



Tween Bridge Solar Farm

A Nationally Significant Infrastructure Project in the Energy Sector

Preliminary Environmental Information Report

Chapter 9 – Ground Conditions

October 2023



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9. Ground Conditions

9.1. Introduction

9.1.1. This chapter of the working draft PEIR assesses the likely significant effects of the Scheme on Ground Conditions including geology, soils, groundwater, and contaminated land.

9.1.2. This assessment reports on the baseline and Scheme design information available at the time of writing this working draft PEIR. The PEIR will be updated as further assessments become available and any update to the baseline will be reported in the next iteration of the PEIR which will be presented as part of the statutory pre-application consultation. Consultation responses and scoping opinions have been taken into account during the preparation of this chapter and this is discussed in detail below.

9.1.3. The chapter and assessment have been carried out by Integrale Limited.

9.1.4. This chapter is supported by the following appendices:-

- **Appendix 9.1** – Phase 1 Ground Conditions Desk Study Volume 1: –

Main Report & Appendices A to G

- **Appendix 9.2** – Phase 1 Ground Conditions Desk Study Volume 2: –

Appendix H Groundsure Data Reports and Historical Maps

- **Appendix 9.3** – Phase 1 Ground Conditions Desk Study Volume 3: –

Tween Bridge Wind Farm Factual Site Investigation Report, Donaldson Associates 2009 & Headland Archaeology Report 2015

9.1.5. Baseline and assessment work is ongoing, it is anticipated that the following information will be made available for the next iteration of the PEIR: –

- Consideration of Cumulative Impacts
- Assessment against the detailed design parameters of the Scheme
- Mineral Resource Safeguarding Assessment
- Peat Stability Assessment
- Horizontal Directional Drilling Method Statement
- Preparation of Outline Construction Environmental Management Plan
- Detailed walkover reconnaissance at potential contaminant linkage locations identified by Phase 1 Ground Conditions Desk Study

9.1.6. The chapter starts by providing details of the consultations to date, the methodology for the assessment and the criteria used for assessing effect magnitude and receptor sensitivity. The

chapter then considers the baseline situation, before the likely environmental effects of the Scheme on ground conditions are identified, during construction, operation, and decommissioning. Mitigation measures to reduce any negative environmental effects are considered and the residual environmental effects assessed. Finally, conclusions are reached as to the significance of the effects.

9.2. Consultation

9.2.1. A summary of consultation responses received to date is provided in Table 9.1

Table 9.1 Summary of Consultation

CONSULTEE	SUMMARY OF CONSULTEE RESPONSE	HOW RESPONSE HAS BEEN ADDRESSED BY APPLICANT
North Lincolnshire Council	Contaminated Land Officer satisfied with baseline study to date and notes intrusive investigation to be undertaken at future stage. Requested clarity on which parts of study relate to differing Local Authorities. Queried gas risk from peat soils.	Phase 1 Desk Study (Appendix 9.1) updated: Local Authority areas clarified in text by colour highlighting in text and boundary used on all drawings as appropriate. Gas risk considered & assessed (Appendix 9.1. Section 3.3).
Environment Agency	Sustainable Places team provided response in Scoping Opinion (13 th March 2023): Source Protection Zones and groundwater vulnerability to be considered, refer to Contaminated Land Special Site to southwest of site, need for land quality assessment where directional drilling proposed, historic landfill site potential for ground gas.	Phase 1 Desk Study (Appendix 9.1) updated: Aspects reviewed and updated once full environmental data reports obtained
Canal & River Trust	Provided response in Scoping Opinion. Noted proximity to Stainforth & Keadby Canal and risk to water pollution from unintentional run-off from exposed soils or dust	Phase 1 Desk Study (Appendix 9.1) updated: Aspects reviewed and updated.
City of Doncaster Council	Provided response in Scoping Opinion. Noted southwestern section partially in a mineral safeguarding area and PEDL licence area.	Phase 1 Desk Study (Appendix 9.1) updated: Aspects reviewed and updated. Mineral Safeguard Area assessed for consented sites, areas of search and proposed sites allocations within period of Adopted Local

	Noted potential for some areas of concern regarding contaminated land and need for Phase II investigation and CEMP	Plan. (Appendix 9.1. Section 2.5.5 and drawings in Appendix E of that report). PEDL licences clarified (Appendix 9.1. Section 2.5.6.2). Consultation with North Sea Transition Authority confirmed direct consultation with licence holders is appropriate. Ongoing. Areas of potential contamination clarified.
Coal Authority	No requirement to consider coal mining legacy	Summarised in Phase 1 Desk Study (Appendix 9.1)

9.3. Assessment Approach

Methodology

9.3.1. The baseline current ground and groundwater conditions are considered in the Phase 1 Desk Study in Appendix 9.1. A conceptual model has been developed and a generic qualitative risk assessment made for potential soil, gas or groundwater contamination. This is summarised below.

Assessment of Significance

9.3.2. The impacts of changes in the conditions of the geology, soils, groundwater and gas regime as a result of the development, both during construction, operation, and decommissioning have been considered. The need for mitigation measures to overcome or reduce the impact of development and address existing contaminant impact is discussed. Any residual impacts that cannot be mitigated are identified.

9.3.3. In order to assess the significance of the development impact, and the significance of any identified contamination, a series of risk rating terms have been adopted as relevant to the site and related to the types of ground conditions, contaminants and receptors anticipated.

9.3.4. Two types of impact need assessment. The first is the effect of the development upon soils and geological resources, including groundwater, and the second is that of the development on risks posed by contamination. The magnitude of each type of impact is assessed according to the criteria below. These can be further classed as beneficial, neutral or adverse impacts.

Table 9.2 Magnitude of Impact on Geology and Soils

Magnitude of Impact on Soils, Geology and Groundwater	Definition by example
High	Soils on a large proportion of the site will be removed (or improved) by the development. Important geological features or high quality agricultural soils will be destroyed. Important mineral resources will be sterilised or made inaccessible by the development. Groundwater resources will be subject to an identifiable change in groundwater flow regime, aquifer use or artesian flows.
Medium	Access to important geological features will be restricted (or improved) by the development. Localised damage (or improvement) to soils quality or geological features. Groundwater resources will be subject to an identifiable change in local groundwater flow regime or aquifer use.
Low	Access to some localised geological features may be restricted (or improved) by the development. Very localised damage (or improvement) to soils or geological features. Measurable change in groundwater levels, but no appreciable change in groundwater flow regime, status or potential use.
Negligible	No damage to important soil, mineral resources or geological features, and only Minor disturbance (or improvement) of soils. No or very limited impact on groundwater resources.

Table 9.3 Magnitude of Impact on Contamination Risk

Magnitude of Contamination Risk	Definition
High	Significant contamination represents an unacceptable risk to identified receptors across much of the site. Site not suitable for current/proposed use without significant remediation. Enforcement action possible. Urgent action required.
Medium	Contaminants may represent an unacceptable risk to identified receptors across parts of the site. Site probably not suitable for current /proposed use without remediation. Action required in the medium term.

Magnitude of Contamination Risk	Definition
Low	Contaminants may be present but are unlikely to create unacceptable risk to identified receptors. Site probably suitable for current use, may require localised remediation for proposed use. Action unlikely to be needed whilst site remains in current use.
Negligible	If contamination sources are present they are considered Minor in nature & extent, and not likely to present a risk to identified receptors. Site suitable for current/proposed use. No further action required.

9.3.5. The presence and sensitivity of receptors which could be impacted by the development, or at risk from land contamination, can be assessed by considering the following: surrounding land uses; proposed end use, type of construction operations necessary, geology, hydrogeology and hydrology of the site and immediate surroundings. In line with Land Contamination Risk Management (LCRM) guidance, Stage 1 Risk Assessment, Environment Agency, 2021 the potential receptors have been reviewed. This is detailed in the Phase 1 Ground Conditions Desk Study, Report No. 22072, Version 2, July 2023 prepared by Integrale Limited (Appendix 9.1).

Table 9.4 Receptor Sensitivity

Receptor	Receptor Sensitivity			
	High	Medium	Low	Negligible
End Users, Workers	Residential, allotments	Landscaping or open space, play areas	Commercial areas	'Hardcover' use, eg roads or industrial areas
Surrounding land uses	Residential	Open space or commercial areas	Commercial areas	'Hardcover' use eg roads or industrial areas
Construction Workers	Extensive earthworks, demolition	Limited earthworks	Minimal/localised earthworks	No earthworks
Controlled Waters	Principal aquifers, Source Protection Zones, Main Rivers	Secondary A Aquifers, Source Protection Zones, Surface Water Courses	Secondary B Aquifers, Surface Water Courses	Non-Aquifers No surface water /drainage courses
Soils/Geology	High cultivation, ecological, mineral, or scientific	Medium cultivation, ecological, mineral or scientific	Low cultivation, ecological, mineral or scientific value /sensitivity	Absent/no cultivation, ecological, mineral or scientific value / sensitivity

Receptor	Receptor Sensitivity			
	High	Medium	Low	Negligible
	value /sensitivity	value /sensitivity		
Built Environment	Historic or other sensitive buildings	Buildings including services and foundations	Buildings including services and foundations	Not applicable

9.3.6. As identified in Table 9.5 below, significance is assessed by combining the magnitude of the effect and the sensitivity of the receptor to produce an assessment ranging from Negligible through Minor, Moderate, or Major. Moderate or Major magnitudes of change are considered Significant where adverse, and will require remedial action or mitigation. Negligible, Minor or Minor to Moderate Adverse change is considered Not Significant and is not likely to require mitigation, but this can be considered where practical and appropriate.

Table 9.5 Significance Matrix

Magnitude of Change	Sensitivity of Receptor				
		High	Medium	Low	Negligible
High		Major	Major	Moderate	Negligible
Medium		Major	Moderate	Minor to Moderate	Negligible
Low		Moderate	Minor to Moderate	Minor	Negligible
Negligible		Negligible	Negligible	Negligible	Negligible

9.3.7. The Phase 1 Desk Study (Appendix 9.1) is being provided to the local authorities and Environment Agency for review and comment, as part of the consultation process. The scope and location of proposed specific targeted Phase II intrusive investigation and risk assessment will be agreed with these regulators in due course and undertaken after consent during the detailed design phase.

Legislative and Policy Framework

National Planning Policy and Legislation

- 9.3.8. UK planning policy is based on the concept that a site is 'suitable for its proposed use' with regard to contaminated land or land stability aspects. Guidance on this aspect of ground conditions adopts a risk framework, as given in Land Contamination Risk Management (LCRM) guidance, 2021.
- 9.3.9. Part 2A of the Environmental Protection Act 1990 as amended by the Environment Act and The Contaminated Land (England) Regulations 2006 (as amended) is the legislative framework for contaminated land, in particular dealing with remediation of historical contamination.
- 9.3.10. The National Policy Statement for Renewable Energy Infrastructure (EN3) (2022) together with the Overarching National Policy Statement for Energy (EN-1) (2023), provide the decision-making basis of the Infrastructure Planning Commission on applications for nationally significant renewable energy infrastructure.
- 9.3.11. The Overarching National Policy Statement for Energy (EN-1) includes policies regarding Geological Conservation which requires developments to 'avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives ...where significant harm cannot be avoided, then appropriate compensation measures should be sought'.
- 9.3.12. The revised draft Overarching National Policy Statement for Energy (EN-1) (2023) provides further information regarding geological conservation and proposes 'where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance', and 'the applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests...'.
- 9.3.13. The Overarching National Policy Statement for Energy (EN-1) includes policies regarding Water Quality which requires development plans to assess impact on water quality and physical characteristics of the water environment, and it encourages protective measures to control the risk of pollution to groundwater beyond those outlined in Groundwater Protection Zones.
- 9.3.14. The National Policy Statement for Renewable Energy Infrastructure (EN-3) (2023) describes time limited consent as 'temporary' due to the finite period of consent, and the need to then either extend the period of consent, or decommission and remove the development (paragraph 3.10.57).
- 9.3.15. It requires consideration of earthworks during construction including soil stripping, storage and replacement to minimise damage and optimise site restoration (paragraphs 3.10.71 and 3.10.72).
- 9.3.16. It requires consideration of the need for geotechnical and hydrological information, including identifying peat areas and the risk of landslide connected to development work. (paragraph 3.10.83). For developments in peat areas, the layout and construction methods should be designed to minimise soil disturbance during construction and maintenance of roads, tracks and other infrastructure, to minimise release of carbon dioxide and maximise the carbon balance savings of the Scheme (paragraph 3.10.147).

9.3.17. The underlying principle of the National Planning Policy Framework (NPPF) is a presumption in favour of sustainable development. With regard to land contamination, the NPPF states that planning policies and decisions should ensure that new development is appropriate for its location and that developers and/or landowners are responsible for securing the safe development of land.

The Development Plans

9.3.18. The Doncaster Council Local Plan 2015–2035 (Adopted 2021) includes: Policy 55 Contamination and Unstable Land. (designed to ensure full and effective use of land in an environmentally acceptable manner); Policy 60 Protecting and Enhancing Doncaster’s Soil and Water Resources (seeks to conserve, protect and enhance land quality, soil and water resources); Policy 61 Providing for and Safeguarding Mineral Resources (aims to plan for steady, adequate, efficiently and sustainably sourced minerals during the plan period, and supports non–mineral development where it will not prevent economically viable mineral resource from being extracted in the future. Temporary development is an exemption from the Mineral Safeguarding Policy.

9.3.19. The North Lincolnshire Council Local Development Framework 2010 and a new Local Plan 2020–2038 Submission made in November 2022 include policies and strategies to safeguard mineral resources and protect the environment. Temporary planning permission is an exception from their minerals safeguarding policy. Other Adopted Planning Policy documents include supplementary document Planning for Solar Photovoltaic (PV) Development, 2016 which provides policy considerations to manage impacts of construction and groundworks.

Scoping Criteria

9.3.20. The following contamination and ground conditions related comments were provided in the Planning Inspectorate Scoping Opinion dated 13 March 2023.

Table 9.6 Extract of aspect based scoping table from Scoping Opinion for Tween Bridge Solar Farm

ID	REF	MATTER	PLANNING INSPECTORATE COMMENTS	APPLICANT RESPONSE
2.1.15	n/a	Impacts from dewatering	Impacts from any dewatering which are likely to result in significant effects should be assessed in relevant ES aspect chapters (such as Cultural Heritage and Ground Conditions).	The Applicant acknowledges this response. This aspect will be considered in the next iteration of this PEIR.
3.8.2	Para 7.3	Key policy and guidance	The ES assessment should also be informed by the Environment Agency’s Land Contamination Risk Management Procedures.	That will be the case.

<p>3.8.3</p>	<p>Paras 7.5 to 7.17</p>	<p>Preliminary baseline information</p>	<p>It is noted that third party data such as a Landmark or Groundsure information report, which typically informs a preliminary risk assessment/ desk study (as provided within Appendix 7.1 of the Scoping Report) has not been provided. The Scoping Report also uses vague terminology such as “several to many metres” to describe the depth of the underlying geology.</p> <p>The ES should provide a detailed description of the baseline environment with reference to the data sources used. The ES should be based on sufficient baseline data to support a robust assessment of likely significant effects as required by the EIA Regulations 2017.</p>	<p>Groundsure data has now been obtained for the specific (Draft) Order Limits area and buffer zone beyond. The assessment is ongoing, including acquisition of previous ground investigation data and liaison with regulators.</p> <p>This will be addressed. Supporting information will indicate where details are taken from specific previous ground investigation data, or are a summary range of the data.</p>
<p>3.8.4</p>	<p>Para 7.17 and Table 7.1</p>	<p>Anticipated superficial/ shallow geology</p>	<p>Table 7.1 of the Scoping Report (‘Anticipated Shallow Soils’) is described as a summary, with the reader referred to Appendix 7.1 for full details. However, no information is given as to the specific location of the relevant evidence within Appendix 7.1. Where the ES Ground Conditions Chapter is to cross refer to appendices or figures, specific paragraph numbers/ figure numbers to the relevant evidence should be provided.</p>	<p>This will be addressed with appropriate cross referencing.</p>
<p>3.8.5</p>	<p>Appendix 7.1</p>	<p>Figures</p>	<p>A number of the figures provided within Appendix 7.1 of the Scoping Report (‘Ground Conditions Study Area’) do not show the red line boundary of the Proposed Development, or the applicable study area. It is also noted that Appendix 7.1, Appendix E (‘Mining, Quarrying and Minerals’) only provides information for part of the red line boundary. A number of the figures contain shaded areas or other graphical representations which are not shown on an accompanying key.</p> <p>Relevant figures accompanying the ES Ground Conditions assessment should consistently and accurately illustrate the red line boundary and applicable study</p>	<p>The ES Appendix will show the final red line boundary of the Scheme, or an applicable study area for the data being assessed.</p> <p>The County boundary through the study area will be marked on figures and appendices, with supporting legends where appropriate.</p>

			area. The figures should clearly present baseline information across the entirety of the application site.	
3.8.6	n/a	Impacts on mineral and hydrocarbon resources	The scoping consultation response from City of Doncaster Council (Appendix 2 of this Opinion) states that “the scoping area” is partially within a Mineral Safeguarding Area and a Petroleum Exploration and Development Licence area. The ES should identify potential impacts on mineral and hydrocarbon resources, including those resulting from sterilisation of the resources during the lifetime of the Proposed Development. Any likely significant effects should be assessed. Effort should be made to discuss and agree the approach with the relevant local planning authorities.	This will be addressed. Liaison with the relevant local planning authorities is being undertaken.

Limitations to the Assessment

9.3.21. The current chapter is based on the findings of the Phase 1 Desk Study and site reconnaissance, as given in Appendix 9.1. No intrusive investigation has been completed for the current proposals at this stage. The factual data used to complete the desk study includes the previous (2009) investigation findings for the Tween Bridge Wind Farm, and borehole records provided as Open Government Licence data by the British Geological Survey. These have been reviewed using Integrale experience and professional judgement.

9.4. Baseline Conditions

Site Description and Context

9.4.1. The Site lies east of Thorne and west of Crowle, bounded north by the Humberhead Peatlands National Nature Reserve and south by Hatfield Moors and the Isle of Axholme. It comprises approximately 1,500 hectares of agricultural land parcels within the lowland basin of the former Rivers Don and Idle. The land is typically at 1–4m OD with very low or Negligible gradients, drained by ditches and larger Drains, with the River Torne forming the southeast boundary. It is crossed by a network of roads, railway and canal.

Baseline Survey Information

9.4.2. The Phase 1 Desk Study in Appendix 9.1 provides details of the sources used to derive the baseline survey information and can be summarised as:

9.4.3. This area of the southern Vale of York is low-lying, low relief ground underlain by thick stratified sequences of complex late Quaternary period superficial deposits. These include deep channels infilled by thick lake deposits, sands and gravels, and partially covered by younger wind-blown sands. Later Alluvium (typically 1–5m but locally more than 15m thick over channels) and marginal

peats partially mantle the area. Artificial 'Flood Warp' alluvium up to 1.5m thick has been deposited in the northeast and beyond the northwest to provide improved well-drained soils.

- 9.4.4. Permo-Triassic Sherwood Sandstone Group and Triassic Mercia Mudstone Group bedrock underlies the superficial deposits at more than 7–15m depth. The Sherwood sandstone in the western and central area forms a Principal Aquifer. The superficial Alluvium Warp and Sands and Gravels form a Secondary A Aquifer.
- 9.4.5. The western and central Site area is a Source Protection Zone 3 (Total Catchment) with an area of Source Protection Zone 2 (Outer Catchment) c. 250m west of the southwest Draft Order Limits extent. Both these relate to an abstraction borehole at Sandtoft Road pumping station at 600m west of southwest Draft Order Limits, which itself forms the centre of a Source Protection Zone 1 (Inner Catchment).
- 9.4.6. The local details of groundwater vulnerability are complex, however the Secondary Superficial Aquifers are typically of Medium groundwater vulnerability in the central and western Site area. Parts of the eastern and northeastern areas, and of the southwest have High groundwater vulnerability in the Secondary Superficial Aquifer, mainly where sands occur.
- 9.4.7. Historical maps indicate a prolonged history of agricultural use, with drainage features of key importance. Peat working was mainly beyond the Site boundaries, but with a peat works at Medge Hall, and at Hatfield Peat Works to the south, just beyond the Draft Order Limits. Small scale peat digging or sand and gravel workings are markedly limited on the mapping. Larger workings at Tudworth Hill are only shown on maps from the 1960's and appear to not be infilled, based on topographic evidence. Further information is required by means of a detailed walkover reconnaissance to be undertaken during autumn/winter 2023, together with enquiries to the Environment Agency and local authority. Some evidence for Flood Warp channels and ponds is noted on the mapping.
- 9.4.8. A World War II airfield at Sandtoft included a bomb store area close to Woodcarr Small Drain, north of the M180. The location of an air crash west of Crowle has not been identified precisely in the soft ground. A Preliminary Unexploded Ordnance Risk Report for the complete Order Limits area will be obtained during autumn 2023, followed by Detailed UXO Risk Report(s) for the former airfield bomb store area and any other areas identified as of concern by the Preliminary Report, prior to final submission of the Environmental Statement
- 9.4.9. Thorne Colliery operated 1925–58 from two shafts approximately 875m north of the Site and not within influencing distance. The Coal Authority have confirmed there is no requirement to consider mining legacy within the EIA.
- 9.4.10. Peat deposits mapped on the geological sheets that fall within the Draft Order Limits are degraded remains of lowland raised bog. These are typically classed as 'wasted peat' damaged by drainage and cultivation which has caused shrinkage, decomposition, wind erosion or compression, as reflected in the LandIS soil descriptions, with no true peat bog soils reported. The near surface sandy or clayey peat thickness anticipated is typically less than 0.6–1m. The overall Site is considered to have a very low or low sensitivity to peat instability due to degradation, drainage and low slope gradients. Where deeper peats would be intersected by construction excavation eg at new accesses or structures, localised peat stability requires consideration at detailed design stage following consent.

- 9.4.11. Former landfills at Tudworth, and a waste transfer station facility at Brier Hills Farm lie adjacent beyond the Site boundaries.
- 9.4.12. Mineral Safeguarding Areas are identified by North Lincolnshire Council for Sand and Gravel and for Brick Clay, and by Doncaster Council for Sand and Gravel, within parts of the Draft Order Limits. Neither of the Councils respective consented extraction sites, areas of search, nor proposed sites allocations lie within the Draft Order Limits. Development which is deemed a Mineral Safeguarding Exception within the relevant Local Plan policies includes the Exemption Criteria of temporary planning permissions, which by definition includes renewables schemes with time limited permission and an integral decommissioning phase.
- 9.4.13. The Initial Conceptual Exposure Model in Section 4 of Appendix 9.1 identifies localised ground workings, the former airfield area, and two previous pollution incidents as the main on-site potential contaminant Sources (Section 4.2 of Appendix 9.1). The off-site Sources identified as requiring consideration are the Tudworth Hall Farm landfill adjacent northwest, the Brier Hills Farm waste management station adjacent south, and the Contaminated Land Determination at Green Tree Garage approximately 600m west.
- 9.4.14. The Conceptual Exposure Model Receptors identified are construction workers, future construction and maintenance staff, drainage ditches and water courses, groundwater within the Secondary Superficial Aquifer, and the solar Scheme infrastructure and plant. There are no residential receptors within 250m of the proposed substations and BESS areas.
- 9.4.15. The Conceptual Exposure Model Pathways identified by which contaminant sources could impact on these receptors are dermal exposure and inhalation, migration of ground gas, contact with unexploded ordnance, creation of new water migration pathways during construction, surface water run-off, and direct contact of construction materials with contaminated ground.
- 9.4.16. The potential Source-Pathway-Receptor linkages identified are summarised in Table 9.7.

Table 9.7 Potential Contamination Linkages

SOURCE		PATHWAY		RECEPTOR
Former Tudworth Sand/Gravel Workings if contaminated soils present	→	Dermal exposure Inhalation (if contamination exposed during groundworks)	→	On-site construction worker.
Former Airfield / bomb store Unexploded Ordnance or contaminated soils	→	UXO risk Dermal exposure Inhalation (if contamination exposed during groundworks)	→	On-site construction worker.
Brier Hills Waste Management Site on southern boundary Area 7B if airborne surface particulates spread beyond	→	Dermal exposure Inhalation of particulates (if surface disturbed significantly during construction)	→	On-site construction worker
Former Tudworth Sand/Gravel Workings if contaminated	→	Creation of new pathways for leaching or migration of liquid contaminants through	→	Surface Water Courses & Groundwater

SOURCE		PATHWAY		RECEPTOR
soils within construction depth		the unsaturated zone by means of new man-made or natural pathways. Inverter stations only.		
Former Airfield / bomb store contaminated soils	→	Creation of new pathways for leaching or migration of liquid contaminants through the unsaturated zone by means of new man-made or natural pathways. Run-off from disturbed soils. Inverter stations only.	→	Surface Water Courses & Groundwater
Pollution Incident 2003 Oil/Fuel impact Area 2 trackway	→	Creation of new pathways for leaching or migration of liquid contaminants through the unsaturated zone by means of new man-made or natural pathways. Run-off from disturbed soils.	→	Surface Water Courses & Groundwater
Clay/Silt laden Run-off (loamy and clayey soils)	→	Mobilisation due to intense machinery traffic during wet weather	→	Surface Water Courses
Former Tudworth Sand/Gravel Workings if contaminated soils within construction depth	→ →	Migration of abnormal ground gases Contact with soils	→ →	Array cables or pipework Inverter stations In-ground concrete
Tudworth Hall Farm Landfill if gas migration has occurred beyond boundaries	→	Migration of abnormal ground gases	→	Array cables or pipework
Former Airfield / bomb store contaminated soils	→	Contact with soils	→	Array cables or pipework In-ground concrete
Pollution Incident 2003 Oil/Fuel impact Area 2 trackway	→	Contact with soils	→	Array cables or pipework In-ground concrete
Brier Hills Waste Management Site on southern boundary Area 7B if airborne surface particulates spread beyond	→	Contact with airborne surface particulates	→	Array cables or pipework In-ground concrete
Highly peaty Alluvium or Peat at shallow depth where Battery Energy Storage (BESS), Substations or Inverters located	→	Migration of combustible gases	→	BESS compound Substations Inverter Stations (and by connection human receptors)

- 9.4.17. At the time of writing the location of trenchless cable works requiring horizontal directional drilling at crossing points is unknown, but likely required near Maud's Bridge for the Stainforth and Keadby Canal and South Humberside Main Line Railway, at the M180 motorway at Hatfields Chase, and at High Level Bank Road (the A18). A number of Internal Drainage Board Managed Watercourses which may require trenchless cable works are being explored.
- 9.4.18. The qualitative risk assessment concludes that the shallow construction activity required for the solar arrays will not create an adverse or worsening impact on the contaminant exposure model. A Construction Environmental Management Plan will be required. Further consideration is needed for structures, confined spaces and sensitive plant, battery storage areas and substations.
- 9.4.19. It is considered that specific targeted contamination investigation at the critical historical land use or environmental features identified within the conceptual exposure model can be undertaken at detailed design stage following consent.
- 9.4.20. For geotechnical design purposes a range of array foundations are available, including both pin pile and concrete ballast types, dependent on the soil conditions in various parts of this very large Site. Piled foundations are the most likely option for substations and the battery energy storage system (BESS). Access roads and tracks are likely to require use of geogrid reinforcement to minimise pavement thickness and materials import, and cable trenching should be scheduled for drier periods. Geotechnical investigation should develop the ground model, particularly where former river channels occur, by use of probing traverses to capture the range of ground conditions, with select control boreholes to aid interpretation. Additional boreholes are needed at directional drilling locations. Foundation trials for arrays could be used to optimise design and construction.
- 9.4.21. The ongoing assessments will be used to update the next iteration of this PEIR. These include: detailed site reconnaissance walkover at specific locations identified in the Phase 1 Desk Study, further liaison with consultees on landfilling and waste management sites outside the Draft Order Limits, and approach to Minerals Safeguarding Areas, and Horizontal Directional Drilling assessment.

Future Baseline

- 9.4.22. In the absence of the Scheme, it is likely that the ground conditions within the Draft Order Limits would remain as existing.

9.5. Assessment of Likely Significant Effects

Construction

- 9.5.1. Site levelling works are not typically envisaged at most locations within the prevalent very low slope angle topography in this area. For the arrays there will be no removal of soil, mineral resources or geological features, and only minor disturbance during construction. At substations, the battery area and compounds topsoil will be stripped and stockpiled for reuse during construction or restoration.
- 9.5.2. Construction of the Scheme is likely to involve installation of cable runs to between 0.5–1.5m below existing ground level and installation of arrays by driving steel pin piles to between 1.5 and 3m depth, or adopting concrete ballast foundations. It may be necessary to adopt piled

foundations for specific substations and the battery energy storage area (BESS), dependent on the anticipated loadings and ground conditions. This will reduce the need for large amounts of mass concrete or trench foundations.

- 9.5.3. New access roads will require stripping of topsoil and placement of aggregate, very likely with geogrid reinforcement to reduce the thickness of new construction required. At inverter stations, substations and the BESS area, along with temporary construction compounds and stores, it is likely that topsoil will be stripped, an aggregate blanket placed and reinforced concrete slabs constructed to support plant, or piled foundations installed. Topsoil would be appropriately stored to minimise damage and provide for initial and final site restoration.
- 9.5.4. The requirement to minimise disturbance of peat soils during construction and maintenance in order to minimise release of carbon dioxide and maximise the carbon balance savings of the Scheme will be considered in Chapter 14 (Air Quality) in the next iteration of the PEIR. Potential effects of disturbance on carbon dioxide release are most likely to occur during the construction period. Given the current degraded ('wasted') soils at the shallow depths anticipated for construction of arrays across the majority of the peaty soils areas, and the current agricultural operations, it is considered that minimal additional disturbance will occur. Where peaty soils occur in areas for compounds, BESS or substations, micro-siting to reduce potential carbon release will be considered at detailed design stage. Reuse of excavated soils and minimising waste will provide further mitigation.
- 9.5.5. At horizontal directional drilling crossing points it is likely that multi-duct installations will be required, with launch and receive pits for the drilling equipment, drilling platforms and potentially a drilling mud storage pit or recycling area pit, along with conventional construction compounds, access and storage areas. A specialist contractors method statement and environmental management plan will be required for this aspect of the construction.
- 9.5.6. The determination of the unmitigated effects relating to soils and water resources and potential contamination during the construction phase is given below.

Table 9.8 Significance of Effects during Construction

Feature / Receptor	Potential Effect	Magnitude of Effect	Receptor Sensitivity	Significance of Effect
Soils & Underlying Geology	Loss of Topsoil / Subsoil	<u>Arrays</u> : Negligible as no removal of important soil, mineral resources or geological features, and only slight disturbance of soils. <u>Substations, BESS, compounds</u> : Low as localised removal and reuse possible	Low or Medium due to current agricultural use and resilience to structural damage.	Minor or Minor to Moderate
Soils	Damage to soils by compaction, rutting and poaching	Low – Short term work at each area for array installation. Heavier trafficked routes and compounds more likely to be damaged if abnormal weather and wet soils	Medium due to current agricultural use, short term and recoverable	Minor to Moderate
Mineral Resource of Underlying Geology	Resource inaccessible	Low – access to local areas restricted only during lifetime of development. No depletion or damage to resource and development temporary.	<u>Safeguarded areas</u> : Medium value as no current consents or areas of search proposals within current Local Plans. <u>Remainder of Site area</u> : Negligible mineral value.	Minor to Moderate
Peat Stability	Unacceptable differential settlement beneath new loaded areas. Stability of excavations. Very localised damage or disruption of continuity possible.	Low – very localised damage or disruption	Medium – construction activities, structures or services	Minor to Moderate

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<p>Groundwater Quality</p> <p>Source Protection Zone 3 on-site (Total Catchment)</p>	<p>Changes to pollutant pathways (Minor nature of most construction limits significant disturbance/ release of contaminants; penetrative foundations could increase potential changes). Short term changes to local groundwater flow regime for new crossing points.</p>	<p>Low – those very few areas of potential (low level) source contamination identified are in array areas only and so unlikely to be disturbed significantly. Any penetrative foundations (ie deeper piling) require further assessment. Groundwater level or flow changes short-lived.</p>	<p>Medium or High – Secondary Aquifer in Superficial Deposits, low to Medium permeability soils, Source Protection Zone 3, some areas of High Vulnerability, groundwater & surface water connectivity assumed</p>	<p>Minor or locally Moderate Adverse</p>
<p>Surface Water Quality</p> <p>Substations, BESS and compounds, new roads/tracks</p>	<p>Disturbance of contamination or run-off to water courses</p>	<p>Medium – due to degree of construction activities proposed, proximity of water courses, likely connectivity with shallow perched groundwater.</p>	<p>Medium – assume likely connectivity between shallow perched groundwater & surface water courses</p>	<p>Moderate – adverse</p>
<p>Surface Water Quality</p> <p>All areas near drainage or water courses where substations, BESS, compounds or new roads/tracks</p>	<p>Mobilisation of clay/silt fines due to machinery traffic during wet weather</p>	<p>Medium – due to degree of construction activities proposed, proximity of water courses</p>	<p>Medium – currently agricultural plant operating similarly across majority of area. Locally High sensitivity</p>	<p>Moderate – adverse</p>
<p>Surface Water Quality</p> <p>Horizontal Directional Drilling Sites</p>	<p>Disturbance of contamination, run-off to water courses, potential use of polluting materials and plant</p>	<p>Medium – proven construction techniques proposed with integral preventative measures</p>	<p>High – due to proximity of water courses and assumed likely connectivity between shallow groundwater & water courses</p>	<p>Major – adverse</p>

<p>Ground Gas Regime</p> <p>Adjacent landfill and waste management sites (no on-site sources confirmed to date)</p>	Linkage of receptors with ground gas	Low – predominantly outdoors usage, with shallow array installation only at these locations. Absence of confined spaces, very low potential for new pathway creation due to shallow installation	Low – no groundworkers in confined space working. Arrays only within influencing distance	Minor
<p>Ground Gas Regime</p> <p>Naturally occurring peat /organic sources</p>	Linkage of receptors with ground gas	Low – predominantly outdoors usage. Shallow array installation. Very low potential for new pathway creation due to shallow construction and ‘wasted peat’ regime. Confined spaces & sensitive infrastructure potential at substations and BESS	Medium – confined spaces & sensitive infrastructure potential at substations and BESS	Minor to Moderate
<p>Surrounding Land Uses</p>	Disturbance /release of contamination beyond Site boundaries	Negligible –no works beyond Site boundary.	Low – agricultural or open space. No residential properties within 250m of substations or BESS	Negligible
<p>Construction Workers</p>	Exposure to contaminants	Low – if contamination sources present they are considered Minor in nature and extent, & short term exposure	Medium – limited earthworks typically	Minor to Moderate
<p>Construction Workers</p>	Unexploded Ordnance (former airfield / bomb store)	High – UXO would represent an unacceptable risk	Medium – limited earthworks for arrays and inverter stations	Major – adverse

9.5.7. During the construction phase, risks to human health for groundworkers, site visitors and neighbours by exposure to any contaminants present will be controlled by the contractor as part of their obligations under the Construction (Design & Management) Regulations 2015 (CDM). by use of Personal Protective Equipment, dust suppression, vehicle sheeting and wheelwashing as necessary, prevention of entry to confined spaces without monitoring or equipment etc. The processes are well practiced and the risks well understood, therefore the construction would

have a remaining Minor adverse potential risk to human health once the risks are correctly controlled.

- 9.5.8. During the limited groundworks, there will be a low likelihood of exposure of workers to any contaminated soils (and potentially to abnormal ground gases in any confined spaces). The unexploded ordnance risk in the former airfield area remains unknown and Preliminary and Detailed UXO risk assessments from a specialist are to be obtained. This is considered a Major and Adverse effect, and therefore Significant. It requires mitigation by means of specialist risk assessment to identify the degree of risk. If that assessment concludes that UXO site supervision and watching brief during groundworks in this area is required, then it will be controlled by the contractor under their CDM obligations and secured by implementation of the Construction Environmental Management Plan (CEMP). The exposure would have a remaining Minor or Negligible adverse potential risk to human health once the risks are correctly controlled.
- 9.5.9. There is clearly potential, as with most construction sites, for oil/diesel or other contaminants to be accidentally spilled or to leak from plant and equipment during the works. In critical locations, this could potentially impact on the groundwater quality, or run-off to surface water courses. The significance of this potential effect in this site context is considered Moderate and Adverse and will therefore require mitigation by design and management identified within the CEMP.
- 9.5.10. There is a low potential for contaminants to be present in any shallow depth Made Ground and Negligible for natural soils. The limited amount of earthworks required for the majority of the area where solar arrays or inverters are proposed will limit disturbance to such soils. The actual degree of contamination present at the substation, BESS and compounds areas or where potentially contaminative features or areas have been identified, and where water courses are in close proximity, is considered a plausible Moderate and Adverse effect and therefore Significant. This will be clarified during further assessment walkover and research and confirmed during post-consent investigation to inform both detailed design and the Detailed CEMP.
- 9.5.11. There is not considered to be any short-term increased risk of dust generation from soils due to the limited nature of proposed earthworks and the predominantly cohesive soils. However this requires control measures identified within the CEMP.
- 9.5.12. There is a Moderate and Adverse potential for mobilisation of fines within run-off during abnormal or extreme wet weather combined with intense traffic movements of construction machinery. While there is currently frequent heavy agricultural plant using similar techniques, this aspect is considered Significant and requires mitigation. The CEMP must include control measures, requirements for use of protective systems such as track matting or membrane cover and protocols for work adaptation.
- 9.5.13. The directional drilling proposals, particularly where adjacent to water courses are considered a plausible Major and Adverse effect due to the type of construction activity in proximity to surface water and with potential to intersect the groundwater table. A specialist directional drilling contractors method statement and environmental management plan will be required for this Significant aspect of the construction to mitigate the potential effects.
- 9.5.14. For Safeguarded Minerals Areas within the Draft Order Limits the temporary nature of the development and the fact that it would not deplete or damage the resource for the longer term indicates a Minor to Moderate effect.

- 9.5.15. Groundwater levels and flow pathways are unlikely to be altered by installation of array foundation pin piles or shallow cabling due to their typical size and length. In cohesive soils the driven installation forms a rapid 'seal' around the pin, thus precluding formation of new vertical pathways.
- 9.5.16. Where peaty soils are present, these are classed as 'wasted' due to prolonged drainage and agriculture. The limited degree of disturbance caused by array piles is unlikely to create any further enhanced drainage or wasting due to the installation. Groundwater within the deeper organic deposits beneath the pin piles would be unaffected.
- 9.5.17. Further assessment of the likely groundwater levels in very low elevation areas such as Tudworth and Hatfield Chase is being undertaken and will be included in the next iteration of this PEIR.

Operation

- 9.5.18. Following commissioning, maintenance engineers would visit on occasion as necessary. Grass pasture will be retained or upgraded between and beneath the arrays which will be available for small livestock grazing.
- 9.5.19. This land use will maintain or lower the probability of future ground contamination of soils and geology occurring. This is a low magnitude effect on a Medium sensitivity receptor and therefore will produce a Minor Neutral or Beneficial effect.
- 9.5.20. The end users and surrounding land uses are limited to maintenance staff during periodic visits and surrounding agriculture or open space sites. The site usage will maintain or lower the probability of exposure to any ground contaminants, by reducing agricultural intervention such as ploughing or digging. This is a low magnitude effect on Medium sensitivity receptors and therefore will produce a Minor Neutral or Beneficial effect.

Decommissioning

- 9.5.21. The decommissioning phase is considered to create potential similar effects to that during construction, or of lesser magnitude. All above ground plant and equipment, and all cabling above 1m below ground would be removed. Any cabling buried 1m+ below ground will not be removed at decommissioning.
- 9.5.22. Bunded topsoil from the initial stripped areas can be reused for site restoration.
- 9.5.23. Where steel pin piles are adopted these installations can be removed easily and economically.

9.6. Mitigation, Enhancement and Residual Effects

Embedded Mitigation

- 9.6.1. Environmental effects on ground conditions which are determined as **Moderate** or **Major** would be mitigated within the embedded design measures, and secured through implementation of the CEMP for the Scheme. Additionally, effects considered above as Minor to Moderate will be mitigated by inclusion within embedded design considerations, the CEMP and good construction practice.

- 9.6.2. Those embedded measures will be secured by adoption of agreed Outline and Detailed Construction Environmental Management Plans. The measures are summarised in Table 9.9 and described further below.
- 9.6.3. Peat stability will be assessed during detailed design at any specific locations where existing geological data or intrusive investigation indicates a sufficient peat thickness would be intersected by the proposed construction, such as at new accesses, tracks or where structures are proposed. Critical areas will be identified and protocols for groundworks activities in these areas developed.
- 9.6.4. Selection of appropriate plant and best practice working methods would be adopted to control or reduce creation of new pathways during penetrative foundations ie piling.
- 9.6.5. Appropriate buffer or non-working zones would be integral to the construction layout alongside surface water courses to prevent fines run-off, or mobilisation of chemicals entering the water courses.
- 9.6.6. Appropriately located storage areas would be allocated for all construction products, in particular hydrocarbons or petrochemicals in accordance with Control of Substances Hazardous to Health (COSHH) Regulations 2002 .
- 9.6.7. For crossing points requiring horizontal directional drilling, specific risk assessments, method statements and environmental management plans, based on location specific topography, ground and groundwater conditions, will be undertaken and agreed with consultees, stakeholders and regulators prior to commencement.
- 9.6.8. Assessment of shallow depth ground gas regime at sensitive infrastructure locations such as substations and BESS is required, with adoption of appropriate gas protection within ground slab design if appropriate.
- 9.6.9. Location specific unexploded ordnance risk assessments would be undertaken by specialist consultancy at detailed design stage and their recommendations embedded in the Detailed CEMP. This may require on-site supervisory watching brief and in situ testing during works.
- 9.6.10. The CEMP would include a requirement for the contractors to maintain an adequate watching brief during all groundworks operations to identify an areas of unforeseen contamination, visual evidence or unusual odours or staining and protocols to deal with this circumstance. This would include procedure for pausing works, restricting access and temporary remedial actions such as use of spill kits, bunding or covers, informing appropriate authorities and project team, remedial action, verification and removal of materials.
- 9.6.11. In addition to the above, the effects prevented or reduced by implementation of the CEMP include: human health exposure through contact or inhalation of residual soil or groundwater contaminants, exposure to potential ground gas in confined spaces, and pollution of water quality in the superficial aquifers.
- 9.6.12. If appropriate mitigation measures, as given above and summarised in Table 9.9 are implemented, then the identified risks are considered to be Negligible and therefore Not Significant.

9.6.13. In addition to specific investigation for Horizontal Directional Drilling locations, a ground investigation would be undertaken following consent and prior to construction to inform detailed design. This would comprise targeted geotechnical investigation to confirm soil parameters for foundation and road design, and geoenvironmental investigation by sampling soils, groundwater and monitoring ground gases. The scope of the intrusive geoenvironmental investigation would be based on the conceptual exposure model given in the Phase 1 Ground Conditions Desk Study. The data results would be used to refine that modelling and undertake a generic quantitative risk assessment. If contaminant linkages not identified previously are determined, which cannot be dealt with by design or CEMP requirements, a Remediation Strategy would be prepared to specify additional protective measures during construction.

Additional Mitigation

9.6.14. No additional mitigation measures are currently envisaged as required prior to and during construction, since the potential effects detailed above are considered localised and temporary, or would be controlled by the embedded design and management measures secured by the CEMP, or controlled by contractors obligations under CDM Regulations.

During Operation

9.6.15. With the implementation of the embedded mitigation measures and those undertaken during the construction phase, the effects on Ground Conditions aspects during operation of the Scheme are considered Negligible.

9.6.16. Maintenance activities involving potentially contaminative products would be controlled under the OEMP. The site drainage strategy would be designed to preclude potentially contaminated run-off. Maintenance works involving in-ground working or excavations would require similar strategy and control to those adopted at construction stage, and again by specified within the OEMP.

9.6.17. No additional mitigation measures are envisaged therefore during operation for ground conditions aspects.

During Decommissioning

9.6.18. At the end of the Scheme operation, it is anticipated that decommissioning works would have similar effects on ground conditions aspects to those during the construction stage. Therefore no additional mitigation measures are envisaged as likely during decommissioning.

Table 9.9: Mitigation Measures by Design or During Construction

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By CEMP Requirements
1	Peat stability assessment	X		
2	Prevent changes to pollutant pathways or prevent new pathways creation	X		X

3	Prevent disturbance of contamination or run off to water courses	X		X
4	Horizontal Directional Drilling Method Statement and CEMP	X		X
5	Gas Risk Assessment	X		
6	Unexploded Ordnance Risk Assessment and potentially on-site supervision / watching brief and in situ testing	X		X
7	Geotechnical & Geoenvironmental Investigation	X		
8	Contractors watching brief for unforeseen contamination			X

Residual Effects

- 9.6.19. Residual impacts are only considered in the assessment assuming implementation of the mitigation measures described above.
- 9.6.20. It is therefore considered that if the mitigation measures are implemented and adhered to then there should be no Significant residual Adverse effects to the soils, geology, hydrogeology, contaminated land, ground gas regime during the construction, operation and decommissioning phases of the Scheme.

9.7. Cumulative and In-Combination Effects

- 9.7.1. The applicant is seeking to develop a long list of sites to be considered for cumulative impact as part of the informal consultation process. Consideration of cumulative impacts should be available for the next iteration of the PEIR. Nevertheless, it is considered that the majority of effects of this Scheme on ground conditions would occur only within a localised area where soils, geology or hydrogeology are linked or have connectivity. This is considered to be no greater than 2 km beyond the Order Limits.
- 9.7.2. Other developments will be required to comply with the planning process which requires the land to be suitable for its intended use and not cause harm to potential receptors. The mitigation measures identified above for the current Scheme would prevent, reduce or offset environmental effects relating to Ground Conditions aspects. Those other developments would also need to demonstrate compliance with these principles.
- 9.7.3. Therefore the cumulative residual effects are likely to be Not Significant for ground conditions aspects.
- 9.7.4. Further consideration of the Minerals Safeguarding Zones will be discussed with the Local Authorities and addressed in the next iteration of this PEIR.

9.8. Summary

Introduction

- 9.8.1. This chapter of the working draft PEIR assesses the likely significant effects of the Scheme on Ground Conditions, including soils, geology, groundwater and contaminated land.
- 9.8.2. The chapter is supported by the findings of a Phase 1 Desk Study (Appendix 9.1) and Scheme design information available at the time of writing and will be updated as further assessments and consultation responses become available.

Baseline Conditions

- 9.8.3. This very large Site is predominantly large agricultural fields with isolated farmsteads, crossed by a network of roads, railway and canal. It forms part of the lowland basin of the former Rivers Don and Idle, being low-lying at typically 1-4mOD, with very low to Negligible natural gradients. The fields are typically bounded by a grid of numerous drainage ditches and larger water courses.
- 9.8.4. The area is underlain by thick sequences of complex superficial deposits including former lake laminated silt/clay deposits, sands and gravels and infill sediments to deep glacial period channels. Thick alluvial clay and silt blankets these and overlap marginal peat deposits. The old rivers have been historically diverted and artificial alluvium (floodwarp) deposited to provide better draining agricultural soils.
- 9.8.5. Surface soils are loamy or clayey, slowly to moderately permeable, or relatively impermeable and seasonally wet with impeded drainage. This helps maintain a naturally high groundwater table. There are no bog peat soils mapped.
- 9.8.6. There is no requirement to consider coal mining legacy within the Draft Order Limits. Peat soils were formerly more extensive, but peat cutting, drainage, ploughing and floodwarping has lowered and compacted the relatively thin surface peats, such that they are classed as 'wasted' within the Draft Order Limits area. Parts of the western and eastern areas are included in Minerals Safeguarding Areas for sands and gravels, although these do not include any operational extraction sites, consented, proposed or search areas within the current Local Plans.
- 9.8.7. The Scheme area lies beyond the Hatfield Moors gasfield and two Petroleum Exploration and Development Licence areas cover parts of the western Draft Order Limits.
- 9.8.8. The area has a prolonged agricultural history with isolated farmsteads. Peat working is not specifically mapped but has likely occurred historically, with peat works beyond the boundaries. A World War II airfield and bomb stores in the extreme southeast has been returned to agriculture.
- 9.8.9. Permeable alluvial superficial deposits typically form a Secondary A Aquifer, whilst the peat and laminated silt/clay deposits are Unproductive. Sherwood Sandstone at depth forms a Principal Bedrock Aquifer. Groundwater levels are maintained below ground level for much of the year by drainage and there is likely hydraulic continuity between groundwater and water courses. The overall level and flow will also be controlled by local factors such as former drainage courses or historical features. The western and central zones are in Source

Protection Zone (SPZ) 3, due to a SPZ 1 at a pumping station 600m west of the Draft Order Limits, and SPZ 2, 250m West. Groundwater vulnerability to pollution is typically Medium, with parts being High where sands of the Secondary Superficial Aquifer occur.

- 9.8.10. Former landfills at Tudworth and a waste transfer station at Brier Hills lie adjacent to the western and southern boundaries respectively. Two past pollution incidents within the Draft Order Limits are considered as plausible contaminant sources and a Contaminated Land Determination 600m west has been considered within the conceptual modelling.
- 9.8.11. Potential Source–Pathway–Receptor linkages identified for assessment can be summarised as: dermal and inhalation exposure and UXO risk to construction workers at the former sand workings, adjacent waste site and airfield; leaching or migration of liquid or mobile contamination to surface water or groundwater; fines laden run-off to water courses if heavy machine working in adverse weather conditions; migration of abnormal ground gases to sensitive structures; direct contact of construction materials with contaminated soils; directional drilling at crossing points adjacent water courses.
- 9.8.12. Assessment concludes that the shallow construction for solar arrays will not create an adverse or worsening effect. A Construction Environmental Management Plan (CEMP) will be required.
- 9.8.13. Further consideration is required for structures, confined spaces and sensitive plant. Specific targeted contamination investigation at critical locations during detailed design stage is proposed, in combination with geotechnical investigation for foundation design and directional drilling.

Likely Significant Effects

- 9.8.14. The assessment indicates that during construction the majority of effects can be controlled by CDM Regulations and the CEMP as they are well understood and practiced. The limited and shallow groundworks create low likelihoods of exposure.
- 9.8.15. Those potential effects deemed **Moderate** or **Major** and **Adverse** comprise: UXO risk at the former airfield/bomb stores; potentially polluting construction plant and materials working near water courses; disturbance of any contaminated soils where deeper or larger scale construction proposed for substations and BESS area; fines run-off to water courses if heavy machinery working during adverse weather; and directional drilling at surface water crossing points.

Mitigation and Enhancement

- 9.8.16. Environmental effects determined as **Moderate** or **Major** would be mitigated within the design measures of the Scheme to prevent, reduce and offset those effects. Those embedded mitigation measures will be secured by adoption of agreed Outline and Detailed CEMP's.
- 9.8.17. With the adoption and implementation of the agreed embedded mitigation measures, the effects identified for construction, operation and decommissioning of the Scheme are Negligible. There is no requirement for additional mitigation measures.

Conclusion

- 9.8.18. The short duration construction period and shallow depth intrusive construction method for the majority of the Scheme are determined as creating only localised and temporary environmental effects. Those elements determined as potentially giving rise to **Moderate** or **Major** effects would be mitigated by implementation of a well understood and practiced CEMP and controlled under CDM Regulations, secured under the DCO. The residual effects are therefore Negligible and Not Significant.
- 9.8.19. Table 9.10 provides a summary of effects, mitigation and residual effects.

Table 9.10: Summary of Effects, Mitigation and Residual Effects

Receptor / Receiving Environment	Description of Effect	Nature of Effect	Sensitivity Value	Magnitude of Effect	Geographical Importance	Significance of Effects	Mitigation Enhancement Measures	Residual Effects
Construction								
Soils & Underlying Geology	Loss of Topsoil / Subsoil	Temporary Direct	Medium	Low	Local	Minor or Minor to Moderate Adverse	None required	Negligible (Not Significant)
Soils	Damage by compaction or rutting	Temporary Direct	Medium	Low	Local	Minor to Moderate Adverse	None required	Negligible (Not Significant)
Mineral Resource of Underlying Geology	Resource inaccessible	Temporary Direct	Medium	Low	Borough / District	Minor to Moderate Adverse	None required	Negligible (Not Significant)
Peat Stability	Settlement, stability, damage, disruption	Permanent Direct	Medium	Low	Local	Minor to Moderate Adverse	None required	Negligible (Not Significant)
Aquifers, Groundwater Quality, Source	Change to pathway, flow Change in quality	Temporary Direct	Medium or High	Low	Borough / District	Moderate Adverse	Design and CEMP	Negligible (Not Significant)

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Protection Zones								
Surface Water Quality	Disturbance of contamination Mobilisation of Fines	Temporary Direct	Medium	Medium	Borough / District	Moderate Adverse	Design and CEMP	Negligible (Not Significant)
Surface Water Quality Directional Drilling Sites	Disturbance of contamination, run-off, polluting materials / plant	Temporary Direct	High	Medium	Borough / District	Major Adverse	Risk Assessment, Design and CEMP	Negligible (Not Significant)
Ground Gas Regime	Linkage of receptors with ground gas	Permanent Direct	Low	Low	Local	Minor Adverse	Design and CEMP	Negligible (Not Significant)
Natural Ground Gas (Peat)	Linkage of receptors with ground gas	Permanent Direct	Medium	Low	Local	Minor to Moderate Adverse	Design and CEMP	Negligible (Not Significant)
Surrounding Land Uses	Release of contaminants beyond boundaries	Temporary Indirect	Low	Negligible	Local	Negligible	CEMP	Negligible (Not Significant)
Construction Workers	Exposure to contaminants	Temporary Direct	Medium	Low	Local	Minor to Moderate Adverse	CDM CEMP	Negligible (Not Significant)

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Construction Workers	Unexploded Ordnance	Temporary Direct	Medium	High	Local	Major Adverse	UXO Assessment CDM CEMP	Negligible (Not Significant)
Operation								
Soils	Future ground contamination	Temporary Direct	Low	Low	Local	Minor Neutral or Beneficial	Not required	Negligible (Not Significant)
End Users and Surrounding Uses	Future contamination exposures	Temporary Indirect	Medium	Low	Local	Minor Neutral or Beneficial	Not required	Negligible (Not Significant)
Decommissioning								
Similar to Construction Phase								
Cumulative and In-Combination								
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

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