



WHITESTONE
solar farm

WHITESTONE SOLAR FARM

Volume 6: Environmental Statement

6.20 Appendix 9.8: Phase 1 Contaminated Land Report: Whitestone 2 (Clean)

Application Document ref. EN0110020/APP/6.20.1

Revision 02

August 2026

Planning Act (2008)
Infrastructure Planning (Applications:
Prescribed Forms and Procedure)
Regulations 2009
Regulations 5(2)(a)

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ENVIRONMENTAL STATEMENT

Document Status					
Version	Purpose of Document	Authored by	Reviewed by	Approved by	Review Date
Rev01	DCO Submission	ERM	TLT, Pershing, DWD, AECOM, Whitestone Net Zero Ltd	Whitestone Net Zero Ltd	01/06/20 26
Rev02	Section 51 / 55 Updates	ERM	DWD, Pershing, Whitestone Net Zero Ltd	Whitestone Net Zero Ltd	August 2026

Approval for Issue			
Whitestone Net Zero Ltd			3 August 2026

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Whitestone Net Zero Ltd

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Glossary

Term	Meaning
<i>Agricultural Land Classification (ALC)</i>	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 characteristics (depth, structure, texture, chemistry, stoniness) as well as climate and site aspects.
<i>Aquifer</i>	"Underground layers of water-bearing, permeable rock from which groundwater can be extracted" (British Geological Survey).
<i>Best and Most Versatile (BMV)</i>	Best and Most Versatile is agricultural land with an Agricultural land Classification of Grade 1, Grade 2 or Grade 3a (National Planning Policy Framework).
<i>Cable Corridors</i>	Corridors within which the high voltage cables would be constructed.
<i>Conceptual Site Model</i>	"A representation of the characteristics of a site which shows the possible relationships between contaminants, pathways and receptors" (Land Contamination Risk Management).
<i>Draft Environmental Statement</i>	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.
<i>Environmental Statement (ES)</i>	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.
<i>Made Ground</i>	Land where the pre-existing ground surface is raised or replaced by artificial or man-made deposits.
<i>Mineral Safeguarding Area</i>	"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).
<i>Principal Aquifer</i>	"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).
<i>Order Limits</i>	Maximum extent of the Proposed Development comprising the Site and Cable Corridors.
<i>Secondary Aquifer</i>	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.

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Term	Meaning
<i>Source Protection Zone</i>	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).
<i>Study Area</i>	The spatial extent within which environmental receptors may experience likely significant effects from the Proposed Development.
<i>The Applicant</i>	Whitestone Net Zero Ltd.
<i>The Application</i>	The Application submitted to the Secretary of State for a Development Consent Order.
<i>The Proposed Development</i>	The proposed Whitestone Solar Farm.
<i>The Site</i>	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.
<i>Whitestone 1 (W1)</i>	The northern parcels of the Whitestone Solar Farm.
<i>Whitestone 2 (W2)</i>	The middle parcels of the Whitestone Solar Farm.
<i>Whitestone 3 (W3)</i>	The southern parcels of the Whitestone Solar Farm.

Acronyms

Acronym	Meaning
<i>ALC</i>	Agricultural Land Classification
<i>AoI</i>	Area of Influence
<i>BESS</i>	Battery Energy Storage System
<i>BGL</i>	Below Ground Level
<i>BGS</i>	British Geological Survey
<i>BMV</i>	Best and Most Versatile
<i>BS</i>	British Standards
<i>CDC</i>	City of Doncaster Council
<i>CEMP</i>	Construction Environmental Management Plan
<i>DCO</i>	Development Consent Order
<i>DEFRA</i>	Department for Environmental, Food and Rural Affairs
<i>DEMP</i>	Decommissioning Environmental Management Plan
<i>EA</i>	Environment Agency
<i>EIA</i>	Environmental Impact Assessment
<i>ES</i>	Environmental Statement
<i>HDD</i>	Horizontal Directional Drilling
<i>IEMA</i>	Institute of Environmental Management and Assessment
<i>LCRM</i>	Land Contamination Risk Management
<i>MRA</i>	Mining Remediation Authority

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Acronym	Meaning
<i>NEDDC</i>	North East Derbyshire District Council
<i>NPPF</i>	National Planning Policy Framework
<i>oCEMP</i>	Outline Construction Environmental Management Plan
<i>oDEMP</i>	Outline Decommissioning Environmental Management Plan
<i>OEMP</i>	Operational Environmental Management Plan
<i>oOEMP</i>	Outline Operational Environmental Management Plan
<i>PCS</i>	Power Conversion System
<i>PLQRA</i>	Preliminary Land Qualitative Risk Assessment
<i>PPL</i>	Potential Pollutant Linkages
<i>PV</i>	Photovoltaic
<i>RMBC</i>	Rotherham Metropolitan Borough Council
<i>SI</i>	Site Investigation
<i>SPZ</i>	Source Protection Zone
<i>W1</i>	Whitestone 1
<i>W2</i>	Whitestone 2
<i>W3</i>	Whitestone 3

Units

Units	Meaning
<i>ha</i>	Hectares
<i>km</i>	Kilometres
<i>kV</i>	Kilovolt
<i>m</i>	Metres
<i>MW</i>	Megawatts

9.8 Phase 1 Contaminated Land Report: Whitestone 2

Introduction

Scope and Purpose

- 9.8.1 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, maintenance, and decommissioning of the Whitestone Solar Farm (the Proposed Development). This Report considers the Site history, geology, hydrogeology and land quality at Whitestone 2 (W2).
- 9.8.2 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

- 9.8.3 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/2.3.1]**.
- 9.8.4 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. It is designed to meet regulatory requirements and guidance, as outlined in the following sub-section.
- 9.8.5 This Report represents the full coverage for W2, the central sections of the Proposed Development. Whitestone 1 (W1) and Whitestone 3 (W3) are presented in **ES Volume 3, Appendix 9.6: Phase 1 Contaminated Land Report: W1 [EN0110020/APP/6.20]** and **ES Volume 3, Appendix 9.9: Phase 1 Contaminated Land Report: W3 [EN0110020/APP/6.20]**, respectively.

Regulatory Requirements and Guidance to the Approach

- 9.8.6 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) 2023²;
- 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 practice⁷;
- BS EN1997 (EC7) and BS 8004:2015+A1:2020 - Code of practice for foundations⁸;
- Institute of Environmental Management & Assessment (IEMA) of Land and Soil in Environmental Impact Assessment (EIA) Guidance (2022)⁹;
- EU Groundwater Directive (2006/118/EC) 2006¹⁰;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017¹¹; and
- EU Water Framework Directive (2000/60/EC)¹².

9.8.7 The approach taken for this Phase 1 desktop study includes a description of the environmental setting for all areas of W2 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 Wales¹³;
- BGS GeoIndex Onshore interactive map viewer, including borehole records¹⁴;
- Defra's 'Magic' Map and Historical Landfills Sites database¹⁵;
- The Mining Remediation Authority's (MRA, formerly the Coal Authority) interactive map viewer¹⁶;
- EA Catchment Data Explorer¹⁷;
- UK Radon Maps¹⁸;
- Rotherham Local Plan Interactive Policies Map¹⁹;
- **ES Volume 3, Appendix 9.3: Landmark Envirocheck® Report – W2 [EN0110020/APP/6.20]**;
- Landmark Envirocheck® Reports for the Cable Corridor Options (see **Volume 3, Appendix 9.5: Landmark Envirocheck® Report for Cable Corridor Options [EN0110020/APP/6.20]**);
- The Coal Authority Consultants Coal Mining Report for W2 (see **ES Volume 3, Appendix 9.11: Phase 1 Coal Mining Risk Assessment: W2 [EN0110020/APP/6.20]**); and
- **ES Volume 3, Appendix 9.11: Phase 1 Coal Mining Risk Assessment: W2 [EN0110020/APP/6.20]**.

- 9.8.8 In line with the guidance above, the Phase 1 desk study includes a preliminary risk assessment framed within a conceptual site models developed for specific parts of W2, 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.
- 9.8.9 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 or design work to be undertaken prior to redevelopment.

Summary of the Proposed Development and Potential Effects on Land Quality

- 9.8.10 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 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. 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 see **ES Volume 1, Chapter 5: The Proposed Development [EN0110020/APP/6.5]**, respectively.
- 9.8.11 The Area of Influence (AoI) considered in this 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 W2 only and immediately adjacent land. The W2 part of the Whitestone Solar Farm will include the location of the BESS, a substation and satellite substation, and the specific effects of these facilities are considered in this Report. At the current stage, the BESS has two location options: W2 P2, located immediately south of the M1 to the east of Upper Whiston; and W2 P3, located to the southeast of W2. The primary substation has four location options: W2 P1, located to the west of W2, adjacent

to the National Grid Brinsworth; W2 P2; W2 P3; and W2 P4, (also an option for satellite substation) located to the southeast of W2, approximately 1.1km north of Todwick. The satellite substation currently has two proposed location options: W2 S1, Located immediately west of the M1, to the south of W2; and W2 P3.

- 9.8.12 The solar PV modules would be mounted on metal racks, known as mounting structures. These mounting structures will be galvanised or bare metal frames which would be pile-driven or installed by helical screws to a maximum depth of 4m below ground level (BGL). Where ground investigation surveys show the ground to be unsuitable for piles or screws, a concrete ballast would be used. Solar PV modules would be bifacial, meaning both faces of the modules would have the capacity to absorb sunlight. The solar PV modules would be installed in rows, with a minimum of 3m between each row.
- 9.8.13 Power Conversion Stations (PCS) manage the output generated by the solar PV modules. They consist of multiple components housed in a single enclosure. A PCS will be placed on a hardstanding foundation which would not typically exceed depths of 2m BGL but could also include piling to depths of up to 4m BGL.
- 9.8.14 The BESS units will be located on foundations of hardstanding, which will not typically exceed depths of 2m BGL. Pile foundations could exceed 2m depth BGL should they be required following ground investigation and could be up to depths of 4m BGL. The dimensions and quantities will depend on the number, size and weight of the BESS units chosen at detailed design stage. The final location for the BESS will be determined by a combination of engineering and environmental assessment, and consultation with stakeholders and communities, and will be confirmed in the Environmental Statement.
- 9.8.15 Primary and satellite substations, and associated infrastructure within the substation compound will be located on concrete foundations with a maximum depth of 2m BGL, unless pile foundations are required, which would exceed 2m BGL, potentially up to 4m BGL.
- 9.8.16 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 that include heat in the case of cables;
 - 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.

- 9.8.17 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.
- 9.8.18 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.
- 9.8.19 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 the Proposed Development, are not included in this Report as they are subject to separate survey and baseline reporting.

Methodology for the Assessment of Effects

- 9.8.20 The normal procedure for assessing land, as detailed by the current 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

- 9.8.21 The sensitivity (value) of potential receptors can be described qualitatively according to the categories presented in **Table 9.8.1**.

Table 9.8.1 Sensitivity of Receptors

Sensitivity	Receptor
High	• Human health: onsite residential developments, onsite construction workers; and

	Controlled waters (groundwater): Source Protection Zone (SPZ) 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

9.8.22 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 9.8.2**.

Table 9.8.2 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 >20ha, or loss or isolation of strategic mineral resource.
Medium	Results in impact on integrity of attribute/or loss of part of attribute, and/or possibly cause exceedance of statutory objectives and/or breach of legislation.	- 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 over an area of 5 – 20ha, 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 <5ha, or a temporary, reversible loss.
Negligible	No loss or alteration of	No significant loss in quality of receptor.

	characteristics, features or elements, no observable impact in either direction.	
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Significance of Effect

9.8.23 The significance of effect is determined by assessing the potential magnitude of impact on the receptors against the sensitivity of the receptor. **Table 9.8.3** presents the matrix for evaluation of the significance of effects. Moderate or major effects are considered significant in EIA terms.

Table 9.8.3 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

9.8.24 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

9.8.25 This section provides a description of the key characteristics of W2. This description is derived from information provided from online public databases and

gathered during the ERM site visits which was undertaken in February to May 2025.

Site Description

- 9.8.26 W2 is located entirely within the administrative area of Rotherham Metropolitan Borough Council, South Yorkshire, and covers approximately 742ha, primarily consisting of agricultural land. The M1 motorway bisects W2, running north to south through its centre. W2 has a broad, open and undulating landscape, forming small shallow valleys with extensive views. Trees and hedgerows form divides between the fields. There are multiple sections to W2. The central and largest sections are located east and west of the M1, with the village of Ulley located at the western boundary and Thurcroft to the north. The western most sections are located south and adjacent to the M1 at junction 33, east of the village of Treeton. The southeastern most section is north of the A57 and west of North Anston. Finally, the northern section is located adjacent to the M18, south of Wickersley. **ES Volume 3, Figure 3.2: Site Referencing [EN0110020/APP/6.19]** show the extent of W2.
- 9.8.27 The Cable Corridor Options within the area of W2 include:
- **CR 2a:** connects to the northernmost part of W2, runs north of Morthen, and crosses the M1 into the northern part of the main body of W2, around W2 P2;
 - **CR 2b:** connects the same parcels as CR 2a, but follows the west/north of the M1, running south of Morthen to cross the M1 and connect to the main body of W2;
 - **CR 2c:** connects to W2 at W2 P2, crosses the M1 and runs west to W2 P1;
 - **CR 2d:** connects the western area of W2 to the main body of W2 (west of the M1);
 - **CR 2e:** a short corridor connecting the western areas of W2, adjacent to Burnt Wood;
 - **CR 2f:** the northern option (following Penny Hill Lane) for corridors connecting the areas of W2 either side of the M1;
 - **CR 2g:** the southern option for corridors connecting the areas of W2 either side of the M1; and
 - **CR 2h:** connects the southeast of W2 with the rest of W2, running north of Todwick.

Surrounding Area Description

- 9.8.28 W2 is bordered by the settlements of Wickersley to the north, North Anston to the southeast, Aughton to the southwest and Thurcroft and Dinnington to the east. The junction of the M1 and M18 is situated immediately north of W2, with the M1 motorway continuing westward beyond the northern boundary. The surrounding area is also predominantly used for agriculture. Along with the nearby settlements, there are a number of individual residential, commercial and industrial properties within the Study Area of W2 and the Cable Corridor Options.

Physical Setting

Topography

- 9.8.29 The topography of W2 is variable across the entirety of the Site and Cable Corridor Options. Higher elevations are observed in the east, with the highest points within W2 around Brampton-en-le-Morthen at 124m above sea level, and the lowest point at 31m above sea level in the northwest of W2, south of Whiston.

Geology

- 9.8.30 According to the BGS GeoIndex (Onshore) the northeast of W2 is underlain by the Upper Pennine Coal Measures consisting of mudstones, siltstone and sandstone, and the Dalton Rock Sandstone Member. To the southwest the geology consists of the Middle Pennine Coal Measures and Mexborough Rock Sandstone Member. For the majority of W2 and the Cable Corridor Options there are no mapped superficial geology deposits. A small area of Head (clay, silt, sand and gravel) is mapped in the east of the Site next to Long Road near Brampton Common. Deposits of Till (diamicton, boulder clay) can be found in the land parcel to the southeast of W2, and deposits of Alluvium (gravel, sand, silt and clay) underlie Cable Route CR 2d and land parcels in the northwest of W2.
- 9.8.31 The BGS Geoindex also indicates the presence of Made Ground present in the western section of W2 as well as some small sections underlaying CR 2c. These records of made ground coincide with potential surface coal workings reported in the Consultants Coal Authority Report (**ES Volume 3, Appendix 9.11: Phase 1 Coal Mining Risk Assessment: W2 [EN0110020/APP/6.20]**). The nearest available borehole (Ref. SK48NW347) recorded the Made Ground as a firm, brown, mottled orange, sandy clay with subrounded to subangular fine to coarse gravels of sandstone between depths of 0.9m – 2m BGL. Nearby borehole ref. SK48NW342 records the presence of coal in returns between depths of 17.9m – 20.5m BGL, which could be possible mine workings.
- 9.8.32 According to the BGS Geoindex, there are several further boreholes located in W2. To the east close to Long Road, borehole SK48NE235 records the geology as (all depths as BGL) 0m - 0.60m of topsoil and made ground, 0.60m - 1.60m clay, 1.60m - 2.40m gravel, 2.40m - 12.0m siltstone with some interbedded sandstone. Many of the boreholes within W2 are not publicly accessible, and some are boreholes drilled from underground positions, associated with coal exploration.

Hydrology

- 9.8.33 W2 has numerous surface water features which vary in size and significance. The following are found within W2: Anston Brook, Cramfit Brook, Kingsforth Brook, Morthen Brook, Pinch Mill Brook, River Rother, Ulley Brook, and Whiston Brook. Ulley reservoir is not located in W2 but is within 500m to the west. Other larger surface water features within 250m of the Site include two ponds at Slacks Farm and two further ponds located at Straight Mile Fisheries. The River Rother intersects Cable Corridor Option CR 2c and flows generally north to south.
- 9.8.34 According to the EA Catchment Data Explorer W2 extends across three Water Bodies. Northeast: Rother, Doe Lea to Don Water Body with a moderate ecological status. Centre: Ulley Brook from Source to River Rother Water Body

with a good ecological status. East and southeast: Anston Brook from Source to Ryton Water Body with moderate ecological status.

- 9.8.35 According to the Envirocheck Landmark Reports no surface water abstractions have been recorded within W2 or within 250m of the Proposed Order Limits (including the Cable Corridor Options).

Hydrogeology

- 9.8.36 According to DEFRA's Magic Map Tool, the bedrock geology underlying W2 is 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.
- 9.8.37 The superficial deposits consisting of Head and Till towards the east of W2 are classified as Secondary Undifferentiated Aquifers. The EA classifies a Secondary Undifferentiated Aquifer where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value. The Alluvium deposit to the west of W2 is considered a Secondary A Aquifer.
- 9.8.38 According to DEFRA's Magic Map Tool, as well as information available in the Envirocheck Landmark Reports, nearly all of W2 is considered to have a high groundwater vulnerability. The land parcels in the far north and far west of W2 are considered to have a medium groundwater vulnerability. In areas where there are superficial deposits the groundwater vulnerability is given as medium-high.
- 9.8.39 According to the EA Catchment Data Explorer, W2 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.
- 9.8.40 The Envirocheck Landmark Reports give various groundwater abstractions associated with Straight Mile Fishery near Todwick in the east of W2. The permits date from June 1996 and December 2002 with no permit end dates supplied. Further groundwater abstractions are recorded for a borehole at Side Farm, Rotherham, dated from March 2005, with no permit end date supplied.
- 9.8.41 There are no SPZs located within W2 or the Cable Corridor Options.
- 9.8.42 One water well (BH Ref. SK48NE262) located in Brampton-En-Le-Morthen, adjacent to the eastern central section of W2, did identify a depth to groundwater of 44.5m BGL within the Middle Coal Measures. Otherwise, an accurate assessment for depth to groundwater has not been established for W2 or the Cable Corridor Options. This is primarily due to the lack of borehole data within the Site detailing groundwater depth. It is expected that depth to groundwater will vary across W2, with shallower groundwater expected in valleys, especially where close to surface water bodies.

Ground Conditions

- 9.8.43 As the Proposed Development is in an area of historic coal mining, further information has been acquired from the Mining Remediation Authority (MRA, formerly known as the Coal Authority) with regard to the ground conditions at W2. This information will be presented in a Coal Mining Risk Assessment (see **ES Volume 3, Appendix 9.11: Phase 1 Coal Mining Risk Assessment: W2**

[EN0110020/APP/6.20]), but information will also be presented in this Report to further describe the baseline.

- 9.8.44 According to the BGS Geoindex (Onshore) and the Landmark Envirocheck Report, there are three geological faults located within W2, with orientations of northwest to southeast. They are recorded near Whiston and Guilthwaite in the northwest of W2.
- 9.8.45 According to the Rotherham Local Plan Sites and Policies Map – Minerals and Wind Energy (adopted 2018), W2 is entirely located within a Shallow Coal, Fire Clay and Brick Clay Mineral Safeguarding Area. Along with this, the most northwestern parcels and Cable Corridor Option, adjacent to the M1 – A630 junction also overlap with a Sand and Gravel Mineral Safeguarding Area. A very small section of the south-eastern most parcels, in the land southwest of North Anston, also overlap with a Magnesian Limestone Mineral Safeguarding Area.
- 9.8.46 According to the Mining Remediation Authority Map Viewer, historic surface coal mining activity is recorded within W2, specifically in the northwestern parcels, east of Treeton as well as the Cable Corridor Options CR 2a, CR 2b and CR 2c north of the M1. These areas overlap with W2 by approximately 21 hectares, around six of which are in Cable Corridor buffer zones. As such, these areas are designated by the MRA as Development High Risk Areas and are significant because the excavations were infilled with unknown materials that could potentially include waste or contaminating materials and could also pose geotechnical ground stability risks. This Made Ground is described in Section 9.8.48. There is a history of underground coal mining within the boundaries of W2 that occurred at depths between approximately 180m to 700m, with the most recent activity recorded in 1990. This was prevalent across the entirety of W2, with at least three different collieries recorded as working coal seams beneath the extent of the Site. According to the MRA, there are no recorded mine entries within W2.

Infilled Land

- 9.8.47 According to the Landmark Envirocheck Report, there is only one instance of potentially infilled land within W2, located in the most northwestern parcel and is likely recording an infilled land drain.

Made Ground

- 9.8.48 According to the BGS Geoindex, there are areas of artificial ground identified in the northwestern sections of W2, as well as the Cable Corridor Options CR 2c, east of Morthen. These correspond with historic mining activities and development high risk areas. The BGS describes these infilled ground units as an area where the pre-existing land surface has been excavated (Worked Ground) and subsequently partially or wholly backfilled (Made Ground). It is likely that these areas were used for historic opencast coal mining, as the Coal Authority and BGS Geoindex identify coal outcroppings at these locations. The land was likely subsequently filled in with mine spoil or other excavated materials. As described above, these areas are significant because the excavations were infilled with unknown materials that could potentially include waste or contaminating materials and made ground may present a geotechnical risk due to its potential heterogeneous and compressible nature.

Ground Stability

- 9.8.49 The Landmark Envirocheck Report defines the ground stability through five different potential hazards: Collapsible Ground, Compressible Ground, Ground Dissolution, Landslide Ground Stability, and Shrinking or Swelling Clay.
- 9.8.50 Each of these potential hazard classifications is rated with a risk value ranging from no hazard to very high. The Landmark Envirocheck report lists multiple records across the Site which are typically no or very low hazard, ranging up to a moderate hazard of Compressible Ground Stability in the northwestern section, east of Treeton. As such, a range of risk levels as been presented for each hazard category. For the Site at W2, 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 – Moderate**, with compressible strata absent across most of the Site. The areas with moderate risk are mapped where there were past shallow coal mine workings;
 - *Potential for Ground Dissolution Stability Hazards:* **No Hazard**, with soluble rocks not present;
 - *Potential for Landslide Ground Stability Hazards:* **Very Low – Moderate**, generally slope instability problems not thought to occur, although there is one identified area of moderate risk from steeper slopes on the east side of Bole Hill in an area that is planned to be mitigation land (i.e. no construction or groundworks); and
 - *Potential for Shrinking or Swelling Clay Ground Stability Hazard:* **No Hazard - Very Low**, with ground conditions predominately non-plastic.
- 9.8.51 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 - Moderate** with compressible strata absent across most of the Site. The areas with moderate risk are mapped where there were past shallow coal mine workings, in the vicinity of CR 2c north of the M1;
 - *Potential for Ground Dissolution Stability Hazards:* **No Hazard** with soluble rocks not present;
 - *Potential for Landslide Ground Stability Hazards:* **Very Low – Moderate** generally slope instability problems not thought to occur, although there is one identified area of moderate risk from steeper slopes at Bole Hill in the buffer zone of western CR 2c. The actual cable route within the buffer zone would chosen to avoid the steep slopes; and
 - *Potential for Shrinking or Swelling Clay Ground Stability Hazards:* **Very Low** with ground conditions predominately non-plastic.

Other Protected Areas / Sensitive Land Uses

- 9.8.52 According to the DEFRA Magic Map Tool, there are no Areas of Outstanding Natural Beauty, National Nature Reserves, National Parks, Special Protection Areas, or World Heritage Sites.

- 9.8.53 There are two Local Nature Reserves within 1km of W2: to the west Catcliffe Flash, to the east Anston Stone Woods.
- 9.8.54 There are a number of Ancient Woodlands surrounding W2, such as Burnt Wood and Treeton Wood in the west near Treeton, Spring Wood in the west located south of Ulley, and Moat Wood next to the northern land parcel near Wickersley.
- 9.8.55 The whole area of W2 is classified as Community Forest and as an Area of Adopted Green Belt.
- 9.8.56 According to DEFRA Magic Map Tool, W2 is located within a Nitrate Vulnerable Zone.
- 9.8.57 As stated above, W2 is not located in any Source Protection Zones or Drinking Water Safeguard Zones.

Radon

- 9.8.58 The UK Maps of Radon indicate that the majority of W2 is in a lower probability radon area, as less than 1% of homes are above the action level. There is a small area in the southeast of W2 where the maximum radon potential is 1-3%.

Historical Use Information

Approach

- 9.8.59 The historical development of W2 and surrounding area has been assessed through a review of available historical maps presented in **ES Volume 3, Appendix 9.3: Landmark Envirocheck® Report: W2 [EN0110020/APP/6.20]**, **ES Volume 3, Appendix 9.5: Landmark Envirocheck® Report for Cable Corridor Options [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

- 9.8.60 Historically, most of the land within W2 and the Cable Corridor Options has remained as largely agricultural land. Since the earliest available maps dating from 1854, the landscape has featured numerous agricultural fields, boundaries, drainage ditches, tracks, roads, footpaths, and a limited number of farm buildings.
- 9.8.61 In 1855, sandstone quarries were mapped to the southwest by Turnshaw Common; however, these were no longer labelled on mapping in 1892–1894, and by 1903–1905 the area was marked only as ‘old quarries.’ A sandstone quarry in the west of W2 next to Cable Corridor Option CR 2d is also identified in 1855, and by 1904–1905 it is marked as ‘old quarries’. Between 1930 and 1932 a railway line was built in the southeast of W2 near Anston and may run along the eastern boundary. In 1967–1968, land immediately north of Long Lane (far west of the Site) and land north of Burnt Wood near Treeton (west section) were recorded as opencast coal workings. At the same time, Mill Brook is labelled next to Cable Corridor Option CR 2a. By 1974, the M1 motorway was shown on maps and crosses the Cable Corridor Options CR 2a/CR 2b, CR 2c and CR 2f/g. A pipeline was additionally labelled to the north of this section at that time.
- 9.8.62 By 1981–1983, the opencast workings in the west were no longer labelled. The M18 can be had been constructed east of the northernmost land parcel along the

boundary. The sandstone quarry next to Cable Corridor Option CR 2d is renamed as 'depot', and from 2000 onwards it is labelled as 'Council Highways Depot'.

- 9.8.63 The Straight Mile Fishery was established within the Site, east of the M1 in 2006. By 2024, the previously mapped pipeline north of the central section was no longer shown, and wind turbines were present within W2. The buffer zone of the Cable Corridor Option CR 2a overlaps Springvale Farm, located northeast of Morthen village.

Surrounding Area History

- 9.8.64 Historically, the area surrounding W2 has also been used for agricultural purposes and historic coal mining. Mapping from 1854–1855 shows the region was predominantly agricultural, with numerous farms scattered across the land. Villages such as Ulley, Morthen, South Anston, and Anston were already established but have increased in size over time, with residential and commercial buildings, and new roads have been built. Sandstone quarries are noted to the south of the central land parcels, and west of the northwestern W2 boundary. To the east of the central land parcels, old quarries were also recorded, one of which remains visible near Hardwick Grange as of 2024. Mapping from 1854-1931 shows the 'Anston brick works' near CR 2h.
- 9.8.65 A sewage works was established in 1924 to the south of the W2 boundary at Falconer Lane next to Cable Corridor Option CR 2c and remains present today, and another was located 200m west of the Site at Second Lane, Wickersley, operating from 1930 to 2006. During 1930–1931, a smallpox hospital and mortuary were constructed near Brampton Common, in the centre of W2, but the area is excluded from the Proposed Development. In 1931 two railway lines were built in the southeast of W2 within 200m of the Site at Dinnington Junction, Common Road, and further west at Anston Station and Anston Junction.
- 9.8.66 The M1 motorway and first leg of the M18 were constructed in the area in the late 1960s to early 1970s. A transformer station was built within 200m of CR 2a and CR 2b. From 1981 to 1985, the sewage works west of CR 2c were no longer labelled, but new sewage works appeared where the coal workings had previously been located. These facilities remain operational to the present day.
- 9.8.67 By 2006 one of the two railway lines in the southeast of W2 on Common Road was dismantled. By 2024 a recycling centre and sewage station were established on the Site of the dismantled railway line. Aerial imagery from 2025 confirms that the recycling centre is still operational and is called Magilla Households Waste Recycling. One railway line remains active within 200m of the Site.
- 9.8.68 In 2024, Brampton Raceway, a car racetrack, was identified on maps and aerial images close to the boundary in the central east land parcels.

Soil and Groundwater Conditions

Potential Baseline Contamination Sources

- 9.8.69 The land use history and baseline knowledge described above has identified potential sources of soils at W2 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 W2 and 250m buffer.

On Site

- Infilled historic surface coal mine workings. Around 16ha in W2 is mapped as Made Ground generally of unknown composition, in one location recorded as grey silty clay with gravel of sandstone, coal and mudstone. Without further ground investigation, the make-up of this material with regard to contamination and adverse ground conditions is unknown;
- Bole Hill BGS Recorded Landfill Site, a small irregular area on the top of Bole Hill that extends by less than 0.3ha onto the north-western part of W2. There is no further information in the Envirocheck records, but 'bole hills' were locations chosen for their windy position, where small-scale lead smelters were placed. It is possible the recorded landfill relates to wastes of this nature, and these could be contaminated with heavy metals; and
- Potentially infilled land (water), located in the northwestern parcels, likely an infilled drain.

Off Site

- Bole Hill Historic Landfill, east of Treeton and adjacent to the north-western boundary. The first input date was recorded as 1965 with deposited waste including inert, commercial and household waste;
- Railway Cutting Historic Landfill, Cramfit Road, North Anston, adjacent to the southeast boundary of W2. It received commercial and household waste between 1964 and 1973;
- Eight records of potentially infilled land (non-water, such as pits or quarries) and five records of potentially infilled land (water, such as ponds and streams) within 250m of the Proposed Development including the Cable Corridor Options;
- Magilla Dumpit Site, Registered Waste Transfer Site, Common Road, North Anston. This site is adjacent to the Railway Cutting Historical Landfill Site, 83m northeast of W2;
- Long Lane Sewage Works, adjacent to W2 in the northwest;
- Old Mill Historic, Local Authority Recorded and Registered Landfill Site, Main Street North Anston. Recorded operation between 1982 and 1988, deposited inert waste, 75m southeast of boundary;
- Guilthwaite Common Historic, and Local Authority Recorded Landfill Site, near Pleasley Road, Sheffield. Opened in 1952 and deposited inert waste. No closing date known, 10m east of W2;
- Brampton Straight Mile Historic and Registered Landfill Site, Thurgroft, Rotherham. Deposited waste included non-hazardous building rubble, non-hazardous excavation waste, soil and subsoil. Permit dated February 1986, 30-60m southeast of W2; and
- Canklow Tip Historic and Local Authority Recorded Landfill Site, Sheffield Parkway. First opened 1953. Deposited waste included industrial waste. No closing date supplied, located 200m west of W2.

Potential Baseline Pollutant Linkages and Receptors

9.8.70 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 waste landfills and infilled land, accumulation of which could lead to a risk of explosion or asphyxiation to construction workers and nearby residents; and
- Inhalation of airborne dust by nearby residents.

Environmental

- Lateral migration of contaminants within perched waters to potentially affect surface water features including multiple unnamed drains throughout the Site and Anston Brook, Cramfit Brook, Kingsforth Brook, Morthern Brook, Pinch Mill Brook, River Rother, Ulley Brook and Whiston Brook as well as any other named surface water features throughout the Site. Other surface water features which could be affected include Ulley Reservoir and further unnamed ponds;
- Vertical percolation of contaminants to affect the underlying aquifers including the predominant bedrock Secondary A Aquifer (Middle and Upper Coal Measures) 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 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 the Proposed Development;
- Lateral migration of ground gasses along natural pathways and along man-made features such as utilities trenches, under foundations and along pilings;
- 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 quality of adjacent agricultural land / soil resource.

Receptors

Human Health

- Future Site users;
- Future construction and maintenance workers; and
- Local residents via potential migration of contamination and gasses.

Environmental

- Underlying bedrock aquifers of Secondary A Aquifer (Middle and Upper Coal Measures) and Secondary Undifferentiated Aquifers (shallow superficial deposits); 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

- 9.8.71 The potential for sources of pollutants varies across the Site of W2. There are areas adjacent to, and just within the northwest of the Site and at other site boundaries where there are records of historic waste landfills, and it is likely many of these to contain contaminated materials and could generate ground gas, which could be mobilised into shallow soils and groundwater due to the construction activities of the Proposed Development. Another potential source of pollutants are several areas across the Site where the Coal Authority believes that surface opencast coal mining has taken place at some point in the past with over 16 ha of land mapped in western W2, as well as other, much smaller areas of infilled land, often quarries and ponds. With unknown material used to infill these areas, it cannot be ruled out that these contain potentially contaminated material, which could be re-mobilised during construction or present adverse ground conditions. Otherwise, the historic use of the Site for deep coal mining activities across most of W2, from at least two collieries, is considered too deep and not likely to interact or be influenced by the Proposed Development.
- 9.8.72 Another potential source of pollutants likely arises 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 W2. If elevated concentrations of polluting chemicals were present in the ground then they could pose a threat to the controlled waters of Anston Brook, Ulley Brook and the River Rother. It is notable that the Rother, Doe Lea to Don Water Body and the Anston Brook Water Body in W2 have only moderate ecological status due to recorded measurements of (polybrominated diphenyl ether) and mercury compounds – the latter could be due to historical agricultural usage as pesticide. The origin of PDBE is less clear, although due to its propensity to bioaccumulate, sewage may contain traces of PBDE and runoff from soils on farmland that have been fertilised with sewage may enter watercourses in this way. It is possible this is the origin of mercury occurrences as well.
- 9.8.73 Polluting chemicals could also potentially pose a threat to the underlying aquifers under current, undisturbed conditions, as well as in the event of disturbance caused by encountering contaminated soils during the construction phase. A potential pathway may be created between perched shallow groundwater and aquifers from associated foundation / piling works during construction, for each of

the solar panels, the BESS and associated substations and power stations, up to 4m depth. The remaining bedrock Secondary A aquifers underlying the majority of W2 also could be impacted by vertically migrating pollutants as the bedrock is also encountered at shallow depths.

- 9.8.74 Adjacent land uses that may already affect the land within W2, in terms of current ground quality and potential additive or cumulative effects via groundwater migration or soil-dust generation, include agricultural activities, historic landfills and infilled land with unknown material, railway land, storage of agricultural chemicals, via leaching of contaminants into groundwater, lateral migration of contaminants and ground gasses within soils and groundwater, as well as potential airborne dust from off-site activities such as farming and construction.

Assessment of Potential Effects

Introduction

- 9.8.75 Screening of potential effects has been informed by currently available baseline data for the Proposed Development. 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.
- 9.8.76 The purposes of the following sections are to assess possible and probable effects and mitigation for the three phases of the Proposed Development.
- 9.8.77 Overall, it is not anticipated that contaminated land is likely to present a significant source of potential effects, particularly as the majority of the Site has historically been used primarily as agricultural land. There are no proven sources of pollution at W2. As described above we consider the following potential sources may be present within W2:
- Potentially infilled land from historic coal mining activities, with around 16 ha of land mapped in the main area of W2 and approximately 7ha in Cable Corridor Option buffer zones mapped as surface mine workings backfilled with unknown material, as well as one record of infilled land drains;
 - A small area (up to 0.3ha) on Bole Hill where a BGS Recorded Landfill extends onto the main W2 area which is of unknown waste material but could possibly be associated with lead smelting;
 - 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); and
 - The two historic landfills adjacent to the Site; the Railway Cutting at Cramfit Road and Bole Hill at Treeton, as well as four further historic and local authority landfills of Brampton Straight Mile, Old Mill, Guilthwaite Common and Canklow Tip within 250m of W2.

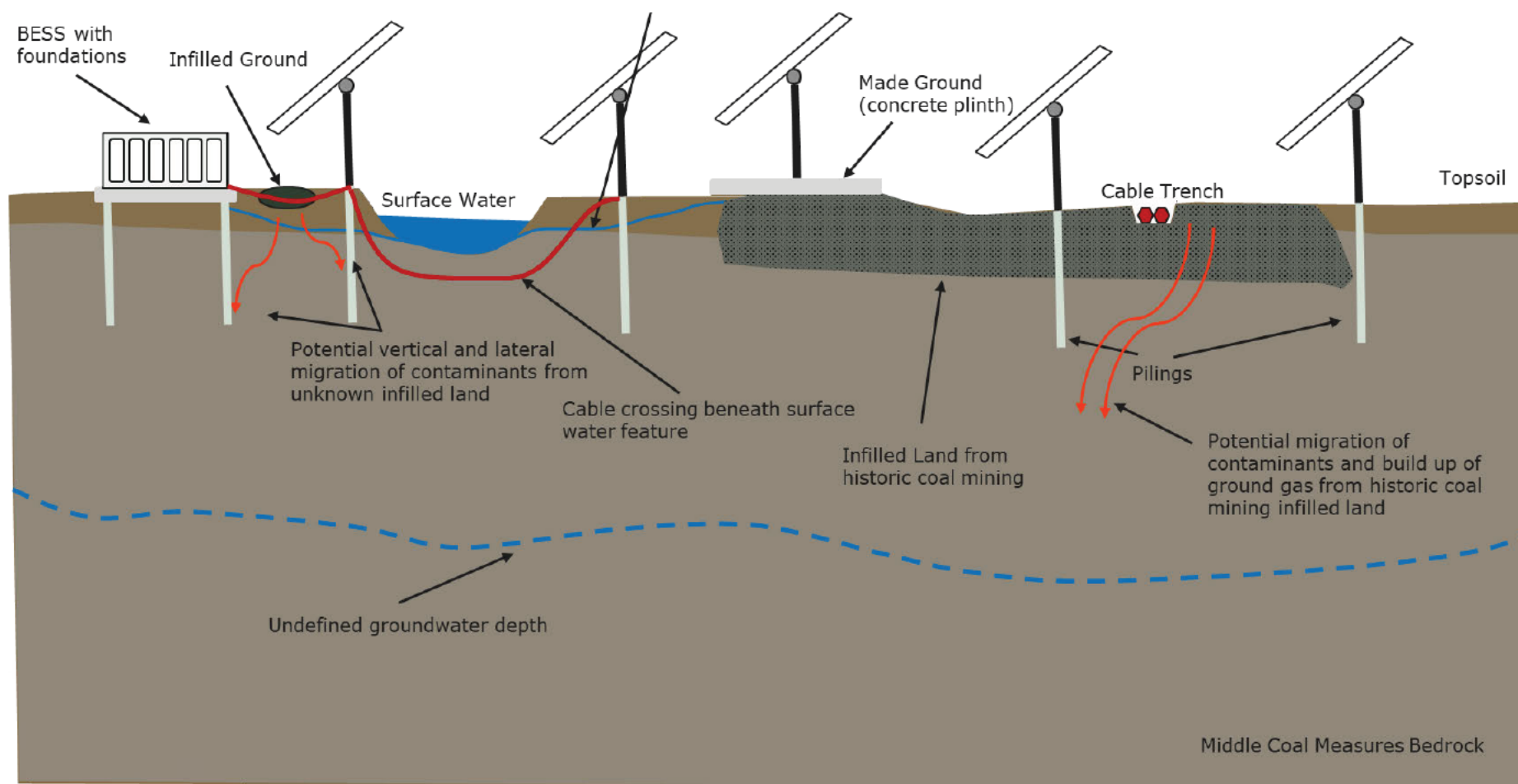
Assessment of Potential Effects During Construction

- 9.8.78 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.

- 9.8.79 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) [EN0110020/APP/5.9]**). In addition, other specific additional mitigation, such as method statements and pollution prevention measures, are identified where required.
- 9.8.80 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;
 - 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.
- 9.8.81 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



ENVIRONMENTAL STATEMENT

Table 9.8.4 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 and solar array foundations in areas of historical landfilling and immediately adjacent to them (Bole Hill, Railway Cutting at Cramfit Road)	Construction workers exposed to historic contaminated soil	Inhalation, ingestion and dermal contact	High	Small	Low	Moderate-Low	Yes – avoid cable laying and piling across areas of historical landfilling and immediately adjacent, 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 (waste landfills) and receptors	High	Small	Very Low	Low	Yes – avoid cable laying and piling across areas of historical landfilling and immediately adjacent, or else Phase 2 SI to assess conditions

ENVIRONMENTAL STATEMENT

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
Excavation of soils for cable laying in areas affected by accidental spillages during construction (e.g. fuels)	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])
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, piling activities and foundation construction, the excavation of cable trenches and / or removal of the made	Potential to remove, relocate or mobilise contaminants (if present) to adjacent agricultural land, underlying	Migration of leaching contaminants to the underlying aquifer.	High	Medium in in areas with worked ground, Low elsewhere	Very Low	Low in areas with worked ground, 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					No – mitigation from CEMP (outline version

ENVIRONMENTAL STATEMENT

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
ground / topsoil, in areas where there was historical landfilling (mainly former surface coal mined areas)	Secondary A aquifer and nearby surface waters.	from surface run-off to surface water features, field drains and adjacent land					provided in oCEMP [EN0110020/APP/5.9]
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])

ENVIRONMENTAL STATEMENT

Activity	Potential Effect / Receptor	Pathway	Sensitivity / Vulnerability of Receptor	Magnitude of impact	Likelihood of PPL / effect	Potential Risk Rating	Mitigation Required?
Cable installation under surface waters and roads using horizontal directional drilling (HDD)	Accidental break-out of HDD fluids into surrounding ground, which may include Secondary A Aquifer, or to surface waters.	Direct release into Secondary A Aquifer, or to surface waters, or migration via baseflow to them.	High	Small	Low	Low	No – mitigation from CEMP (outline version provided in oCEMP [EN0110020/APP/5.9])

Assessment of Potential Effects During Operation and Maintenance

- 9.8.82 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;
 - Ground stability on infilled land; and
 - Heat generated by the buried high voltage cables through the Cable Corridors.
- 9.8.83 As with the construction-related effects identified in **Table 9.8.4**, 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 9.8.5**.

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Table 9.8.5 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 aquifer.	Heat transfer and groundwater migration	High	Small – cable trench likely to be above Secondary A Aquifer in most places	Moderate	Moderate-Low	Yes – consider thermally insulated cables and, measures to minimize lateral groundwater flow in areas where present
Site activities and facilities including handling and containment of any generated	Spills and leaks of oil, fuel and other polluting substances entering surface	Spill of materials followed by leaching or lateral migration from	High	Small	Low	Low	No – will be covered in operational environmental management plans (outline version provided in oOEMP [EN0110020/APP/5.10])

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waste and potential chemical and oil storage areas.	watercourses, or infiltrating soils into shallow groundwater.	surface run-off					
Ground Conditions							
Installation of solar array piles and cables over ground with moderate risk of compressible soils (e.g. in the areas of backfilled surface mining) or of landslip (one stretch of Cable Corridor near Bole Hill)	Excessive and differential settlement causing damage to pile structures and cables, or damage caused by a landslip event. Increased costs for maintenance / remedial works.	Settlement and subsidence, or landslip	Low	Moderate	Low	Low	No – will be covered in operational environmental management plans. (outline version provided in oOEMP [EN0110020/APP/5.10]) Landslide risk considered in Cable Corridor selection and design.

Assessment of Potential Effects During Decommissioning

- 9.8.84 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.
- 9.8.85 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.
- 9.8.86 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.
- 9.8.87 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 9.8.6**.

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Table 9.8.6 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])

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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 aquifer, 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])

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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 (up to 4m) in areas where there was historical landfilling (mainly former surface coal mined areas)	Preferential vertical pathway created for migration of contaminated materials to underlying Secondary A Aquifer	Contaminated soils could leach and / or groundwater could migrate vertically through shallow deposits and into Secondary A Aquifer and potentially on to surface waters via baseflow	High	Medium in in areas with worked ground, Low elsewhere	Very Low	Low in areas with worked ground, Very Low elsewhere	Yes – was avoided or assessed by Phase 2 SI in the construction phase.

Summary and Conclusions

- 9.8.88 This Report presents a preliminary qualitative risk assessment of land quality and ground conditions for W2 of the Proposed Development, located in South Yorkshire within the administrative area of Rotherham Metropolitan Borough Council. The assessment covers the 742ha W2 site and associated Cable Corridor Options, forming the central section of the wider Whitestone Solar Project. 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.
- 9.8.89 The W2 site comprises predominantly agricultural land, bisected by the M1 motorway and characterized by a broad, open, and undulating landscape with shallow valleys, trees, and hedgerows dividing fields. The area includes several sections east and west of the M1, with adjacent settlements such as Ulley, Thurcroft, Treeton, North Anston, and Wickersley. The topography varies from 31m to 124m above sea level. The underlying geology is dominated by Upper and Middle Pennine Coal Measures (mudstone, siltstone, sandstone), with localised superficial deposits of Head, Till, and Alluvium. Made Ground is present in the northwestern sections, associated with historic surface coal mining. The bedrock is classified as a Secondary A Aquifer, considered to have high groundwater vulnerability, with some areas of medium vulnerability.
- 9.8.90 The Site and its surroundings have a long history of agricultural use, with historic coal mining (both surface and underground), quarries, and landfilling activities. Over 16ha of the Site is mapped as made ground from historic surface coal mining, and there are records of infilled land drains. A small part of a BGS recorded landfill extends over W2 at Bole Hill that could potentially have mineral smelting wastes, and there are several other historic and registered landfills adjacent (e.g. Bole Hill, and the Railway Cutting at Cramfit Road) and within 250m of W2, with waste types including inert, commercial, and household materials. Other adjacent land uses include sewage works, a recycling centre, and industrial properties.
- 9.8.91 Potential sources of contamination include infilled land from historic mining, diffuse agricultural pollutants (e.g., pesticides, herbicides), and nearby landfills. Pathways for potential pollutant migration include direct contact, inhalation of dust, ground gas migration, leaching to groundwater, and lateral migration to surface waters. Sensitive receptors identified are future site users, construction and maintenance workers, local residents, underlying aquifers, and adjacent surface water bodies such as Anston Brook, Ulley Brook, and the River Rother.
- 9.8.92 The Proposed Development will involve ground disturbance through pile driving for solar arrays (up to 4m depth), trenching for cable installation (typically 1.2m depth), and construction of foundations for substations, BESS units, and supporting infrastructure (up to 4m depth). The risk assessment considers potential pollutant linkages (PPLs) for construction, operation, and decommissioning phases, evaluating the sensitivity of receptors, magnitude and likelihood of effects, and the need for mitigation.
- 9.8.93 In most cases, potential effects can be avoided or minimised through standard construction and operational management practices (e.g., CEMP, Operational

Environmental Management Plan (OEMP), DEMP). Moderate and some low risk PPLs during construction include:

- Excavation in areas of historical landfilling (e.g. Bole Hill), with potential exposure of workers to contaminated soils, as well as in land adjacent to waste landfills elsewhere where ground gasses could also be mobilised;
- Mobilisation of contaminants through soil handling, potentially affecting adjacent land, aquifers, and surface waters;
- Creation of preferential pathways for contaminant migration via foundations and cable trenches, particularly in areas of infilled land; and
- Accidental release of drilling fluids during HDD for cable installation.

- 9.8.94 During operation, 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.
- 9.8.95 Decommissioning effects are expected to be similar to those during construction, with risks managed through appropriate environmental management plans and by avoiding disturbance of historically infilled land where possible.
- 9.8.96 In conclusion, while the W2 site includes areas of historic landfilling, coal mining, and sites of potential contamination, the majority of the land is agricultural with no proven significant sources of pollution. Adherence to standard management plans and targeted mitigation, such as avoiding ground disturbance in the small waste landfill area at Bole Hill, and at immediately adjacent to other off-site waste landfills, along with providing thermal shielding for high-voltage cables, will reduce overall risks to low. No further Phase 2 intrusive investigation, remediation, or special measures are considered necessary for land quality and ground conditions at this stage.

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