Boom Power

LOW FARM, WAKEFIELD

Preliminary Phase 1 Geo-environmental Assessment and Preliminary Coal Mining Risk Assessment

JULY 2021

PUBLIC

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APPENDICES

1 INTRODUCTION

1.1 TERMS OF REFERENCE

WSP UK Ltd (WSP) was instructed by Aardvark EM Ltd on behalf of Boom Power Limited ('the Client') to undertake a Preliminary Phase 1 Geo-Environmental Risk Assessment (PRA) and Preliminary Coal Mining Risk Assessment (CMRA) for a proposed solar farm development on land off Wakefield Road in Grange Moor, Wakefield, WF4 4BB (the site).

A site location plan is presented as Figure 1 included in **Appendix A**.

1.2 PROPOSED DEVELOPMENT

The proposed development comprises the installation of a Solar Photovoltaic Farm and associated infrastructure on nine separate land parcels (Parcels 1-9) to the north and south of Wakefield Road in Grange Moor, Wakefield.

The proposed associated infrastructure elements include access roads leading off Wakefield Road to the centres of the land parcels, transformer units and a new substation to be constructed in the eastern portion of the site (Parcel 9). The electricity generated is proposed to be transferred via underground cables to a Point of Connection (POC) at an existing pylon at Lady Ings Farm, 58 Low Lane, Middlestown, Wakefield, WF4 4 PT.

A proposed development layout is included as Boom Power drawing No. B001 v2.7, Overall Layout, provided in **Appendix A**. It is noted that the Overall Layout plan v2.7 was current at the time of writing, it may be subject to further revisions as development design evolves and the scheme progresses through planning.

1.3 AIMS & OBJECTIVES

The aim of the report is to assess the potential key land quality/ coal mining related development constraints, which could impact the feasibility of development of the site and support an outline planning application.

1.4 SCOPE OF WORKS

The following scope of works was undertaken to meet the aims and objectives of this assessment:

- Completion of a site walkover survey of accessible areas on the site, to determine the site's current land use and its environmental setting;
- Desk-based review of public regulatory records, published geological and hydrological data, historical Ordnance Survey mapping, Coal Authority (CA) records, unexploded ordnance risk mapping and radon risk information;
- Consultation with regulatory authorities (as appropriate);
- Development of a preliminary conceptual site model (CSM) following the source-pathway-receptor contaminant linkage approach;
- The delivery of a PRA and CMRA with respect to ground, groundwater and ground gas conditions, which may potentially arise as liabilities;
- The delivery of a CMRA including a review of coal mining status of the site, the risk of shallow mine workings and the potential impacts of known deep mining.

1.5 SOURCES OF INFORMATION

The following sources of information have been used in the production of this report.

Table 1-1 – Sources of Information

Source	Information
Site Reconnaissance	1. WSP site walkover carried out on 11 May 2021 (Photographs included as **Appendix C**).
Public Information	2. British Geological Society (BGS) 1:50,000 Series Geological Map Sheet 77 Huddersfield, Solid and Drift, 2003; 3. BGS 1:10,560 Series, Maps 247SE Thornhill (Drift & Solid) and 261NE Flockton (Drift & Solid); 4. BGS 'Geology of Britain' online viewer accessed 15 March 2021. 5. BGS 'GeoIndex' online viewer accessed 15 March 2021. 6. Coal Authority Interactive Map Viewer (CA) accessed between 15 March 2021 and 08 June 2021. 7. Zetica 'Regional unexploded bomb risk map' website accessed 15 March 2021.
Third Party Information	8. Groundsure Insight Reports including historical Ordnance Survey mapping dated March 2021 *; a. WSP - 7874473, 7874474 and 7874476 (Parcel 1); b. WSP - 7874477, 7874478 and 7874480 (Parcels 2, 3, 7 and 8); c. WSP - 7874481, 7874482 and 7874484 (Parcel 4); d. WSP - 7874485, 7874486 and 7874488 (Parcels 5 and 6); e. WSP - 7874414, 7874415 and 7874417 (Parcel 9); 9. Memoirs of the Geological Survey England & Wales Explanation of Sheet 77 The Geology of the Country around Huddersfield and Halifax by D.A Wray et al, 1930 10. Coal Authority (CA) Consultants Coal Mining Report references: 51002535484001, 51002545485001, 51002545487001, 51002545462001 and 51002545483001, all dated 19/05/2020. 11. The following CA Mine Abandonment Plans: a. 17558 b. NE206 c. NE249 d. NE387 e. OC122 f. OC176 12. Boom Power Ltd (Boom Power), Drawing – V1.5, Option Plan dated 17 March 2021. 13. Boom Power, Drawing – V2.7, Overall Layout, Drawing No. B001, dated 22 April 2021.

Source	Information
	14. Survey Solutions, Drawing –Topographical Survey, Drawing No. 31351NGLS_09, Rev A dated 10 March 2021. 15. Survey Solutions, Drawing –Topographical Survey, Drawing No. 31351NGLS_02, dated 01 April 2021.
* The reports contain British Geological Survey materials ©NERC 2021 and Environment Agency information ©Environment Agency and database right.	

WSP has not been provided with any previous ground investigation reports for the site.

1.6 LIMITATIONS

The report is addressed to and may be relied upon by the following:

Boom Power Ltd, Unit 5e Park Farm, Chichester Road, Arundel, West Sussex, United Kingdom, BN18 0AG

This assessment has been prepared for sole use of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of WSP. No responsibility will be accepted where this report is used in its entirety or in part, by any other party. Information provided by others is taken in good faith as being accurate. WSP cannot and will not accept liability for any deficiencies in third party information. General Limitations are presented in **Appendix B.**

2 SUMMARY OF THE SITE AND SURROUNDING AREA

2.1 SITE DETAILS AND RECONNASSANCE

The site comprises largely undeveloped agricultural land and woodland to the north and south of Wakefield Road (A642) in Grange Moor, Wakefield, WF4 4BB. A site location plan is included as Figure 1 in **Appendix A**.

The site comprises nine land parcels (Parcels 1-9) which cover a total area of approximately 85 hectares (ha). Parcels 1-3 and 7-9 are located north of Wakefield Road; Parcels 4-6 are located to the south. A site boundary plan is included as Figure 2 and an existing site layout plan is included as Figure 3, both provided in **Appendix A**.

A site walkover was carried out by WSP on 11 May 2021. A photographic record of the walkover is provided in **Appendix C**. Descriptions of the individual land parcels, their current land use and pertinent features are summarised in the following sections.

A summary of the pertinent site details of the location where the solar farm would connect into the wider electricity grid via an existing pylon (the POC) is provided in Section 8. It is noted this area was not included on the site walkover undertaken and given the small scale of the works a separate Groundsure report was not obtained for this area.

2.1.1 PARCEL 1

Table 2-1 - Summary of Site Details - Parcel 1

Detail	Comment
National Grid Reference (approximate centre)	423556, 415907
Site Description and Current Use	Parcel 1 is open fields with a low-level arable crop, possibly rapeseed. The western field is separated from the remaining fields by semi mature and mature trees.
Area	Approximately 25ha
Site Setting and Surrounding Area	Parcel 1 is surrounded by woodland to the north, south and east, with open fields to the west. Wakefield Road (A642) is present immediately to the south.
Topography and Ground Cover	The land slopes down towards the northern and north-eastern corner of the parcel, from approximately 192m above Ordnance Datum (AOD) in the south to 180m AOD in the north.
Site Boundary Type and Condition	The parcel is bound by hedgerows and wooden fences on all sides.
Drainage & Flooding	A series of likely man-made ponds is present to the east of the parcel, immediately adjacent to the parcel boundary.

Detail	Comment
Trees & Vegetation (including invasive species)	Woodland is present to the north, east and southeast of the parcel and between the western field and the remainder of Parcel 1. The invasive plant species Japanese Knotweed was noted along the field boundary in the northeast corner of the parcel. Note the site walkover was not completed by a qualified ecologist.
Structures, foundations, Retaining Walls & Basements Evident on site	A derelict brick building is present approximately 10m to the northeast of the site (this is likely to be the former icehouse as shown on historical plans).
Visual Observations of Contamination or Ground Subsidence	Visible Made Ground at surface level across the parcel.
Other notable features	None observed.

2.1.2 PARCELS 2, 3, 7 & 8

Table 2-2 – Summary of Site Details – Parcels 2,3,7 &8

Detail	Comment
National Grid Reference (approximate centre)	Parcel 2: 424449, 416224 Parcel 3: 424094, 416129 Parcel 7: 424591, 416395 Parcel 8: 424739, 416364
Site Description and Current Use	Parcel 2: The northern fields are planted with arable crops, the southern field forms open grassland. A public footpath (Kirklees Trail) runs down the west edge of the parcel. There are 11kV overhead lines running east-west above the centre of this parcel. Parcel 3: The parcel comprises maintained grassland and arable crop. There are 11kV overhead lines running east-west above the centre of this parcel. Parcels 7 & 8: The parcels comprise arable farmland, at the time of the walkover this appeared to be a cereal crop.
Area (approximately)	Parcel 2: 22.5ha Parcel 3: 11.0ha Parcel 7: 2.0ha Parcel 8: 3.5ha
Site Setting and Surrounding Area	Parcel 2: The parcel is located between Parcels 1 and 3, surrounded by open grassed fields (to the north south and west) and woodland (to the east). Ponds are located between Parcels 1 and 2. Parcel 3: This parcel is east of Parcel 2 and southwest of Parcel 7.

Detail	Comment
	Parcel 7: The parcel is bound to the west by Parcel 2, the south by Parcel 3 and the east by Parcel 8. Woodland is present to the immediate north. Parcel 8: The parcel is open fields, surrounded by further fields, with woodland to the northwest. The National Coal Mining Museum for England is located adjacent to the south eastern boundary of the parcel.
Topography and Ground Cover	Parcel 2: Slopes down towards the northeast, from approximately 180m AOD in the southwest, to 155m AOD in the centre north and 105m AOD in the northeast. Parcel 3: Slopes down to the north from approximately 170m AOD in the south to 150m AOD in the north of the parcel. Parcel 7: Approximately 140m AOD, generally flat. Parcel 8: The parcel slopes down to the northwest, approximately 20m fall in elevation from 150m AOD to 130m AOD in the northwest.
Site boundary type and condition	All parcels are bound by hedgerows and wooden fences on all sides.
Drainage & Flooding	Parcel 2 & 7: None observed. Parcel 3: A drainage ditch is present within the woodland 'spur' in the north of the parcel. Poor drainage in the northwest of the parcel was noted during the site walkover, some evidence of standing surface water. Parcel 8: A pond is located immediately adjacent to the northeast corner of the parcel.
Trees & Vegetation (including invasive species)	Parcel 2: Parcel is bound to the west, north, east and southeast by trees. Japanese Knotweed was noted to be present along the field boundary in the far west of the parcel. Parcel 3: Parcel is bound to the north, west and southeast by trees. Parcel 7: Parcel is bound to the north by trees. Parcel 8: Parcel is bound to the northwest by trees.
Structures, foundations, Retaining Walls & Basements Evident on site	None observed in any parcel.
Visual Observations of Contamination or Ground Subsidence	Parcels 2, 7 & 8: None observed Parcel 3: Evidence of Made Ground present in the northwest of the parcel comprising fused slag, red shale and plastic present at the surface. Some fly tipping present in the woodland located in the south western corner of the parcel.
Other notable features	Parcel 3: Brick rubble and sandstone slabs were noted in the woodland located to the southwest of the parcel. Parcel 7: A series of drystone walls were noted within the woodland to the north of Parcel 7, local undulations in ground level were also present. These features may indicate the potential presence of mine shafts shown on the CA Interactive Map Viewer to be present in the wooded area to the north of Parcel 7.

Detail	Comment
	Parcel 8: The National Coal Mining Museum is located to the southeast of the parcel.

2.1.3 PARCEL 4

Table 2-3 - Summary of Site Details - Parcel 4

Detail	Comment
National Grid reference (approximate centre)	423993, 415528
Site Description and Current Use	The parcel comprises low level grassland across three fields.
Area	Approximately 11.5ha
Site Setting and Surrounding Area	The parcel is surrounded by open fields, woodland to the immediate southeast and Wakefield Road (A642) to the north. A small area of woodland also borders a section of the south western boundary.
Topography and Ground Cover	The parcel slopes down to the south, from approximately 190m AOD to 180m AOD.
Site boundary type and condition	The parcel is bound by wooden fences on all sides and the fields making up the parcel are bound by a wooden fence.
Drainage & Flooding	None observed
Trees & Vegetation (including invasive species)	The parcel is bound by fence line and hedgerows to the west and south. A copse of trees is present adjacent to the southwest and a larger woodland adjacent to the southeast. Japanese Knotweed was identified along the south eastern boundary, adjacent to the woodland.
Structures, foundations, Retaining Walls & Basements Evident on site	None observed.
Visual Observations of Contamination or Ground Subsidence	Visible constituents of Made Ground are present at ground level across the parcel. Visible Made Ground and colliery spoil was noted at ground level within the woodland to the southwest.
Other notable features	A localised depression was noted in the woodland to the southwest of the parcel, potentially indicating the presence of the mine shaft shown on the CA Interactive Map Viewer to be located in this area.

2.1.4 PARCELS 5 & 6

Table 2-4 – Summary of Site Details – Parcels 5 & 6

Detail	Comment
National Grid reference (approximate centre)	Parcel 5: 424610, 415846 Parcel 6: 424799, 416000
Site Description and Current Use	Parcel 5: Parcel comprises low level grassland Parcel 6: Parcel comprises farmland and arable crop.
Area (approximately)	Parcel 5: 7.0ha Parcel 6: 3.0ha
Site Setting and Surrounding Area	Parcel 5: Parcel is surrounded by open grassed fields, Grange Lane lies immediately north of the parcel, separating it from Parcel 6. The eastern extent of Parcel 5 is currently proposed to be a no build / ecological area. Parcel 6: Parcel is surrounded by open grassed fields, the A642 lies immediately north of the parcel with farm buildings beyond.
Topography and Ground Cover	Parcel 5: The parcel generally slopes down from west to east, from approximately 181m AOD to 157m AOD. Parcel 6: Generally flat, approximately 180m AOD.
Site boundary type and condition	Parcel 5: The parcel is bound by wooden fences. Grange Lane lies immediately north of the parcel. Parcel 6: The parcel is bound by wooden fences. Grange Lane lies immediately south of the parcel and the A642 to the north. Woodland is present immediately west, east and southeast of the parcel.
Drainage & Flooding	Parcel 5: None observed Parcel 6: A drainage ditch was noted along the south eastern boundary of the adjacent woodland.
Trees & Vegetation (including invasive species)	Parcel 5: Some hedgerow and semi mature trees along the boundaries of the parcel. A small copse of trees is present to the north of the parcel, beyond Grange Lane. Parcel 6: Woodland is present immediately east and west of the parcel.
Structures, foundations, Retaining Walls & Basements Evident on site	Parcel 5: A derelict brick structure was noted on the eastern boundary of the parcel. Parcel 6: None observed
Visual Observations of Contamination or Ground Subsidence	Parcel 5: None observed Parcel 6: Substantial evidence of Made Ground (topsoil with plastic, red shale and coal throughout) present at surface.

Detail	Comment
Other notable features	Parcel 5: No evidence at the surface of the six mine entries shown on the CA records. Parcel 6: No evidence of the mapped mine entries shown on the CA records in the northeast corner of the parcel. A substantial amount of Made Ground was noted at surface level within the woodland to the east of the parcel.

2.1.5 PARCEL 9

Table 2-5 – Summary of Site Details – Parcel 9

Detail	Comment
National Grid reference (approximate centre)	424811, 416152
Site Description and Current Use	The parcel comprises maintained grassland.
Area	Approximately 0.5ha
Site Setting and Surrounding Area	The parcel is surrounded by farm buildings to the north, west and east and the A642 lies to the south.
Topography and Ground Cover	The parcel slopes down towards the north from approximately 155m AOD to 150m AOD.
Site boundary type and condition	The parcel is bound by hedgerows to the north and west, and a small wooden fence to the east and south.
Drainage & Flooding	None observed during site walkover
Trees & Vegetation (including invasive species)	The north and west of the parcel is bound by hedgerows and semi-mature trees. No invasive species were observed during the walkover. Note the walkover was not completed by an ecologist.
Structures, foundations, Retaining Walls & Basements Evident on site	None observed during the walkover.
Visual Observations of Contamination or Ground Subsidence	Miscellaneous waste materials border the parcel, including sandstone setts, timber, old agricultural machinery and trailers.
Other notable features	Historical mine entry (including head gear) present approximately 30m to the northeast of the parcel, located at the National Coal Mining Museum.

3 HISTORICAL LAND USES

3.1 GENERAL

A review of historical Ordnance Survey (OS) maps and research into the coal mining legacy (including review of abandonment plans obtained as part of the CMRA presented in Section 6) has been undertaken to identify former land uses, potential sources of historical contamination and potential sensitive receptors.

Historical land uses of the nine land parcels and the surrounding land including potentially contaminative land uses identified on historical mapping are summarised in Table 3-1. The historical OS maps are provided in **Appendix D** and further detail on the historical land use in each parcel is included in **Appendix E**. The coal mining legacy of the site is discussed in Section 6 and the extent of open cast mining is shown on plans provided in the CA Mining Reports presented in **Appendix I** and the abandonment plans presented in **Appendix J**

Table 3-1 – Historical Summary

Land Parcel	Key Historical Site Features	Historical Adjacent Land Use
Parcel 1	Historical OS plans show Parcel 1 to have largely remained undeveloped open land / agricultural land. Parcel 1 is labelled as 'Grange Park' on earliest available OS Maps through to latest OS Maps. CA records indicate that open cast mining has taken place on site in the northern and central western portion of Parcel 1, the mined areas were subsequently returned to open / agricultural land use.	Predominantly open land and plantations. Grange Wood to the north. Sandstone quarries to the east, west, north and southwest. 'Fish Ponds' to the immediate east and southeast.
Parcels 2, 3, 7 & 8	1854-1855 mapping shows a 'Sandstone Quarry' to be located in the southern section of Parcel 2. A 'Sandstone Quarry' is also shown to the immediate north of Parcel 7 & 8. The sandstone quarries are no longer labelled on the OS maps dated 1891-1892 and with the exception of a small quarry along the western boundary Parcel 2 is shown to comprise open land. Parcels 3, 7 & 8 have remained largely undeveloped open land / agricultural land. CA records indicate that open cast mining has taken place in the northern and central area of Parcel 2, the south and north west of Parcel 3 and the	A number of plantations, sandstone quarries, collieries (including shafts, coke ovens, kiln and mineral railways) and coal pits have historically been located within 250m of the parcels.

Land Parcel	Key Historical Site Features	Historical Adjacent Land Use
	south and northeast of Parcel 8. The mined areas were subsequently returned to open / agricultural land use.	
Parcel 4	Historical OS mapping indicates that the site has remained undeveloped open land / agricultural land. CA records indicate that open cast mining has taken place in the eastern section of Parcel 4, the mined area was subsequently returned to open / agricultural land use.	Predominantly undeveloped open land / agricultural land with a recreation ground (later a cricket ground) and allotment gardens shown adjacent to the southern site boundary from c. 1930 to present day.
Parcel 5&6	Denby Grange Colliery was located in Parcel 5 (including Blossom Pit in the eastern portion) and two old coal pits (in the western portion), with spoil heaps associated with the colliery present until 1966-1967 mapping. CA records indicate that open cast mining has taken place across the majority of Parcel 5 the mined area was subsequently returned to open / agricultural land use. Parcel 6 has remained undeveloped open land / agricultural land.	Several plantations and coal pits have historically been located within 250m of the parcels. A mineral railway was also historically located along the eastern boundary of Parcel 6.
Parcel 9	Parcel 9 has remained undeveloped open land / agricultural land.	Hope Pit was historically located to the north of the site, with a sandstone quarry located approximately 100m to the northwest. Associated shafts and railway sidings have also been present.

4 REGULATORY INFORMATION AND CONSULTATION

4.1 REGULATORY DATABASE

A review of regulatory information contained within the Groundsure Insight Reports has been completed. The reviewed regulatory information includes data collated from several organisations, including the Environment Agency (EA), the Local Authority, the British Geological Survey (BGS), Department for Environment, Food & Rural Affairs (DEFRA), Health & Safety Executive (HSE), the National Radiological Protection Board (NRPB) and the CA.

All parcels are located within a radon affected area where the percentage of homes estimated to be affected by radon is between 1-3%, with the exception of Parcel 9 where the parcel is not within a Radon affected area.

The Groundsure Reports are provided in **Appendix D**.

4.1.1 PARCEL 1

No Contaminated land register entries and notices, landfill sites, Fuel Station Entries, Waste Exemptions, Consents issued under the planning (Hazardous Substances) act 1990, Control of Major Accident Hazard (COMAH) sites or Historical Military Land exists within 500m of Parcel 1. A summary of regulatory information pertinent to Parcel 1 is presented below.

Aspect	Onsite	0 – 50m	50 - 250m	Details
Historical tanks	0	5	0	Historical tanks mapped within 50m: ▪ 18m northwest, Unspecified tank, 1960 mapping ▪ 20m northeast, Unspecified tank, 1960-1993 mapping ▪ 21m northeast – Unspecified ▪ 31m northeast, Unspecified tank, 1960 – 1993 mapping ▪ 32m northeast, Unspecified
Historical Industrial Land uses	1	5	19	On site: ▪ Plant nurseries mapped on site 1966-1982 Off-site (up to 250m) ▪ Unspecified Ground Workings, 3m northwest ▪ Unspecified Heap, 41m southwest ▪ Refuse Heap, 46m southwest ▪ Unspecified Heaps, located 49m, 50m and 53m southeast and 90m north ▪ Unspecified Quarry, 75m northeast ▪ Unspecified Pit, located 124m, 127m and 129m north ▪ Unspecified Ground Workings 158m west ▪ Refuse Heap 160m northwest

Aspect	Onsite	0 – 50m	50 - 250m	Details
				▪ Unspecified Quarry 161m west ▪ Unspecified Heaps located 163m, 167m, 168m, 170m and 175m northwest ▪ Unspecified Mine 233m west ▪ Unspecified Shaft 236m southwest ▪ Colliery and Unspecified Shaft 250m southwest
Licensed Waste Sites	0	3	0	▪ Waste transfer station, 20m northwest, H&G Developments, The Cottage, Denby Grange Lane, WF4 4BE. Household, Commercial & Industrial Waste. Issued 31/01/2008. Noted twice. ▪ Waste transfer station, 20m northwest, PP Recycling, The Stone Yard, Denby Grange Land, WF4 4BE. Household, Commercial & Industrial Waste. Issue Date 31/01/2008, expired.
Discharge Consents	2	0	0	▪ Same permit number listed twice. Kaye Arms, 29 Wakefield Road, Grange Moor, WF4 4BG. Sewage & trade combined, permit no. 3660. Now revoked.
Pollution Incidents	0	0	1	▪ 89m northwest, 02/08/2007 incident ref. 519610, Pollutant: inert materials and wastes (Construction and demolition materials). Land impact: Category 3 (Minor), Water and Air impact: Category 4 (No impact).
Potentially Infilled Land	4	1	24	Infilled ground and Made Ground identified on site in the north, centre and west of Parcel 1.
Historical flood events	1	1	0	▪ On site, 29/12/2015, flood event name: Yorkshire. Unclassified, no data. ▪ 15m west, 29/12/2015, flood event name: Yorkshire

4.1.2 PARCELS 2, 3, 7 & 8

No Contaminated land register entries and notices, Fuel Station Entries, Consents issued under the planning (Hazardous Substances) act 1990, Control of Major Accident Hazard (COMAH) sites or Historical Military Land exists within 500m of Parcels 2, 3, 7& 8. There are no historical landfills listed within 250m of the site.

A summary of regulatory information pertinent to the Parcels 2, 3, 7 & 8 is presented below.

Aspect	Onsite	0 – 50m	50 – 250m	Details
Historical tanks	0	4	0	▪ Unspecified tank 13m southwest of Parcel 2, mapped 1960-1993 (mapped twice) ▪ Unspecified Tank mapped 21m southwest of Parcel 2, mapped 1960-1993 (mapped twice)
Historical Industrial Land uses	24	18	83	Historical land uses identified on site include: ▪ Brick and China Clay works on boundary of Parcel 2 & 3 ▪ Railway sidings on south eastern boundary of Parcel 8 ▪ Unspecified Mine and Collieries on south eastern boundary of Parcel 8 ▪ Quarry on boundary between Parcel 2 & 3 ▪ Refuse heap on Parcel 3
Historical Waste Sites (unlicensed)	0	1	1	▪ Historical Waste Disposal site mapped 36m south of Parcel 2 – ground workings and refuse heap. ▪ Historical Waste Disposal site mapped 100m east of Parcel 8 – ground workings and refuse heap.
Waste Exemptions	0	0	13	▪ The nearest waste exemptions relate to 62m southeast of Parcel 8, Low Farm 51, Wakefield Road, WF4 4BB, ref. EPR/SE5084GB/A001, Waste Disposal Exemption relating to Agricultural Waste only; burning of waste in the open; use of waste for a specified purpose.
Discharge Consents	0	0	7	▪ Nearest is located 65m east of Parcel 8, Low Farm, Flockton, Wakefield, permit no. WRA8951 relates to sewage discharges, final treated effluent. Receiving water: Groundwater via soakaway. Issued 10/05/2006 and revoked 25/07/2012. New permit issued 26/07/2012.

Aspect	Onsite	0 – 50m	50 – 250m	Details
				▪ 154m southeast of Parcel 8, Caphouse Colliery, Overton, Wakefield. Permit no. 3346 relates to trade discharges – mineral workings, receiving water – Smithy Beck. Issued 06/03/1979, revoked 17/06/2004. ▪ 173m east of Parcel 8, National Coal Mining Museum, Caphouse Colliery. Permit no. WRA7882, receiving water: Smithy Beck. Issued 07/11/2002, revoked 30/09/2004. New permit issued 01/10/2004.
Pollution Incidents	0	0	1	▪ 207m southeast of Parcel 8, 04/02/2002 relating to inert materials and wastes (construction and demolition waste), incident ref. 56319. Land impact: Category 3 (Minor), Water and Air impact: Category 4 (No impact).
Potentially Infilled Land	6	4	10	Infilled ground/artificial ground is mapped in the following locations on site: ▪ Centre/south of Parcel 2 ▪ Boundaries between Parcel 2 & 3 ▪ Centre and north of Parcel 3, Centre and south of Parcel 8 ▪ North of Parcel 7
Historical flood events	0	0	0	▪ n/a

4.1.3 PARCEL 4

No Contaminated land register entries and notices, Fuel Station Entries, landfills, Waste sites, Pollution Incidents, Consents issued under the planning (Hazardous Substances) act 1990, Control of Major Accident Hazard (COMAH) sites or Historical Military Land exists within 500m of Parcel 4. A summary of regulatory information pertinent to the parcel is presented below.

Aspect	Onsite	0 – 50m	50 – 250m	Details
Historical tanks	0	0	0	▪ n/a
Historical Industrial Land uses	0	3	15	▪ 30m east, refuse heap (mapped twice) ▪ 39m east, refuse heap
Waste Exemptions	0	0	0	Nearest waste exemptions: ▪ 355m east, Langley Holme Farm, Barnsley Road, Flockton, WF4 4AA. Ref. WEX006870, storage of sludge on a farm. ▪ 377m south, Barratt Homes – Chapel Lea, Barnsley Road, WF4 4AA. Ref. WEX160544. Use of waste in construction. ▪ 459m east, Langley Holme Farm, Barnsley Road, WF4 4AT. Ref. EPR/YH0970UU/A001, storage of sludge, non-agricultural waste.
Discharge Consents	0	0	1	Nearest discharge consent: ▪ 345m south, 3&5 Barnsley Road, Flockton. Permit no. 873, effluent type – sewage discharges, receiving water: Tributary of Flockton Beck. Status: transferred from R(PP)A 1951-1961. Issued: 01/08/1958.
Potentially Infilled Land	1	3	5	Eastern portion of Parcel 4 mapped as infilled land.
Historical flood events	0	0	0	▪ n/a

4.1.4 PARCELS 5 & 6

No Contaminated land register entries and notices, Fuel Station Entries, landfill sites, Waste Exemptions, Consents issued under the planning (Hazardous Substances) act 1990, Control of Major Accident Hazard (COMAH) sites or Historical Military Land exists within 500m of Parcels 5 & 6. A summary of regulatory information pertinent to the parcels is presented below.

Aspect	Onsite	0 – 50m	50 - 250m	Details
Historical tanks	0	0	1	▪ 127m southeast of Parcel 6 – Unspecified tank (mapped 1960, 1974 and 1990)
Historical Industrial Land uses	24	23	73	▪ 4 collieries mapped on site ▪ 10 refuse heaps/unspecified heaps mapped ▪ 4 cuttings mapped on site ▪ 3 unspecified old shaft/pit mapped ▪ 1 clay pit mapped ▪ 2 unspecified ground workings
Waste sites (unlicensed)	0	0	2	▪ 131m northwest of Parcel 5, ground workings and refuse heap ▪ 184m northeast of Parcel 6, ground workings and refuse heap
Discharge Consents	0	0	8	▪ 141m northeast of Parcel 6, Caphouse Colliery, Overton, Wakefield. Trade discharges – mineral workings. Permit no. 3346. Receiving water: Tributary of Smithy Brook. Issued: 06/03/1979, Revoked: 17/06/2004 ▪ 159m northeast of Parcel 6, Grange Lane STW, Grange Lane, Wakefield. Sewage discharges - final/treated effluent. Permit no. E736(SS), receiving water: Tributary Smithy Brook. Issued: 16/12/1981, Revoked: 09/11/1985. Reissued: 10/11/1985, Revoked: 09/10/1996. Reissued: 10/10/1996 (Version 3).
Pollution Incidents	0	0	1	▪ 111m northeast of Parcel 6 04/02/2002 relating to inert materials and wastes (construction and demolition waste), incident ref. 56319. Land impact: Category 3 (Minor), Water and Air impact: Category 4 (No impact).
Potentially Infilled Land	1	4	6	▪ Parcel 5 mapped as infilled land

Aspect	Onsite	0 – 50m	50 - 250m	Details
Historical flood events	0	0	0	▪ n/a

4.1.5 PARCEL 9

No Contaminated land register entries and notices, Fuel Station Entries, landfill sites, Waste, Disposal Sites, Pollution Incidents, Pollution Incidents, Consents issued under the planning (Hazardous Substances) act 1990, Control of Major Accident Hazard (COMAH) sites or Historical Military Land exists within 500m of Parcel 9. A summary of regulatory information pertinent to the parcel is presented below.

Aspect	Onsite	0 – 50m	50 – 250m	Details
Historical tanks	0	0	0	The nearest historical and mapped tank is located 286m southeast and is ▪ mapped as unspecified.
Historical Industrial Land uses	5	15	65	▪ On site: Colliery and unspecified mines are mapped on site. ▪ Industrial land uses in the surrounding area comprise further collieries, mines, shafts and heaps.
Waste sites (unlicensed)	0	1	1	▪ 25m north, Ground workings and refuse heap ▪ 166m northeast, Ground workings and refuse heap
Waste Exemptions	0	0	13	Nearest is: ▪ 100m southwest, 7 Low Farm, Wakefield Road, Grangemoor, WF4 4BB. WEX141840. Deposit of agricultural waste consisting of plant tissue under a Plant Health notice; burning of waste in the open; use of waste for a specified purpose.
Discharge Consents	0	0	5	▪ 117m west, Low Farm off A642. Sewage discharges to groundwater via soakaway. Permit WRA8951, issued 10/05/2006, revoked 27/07/2012; New permit issued 26/07/2012 ▪ 156m east, Caphouse Colliery. Trade Discharges from mineral workings to tributary of Smithy Brook. Permit 3346. Issued 06/03/1979, revoked 17/06/2004

Aspect	Onsite	0 – 50m	50 – 250m	Details
Potentially Infilled Land	0	1	8	Made Ground mapped to the immediate northeast of Parcel 9.
Historical flood events	0	0	0	▪ n/a

4.2 CONSULTEES AND ADDITIONAL RECORDS

The following individuals, organisations and records have additionally been consulted.

Table 4-1 – Summary of Consultees and Additional Records

Consultee/Record	Comment
Local Authority Contaminated Land Officer (CLO)	CLO was contacted, at the time of writing a response has not been received.
Petroleum Officer (PO)	PO was contacted, at the time of writing a response has not been received.
Environment Agency (EA)	No issues were identified that are considered as having warranted direct consultation with the EA.
Coal Authority (CA) Report	According to the Coal Authority Online Map Viewer the site lies within a Coal Mining Reporting Area and the majority of the site lies within a Development High Risk Area as such Coal Authority Coal Mining Consultants Reports have been obtained and are discussed in Section 6.
Historical Photograph Review	WSP has reviewed historical aerial photo website Britain from Above, images included in the Groundsure Report, Google Maps and Bing maps, and has not observed any site features beyond those identified in the historical map review and site walkover.
Site Environmental and Heritage Setting Data	▪ Scheduled Monument located 270m east of Parcel 8 – part of the National Coal Mining Museum ▪ The parcels are within an area of Community Forests, which are managed through a partnership between the local authority, Forestry Commission and Natural England. ▪ A Grade II listed building is present on the northern boundary of Parcel 4.
Unexploded Ordnance (UXO)	Zetica online UXO risk map (included in **Appendix F**) shows the site to be at a low risk for UXO. A Pre - Desk Based Assessment (PDSA) completed by Zetica (included in **Appendix F**) determined that no further detailed assessment is considered essential for any of the land Parcels 1 to 9.
Animal and Plant Health Agency (APHA)	The APHA was contacted to enquire as to whether there are any animal burial sites on site. A response has not yet been received.

5 ENVIRONMENTAL SETTING

5.1 GEOLOGY

A review of records published by Groundsure, the BGS and the CA has been undertaken to assess the geology of the site. Sources of information are summarised in Table 1-1.

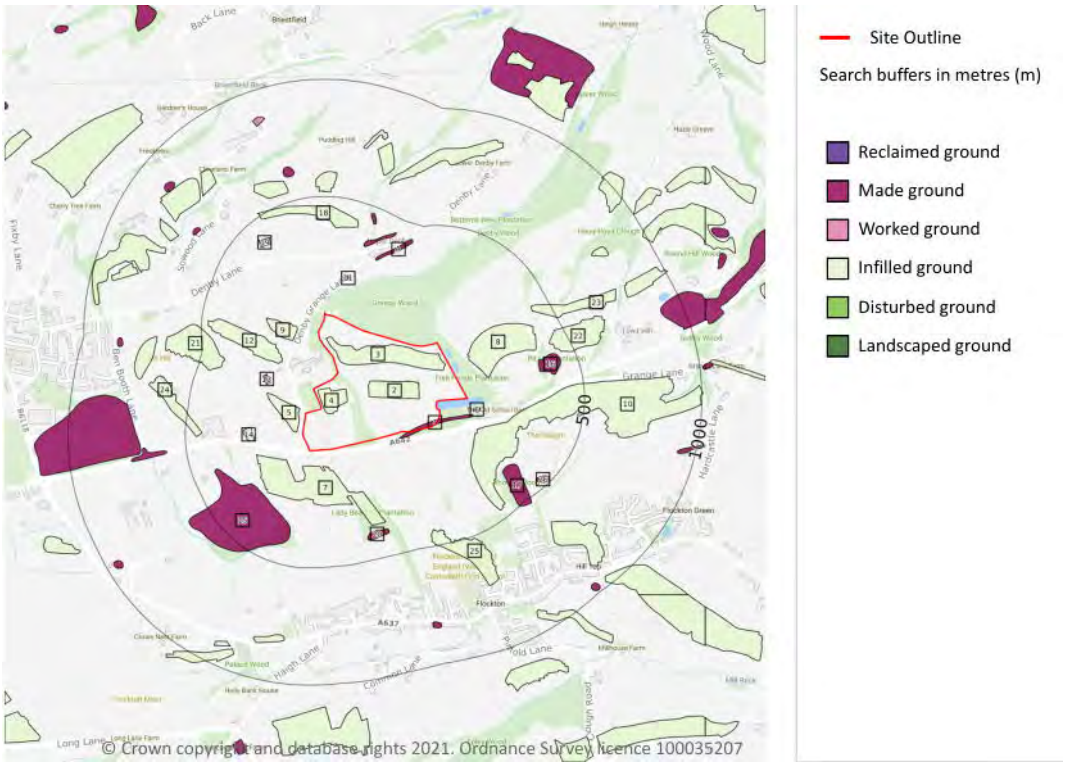
5.1.1 ARTIFICIAL OR MADE GROUND

The BGS GeoIndex indicates the potential presence of artificial ground in the following areas:

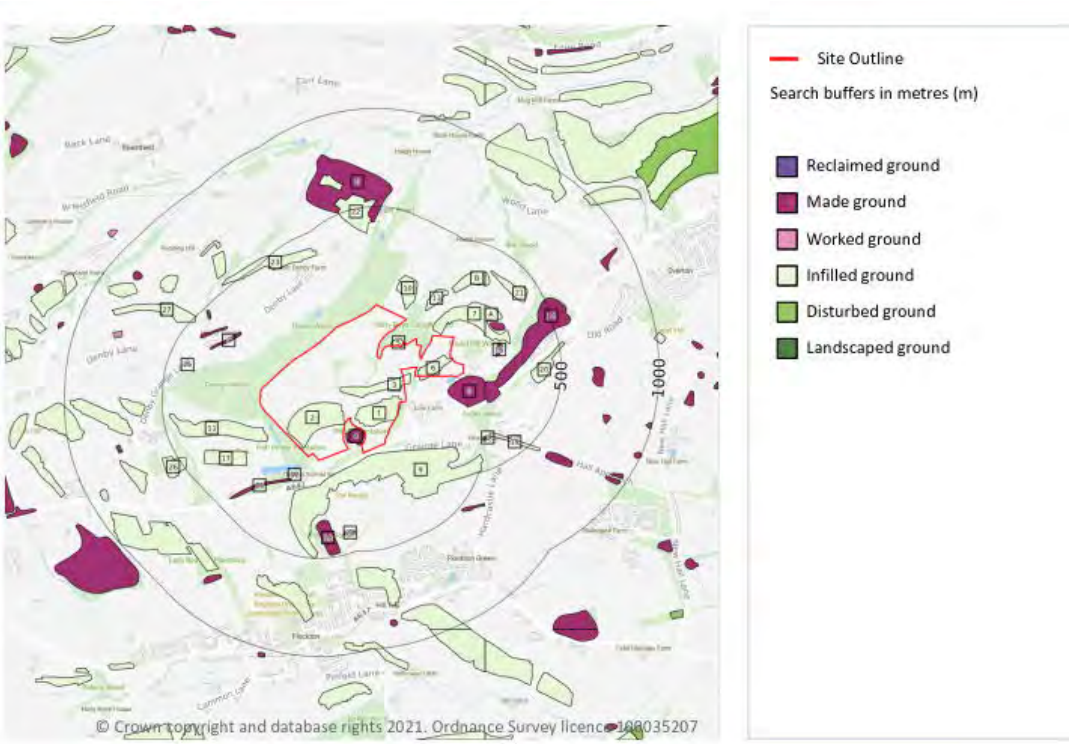
- Northern, central and western areas of Parcel 1;
- Centre and south of Parcel 2;
- Centre and north of Parcel 3;
- Eastern section of Parcel 4;
- Majority of Parcel 5;
- Centre and south of Parcel 8;
- To the immediate northeast of Parcel 9.

Extracts from the Groundsure reports showing the extent of the artificial ground are shown in Inserts 5-1 – 5-5. The areas of artificial ground generally relate to the areas of open cast mining as shown on the CA records provided in **Appendix I** and the CA abandonment plans provided in **Appendix J**.

Insert 5-1 – Artificial and Made Ground – Parcel 1



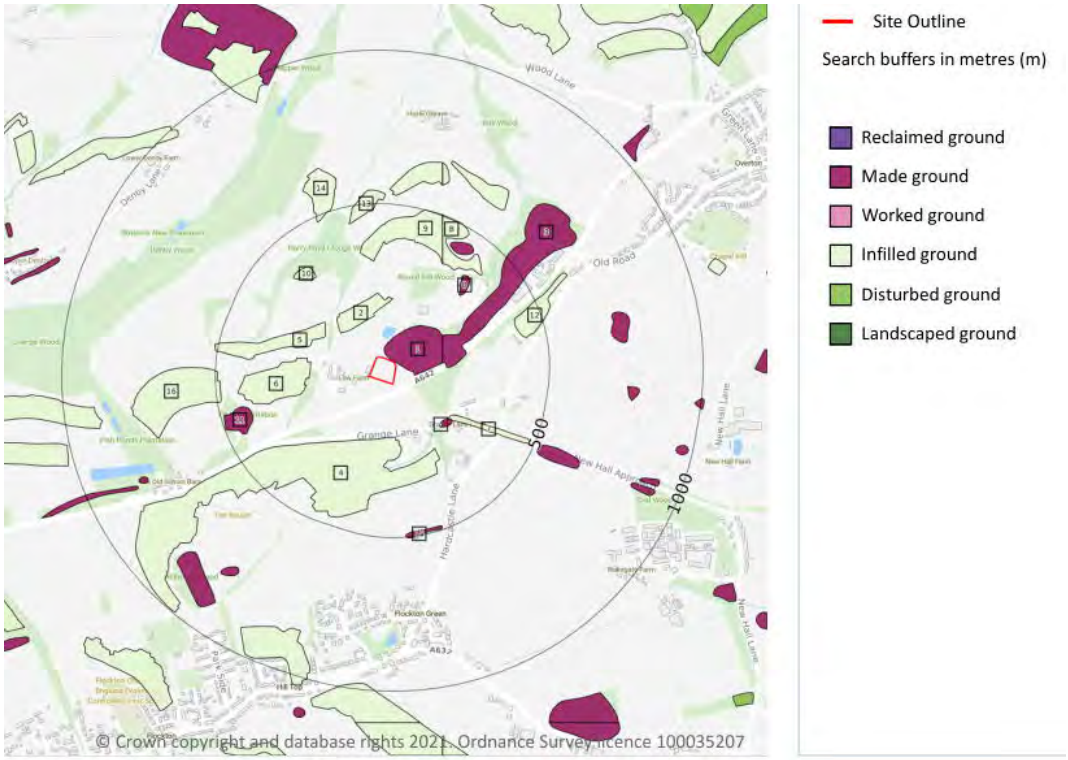
Insert 5-2 – Artificial and Made Ground – Parcels 2, 3, 7 & 8



Insert 5-3 – Artificial and Made Ground – Parcel 4

Insert 5-4 – Artificial and Made Ground – Parcels 5 & 6

Insert 5-5 – Artificial and Made Ground – Parcel 9



5.1.2 SUPERFICIAL DEPOSITS

No superficial deposits are recorded in the reviewed sources, indicating superficial deposits across the area are likely to be absent.

5.1.3 BEDROCK GEOLOGY

Solid strata beneath the site are recorded to comprise massive sandstones, siltstone, mudstone, ironstone bands and coal seams of the Pennine Middle Coal Measures and Pennine Lower Coal Measures (PMCM and PLCM respectively).

The site is located between two major northwest / southeast trending faults, shown to the west and east; crossing the westernmost extent of Parcel 1 and the easternmost extent of Parcel 2 and Parcel 8. Smaller fault lines crossing the individual land parcels are discussed in Section 6.

The BGS hold accessible records for five historical boreholes located within 250m of the site. Four of which have been drilled from coal seams underlying the site to prove deeper seams, with logs starting at approximately 7m bgl. The historical borehole SE21NW9 (provided in **Appendix G**), located immediately north of Parcel 9 and drilled from ground level, recorded 'clay and bind' of 3.8m thickness, overlying a coal seam (Flockton Thick Seam) of 0.91m thickness and rock.

5.1.4 COAL MINING LEGACY

The CA interactive map viewer shows the site is located within a Coal Mining Reporting Area. The majority of the site (except for the northern parts of Parcels 2 and 4) is indicated to be located within DHRAs as defined by the CA. The DHRAs are associated with probable shallow underground coal mine workings (and associated mine entries) and past surface mine workings. Information on past coal mining activities on the site and coal mining related risk are discussed further in Section 6.

5.2 HYDROGEOLOGY

Information included within the Groundsure Report indicates that the solid strata beneath the site are classified as a Secondary A Aquifer. This indicates that the underlying bedrock aquifer comprises predominantly permeable layers capable of supporting water supplies at a local rather than strategic scale and in some instances may form an important source of base flow to rivers.

The site is not located within or near a groundwater source protection zone. No licensed groundwater abstractions are recorded on or within 2 km of the site.

5.3 GEOHAZARD INFORMATION SUMMARY

An assessment of potential geohazards affecting the site is presented within the Groundsure reports. A summary is provided in Table 5-1.

Table 5-1 – Geohazard Summary

Geohazard	Risk
Shrinking/ swelling clay	Very low risk in Parcels 1-9
Running sands	Very low risk in Parcels 1-9
Compressible deposits	Moderate risk in centre of Parcels 1-3, in east of Parcel 4, in most of Parcel 5 and in south of Parcel 8
Collapsible deposits	Very low risk in Parcels 1-9
Landslides	Low to very low risk in Parcels 1-9
Ground dissolution of soluble rocks	Negligible risk in Parcels 1-9

5.4 HYDROLOGY

No classified surface watercourses have been identified within any of the land parcels.

A classified watercourse, mapped as Smithy Brook from source to River Calder, is located approximately 50m east and south of Parcels 5 and 6, flowing to the northeast. The Smithy Brook is within the Calder Lower catchment and classified as moderate quality with respect to ecology and failed with respect to chemistry, with an overall classification of moderate.

Howroyd Beck, a tributary of Smithy Brook is mapped approximately 75m to the north of Parcels 2 & 3, flowing to the northeast and joining Smithy Brook approximately 1km to the northeast of Parcel 2. Two unnamed tributaries of Howroyd Beck are shown to emerge in Grange Wood along the northern boundary of Parcel 1, flowing in a north easterly direction to join Howroyd Beck.

An unnamed watercourse, also a tributary of Smithy Brook emerges in Harry Royd Clough Wood to the immediate north of Parcel 7 and flows in a north easterly direction to join Smithy Brook approximately 750m north of Parcel 7.

There are no licensed surface water abstractions listed on or within 500m of the site.

5.5 SENSITIVE LAND USES

Parcel 4 is partially located within a Nitrate Vulnerable Zone (southern portion Parcel 4).

An area of ancient woodland (Grange, Hepper and Denby Woods) is located off-site on the northern boundaries of Parcels 1 and 2. A second smaller area of ancient woodland (Harry Royd Clough Wood) is located off-site to the north-east and borders Parcels 2, 3, 7 and 8. It is noted that the Groundsure Reports record both ancient woodland areas as being on site; however, these areas are likely related to off-site woodland and ancient woodland areas are not anticipated within the site boundaries.

There are no Sites of Special Scientific Interest (SSSI) or Special Areas of Conservation (SAC) within 1km of the site.

6 PRELIMINARY COAL MINING RISK ASSESSMENT

6.1 INTRODUCTION

The site is situated within a Coal Authority (CA) reporting area and the majority within a *'Development High Risk Area'* hence a CMRA is required.

This preliminary CMRA is an interpretation of readily available historical, archival and current information, including that obtained from the sources listed in Section 1.5. The purpose of this Preliminary CMRA is to:

- Present a desk-based review of readily available information on coal mining issues which are relevant to the application site;
- Use that information to identify and assess the risks to the development of the site from coal mining legacy, including cumulative impact of issues; and,
- Set out appropriate mitigation measures to address identified coal mining legacy issues affecting the site, including necessary remedial works and / or demonstrate how coal mining issues may affect the proposed development;

Information on the site history and environmental setting is presented in Sections 3 and 5 of this report.

The CA Consultants Coal Mining reports obtained for the site are provided in **Appendix I** and CA Mine Abandonment Plans are provided in **Appendix J**.

6.2 ANTICIPATED COAL AND IRONSTONE SEAMS FROM BGS AND COAL AUTHORITY DATA SET

The expected coal seams in the site area (in descending stratigraphic order and a general south to north progression through the site) based on information in BGS memoir for the district, 1:10;560 geology maps and CA data sets are summarised in Table 6-1.

Table 6-1 - Expected coal seams in the site area

Seam Name	Typical seam thickness (m)	Outcrop locations	Comment
Joan Coal	0.6	Parcels 3, 4, 5, 6	Typical thickness obtained from CA abandonment plan references NE206 and NE387.
Tankersley Ironstone	Unknown	Parcels 1, 2, 3, 4	No information available on its thickness
Flockton Thick Coal	Between 0.9 and 1.1	Parcels 1, 2, 3	Typical thickness stated is the combined thickness of the two seams obtained from CA abandonment plan references NE206, OC122 and OC176.

Seam Name	Typical seam thickness (m)	Outcrop locations	Comment
Flockton Thin Coal	0.6	Parcels 1, 2, 3, 7, 8	Typical thickness obtained from CA abandonment plan references NE206 and NE249
Old Hards Coal	0.6	N/A – to the north	BGS memoir also describes the 'Old Hards Coal' as 'Brown Metal Coal'. Typical thickness based on a section at Flockton Moor described in the BGS memoir.
Middleton Little Coal	0.64	N/A – outcrop to the north	Middleton Little coal is also described as 'Green Lane Coal' in the BGS memoir and BGS 1:10,560 maps. Typical thickness taken from CA Consultant's Coal Mining Reports
Middleton Main Coal	Between 0.63 and 1.27	N/A – outcrop to the north	Middleton Main Coal also described as 'New Hards Coal' in the BGS memoir and BGS 1:10,560 maps. Typical thickness obtained from CA Consultant's Coal Mining Reports
Wheatley Lime Coal	Between 0.76 and 0.84	N/A – outcrop to the north	Wheatley Lime Coal also known as Three Quarters Coal in the BGS memoir. Typical thickness taken from CA Consultant's Coal Mining Reports
Silkstone Coal	Between 0.53 and 0.71	N/A – outcrop to the north	Typical thickness taken from CA Consultant's Coal Mining Reports
Top Beeston Coal	Between 0.56 and 0.99	N/A – outcrop to the north	Typical thickness taken from CA Consultant's Coal Mining Reports

6.3 COAL AUTHORITY RECORDS AND REPORTS

The following section summarises data from the various CA datasets, including a series of CA Consultants Coal Mining Reports that were purchased (dated 19/05/2021) and included in **Appendix I**. For consistency of reporting throughout this document, this information has been divided into the parcels of land within the site and the associated CA reports.

6.3.1 COAL AUTHORITY ONLINE DATABASE AND CONSULTANTS COAL MINING REPORTS

6.3.1.1 Parcel 1 (Report ref: 51002535484001)

The CA online viewer indicates that the majority of Parcel 1 is within a '*Development High Risk Area'* associated with the reported '*surface mining (past)*' and '*probable shallow coal mine workings'* across the site.

[Note: in this context, '*shallow coal mine workings'* is taken to mean '*within 30m of ground level' and* '*probable shallow coal mine workings'* relates to a potential for unrecorded shallow coal mine workings to exist].

Subcrops of two coal seams are shown to be present within the north of Parcel 1, both trending approximately west to east, with the Tankersley Ironstone outcrop between the two. The CA Consultant's Coal Mining Report and the BGS 1:10,560 mapping note/show these two coal seams to be the Flockton Thin (northern-most) and Flockton Thick (southern-most) coal seams.

No mine entries are shown to be present with Parcel 1 or at a distance close enough to the parcel boundary to likely impact the site.

Other pertinent data from the CA Consultant's Coal Mining Report includes:

- A north to south trending fault is shown crossing the western extent of the site.
- Areas of unlicensed open cast coal mining are recorded in the southwest and in the north of the site.
- Underground coal workings are recorded in the following coal seams beneath the site:
  - Middleton Main coal seam, worked at depths ranging between 65m and 97m bgl with an extraction thickness ranging between 0.63m and 1.27m, last worked in 1917.
  - Wheatley Lime coal seam, worked at depths ranging between 79m and 96m bgl with an extraction thickness of 0.84m, last worked in 1950.
  - Silkstone coal seam, worked at depths ranging between 110m and 128m bgl with an extraction thickness of between 0.61m and 0.71m, last worked in 1966.
  - Top Beeston coal seam, worked at depths ranging between 158m and 174m bgl with an extraction thickness of between 0.74m and 0.84m, last worked in 1963.
- The site is not affected by spine roadways at shallow depth.
- The CA has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.
- There is no current Stop Notice delaying the start of remedial works or repairs to the property.
- The CA is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991
- There is no record of mine gas within 500 metres of the enquiry boundary.

6.3.1.2 Parcels 2, 3, 7 and 8 (Report ref: 51002545483001)

The CA online viewer indicates that the majority of Parcels 2, 3 and 8 are within '*Development High Risk Areas'* associated with the reported '*surface mining (past)'* and '*probable shallow coal mine workings*'.

The subcrops of two coal seams, both trending south-west to north-east (with the Tankersley Ironstone outcrop between the two) are shown to be present within:

- The central and northern parts of Parcel 2 and 3; and,
- The north and southeast of Parcel 8.

The CA Consultant's Coal Mining Report (reference 51002545483001) and the BGS 1:10,560 mapping note/show these two coal seams to be the Flockton Thin (northern-most) and Flockton Thick (southern-most) coal seams.

A third coal seam subcrop is shown to be present in the southern extents of Parcel 3, noted to be the Joan coal seam.

No mine entries are shown to be present within Parcels 2, 7 and 8. Two mine entries (shafts) with CA references 424416-009 and 424416-010 are shown to be present within Parcel 3. A further mine shaft (CA reference 424416-008) is shown to be within approximately 20m of the Parcel 7 boundary. Further information on the mine entries within, and within 20m of, the parcels are presented in Table 6-2. All three mine entries have recorded CA *Departure Distances* of 10m, suggesting that there is uncertainty around the exact locations of the mine entries.

Other pertinent data from the CA Consultant's Coal Mining Report includes:

- Two northwest to southeast trending faults in the northern extents of Parcel 2 and Parcel 8.
- Areas of unlicensed open cast coal mining in the north and south of Parcels 2, 3 and 8.
- Underground coal workings in the following coal seams beneath the site:
    - Middleton Main coal seam, worked at depths ranging between 49m and 134m bgl with an extraction thickness ranging between 0.63m and 1.27m, last worked in 1895.
    - Wheatley Lime coal seam, worked at depths ranging between 73m and 115m bgl with an extraction thickness ranging between 0.76m and 0.84m, last worked in 1950.
    - Silkstone coal seam, worked at depths ranging between 98m and 150m bgl with an extraction thickness between 0.53m and 0.63m, last worked in 1964.
    - Top Beeston coal seam, worked at depths ranging between 149m and 193m bgl with an extraction thickness between 0.76m and 0.99m, last worked in 1963.
- The site is not affected by spine roadways at shallow depth.
- The CA has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.
- There is no current Stop Notice delaying the start of remedial works or repairs to the property.
- The CA is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991
- There is no record of mine gas within 500 metres of the enquiry boundary.

Table 6-2 – Summary information of mine entries present within Parcel 3 and within 20m of Parcel 7

Entry Type	CA Reference	Grid Reference	Diameter (m)	Depth (m)	Treatment Description
Mine entries present within Parcel 3					
Shaft	424416-009	424432 416120	2.0*	Unknown	*Has been filled to an unknown specification and has probably been removed to some extent by open cast mining.*
Shaft	424416-010	424567 416269	2.0*	Unknown	*Has been filled to an unknown specification and has probably been removed to some extent by open cast mining.*
Mine entries present within 20m of Parcel 7					
Shaft	424416-008	424662 416484	2.0*	18	No treatment information available

*assumed diameter from CA online database.

6.3.1.3 Parcel 4 (Report ref: 51002545485001)

The CA online viewer indicates that the northeast and southern parts of Parcel 4 are within '*Development High Risk Areas'* associated with reported '*surface mining (past)*' and '*probable shallow coal mine workings'*.

One coal seam outcrop, trending approximately north to south, is shown within the centre of Parcel 4. The CA Consultant's Coal Mining Report (reference 51002545485001) and the BGS 1:10,560 mapping note this coal seam to be Joan coal seam.

Three mine entries (mine shafts) with CA references 424415-031, 424415-043 and 424415-044 are shown within Parcel 4. Another mine shaft with CA reference 423415-010 is shown to be within approximately 20m of the Parcel 4 boundary. Further information on the mine entries within the parcels and within 20m of the parcels are presented in Table 6-3. The mine entries have recorded CA *Departure Distances* of 8 to 10m, suggesting that there is uncertainty around their exact locations.

Other pertinent data from the CA Consultant's Coal Mining Report includes:

- There are no faults, fissures or breaklines recorded.
- Areas of unlicensed open cast coal mining in the northeast and south of the site.
- Underground coal workings in the following coal seams beneath the site:
  - Flockton Thick coal seam, worked at a depth of 51m bgl with an extraction thickness of 0.51m, last worked in 1824.

- Middleton Main coal seam, worked at depths ranging between 97m and 121m bgl with an extraction thickness of 0.63m, last worked in 1884.
- Wheatley Lime coal seam, worked at depths ranging between 118m and 136m bgl with an extraction thickness of 0.84m, last worked in 1950.
- Silkstone coal seam, worked at depths ranging between 144m and 164m bgl with an extraction thickness ranging between 0.61m and 0.63m, last worked in 1956.
- Top Beeston coal seam, worked at depths ranging between 204m and 211m bgl with an extraction thickness ranging between 0.56m and 0.76m, last worked in 1965.

- The site is not affected by spine roadways at shallow depth.
- The CA has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.
- There is no current Stop Notice delaying the start of remedial works or repairs to the property.
- The CA is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.
- There is no record of mine gas within 500 metres of the enquiry boundary.

Table 6-3 - Summary information of mine entries present within Parcel 4 and within 20m of Parcel 4

Entry Type	CA Reference	Grid Reference	Diameter (m)	Depth (m)	Treatment Description
Mine entries present within Parcel 4					
Shaft	424415-031	424093 415638	2.0*	Unknown	No treatment information available. It is however located within the open cast and is likely to have been removed in part by open cast mining.
Shaft	424415-043	424103 415374	2.0*	Unknown	No treatment information available. It is however located within the open cast and is likely to have been removed in part by open cast mining.
Shaft	424415-044	424008 415334	2.0*	Unknown	No treatment information available. It is however located within the open cast and is likely to have been removed in part by open cast mining.
Mine entries present within 20m of Parcel 4					
Shaft	423415-010	423898 415397	2.5*	Unknown	No treatment information available. It is however located within the open

Entry Type	CA Reference	Grid Reference	Diameter (m)	Depth (m)	Treatment Description
					cast and is likely to have been removed in part by open cast mining.

*assumed diameter from CA online database.

6.3.1.4 Parcels 5 and 6 (Report ref: 51002545487001)

The CA online viewer indicates that Parcel 5 is entirely within a '*Development High Risk Area'* associated with reported '*surface mining (past)*' and '*probable shallow coal mine workings*'. The majority of Parcel 6 is indicated to be within a '*Development High Risk Area*' associated with '*probable shallow coal mine workings'*.

One coal seam outcrop is shown to be present within the central part of Parcel 6 and the south eastern corner of Parcel 5. The CA Consultant's Coal Mining Report (reference 51002545487001) and the BGS 1:10,560 mapping note/show this to be the Joan coal seam.

Six mine entries (four mine shafts with CA references 424415-002, 424415-013, 424415-014 and 424415-065) and two adits with CA references 424415-012 and 424415-028 are shown to be present within Parcel 5. Two mine entries (mine shafts) with CA references 424416-017 and 424416-018 are indicated to be present within Parcel 6. Further information on the mine entries within the parcels are presented in Table 6-4. The mine entries have recorded CA *Departure Distances* of 5 to 10m, suggesting that there is uncertainty around their exact locations.

Other pertinent data from the CA Consultant's Coal Mining Report includes:

- A fault trending northeast to southwest across Parcels 5 and extending into Parcel 6. Two further faults are recorded in the east of Parcel 6.
- Unlicensed open cast coal mining across Parcel 5. No licensed or unlicensed open cast mining is recorded in Parcel 6.
- Underground coal workings in the following coal seams beneath the site:
  - Middleton Main coal seam, worked at depths ranging between 95m and 113m bgl with an extraction thickness ranging between 0.63m and 0.91m, last worked in 1884.
  - Wheatley Lime coal seam, worked at depths ranging between 123m and 147m bgl with an extraction thickness ranging between 0.76m and 0.84m, last worked in 1965.
  - Silkstone coal seam, worked at depths ranging between 137m and 138m bgl with an extraction thickness of between 0.53m and 0.61m, last worked in 1960.
  - Top Beeston coal seam, worked at depths ranging between 186m and 212m bgl with an extraction thickness of between 0.76m and 0.99m, last worked in 1963.
- The site is not affected by spine roadways at shallow depth.
- The CA has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.
- There is no current Stop Notice delaying the start of remedial works or repairs to the property.
- The CA is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

- There is no record of mine gas within 500 metres of the enquiry boundary.

Table 6-4 - Summary information of mine entries present within Parcel 5 and 6

Entry Type	CA Reference	Grid Reference	Diameter (m)	Depth (m)	Treatment Description
Mine entries present within Parcel 5					
Shaft	424415-002	424603 415903	2.0*	Unknown	*Has been filled and has probably been removed to some extent by open cast mining.*
Adit	424415-012	424810 415832	2.0*	Unknown	*Has probably been removed to some extent by open cast mining.*
Shaft	424415-013	424547 415859	2.5*	73.2	*Has been filled and has probably been removed to some extent by open cast mining.*
Shaft	424415-014	424456 415812	2.5*	73.2	*Has been filled and has probably been removed to some extent by open cast mining.*
Adit	424415-028	424881 415920	2.0*	Unknown	No treatment information available. It is however located within the open cast and is likely to have been removed in part by open cast mining.
Shaft	424415-065	424797 415842	2.0*	Unknown	No treatment information available. It is however located within the open cast and is likely to have been removed in part by open cast mining.
Mine entries present within Parcel 6					
Shaft	424416-017	424878 416063	2.0*	Unknown	No treatment information available.
Shaft	424416-018	424864 416050	2.0*	Unknown	No treatment information available.

*assumed diameter from CA online database.

6.3.1.5 Parcel 9

Reference to the Coal Authority (CA) online viewer indicates that Parcel 9 is within a '*Development High Risk Area*' associated with '*probable shallow coal mine workings'*.

No coal seam outcrops are shown within Parcel 9.

No mine entries are shown within Parcel 9 or within 20m of its boundary.

Other pertinent data from the CA Consultant's Coal Mining Report includes:

- No faults, fissures or breaklines recorded.
- No licensed or unlicensed open cast mining within the site.
- Underground coal workings in the following coal seams beneath the site:
  - Middleton Main coal seam, worked at a depth of 95m bgl with an extraction thickness of 0.91m, last worked in 1884.
  - Wheatley Lime coal seam, worked at depths ranging between 115m and 116m bgl with an extraction thickness of 0.76m, last worked in 1932.
  - Silkstone coal seam, worked at depths ranging between 140m and 152m bgl with an extraction thickness ranging between 0.53m and 0.61m, last worked in 1960.
  - Top Beeston coal seam, worked at depths ranging between 194m and 212m bgl with an extraction thickness ranging between 0.76m and 0.99m, last worked in 1963.
- The site is not affected by spine roadways at shallow depth.
- The CA has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.
- There is no current Stop Notice delaying the start of remedial works or repairs to the property.
- The CA is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.
- There is no record of mine gas within 500 metres of the enquiry boundary.

6.3.2 ABANDONMENT PLANS

A CA search for mine abandonment plans for shallow underground mine workings and open cast mine workings was completed and the relevant available plans were purchased for the site (**Appendix J**), all of which relate to open cast mine workings. Pertinent details from the abandonment plans are summarised in the following sections.

6.3.2.1 CA abandonment plan NE249

This plan shows the Flockton Thin coal seam to have been worked by open cast methods in the north of Parcel 1. A summary is provided below:

- It shows the bottom of coal level in the mine to vary between 534.9ft OD (approx.163.0m OD) and 600.5ft OD (approx.183.0m OD).
- Ground levels are shown to vary between 632.6 ft OD (approx. 192.8m OD) and 552.2ft OD (approx.168.3m OD). As such, the recorded depth to the base of the Flockton Thin coal seam ranges between 5.6ft bgl (1.7m bgl) in the north to 42.4 ft bgl (12.9m bgl) in the south.
- The Flockton Thin coal seam is shown to subcrop immediately to the north of the mine, dipping to the southeast at a gradient of 1V : 17H.
- The mine is recorded to have been extracting coal in 1955 and backfilled in 1956.

- No areas of ‘old workings’ or ‘voids’ are recorded on the abandonment plan, although some areas on the northern edge of the pit are recorded as ‘excavation only’. This may relate to areas of notably poor quality or highly weathered coal.

6.3.2.2 CA abandonment plan OC122

This plan shows the Flockton Thick coal seam to have been worked by open cast method in the west of Parcel 1. A summary is provided below:

- It shows the bottom of coal level in the mine to vary between 650.0ft OD (approx.198.1m OD) and 626.7 ft OD (approx.191.0m OD).
- Ground levels at the mine are shown to vary between 682.5ft OD (approx. 208.0m OD) and 651.8ft OD (approx.198.7m OD). As such, the depth to base of the Flockton Thick coal seam ranges between 8.6ft bgl (approx. 2.6m bgl) in the north and 38.0ft bgl (approx.11.6m bgl) in the southwest.
- The Flockton Thick coal seam is shown to subcrop to the north of the pit, dipping southeast at a gradient of 1V : 16H.
- The mine is noted to have been abandoned (and assumed to have been backfilled) in April 1944.
- The mine is shown to be surrounded by ‘old workings’ and ‘old bell pits’, indicating that the area has been subjected to historical unrecorded shallow workings.

6.3.2.3 CA abandonment plan 17558

This plan shows mainly the Flockton Thin coal seam to have been worked by open cast methods in the north of Parcel 2. A summary is provided below:

- It shows the average dip of the seam to be 1V : 15H It notes that coaling was completed in the pit in 1982. However, it does not provide any information on the depth of the coal seam.
- The plan also shows localised working in the Flockton Thick coal seam in the south of the mine.
- No areas of ‘old workings’ are recorded on the abandonment plan.

6.3.2.4 CA abandonment plan OC176

This plan shows the Flockton Thick coal seam to have been worked by open cast method in the central parts of Parcel 2. A summary is provided below:

- It shows the bottom of coal level in the mine to vary between 530.0ft OD (approx.161.5m OD) and 571.0ft OD (approx.174.0m OD).
- Ground levels at the mine are shown to vary between 536.6ft OD (approx. 163.6m OD) and 593.6ft OD (approx.180.9m OD). As such, the depth to the base of the Flockton Thick coal seam range between 1.4ft bgl (approx. 0.4m bgl) in the north and 38.4ft bgl (approx. 11.7m bgl) in the southwest.
- The Flockton Thick coal seam is indicated to dip to the east at a gradient of 1V : 19H.
- The mine is noted to have operated between 1944 and 1945 and was backfilled in 1945.
- ‘Old workings’ are noted in the southeast of the mine, indicating that the area has been subjected to historical unrecorded shallow workings.

6.3.2.5 CA abandonment plan NE206

This plan shows open cast coal workings in the Joan, Flockton Thin and Flockton Thick coal seams, although the workings in the Joan Coal seam are outwith (to the northeast of) the proposed development site. The plan shows the following information relevant to the proposed development:

- Coal working by open cast method in the Flockton Thin coal seam in the north of **Parcel 3**.
  - The bottom of coal level in the mine is shown to vary between 457.6ft OD (approx.139.5m OD) and 497.2ft OD (approx. 151.5m OD).
  - Ground levels at the mine are shown to vary between 472.8ft OD (approx. 144.1m OD) and 519.1ft OD (approx.158.2m OD). As such, the depth to base of the coal seam is between 6.0ft bgl (approx. 1.8m bgl) in the north and 33.1ft bgl (approx. 10.1m bgl) in the southeast.
  - The Flockton Thin coal seam is shown to dip southeast at a gradient of 1V : 23H.
  - No areas of 'old workings' or 'voids' are recorded around the mine.
- Coal working by open cast method in the Flockton Thick coal seam in the south of **Parcel 3**.
  - The bottom of coal level is shown to vary between 498.0ft OD (approx.151.8m OD) and 525.5ft OD (approx. 160.2m OD).
  - Ground levels are shown to vary between 514.8ft OD (approx. 156.9m OD) and 560.6ft OD (approx.170.9m OD). As such, the depth to base of the coal seam ranges between 7.5ft bgl (approx. 2.3m bgl) in the north and 47.0ft bgl (approx. 14.3m bgl) in the southeast.
  - The coal seam is shown to dip to the southeast at a gradient of 1V : 23H.
  - 'Old workings' are shown in the south of the mine, indicating that the area has been subjected to historical unrecorded shallow workings.
- Coal working by open cast method in the Flockton Thin Coal seam in the south of Parcel 8.
  - The bottom of coal level is shown to vary between 436.6ft OD (approx.133.1m OD) and 454.1ft OD (approx. 138.4m OD).
  - The ground levels are shown to vary between 451.8ft OD (approx. 137.7m OD) and 486.4ft OD (approx.148.3m OD). As such, the depth to base of the coal seam ranges between 4.3ft bgl (approx. 1.3m bgl) in the north and 39.8ft bgl (approx. 12.1m bgl) in the southeast.
  - The coal seam is shown to dip to the southeast at a gradient of 1V : 23H.
  - No areas of 'old workings' or 'voids' are recorded around this mine.
- Coal working by open cast method in the Flockton Thick coal seam in the northeast of Parcel 8. The mine is shown extending beyond the parcel's eastern boundary.
  - The bottom of coal level is shown to vary between 435.7ft OD (approx.132.8m OD) and 452.9ft OD (approx. 138.0m OD).
  - Ground levels vary between 458.9ft OD (approx. 139.9m OD) and 472.3ft OD (approx.144.0m OD). As such, the depth to base of the coal seam ranges between 6.0ft bgl (approx. 1.8m bgl) in the north and 36.6ft bgl (approx. 11.2m bgl) in the south.
  - Although no areas of 'old workings' or 'voids' are recorded around the mine, there are a number of circles/dots depicted on its western side where the coal is recorded to be shallowest. These features may relate to old unrecorded bell pits that were encountered during open casting and may suggest the potential for other bell pits/unrecorded shallow workings in the area.

- The plan records that the above pits were operated between 1954 and 1955.

6.3.2.6 CA abandonment plan NE387

This plan shows the Joan coal seam to have been worked by open cast method in the eastern part of Parcel 4 and the majority of Parcel 5. A summary is provided below:

- Parcel 4:
  - The bottom of coal level in the mine is shown to vary between 592.5ft OD (approx.180.5m OD) and 608.2ft OD (approx.185.4m OD).
  - Ground levels are shown to vary between 605.8ft OD (approx. 1846m OD) and 636.3ft OD (approx.194.0m OD). As such, the depth to base of the seam ranges between 5.3ft bgl (approx. 1.6m bgl) in the southwest of the mine and 43.8ft bgl (approx. 13.4m bgl) in the east.
  - The seam is shown to be dipping to the southeast at a gradient of 1V : 17H.
  - An area on the northern edge of the mine within Parcel 4 is recorded as 'excavation only'. This may relate to areas of notably poor quality or highly weathered coal.
  - Although no areas of 'old workings' or 'voids' are recorded around the mine, they are noted in other areas around the mine, indicating that the wider area has been subjected to historical unrecorded shallow workings.
- Parcel 5:
  - The bottom of coal level in the mine is shown to vary between 515.1ft OD (approx.157.0m OD) and 580.8ft OD (approx.177.0m OD).
  - Ground levels are shown to vary between 520.2ft OD (approx. 158.6m OD) and 605.6ft OD (approx.184.6m OD). As such, the depth to base of the seam in this section of the mine generally ranges between 5.1ft bgl (approx. 1.6m bgl) in the southwest and 40.9ft bgl (approx. 12.5m bgl) in the southeast.
  - Two faults are recorded within this section of the mine, both with a southwest to northeast orientation. The northern fault is recorded to be downthrown to the south by 4.2 to 5.0 ft (1.3 to 1.5m). The southern fault is recorded to be downthrown to the north by 1.6 to 2.0 ft (0.5 to 0.6m).
  - The seam is shown to be dipping to the southeast at a gradient of 1V : 24H.
  - Areas of 'Old workings' are recorded within the mine, indicating that those areas had been subjected to historical unrecorded shallow workings. Some areas on the eastern edge of the pit are also recorded as 'excavation only' which may relate to areas of notably poor quality or highly weathered coal.

6.4 PRELIMINARY COAL MINING RISK ASSESSMENT

Based on the information reviewed above, a preliminary assessment of coal mining related risks that may affect the site has been undertaken and is presented below.

6.4.1 RECORDED COAL MINING AT SHALLOW DEPTH

The CA records do not indicate any recorded coal mine workings at shallow depth (i.e. within 30m of ground level) beneath the site as a whole. Therefore, the risk of ground instability related to recorded shallow coal mine workings is considered to be low.

6.4.2 RECORDED COAL MINING AT GREATER DEPTH

Coal mining on seams deeper than 30m is recorded beneath the majority of the site. The shallowest is recorded to be on the Middleton Main Coal seam, where it is recorded at 49m bgl beneath Parcel 3. This seam is recorded to be up to 1.27m thick beneath the site.

Based on the recorded seam thickness and depth, the thickness of rock cover above the shallowest recorded mine workings is expected to be sufficient such that these workings do not present a risk of surface instability.

6.4.3 UNRECORDED COAL MINING AT SHALLOW DEPTH

The CA records *'Probable Shallow Mine Workings'* beneath the majority of the parcels, the exception being **Parcel 7**.

The open cast mine abandonment plans reviewed record '*old workings*' and '*Old Bell Pits'* having been encountered within Parcels **1, 2, 3, 5** and possibly **Parcel 8**.

In addition, the Tankersley Ironstone seam is recorded to subcrop in **Parcels 1, 2, 3,** and **4**. There are no records of workings in the Tankersley Ironstone seam, although unrecorded workings may exist.

Based on the above, the potential presence of unrecorded shallow coal mining outwith the areas of surface mining cannot be discounted across all parcels except Parcel 7. Where surface mining has taken place, any unrecorded workings in the seams being extracted should have been removed.

6.4.4 SURFACE MINING (OPEN CAST WORKINGS)

The CA records show historical open cast coal mining activities to have taken place within **Parcels 1, 2, 3, 4, 5** and **8**. All the open cast workings are understood to be complete and backfilled, although the nature of the backfill is unknown. Typically at sites like these, the soils would be placed to a standard suitable to allow agricultural activities to be resumed, where some long term settlement of the backfill ground was acceptable. As such, the backfill was not formally engineered/ compacted during placement.

6.4.5 MINE ENTRIES

The assessment of risk from recorded coal mine entries is presented in Table 6-5.

Table 6-5 – Mine entries risk assessment

Land Parcel Reference	Risk Assessment
Parcel 1	▪ No mine entries are recorded within this parcel or within 20m of its boundary. However, there may be unrecorded mine entries that do not appear on CA records.
Parcel 2, 3, 7 and 8	▪ No mine entries are shown to be present within Parcels 2, 7 and 8. ▪ Two mine entries (shafts) with CA references 424416-009 and 424416-010 are shown to be present within Parcel 3, both of which are recorded to have been filled to an unknown specification and have probably been removed to some extent by open cast mining. ▪ Another mine shaft (CA reference 424416-008) is shown to be within 20m of the Parcel 7 boundary. No treatment records are available for this mine shaft. ▪ The presence of other unrecorded mine entries that do not appear on CA records should be considered.
Parcel 4	▪ Three mine entries (mine shafts) with CA references 424415-031, 424415-043 and 424415-044 are recorded within Parcel 4. Another mine shaft with CA reference 423415-010 is shown to be within 20m of the Parcel 4 boundary. No treatment information is available for any of these mine entries. ▪ Based on their recorded locations it is considered that they are all likely to have been removed to some extent by open cast mining. ▪ The presence of other unrecorded mine entries that do not appear on CA records should be considered.
Parcel 5 and 6	▪ Six mine entries (four mine shafts (CA references 424415-002, 424415-013, 424415-014 and 424415-065) and two adits (CA references 424415-012 and 424415-028)) are recorded within Parcel 5. ▪ Two mine entries (mine shafts) with CA references 424416-017 and 424416-018 are recorded within Parcel 6. ▪ Mine entries 424415-002, 424415-012, 424415-013, 424415-014 are recorded to have been filled to an unknown specification and have probably been removed to some extent by open cast mining. ▪ There is no treatment information available for mine entries 424415-028, 424415-065, 424416-017 and 424416-018. However, it is considered that, based on their recorded locations, mine entries 4424415-028 and 424415-065 are likely to been removed to some extent by open cast mining. ▪ The presence of other unrecorded mine entries that do not appear on CA records should be considered.
Parcel 9	▪ No mine entries are recorded within this parcel or within 20m of its boundary. However, there may be unrecorded mine entries that do not appear on CA records.

Based on the above, the presence of known mine shafts within Parcels 2, 3, 4, 5, 6, 7 and 8 should be taken into account when assessing the overall coal mining risk of these parcels.

6.4.6 COAL MINING GEOLOGY

Fault lines are recorded at the site as follows:

- Across the southwest corner of Parcel 1, trending northwest to southeast;
- Across central parts of Parcels 5 and extending into Parcel 6, trending northeast to southwest
- Across the north of Parcel 8 and extending northwest across the north eastern extent of Parcel 2.

The above faults are not considered to have been caused by coal mining activity. The CA has no records of any damage due to geological faults or other lines of weakness that have been caused by coal mining. Risk of ground stability from coal mining induced faulting is considered to be low.

6.4.7 MINE GAS EMISSIONS

The CA has no record of past mine gas emissions requiring action.

Due to the presence of recorded and unrecorded coal workings beneath the site on a number of seams and the presence of the sub-cropping and very shallow coal seams on site, there is potential for mine gases to migrate to the surface through fissures within the bedrock and superficial strata.

The presence of backfilled open cast workings also presents a potential mine gas risk.

The accumulation of mine gases in confined spaces poses a risk to human health receptors and the proposed development, which should be further assessed along with other sources of ground gas (as also discussed within this report).

6.4.8 RECORDED COAL MINING SURFACE HAZARD

The site has not been subject to remedial works by, or on behalf of, the CA under its Emergency Surface Hazard Call Out procedures. There is a recorded remediated site approximately 40m northeast of Parcel 6 where the CA has investigated and, where necessary, remediated mine entries and or shallow mine workings following specific reported hazards. The relevant CA *Surface Hazards Incident Report* should be obtained and reviewed during the detailed CMRA.

6.4.9 SUMMARY OF ASSESSED COAL MINING RISKS

Table 6-6 presents a summary of the coal mining risks based on this preliminary assessment.

Table 6-6 – Preliminary coal mining risk assessment summary

Coal Mining Issue	Development Parcel								
	1	2	3	4	5	6	7	8	9
Underground coal mining (recorded at shallow depths)	No	No	No	No	No	No	No	No	No
Underground coal mining (probable at shallow depths) i.e. unrecorded workings	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Surface mining (open cast workings)	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Mine entries*(shafts/ adits)	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Coal mining geology (fissures)	Yes	Yes	No	No	Yes	Yes	No	Yes	No
Record of past mine gas emissions	No	No	No	No	No	No	No	No	No
Potential for mine gas emissions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recorded coal mining surface hazard	No	No	No	No	No	No	No	No	No
* Mine entries on or within 20m of the land parcel boundary									

6.5 FURTHER INVESTIGATION AND MITIGATION

The following areas of coal mining risk should be further investigated as part of a site-specific intrusive investigation to inform the detailed CMRA and any mitigation measures recommended as a result.

A preliminary assessment of potential mitigation measures has been included, although this is subject to the findings of the intrusive investigation and should be further assessed as part of a detailed CMRA.

6.5.1 RISK FROM UNRECORDED SHALLOW MINE WORKINGS

The CA records identify a potential risk of unrecorded shallow workings in all the parcels with the exception of Parcel 7. In order to better define this risk, intrusive investigation by means of rotary

drilling would be required to investigate the possible presence of unrecorded shallow mine workings in areas outwith the open cast extents.

If encountered, unrecorded shallow mine workings with insufficient solid rock cover would likely require remediation as part of site development enabling works. This may comprise either treatment by grout injection beneath any infrastructure considered sensitive to ground movement or use of high strength geogrids to manage the impacts of any ground movement below less sensitive areas.

6.5.2 RISK FROM SURFACE MINING (OPEN CAST)

The CA records indicate historical open cast coal mining activities to have taken place within Parcel 1.

Investigation to confirm the extents of the open cast areas (spatially and depth) are recommended. These may include:

- Intrusive ground investigations (trial trenching to assess the plan extents and cable percussive/rotary boreholes to assess the depth).

Intrusive ground investigations are also recommended to assess the backfill condition and material properties within these open cast areas to inform the foundation design of proposed infrastructure.

It is likely that the open cast mine has been backfilled with colliery spoil. The potential for ignition and spontaneous combustion of the open cast backfill and shallow coal at the site should be assessed in detail as part of any future ground investigation as this could pose a risk to buried cables and buried structures associated with the proposed development.

6.5.3 RISK FROM RECORDED AND UNRECORDED MINE ENTRIES

The CA records mine entries to be present in Parcels 3, 4, 5, 6 and within 20m of the boundary of Parcel 7. Many of the entries have been filled to unknown specifications and have probably been removed to some extent in the open cast mining.

It is recommended that CA '*Mine Entries Plan and Data Set'* covering all the mine entries should be obtained and reviewed as part of detailed CMRA prior to the intrusive investigation phase.

The risk from those mine entries located within the open cast pits should be re-assessed following intrusive ground investigations and appropriate mitigation considered.

Mine entries within the site but outside the open cast pits are recorded to include 424416-017 and 424416-018 in Parcel 6, and 424416-008 in Parcel 7. The CA records indicate that there may be up to +/-10m positional inaccuracy (departure) for each of these mine entries.

A potential option to mitigate the risk of ground instability due to these mine entries is to adopt a development exclusion zone around the reported location of these mine entries, although given the uncertainty in the locations (as recorded by the CA) these exclusion zones may be quite large.

Alternatively, the mine entries could be located by appropriate ground investigation techniques during enabling works and treated to the satisfaction of the CA prior to site occupation. If the shafts are located outwith the site, then the adoption of development exclusion zones for those areas of the site within the influence zone of the shafts is likely to be required.

The presence of unrecorded mine entries cannot be discounted due to the incomplete nature of the records held by the CA, the presence of shallow coal seams below the site, and the history of mining

in the area. Therefore, it is recommended that a watching brief is in operation during topsoil strip and general site preparatory earthworks. If any unusual ground conditions or features are exposed which may represent an unrecorded mine entry, additional assessment and investigation should be carried out and appropriate mitigation implemented to the satisfaction of the CA.

6.5.4 RISK FROM MINE GAS EMISSIONS

There is a risk of mine gas emissions affecting enclosed spaces associated with the proposed development due to the presence of open cast, unrecorded shallow and recorded deep coal mine workings as well as subcropping coal seams on the site.

A ground gas monitoring programme should be undertaken to monitor the presence and concentration of hazardous ground gases on the site and to enable a gas risk assessment to be completed for the site. The presence of hazardous ground gases on the site may require the implementation of gas protection measures if any enclosed and occupied spaces are proposed.

7 PRELIMINARY CONCEPTUAL SITE MODEL

7.1 INTRODUCTION

The potential risks from contamination within soil and groundwater are assessed according to the environmental setting/ ground model, likely presence of potential sources of contamination and the proposed land use.

The source-pathway-receptor model forms the basis of the risk assessment; potential risks are only considered to exist if there is a credible source (e.g. chemical substance capable of causing harm); a pathway for migration of the source to the receptor; and a receptor that could be affected (e.g. nearby river or future site users). A source-pathway-receptor contaminant linkage assessment is termed a CSM. A preliminary CSM is produced prior to intrusive ground investigation and is refined following the collection of site-specific data (if appropriate).

This CSM has been prepared based on the site being redeveloped for a Solar Photovoltaic Farm to comprise the installation of rows of solar photovoltaic panels and associated infrastructure.

The site currently comprises predominantly agricultural land, with some areas of woodland. The area has a significant coal mining legacy, both underground and open cast, as well as historical quarrying (sandstone). The key potential sources of contamination (expanded further in Section 7.2.1) have been identified as the unknown nature of any backfill material used to backfill the open cast mines / quarries.

7.2 SOURCES, PATHWAYS AND RECEPTORS

The potential sources of contamination, receptors relevant to the proposed development and potential exposure pathways have been identified and are presented below:

7.2.1 POTENTIAL SOURCES

Table 7-1 provides a summary of the potential sources of contamination and the likely nature of such sources both on-site and in the immediate surrounds.

Table 7-1 – Summary of Potential Sources of Contamination

Description	Anticipated Contaminants
Parcel 1 (onsite)	
Agricultural usage of land	Pesticides, herbicides and fertilisers
Areas of backfilled open cast workings - potential for coal spoil but also general fill Limited general Made Ground identified on site	Total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), heavy metals, phenols, asbestos. High calorific value materials. Ground gas (methane, carbon dioxide and hydrogen sulphide)
Historical coal mining beneath the site (seams worked at depths between 65 and 174m bgl)	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Parcel 1 (offsite)	
Backfilled sandstone quarries historically mapped approximately 170m west of the site. "Old Quarry" historically mapped 170m north of the parcel.	Ground gas (methane, carbon dioxide and hydrogen sulphide) TPH, PAHs, heavy metals, asbestos.
Historical "unspecified" tanks located within 250m of the parcel boundary.	TPH, PAHs
Historical off site coal mining	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Parcels 2, 3, 7 and 8 (onsite)	
Agricultural usage of land	Pesticides, herbicides and fertilisers
Made Ground associated with the backfilled sandstone quarries formerly located on site.	TPH, PAHs, heavy metals, phenols, asbestos. High calorific value materials.

Description	Anticipated Contaminants
Areas of backfilled open cast workings (Parcels 2, 3 & 8)	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Historical coal mining beneath the site	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Parcels 2, 3, 7 and 8 (off site)	
Historical off site coal pits, Denby Grange Colliery to the east of Parcel 3 and southeast of Parcel 8; coke ovens, kilns, mineral railway and sidings, pithead buildings.	TPHs, PAHs, Benzene, Toluene, Ethylbenzene & Xylene (BTEX), heavy metals, phenols, cyanides, creosotes, asbestos.
Coal Mining legacy – shallow mining and associated mine entries	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Poultry Farm historically mapped immediately east of Parcel 3	TPHs, PAHs, heavy metals, phenols, creosotes
Historical “unspecified” tanks located within 250m of the parcel boundary.	TPH, PAHs
Parcel 4 (onsite)	
Agricultural usage of land	Pesticides, herbicides and fertilisers
Areas of backfilled open cast workings Limited general Made Ground identified on site	Total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), heavy metals, phenols, asbestos. High calorific value materials. Ground gas (methane, carbon dioxide and hydrogen sulphide)
Historical coal mining beneath the site	Ground gas (methane, carbon dioxide and hydrogen sulphide)

Description	Anticipated Contaminants
Parcel 4 (offsite)	
Historical off site coal pits	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Parcels 5 & 6 (onsite)	
Made Ground associated with the former Denby Grange Colliery (Parcel 5) including Blossom Pit in the east and two old coal pits in the west of Parcel 5.	TPHs, PAHs, Benzene, Toluene, Ethylbenzene & Xylene (BTEX), heavy metals, phenols, cyanides, creosotes, asbestos.
Agricultural usage of land	Pesticides, herbicides and fertilisers
Areas of backfilled open cast workings in Parcel 5 Substantial evidence of Made Ground present at surface including plastic, red shale and coal on Parcel 6 (potentially associated with historical mining)	Total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), heavy metals, phenols, asbestos. High calorific value materials. Ground gas (methane, carbon dioxide and hydrogen sulphide)
Historical coal mining beneath the site	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Parcels 5 & 6 (offsite)	
Historical off site coal pits	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Mineral Railway historically mapped adjacent to Parcel 6 boundary.	TPHs, PAHs, heavy metals, phenols, asbestos
Historical “unspecified” tanks located within 250m of the parcel boundary.	TPH, PAHs
Parcel 9 (onsite)	
Agricultural usage of land	Pesticides, herbicides and fertilisers
Potential for the presence of limited Made Ground on site.	TPHs, PAHs, heavy metals, phenols, asbestos

Description	Anticipated Contaminants
Historical coal mining beneath the site	Ground gas (methane, carbon dioxide and hydrogen sulphide)
Parcel 9 (offsite)	
Historical off site coal pits	Ground gas (methane, carbon dioxide and hydrogen sulphide)

7.2.2 POTENTIAL MIGRATION PATHWAYS

Relevant exposure pathways are considered to include:

- Inhalation of asbestos fibres if liberated from soils.
- Direct contact, ingestion and inhalation of other soil-bound chemical substances.
- Inhalation of vapours associated with volatile substances in soil or groundwater.
- Migration of leachable/ mobile contaminants through soil and groundwater.
- Migration of hazardous ground gases through shallow soils and accumulation in confined spaces, followed by inhalation / risk of explosion,
- Direct contact between potential contaminants and buried services.
- Spontaneous combustion of materials with a high calorific value (e.g. high coal content)

7.2.3 POTENTIAL RECEPTORS

The potential receptors listed below are considered given the contamination identified, current status of the site and surrounding area, and the future proposed land use.

HUMAN HEALTH:

- Construction workers during redevelopment;
- Adjacent land/land users during redevelopment;
- Future site users (i.e. future site visitors and maintenance workers).

CONTROLLED WATERS

- Underlying groundwater (Secondary A Aquifer) and the wider groundwater environment
- Surface Water (including ponds and unnamed drainage ditches present on site, Howroyd Beck, unnamed tributary of Smithy Brook and Smithy Brook)

7.3 CONTAMINATION RISK RANKING

Sensitive ecological receptors such as the neighbouring ancient woodland have also been identified as potential receptors however given the nature of the proposed development have been discounted from further assessment with respect to potential risks associated with contamination.

A qualitative risk ranking has been applied to the potentially complete contaminant linkages presented (based on CIRIA C552 documentation), which considers a combination of the potential severity of the harm and the likelihood of the harm occurring. The CIRIA risk rating is described in **Appendix H**.

7.4 PRELIMINARY CONCEPTUAL SITE MODEL

In consideration of the potential sources, pathways and receptors identified in Sections 7.2.1 to 7.2.3 the preliminary CSM providing a summary of potential complete pollutant linkages is provided in Table 7-2.

Table 7-2 – Preliminary Conceptual Site Model

Source	Pathway	Receptor	Probability of Complete Linkage	Consequence if Linkage Present	Risk	Discussion of Pollutant Linkage
Asbestos, if present, within Made Ground (associated with backfilled quarries / open cast mining in Parcels 1, 2, 3, 4, 5 & 8, Denby Grange Colliery in Parcel 5, or limited general Made Ground.	Liberation followed by inhalation	Construction workers during redevelopment	Likely Reduced to unlikely with the use of appropriate PPE.	Medium	Moderate Reduced to Low with the use of appropriate PPE.	Backfilled open cast workings identified within Parcels 1, 2, 3, 4, 5 & 8, likely backfilled with colliery spoil, potential for backfill to also comprise Made Ground of unknown origin potentially associated with the colliery. Limited Made Ground has been identified at the surface within a number of parcels onsite. Open cast backfill material and general Made Ground may contain asbestos fibres that could be liberated during ground works. Appropriate work control procedures (such as the use of personal protective equipment (PPE)) would be required to control any exposure risk during the works, reducing the risk to Low.
		Neighbouring site users	Unlikely	Medium	Low	If asbestos is liberated during ground works, there is a potential for exposure, but this is considered low due to the distance of identified receptors from the site.
		Site end users and maintenance workers	Low	Medium	Low to moderate	Given the nature of the proposed development there is considered a limited exposure pathway to site end users. Maintenance workers (groundworkers) may come into contact with open cast backfill / general Made ground. Risk of exposure

Source	Pathway	Receptor	Probability of Complete Linkage	Consequence if Linkage Present	Risk	Discussion of Pollutant Linkage
						can be reduced to low with the appropriate use of PPE.
Chemicals of concern within Made Ground associated with previous historical uses on site/ off-site such as: Agricultural usage of land across all parcels. Historical quarrying / open cast mining in Parcels 1, 2,3, 4, 5 & 8 and Denby Grange Colliery in Parcel 5 Historical unspecified tanks located within 250m of the boundary of Parcels 1, 2, 3, 5, 6, 7 and 8)	Direct contact, ingestion, dust inhalation	Construction Workers (during redevelopment)	Likely Reduced to unlikely with the use of appropriate PPE.	Medium	Moderate Reduced to Low with the use of appropriate PPE.	Exposure of construction workers to contamination in soils and groundwater is possible during construction, particularly groundworkers. Measures to limit exposure (e.g. appropriate PPE) may be required and will reduce the probability of exposure to unlikely.
		Adjacent site users	Unlikely	Mild	Very Low	Adjacent site users unlikely to be exposed to chemical contamination during construction due to distance from site and limited exposure times. Following construction, no exposure pathways identified.
		Site end users and maintenance workers, including groundworkers (post development)	Unlikely (end users) Likely (maintenance workers). Reduced to unlikely with the use of appropriate PPE.	Medium	Low (end users) Moderate (maintenance workers). Reduced to Low with the use of appropriate PPE.	Given the nature of the proposed development there is considered a limited exposure pathway to site end users. Maintenance workers (groundworkers) may come into contact with open cast backfill / general Made ground. Risks reduced to low with the appropriate use of PPE.
	Direct contact	Below ground buildings and services	Low	Mild	Low	Presence of made ground may present aggressive ground conditions with respect to below ground concrete.

Source	Pathway	Receptor	Probability of Complete Linkage	Consequence if Linkage Present	Risk	Discussion of Pollutant Linkage
						Also potential for presence of contaminants which may have detrimental effect on services (principally potable water supply pipes), source areas, if present are likely to be localised. Potable water supply pipes are not to be installed as part of the development.
	Leaching / mobilisation and migration	Controlled waters- Secondary A bedrock aquifer, Smithy Brook	Low Likelihood	Medium	Low to Moderate	should chemicals of concern be present, they could be migrating through granular soils and rock to impact the underlying aquifer. Secondary Aquifer is considered medium sensitivity given coal mining legacy in the area and lack of potable groundwater abstractions within 1km of the site. Local groundwater is considered overall to be of poor quality given the coal mining legacy of the area. Any sources within the open cast backfill or general Made Ground on site are considered diminishing sources and are unlikely to be presenting a detrimental effect on the local groundwater quality.
Hazardous ground gases arising from Made Ground / Historical coal mining	Accumulation in confined spaces followed by inhalation,	Construction workers	Low	Medium	Low to Moderate	Given the likely age of the fill materials and the age of the workings beneath the site, the likelihood of significant gas generation is considered low but cannot be ruled out.
		Neighbouring site users	Low	Medium	Low to Moderate	

Source	Pathway	Receptor	Probability of Complete Linkage	Consequence if Linkage Present	Risk	Discussion of Pollutant Linkage
	asphyxiation, explosion	Site end users and maintenance workers	Likely (proposed occupied structures) Unlikely (majority of development)	Medium	Moderate (proposed occupied structures) Low (majority of development)	Given the nature of the development there are limited confined spaces for ground gas to accumulate in, the majority of the development is therefore assigned a Low risk. However structures such as a substation building and storage buildings will be installed as part of the development, where structures are proposed a Moderate risk rating has been assigned. Potential risks during construction would be managed by working in accordance with appropriate Risk Assessments and Method Statements (RAMS) when working in confined spaces and used of appropriate PPE.
Colliery Spoil within backfilled open cast workings presenting a risk of spontaneous combustion	Spontaneous combustion	Construction workers Site end users including maintenance workers Future structures	Unlikely	Medium	Low	Spontaneous combustion of colliery spoil has the potential to occur where material with a high calorific content is present. Spontaneous combustion generally occurs within loosely tipped, highly aerated spoil heaps. The coal content (i.e. calorific content) of the open cast backfilled workings is currently unknown however it is considered likely to be relatively well compacted (even if not formally engineered during placement). There are no known records of any instance of spontaneous combustion within the backfilled open cast workings. On the basis of the above the risk of spontaneous combustion is considered low.

Source	Pathway	Receptor	Probability of Complete Linkage	Consequence if Linkage Present	Risk	Discussion of Pollutant Linkage
Underground fires within mine workings	Leading to explosion	Construction workers Site end users including maintenance workers Future structures	Unlikely	Medium	Low	Given the nature of the proposed development and the depth of the mine workings it is considered unlikely that a source of ignition will be introduced as a result of the proposed development. There is no indication that there is a history of underground fires within the underground workings as such the risk of underground fires is considered Low.

8 POINT OF CONNECTION

The POC is located at Lady Ings Farm, 58 Low Lane, Middlestown, Wakefield, WF4 4PT (National Grid Reference 427220, 417636), approximately 2.2km to the east of Parcel 9. The cables will run along the A642 from Parcel 9 and cross the field to the POC as indicated on Insert 8-1 below. This section provides a summary of the anticipated ground conditions along the route of the cable across the field, between the A642 and the POC. It is understood the proposed works in this location will comprise the excavation of a shallow service trench only, with no other structures or infrastructure proposed. It is noted that a walkover of this area has not been undertaken as a summary of this area was not included within the original scope of works and has been added on client request.

Insert 8-1 – POC cable route

The field across which the cable route runs is surrounded by farm buildings to the northwest, with fields to the north, east and west. The field slopes up towards the north from approximately 48m AOD to 45m AOD and is bound by hedgerows to the east, west and south and a small wooden fence to the north.

A review of publicly available historical imagery indicates the POC site has largely remained undeveloped open land / agricultural land since the earliest available mapping until present day. The BGS GeoIndex shows artificial ground and superficial deposits to be absent across the POC site and the underlying solid geology is shown to comprise Thornhill Rock Sandstone of the Pennine Middle Coal Measures. Based on the above, ground conditions are anticipated to comprise topsoil and/or limited Made Ground associated within installation of the existing pylon over weathered bedrock.

The POC cable route across the fields lies within a CA Coal Mining Reporting Area however does not lie within a CA Development High Risk Area (DHRA), this area has therefore not been included within the preliminary CMRA presented in Section 6.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 GEO - ENVIRONMENTAL CONCLUSIONS

Given the site's (and surrounding areas) land use history, a number of substances of concern could potentially be present within the underlying soils/ groundwater, which could present a risk to human health and controlled waters receptors via a number of potentially complete contaminant linkages.

The site currently comprises predominantly agricultural land and has a significant coal mining legacy, both underground and open cast, as well as historical quarrying (sandstone). A review of CA abandonment plans indicates the presence of open cast workings within Parcels 1, 2, 3, 4, 5 & 8. Open cast workings are likely to have been backfilled predominantly with colliery spoil however quantities of Made Ground originating from unknown sources may also have been used as backfill.

A number of historically potentially contaminating land uses have been identified within close proximity to the site, predominantly associated with extensive coal mining (open cast and underground) in the area. Particular off site sources include Denby Grange Colliery to the east and northeast of the site (including coke ovens, kilns, filter tanks, general pithead infrastructure and a mineral railway with sidings). A number of historical unspecified tanks have been identified in close proximity to Parcels 1, 2, 3, 5, 6 ,7 and 8.

Following a review of information publicly available for the route of the cable across the field from the A642 to the POC, limited potential sources of contamination have been identified. Artificial ground is not shown to be present in the POC area, limited Made Ground may be present associated with installation of the existing pylons.

Considering the information presented within previous sections key potential sources of contamination include open cast backfill material within Parcels 1, 2, 3, 4, 5 & 8 and potential presence of general Made Ground associated with the areas coal mining past. The potential for ground gases associated with both the backfilled open cast workings and underground mine working has also been identified, although it is recognised that the development comprises limited confined spaces.

In consideration of the nature of the proposed development in summary the overall risk posed to human health from potential contaminants of concern (including asbestos) within soils on site ranges between Low and Low to Moderate on the assumption that applicable RAMS to include the use of appropriate PPE will be implemented during construction. The risks posed to identified controlled waters receptors has been assessed as Low to Moderate. Risks posed by potential ground gases have been assessed as Low across the majority of the site, increased to Moderate where potentially occupied buildings (e.g. the substation) are proposed.

The risk of spontaneous combustion within the backfilled open cast workings has been considered and assigned a risk rating of low, as has the risk of potential underground fires.

In consideration of the nature of the proposed development and installation; solar panels to be founded on short (maximum length 1800mm), driven metal piles extensive site wide intrusive site investigation and risk assessment is not considered essential at this stage. Limited, targeted site investigation may be required to enable further assessment to be completed in consideration of the potential risks posed to proposed structures e.g. the substation.

There are no deep groundworks or extensive reuse of material currently proposed as part of the development however there will be the excavation of service trenches, given the unknown nature of the opencast backfill it would be prudent to complete limited, targeted intrusive site investigation to confirm the nature of the material likely to be encountered during excavation of the service trenches.

9.2 COAL MINING RISK CONCLUSIONS

The following conclusions are made from the preliminary CMRA:

- The site is situated within a Coal Authority (CA) reporting area and with the exception of Parcel 7 is also within a '*Development High Risk Area'*
- There are no recorded coal mine workings at shallow depth (i.e. within 30m of ground level) beneath the site as a whole.
- Coal mining on seams deeper than 30m is recorded beneath the majority of the site. The thickness of rock cover above the shallowest recorded mine workings is expected to be sufficient such that these workings do not present a risk of surface instability.
- There is a potential risk of unrecorded shallow workings in all the parcels with the exception of Parcel 7.
- Historical open cast coal mining activities have taken place within Parcels 1, 2, 3, 4, 5 and 8.
- Mine entries are present in Parcels 3, 4, 5, 6 and within 20m of the boundary of Parcel 7. Many of these entries are recorded to have been filled to unknown specifications. Those recorded to be present within areas of open cast mining have probably been removed to some extent by the open cast mining activities.
- There is a risk of mine gas emissions affecting enclosed spaces associated with the proposed development due to the presence of open cast, unrecorded shallow and recorded deep coal mine workings as well as subcropping coal seams on the site.

9.3 DATA GAPS AND UNCERTAINTIES

There is no previous site investigation data available for the site. Only one BGS borehole record providing information from ground level is available in the vicinity of the site, this provides limited information.

Open cast mining is known to have occurred across the majority of the site (Parcels 1, 2, 3, 4, 5 & 8), although the origin of the backfilled material is unknown it is considered likely to predominantly comprise colliery spoil along with potential general Made Ground of unknown origin.

9.4 RECOMMENDATIONS

9.4.1 GROUND CONDITIONS:

Based on the findings of the PRA it is recommended that limited, targeted intrusive ground investigation of the site (including limited ground investigation at the POC) is undertaken. The ground investigation should be proportionate to the nature of the development and designed to achieve the following objectives:

- Confirm the presence/ absence of contaminant linkages, including the assessment of risks associated with the potential presence of ground gases particularly in areas of proposed

structures (occupied buildings or enclosed spaces) to enable an informed gas risk assessment to be completed.

- If required, obtain geotechnical parameters of soils and rock to aid in the design of any proposed structures.
- It would be prudent to complete limited, targeted intrusive site investigation to confirm the nature of the material likely to be encountered during excavation of the service trenches, to enable appropriate management of potential risks posed to groundworkers and assess suitability for reuse (if required).
- Obtain sufficient data on ground conditions and ground/ groundwater contamination to inform a Phase 2 ground investigation report, if required to inform a planning condition.
- Provide data to enable a waste classification assessment of any soils destined to be taken off site during redevelopment to determine appropriate disposal routes and cost estimates (if required).

9.4.2 COAL MINING RISK

The preliminary CMRA has identified potential risks associated with the coal mining legacy of the site and surrounding area. Potential risks have been identified in relation to the potential presence of unrecorded shallow mine workings, the presence of mine entries, open cast mining and associated backfill and mine gas emissions (in consideration of enclosed spaces).

Given that the proposed development comprises the installation of solar panels, founded on short metal driven piles and no significant earthworks or construction of significant structures are proposed ground investigation to assist in detailed design of the development is not considered a requirement at this stage. However, further assessment to further inform the preliminary CMRA may be requested by the Coal Authority as a consultee of the planning process, this may involve the requirement for intrusive ground investigation. Any ground investigation should be proportionate to the nature of the development and may be required to be designed to obtain field data to further assess the following:

- Risk from surface mining – investigation to confirm the extents of the open cast areas (spatially and depth);
- Risk from recorded and unrecorded mine entries;
- Risks from mine gas emissions – investigation in areas of proposed structures (enclosed or occupied spaces) should be completed to enable an informed gas risk assessment to be completed.

9.4.3 OTHER

It is recommended that should intrusive investigation be completed, prior to its completion further research into the likelihood of nearby offsite below ground tanks presenting a potential contamination source is undertaken and the resulting likely impact on proposed structures and service corridors be assessed. Further information, if available, may be obtained from the petroleum officer.

Based on the current proposals significant earthworks as part of the development are considered unlikely, however should earthworks be required as part of the redevelopment, there is potential to generate material which may be suitable for reuse on site. If a significant volume of material is likely to be generated, it is recommended that a Materials Management Plan (MMP) is completed in accordance with the CL:AIRE guidance: The Definition of Waste: Development Industry Code of

Practice (DoWCoP). Working in accordance with DoWCoP is intended to minimise the volumes of soil being taken to landfill and to demonstrate that material has been re-used in such a way that it does not pose future risks to site users or the environment. Whilst the scheme is voluntary, it demonstrates best practice and provides some assurance to regulators that the site is being developed with due consideration of the environment.

Should surplus soils require off site disposal, these materials will require classification in accordance with WM3: Waste Classification - Guidance on the classification and assessment of waste for disposal at an appropriately licensed facility.

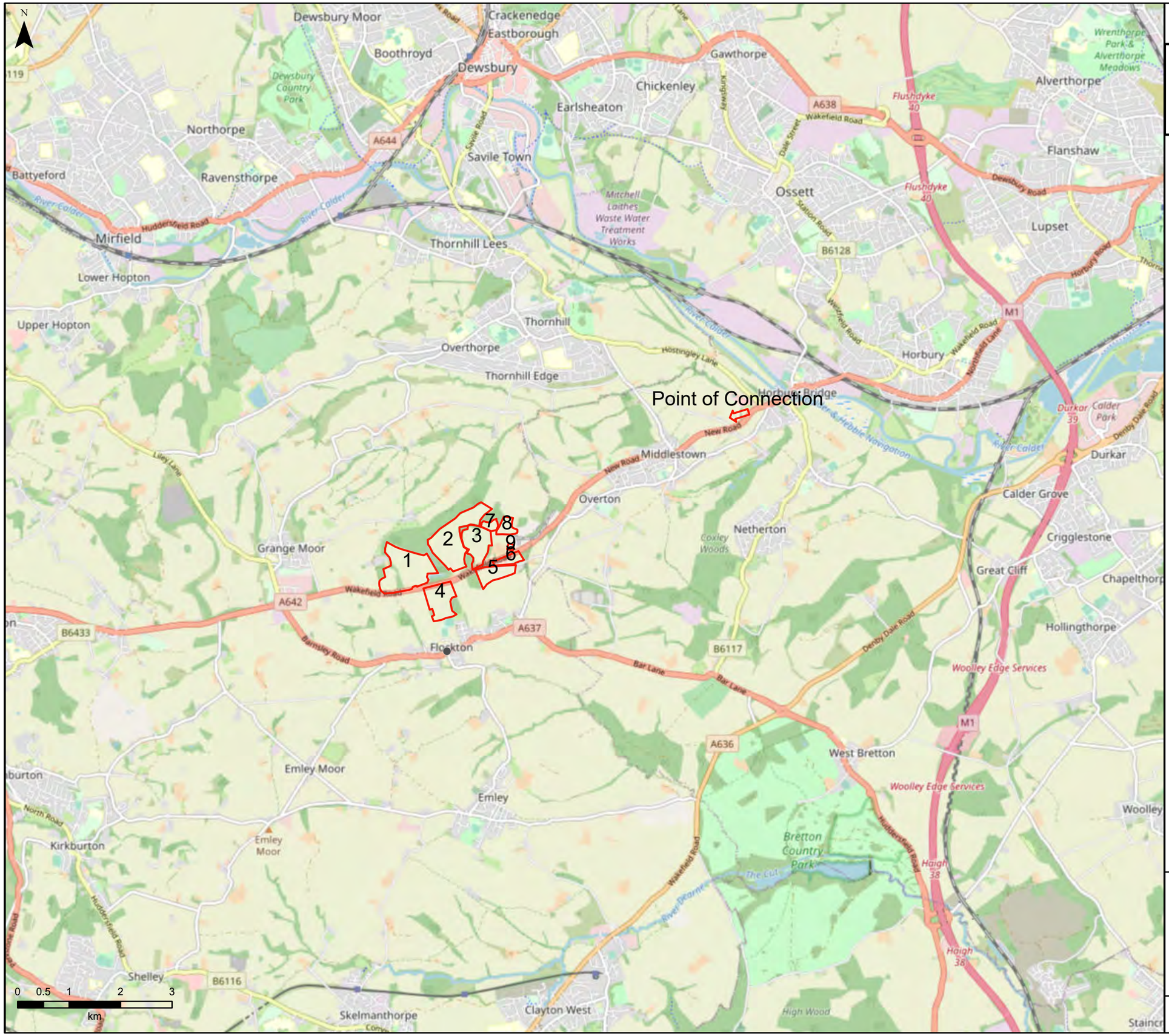
Japanese Knotweed was noted on or bordering Parcels 1, 2 and 4, although it is noted that the walkover was not completed by a qualified ecologist. Under UK Law, Japanese Knotweed is classed as a controlled plant under the Wildlife and Countryside Act 1981 section 114 (2) (WCA 1981) and it illegal to cause or allow the plant to spread, therefore this must be considered whilst planning any future works in or near these areas. It is recommended that a Japanese Knotweed specialist is appointed to undertake a detailed survey and assess whether pro-active spray treatment may be suitable to control invasion onto the development site.

It is recommended that the extent of the ancient woodland designations are clarified as the Groundsure Reports record areas of ancient woodland as being within the site boundary, however it is considered likely the designated areas lie beyond the site boundary.

Appendix A

FIGURES & DRAWINGS

Confidential



DO NOT SCALE

Information Classification:

INTERNAL

Information that is only intended for internal distribution among WSP employees, independent consultants, contractors, sub-contractors, clients and authorised third parties.

Legend :

Approximate Site Boundary

Figure 1 - Site Location Plan

Title : ArcGIS Web Map
Author : ArcGIS Web AppBuilder
Scale : 1:72,224
Layout : WSP A3 Landscape
Current Time : 24/06/2021 14:15

© WSP UK Ltd

LEGEND:

SITE BOUNDARIES

SCALE: 1:5000

Point of connection approximately 2.2km to the north-east.

1 Grange Park

2

3

4

5

6

7

8

9

Denby Wood

New Plantation

Pit Hill Plantation

Fish Ponds Plantation

Hillhouse Wood

Gulley Wood

Woodlands Farm

The Dower House

Upper Denby

Grange Wood

Wood Nook

Denby Grange

The Rookery

The Rough

New Park

Low Farm

Mining Museum

Grange Farm

Icehouse (disused)

Ford

Track

Path

Issues

Sinks

Drain

Tk

FB

152m

163m

181m

176m

186m

198m

197m

WAKEFIELD ROAD

GRANGE LANE

Caravan

File name: \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70078XXX\70078523 - LOW FARM, WAKEFIELD\03 WIP\DRAWINGS\LOW FARM FIGURES.DWG, printed on 24 June 2021 11:40:38, by Duchene, Tobi

wsp

TITLE:

Low Farm, Wakefield
Site Boundary Plan

FIGURE No:

Figure 2

DO NOT SCALE

Information Classification:

INTERNAL

Information that is only intended for internal distribution among WSP employees, independent consultants, contractors, sub-contractors, clients and authorised third parties.

Legend :

Approximate Site Boundary

Figure 3 - Existing Site Layout Plan

Title : ArcGIS Web Map

Author : ArcGIS Web AppBuilder

Scale : 1:18,056

Layout : WSP A3 Landscape

Current Time : 24/06/2021 14:00

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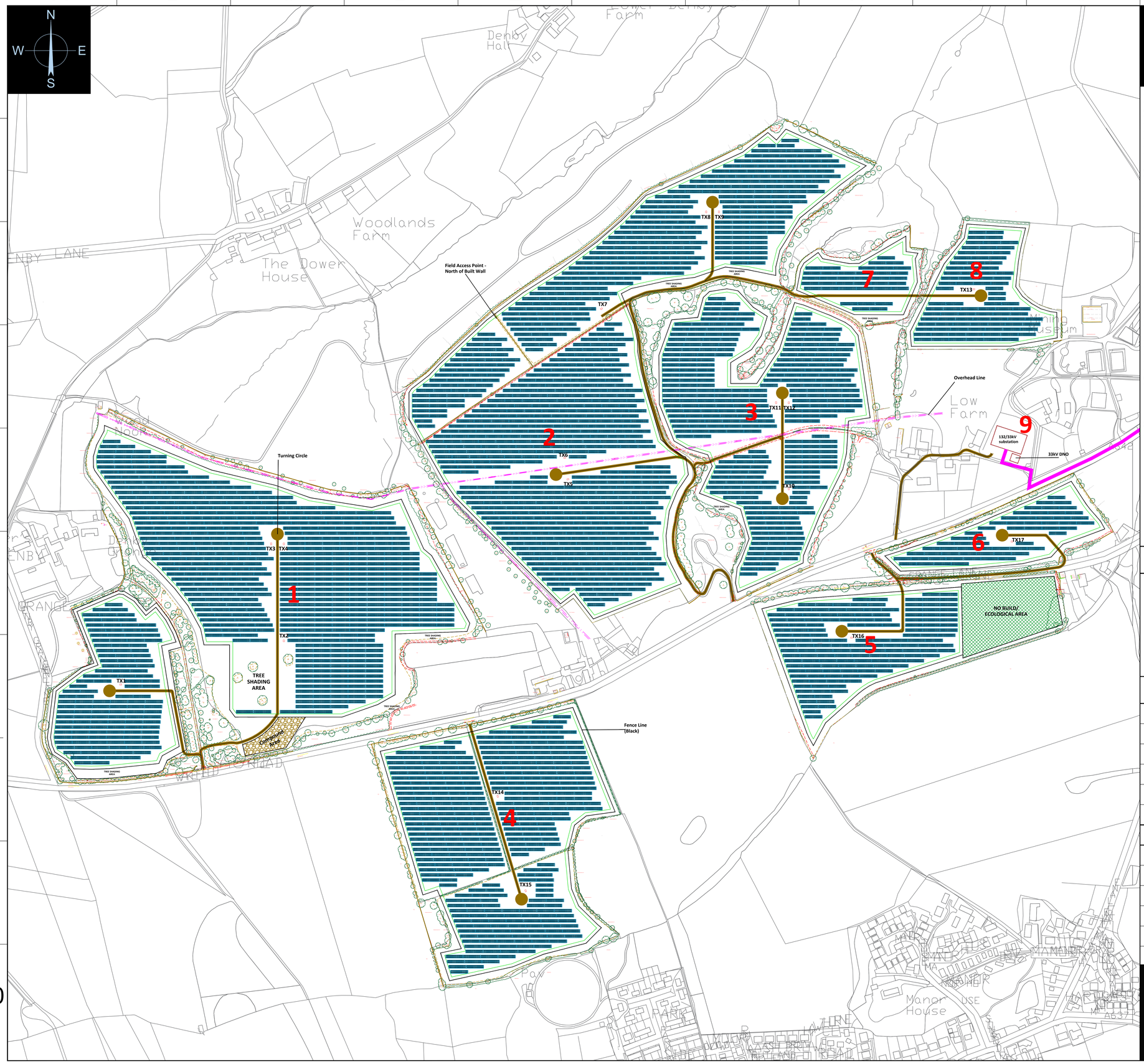

LOW FARM SOLAR FARM PROJECT INFOBOX

Lease Area	210.30 Acres
Site Area	186.10 Acres
Latitude	53°38'25.53" N
Longitude	1°38'00.80" W
Module Angle	15°
Shading Angle	20°
Pitch	8.127m
Row Distance	3.500m
Mounting System	Soportes Solares
Module Table 1 (Full)	2V - 24x2 (48 mod)
Table Pcs	2,430 Pcs
Module Table 2 (Half)	N/A
Table Pcs	N/A
Module Type 1	Jinko TR 570wp
Module Pcs	116,640 Pcs
Module Dimensions	2385 x 1122 x 35mm
DC Combiner Boxes	N/A
Inverter Type	Huawei SUN2000 185KTL
Inverter Pcs	270
String Configuration	24 modules / string 18 strings / inverter
Connection	33kV POC
Front of Table Height	800mm
Back of Table max Height	1900mm
TOTAL AC OUTPUT	49,950.000 kWp
TOTAL INSTALLED CAPACITY	66,484.800 kWp

Boom Power Ltd. Address	Project Address
Boom Power Ltd. Unit 5E Park Farm Chichester Road Arundel West Sussex BN18 0AG	Low Farm Wakefield Road Grange Moor Wakefield East Yorkshire WF4 4BB

Drawing Infomation

V No	Revision Note	By	Date
2.3	Shading Calculated	SH	14/04/2021
2.4	Field Numbers Added	SH	19/04/2021
2.5	Field 2 Access Annotation	SH	19/04/2021
2.6	Cable Route to POC Added	SH	21/04/2021
2.7	DNO Annotation Updated	SH	22/04/2021

Drawing Infomation

Scale	1:5000 @ A0
Stage	ISSUED FOR REVIEW
Drawing Name	Overall Layout
Drawing Number	B001
Designed By	Samuel Hogan
Sheet 1 of 1	

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LOW FARM SOLAR FARM SITE INFOBOX

Lease Line	
Access Points	
Compound Area	
Lease Area	
Parcel 1	61.1 Acres
Parcel 2	55.7 Acres
Parcel 3	27.05 Acres
Parcel 4	28.3 Acres
Parcel 5	17.1 Acres
Parcel 6	7.2 Acres
Parcel 7	5.0 Acres
Parcel 8	8.5 Acres
Parcel 9	1.22 Acres
Total Lease Acreage	211.17 Acres
Land Owner	Mr. Thomas Anthony Verity

Boom Power Ltd. Address	Project Address
Boom Power Ltd. Unit 5E Park Farm Chichester Road Arundel West Sussex BN18 0AG	Low Farm Wakefield Road Grange Moor Wakefield East Yorkshire WF4 4BB

Drawing Infomation	
Scale	1:1000 @ A0
Drawing Stage	ISSUED FOR REVIEW
Version Number & Name	V1.5 OPTION PLAN
Drawing Designer	SAMUEL HOGAN
Signed	

V No	Revision Note	By	Date
1.3	Option Plan Initail	SH	02/12/2020
1.4	Contact Number Upate	SH	17/03/2021
1.5	Field 9 Added	SH	17/03/2021

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TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

ABBREVIATIONS & SYMBOLS

AH	Arch Head Height	ER	Earth Rod	RSD	Roller Shutter Door
AB	Air Brick	ET	Elf+Transformer	RSJ	Rolled Steel Joist
AR	Assumed Route	FB	Flower Bed	SI	Sign Post
AV	Air Valve	FBD	Floor Board Direction	SP	Arm Spring Point Height
BB	Bellaire Beacon	FH	Fire Hydrant	SV	Stop Valve
BH	Bore Hole	FL	Floor Level	SW	Surface Water
BL	Bed Level	FP	Flag Pole	TB	Cable Box
BO	Bollard	GA	Grid Arrow	TC	Traffic Pinning
BP	Boundary Post	GG	Gas Grate	TC	Telecom Cover
BS	Bus Stop	GV	Gas Valve	TH	Trial Pit
BU	Bush	HH	Head Height	THL	Threshold Level
BW	Barbed Wire Fence	IC	Inspection Cover	TL	Traffic Light
BX	Box (Utilities)	IL	Invert Level	ToW	Top of Wall
CB	Close Board Fence	IR	Iron Railings	TP	Telegraph Pole
CH	Cill Height	KO	Kerb Outlet	TS	Traffic Signal Cover
CL	Cover Level	LP	Lamp Post	TV	Cable TV Cover
CL	Chain Link Fence	MH	Manhole	UB	Universal Beam
C-Lev	Ceiling Level	MP	Marker Post	UC	Universal Cover
Col	Column	NB	Name Board	UK	Unknown Tree
CrP	Chestnut Paling Fence	OHL	Overhead Line (approx)	UMG	Unmade Ground
CR	Cable Riser	Pan	Panel Fence	USB	Under Side Beam
CW	Chicken Wire	PB	Post Box	UTL	Unable To Lift
DC	Drainage Channel	PM	Parking Meter	UTS	Unable To Survey
DH	Door Head Height	PO	Post	VP	Vent Pipe
DL	Dilapidated	P/R	Post & Rail Fence	WB	Waste Bin
DP	Down Pipe	P/W	Post & Wire Fence	WH	Weep Hole
DR	Drain	P/Wall	Partition Wall	WL	Water Level
EBx	Electric Box	RE	Rodding Eye	WM	Water Meter
EC	Electric Supply Cover	RL	Ridge Level	WO	Wash Out
EL	Electric Line	RP	Reflector Post	FC	Floor to Ceiling Height
EP	Electric Pole	RS	Road Sign	FFC	Floor to False Ceiling Ht

Survey Control Station

DRAWING NOTES

Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including; sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Surveyed physical features may not necessarily represent the legal boundary line.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical.

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

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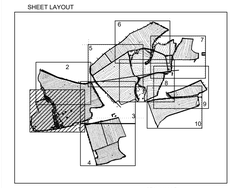
Do not scale from this drawing.

SHEET LAYOUT



Not to scale

SURVEY CONTROL CO-ORDINATES

STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
ST01	423504.814	415627.814	196.725	Nail in peg
ST02	423505.887	415656.101	195.229	Nail in peg
ST03	423374.505	415766.556	205.042	Nail in peg
ST04	423476.307	415801.047	195.334	Nail in peg
ST05	423474.307	415802.047	195.334	Nail in peg
ST06	423534.814	415827.814	197.086	PK Nail
ST07	423611.236	415842.652	194.955	PK Nail
ST08	423479.093	415819.239	200.458	PK Nail
ST09	423479.293	415819.439	200.458	Nail in peg
ST10	423760.279	415878.397	185.427	Nail in peg
ST11	423534.586	415857.582	181.545	Nail in peg
ST12	423734.581	415923.403	179.018	Nail in peg
ST13	423734.681	415923.403	179.018	Nail in peg
ST14	423609.267	416051.003	179.818	Nail in peg
ST15	423609.467	416051.003	179.818	Nail in peg
ST16	424029.883	415962.883	188.609	Nail in peg
ST17	423953.094	415886.411	187.069	Nail in peg
ST18	423953.294	415886.411	187.069	Nail in peg
ST19	424063.828	415978.157	182.101	Nail in peg
ST20	423958.482	415704.155	187.251	PK Nail
ST21	424023.041	415921.025	184.602	PK Nail
ST22	424047.060	415951.072	173.854	Nail in peg
ST23	424047.260	415951.072	173.854	Nail in peg
ST24	424063.553	415977.411	188.502	Nail in peg
ST25	424060.618	415973.486	188.699	PK Nail
ST26	424060.818	415973.486	188.699	Nail in peg
ST27	424089.866	416134.615	171.208	Nail in peg
ST28	424450.483	416021.394	171.208	Nail in peg
ST29	424450.683	416021.394	171.208	Nail in peg
ST30	424457.045	416047.544	172.949	PK Nail
ST31	424283.040	416134.481	189.319	Nail in peg
ST32	424283.240	416134.481	189.319	Nail in peg
ST33	424329.883	416062.093	176.424	Nail in peg
ST34	424017.544	415988.332	178.666	Nail in peg
ST35	423978.367	415972.571	173.613	Nail in peg
ST36	423982.980	416161.648	199.526	Nail in peg
ST37	424263.781	416023.770	147.647	Nail in peg
ST38	424263.781	416023.770	147.647	Nail in peg
ST39	424329.723	416462.145	143.183	Nail in peg
ST40	424329.923	416462.145	143.183	Nail in peg
ST41	424469.168	416583.758	133.244	Nail in peg
ST42	424474.892	416322.406	140.524	Nail in peg
ST43	424788.811	416318.501	144.281	Nail in peg

SURVEY GRID AND LEVEL DATUM

The coordinate system established for this survey is related to Ordnance Survey (OS) national grid at a single point using Smartnet, then orientated to on grid north with a scale factor of 1.000.

The level datum established for this survey is related to Ordnance Survey (OS) using GPS Smartnet.

To avoid discrepancies any coordinated data used in conjunction with this survey must be derived directly from this control data.

REV.	DESCRIPTION	DRAWN	APPR.	DATE

SURVEY SOLUTIONS

LAND SURVEYING
BUILDING SURVEYING
UNDERGROUND SURVEYING
SITE ENGINEERING
MONITORING

0845 040 5969
survey-solutions.co.uk

IPSWICH BRENTWOOD COVENTRY GLASGOW NORWICH NOTTINGHAM YEOVIL

PROJECT TITLE	LOW FARM, WAKEFIELD ROAD GRANGE MOOR, WAKEFIELD, WF4 4AR		
DRAWING DETAIL	TOPOGRAPHICAL SURVEY Sheet 1 of 10		
CLIENT	BOOM POWER LTD		SCALE 1:500
SURVEYOR: SCP	SURVEY DATE: 10/03/2021	CHECKED BY: MM	APPROVED BY: RAG / DWG STATUS: FINAL
DRAWING NUMBER	3132-1NGLS_01	REVISION	ISSUE DATE 01/04/2021

ISO 9001 BSI FM 530352

RICS

ACIES

THE SURVEY ASSOCIATION