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Phase 1 Desk Study Site Investigation Report

LOCATION	Land at Back Marriot Street, Dewsbury WF13 1PA
ISSUE DATE	May 2026
FOR	MIBZ Developments Ltd
CLIENT REF.	
OUR REF.	G26181

Prepared by

Checked by

Jonathan Jones BSc (Hons),
Assistant Geotechnical Engineer

Stuart Howe BSc (Hons) FGS
Senior Geotechnical Engineer

**Head Office**

Units 3a and 4 Terry Dicken Industrial Estate
Ellerbeck Way
Stokesley
North Yorkshire
TS9 7AE
Tel. 01642 713779
enquiries@geoinvestigate.co.uk

Nottingham

Unit 4 Bailey Brook Industrial Estate
Amber Drive, Langley Mill
Nottingham
NG16 4BE
Tel. 01773 301 235
enquiries@geoinvestigate.co.uk

Manchester

Suite 26 Atlantic Business Centre
Atlantic Street
Altrincham
WA14 5NQ
Tel. 07795 845 729
enquiries@geoinvestigate.co.uk

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Appendix 1 – Historical Map Record

Appendix 2 – GroundSure Enviro + GeoInsight Report

Appendix 2 – The Coal Mining Risk Assessment (incl Coal Authority) Report

Executive Summary

The major conclusions of this desk-based Phase one study are summarised in the table below:

Site Suitability	Desk Study Finding	Preliminary Assessment
Normal Foundations	A potential for deeper made/infilled ground has been identified underlain by competent natural deposits at unknown depth.	Unclear
Soakaways	Sandstone/mudstone/siltstone bedrock unlikely to offer sufficient permeability with thin overlying clay deposits.	Unlikely to be suitable

Potential Risks	Desk Study Finding	Preliminary Risk Assessment
Radon Gas	Between 1% and 3% of properties affected	Very Low
Chemical Contamination	Historical nearby and on-site land uses potentially giving rise to a range of inorganic and organic contaminants including asbestos, metals/metalloids, PAHs and petroleum hydrocarbons.	Moderate
Hazardous Gas	Potential for hazardous gas to migrate from possible unrecorded coal mine workings. Potential for hazardous gas to be generated in made/infilled ground deposits.	Moderate
Ground Instability/ subsidence	Potential for vegetation influence on shrink-swell clays which may be present, including risk of soil heave.	Very Low
	Potential for significant deposits of compressible made/infilled ground.	Low
Ground Instability/ subsidence	Potential for unrecorded shallow coal mining.	Moderate

NB. Arbitrary potential hazard assessment: High (Red), Moderate (Amber), Low (Yellow), Very Low (Green), Negligible (uncoloured)

1. Introduction

In accordance with your instruction, Geoinvestigate Ltd. has carried out a Phase 1 Desk Study Investigation of the Land at Back Marriot Street, Dewsbury WF13 1PA. The location of the site is shown on the Groundsure Enviro+Geo Insight report presented in Appendix 2.

The site comprises an irregularly shaped parcel of land of approximately 0.08 ha, situated between existing residential properties to the west and commercial/industrial premises fronting Pepper Road to the east. Access is available from St Philip's Close/Battye Street at the southern boundary, with a secondary access point from Camroyd Street to the north. The land is currently undeveloped and is comprises dense vegetation, including scrub, overgrown grassland and several mature trees concentrated toward the centre of the site. There are no permanent structures or areas of hardstanding within the boundary. Topographically, the site is generally level, with a slight fall from south to north, with the site being retained behind the north and west.

It is understood that the proposed development comprises the construction of two new residential dwellings, together with improved access arrangements, associated parking, waste-storage provision and landscaping.

The purpose of the Phase 1 Desk Study investigation was to review the historical land use and geological information for the site in order to provide an assessment of the potential geotechnical/foundation problems together with a qualitative contamination and ground gas risk assessment.

2. Scope of Works

The investigation comprised a review of the following information;

- An extract from the 1:50,000 BGS geological mapping.
- Historical OS maps of various scales dating back to 1854 (presented in Appendix 1).
- Observations from a walkover study carried out by Geoinvestigate.
- Review of a Coal Mining Risk Assessment carried out by Geoinvestigate.

3. Findings of Phase 1 Investigation

3.1 Anticipated Geology

The extract of the 1: 50,000 BGS geological mapping, indicates the site to be underlain by little to no thickness of superficial deposits in turn underlain by Pennine Lower Coal Measures Formation bedrock lying at or near surface comprising mudstones, siltstones, and sandstones with subordinate coal horizons.

Nearby BGS borehole records indicate shallow superficial deposits comprising road surfacing and made ground/fill materials overlying weathered mudstone and clay deposits. Bedrock, comprising interbedded shale, mudstone and sandstone of the Coal Measures sequence, is recorded from approximately 0.90m below ground level, with sandstone horizons encountered from depths of approximately 5m below ground level.

3.2 Historical OS Maps and Historical Land Use

Copies of historical OS maps were obtained for the site covering the period 1854 to 2026. Historical land uses and major features located within the site boundary and externally but potentially within influencing distance are summarised in Table 1. The earliest OS map of 1854 shows the site to be undeveloped.

Table 1: Summary of Historical OS Map Land Use & Potential Hazard Identification

Map Feature	Location	Appears	Absent	Notes
Caulms Wood Colliery	200m Northeast	1854	1892	Historic coal mining; potential for mine gas, contaminated spoil (sulphides, metals), hydrocarbon residues, and possible shallow workings causing instability.
Kiln Croft Colliery	180m Southwest	1854	1892	
Cracken Edge Colliery	300m Northwest	1854	1892	
Sandstone Quarry	90m South (closest)	1854	1892	Former quarries may be infilled with uncontrolled waste; potential contaminants and soft/unstable ground.
Mills	170m West	1854	1978-1983	Mills may have used oils, fuels, solvents; potential asbestos; contaminated made ground from demolition.
	30m East	1890	1982-1987	
	25m East	1890	1982-1987	

NB. Arbitrary potential hazard assessment: High (Red), Moderate (Amber), Low (Yellow), Very Low (Green), Negligible (uncoloured)

Table 1 (Ctd): Summary of Historical OS Map Land Use & Potential Hazard Identification

Buildings	On site	1890	1962-1966	Former structures may leave deep made ground, asbestos or residual contaminants depending on past use.
Works	2m East 30m East 25m East 40m North	1890 1982-87 1982-87 1890	1907 Recent Recent 1933	Industrial uses may involve hydrocarbons, solvents, metals, chemical storage, spills, and contaminated made ground.
Unspecified Ground Works	35m Northwest 50m East	1890 1890	1922 Recent	Unknown ground disturbance; potential for buried waste, uncontrolled fill, or localised contamination.
Mill Pond/Reservoir	60m East	1890	1971-74	Silts may contain metals, oils, organic contaminants; potential soft ground.
Warehouse	2m East 180m Southwest	1938 1954-55	Recent 1990-92	Possible storage of chemicals or goods; risk of spills or residual contamination depending on former use.

NB. Arbitrary potential hazard assessment: High (Red), Moderate (Amber), Low (Yellow), Very Low (Green), Negligible (uncoloured)

A review of the historical OS maps has highlighted the land uses most likely to present (or have presented) a hazard or source of potentially harmful contamination to the study area. The primary features of interest comprise the former onsite buildings, the adjacent works, mills and warehouse, and the nearby collieries, all of which present potential sources of contamination or evidence historical coal mining activity within the surrounding area.

The unspecified ground works and Mill Pond/reservoir are unlikely to have had any lasting effect on the site and the remaining features presented are likely too distant to have meaningfully affected the site.

3.3 GroundSure Enviro + GeoInsight Reports

The GroundSure Enviro+Geo Insight Report presented in Appendix 2 provides listings of potentially contaminative, current and past land uses together with possible pathway and receptor information. It also covers other potential risks to the site including ground hazards associated with the area's natural geological setting and man-made hazards such as those arising from development activities. A summary of the relevant Report findings is presented in Table 2 below and on the following pages.

An arbitrary potential hazard assessment has been made as follows: potentially significant (yellow), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue.

Table 2: GroundSure Enviro+Geo Insight Summary:

Details	Feature	Location relative to site
Past land use		
Historical industrial land uses	Unspecified Mills (8) Unspecified Works Unspecified Ground Workings (14) Refuse Heap (3) Rope Walk Unspecified Commercial/Industrial (5) Unspecified Disused Quarry (8) Unspecified Quarry (7) Unspecified Heap (10) Unspecified Pit (15) Railway Sidings (26) Railway Station (8) Tunnel (13) Cuttings (13) Unspecified Old Shaft (3) Unspecified Mill (5) Railway Building (13) Goods Station Unspecified Foundry (4) Goods Sheds (5) Police Station (3) Colliery Fire Station Woollen Mills Dairy (3)	3.6m Northwest (closest) 42.6m North 52m East (closest) 55.8m North (closest) 91.9m North 112.9m Northwest (closest) 140.8m Northeast (closest) 159.2m North (closest) 167.4m East (closest) 190.1m Northwest (closest) 191.8m Southwest (closest) 220m Southwest (closest) 222.2m South (closest) 250.8m Southeast (closest) 301.9m South (closest) 314.5m South (closest) 357.2m South (closest) 358.3m South 359.9m Southwest (closest) 363.1m South (closest) 370.1m Southwest (closest) 380m South 396.1m Southwest 451.2m West 494m Southeast (closest)
Historical Tanks	Tanks (4) Unspecified Tank (7)	48m Northwest (closest) 142m West (closest)
Historical Energy Features	Electrical Substation (27)	276m Southeast (closest)
Historical garages	Garage (14)	277m West (closest)
Landfill and Other Waste Sites		
Historical landfill (EA/NRW records)	Inert, Commercial	305m West
Waste exemptions	Disposing of waste exemption Treating waste exemption (11)	43.1m Northeast 93.8m Southeast (closest)
Past land use		
Recent industrial land uses	H & P Lister C V M Ltd Works (4) Electricity Sub Station Ramsheet Metal S H Services Speight's of Dewsbury Wilsons Autocare Haigh Huddleston & Associates Caulms Wood Quarry (Disused) Pylon	6.6m Southeast 34.9m East (closest) 47.2m West 107m East 173.8m West 182.4m Southwest 191.1m Southwest 201.3m East 221.6m Northeast 246.4m North
National Geographic Database (NGD) - Current or recent tanks	Roofed Storage Tank	145m Northeast
Licensed pollutant release (Part A(2)/B)	Petrol Vapour Recovery; Unloading of Petrol into Storage at Service Stations Waste Oil Burner 0.4 MW	332m South 420m West
Licensed Discharges to controlled waters	Sewage Discharges (6)	284m Southwest (closest)
List 2 Dangerous Substances	Chromium, Copper, Zinc	425m Southwest
Pollution Incidents (EA/NRW)	Specific Waste Materials Atmospheric Pollutants and Effects (2)	248m East 389m South (closest)

Table 2 is continued on the following page

NB Arbitrary potential hazard assessment: potentially significant (yellow), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue.

Table 2 (ctd.): GroundSure Enviro+Geo Insight Summary:

Details	Feature	Location relative to site
Hydrogeology - Superficial aquifer		
Superficial aquifer	Secondary A (2)	284m Southwest (closest)
Bedrock aquifer	Secondary A (2)	On site (closest)
Groundwater vulnerability	Medium (2) High	On site (closest) 35m South
Groundwater Abstractions	Active (3) Historical (14)	736.5m South (closest) 736.5m South (closest)
Surface Water Abstractions	Historical (5) Active	808m Southwest (closest) 843m Southwest
Hydrology		
WFD Surface water body catchments	River WB catchment	On site
WFD Surface water bodies	River	279m Southwest
WFD Groundwater bodies	Aire & Calder Carb Limestone / Millstone Grit / Coal Measures.	On site
Surface water flooding		
Surface water flooding	Highest risk on site Highest risk within 50m	Negligible Negligible
Groundwater flooding		
Groundwater flooding	Highest risk on site Highest risk within 50m	Negligible Negligible
Environmental designations		
Local Nature Reserves (LNR)	Sparrow Wood	1734m South
Green Belt	South and West Yorkshire Green Belt (6)	42m North (closest)
Nitrate Vulnerable Zones	Spennet Beck from Source to River Calder NVZ	1454m West
Visual and cultural designations		
Listed Buildings	Former Eastborough Country School, Including Gatepiers, Gates And Railings	165m Southwest
Conservation Areas	Dewsbury Town Centre	241m Southwest
Agricultural and Habitat designations		
Agricultural Land Classification	Urban	On site
Priority Habitat Inventory	Deciduous woodland (14)	35m West (closest)
Open Mosaic Habitat	Sites verified as Open Mosaic Habitat. Mosaic habitats are brownfield sites that are identified under the UK Biodiversity Action Plan as a priority habitat due to the habitat variation within a single site, supporting an array of invertebrates.	164m East
Geology 1:10,000 scale		
Artificial and made ground (10k)	Worked Ground-Void (4) Made Ground-Artificial deposit (7) Infilled Ground-Artificial deposit (2)	12.2m North (closest) 87m North (closest) 187.9m North (closest)
Superficial geology (10k)	Alluvium-Clay, Sand And Gravel (2)	281m Southwest (closest)
Bedrock geology (10k)	PLCM Formation-Mudstone, siltstone and sandstone (7) Emley Rock-Sandstone (3) PMCM Formation-Mudstone, siltstone and sandstone (6) Birstall Rock-Sandstone (2) Thornhill Rock-Sandstone (3)	On site (closest) 54.9m Northwest 76.7m North (closest) 149.8m West (closest) 176.7m Southeast (closest)
Bedrock faults and other linear features (10k)	Fault, inferred, displacement unknown (2) Coal seam, inferred (13) Coal seam, observed	52m Northwest (closest) 57m Northwest (closest) 241m Southwest (closest)

Table 2 is continued on the following page

NB Arbitrary potential hazard assessment: potentially significant (yellow), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue.

Table 2 (ctd.): GroundSure Enviro+Geo Insight Summary:

Details	Feature	Location relative to site
Geology 1:50,000 scale		
Artificial and made ground (50k)	Made Ground-Artificial deposit (3) Infilled ground-Artificial deposit	92m North (closest) 315m South
Superficial geology (50k)	Alluvium Clay, silt, sand and gravel	284m Southwest
Bedrock geology (50k)	PLCM Formation-Mudstone, siltstone and sandstone (4) Emley Rock-Sandstone (3) PMCM Formation-Mudstone, siltstone and sandstone (3) Birstall Rock-Sandstone (2) Thornhill Rock-Sandstone (2)	On site (closest) 51.4m Northwest (closest) 71m North (closest) 149m West (closest) 177.4m Southeast (closest)
Bedrock permeability (50k)	Fracture (moderate to low) (2)	On site (closest)
Bedrock faults and other linear features (50k)	Fault, inferred, crossmark on downthrow side, throw in metres Coal seam, inferred (9)	48m Northwest 53m Northwest (closest)
Natural ground subsidence		
Shrink swell clays	Very low (2)	On site (closest)
Running sands	Negligible (2)	On site (closest)
Compressible deposits	Negligible (2)	On site (closest)
Collapsible deposits	Very low (2)	On site (closest)
Landslides	Low (2) Moderate Very Low	Onsite (closest) 5m North 23m Southwest
Ground dissolution of soluble rocks	Negligible (2)	Onsite (closest)
Mining, ground workings and natural cavities		
BritPits	Sandstone (7) Coal, Deep	118m South (closest) 367m Northwest
Surface ground workings	Unspecified Ground Workings (10) Refuse Heap (3) Pond (2) Reservoir (2) Ponds (3) Reservoirs (3) Unspecified Disused Quarry (7) Unspecified Quarry (7) Unspecified Heap (4) Unspecified Pit (5)	52m East (closest) 55.8m North (closest) 59.2m East (closest) 62.7m East (closest) 124.8m West (closest) 124.8m West (closest) 140.8m Northeast (closest) 159.2m North (closest) 167.4m East (closest) 190.1m Northwest (closest)
Underground workings	Tunnel (10) Unspecified Old Shaft Colliery Unspecified Old Shafts	222m Southwest (closest) 304m South 896m Southeast 994m Southeast
Coal mining	The site is located within a coal mining area as defined by the Coal Authority. A Consultants Coal Mining Report is recommended to further assess coal mining issues at the site.	On site
Radon Risk		
Radon Risk	Between 1%-3% No protection required	On site

NB Arbitrary potential hazard assessment: potentially significant (yellow), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue.

Table 2 (ctd.): GroundSure Enviro+Geo Insight Summary:

Details		Feature			Location relative to site	
Soil chemistry						
Location	Arsenic mg/kg	Lead mg/kg	Bioaccessible Lead mg/kg	Cadmium mg/kg	Chromium mg/kg	Nickel mg/kg
On site	25-35	100-200	60-120	1.8	90-120	15-30
35m South	25-35	100-200	60-120	1.8	60-90	15-30
Railway infrastructure and projects						
Historical railway and tunnel features		Railway (2) Railway Sidings (7) Tunnel (11)			188m Southwest (closest) 192m Southwest (closest) 222m Southwest (closest)	
Historical Railways		Razed (2) Historical OSM (2)			219m Southwest (closest) 222m Southwest (closest)	

NB Arbitrary potential hazard assessment: potentially significant (yellow), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue.

The GeoInsight report has highlighted the following additional potential risks to the site or the intended development arising due to historical or current land uses and the site's geological setting beyond those already discussed these include:

- The site is located within a coal mining area as defined by the Coal Authority (requiring compilation of a CMRA report).
- Presence of a landfill 53m distant from the site.
- Moderate risk of landslides only 5m north of the site.

3.4 Coal Mining Risk Assessment Report Summary

The CMRA report (see Appendix 3) states that:

- Three levels of past underground workings are recorded in the surrounding area; the shallowest workings occur within the Top Beeston Seam at around 178m depth to the north of the site. These workings are too deep and too distant to pose any surface stability risk.
- The site lies within an area of probable unrecorded shallow coal workings, defined by the CA as areas where unrecorded workings may exist at depths of less than 30m.
- The CA identify outcrop of the Flockton Thin Coal 32m southwest of the site. According to the CA this coal is workable. However contrary to the BGS geology map the CAs report and the extract of CA online interactive mapping provided in Appendix F indicate the Flockton Thin Coal horizon is present beneath the site and not the Flockton Thick in which case BGS log SE22SW/924 suggests workings in the Flockton Thin may be expected between depths of 10m to 15m below the development area. This however is speculation.
- The Coal Authority report identifies four mine entries within 100m of the site boundary. While in Geoinvestigates opinion these mine entries are too distant to impact surface ground stability in the development area however their proximity raising further concern about underground mining at this locality.
- The Coal Authority 'Summary of Findings' map also records an area of unlicensed opencast working to the southwest. Further research established this working relates to the construction of the Dewsbury Ring Road, with mine plan ref. 17097 identifying the coal recovered in this area as 'incidental coal' rather than deliberate opencast extraction.
- The CMRA indicates that conditions may exist at this site increasing mine gas risk namely the possible presence of shallow mine workings. However, the risk may be less as there has been no

reported mine gas incident at this locality and typically surface mine gas is rarely a problem on the UK coalfields.

- The CA reports 'Summary of findings' map shows two areas of previous site investigation. One at Eastborough Mills on the east of the development area obtained by means of Oldham Council's planning portal suggests there may be a shallow mining hazard beneath the Mills site requiring intrusive investigation.

In Geoinvestigate's opinion, the potential for unrecorded shallow workings beneath the site represents a significant ground stability risk, and intrusive rotary borehole investigation is required to confirm the presence or absence of shallow mine workings.

3.5 Walkover Survey Observations

A site reconnaissance visit was undertaken on the 15th May 2026 by Connor Daniel of Geoinvestigate.

The site comprises an irregularly shaped parcel of land extending to approximately 0.08 ha, located between existing residential properties to the west and commercial/industrial premises fronting Pepper Road to the east. Primary access is available from St Philip's Close/Battye Street at the southern boundary, with a secondary access point from Camroyd Street to the north.

At the time of the walkover survey, the site was observed to be extremely overgrown and largely inaccessible in places due to dense vegetation. Ground cover consists predominantly of tall vegetation, dense scrub, and overgrown grassland, with several mature trees concentrated toward the centre of the site. Vegetation density significantly restricts movement across the site and limits visibility in some areas. Evidence of fly-tipping and general waste deposition was also noted during the survey, including discarded mattresses and other miscellaneous refuse within the vegetated areas. The site is currently undeveloped, with no permanent structures or formal areas of hardstanding present within the boundary. Topographically, the land is generally level, with a slight fall in elevation from south to north. A masonry retaining wall is present along the northern boundary, retaining higher ground to the rear. The structure is heavily overgrown and its condition could not be fully assessed during the walkover. The presence of the wall indicates a change in ground level and possible made ground behind it.

The inspection of the surface of the site found no obvious evidence of physical hazards or odours, staining, or residues that might be indicative of the presence of chemical (including hydrocarbon) contamination. However, dense vegetation and restricted access across large parts of the site limited the extent of the visual assessment. Localised evidence of fly-tipping and general waste deposition was observed, although this is not considered indicative of widespread contamination. On the basis of the walkover inspection only, the risk of a serious contamination hazard occurring at this site would be assessed to be low given the current condition of the site, albeit with some uncertainty due to the limited visibility. The hazardous gas risk at the site, based solely on the findings of the walkover survey, would also be assessed to be low to moderate; this reflects the limited exposure of underlying ground conditions and the presence of a low masonry retaining wall along the northern boundary, which indicates a localised change in ground level and suggests that made ground may be present in this area.

It is noted however that despite the apparent lack of evidence of any contamination encountered during the visual inspection described above, any planning application is likely to require confirmation that no contamination is likely to have occurred. Photographs taken during the walkover survey are presented below and on the following page:



Photograph 1: Entrance to site from Camroyd Street to the north.



Photograph 2: Northern area of the site, showing a low masonry retaining wall along the boundary.



Photograph 3: View across the site looking north, showing dense overgrown vegetation and localised evidence of fly-tipping.

4. Qualitative Risk Assessment

4.1 Methodology

In order to assess the potential risks to the site, information obtained on the potential sources of hazard identified in Section 3 have been reviewed and applied to a model of the site. This allows an assessment of the potential sources of contamination to be made by examining the potential pollutant linkages between these and the receptors at the site.

The risk assessment presented comprises a source-pathway-receptor model developed in the context of the intended end use of the site (Residential use).

It is noted that an alternative land use would present different pollutant linkages with more or less vulnerable receptors and differing pathways for exposure. Were the intended land use to be changed at the site, a revised risk assessment would be required.

Identified potential sources of hazard or contamination, vulnerable receptors, and possible pathways by which they may be exposed are presented in the Conceptual Ground Hazard Model (CGHM) presented in Figure 1, see Section 4.2.

In addition to risks to human health and controlled waters and aquifers posed by contamination and ground gas, the CGHM examines the potential risks to the construction of the development including its buildings from geological or geotechnical hazards.

It allows an overall assessment to be made of the potential hazards and risks to the site and the proposed development with respect to “fitness for purpose”. Bedrock geology which is anticipated to underlie the site is assumed to exhibit potentially variable permeability and only limited superficial geology is expected.

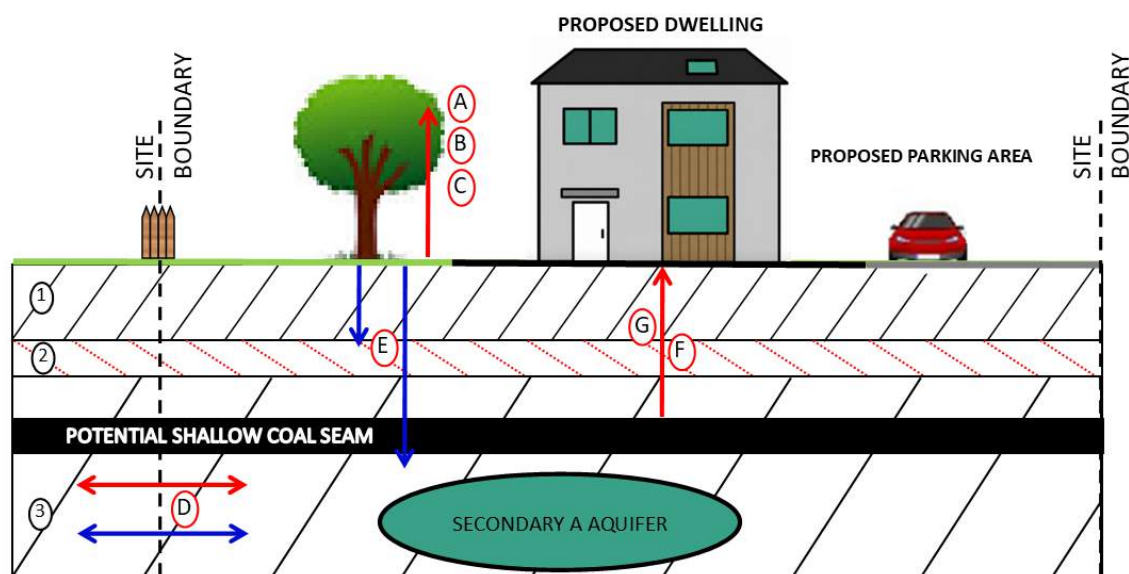
4.2 Risk Assessment

The desk study has highlighted the presence of possible sources of contamination which could potentially affect (or have affected) the site, primarily comprising the former on-site buildings, adjacent works, mills and warehouse, and the nearby collieries. Additional risk arises from the site’s position near to recent industrial land uses in the surrounding area.

Contamination from external sources would require a viable migration pathway into the site. The BGS mapping records no superficial deposits however nearby borehole records suggest that the superficial deposits will primarily comprise clay soils which would have intrinsically low permeability. As such, it is unlikely that a plausible pathway for contamination migration into or out of the site could exist and thus the risk of contamination migration is probably very low.

Potential receptors at the site would include the end users of the site (residents), workers employed in the construction of the new development, the buildings themselves and their services, plants and vegetation, neighbouring sites (and their users/occupants), nearby surface water and ground water at depth. A representation of the potential hazards and pollutant linkages is shown in Figure 1 overleaf.

Figure 1 – Conceptual Ground Hazard Model of site including a Source, Pathway and Receptor Model



- ① MADE GROUND OVERLAIN BY TOPSOIL
 ② SUPERFICIAL GEOLOGY—WEATHERED ROCKHEAD / CLAY DEPOSITS
 ③ BEDROCK GEOLOGY— PENNINE LOWER COAL MEASURES FORMATION

IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

- Possible presence of deep made ground and/or potential historical contamination of shallow soils by past land use both within and near to the site.
- Ground stability. Potential for shallow mining or intact coal beneath the site.
- Potential for made ground and shallow coal mining to generate ground gases.

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

- A—** End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard standing will encompass some of the site, removing any pathway to end users through direct contact in these areas.
- B—** Plants and Trees through uptake, possible given the intended end use of the site.
- C—** End Users through cultivation and consumption of vegetables / fruit. Possible given the intended end use of the site.
- D—** Neighbouring Sites through lateral migration (in soil and water, including surface water run off).
- E—** Ground water through leaching of sub-soil.
- F—** Buildings and services through direct contact. Buildings and hard standing will encompass some of the site, removing any pathway to end users through direct contact in these areas.
- G—** End users and buildings through ground gas migration. Buildings and hard standing will encompass some of the site, removing any pathway to end users through direct contact in these areas.

The CGHM and the summary table below (Table 3) present the most likely potential sources of contamination, gas or geotechnical risk that are considered to be possible either within or near to the study site.

The identified potential contamination sources could feasibly have given rise to harmful and potentially mobile contamination of made ground and/or natural deposits which might underlie the site.

Superficial deposits are anticipated to primarily comprise low permeability clay soils and so significant contamination migration into or out of the site is currently thought unlikely to be possible / have occurred.

Therefore, assuming the worst-case scenario, the potential for harmful contamination to exist at the site from historical sources is assessed to be moderate (as opposed to low or very low) owing to the potentially contaminative activities located near to and/or within the study area (primarily concerning the former on-site buildings, adjacent works, mills and warehouse, and the nearby collieries. Additional risk arises from the site's position near to recent industrial land uses in the surrounding area).

The hazardous gas risk is assessed to be Moderate due to the potential for unrecorded shallow coal mining and the potential for significant (>1.0m deep) made/infilled ground beneath the site.

The actual current level of risk to the development and its users can only be ascertained for certain through confirmation of the ground conditions by a Phase 2 intrusive investigation, including a contamination survey, a rotary probe drilling exercise to check for shallow mining, and potentially a gas monitoring survey.

Table 3: Summary of Conceptual Ground Hazard Model

Potential Source	Nature of Hazard	Associated Contaminants	Pathway	Receptor	Preliminary Risk Rating
Historical land use and development. Possible made ground.	Inorganic and organic chemical contaminants within soil.	-Trace metals -PAHs -Petroleum hydrocarbons -Asbestos -Pesticides -Pathogens (microbiology)	-Direct human contact -Ingestion of soil -Ingestion of dust -Inhalation of vapour -Leaching into ground or surface waters -Overground migration to external sites (soil and water)	-Site Operatives -End Users -Vegetation -Controlled waters -Structures and services -Neighbouring sites/users	Moderate
Possible made ground and shallow coal workings	Hazardous ground gas migration.	Landfill-type gases (CO ₂ , CH ₄ etc.)	-Inhalation -Explosion risk	-Site Operatives -End Users -Structures	Moderate
Local Geology	Radon gas migration	Radon gas	-Inhalation	-End Users	Very Low
Shallow coal mine workings	Ground instability via risk of settlement / collapse	N/A	Direct	-End Users -Structures	Moderate
Shrink-swell clays	Ground instability vegetation influence / heave	N/A	Direct	-End Users -Structures	Very Low
Infilled ground	Ground instability via risk of settlement	N/A	Direct	-End Users -Structures	Low to Moderate

NB. Arbitrary potential hazard assessment: High (Red), Moderate (Amber), Low (Yellow), Very Low (Green), Negligible (uncoloured)

5. Conclusions

A summary of the anticipated ground conditions, risks and implications based on the findings of Sections 3 and 4 of this report is presented in Table 4 below:

Table 4: Summary of Phase 1 Desk Study Findings

Concern	Desk Study Finding	Initial Risk Assessment	Potentially Useful Action in a Phase 2 Site Investigation
Normal Foundations	A potential for deeper made/infilled ground has been identified underlain by competent natural deposits at unknown depth.	Unclear	Borehole investigation to confirm strength of ground with regard to supporting building loads. Soil analysis might also be included to establish risk with regard to shrink-swell clay to rule out vegetation influence, or assess strength of any potentially weaker soils.
Soakaways	Sandstone/mudstone/siltstone bedrock unlikely to offer sufficient permeability with thin overlying clay deposits.	Unlikely to be suitable	Water infiltration testing to quantify permeability of superficial deposits if granular strata are encountered.
Radon Gas	Between 1% and 3% of properties affected	Very Low	None. No radon protection required.
Chemical Contamination	Historical nearby and on-site land uses potentially giving rise to a range of inorganic and organic contaminants including asbestos, metals/metalloids, PAHs and petroleum hydrocarbons.	Moderate	Chemical analysis for potential contaminants in soil samples (and potentially leachate). Samples should be recovered from made ground (if found) and topsoil, and also potentially underlying natural sub soils to check for potential leaching and/or migration into the site from possible external sources.
Hazardous Gas	Potential for hazardous gas to migrate from possible unrecorded coal mine workings. Potential for hazardous gas to be generated in made/infilled ground deposits.	Moderate	Ground gas monitoring wells in shallow boreholes to monitor CO ₂ , CH ₄ content etc.
Ground Instability/ subsidence	Potential for vegetation influence on shrink-swell clays which may be present, including risk of soil heave.	Very Low	Borehole investigation to confirm strength of both natural and made ground and shrinkage potential of any cohesive soils.
	Potential for significant deposits of compressible made/infilled ground.	Low to Moderate	
	Potential for unrecorded shallow coal mining.	Moderate	Rotary borehole investigation.

The initial risk assessment provided above is tentative as it is based only on the Phase 1 desk study. The risks will need to be reassessed and may perhaps change significantly becoming higher or lower depending on the results of the Phase 2 intrusive investigation and contamination/gas survey, should these be undertaken.

6 Recommendations

In light of the Phase 1 desk study findings, it is recommended that a Phase 2 investigation be undertaken at the site to better explore the possible risks that have been identified. This should include contamination analyses and ground gas monitoring together with a geotechnical appraisal of the site to establish correct foundation requirements. As there are relative uncertainties, this work is

recommended in order to establish the actual site conditions and to properly assess both geotechnical and environmental risks.

The Phase 2 investigation should be designed to focus on the potential contaminants highlighted in the CGHM (Figure 1 and Table 4). As there is a potential hazardous gas risk, a gas survey is recommended, as well as a shallow mining rotary borehole investigation.

Table 5: Proposed Phase 2 Site Investigation Specification

Action	Quantities	Justification/Details
Window Sampling Boreholes	Up to 5 boreholes. (up to 4-5m in depth – if achievable)	Establish actual ground conditions and confirm strength of ground. Retrieve samples of possible made ground and natural soils for geotechnical testing and contamination analysis. Potentially recover ground water samples if encountered. Installation of ground gas monitoring wells
Hand excavated trial pits	Up to 3 (up to 1m in depth – if achievable)	Further inspect condition and composition of soils and recover additional samples for contamination analyses, including in locations which may be difficult for plant to access.
Rotary Open Hole Boreholes	Up to 3 boreholes (up to 30m in depth).	Inspect for evidence of shallow coal mining such as voiding / broken ground. Water flush should be used to ensure safe drilling.
Chemical Contamination Analysis of Soils and Leachate (and possibly ground water if pertinent)	Up to 6 No. samples from topsoil and/or made ground at shallow depth (<1m) and potentially also deeper natural strata or made ground (if encountered).	Quantify risk posed to receptors identified in CGHM (see Figure 1) for revised risk assessment. Determinands should include a range of metals/metalloids, speciated PAH content, petroleum hydrocarbon content, BTEX, asbestos presence, and soil organic matter content (to aid in revised risk assessment).
Gas monitoring	Up to 6 No. visits over 3 months. Preferably including occasions of <1000mb and after sharp drop (may only be required in made ground encountered at site).	Quantify risk posed by potential hazardous gas from made/in-filled ground or shallow coal mining. Possible analysis of Total Organic Carbon (TOC) to support gas measure recommendations (or in the absence of gas monitoring data) using guidance published in CL:AIRE research bulletin RB17.
Geotechnical Testing	Up to 50+ No. Up to 5 No.	Moisture content determination to classify nature of soils. Atterberg Limit determinations to assess the shrinkage and swelling characteristics of the ground should clay soils be encountered.
Provision of Factual and Interpretive Report	N/A	Presentation of findings and implications including: • Site plan • Borehole and trial pit logs • Results of geotechnical testing • Contamination analysis results • Ground gas measurements (if appropriate) • Revised CGHM and chemical contamination risk assessment including appropriate soil assessment criteria. • Advice regarding any necessary remediation/validation • Advice regarding foundation design etc.

END OF REPORT