural ground conditions are considered to present a low risk of ground gas generation (i.e. the construction compound sites are not recorded to be underlain by peat or alluvium). Therefore, it is not considered that there is a possible source-pathway-receptor linkage for the direct vertical migration of ground gas into the construction compound sites.

10.9.22 However, there are several former quarries within the vicinity of the construction compounds in the Monk Fryston Area (Section F) and Tadcaster Area (Section D). If they have been historically infilled, then former quarries can present a ground gas source (depending on the organic matter content of the backfill, amongst other things). Therefore, the potential for the compounds to be affected by lateral migration from these sites requires consideration.

10.9.23 The configuration of the former quarries in relation to the construction compounds in the Monk Fryston Area (Section F) is shown on **Figure 10.11, Document 5.4.10, Volume 5**.

10.9.24 There are potential source-pathway-receptor linkages from the two backfilled former quarries closest to the western of the two proposed compounds. In particular, Mile Gap Quarry Landfill (75m north of the construction compound) is a former landfill that accepted wastes of an unknown type. The receptor sensitivity and magnitude of effect are both classified as **high**.

10.9.25 Construction compounds typically consist of modular steel buildings so are relatively resistant to gas ingress. Furthermore, where there is a concern regarding gas ingress, construction with a clear air gap between the ground and floor of the units can easily be accommodated, such that the probability of an adverse effect would be negligible. Therefore, Effect GH6 in relation to the construction compounds at Monk Fryston is assessed as negligible and **Not Significant.**

10.9.26 The configuration of the former quarries in relation to the construction compounds in the Tadcaster Area (Section D) is shown on **Figure 10.12, Document 5.4.10, Volume 5**.

10.9.27 It is noted that the majority of the historical quarry extents to the south of the A64 remain as voids that have not been backfilled, and that this remains an operational site.

10.9.28 The gas risk at Tadcaster is considered to be less than that at Monk Fryston primarily due to the absence of landfills. Therefore, the Monk Fryston Area (Section F) assessment of Effect GH6 as a negligible[55] effect, which is **Not Significant,** is also applicable to the Tadcaster Area (Section D).

10.9.29 In addition to risks to users of buildings associated with the Project, Effect GH6 also includes the potential for construction activities associated with the Project to disturb ground gas sources and cause gas migration towards existing buildings within the 500m Study Area. However, this would typically require substantial ground disturbance at a highly gassing site (for example, household waste landfill or a sewage works) in close proximity of buildings. The Project will not involve any such scenarios. Furthermore, in general (with the exception of piling and HDD), the construction activities will involve excavations that are open to the atmosphere, so any ground gas present would be

[55] The output of the assessment is a risk classification, rather than a predicted effect. A negligible classification means that there is a negligible/very low risk of significant ground gas ingress into compounds and corresponding harm to health.

expected to travel vertically into the atmosphere rather than laterally. Therefore, it is considered that there are no potential source-pathway-receptor linkages to assess in relation to risks to existing buildings.

Human health receptors (operational phase)

10.9.30 The human health receptors during the operational phase will comprise maintenance workers and users of land within the Order Limits, resulting from temporary land take from construction being returned to its former (primarily agricultural) use during the operation of the Project.

10.9.31 The potential effects in relation to these receptors are:

- harm to health resulting from the exposure to soil contamination, either as result of Project maintenance activities (GH9) or future land use (GH8); and
- harm to human health resulting from the accumulation of ground gas within permanent infrastructure (explosion or asphyxiation) (GH10).

Effect GH8: Harm to health resulting from the exposure to soil contamination during future land use

10.9.32 It is not anticipated that the Project would introduce new contamination or involve the redeposition of excavated soils in locations in which they may present a health risk should they be disturbed by future land users. It is anticipated that the majority of excavations would be into uncontaminated natural (agricultural) ground, that all work would be supported by suitable pre-construction ground investigation, that any materials would be re-used in locations demonstrated to be suitable, that their re-use would be tracked in accordance with the CL:AIRE '*Definition of Waste: Development Industry Code of Practice*'[47], and that site activities (for example, fuel usage and storage) would be undertaken in accordance with all relevant good practice measures and secured through a CoCP. As a result of these control measures that would be implemented during the construction phase, the Project would not leave any legacy of increased contamination risks relative to baseline (pre-construction) activities that could affect future site users during the operational phase. Therefore, the magnitude of effect in relation to Effect GH8 is classified as **negligible**, and there is a corresponding negligible probability of adverse effects. The receptor sensitivity is assessed as **high**, providing a classification for Effect GH8 of negligible and **Not Significant**.

Effect GH9: Harm to health resulting from exposure to soil contamination, as result or Project maintenance activities

10.9.33 Similar to the human health risks during the construction phase, for Effect GH9 to occur, soil contamination would need to be present within the Order Limits in locations of ground disturbance. Therefore, the characterisation and assessment for Effect GH9 is similar to that for Effect GH1 (the equivalent effect during the construction phase). The receptor sensitivity is **high**, the magnitude of effect is **high**, but the probability is negligible. The reasons that the probability is assessed as negligible are:

(i) the presence and extent of potential contamination sources is limited;

(ii) any such sources would not be routinely disturbed by operational maintenance (which would only involve very occasional ground disturbance/excavations if needed for repairs); and

(iii) the embedded measures described in **Table 10.9** (for example, the use of suitable PPE) would minimise the probability of an adverse effect occurring.

10.9.34 Therefore, Effect GH9 would be negligible (**Not Significant**).

Effect GH10: Accumulation of ground gas within permanent structures, resulting in asphyxiation of occupants or explosion during periods of manual access to operate/maintain the infrastructure (for example, at substations).

10.9.35 Effect GH10 is only relevant to the proposed Overton Substation and proposed Monk Fryston Substation. Neither of the substations would be situated on ground that is likely to have a significant ground gas generation potential. The proposed Monk Fryston Substation is located approximately 110m east of a backfilled former quarry and is also 410m south of Mile Gap Quarry Landfill, although the intervening natural superficial geology includes areas underlain by the relatively low permeability Harrogate Till. Therefore, a gas migration pathway is unlikely. Furthermore, in line with the embedded measures in **Table 10.9**, in the event that post-consent detailed engineering design identified the presence of substantial concentrations and flows of hazardous ground gases, then the ingress of these into the substations would be expected to be prevented by the use of standard construction techniques for such situations (for example, the installation of gas resistant membranes within the sub-floor construction, which may include protection against radon gas at the proposed Monk Fryston Substation).

10.9.36 Therefore, it is concluded that there is a **high** receptor sensitivity and a **high** magnitude of effect (explosion/asphyxiation), but that the likelihood of a source-pathway-receptor linkage being present is low and would be broken by standard construction design procedures even if present. Therefore, the probability of an adverse effect is **negligible** and **Not Significant**.

Hydrogeological (Groundwater) receptors – Construction Phase

10.9.37 The groundwater receptors consist primarily of the Principal Aquifers that underlie the majority of the route; Sherwood Sandstone to the north of the approximate position of existing pylon XC467, and Zechstein Group limestone and dolostones to the south of this. The Sherwood Sandstone aquifer is generally confined by low permeability superficial deposits whereas the limestone/dolostone aquifers are in many areas unconfined due to an absence of superficial cover (based on published mapping data, as shown on **Figures 10.1** and **10.2, Document 5.4.10**).

10.9.38 These aquifers are abstracted locally (see **Table 10.7**) and SPZs are present within the Order Limits and 500m Study Area, as shown on **Figure 10.4, Document 5.4.10**. These aquifers, SPZs and abstractions are **high** sensitivity receptors.

10.9.39 With the exception of the Alne Glaciolacustrine Formation (present to the north of existing pylon XC445), the superficial deposits are variably described as Secondary Aquifers, so also represent potential receptors. These are generally lower permeability Secondary Undifferentiated Aquifers, with only sporadic localised more permeable granular deposits that are classified as Secondary A Aquifers. These aquifers are classified as having a **medium** sensitivity.

10.9.40 The potential construction phase effects on groundwater receptors are:

- deterioration of chemical quality of the groundwater, from the mobilisation of pre-existing contamination through either leaching/infiltration (Effect GH2A) or as a result of dewatering (Effect GH2B);

- deterioration of the chemical quality of groundwater due to the release of contamination by activities associated with the Project (for example, loss of fuels to an aquifer) (Effect GH3); and
- physical effects on groundwater such as depletion of an aquifer and increased solids/turbidity (Effect GH4), or discharges from the Project to groundwater (Effect GH5).

Effect GH2A: Deterioration in the chemical quality of groundwater, from the mobilisation of pre-existing contamination

10.9.41 This effect has the potential to occur in circumstances where the construction activities involve disturbance of the ground, potentially increasing the leaching of contamination to an aquifer. The locations and nature of potential ground contamination sources, and how these may be disturbed by the Project construction activities, have been described and characterised in relation to Effect GH1.

10.9.42 The potential effects on aquifers, SPZ and abstractions are described, moving from north to south, in the following paragraphs.

10.9.43 To the north of existing pylon XC445, the previous land use indicates that the potential for contamination sources is low, and the presence of the Alne Glaciolacustrine Formation deposits is likely to prevent/minimise any pathways between the surface and the Sherwood Sandstone Principal Aquifer. In the small area in which the Alne Glaciolacustrine Formation is mapped to be absent (that is, where granular superficial deposits are present) there is no recorded historical industrial land use. Therefore, it is considered that there is no potential source-pathway-receptor linkage to assess in relation to the risks of shallow construction activities (such as excavations) mobilising pre-existing contamination to groundwater receptors. Should piling be required for pylon and substation construction to the north of existing pylon XC445, then it is possible that this could introduce a pathway for contamination to breach the low permeability cover and enter the aquifer. This potential source-pathway-receptor linkage is assessed as follows: the receptor sensitivity is **high**, the magnitude of effect is potentially **high**, the probability of the effect occurring is **negligible**. The reason that the probability is assessed as negligible is that the potential for pre-existing ground contamination sources to be present is low, and even if these were found to be present then selection of a suitable piling method, in line with the embedded measures in **Table 10.9**, would prevent significant downwards migration of contamination. This provides a classification of Effect GH2A from piling as negligible and **Not Significant.**

10.9.44 This assessment is consistent with the findings of the ground investigations undertaken at the proposed Shipton CSECs site and Overton Substation site (**Appendix 10E, Document 5.3.10E**). These identified the near surface soils at these sites to be natural materials with low contaminant concentrations, with substantial thicknesses of low permeability soils between the ground surface and the bedrock aquifers. An elevated leachable iron concentration was recorded in topsoil, but only in comparison to acceptable concentrations in drinking water (i.e. at a consumer's tap). It is considered highly unlikely that disturbance of topsoil would cause leaching of iron to an extent that could cause perceptible contamination of the aquifers, given the small thickness of these deposits (i.e. limited source) and low permeability underlying materials (i.e. no pathway).

10.9.45 Moving southwards, between the approximate positions of existing pylon XC445 and XC471 (Section C), the Sherwood Sandstone Aquifer is overlain by Secondary Aquifers. These are generally glacial till (the Harrogate Till Formation), which may afford

protection to the aquifer, but notable areas of granular deposits are present. The proposed construction works in this area involve only surface/overhead works such as access tracks and modification[56] of existing pylons, so no potential source-pathway-receptor linkages have been identified in relation to Effect GH2A in this location.

10.9.46 Between existing pylons XC471 and XC479 (Section C: Moor Monkton to Tadcaster), the Project is underlain by limestone/dolostone Principal Aquifer deposits with a general absence of superficial deposits. Parts of the Order Limits in this area are also within SPZ2 and SPZ3, with a very small section in SPZ1 (where access is required). Based on a review of the historical mapping, it is considered unlikely that construction activities between existing pylons XC471 and XC479 would be situated on land affected by contamination. Furthermore, the construction activities in this area involve only surface/overhead works such as access tracks and modification of existing pylons. Therefore, no potential source-pathway-receptor linkages have been identified in relation to Effect GH2A in this location.

10.9.47 To the south of existing pylon XC479, the Project enters the Tadcaster Area (Section D), where various activities involving ground disturbance are proposed (see **Table 10.16**). This will include the installation of underground cables (currently assumed to be by HDD, but this to be confirmed as part of post-consent detailed engineering design) and CSEC construction in SPZ2 and SPZ3, and the construction of new pylons in SPZ3 (see **Figure 10.13, Document 5.4.10, Volume 5**). Parts of the underground cable route and CSEC are located on a backfilled former quarry. Therefore, there is a potential source-pathway-receptor linkage should the construction activities disturb soils containing contamination and increase leaching to the aquifer. The receptor sensitivity is **high**, and due to the unknown nature of any potential contamination the possible magnitude of effect is also classified as **high** on a precautionary basis.

10.9.48 The aquifer in this location is unconfined, with groundwater at approximately 40m depth in the area. The Project construction activities would have to cause a substantial increase in leaching of contamination to have a discernible effect on the aquifer. The worst case construction methods (HDD and/or small-scale excavations) are considered very unlikely to have the potential to cause such a change, or to introduce new contaminant migration pathways. Furthermore, the embedded measures (see **Table 10.9**) will provide assurance of this prior to construction commencing. These measures include pre-construction ground investigation, to ensure that any contaminants that may be present in the ground are identified and that construction methods, health and safety procedures, and environmental management procedures are reflective of the ground conditions. Therefore, the probability of Effect GH2A occurring in the Tadcaster Area (Section D) is assessed as negligible, providing an overall classification of the effect as negligible (**Not Significant**).

10.9.49 This classification is based on the underground cable and CSEC construction activities but is also applicable for the other construction works (for example, pylon construction) in the Tadcaster Area (Section D), which are on land not recorded to have a former

[56] Pylon modifications may involve a range of activities including painting, refurbishment / modification of steelwork, and repairs/refinishing of concrete foundations at/near ground level. In a limited number of cases, modifications may also require bespoke foundation strengthening works that could include mini-piling. None of the pylons requiring modifications are located on land with an identified potential risk of contamination (based on historical mapping) and any piling works would be controlled under pre-construction piling risk assessment in accordance with **Table 10.9**. As such, pylon modifications would not introduce a potential source-pathway-receptor linkage.

industrial land use. The only difference in these locations is the potential for piled foundations (for new pylons / temporary structures). However, the aquifer is unconfined and groundwater is anticipated to be deep; (approximately 40m bgl), meaning that there is already a long unsaturated zone pathway and that piling would not be expected to substantially increase/alter the downwards migration of contamination. Therefore, it is considered that piling activities on agricultural land would not be expected to introduce any new source-pathway-receptor linkages in relation to Effect GH2A, with additional assurance provided by the embedded measures described in **Table 10.9** (specifically, the requirement for pre-construction piling groundwater risk assessments, to inform the specific piling methods in accordance with Environment Agency guidance[43,44]).

10.9.50 Moving southwards from the Tadcaster Area (Section D) to existing pylon XC521 (Section E: Tadcaster to Monk Fryston), the land within the Order Limits is characterised generally by unconfined limestone/dolostone Principal Aquifers on which the Project would involve only surface/overhead works such as access tracks and modification of existing pylons. The land in this area has primarily been agricultural throughout its history. Therefore, it is considered unlikely that significant contamination sources will be present and that, even if localised shallow soil contamination was to be present, the construction phase activities would not have the potential to increase contaminant leaching so would not introduce any source-pathway-receptor linkages. This area includes land within an SPZ1, in which the Project has been designed to minimise construction activities to those shown on **Figure 10.14, Document 5.4.10, Volume 5**, with construction working areas for pylon upgrades configured to avoid the SPZ1 are far as practicable.

10.9.51 To the south of existing pylon XC521, the Project enters the Monk Fryston Area (Section F). The proposed construction activities in this area that would involve notable ground disturbance are situated on land recorded to be underlain by the Harrogate Till Formation, and due to the presence of this assumed aquiclude, would not have the potential to introduce a migration pathway for near surface contamination to reach the underlying limestone/dolostone Principal Aquifer, or corresponding effects on nearby abstractions from this aquifer (for example the abstractions at/near Lumby Garden Centre 320m west of existing pylon XC522T). This is corroborated by ground investigation data from the proposed Monk Fryston Substation site, which indicates cohesive deposits of the Harrogate Till Formation of between 2.8m and 6.7m thickness at and adjacent to this site.

10.9.52 The possible exception to this is piling (for example, at new pylon and substation locations). However, the proposed pylon and substation locations are on land with no recorded non-agricultural previous land use (so there is a low potential for a contamination source). This is consistent with the findings of the 2022 ground investigation undertaken at the proposed Monk Fryston Substation site (**Appendix 10E, Document 5.3.10E, Volume 5**). The results of contamination testing undertaken as part of this investigation do not indicate the presence of a contamination source. The only exceedance of highly conservative screening criteria (Environmental Quality Standards and UK Drinking Water Standards) was an elevated concentration of leachable iron in topsoil. The risk that localised disturbance of relatively small amounts of topsoil during piling could generate substantial amounts of iron contaminated leachate that could perceptibly affect aquifers is very low. Furthermore, the selection of a suitable piling method, in line with the embedded measures in **Table 10.9**, would prevent significant downwards migration of contamination. The receptor sensitivity is assessed as **high**, the magnitude of the potential effect is assessed as **high**, and the probability of adverse effects is assessed as negligible (for the reasons described above). This provides a

classification of Effect GH2A from piling to the south of existing pylon XC521 of negligible (**Not Significant**).

10.9.53 Whist the effects on the Principal Aquifer would not be expected to be significant, it is also noted that the Harrogate Till Formation itself is classified as a Secondary Undifferentiated Aquifer. This designation often relates to generally low permeability materials with occasional higher permeability horizons (for example, sand lenses in glacial till deposits that are predominantly clay). The receptor sensitivity and magnitude of effect in relation to Effect GH2A for the Secondary Undifferentiated Aquifer are both classified as **medium**. The probability of an adverse effect occurring is assessed as low for the following reasons:

1. The previous land uses (as shown on **Figure 10.3, Document 5.4.10, Volume 5**, specifically Sheet 6) indicate that there is a low potential for a contamination source to be present.
2. Ground investigation at the proposed Monk Fryston Substation site indicates low contamination concentrations, other than an elevated concentration of leachable iron relative to the UK drinking water standard. The near surface soils can be characterised as a low-risk contamination source.
3. Ground investigation at the Harrogate Till Formation did not identify higher permeability horizons (e.g. sand lenses) within the upper part of the ground profile. The top c.3m of the Harrogate Till was recorded to contain cohesive deposits, with no groundwater strikes during drilling.

10.9.54 The above factors indicate that the possibly of a source-pathway-receptor linkage is very low, because there is a minimal contamination source and the pathway is likely to be broken by low permeability deposits. Nevertheless, ground conditions may vary locally, so the probability of an effect is assessed as **low** (rather than negligible) on a precautionary basis. This provides an assessment of Effect GH2A in relation to this aquifer of minor and **Not Significant.**

Effect GH2B: Deterioration in the chemical quality of groundwater due to the mobilisation of pre-existing contamination as a result of dewatering, for example the dewatering of trenches for new underground cables or the dewatering of foundation excavations for new structures

10.9.55 This effect only has the potential to affect the shallow superficial aquifers, as this is the only groundwater that would be expected to be encountered during construction excavations (noting that, where superficial deposits are absent, groundwater levels in the bedrock Principal Aquifers are such that groundwater would not be expected to be encountered during excavations). The assessment of effects on these Secondary Superficial Aquifers is the same as that for Effect GH2A, for the same reasons. A potential source-pathway-receptor linkage is only identified in the Monk Fryston Area (Harrogate Till Secondary Undifferentiated Aquifer) and assessed as minor and **Not Significant.**

Effect GH3: Deterioration in the chemical quality of groundwater due to the release of contamination by activities associated with the development (for example, loss of fuels to an aquifer)

10.9.56 Effect GH3 relates to the release of contaminants from construction activities (as opposed to Effects GH2A/2B, which relate to the mobilisation of contaminants that are already in the ground). Examples of such contaminants would be fuels and oils used to

power and maintain construction equipment, the loss of concrete to an aquifer during piling, or the loss of drilling fluids during HDD.

10.9.57 Fuel/chemical storage areas would be located at the proposed construction compound sites. Six of the eight compounds are situated outside SPZs, with one within SPZs in the Tadcaster Area (Section D)/ The construction compound at the Tadcaster Area is sited outside SPZ1 and 2, but within SPZ3.

10.9.58 The use of construction plant along the length of the Project also provides potential for the release of contaminants due to incidental fuel spills or leaks. The Project design has sought to minimise construction activities in SPZ1, resulting only in the very minor proposed activities shown on **Figure 10.14, Document 5.4.10, Volume 5**. No chemical storage or vehicle parking is proposed within SPZ1.

10.9.59 The receptor sensitivity is assessed as **high** (due to the presence of Principal Aquifers and SPZ), although it is recognised that in some locations the bedrock Principal Aquifers would be protected from the downwards migration of contamination from the surface by low permeability superficial deposits. The magnitude of effect is assessed as **high**, due to the potential nature of the adverse effects that could result from a substantial loss of fuels or chemicals. The probability of effect is assessed as negligible, since construction activities would use commonly adopted methods and plant, for which there is well established environmental compliance guidance and legislation. Such processes form part of the embedded measures (**Table 10.9**) and will be secured through the CoCP. These measures include things such as the storage of fuels in accordance with legislation and good practice, proper maintenance of plant, and the use of plant nappies and drip trays. As a result, Effect GH3 in relation to groundwater receptors is assessed as negligible (**Not Significant**). This also applies to the superficial Secondary Aquifers (medium sensitivity receptor, with the same magnitude and probability criteria).

10.9.60 Piling activities will be controlled by best practice environmental management measures, including piling method selection and pile design with regard to the risk of concrete loss to aquifers in accordance with Environment Agency good practice (as per the embedded measures in **Table 10.9**). Similarly, HDD will be undertaken with regard to the geology (fractured limestone). This will be characterised in advance by suitable ground investigations, with the HDD methodology designed based on the findings to ensure a minimal risk of bentonite loss to the aquifer (for example, by selection and monitoring of drilling fluid characteristics and fluid pressures/flow). Therefore, the assessment above (negligible effect and **Not Significant**) is also considered applicable to piling and HDD activities.

10.9.61 No piling or HDD activities are proposed within SPZ1. HDD drilling or shallow open cut excavations may be undertaken in SPZ2 and 3 at the Tadcaster Area (Section D) to install underground cabling (subject to engineering design to determine the method of underground cable installation in the vicinity of gas pipes), where it is also proposed to construct a new (replacement) permanent pylon and two temporary pylons (along the temporary diversion that will be in place during the construction phase) within SPZ3[57]. Therefore, whilst the proposed construction activities represent a low risk that can be controlled through good practice at detailed design stage, in these higher sensitivity areas localised confirmatory groundwater monitoring may need to be accommodated, to verify that the works are not affecting the aquifer. Any such monitoring requirements

[57] Pylon foundation types are subject to detailed engineering design, so at present it is assumed on a worst-case basis that these pylons would be piled.

would depend on the piling technique and depths and would be specified as an output of the pre-construction piling risk assessment, in accordance with the embedded measures in **Table 10.9**.

Effect GH4: Physical effects on groundwater such as depletion of the aquifer and increased solids/turbidity, caused by ground disturbance during construction and/or dewatering.

10.9.62 Where the proposed construction work involves minimal ground disturbance (pylon modifications and access tracks) it is not anticipated that there would be a requirement for any notable dewatering. Therefore, the assessment of Effect GH4 is targeted on the three Focus Areas (North-West of York, Tadcaster, and Monk Fryston).

10.9.63 A dewatering assessment has been undertaken for each of these Focus Areas, which is provided in **Appendix 5.3.10B, Document 5.3.10, Volume 5**. The North-West of York Area (Section B) has been assessed as two discrete locations: the proposed Overton Substation and the Shipton CSEC site. The remainder of the land in the Northwest of York Area consists of pylon construction or removal work on Unproductive Strata (with the exception of one proposed pylon on alluvium).

10.9.64 The findings of the assessment provided in **Appendix 5.3.10B, Document 5.3.10, Volume 5** are summarised as follows:

- At the Shipton CSEC site and proposed Overton Substation site, any dewatering would be restricted to shallow perched groundwater within the low permeability superficial deposits (Alne Glaciolacustrine Formation; Unproductive Strata). The underlying bedrock Principal Aquifer would be unaffected by dewatering, with the groundwater level in this aquifer anticipated to be around a least 13m below the base of any construction excavations. Therefore, the construction activities would not have the potential to affect groundwater levels or physical properties (turbidity/solids) in the Principal Aquifer or at nearby abstractions from this aquifer.
- At the Tadcaster Area (Section D), the bedrock aquifer is unconfined and groundwater levels are anticipated to be over 30m bgl, well below the level of any excavations that would be associated with the Project. Therefore, dewatering of the aquifer would not occur as part of the Project, so there is not a potential for corresponding effects on groundwater levels or physical properties.
- At the Monk Fryston Area (Section F), it is expected that groundwater levels within the limestone/dolostone aquifer deposits would be greater than 15m below the base of any excavations associated with the Project. Therefore, construction activities would not have the potential to affect groundwater levels or physical properties in this aquifer, or at nearby abstractions from it.

10.9.65 Principal Aquifers, SPZ and groundwater abstraction are **high** sensitivity receptors. Given that no dewatering of the bedrock aquifers is expected, the magnitude of effect on these receptors is predicted to be **negligible**. There is a high degree of certainty in this (due to the substantial 'safety factor' between the anticipated depth of excavations and the anticipated groundwater level in the aquifers) so the probability of adverse effects is classified as negligible. This gives an overall classification of Effect GH4 on these receptors of negligible **(Not Significant)**. The superficial Secondary Aquifers are classified as **medium** sensitivity receptors. Considering the nature of the aquifers and the likely scale of dewatering (rainwater and localised perched water from localised excavations), the magnitude of effect is assessed as **low** (would not be expected to affect the use or status of the groundwater). The probability of this effect is classified as low, as the superficial aquifers are generally cohesive, so notable groundwater

dewatering requirements are unlikely. This provides an overall assessment of Effect GH4 in relation to superficial Secondary Aquifers of **minor** (**Not Significant**). It should be noted that this only applies to the Harrogate Till Formation Secondary Undifferentiated Aquifer, as the Secondary Aquifers elsewhere in the Order Limits are primarily in locations where the construction work is restricted to pylon modifications, which would involve no/minimal dewatering.

10.9.66 Substantial parts of the Order Limits contain unconfined aquifers with deep groundwater, so display no potential for artesian conditions. Where superficial cover is present, the potential for sub-artesian/artesian conditions within confined aquifers cannot be discounted. However, this groundwater would be too deep to be intersected by construction activities, possibly with the exception of piling. Pile locations and depths would be determined, post-consent, following geotechnical ground investigations. Should this process identify potential artesian conditions, then suitable piling methods would be used for these conditions (for example, driven precast piles rather than bored cast in place/continuous flight augured piles). This process will form part of the detailed engineering design for the Project and would interface with environmental compliance aspects through the embedded measures and the CoCP (for example, piling assessments as per **Table 10.9**).

Effect GH5: Physical effects on groundwater due to discharges from the Project to groundwater

10.9.67 Effect GH5 relates to the potential degradation of the physical or chemical properties of groundwater as a result of discharges of water from the construction activities. It is expected that the volumes of water pumped from excavations in order to construct the Project would be modest. Project construction would involve only limited/localised excavations which would be terminated well above the standing groundwater level in the regional aquifers, such that pumping would only be required to deal with rainwater and localised perched groundwater.

10.9.68 Temporary discharges during construction will be managed through closed system drainage where there is a potential pollution risk (e.g. parking and compound areas). This will involve water collection and either removal by tanker or discharge to sewer under an appropriate consent, rather than release to the environment. Where there is no pollution risk, then temporary discharges to the ground may be provided (e.g. through swales). These would be expected to be of a minimal scale/volume (in the context of the volumes of water that would be required to have perceptible physical effects on aquifers) and would be carried out under appropriate consents and managed as per the embedded measures outlined in **Table 10.9.** Allowing for this, the receptor sensitivity is assessed as **high**, the magnitude of effect as **low**, and the probability of an adverse effect negligible. This provides an overall assessment of the effects of discharges of water arising from construction activities on groundwater receptors (Effect GH5) of negligible and **Not Significant**.

Hydrogeological (Groundwater) receptors – Operational Phase

10.9.69 The operation of the Project would not involve any dewatering activities, and the only potential adverse effect identified is the degradation of groundwater quality or changes in levels should the Project alter infiltration patterns or affect groundwater flows (Effect GH11).

Infiltration

10.9.70 Infiltration may be affected at Overton Substation and the proposed Monk Fryston Substation, due to the replacement of greenfield conditions with hard surfacing and the installation of engineered drainage for the substations.

10.9.71 The proposed permanent drainage strategy at the Overton Substation site is as follows:

- Attenuation will be provided for surface run-off, making use of the void space within granular imported sub-base material. This will be underlain by a low permeability membrane, allowing the water to collect in this material and preventing infiltration to the ground below. The attenuated water will be collected in a collection pipe which will outfall to surface water (Hurns Gutter) under an appropriate consent.
- Areas where site processes may cause pollution of run-off (e.g. transformers) would be drained through a separate closed system, via an oil-water separator.

10.9.72 The proposed permanent drainage strategy at the proposed Monk Fryston Substation site is as follows:

- Attenuation for the northern half of the site will be accommodated through use of the void space within granular imported sub-base material. An impermeable membrane will be installed at the southern boundary of this area to separate it from the southern half of the site (which will be attenuated differently due to different topography).
- Attenuation for the southern half of the site will be accommodated through terraced granular near-surface storage layers, to account for the sloping topography of this area.
- Attenuated surface run-off will be diverted to the outfall system for the existing substation adjacent to the west, which outfalls to a surface water ditch.
- Areas where site processes may cause pollution of run-off (e.g. transformers) would be drained through a separate closed system, via an oil-water separator.

10.9.73 Therefore, for both substation sites, surface water will be attenuated in very near surface granular deposits and discharged to surface water, with minimal infiltration to the ground. All potentially contaminated water will be collected and treated prior to discharge through a separate piped drainage system with an oil-water separator. Therefore, there is no potential that the drainage systems at the site could adversely affect the chemical quality of aquifers beneath the sites.

10.9.74 However, a result of this drainage will be that infiltration to the ground will decrease at each site. This has the potential to affect aquifer recharge and therefore groundwater levels.

10.9.75 Both sites are located on low permeability superficial deposits. Therefore, the magnitude of effect on recharge in the Principal Aquifers beneath these low permeability deposits that will result from the decrease in infiltration capacity is expected to be **negligible**, as is the corresponding probability of an adverse effect on groundwater levels. Together with a **high** receptor sensitivity, the effect of decreased permeability at the substation sites on groundwater levels in the bedrock Principal Aquifers is assessed as negligible and **Not Significant**.

10.9.76 The assessments above relate to Principal Aquifers. The proposed Monk Fryston Substation site is situated on a Secondary Undifferentiated Aquifer (Harrogate Till Formation), which overlies the Principal Aquifer in this location. This is a separate

receptor from the Principal Aquifer and has a **medium** sensitivity. The magnitude of effect is assessed as **low**. Accounting for the generally low permeability of glacial till, the probability of an adverse effect on groundwater flows is assessed as negligible, providing an overall assessment of negligible and **Not Significant.**

10.9.77 The assessments above (for both Principal and Secondary Aquifers) relate to the proposed new substations only. Elsewhere, the only permanent hardstanding installed as part of the Project would be at the CSECs and associated permanent access tracks. The CSECs would comprise two hard surfaced areas both around 40m x 40m and 40m x 80m in area and 40m apart at the Shipton CSECs site (Section B), and two hard surfaced areas of around 40m x 30m and 50m x 35m around 280m apart in the Tadcaster area (Section D). At the Shipton CSECs site, the mapped geology is the same as at the Overton Substation site, so the assessments above apply (i.e. negligible effect), as the situation is effectively the same only with a smaller area covered by hardstanding (for comparison, the substation footprint is approximately 300m x 250m). In the Tadcaster Area (Section D), the recorded geology is limestone/dolostone with an absence of superficial deposits, and groundwater expected to be at around 40m depth. Therefore, the presence of small areas of surface hardstanding, or associated small-scale surface drainage that may be required, would not have the potential to affect infiltration to the extent that could affect groundwater levels in the limestone/dolostone regional aquifer.

Groundwater Flow

10.9.78 A further mechanism by which Effect GH11 could occur would be the presence of Project infrastructure providing a physical barrier to groundwater flow within the ground, altering groundwater flow pathways/levels. This is assessed as follows:

- Principal Aquifers: The only construction elements that would be sufficiently deep to possibly intersect groundwater in these aquifers would be piled foundations. The receptor sensitivity is **high**. The magnitude of effect is **negligible** in relation to the sandstone aquifers because the cross-sectional area of piles relative to the scale of the aquifer means that any effect on groundwater flows would be likely to be indiscernible. However, limestone aquifers may exhibit fracture flow, so there is a theoretical low magnitude of effect where piling would be into limestone, should this intersect major fractures. The magnitude is assessed as **low** due to the size of a pile relative to the scale of the aquifers, and the low intensity of piling associated with the construction of the Project. The probability of this adverse effect is assessed as negligible, because:

  (i) the spatial frequency of any piling would be low (consistent with the spread-out nature of the proposed new infrastructure);

  (ii) groundwater in the limestone/dolostone may be deeper than likely piling depths in the highest sensitivity part of the Order Limits (for example, in the Tadcaster Area), although this is subject to ground investigation and detailed engineering design; and

  (iii) even if a fracture was to be intersected, the scale of the aquifer is such that this would be unlikely to discernibly affect groundwater flow patterns.

  Therefore, the potential presence of piled foundations is assessed as having a negligible and **Not Significant** effect on groundwater levels/flows (GH11).

- Secondary Aquifers: New below ground infrastructure (most notably, foundations) would intersect superficial deposits classified as Secondary Undifferentiated

Aquifers (Harrogate Till Formation). The other Secondary Aquifers identified are generally in locations where the Project would involve only pylon modifications/access tracks, so there is no potential for groundwater flows to be affected in these aquifers during the operational phase. The Harrogate Till Formation's sensitivity is classified as **medium** and the magnitude of effect as **low**. Considering the generally low permeability of glacial till, the probability of an adverse effect on groundwater flows is assessed as negligible, providing an overall assessment of negligible and **Not Significant.**

Land Quality receptors

10.9.79 Agricultural land within the Order Limits is a potential receptor in relation to the mobilisation of pre-existing contamination, or the introduction of new contamination by Project construction activities (Effects GH2A and GH3) or operational maintenance (Effect GH9). These effects can cause a degradation in the chemical condition of land. The receptor sensitivity is **medium**. With regard to the detailed discussion of potential contamination source-pathway-receptor linkages previously provided in relation to contamination effects on other receptors, the potential magnitude of effect is **medium** and the probability of effect is negligible (effectively, the assessment is the same as the assessment of effects from contamination on human health receptors, only with a lower receptor sensitivity receptor and magnitude of potential effect). The probability of effects assessment is based on the general low risk of substantial pre-existing contamination, together with the adoption of the embedded measures (which include the prevention of the release of contaminants from Project activities, and the correct use of herbicides during maintenance). Therefore, the potential effects on land quality receptors from contamination are assessed as negligible and **Not Significant**.

Ground instability effects (Effect GH7)

10.9.80 Where the potential for a ground instability event is identified, a worst-case scenario has been assumed whereby an individual (for example, a construction worker or adjacent land user) is in the location at the time of the event. Therefore, the receptor sensitivity is set to **high** on a default basis. This gives a precautionary classification for any other receptors that may be present (for example, buildings), without the need to assess the effects on these receptors separately. This is because these receptors could not be any closer, have any higher sensitivity, or experience any greater magnitude of effect than an individual in the location of the event.

10.9.81 The scope of this assessment relates only to risks to construction activities (including construction workers) and existing structures from natural geohazards. Therefore, with regard to the baseline information, the only natural geohazard that has the potential to cause an environmental impact is landslides. Compressible ground, soluble rocks and shrink-swell geohazards may be considerations for the stability of the proposed infrastructure, but as noted in **Section 10.7** this is an engineering design matter and is scoped out of the environmental assessment. This also applies to collapsible ground deposits (this classification relates to loss of structure at depth due to loading) although it is noted that the BGS geohazard mapping suggests that the Order Limits is unlikely to contain collapsible deposits in any case. Running sand hazards are also recorded to be generally low, although are noted in areas underlain by alluvium. Running sands are a common construction consideration and relate to excavation stability in excavations containing sand below the water table. For reasons of construction practicality, such

excavations would need to be suitably supported or to accommodate any running sand hazards, so there is no potential for this to cause an 'environmental' effect[58].

10.9.82 In relation to the potential effects from construction activities triggering a landslide, the receptor sensitivity and potential magnitude of effect are both **high**. The probability of the effect occurring relates to the proximity of the proposed construction works to any potentially unstable slopes. From the currently available information, the possible hazard areas are those shown in light blue on **Figure 10.15, Document 5.4.10, Volume 5**. In all instances where these are within/close to the Order Limits, the nearby proposed construction works involve either surface works, overhead line works or modifications to existing pylons. It would be expected that with suitable engineering consideration the Project could be safely constructed without triggering landslides in these locations[59], given the nature of the construction works and the small extent of the potential hazard areas. Therefore, the probability of the Project causing, or being affected by, landslides is assessed as negligible. This provides an assessment of Effect GH7 in relation to landslides of negligible and **Not Significant.**

10.10 Assessment of cumulative effects

Inter-project (combined with other development) cumulative effects

10.10.1 An assessment of the effects which could result from the Project in cumulation with other developments in the vicinity of the Project is provided in **Chapter 18: Cumulative Effects Assessment (Volume 5, Document 5.2.18).**

Intra-project (within the Project) cumulative effects

10.10.2 Intra-related effects have been considered in this assessment, i.e. where effects in one environmental area could give rise to effects in others. The greatest potential for Geology and Hydrogeology effects that are inter-related with other aspects is considered to be with Hydrology (**Chapter 9, Document 5.2.9, Volume 5**).

10.10.3 A summary of the intra-project cumulative effects is provided in **Chapter 18, Document 5.2.18, Volume 5**.

10.11 Significance conclusions

10.11.1 A summary of the results of the preliminary geology and hydrogeology assessment is provided in **Table 10.17**.

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[58] Should running sand conditions require temporary works groundwater control (such as temporary dewatering to produce a dry excavation), then any dewatering effects are accommodated in the assessment of Effect GH4. Due to the limited spatial extent of the running sand risk within the Order Limits, it is not considered that any such construction requirements would contribute significantly towards Effect GH4.

[59] It should be noted that this is not an engineering or slope stability assessment and does not to any extent replace the requirement for such assessments to be carried out as part of the engineering design and construction process, informed by inspection and engineering assessments (and, if deemed necessary, ground investigation), prior to construction. The assessment is intended only to provide a general overview of the likely risk of landslides, on the assumption that the Project will adhere to general engineering good practice.

Table 10.17 – Summary of significance of effects

Receptor and Summary of Predicted Effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of Change[2]	Probability of Adverse Effect[3]	Significance[4]	Summary Rationale
Construction workers, occupational maintenance workers, adjacent site users, future site users. Harm to health via Effects GH1 (construction phase), GH8 and GH9 (occupational phase).	High	High/medium, depending on specific source (GH1) Negligible (GH8) High (GH9)	Negligible	Not Significant (Negligible)	The Order Limits are unlikely to be affected by substantial or widespread contamination, and the Project would cause ground disturbance in only a small proportion of the Order Limits. Embedded measures would prevent significant exposure to contaminants.
Construction workers, occupational maintenance workers, adjacent site users. Harm to health from ground gas (explosion/ asphyxiation) during construction (Effect GH6) or operation (Effect GH10)	High	High	Negligible	Not Significant (Negligible)	Possible source-pathway-receptor linkages identified in relation to gas ingress into construction compounds and substations, particularly in the Monk Fryston Area (Area F). Embedded measures (such as air space beneath modular units, or passive protection in substations if considered necessary following detailed design), able to mitigate the effect (risk) to negligible significance.
Groundwater (Principal Aquifers, SPZ, abstractions).	High	High (GH2a and GH3)	Negligible	Not Significant (Negligible)	The Order Limits are unlikely to be affected by substantial or widespread contamination, and the Project would cause ground disturbance in only a small proportion of the Order Limits.

Receptor and Summary of Predicted Effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of Change[2]	Probability of Adverse Effect[3]	Significance[4]	Summary Rationale
Deterioration in chemical quality due to mobilisation of pre-existing contamination (Effect GH2A) or release of contaminants from Project activities (Effect GH3)					Groundwater is either protected by superficial cover or at substantial depth. Embedded measures would prevent releases of contamination from Project activities, including piling.
Groundwater (Secondary Aquifer). Deterioration in chemical quality due to mobilisation of pre-existing contamination (Effect GH2A and GH2B) or release of contaminants from Project activities (Effect GH3)	High	Medium (Effects GH2A and GH2B) High (Effect GH3)	Low (Effects GH2A and GH2B) Negligible (Effect GH3)	Not Significant (Minor (Effects GH2A and GH2B)) Not Significant (Negligible (Effect GH3))	The Order Limits are unlikely to be affected by substantial or widespread contamination, and the Project would cause ground disturbance in only a small proportion of the Order Limits. Possible pathway from localised areas of contamination to Secondary Undifferentiated Aquifer (Harrogate Till Formation). Embedded measures would minimise (already low) risk of mobilising pre-existing contamination and prevent new releases of contamination occurring.
Groundwater (Principal Aquifers, SPZ, abstractions). Physical effects on groundwater due to dewatering (Effect GH4)	High	Negligible	Negligible	Not Significant (Negligible)	Groundwater in the aquifers expected to be well below the base of any construction excavations.

Receptor and Summary of Predicted Effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of Change[2]	Probability of Adverse Effect[3]	Significance[4]	Summary Rationale
Groundwater (Secondary Aquifers). Physical effects on groundwater due to dewatering (Effect GH4)	Medium	Low	Low	Not Significant (Minor)	Only potentially applicable in relation to the Harrogate Till Formation. Due to the nature of the aquifer (generally cohesive, low permeability materials) and likely scale of any dewatering, significant effects would not be expected.
Groundwater (Principal Aquifers, SPZ, abstractions, Secondary Aquifers). Physical and chemical effects on groundwater as a result of the discharge of groundwater arising from dewatering (GH5)	High (Principal Aquifers, SPZ, abstractions). Medium (Secondary Aquifers).	Low	Negligible	Not Significant (Negligible)	Discharges likely to be restricted to perched water and rain water from shallow excavations. To be managed as per the embedded measures.
Groundwater (Principal Aquifers, SPZ, abstractions, Secondary Aquifers). Changes to infiltration and effects on groundwater levels or quality as a result of the presence of new	High (Principal Aquifers, SPZ, abstractions). Medium (Secondary Aquifers).	Varies between negligible and low, depending on specific activity and receptor considered.	Negligible	Not Significant (Negligible)	Infiltration primarily affected at substation sites, where bedrock aquifers are confined, so infiltration capacity changes unlikely to be important for groundwater levels. The drainage design uses near surface attenuation and collection, isolating surface water drainage from groundwater and thus preventing any adverse chemical effects.

Receptor and Summary of Predicted Effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of Change[2]	Probability of Adverse Effect[3]	Significance[4]	Summary Rationale
structures and surfaces (GH11)					
Land quality. Deterioration in the chemical quality of land due to the mobilisation of pre-existing contamination or the release of new contamination (Effect GH2A/GH3). (N.B. Soil and land quality receptors are only relevant to the Geology and Hydrogeology assessment insofar as is relevant to land contamination)	Medium	Medium	Negligible	Not Significant (Negligible)	Low risk of substantial pre-existing contamination, together with the benefits of the embedded measures (for example prevention of the release of contaminants from Project activities, correct use of herbicides during maintenance).
Construction workers, adjacent site users, existing buildings. Harm to health or damage to buildings from ground instability	High (assessed on the conservative basis of the worst-case sensitivity of any possible receptor).	High	Negligible	Not Significant (Negligible)	The only potential natural geohazards identified in the context of this assessment are small areas of possible slope instability hazard. It would be expected that with suitable engineering consideration the Project could be safely constructed without triggering landslides in these locations, given the nature of the

Receptor and Summary of Predicted Effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of Change[2]	Probability of Adverse Effect[3]	Significance[4]	Summary Rationale
caused by the Project (Effect GH7)					construction works and the small extent of the potential hazard areas.

1. The sensitivity of a receptor is defined using the criteria set out in **Section 10.8** and is defined as high, medium, low or negligible.
2. The magnitude of effects on a receptor resulting from activities relating to the development is defined using the criteria set out in **Section 10.8** and is defined as high, medium, low or negligible.
3. The probability of adverse effects occurring is defined using the criteria set out in **Section 10.8** and is defined as high, medium, low or negligible.
4. In accordance with the requirement for effects to be assessed using a risk-based approach, the assessments of effects relate to the **level of risk** rather than an anticipated level of harm to health.

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