WHITESTONE SOLAR FARM

Volume 6: Environmental Statement

6.20 Appendix 9.7: Phase 1 Contaminated Land Report: Whitestone 1

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Contents

Tables

Figures [EN0110020/APP/6.19]

Figure Number	Figure Title
9.1	Study Area
9.2	ALC Survey Results
9.3	Coal Mining High Risk Development Areas
9.4	Mineral Safeguard Areas
9.5	SPZ and Ground Water Abstractions
9.7.1	Map of Potentially Contaminated Sites
9.10.1	Superficial Geology
9.10.2	Bedrock Geology
9.10.3	Borehole Locations

Appendices [EN0110020/APP/6.20]

Appendix Number	Appendix Title
9.1	Legislation, Policy and Guidance
9.2	Landmark Envirocheck® Report: Whitestone 1
9.3	Landmark Envirocheck® Report: Whitestone 2
9.4	Landmark Envirocheck® Report: Whitestone 3
9.5	Landmark Envirocheck® Report: Cable Corridors
9.6	Agricultural Land Classification Report
9.7	Phase 1 Contaminated Land Report: Whitestone 1
9.8	Phase 1 Contaminated Land Report: Whitestone 2
9.9	Phase 1 Contaminate Land Report: Whitestone 3
9.10	Phase 1 Coal Mining Risk Assessment: Whitestone 1
9.11	Phase 1 Coal Mining Risk Assessment: Whitestone 2
9.12	Phase 1 Coal Mining Risk Assessment: Whitestone 3

Glossary

Term	Meaning
Agricultural Land Classification (ALC)	A system of classification of agricultural resource value of soils in England devised by Natural England, from Grade 1 (best quality) to Grade 5 (poorest quality), and based on criteria including soil

Term	Meaning
	characteristics (depth, structure, texture, chemistry, stoniness) as well as climate and site aspects.
Aquifer	"Underground layers of water-bearing, permeable rock from which groundwater can be extracted" (British Geological Survey).
Best and Most Versatile (BMV)	Best and Most Versatile is agricultural land with an Agricultural land Classification of Grade 1, Grade 2 or Grade 3a (National Planning Policy Framework).
Cable Corridors	Corridors within which the high voltage cables would be constructed.
Conceptual Site Model	"A representation of the characteristics of a site which shows the possible relationships between contaminants, pathways and receptors" (Land Contamination Risk Management).
Draft Environmental Statement	The Draft Environmental Statement which presented the preliminary environmental information relating to the Proposed Development. The Draft ES was prepared to present information for statutory consultation in accordance with current EIA regulation.
Environmental Statement (ES)	The Environmental Statement which presents the environmental information relating to the Proposed Development. The ES has been prepared to present information for formal consultation in accordance with current EIA regulation.
Made Ground	Land where the pre-existing ground surface is raised or replaced by artificial or man-made deposits.
Mineral Safeguarding Area	"An area designated by a Mineral Planning Authority which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary sterilisation by non-mineral development" (Planning Practice Guidance).
Principal Aquifer	"Rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers, lakes and wetlands on a strategic scale. They typically have a high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage" (Environment Agency).
Order Limits	Maximum extent of the Proposed Development comprising the Site and Cable Corridors.
Secondary Aquifer	Rocks which "can provide modest amounts of water, but the nature of the rock or the aquifer's structure limits their use. They support water supplies at a local rather than strategic scale (such as for private supplies) and remain important for rivers, wetlands and lakes. They have a wide range of water permeability and storage" (Environment Agency). Secondary Aquifers may be further classified as 'A', 'B' or 'Undifferentiated' based on their permeability and ability to support local water supplies and/or base flow to rivers.
Source Protection Zone	Defined around large and potable groundwater abstractions sites with the purpose to "provide additional protection to safeguard drinking water quality through constraining the proximity of an activity what may impact upon a drinking water abstraction" (Environment Agency).

Term	Meaning
Study Area	The spatial extent within which environmental receptors may experience likely significant effects from the Proposed Development.
The Applicant	Whitestone Net Zero Ltd.
The Application	The Application submitted to the Secretary of State for a Development Consent Order.
The Proposed Development	The proposed Whitestone Solar Farm.
The Site	The land planned to be used for solar PV array and associated infrastructure, BESS, substation, and landscaping and habitat enhancement. The Site is split into W1, W2, and W3.
Whitestone 1 (W1)	The northern parcels of the Whitestone Solar Farm.
Whitestone 2 (W2)	The middle parcels of the Whitestone Solar Farm.
Whitestone 3 (W3)	The southern parcels of the Whitestone Solar Farm.

Acronyms

Acronym	Meaning
ALC	Agricultural Land Classification
AOD	Above Ordnance Datum
BESS	Battery Energy Storage System
BGS	British Geological Survey
BMV	Best and Most Versatile
BS	British Standards
CDC	City of Doncaster Council
CEMP	Construction Environmental Management Plan
COMAH	Control of Major Accident Hazards
DCO	Development Consent Order
DEFRA	Department for Environmental, Food and Rural Affairs
DEMP	Decommissioning Environmental Management Plan
EA	Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
HDD	Horizontal Directional Drilling
IEMA	Institute of Environmental Management and Assessment
LCRM	Land Contamination Risk Management
MRA	Mining Remediation Authority
MSA	Mineral Safeguarding Area
NEDDC	North East Derbyshire District Council
NGR	National Grid Reference
NPPF	National Planning Policy Framework

Acronym	Meaning
oCEMP	Outline Construction Environmental Management Plan
oDEMP	Outline Decommissioning Environmental Management Plan
oOEMP	Outline Operational Environmental Management Plan
PBDE	Polybrominated Diphenyl Ethers
PCS	Power Conversion System
PFOS	Perfluorooctane Sulphonate
PLQRA	Preliminary Land Qualitative Risk Assessment
PPL	Potential Pollutant Linkages
PV	Photovoltaic
RMBC	Rotherham Metropolitan Borough Council
SI	Site Investigation
SSSI	Site of Special Scientific Interest
W1	Whitestone 1
W2	Whitestone 2
W3	Whitestone 3
ZoI	Zone of Influence

Units

Units	Meaning
ha	Hectares
km	Kilometres
kV	Kilovolt
m	Metres
km	Kilometres

9.7 Phase 1 Contaminated Land Report: Whitestone 1

Introduction

Scope and Purpose

9.7.1 This Phase 1 Contaminated Land Report has been prepared on behalf of Whitestone Net Zero Ltd ('the Applicant') to present a preliminary risk assessment of the potential ground quality effects in relation to the Development Consent Order (DCO) Application for the construction, operation, and maintenance, and decommissioning of Whitestone Solar Farm (the Proposed Development). This Report considers the Site history, geology, hydrogeology and land quality at the Proposed Development.

9.7.2 This Report was prepared in November 2025 to support the design process of the Proposed Development and provides information on specific areas which were removed following during Stage 4 design (see **ES Volume 1, Chapter 4: Alternatives and Design Evolution [EN0110020/APP/6.4]**). Consequently, in places this Report refers to areas of previous designs which have since been removed from the Proposed Development through design refinement. Relevant parts of this Report have been extracted for use in **ES Volume 2, Chapter 9: Ground Conditions and Land Quality [EN0110020/APP6.9]** and the design referenced in the Report is the Stage 3 design shown in **ES Volume 3, Appendix 4.2: Design Evolution [EN0110020/APP/6.20]**.

The Order Limits

9.7.3 This extent of the Order Limits are shown in **ES Volume 3, Figure 3.1: Order Limits EN0110020/APP/6.19]** and the Proposed Development is described in full in **ES Volume 1, Chapter 5: The Proposed Development [EN0110020/APP/6.5]** and shown spatially on the **Works Plans [EN0110020/APP/2.3].**

9.7.4 This Phase 1 desktop study covers all areas where the ground is to be disturbed and focuses on areas with potentially contaminated land, as well as considering if any ground conditions exist that may affect the Proposed Development. This Report has been prepared in line with regulatory requirements and guidance, as outlined below.

9.7.5 This Report represents the full coverage for Whitestone 1 (W1), the northernmost section of the Proposed Development. Whitestone 2 (W2) and Whitestone 3 (W3) are presented in other Phase 1 Technical Reports to sufficiently detail the entirety of the Proposed Development.

Regulatory Requirements and Guidance to the Approach

9.7.6 This Phase 1 contaminated land report is a desktop study that includes a preliminary risk assessment which has been undertaken in line with the following legislation, policy and guidance:

- The Environmental Protection Act 1990, and Part 2A of the Environmental Protection Act 1990 (and subsequent amendments)[1];
- Environment Agency (EA) / Department for Environment, Food and Rural Affairs (DEFRA) Land Contamination Risk Management (LCRM) 2023[2];

- Environmental Permitting (England and Wales) Regulations 2016 (and subsequent amendments)[3];
- National Planning Policy Framework (NPPF) (2024)[4];
- NPPF planning practice guidance for Land affected by contamination (2019)[5];
- NPPF planning practice guidance for Land stability (2019)[6];
- BS 10175:2011 + A2:2017 Investigation of potentially contaminated sites - Code of practice[7];
- BS EN1997 (EC7) and BS 8004:2015+A1:2020 - Code of practice for foundations[8];
- Institute of Environmental Management & Assessment (IEMA) of Land and Soil in Environmental Impact Assessment (EIA) Guidance (2022)[9];
- EU Groundwater Directive (2006/118/EC) 2006[10];
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[11]; and
- EU Water Framework Directive (2000/60/EC)[12].

9.7.7 The approach taken for this Phase 1 desktop study includes a description of the environmental setting for all areas of W1 where the ground is to be disturbed and focus on areas with potentially contaminated land. Baseline information has come from online sources, commercial geodata sources and from a site walkover undertaken by ERM staff from February to May 2025. Data sources that were reviewed to establish the baseline included:

- British Geological Survey (BGS) Solid and Drift Geology, 1:50,000 England and Wales[13];
- BGS GeoIndex Onshore interactive map viewer, including borehole records[14];
- Defra's 'Magic' Map and Historical Landfills Sites database[15];
- The Mining Remediation Authority's (MRA, formerly the Coal Authority) interactive map viewer[16];
- EA Catchment Data Explorer[17];
- UK Radon Maps[18];
- Doncaster Local Plan Policies Map[19];
- Landmark Envirocheck® Reports for W1 (see **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**); and
- Landmark Envirocheck® Reports for the Cable Corridor Options (see **ES Volume 3, Appendix 9.5: Landmark Envirocheck® Report for Cable Corridors [EN0110020/APP/6.20]**); and

9.7.8 The Coal Authority Consultants Coal Mining Report for W1 (see **ES Volume 3, Appendix 9.10: Phase 1 Coal Mining Risk Assessment: Whitestone 1 [EN0110020/APP/6.20]**); In line with the guidance above, the Phase 1 desk study includes a preliminary risk assessment framed within a conceptual site model developed for specific parts of W1, as well as general conditions, at the construction, operational and decommissioning phases of the Proposed Development. The preliminary risk assessment considers the potential pollutant pathways, land stability and ground conditions and will specify and assess the significance of sources (of pollution), pathways (that transmit the pollution) and

receptors (such as controlled waters, humans and livestock) and potential pollutant linkages, in line with the approach in the Land Contamination Risk Management (2023) and the 2012 statutory guidance under Part 2A of the Environmental Protection Act (1990). Recent amendments (2023) to the Environmental Permitting (England and Wales) Regulations (2016) expanded the definition of pollutants in groundwater to include heat and so heat from buried high voltage cables affecting groundwater is also considered within this preliminary risk assessment.

9.7.9 A further purpose of the Phase 1 preliminary risk assessment is to determine if supplemental Phase 2 intrusive investigations are required to confirm or otherwise the quantum of land pollution in suspected source areas (by taking samples of soil and controlled waters), test the validity of potential pollution linkages, or characterise any significant geotechnical features that may affect the Proposed Development. The objective of a Phase 2 investigation, if one is required, is to provide sufficient data to undertake a detailed, quantitative risk assessment which will inform the need for any remedial work to be undertaken prior to redevelopment.

Summary of the Proposed Development and Potential Effects on Land Quality

9.7.10 The Proposed Development is located to the east of Sheffield, South Yorkshire, within the administrative areas of the City of Doncaster Council (CDC), North East Derbyshire District Council (NEDDC) and Rotherham Metropolitan Borough Council (RMBC). At current scope, the Proposed Development involves the construction, operation and maintenance, and decommissioning of over 100 megawatts (MW) of solar photovoltaic (PV) array, Battery Energy Storage System (BESS), onsite substations and supporting infrastructure, and grid connection infrastructure. The grid connection infrastructure would connect the Proposed Development to the National Grid at the new 400 kilovolt (kV) National Grid substation proposed on land immediately east of Long Lane, Brinsworth S60 4JJ (Long Lane 400kV Substation). National Grid are currently undergoing consultation on plans for the development of this new substation which is expected to be operational in time for the Proposed Development to connect in 2029.

9.7.11 The area of influence considered in this technical report is defined within **ES Volume 3, Figure 9.1: Study Area [EN0110020/APP/6.19]** and mainly focuses on the operational area of the Proposed Development for W1 only and immediately adjacent land. The W1 part of the Whitestone Solar Farm does not include a BESS and so the specific effects of this facility is not considered in this Report, although it does feature in the W2 report. W1 will include a satellite substation. The current location options for this are as follows: W1 S1; Located in the centre of W1, immediately west of Park Lane; W1 S2; Located in the centre of W1, immediately south of W1 S1; and W1 S3; Located approximately 410m south of Clifton. A full description of the Site and the Proposed Development can be found in **ES Volume 1, Chapter 3: The Site and Surrounding Area [EN0110020/APP/6.3]** and **ES Volume 1, Chapter 5: The Proposed Development [EN0110020/APP/6.5]** respectively.

9.7.12 Potential effects of the Proposed Development on geology, hydrogeology and land quality mostly occur in the construction and decommissioning phases, and comprise:

- Disturbance and / or removal of the ground and potentially groundwater which could potentially remove, relocate or mobilise pollutants;
- Use of plant and equipment which could accidentally leak fuels and oils, introducing contaminants to the ground;
- Use of horizontal drilling techniques to install cables which could accidentally leak drilling fluids, introducing pollutants to the ground and potentially into surface water;
- Installation of sub-surface structures, such as cables, piles and foundations, which could act as new pathways for mobilised pollutants;
- Storage and use of hazardous materials and substances (e.g. concretes, fuel, oils and drilling fluids) which could be mobilised to ground or controlled waters;
- Exposure of construction/decommissioning workers to dust during soil excavation activities; and
- Ground stability issues such as subsidence related to historic coal mining infrastructure.

9.7.13 Some of these effects could persist into the operational phase, and other land quality effects that could arise from site activities in operations are around storage of wastes, vehicular access and maintenance, as well as from the heat generated by the high-voltage cables that will be located in the Cable Corridors and are buried in the ground.

9.7.14 The Proposed Development could also be adversely affected by ground conditions during any phase from instability caused by compressible ground or subsidence, soluble bedrock or shrinking / swelling clays, that could be either naturally occurring or as a result of historic quarrying, landfilling and coal mining activity and infrastructure.

9.7.15 Considerations of agricultural land use, as graded by surveys for Agricultural Land Classification (ALC) to determine Best Most Versatile (BMV) land and to consider the potential impacts to that from Proposed Development, are not included in this Report as they are subject to separate survey and baseline reporting.

Methodology for the Assessment of Effects

9.7.16 The normal procedure for assessing land, as detailed by the current Land Contamination Risk Management (LCRM guidance), dictates that potential contaminants, pathways, and receptors should be considered within the context of contaminant or contaminant linkages. An evaluation of the risks associated with each linkage should drive decisions regarding the status of the land as contaminated and requiring remediation, uncontaminated or requiring further investigation. Where the Preliminary Land Qualitative Risk Assessment (PLQRA) indicates a low or negligible risk, no further investigation is recommended. The PLQRA methodology specific to this contaminated land assessment is outlined in the following sections and also incorporates relevant Environment Agency and British Standards (BS) guidance. The potential impacts for this topic are characterised on the basis of the potential harm to a receptor within a given source-pathway-receptor combination, or a pollutant linkage and graded with a level of magnitude. In order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences a source-pathway-receptor methodology is adopted, with the underlying principle that the identification of pollutant linkages consists of the following three elements:

- A source hazard (a substance or situation that has the potential to cause harm or pollution);
- A pathway (a means by which the hazard moves along); and
- A receptor/target (an entity that is vulnerable to the potential adverse effects of the hazard).

Sensitivity of Receptors

9.7.17 The sensitivity (value) of potential receptors can be described qualitatively according to the categories presented in **Table 9.7.1**.

Table 9.7.1 Sensitivity of Receptors

Sensitivity	Receptor
High	• Human health: onsite residential developments, onsite construction workers; and • Controlled waters (groundwater): Source Protection Zone or highly productive aquifer.
Medium	• Human health: onsite commercial developments, off-site residential developments; and • Controlled waters (groundwater): Moderately productive aquifer.
Low	• Human health: transient or limited access, off-site commercial development; and • Controlled waters (groundwater): Low productivity aquifer or rocks essentially with no groundwater.

Magnitude of Impact

9.7.18 The magnitude of impacts is determined by considering the intensity (or scale), spatial coverage and longevity of an impact. The magnitude of impact on the receptors is presented in **Table 9.7.2**.

Table 9.7.2 Magnitude of Impact

Magnitude	Description	Example
Large	• Results in loss of attribute and/or likely to cause exceedance of statutory objectives and/or breach of legislation.	• Impact of the health of a large number of human receptors, including off-site. Contamination of a highly productive aquifer; • Loss or isolation of a strategic mineral resource; and • Permanent or irreversible loss of soil functions over an area of >20 ha, or loss or isolation of strategic mineral resource.
Medium	• Results in impact on integrity of attribute/or loss of part of attribute, and/or	• Loss or isolation of a regional/local mineral resource; • Contamination of a moderately productive aquifer; • Reduction in the value of a feature, permanent or irreversible loss of soil functions

	possibly cause exceedance of statutory objectives and/or breach of legislation.	over an area of 5 – 20 ha, or loss or isolation of regional/local mineral resource; and • Impact on the health of on-site human receptors (i.e. the workforce).
Small	• Results in minor impacts on receptor.	• Measurable change in receptor, but of limited size/proportion; • Contamination of a poor yielding aquifer; and • Reduction in the value of a feature, permanent or irreversible loss of soil functions over an area of <5 ha, or a temporary, reversible loss.
Negligible	• No loss or alteration of characteristics, features or elements, no observable impact in either direction.	• No significant loss in quality of receptor.

Significance of Effect

9.7.19 The significance of effect is determined by assessing the potential magnitude of impact on the receptors against the sensitivity of the receptor. **Table 9.7.3** presents the matrix for evaluation of the significance of effects. Moderate or major effects are considered significant in EIA terms.

Table 9.7.3 Significance of Effect

Sensitivity	Magnitude of Impact			
	Negligible	**Small**	**Medium**	**Large**
High	Not Significant	Moderate – Significant	Moderate – Significant	Major – Significant
Medium	Not Significant	Minor – Not Significant	Moderate – Significant	Moderate – Significant
Low	Not Significant	Not Significant	Minor – Not Significant	Minor – Not Significant

Likelihood of Occurrence

9.7.20 The significance of effects is determined as if the impact has actually happened. However, in the context of land quality and ground conditions it is also important to consider the likelihood of the impact occurring when assessing the overall significance of effects. The likelihood of occurrence is defined as follows:

- **High:** Occurrence of an impact is very likely in the short-term and is almost certain to occur in the long term, or a complete pollutant pathway is known to already exist;
- **Medium:** An impact may occur, either due to an unplanned event or the presence of a complete pathway, and it is probable that it will do so over the long term;
- **Low:** An impact may occur, either due to an unplanned event or the presence of a complete pathway, and it is possible that it will do so over the long term but there is no certainty that it will do so; and
- **Unlikely:** The potential for an impact to occur may be present, but the circumstances under which an adverse effect would materialise, even in the long-term, are improbable.

Site and Surrounding Area

9.7.21 This section provides a description of the key characteristics of W1. This description is derived from information from online public databases (in March 2025) and gathered during the ERM site visits which were undertaken in February to May 2025.

Site Description

9.7.22 W1 is located in the administrative area of CDC, approximately 1.3km to the west of Conisbrough (centred on National Grid Reference (NGR) SK 505963). W1 covers an area of approximately 450ha, predominantly made up of agricultural fields and four agricultural/commercial properties located in the north, east, and central areas of the Site. **ES Volume 3, Figure 3.2: Site Referencing [EN0110020/APP/6.19]** show the extent of W1.

9.7.23 There are currently three Cable Corridor Options included within the parameters of W1 which are:

- **CR 1a**: connecting to the east of W1, running west of the M18, to connect to the north of W2;
- **CR 1b**: connects to the south of W1, crosses the M18 and runs between Hellaby industrial estate and Maltby, and crosses back under the M18 to connect back to the north of W2; and
- **CR 1c**: connecting the main body of W1 with the eastern section of W1.

9.7.24 W1 almost entirely consists of agricultural land, with the exceptions being overlapping infrastructure, such as roads. The limits of W1 are defined by field boundaries as well as major roads in the area.

9.7.25 The Cable Corridor Options extend further south, straddling the M18 around Hellaby and joining with the most northern sections of W1 south of Wickersley.

9.7.26 Within the extents of W1 boundaries are four farm properties (and their associated private lands), which have been excluded from W1. The following information is gathered by satellite imagery and information in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**.

9.7.27 The most southerly of the farms is Conisbrough Lodge Farm, which is access via Park Lane which is located in the centre of W1. From satellite images the farm appears not to be in use. The property consists of three agricultural structures,

according to **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there is a Tank registered at this farm.

9.7.28 Hill Top Farm is located in the northwestern boundary and is accessed via an unnamed private road off Frisby Lane. Hill Top Farm also includes various auxiliary buildings and a large agricultural shed. According to **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, the Farm is registered as livestock farming.

9.7.29 The third farm property is located in the northeast area of W1, named Conisbrough Parks Farm. The farm is accessed via an unnamed road via Park Lane. The farm appears to consist of a residential building, and five agricultural structures or sheds.

9.7.30 W1 is bounded by a number of roads, A630/Sheffield Road along the northern boundary, Firsby Lane along the northwest boundary, and Ruddle Lane along the southeastern boundary. Park Lane is located in the centre of W1 and intersects the east and west areas of the Site. Beacon Lane is located in the southeastern area of W1. Two unnamed roads are located in the northern areas of W1. Three surface water features are located within W1 or directly adjacent to the boundary. Kearsley Brook is adjacent to the northeastern boundary, Firsby Brook is adjacent to the southern boundary, and The Brook is located within the centre of W1 and runs through both the northern boundary and southern boundary.

Surrounding Area Description

9.7.31 W1 is located in a predominantly rural area. The surrounding land is used for agricultural, as well as residential and commercial purposes. There are several farms and small residential clusters within approximately 250m of the Order Limits. Residential settlements (hamlets and villages) near W1 include; Hill Top (80m NW), Conanby (50m N), and Clifton (200m E). Villages including residential and commercial properties near the Cable Corridor Options include Hellaby (~200m east of CR 1a, ~180m west of CR 1b, Cliff Hills (~150m east of CR 1b), and Bramley (~260m west of CR 1a). There are also numerous individual properties distributed across the surrounding area within 250m of W1. These include Birk Lodge Farm / Squeaky Clean Cleaners (200m S), Firsby Hall Farm / Lee Ashworth (100m SW), Atlanta House (200m W), and Spring Bank Bungalow / Mucky Paws Pet Groomer (50m N).

Physical Setting

Topography

9.7.32 The topography of W1 is generally flat in the north, central, and west areas with the elevation difference approximately between 55 to 90m Above Ordnance Datum (AOD). The east and southeast areas of W1 have an elevation difference of 85 to 120m AOD with the elevation gradually increasing further east. The topography of the Cable Corridor Options ranges from 95 to 125m AOD.

Geology

9.7.33 According to the BGS Geology Viewer, a majority of W1 is underlain by bedrock geology of the Pennine Upper Coal Measures Formation (Carboniferous) consisting of mudstone, siltstone and sandstone. Southeastern areas and along parts of the northern boundary are underlain by bedrock geology of Cadeby

Formation (Permian) consisting of dolostone. The northwestern area of W1 is underlain by the sandstone Ravenfield Rock Member (Carboniferous). The majority of W1 has no mapped superficial geology, although a small area along the northern boundary of W1 is underlain by superficial Glaciofluvial Deposits (Mid Pleistocene) consisting of sand and gravel.

9.7.34 The Cable Corridor Options are underlain by similar geology, with no mapped superficial geology within the buffers of the Cable Corridor Options. The CR 1a and CR 1b routes are underlain by various sandstone Members of the Pennine Upper Coal Measures Formation. CR 1c is underlain by the Cadeby Formation consisting of dolostone.

9.7.35 The Cadeby Formation dolostone is extensively worked in the Doncaster area, with the closest works located at Holme Hall Quarry, approximately 1.2km east of W1. Consideration of impacts to the potential mineral resources are not covered in this PLQRA, having been addressed in the Draft ES.

9.7.36 According to the BGS Geoindex (Onshore), there are six borehole records which are directly within W1. Two of these are located in the west area of W1, near Firsby Lane (SK49NE2, and SK49NE2/A), one in the center of W1 (SK59NW47), another is located in the northern area of W1 (SK59NW23), and the last two boreholes are located in the south (SK59NW25) and southwest area of W1 (SK49NE84). There are many other boreholes recorded in the area around W1 and a vast majority of them are recorded for the purpose of coal exploration, with many being underground boreholes. Borehole Ref. SK59NW25 records interbedded sandstone and mudstones (Ravenfield Rock) from 16m BGL – 108m BGL. This is followed by similar rock types with interbedded coal. Multiple named seams of coal are identified up to a final depth of 735m BGL.

Hydrology

9.7.37 W1 has numerous surface water features which vary in size and significance. Kearsley Brook is adjacent to the northeastern boundary, Firsby Brook is adjacent to the southern boundary of W1 and cross through the northern area of CR 1a, and The Brook is located within the centre of W1 and goes through both the northern boundary and southern boundary. The Brook also crosses through northern area of CR 1b. Hellaby Brook crosses through the centre of CR 1a. Maltby Dike cross through the southern area of CR 1b.

9.7.38 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there are no water abstractions located in W1. There is one surface water abstraction record located approximately 100m southwest of W1. It is registered by Phoenix Sports and Social Club, and abstraction type is not supplied. as shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there are no water abstractions located within the buffer boundaries of CR 1a, CR 1b, or CR 1c.

9.7.39 Ravenfield Ponds are located approximately 150m west of W1. The River Don is located approximately 2.5km west of W1 and flows in a northeasterly direction where it joins the Humber estuary. This is the main river in the vicinity of W1 and it is expected that all main surface water courses within the Site will drain towards the River Don.

9.7.40 According to the EA Catchment Data Explorer, W1 extends over three different catchments. The southeastern section, up to roughly the area south of Beacon Lane, lie within the St. Catherine's Well Stream from source to the Torne Water Body Catchment that has moderate ecological status. Reasons for not achieving

good status are stated as pollution from wastewater and from towns, cities, and transport. The second catchment area is the Kearsley Brook Water Body Catchment, classified with moderate ecological status. This covers most of W1, encompassing the northern, eastern and southern areas. The final catchment area is the Hooton Brook from source to River Don Water Body, in the western areas of W1, classified as having good ecological status.

9.7.41 The Cable Corridor Options extend over a number of different catchments. CR 1c and north of CR 1b are within the Kearsley Brook Water Body Catchment. Northern areas of CR 1a and CR 1b are within the Hooton Brook from source to River Don Water Body. The central and southern areas of CR 1a, and CR 1b are within the Oldcotes Dyke Catchment (tributary of the Ryton) Water Body, which according to the EA Catchment Data Explorer, has a poor ecological status attributed to poor biological quality elements for fish, as well as failed hazardous chemical substance levels for mercury and its compounds, Perfluorooctane sulphonate (PFOS) and Polybrominated diphenyl ethers (PBDE).

Hydrogeology

9.7.42 According to DEFRA's Magic Map Tool, the Upper Coal Measures bedrock geology, which underlies the majority of W1, is classified as a Secondary A Aquifer. The EA designates a Secondary A Aquifer as a permeable layer capable of supporting local water supplies and, in some cases, forming an important source of base flow to rivers. The Cadeby Formation of dolostone, underlying small areas in the north and east of W1, is classified as a Principal Aquifer. Principal aquifers are designated by the Environment Agency as strategically important rock units that have high permeability and water storage capacity. The small area of superficial geology deposits in the north of W1 are classified as a Secondary A Aquifer.

9.7.43 As shown in **ES Volume 3, Appendix 9.5: Landmark Envirocheck® Report – Cable Corridors [EN0110020/APP/6.20]** report, the bedrock aquifer designation for all Cable Corridor Options is classified as a Secondary A Aquifer. The EA designates a Secondary A Aquifer as a permeable layer capable of supporting local water supplies and, in some cases, forming an important source of base flow to rivers. One exception is the southern area of CR 1a is classified as both Secondary A Aquifer and a Principal Aquifer. Principal aquifers are designated by the Environment Agency as strategically important rock units that have high permeability and water storage capacity. There is no superficial aquifer information available for the Cable Corridor Options.

9.7.44 The groundwater vulnerability for all of W1 is classified as high, with small sections of CR 1a located within areas of medium vulnerability. There is no soluble rock risk for W1.

9.7.45 The regional groundwater across the western and northern sections of W1 is expected to flow in a western / north-westerly direction towards the River Don, north of W1, while the groundwater across the eastern and southern sections of W1 is expected to flow towards the Idle River and Isle of Axholme catchment in an easterly and southerly direction. This is implied by the regional hydrogeology map[20], which shows that the Cadeby Principal Aquifer has potentiometric surface strongly dipping towards the east. It is also noted that the groundwater catchment divide runs in a northeast-southwest direction in the very eastern section of W1.

9.7.46 According to the EA Catchment Data Explorer, the majority of W1 is located in the Don & Rother Millstone Grit & Coal Measures Water Body. In 2019 it was

classified as having poor overall status due to poor groundwater chemical status attributed to historic mining and quarrying, as well as natural mineralisation. The most easterly parcels of W1, around the village of Clifton lie in the Idle Torne Magnesian Limestone Water Body. In 2019 it was classified as having poor overall status due to poor groundwater chemical status attributed to poor nutrient management from agriculture.

9.7.47 There is one groundwater abstraction recorded 100m southwest of W1 at Firsby Hall Farmland. The permit is for 'general farming and domestic' and the start date is listed as 1965 with no end date provided.

9.7.48 An accurate assessment for depth to groundwater has not been established for W1 or the Cable Corridor Options. This is primarily due to the lack of recorded borehole data with groundwater depth or detail in the regional hydrogeological mapping, although this does suggest that in the Clifton area the Cadeby Principal Aquifer is around 100m AOD, and so at a depth of around 20-30m BGL (if the Cadeby is actually that thick in the area, which is at the up-dip edge of its outcrop). It is expected that depth to groundwater will vary across W1, with shallower groundwater expected in valleys, especially where close to surface water bodies.

Ground Conditions

9.7.49 According to the Coal Authority Coal Mining Report there are historic underground coal sites in the centre and northern parts of W1. The mining depths are recorded between 750m and 995m between 1937 and 2003, and shallower historical coal workings (up to 30m depth) are considered likely. There have been a series of coal mine subsidence damage claims made, some successful, between 1995 and 2005 at and around Parks Farm in the northern central area oi W1. There have been no further records or claims of coal mine subsidence since 2005. There is a geological fault in the northwest of W1 with an orientation of northeast to southwest. This information is presented more fully in a Coal Mining Risk Assessment (**ES Volume 3, Appendix 9.10: Coal Mining Risk Assessment – W1 [EN0110020/APP/6.20]**) and is summarised and used in this Report to further describe the baseline.

9.7.50 According to the Doncaster Local Plan Sites and Policies Map, W1 is completely covered in Mineral Safeguarding Areas. The majority if W1 lies within a Shallow Coal Mineral Safeguarding Area (MSA), while the eastern most extents around the village of Clifton lie within a Magnesian Limestone MSA. There is also a very small area in the northwest of the W1, south of Sheffield Road, which is designated as a Sand and Gravel MSA.

9.7.51 According to the DEFRA Magic Map, a majority of W1 is classified as *"slowly permeable seasonally wet acid loamy and clayey soils, typical of those forming on the Coal Measure sandstones"*. Areas to the east and northwest are categorised as *"freely draining lime-rich loamy soils, probably related to the underlying Cadeby Formation dolostones."* There are no records of any peat soils being present within W1.

9.7.52 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there are two BGS recorded Mineral Site located within W1. One of these records is located in western area of W1, west of Park Lane. The Site name is reported as Conisbrough Parks Brick Field. The commodity is listed as common clay and shale, and the status is ceased. The second record is located in the northeastern area of W1, north of Conisbrough

Parks Farm. The Site name is reported as Clifton Common Shaft, the commodity is listed as coal-deep.

9.7.53 According to the Consultants Coal Mining Report, provided by the MRA, there are three recorded mine entries located within the northern and central section of the W1. The most northern of these, just south of Kearsley Brook, likely is the same shaft as Clifton Common Shaft. The Consultants Coal Mining Report refers to all three of these as mine shafts and they are recorded as having unknown treatment details. Further information is provided in the Coal Mining Risk Assessment (**ES Volume 3, Appendix 9.10: Coal Mining Risk Assessment – W1 [EN0110020/APP/6.20]**). The MRA designates that:

"Each mine entry has a zone of influence buffer around the mine entry. The Zone of Influence (ZoI) highlights the area on the surface that could potentially be affected in the unlikely event a collapse was to occur. The calculation takes into account the size of the mine entry entrance, the geological 'drift' deposits for the area and the original source from which the mine entry was captured. Where the calculated ZoI is less than 20m then a default value of 20m is used."

9.7.54 As such, for the mine entries recorded within W1, the ZoI is estimated to be 20m around the recorded entry.

Infilled Land

9.7.55 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]** and **ES Volume 3, Appendix 9.5: Landmark Envirocheck® Report – Cable Corridors [EN0110020/APP/6.20]**, four records of Potentially Infilled Land (Non-water) are located within W1. Two records of Potentially Infilled Land (Non-water) are located within the western area of W1, north of Conisbrough Lodge Farm. For both records the use is listed as 'Unknown Filled Ground (Pit, quarry etc)' and the date of mapping is listed as 1994. Two records of Potentially Infilled Land (Non-water) are located within the northeastern area of W1, north and west of Conisbrough Parks Farm. For both records the use is listed as 'Unknown Filled Ground (Pit, quarry etc)' and the date of mapping is listed as 1994.

Ground Stability

9.7.56 **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]** defines the ground stability through five different potential hazards: Collapsible Ground, Compressible Ground, Ground Dissolution, Landslide Ground Stability, and Shrinking or Swelling Clay.

9.7.57 Each of these potential hazard classifications is rated with a risk value ranging from no hazard to very high. **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]** lists multiple records across the Site which are all no or very low hazard. As such, a range of risk levels as been presented for each hazard category. For the Site at W1, these are as follows:

- *Potential for Collapsible Ground Stability Hazards*: **Very Low**, with deposits with potential to collapse when loaded and saturated unlikely to be present;
- *Potential for Compressible Ground Stability Hazards*: **No Hazard**, with compressible strata absent across the Site;

- *Potential for Ground Dissolution Stability Hazards*: **No Hazard – Very Low**, with issues associated with soluble rocks not likely to occur;
- *Potential for Landslide Ground Stability Hazards*: **Very Low**, with slope instability problems not thought to occur; and
- *Potential for Shrinking or Swelling Clay Ground Stability Hazard*: **No Hazard - Very Low**, with ground conditions predominately non-plastic.

9.7.58 For the Cable Corridor Options, the risk ratings are defined as follows:

- *Potential for Collapsible Ground Stability Hazards*: **Very Low** with deposits with potential to collapse when loaded and saturated unlikely to be present;
- *Potential for Compressible Ground Stability Hazards*: **No Hazard – Very Low** with compressible strata absent across most of the Site;
- *Potential for Ground Dissolution Stability Hazards*: **No Hazard – Very Low** with issues associated with soluble rocks not likely to occur;
- *Potential for Landslide Ground Stability Hazards*: **Very Low** with slope instability problems not thought to occur; and
- *Potential for Shrinking or Swelling Clay Ground Stability Hazards*: **Very Low** with ground conditions predominately non-plastic.

Other Protected Areas / Sensitive Land Uses

9.7.59 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there are no Areas of Unadopted Green Belt, Areas of Outstanding Natural Beauty, Environmentally Sensitive Areas, Forest Parks, Local Nature Reserves, National Nature Reserves, Marine Nature Reserves, National Parks, Nitrate Sensitive Areas, Ramsar Sites, Sites of Scientific Interest (SSSI), Special Areas of Conservation, Special Protection Areas, or World Heritage Sites within W1 or within 250m of the boundaries of W1.

9.7.60 According to the DEFRA Magic Map Tool, there are no Source Protection Zones, Drinking Water Protected Areas, or Drinking Water Safeguard Zones for surface water or groundwater.

9.7.61 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there are two 'Ancient Woodland' records reported within 250m of the Site. One record is located on the Site, in the southwestern area, and is approximately 11,300m^2 in area, and is reported as 'ancient and semi-natural woodland. The second record is located 8 meters west of the Site and is approximately 70,000 m^2 in area, named Hooton Cliff. This record is also reported as 'ancient and semi-natural woodland'.

9.7.62 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, there is one Local Nature Reserve record 3m southwest of the Site named 'Frisby Reservoir'.

9.7.63 As shown in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]**, the Site is located within a Nitrate Vulnerable Zone.

Radon

9.7.64 The UK Maps of Radon indicate that W1 is in a low probability radon area, as between 3-5% of homes at or above the action level. The majority of the Cable Corridor Options are within a low probability radon area, with between 1-3% of

homes above the action level. The southern areas of CR 1a and CR 1b are within a low probability radon area, with less than 1% of homes above the action level.

Historical Use Information

Approach

9.7.65 The historical development of W1 and surrounding area has been assessed through a review of available historical maps from the 1850s onwards, presented in **ES Volume 3, Appendix 9.2: Landmark Envirocheck® Report – W1 [EN0110020/APP/6.20]** and **ES Volume 3, Appendix 9.5: Landmark Envirocheck® Report – Cable Corridors [EN0110020/APP/6.20]**, aerial photographs and Google Earth. A summary of the key historical land uses and developments in the surrounding area is presented below.

Land Use History

9.7.66 The vast majority of W1 has been agricultural and undeveloped land since first mapped in the 1850s. Earliest maps dated 1854 show the Site area used as mainly agricultural fields, with structures observed where Conisbrough Lodge Farm, Hill Top Farm, and Conisbrough Parks Farm are similar to that observed in current aerial photographs. An area in the southwest area of the Site, northwest of 'Conisbrough Lodge Farm' is labelled as 'Brick field'. In 1893 maps, the area labelled 'Brick field' is no longer present and the rest of the Site remains the same. The Site remains unchanged until in maps dated 1903, where three areas in the northeast area of the Site is observed labelled "old shaft". One of the shafts is located north of 'Conisbrough Parks Farm' and is no longer shown on the maps dated 1930. The second is located immediately west of 'Conisbrough Parks Farm' and is observed on the maps until 1956. The third is located north of 'Conisbrough Lodge Farm' and is observed on the maps until 1956. The Site remains largely unchanged until in maps dated 1930, where an area in the northern area of the Site named "Parks Farms Cottages" is observed, located east of Park Lane. A railway line from north to south is located in the western area of the Site, which is shown on maps from 1930 until 1983. Two areas labelled 'windpump' are observed in the northern and southern areas of the Site. The first is observed north of 'Parks Farm Cottages' in the northern area of the Site and is observed in maps from 1930 to 1948. The second is observed south of 'Conisbrough Lodge Farm' and observed in maps from 1930 to 1973. An area labelled 'Tank' is observed associated with 'Hilltop Farm' located in the northwestern area of the Site. The area is observed in maps dated 1930 until 1956. The Site remains largely unchanged until maps dated 1956, where six areas labelled 'Air Shafts' are observed in the central area of the Site, southwest of 'Parks Farm Cottages'. These shafts are observed in maps dated 1956 to 2024. The Site remains largely unchanged until maps dated 2000, where a network of field drains are observed in the southwestern and eastern areas of the Site, that are observed through to 2024 maps.

9.7.67 The land use history within the Cable Corridor Options is similar to W1, with the majority of the land used for agricultural purposes since at least 1854. Between this date and the mid 1900s a number of settlements and individual properties that appear within the corridor of CR 1a and CR 1b but few other changes are observed. By 1930, there are two railway lines present which overlap with both CR 1a and CR 1b. CR 1a intersects with the Hull and Barnsley Joint Railway and the Midland Joint Railway at the Braithwell Northern Junction. CR 1b intersects

with the Hull and Barnsley Joint Railway south of Hellaby and again as the Cable Corridor Option diverts westward, north of the Braithwell Northern Junction. These railway lines are all marked as dismantled by 1974. By 1974, the M18 has been constructed, with CR 1a straddling its western side all the way from its southern point to the northern connection with W1. There is significantly more development within the corridor of CR 1b from 1930 onwards. In the land east of Hellaby, a large brick works is present from at least 1931. These brickworks see significant expansion through the 1940s and 1950s. By the 1960s, there are many more residential and other works buildings present east and north of Hellaby. By 1974, the brick works are now expanded into a large clay pit, which CR 1b directly passes through. Along with this, there are a number of factories, depots, warehouses and a school that CR 1b runs to the west of. From 1982 to 2000, there are further clay pits located in the same area. By 2006, most of the clay pits are labelled as disused, and the works buildings have been much reduced in size with most gone. Current satellite imagery shows the Site is mostly overgrown with vegetation, with some buildings remaining. The Site is currently designated as a significant historic landfill. Otherwise, the remaining sections of CR 1a, CR 1b and CR 1c all remain unchanged up to the present day, with agricultural/non-developed land as the primary use.

9.7.68 There are three large wind turbines present within W1, two in the north, one central. The nature of construction, cable connection and ownership of these turbines are not known, although will have required foundations at least a few metres deep, and possibly deeper piling in softer ground. W1 is also crossed by overhead powerlines suspended from tall pylons. Again, the construction details are not known but concrete encased foundations can be installed several metres into the ground, depending on the height and weight of the pylon and ground conditions.

Surrounding Area History

9.7.69 Historically, the area surrounding W1 has also been used for agricultural purposes, along with residential purposes. Since the earliest maps dated 1854, residential and commercial properties associated with the towns of; Hill Top (50m north of Site), Frisby (50m south of the Site), and Clifton (200m east of the Site) are observed through to present day. ‘Burcliff Wood’ and ‘Fish Ponds’ are located immediately west of W1. ‘Burcliff Wood’ area is labelled ‘Ravenfield Gorse’ from 1930 to present day maps. ‘Birk Lodge’ is located 200m south of the Site and is observed from 1854 to present day. A Sandstone Quarry is mapped 200m west of the Site from 1854 until 1893. Two springs are located 200m west of the Site and the ‘Frisby Reservoir’ is located 180m south that have been present since first mapped in the 1850s. In 1903 maps, an area labelled ‘Old Quarry’ is located 180m southwest of the Site and is observed on maps from 1903 until 1930. A railway line is observed in the south and northeast areas of the Site on maps from 1930 until 1983. Other features include a ‘Reservoir (Doncaster & Tickhill Joint Water Board)’ mapped 100m east of the Site from 1930 until 1966; a Windpump east of the Site on maps from 1930 to 1938; a ‘Sand Pit’ northwest of the Site on maps from 1930 to 1956; and a Limekiln 250m east of the Site on maps from 1930 to 1956. The “Sand Pit” corresponds to an identified MSA for sand and gravel adjacent to the Site boundary, and shows this area has already been worked to a certain extent. Otherwise, the adjacent areas remain largely unchanged until 1967, when what would become the M18 motorway was constructed and passes 20m southeast of the Site, and in 1983, when Sewage Works is observed located 10m northeast of the Site, still present.

9.7.70 The Cable Corridor Options have been predominantly surrounded by agricultural / non-developed land since mapped in the 1850s. Hellaby Hall is a significant private residence located 800m east of CR 1a and 450m west of CR 1b. Between 1854 and 1966, there is the expansion of a number of settlements and residential properties in the area around Hellaby and Bramley. By 1974, there are a number of works buildings in the land between CR 1a and CR 1b, now also east of the newly build M18. These works buildings see significant expansion throughout the 1980s and 1990s, eventually becoming Hellaby Industrial Estate, including warehouses, depots and an assembly hall. By 2000, the settlements of Bramley and Hellaby have also grown and now include many residential and commercial properties. Hellaby Industrial Estate remains to the present day and still contains a varied number of industrial and commercial properties. One of these properties (Great Bear Distribution Limited, Rotherham Warehouse, S66 8HN) is designated as a Control of Major Accident Hazards Site (COMAH).

9.7.71 There are no further notable sites of industrial or commercial use within 250m of the Site.

Soil and Groundwater Conditions

Potential Baseline Contamination Sources

9.7.72 The land use history and baseline knowledge described above has identified potential sources of soils at W1 as follows. **ES Volume 3, Figure 9.7.1: Map of Potentially Contaminated Sites [EN0110020/APP/6.19]** shows all identified Potential Sources of Contamination within the W1 and 250m buffer.

On Site

- Four records of Potentially Infilled Land (Non-water) ‘Unknown Filled Ground (Pit, quarry etc)’ and three mine entries with no records of whether infilled or not;
- Historical railway land located in the eastern area of W1 and overlapping with the southern extents of CR 1a and CR 1b (since 1930);
- Two BGS Recorded Mineral Sites, Conisbrough Parks Brick Field and Clifton Common Shaft;
- Within the CR 1a boundary, the Hellaby Park Farm Registered Landfill, Lidget Lane, Ravenfield, Rotherham. The licence holder is registered to R Wharam, and the maximum input rate is listed as Large, with 75,000 to 250,000 tonnes per year of waste deposited. There are no known restrictions on sources of waste;
- Within the CR 1a boundary, Hellaby Landfill historical landfill site, Ravenfield, Rotherham. Input dates between 1973 and 1973 with deposited waste including industrial, commercial and household waste, and liquid sludge; and
- Within the northeast area of CR 1b boundary, Maltby Brickworks Quarry historical and registered landfill site, Maltby, Rotherham. Size listed as very large (more than 250,000 tonnes per year), with no known restriction on the sources of waste.

Off Site

- Disused Railway Cutting Historic and Local Authority Recorded Landfill, Off Common Lane, Conisbrough, Doncaster, adjacent to the north. Last recorded input 29th April 1994. Deposited Waste included inert, industrial, commercial and special waste, liquid sludge, fume extraction dust, fume extraction sludge, industrial non-hazardous waste, iron hydroxide sludges, non-hazardous building/demolition/excavation waste, and non-hazardous and non-flammable sludges;
- Two records of Potentially Infilled Land (Non-water) 'Unknown Filled Ground (Pit, quarry etc)' located 246m southeast and 179m southwest of W1;
- Two records of Potentially Infilled Land (Water) 'Unknown Filled Ground (pond, marsh, river, stream)' located 237m east and 108m northeast of CR 1a;
- Bantry Road Historic and BGS recorded Landfill Site, located 84m north of CR 1a. No known last input date. Deposited Waste included inert, industrial, commercial and household waste, and liquid sludge;
- Hellaby Lane historic landfill Site, located 242m south of CR 1a. Site is also listed as a licensed waste management facility under Trevor Potts Waste Disposal Limited. Size is listed as large (more than 75,000 tonnes per year) with deposited waste including inert waste;
- Bramley Grange local authority recorded landfill site, located 165m north of CR 1a. Site is recorded as closed with types of waste including domestic and sewage sludge;
- Lidget Lane registered landfill site, located 61m west of CR 1a. The same site is also listed as a licensed waste management facility under H W Martin Waste Limited. There is no known restriction on source of waste;
- Back Lane historic landfill site, located 62m south of CR 1b. Licence holder is listed as T T Alton and Company Limited and deposited wastes included inert waste;
- Micklebring Quarries BGS Recorded Mineral Site, located 169m southwest of CR 1a;
- One record of Potentially Infilled Land (Non-water) 'Unknown Filled Ground (Pit, quarry etc)' located 205m northeast of CR 1b; and
- One COMAH Site, located 121m south of CR 1b, listed as Great Bear Distribution Limited, Rotherham Warehouse, Hellaby Lane, Hellaby, Rotherham, S66 8HN and the status is recorded as active.

Potential Baseline Pollutant Linkages and Receptors

9.7.73 The potential pathways and sensitive receptors associated with the baseline conditions (i.e. before the effects of the Proposed Development are taken into account) are described below.

Pathways

Human Health

- Inhalation of airborne dust and volatile vapours, ingestion of soil through handling and / or dermal absorption through skin from handling or working any

contaminated soils present during construction works or farming activities (e.g. ploughing);

- Ground gases, such as methane and carbon dioxide, that could form from natural deposits (e.g. peat), organic matter in landfills and infilled land, or from underground coal mine workings and mine entries (mine gas), accumulation of which could lead to a risk of explosion or asphyxiation to construction workers and nearby residents; and
- Inhalation of airborne soil dust by nearby residents.

Environmental

- Lateral migration of contaminants within perched waters to potentially affect surface water features present directly within W1 and the Cable Corridor Options including Kearsley Brook, Firsby Reservoir and The Brook. West of W1, surface water features which could be affected include Ravenfield Ponds and the River Don;
- Vertical percolation of contaminants to affect the underlying aquifers including the predominant bedrock of Secondary A Aquifer (Upper Coal Measures), areas of Principal Aquifer (Cadeby Formation Dolostone) and Secondary Undifferentiated Aquifers (shallow superficial deposits) potentially via pathways created by historical foundation / piling works during construction, at pylons and wind turbines, or along historic coal mine shafts, boreholes and water wells;
- lateral migration of contaminants within perched waters or from surface water runoff to potentially affect water-dependent habitat and ecology associated with adjacent surface water features adjacent to and within W1;
- lateral migration of ground gasses along natural pathways and along man-made features such as utilities trenches, under foundations and along pilings, as well as former coal mining structures;
- airborne migration of potentially contaminated soils by dusts generated by during construction works or farming activities (e.g. ploughing) to surface waters, designated habitats and adjacent agricultural land / soil resource; and
- lateral migration of contaminants to potentially affect the quality of adjacent agricultural land / soil resource.

Receptors

Human Health

- Future Site users and visitors;
- Future construction and maintenance workers; and
- Local residents via potential migration of contamination and gasses offsite in the zone of influence.

Environmental

- Underlying bedrock aquifers of Secondary A (Upper Coal Measures) and a small area of Principal Aquifer (Cadeby Formation dolostone) in the easternmost part of W1; and

- Surface water bodies including streams and lakes / ponds located on and near the Site and the aquatic habitats they support.

Preliminary Conceptual Site Model

9.7.74 The main potential sources of pollutants are likely to arise from the presence of historic landfills and quarries which have subsequently been infilled with known contaminating wastes, or with waste material of unknown composition. This is particularly prevalent in the area around Hellaby Industrial Estate where CR 1a and CR 1b transect either side and overlap with several known landfill sites with contaminating wastes. The remaining landfills and infilled land within close vicinity to the Cable Corridor Options as well as small areas in W1 that have the potential to contain contaminated waste materials, which could be mobilised into shallow groundwaters due to the construction activities of W1.

9.7.75 Another significant potential source of pollutants is the historic use of the Site for underground coal mining activities. Although the vast majority of mining activities took place well beneath the surface within the Study Area in the 20th century, some shallower historic infrastructure is thought likely. There have been no records of coal subsidence in the area for over 20 years. There are three recorded mine entries clustered in the northern section of W1. According to the Coal Authority Consultants Coal Mining Report (**ES Volume 3, Appendix 9.10: Phase 1 Coal Mining Risk Assessment: Whitestone 1 [EN0110020/APP/6.20]**), all have no recorded treatment details. As such, it cannot be ruled out that these mine entries were infilled with potentially contaminated material, which could be re-mobilised during construction, or remain as voids.

9.7.76 Other potential sources of pollutants could come from the current and historic agricultural land uses, including the use of pesticides, herbicides and storage of wastes and chemicals in and around farm buildings adjacent to W1. If elevated concentrations of polluting chemicals were present in the ground then they could pose a threat to the waters of Kearsley Brook, Firsby Brook and The Brook, as well as regional water bodies including Ravensfield Ponds and Firsby Reservoir.

9.7.77 Polluting chemicals could also potentially pose a threat to the underlying aquifers. The Cadeby Formation Principal Aquifer, present in the small area in the east, is vulnerable to leaching of contaminants due to the shallow depth to bedrock, with little intervening cover. Secondary A aquifers underlaying the majority of W1 could also be impacted by vertically migrating pollutants as the bedrock is also encountered at shallow depths. Potential pathways may be created between perched shallow groundwater and aquifers from the foundation / piling works during construction of solar arrays and substations, as well as at existing pylons and wind turbines, boreholes and mine shafts.

9.7.78 Adjacent land uses may already affect land quality within the area of W1, leading to potential additive or cumulative effects. This could include effects from registered and historical landfills, agricultural activities, railway land, storage of agricultural chemicals, historic industrial and coal mining activities and infilled land with unknown material. Pathways for effects from off-site sources could include leaching of contaminants into groundwater, lateral migration of contaminants within the groundwater and ground gasses, as well as potential airborne dust from off-site activities such as farming and construction.

Assessment of Potential Effects

Introduction

9.7.79 Screening of potential effects has been informed by currently available baseline data for W1. Qualitative assessment of risk from potentially contaminated land is covered under guidance documents, the approach of which has been combined with impact assessment methodologies in the following sub-sections with a view to identify mitigation that may be required during construction, operation or decommissioning.

9.7.80 The purposes of the following sections are to assess possible and probable effects and mitigation for the three phases of the Proposed Development.

9.7.81 Overall, it is not anticipated that contaminated land is likely to present a significant source of potential effects, particularly as the majority of W1 has historically been used primarily as agricultural land. The only proven potential sources of pollution in and around W1 are the landfills intersected by Cable Corridor Options, although it is not the intention that the final cable route choice would be such that a trench would actually excavate through known licenced waste landfill material. There is also a proven potential source at the small landfill in the former railway cutting adjacent to the northeast of W1, although proposed works here are for mitigation land, and no trenching or piling works will be carried out nearby.

9.7.82 As described above we consider the following potential sources may be present within the Proposed Development:

- Current and historic landfills located adjacent or within 250m of W1;
- Potentially infilled land from BGS mineral sites (Conisbrough Parks Brick Field and Clifton Common Shaft), infilled mine entries and any other record of infilled land mapped in W1, as all of these workings may be backfilled with unknown material; and
- Current and historic agricultural use of land with potential for diffuse pollutants across fields at lower concentrations (e.g. herbicides and pesticides, reduced nitrogen compounds).

Assessment of Potential Effects During Construction

9.7.83 Effects during construction have the potential to result from changes in contamination sources, pathways and receptors (construction workers and visitors) compared to baseline conditions. Construction of the Proposed Development may be expected to include potential activities which could, in the absence of mitigation, influence contamination sources and pathways.

9.7.84 It should be noted that ‘an effect’ would only be expected where a pollutant linkage exists (i.e. a defined source was connected via a defined pathway to a defined receptor). In the majority of cases, potential effects during construction can be avoided and minimised through standard construction management practices (e.g. those in the Outline Construction Environmental Management Plan (oCEMP)). In addition, other specific additional mitigation, such as method statements and pollution prevention measures, are identified where required.

9.7.85 Potential effects of the Proposed Development in the construction phase are:

- Disturbance and / or removal of polluted ground and potentially groundwater which could potentially remove, relocate or mobilise pollutants, including ground gasses;
- Use of plant and equipment which could accidentally leak fuels and oils, introducing contaminants to the ground;
- Use of horizontal drilling techniques to install cables which could accidentally leak drilling fluids, introducing pollutants to the ground and potentially into surface water;
- Installation of sub-surface structures, such as cables, piles and foundations, which could act as new pathways for mobilised pollutants (including heat in groundwater and ground gasses);
- Storage and use of hazardous materials and substances (e.g. concretes, fuel, oils and drilling fluids) which could accidentally escape to ground or controlled waters; and
- Exposure of construction workers to soil excavation activities via dust inhalation, ingestion and dermal contact.

9.7.86 A schematic cross-section of the Conceptual Site Model (**Plate 1**) has been developed to visualise the potential contaminant pathways and receptors described in the following tabulations.

Plate 1 Cross Section of Conceptual Site Model

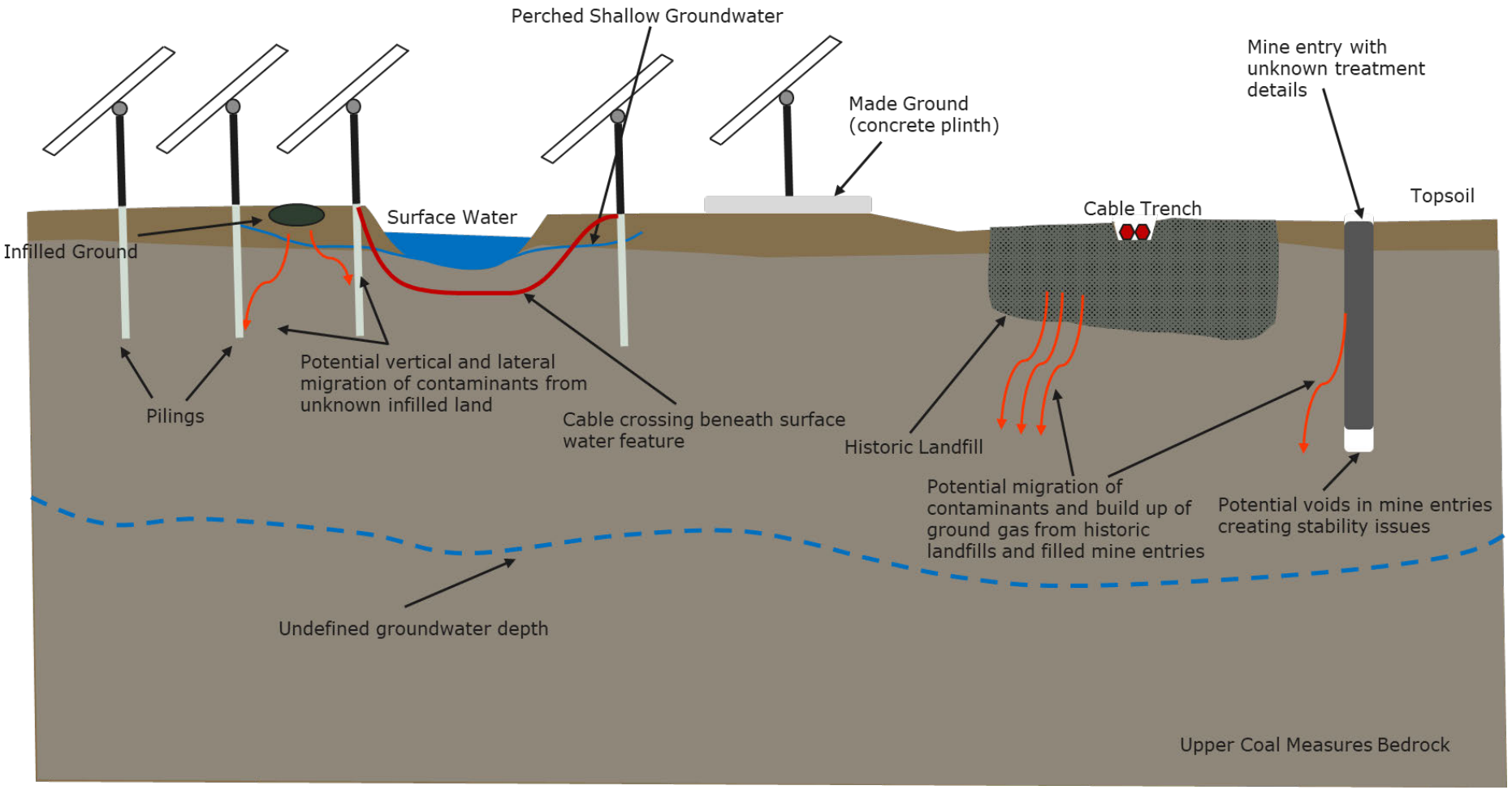

Table 9.7.4 Assessment of Potential Effects During Construction

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
Human Health							
Excavation of soils for cable laying in areas of historical waste landfilling, or adjacent to them.	Construction workers exposed to historic contaminated soil	Inhalation, ingestion and dermal contact	High	Small	Low	Moderate-Low	Yes – avoid cable laying across areas of historical waste landfilling, or else Phase 2 Site Investigation (SI) to assess conditions
Trenching and piling for the installation of cables, solar panels and foundations producing new pathways for ground gas migration	Construction workers and nearby residents / workers exposed to ground gas accumulation with risk of explosion or asphyxiation	Introducing new pathways between ground gas sources / accumulations (especially waste landfills and mine entries) and receptors	High	Moderate	Very Low	Moderate-Low	Yes – avoid subsurface installations in or adjacent to areas of known waste landfilling or mine ZoIs, or else Phase 2 SI to assess conditions
Excavation of soils for cable laying in areas affected by accidental spillages during	Construction workers exposed to accidentally contaminated soil	Inhalation, ingestion and dermal contact	High	Small	Very Low	Low	No – mitigation from Construction Environmental Management Plan (CEMP) (outline version provided in **oCEMP [EN0110020/APP/5.9]**)

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
construction (e.g. fuels)							
Traffic movement, creation of contaminative dust from historical, agricultural or accidental sources	Construction workers and nearby residents / workers exposed to potentially contaminated dust	Inhalation of airborne dust	High	Small	Low	Moderate-Low	No – mitigation of dust management within CEMP (outline version provided in **oCEMP [EN0110020/APP/5.9]**)
Environment							
Earthworks and piling activities, the excavation of cable trenches and / or removal of the made ground / topsoil, at or adjacent to historical waste landfilling (mainly in the Cable Corridor Options where routes overlap	Potential to remove, relocate or mobilise contaminants (if present) to adjacent agricultural land, underlying Secondary A and Principal aquifers and nearby surface waters.	Migration of leaching contaminants laterally, or vertically to the underlying aquifer	High	Large in southern CR 1a and CR 1b, Low elsewhere (including land infilled with unknown material)	Low, Very Low for land infilled with unknown material	High in southern CR 1a and CR 1b, very Low elsewhere	No – low to very low risk overall. Include encountering potential contaminated soils procedure in CEMP (outline version provided in **oCEMP [EN0110020/APP/5.9]**)
		Migration of contaminants from surface run-off to surface water features, field drains and adjacent land					No – mitigation from CEMP (outline version provided in **oCEMP [EN0110020/APP/5.9]**)

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
with known landfills), as well as land infilled with unknown materials							
Use of plant and equipment during construction	Potential of accidental leakage of fuels and oils, introducing contaminants to the ground	Migration of leaching contaminants from spills to soils and groundwater, with potential run-off to surface water features	High	Small	Low	Low	No – mitigation from CEMP (outline version provided in **oCEMP [EN0110020/APP/5.9]**)
Storage and use of materials and substances with polluting potential (e.g. concrete, fuel, oils and soils)	Potential for mobilisation to ground and surface waters or Secondary A aquifer if leak occurs.	Migration of leaching contaminants from spills, with potential for run-off to surface waters or infiltration into Secondary A aquifer.	High	Small	Low	Low	No – mitigation from CEMP (outline version provided in **oCEMP [EN0110020/APP/5.9]**)
Cable installation	Accidental break-out of	Direct release into	High	Small	Low	Low	No – mitigation from CEMP (outline version

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
under surface waters and roads using horizontal directional drilling (HDD)	HDD fluids into surrounding ground, which may include Secondary A Aquifer, or to surface waters.	Secondary A Aquifer, or to surface waters, or migration via baseflow to them.					provided in **oCEMP [EN0110020/APP/5.9]**)
Ground Conditions							
Installation of solar array piles or cable trenching over mine entries (capped or uncapped)	Excavation instability, leading to potential for death or injury to construction workers and/or damage to equipment	Geotechnical failure of cap or in the case uncapped mine entries	High	Small	Medium	Moderate	Yes – avoid cable laying, piling & foundations across mine entry zones of influence, or else Phase 2 SI to assess conditions

Assessment of Potential Effects During Operation and Maintenance

9.7.87 Potential effects during the operation and maintenance of the Proposed Development may result from:

- Changes to receptors which will now compromise any site maintenance workers, potential new nearby residents and visitors;
- Changes to the amount and nature of wastes produced;
- Storage and handling of site maintenance materials such as fuels and other chemicals, which could leak and/or spill, introducing contaminants to the ground and/or groundwater; and
- Heat generated by the buried high voltage cables through the Cable Corridors.

9.7.88 As with the construction-related effects identified in **Table 9.7.4**, it is envisaged that the majority of potential effects can be avoided and /or minimised through good operational management practice. The potential effects during operation are summarised in **Table 9.7.5**.

Table 9.7.5 Assessment of Potential Effects During Operation and Maintenance

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
Human Health							
Site activities and facilities including handling and containment of any generated waste and potential chemical and oil storage areas	Handling of wastes, any accidental spills or soils impacted by them by site workers	Inhalation, ingestion and dermal contact of wastes or accidentally introduced contaminated soils	High	Small	Low	Low	No – will be covered in operational environmental management plans (outline version provided in **Outline Operational Environmental Management Plan (oOEMP) [EN0110020/APP/5.10]**)
Environment							
High voltage buried cable route (note low voltage routes have negligible effect)	Heating of surrounding soils that may include underlying Secondary A or Principal aquifers	Heat transfer and groundwater migration	High	Small – cable trench likely to be above Secondary A and Principal Aquifer in	Moderate	Moderate-Low	Yes – consider thermally insulated cables and, measures to minimize lateral groundwater flow in areas where present

				most places				
Site activities and facilities including handling and containment of any generated waste and potential chemical and oil storage areas	Spills and leaks of oil, fuel and other polluting substances entering surface watercourses, or infiltrating soils into shallow groundwater	Spill of materials followed by leaching or lateral migration from surface run-off	High	Small	Low	Low	No – will be covered in operational environmental management plans (outline version provided in **oOEMP [EN0110020/APP/5.10]**)	

Assessment of Potential Effects During Decommissioning

9.7.89 Decommissioning is anticipated to involve the removal of all above surface structures and possibly some of the buried cables, followed by reinstatement of ground to a condition suitable for whatever after use is proposed, most likely agriculture. A laydown area will also be involved.

9.7.90 Potential effects during the decommissioning phase will be broadly similar to those during the construction phase in that there will be an influx of new contractors to deconstruct the plant and equipment.

9.7.91 Potential effects during the decommissioning phase of the Proposed Development may result from:

- Changes to receptors, which comprise decommissioning contractors, nearby residents and visitors;
- Storage and handling of materials (oil, fuel and others) which could leak and/or spill, introducing contaminants to the ground and/or groundwater; and
- Possible disturbance of contamination sources through ground disturbance.

9.7.92 As with the earlier phase effects identified, it is envisaged that the majority of potential effects can be avoided and /or minimised through good operational management practice, including those to be developed in the future (e.g. Decommissioning Environmental Management Plan (DEMP)). The potential effects during decommissioning are summarised in **Table 9.7.6**.

Table 9.7.6 Assessment of Potential Effects During Decommissioning

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of Impact	Likelihood of PPL / Effect	Potential Risk Rating	Mitigation Required?
Human Health							
Excavation of soils for the removal of cables in areas affected by accidental spillages or historical contamination	Construction workers exposed to accidentally contaminated soil	Inhalation, ingestion and dermal contact	High	Small	Very Low	Low	No – mitigation from DEMP (outline version provided in **Outline Decommissioning Management Plan (oDEMP) [EN0110020/APP/5.11]**)
Traffic movement, creation of contaminative dust from historical, agricultural or accidental sources	Construction workers and nearby residents / workers exposed to potentially contaminated dust	Inhalation of airborne dust	High	Small	Very Low	Low	No – mitigation of dust management within DEMP (outline version provided in **oDEMP [EN0110020/APP/5.11]**)
Environment							
Excavation of soils for the removal of cables in areas affected by accidental spillages or	Potential to remove, relocate or mobilise contaminants (if present) to adjacent agricultural	Migration of leaching contaminants vertically and laterally from contaminants in soils and underlying	High	Low	Very Low	Low	No – mitigation from DEMP (outline version provided in **oDEMP [EN0110020/APP/5.11]**)

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of Impact	Likelihood of PPL / Effect	Potential Risk Rating	Mitigation Required?
historical contamination	land, underlying Secondary A and Principal aquifers, and nearby surface waters	aquifers with potential run-off to surface water features					
Use of plant and equipment during decommissioning	Potential of accidentally leakage of fuels and oils, introducing contaminants to the ground	Migration of leaching contaminants from spills in soils and underlying aquifers with potential run-off to surface water features	High	Small	Very Low	Low	No – mitigation from DEMP (outline version provided in **oDEMP [EN0110020/APP/5.11]**)
Storage and use of materials and substances with polluting potential (e.g. concretes, fuel, oils and soils)	Potential for mobilisation to ground and controlled waters or Secondary A aquifer if leak occurs	Migration of leaching contaminants from spills, with potential for run-off to surface water features or infiltration to Secondary A aquifer	High	Small	Low	Low	No – mitigation from DEMP (outline version provided in **oDEMP [EN0110020/APP/5.11]**)

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of Impact	Likelihood of PPL / Effect	Potential Risk Rating	Mitigation Required?
Removal of shallow to moderate depth, cables (1.2m), panel frame posts and substation and Power Conversion System (PCS) foundations (up to 4m) in areas where there was historical landfilling (mainly in the Cable Corridor Options where routes overlap with known landfills)	Preferential vertical pathway created for migration of contaminated materials to underlying Secondary A and Principal Aquifers	Contaminated soils could leach and / or groundwater could migrate vertically through shallow deposits and into Secondary A and Principal Aquifers and potentially on to surface waters via baseflow	High	Large in southern CR 1a and CR 1b, Low elsewhere	Low	High in southern CR 1a and CR 1b, very Low elsewhere	Yes – was avoided or assessed by Phase 2 SI in the construction phase.

Summary and Conclusions

9.7.93 This Report presents a preliminary qualitative risk assessment of land quality and ground conditions for W1 located to the east of Sheffield in the administrative area of CDC, approximately 1.3km south of Conisbrough. The assessment covers the 450ha W1 site and associated Cable Corridor Options, forming the northernmost section of the Proposed Development. This Phase 1 desktop study focuses on all areas where ground disturbance is anticipated, with particular attention to potentially contaminated land and ground conditions that may influence the Proposed Development. The assessment is undertaken in accordance with relevant regulatory requirements and guidance, including the Environmental Protection Act 1990, EA/DEFRA LCRM 2023, and the National Planning Policy Framework.

9.7.94 The W1 site comprises predominantly agricultural land, with boundaries defined by field edges and major roads such as the A630, Firsby Lane, and Ruddle Lane. The area is characterised by generally flat topography (55–120m AOD), intersected by surface water features including Kearsley Brook, Firsby Brook, and The Brook, and encompasses several farms, and is adjacent to residential clusters, and commercial properties. The underlying geology is dominated by Pennine Upper Coal Measures Formation (mudstone, siltstone, sandstone), with small areas of Cadeby Formation (dolostone) in the east and Ravenfield Rock (sandstone) in the west. Superficial deposits are limited, with some glaciofluvial sand and gravel in the north. The Cable Corridor Options cross similar geological units, passing over both Principal and Secondary Aquifers. Groundwater vulnerability is classified as high across most of W1.

9.7.95 The W1 site and its surroundings have a long history of agricultural use, along with smaller areas of historic coal mining, including 3 mine shafts, brick works, quarries, and railway infrastructure. There are multiple records of infilled land, quarries, and land drains, as well as several historic and registered waste landfills both adjacent and within 250m of W1. Some parts of the Cable Corridor Options pass over or alongside historic and registered waste landfills in the Hellaby area. Waste types disposed in these include inert, industrial, commercial, domestic, sewerage and liquid sludge. Other adjacent land uses include farms, residential properties, and again, mainly in the Hellaby area, industrial estates and a Control of Major Accident Hazards site. Other potential sources of contamination include infilled land from historic mining and quarrying, diffuse agricultural pollutants (e.g., pesticides, herbicides), and nearby landfills.

9.7.96 Pathways for potential pollutant migration include direct contact, inhalation of dust, ground gas migration (from both waste landfills and from mine entries), leaching to groundwater, and lateral migration to surface waters. Sensitive receptors identified are future site users and visitors, construction and maintenance workers, local residents, underlying aquifers, and adjacent surface water bodies. The Proposed Development will involve ground disturbance through pile driving (up to 4m depth), trenching for cable installation (typically 1.2m depth), and construction of foundations for substations and supporting infrastructure.

9.7.97 The risk assessment considers Potential Pollutant Linkages (PPLs) for construction, operation and maintenance, and decommissioning phases, evaluating the sensitivity of receptors, magnitude and likelihood of effects, and the need for mitigation. In most cases, potential effects can be avoided or minimised through standard construction and operational management practices which are

set out in the management plans accompanying the DCO Application. Moderate and some low risk PPLs during construction include:

- Excavation in areas of historical waste landfilling, with potential exposure of workers and nearby residents to contaminated soils and ground gasses;
- Excavation in areas of mine entries, with potential exposure of workers to unstable ground, contaminated soils and ground gasses;
- Mobilisation of contaminants through soil handling, potentially affecting adjacent land, aquifers, and surface waters;
- Creation of preferential pathways for contaminant migration, including ground gasses, via foundations and cable trenches, particularly in or adjacent to areas of waste landfills or mine entries; and
- Accidental release of drilling fluids during Horizontal Directional Drilling (HDD) for cable installation.

9.7.98 During operation and maintenance, the primary PPL requiring further mitigation is the potential heating of soils and groundwater by high-voltage buried cables, particularly where these cross sensitive aquifers. Mitigation may include the use of thermally insulated cables and measures to minimise groundwater flow. Decommissioning effects are expected to be similar to those during construction, with risks managed through appropriate environmental management plans and by avoiding disturbance of waste landfills, and of other infilled land where possible.

9.7.99 In conclusion, while the W1 site includes historic and registered waste landfills along parts of the Cable Corridor Options and adjacent to W1, as well as areas of historic infilled land and coal mining features, the majority of the land is agricultural with no likely significant sources of pollution. Adherence to standard management plans and targeted mitigation, such as avoiding ground disturbance in and adjacent to historic and registered waste landfills and providing thermal shielding for high-voltage cables, will reduce overall risks to low. For piling and trenching activities that cannot be avoided in the small areas of infilled land or in the zones of influence of coal mine entries in W1, additional Phase 2 intrusive investigation may be considered to assess the land quality and ground conditions prior to works commencing.

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