GROUNDSMITHS
GEOTECHNICAL ENGINEERS

LCRM: Stage 1 Risk Assessment & CMRA

BIRKLAND FARM, GILBERT HILL, LANGSETT

Project Ref: GUK-0625-03

For: Whitshaw Builders Ltd

SITE REFERENCE:

Birkland Farm, Gilbert Hill, Langsett

CLIENT:

Whitshaw Builders Ltd

PROJECT:

Residential Development

REPORT REFERENCE:

GUK-0625-03/Rp-001

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EXECUTIVE SUMMARY

This summary presents the salient points of the Report but should not be referred to in isolation of the body text. There will be other information contained within the Report which puts into context the findings of the Executive Summary. No reliance should therefore be placed on the Executive Summary until the Report has been read in full. The recommendations given are considered reasonable based on available information and the assessment of the Site as carried out by Groundsmiths (UK) Ltd at this time.

1 ENVIRONMENTAL CONSTRAINTS

Ground Investigation: A general environmental ground investigation is considered necessary given the current status and proposed end use of the development in relation to the identified levels of risk associated with the Site.

Biogenic Ground Gases: Risk from ground gas is currently anticipated based on the Site's environmental setting. A BS8485 Characteristic Situation 2 determination for the Site is therefore given at this time, but will need to be confirmed.

Radon: No radon precautions are indicated to be required in construction.

General Soil Contamination: A general check on contaminant levels should be undertaken within the remit of an intrusive ground investigation.

Asbestos in Soil: A general check on the presence of any asbestos containing materials should be undertaken within the remit of an intrusive ground investigation.

Remediation Requirements: If required, an LCRM Stage 3 Remedial Strategy incorporating current YALPAG and Sheffield City Council guidelines would need to be issued to address any soils and/or ground gas remediation requirements. Validation reporting would also be needed on a separate basis, once any remedial works had been completed.

Risk to Construction Workers: All works to be undertaken should be specifically assessed as part of a health and safety evaluation to mitigate the exposure of workers to any dusts and fibres as may be generated during development.

Controlled Waters Receptors: Risk from the off-site discharge of any leachable contaminants is considered to be very low. No further assessment is considered necessary.

Invasive Plants Species: Specialist assessment should be completed as required.

2 GEOTECHNICAL & GENERAL DEVELOPMENT CONSTRAINTS

Ground Investigation: A formal geotechnical assessment will need to be carried out to confirm the presence of any made ground materials, in addition to assessing the nature of the underlying natural strata to refusal given the potential for variation with spatial extent and depth.

Buried Concrete: Protection to buried concrete products will be required where they come into contact with soils that exhibit levels of sulphate above DS1, although final design parameters should be discussed with the Designing Engineer following completion of laboratory testing.

Anticipated Foundation Type & Ground Slab: To be confirmed following completion of ground investigation works and consultation with the Designing Engineer.

General Ground Stability: Global slope stability problems are not expected, although due consideration should always be given to how other off-site land could impact on the Site. The instability of loose and/or weathered strata should be anticipated, particularly during prolonged periods of wet weather, where any excavations are deep, or are left open for protracted periods of time. Where there is the possibility of weak/unstable ground being present or passing across any boundary, a geotechnical risk assessment of the integrity/stability should be undertaken prior to excavation works being carried out. Designed and engineered temporary or permanent works should be deployed to ensure their continued stability, as necessary.

Heave Precautions: To mitigate against heave, foundations would need to be constructed in accordance with current guidelines where they are found to lie within influencing distance of removed, existing, or proposed planting when in cohesive soils. The testing of soils would be required to determine this.

Excavation Obstructions: Existing foundations and other substructure would need to be grubbed-out accordingly.

Potable Water Supplies: Protection consistent with brownfield development (e.g. Protecta-Line) could potentially be required. This will need to be confirmed.

Surface Water Drainage: Should infiltration testing be required, this should be carried out in accordance with the method prescribed in BRE365. It should be noted, however, that the Site is underlain by soils that will likely have a low infiltration potential. Furthermore, it would not be appropriate for unstable, potentially unstable, or any contaminated soils to receive point-source flows of water from dedicated soakaways.

Pavement: The existing driveway onto Site is to be retained, but it is considered that the localised excavation and replacement of any unsuitable material with suitably compacted engineered fill will be needed for new areas of parking. Since the minimum permitted design CBR is 2.5%, it is recommended at this stage that this conservative value for subgrade be used. Frost susceptibility should be expected.

Archaeology: The need for archaeological monitoring has not been identified within the remit of this assessment.

3 MINING LEGACY CONSTRAINTS

The MRA indicates that the Site could potentially be at risk from shallow unrecorded coal mine workings at <30m depth.

The treatment of any shallow mining legacy would be required if they are found to present an unacceptable level of risk (instability) to the proposed development. Specific proposals to consolidate any such workings would need to be completed in accordance with current UK guidance.

All mining-related investigation and any treatment works to be completed would need to be undertaken in accordance with the MRA's permitting requirements.

1 INTRODUCTION

1.1 Appointment

Groundsmiths (UK) Ltd ('Groundsmiths') were appointed by Whitshaw Builders Ltd (the 'Client') to provide professional services in relation to the preliminary geotechnical and geo-environmental assessment of land at Birkland Farm, Gilbert Hill, Langsett (herein referred to as the 'Site').

Groundsmiths have prepared this report (the 'Report') for the sole use of the Client that commissioned it in accordance with the agreement under which our services are performed. No other warranty, expressed or implied, is made as to the professional advice included in this Report. Any unauthorised third parties using the information presented in this Report do so entirely at their own risk and are duly excluded from any warranty, duty of care, or skill.

No part of this Report shall be reproduced or redistributed without the prior written consent of Groundsmiths. However, the Report may be issued by the Client or their Agent to the Local Planning Authority (the 'LPA') to support the discharge of any pre-commencement or other such pre-occupancy planning condition as may be imposed in relation to the Site's redevelopment under the Town and Country Planning Act 1990.

1.2 Report Context and Status

It is understood that it is the Client's intention to redevelop the Site for residential end use, with this comprising a single dwelling with areas of soft landscaping, access, and parking within its curtilage. The aim of this Report, therefore, is to present a preliminary assessment of the geotechnical, mining legacy, and land contamination conditions thought likely to be encountered.

The assessment given herein follows a review of currently available published geological, hydrogeological, Mining Remediation Authority (the 'MRA'), and geo-environmental records, with works being completed in accordance with the general requirements of BS10175 [1], BS5930 [2], Land Contamination Risk Management ('LCRM') guidance [3], and MRA guidance [4].

Notwithstanding the provision of discourse on any geotechnical, coal mining, or general construction matters that apply, the assessment also includes for potential sources of historic ground contamination, its anticipated impact on sensitive receptors, and identifies where any further risk assessment or intrusive works are required to facilitate development within the framework of a generic residential with home-grown produce exposure scenario as defined by the Environment Agency [5].

Interpretation and recommendations given in this Report should not be assumed valid for adjacent areas of land, or for alternate land use. Should the proposed Site usage change, or significant other information come to light, the recommendations and conclusions presented in this Report may need to be re-assessed in accordance with current guidance.

1.3 Objectives

The primary objectives of this Report are to:

- Obtain current information from published sources with respect to any environmental designations, SSSI, visual and cultural designations, and agricultural and/or habitat designations as may exist on Site or within the immediate area of development;
- Obtain current information from published sources about the likely soil and groundwater conditions within the area of development;
- Identify and assess the potential for any ground related environmental hazards, including the potential for where any adverse ground gas regime may represent constraints to the proposed development;
- Identify and assess the potential for any ground related geotechnical hazards, including the potential for any ground instability arising from coal mining legacy;
- Define an up-to-date preliminary Conceptual Site Model ('CSM') of plausible source-pathway-receptor linkages and undertake a qualitative assessment to evaluate the level of risk associated with each linkage in accordance with the proposed development end use scenario;
- Outline preliminary development recommendations, and
- Provide advice on any additional stages of LCRM assessment that may need to be completed to satisfy the concerns of the regulatory authorities, this including Stage 1 generic or detailed quantitative risk assessment with ground investigation, Stage 2 options appraisal [6], and/or Stage 3 remedial actions [7].

1.4 Scope of Works

Further to the Site walkover, assessment undertaken within the context of this Report comprised a review of the following sources of publicly available data:

- British Geological Survey ('BGS') series geological mapsheets [8,9]
- British Geological Survey Onshore GeoIndex records database [10]
- Emapsite - Enviro+GeoInsight Data Report (Appendix A) [11]
- Emapsite - Historical Ordnance Survey ('OS') Plans (Appendix B) [12]
- Zetica UXO [13]
- Mining Remediation Authority Consultants Coal Mining Report (Appendix C) [14]

1.5 Previous Reports

Groundsmiths are not aware of any previous studies having been completed for the Site.

1.6 Limitations of Study

This appraisal has been undertaken subject to the limitations detailed in Section 9 and any other limitations stated specifically in the Report. Where further works are identified, these shall be undertaken as required within the framework of LCRM, the MRA's permitting Terms and Conditions, and in accordance with any other current UK regulation.

No intrusive ground investigation works have been completed as part of this assessment.

2 SITE SETTING

2.1 Details & Description

A general summary of the Site's setting is given in Table 2.1, below. This is based on current information and the Site walkover.

Table 2.1 - General Site Details

National Grid Reference	The National Grid Reference (NGR) for the Site is indicated to be 420857mE 400927mN.
Area of Development	The area of development is indicated to be 0.75ha.
Ground Elevations	General topographic data indicates that the Site lies broadly at 307-309m AOD.
General Site Features	For reference, a photographic record of the walkover is presented as Plates 1 to 32. Access to the Site is from Gilbert Hill in the east, with this leading along a track with dense vegetation on either side (Plates 1 and 2); on the southern side of the track is a paddock (Plates 3 to 6) that is currently leased to a local farmer for the grazing of cattle. At the end of the track is a collection of ramshackle buildings of blockwork and timber construction (Plates 7 to 11), which it is understood was the dwelling and general living-accommodation of the previous owner. These comprise an interconnected network of rooms (kitchen, bedrooms, living room…), some internal garaging (Plate 12), and former animal barn (Plates 13 to 15). Adjoining the buildings to their south are some old timber-framed and corrugated metal-clad barns that are used for hay storage and the keeping of cattle (Plates 16 to 19). On the Site's northern boundary are a row of ramshackle outbuildings (Plates 20 to 26) that were used for the keeping of small livestock and chickens etc; there's also a dog kennel and a car port present too. To the rear of the buildings is the former garden. This is a large flat area that was heavily vegetated (but recently cleared). Beyond this to the west is a rectangular-shaped area of dense tree planting (Plates 27 to 32).
Boundary Development and Adjacent Land Use	The Site is surrounded on all sides by open and undeveloped agricultural land.
Invasive Species	Specialist assessment to identify the presence of any invasive plant species should be completed as required.

2.2 Anticipated Geology & Hydrogeology

A summary of the salient geological data for the Site is given in Table 2.2, below and overleaf.

Table 2.2 - Published Geological Conditions

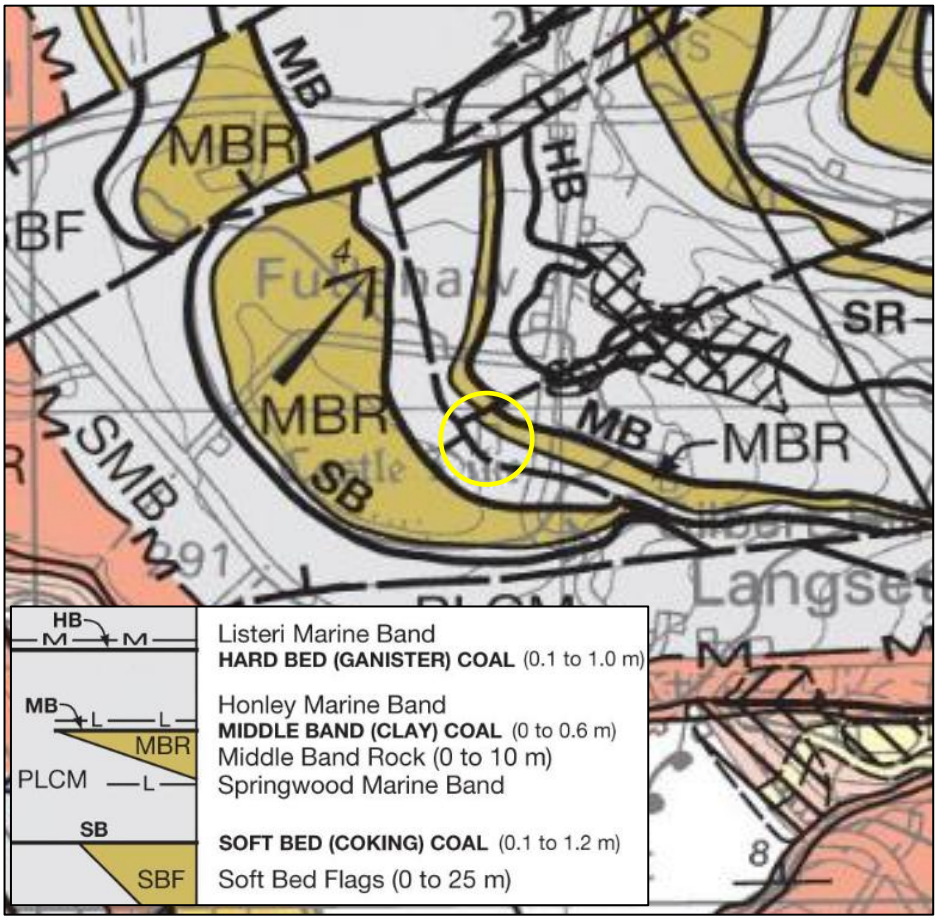
Radon	Third party data indicates that <1% of properties exceed the Radon Action Level in the area. No radon protective measures are indicated to be required in construction on this basis.
Superficial Geology	Data obtained from the BGS indicates that there are no superficial deposits present on-Site or within at least 500m.
Bedrock Geology	The solid geology underlying the Site is indicated to comprise deposits of the Pennine Lower Coal Measures ('PLCM'). These comprise a cyclic sequence of deposition consisting of interbedded horizons of mudstone, siltstone, and sandstone with numerous coal seams and their associated seatearths. Specifically, part of the driveway is mapped as being underlain by sandstone of the Middle Band Rock, whilst the remaining area is shown to be underlain by undifferentiated mudstone and siltstone. The dip of the bedrock is anticipated to be broadly between 4° and 5° towards the north-east, although some variation to this should be assumed.  Source: BGS Map Sheet 86. Barnsley (1:50,000 scale) (2012)</td>

Table Contd./

Bedrock Faults	There conjectured position of a normal geological fault is mapped across the western part of the Site. This trends north-west south-east and is downthrown on its south-eastern side.
Infilled or Made Ground Deposits	Records at the 1:10,000 and 1:50,000 scales indicate the nearest area of artificial deposit (infilled ground) to be located from 89m to the north-east, and for a former void to be present from 369m to the north-east.
Coal	See Section 3.
Hydrogeology	Aquifer within Superficial Deposits on Site: Not applicable. Aquifer within Bedrock on Site: Secondary A (formerly minor aquifers given their potential to support water supplies at a generally local scale). Source Protection Zones: There are no source protection zones within 500m. Source Protection Zones within Confined Aquifers: There are no source protection zones within confined aquifers within 500m. Groundwater Vulnerability Zones: The soil/surface leaching potential is classed as being high (>70% infiltration with >550mm/year dilution), whilst the vulnerability of the bedrock geology is also indicated to be high. Groundwater flow through the bedrock would be via secondary porosity. Groundwater Vulnerability – Soluble Rock Risk: No soluble rocks are identified as being present beneath the Site.
Hydrology	The nearest recorded (unnamed) surface water feature lies 235m to the south-east. The Site is indicated to lie within two Water Framework Directive Surface Water Body catchments, these being associated with: • Little Don from source to River Don (Ref. GB104027057460); • River Don from source to Scout Dyke (Ref. GB104027057500). Furthermore, the Site is indicated to lie within a Water Framework Directive Groundwater Body Catchment. Data provided by the Environment Agency [15] indicates that the groundwater body associated with the 'Don & Rother Millstone Grit & Coal Measures' achieved an overall classification of 'Poor' in 2019.

2.3 Designations

The Enviro+GeoInsight report provides details on property-specific environmental designations in addition to other potential actions associated with non-environmental search returns such as planning constraints. The following salient information is presented in Table 2.3, below and overleaf.

Table 2.3 - Published Designations & Other Potential Actions

SSSI	There are four statutory protection sites within 2km. These relate to the Dark Peak SSSI (961m south-west), the Little Don Stream Section SSSI (1.2km east), and the Spring Meadows/Alderman's Head & Cow Croft Meadows SSSI (1.2km and 1.7km east).

Table Contd./

Ramsar	There are no records relating to conserved wetland areas under the Convention of Wetlands of International Importance within 500m.
SAC	There are no records of Special Areas of Conservation having been designated under the EC Habitats Directive within 500m.
SPA	There are no records of sites having been classified by the UK Government under the EC Birds Directive within 500m.
NNR	There are no records relating to important natural or semi-natural terrestrial ecosystems within 500m.
Nature Reserves	There are no records relating to local nature reserves within 500m.
Designated Woodland	There are no recorded areas of ancient woodland within at least 1.5km.
Green Belt	The Site lies within Barnsley's South & West Yorkshire Green Belt.
Nitrate Sensitivity	There are no records relating to nitrate sensitive areas within 2km.
Nitrate Vulnerability Zones	There are no records relating to nitrate vulnerable zones within 2km.
Visual & Cultural Designations	There are no world heritage sites, areas of outstanding natural beauty, national parks, listed buildings, conservation areas, scheduled ancient monuments, or registered parks and gardens within at least 250m.
Habitat Networks	There are no indicated priority habitat inventory sites, habitat networks, open mosaic habitats, or limestone pavement orders within at least 250m.
Archaeology	The potential for below-ground archaeology has not been identified within the remit of this assessment.
UXO	Information obtained from Zetica (https://zeticauxo.com) suggests that the Site lies within a low risk zone from unexploded ordnance. Further detailed risk assessment is unlikely to be required.

2.4 Environmental Records

A summary of salient published environmental data is presented in Table 2.4, below and overleaf.

Table 2.4 - Published Environmental Data

Landfill	GroundSure data indicates the presence of an historic landfill (based on Environment Agency/Natural Resource Wales records) from 176m to the east. This is associated with the landfilling of non-biodegradable materials (inert, industrial, commercial, and sludge) at the former Hood Lands quarry site between 1983 and 1994. Operated by P.C. Hewitt; Licence Holder was Paul Beever Plant Hire Limited.

Table Contd./

Flooding	Assessment of risk against flooding events is not within the remit of this study, so specialist advice should be sought as required, with all necessary studies and reports being completed to obtain regulatory sign-off. River & Coastal Flooding: The Site is not indicated to lie within either Flood Zone 2 or Flood Zone 3. Surface Water & Groundwater Flooding: The highest risk from on-Site surface water flooding and groundwater flooding (and including that within 50m of the Site) is indicated to be negligible.
Potable, Surface, and Groundwater Abstractions	The nearest recorded active potable water abstraction point is indicated to be 650m to the south-east, with this being at Langsett Reservoir (Yorkshire Water Services Ltd). The nearest recorded active surface water abstraction point is indicated to be 650m to the south-east, with this being at Langsett Reservoir (Yorkshire Water Services Ltd). The nearest recorded active groundwater abstraction point is indicated to be 1.4km to the north-east, with this being for bottled water (Marsdens Developments Ltd at Liley Farm, Millhouse Green, Sheffield).
Public Register of Contaminated Land	There are no sites determined as being Contaminated Land under Part 2A of the Environmental Protection Act (1990).
Dangerous or Hazardous Sites	There are no COMAH recorded sites within at least 500m.
Radioactive Substances	There are no live radioactive substance authorisations within 500m.
Historical Fuel Sites	There are no records of any historic petrol stations within 500m.
Active Fuel Sites	There are no records of any active petrol stations within 500m.
Garages/Workshops	There are no records of any historic garages within 500m.
National Grid	There are no records relating to National Grid high pressure gas transmission pipelines or high voltage underground electricity transmission cables within 500m.
Mine Gases	Mine gas emission requiring action by the MRA is not anticipated. This does not preclude, however, the presence of any other biogenic gases (i.e. carbon dioxide and/or methane) that may be derived from other sources.
Hazardous Substance Storage/Use	There are no recorded consents for any site to hold hazardous substances at or above defined limits within at least 500m.
Pollutant Release to Surface Water	There are no recorded discharges within at least 500m.
List 1 Dangerous Substances	There are no recorded List 1 discharges within at least 500m.
Pollution Incidents	There are no recorded pollution incidents (EA/NRW) within at least 500m.

2.5 Site History

It is not the intention of this Report to reproduce or describe in detail all of the changes that may have occurred on, or within a radius of 250m to the Site, although a general review of available historical OS maps has been undertaken to identify any potentially contaminative former land-uses that may significantly impact upon the proposed development.

It should be noted that defined boundary on some of the maps may not fully align with the Site's position. Furthermore, some of the OS map editions may not be fully complete. It is possible, therefore, that additional land uses to those presented on the plans could have occurred in the past.

A general summary of the historical land use at the Site and within its surrounding area is presented in Table 2.5, below.

Table 2.5 - Principal Historical Ordnance Survey Features

Year	Principal On-Site Features	Principal Off-Site Features
1854-1891	The first edition OS plans dating back to 1854 show the Site to be open undeveloped farmland.	A small ganister pit is indicated to the north-east of the Site from about 160m on the 1854 OS plan (on the opposite side of Fullshaw Lane), whilst a coal pit and sandstone quarries are indicated to the south-east at the hairpin on Gilbert Hill (~230m). These appear to be disused by 1891. Additional ground working is mapped on the 1891 OS plan in fields adjacent to that where previous workings were recorded, and for these to be more extensive.
1893-1905	No development is shown within the boundaries to the Site and it remains as open field.	There's no new apparent working within 250m of the Site on the 1903-1905 OS plans; the ganister workings are now labelled as Bradshaw Ganister Works.
1931-1948		The ganister mine workings continue to expand into various other adjacent fields until they become disused c.1964-1967. The nearest they come to Site is ~250m to the east.
1951-1991		
2001-2025	It's not until the c.2001-2003 OS plans that on-Site development is mapped. At this time, the Site is indicated in its current layout (buildings, open areas, and woodland); it is understood that the previous owner used the Site as a smallholding to rear animals for their local butcher's business. No further changes are noted on the more recent 2010 and 2025 OS plans given their scaling.	The more recent OS plans from c.2001 show no further detail and no information regarding any land filling that may have occurred.

3 IDENTIFICATION AND ASSESSMENT OF SITE SPECIFIC COAL MINING & OTHER MINERAL WORKING RISKS

3.1 DHR or DLR?

The MRA [16] is a statutory consultee on planning applications for development within defined coal mining areas in England, Scotland, and Wales. They have specific statutory responsibilities associated with, for example, the licensing of coal mining operations, the handling of subsidence claims, providing information on coal mining, and in managing the environmental legacy of coal mining activities. The risk-based approach to development management adopted by the MRA [17], with respect to planning applications, is centred around two spatial areas. These are referred to as 'Development High Risk' and 'Development Low Risk' and are defined in the following way:

- **Development High Risk (DHR)** areas cover approximately 15% of the coalfield and refer to those areas where specific recorded coal mining legacy is present or suspected which poses a risk to public safety and/or ground stability (e.g. mine entries, shallow recorded or probable workings, coal opencast sites etc), and

- **Development Low Risk (DLR)** areas cover approximately 85% of the coalfield and refer to those areas where historic coal mining activity has taken place at sufficient depth that it poses only a low risk to new development.

Where built development lies within a low risk area, guidance indicates that there is no statutory requirement to submit a coal mining-related assessment to the LPA[1] as part of any planning submission. However, where such development lies within a high risk area, new construction proposals (notwithstanding any exemptions that may apply) are required to assess potential coal mining legacy issues. In these instances, assessment is prepared in accordance with the general requirements of preliminary risk assessment as defined by the MRA in order to:

- Determine the possible ground related hazards and risks associated with any historic coal mining legacy and other mineral workings, and

- Demonstrate to the LPA that the application Site is, or can be made, safe to meet the requirements of the National Planning Policy Framework (the 'NPPF') [18], notably Paragraphs 196 and 197 (Ground Conditions and Pollution), which states that planning policies and decisions (*with respect to mining legacy)* should ensure that:

  Para.196: a) *a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining,*

[1] NOTE: The LPA can request the submission of any information it considers necessary to inform the decision making process for a site and this could include a Coal Mining Risk Assessment, irrespective of whether the site lies within a low risk area. Other interested parties (e.g. Building Control and/or a third party Warranty provider) may also request that coal mining related information is provided.

and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

Para.196: c) *adequate site investigation information, prepared by a competent person, is available to inform assessments;*

Para.197: *Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.*

Based upon available information, Groundsmiths indicate that the Site lies within a defined coal mining reporting area and that it is DHR.

This determination is based upon MRA records, such as that presented on their interactive database, but also from other available information sources [19,20]. For the purposes of this assessment, the initial risk level is determined as being:

INITIAL RISK LEVEL DETERMINATION: MODERATE to HIGH

3.2 Consultants Coal Mining Report

Salient information provided by the MRA, as indicated in their appended report, may be summarised as follows:

- No past underground coal mining was recorded;
- Probable unrecorded shallow workings are indicated;
- There are no recorded shallow-depth spine roads;
- There are no recorded coal mine entries within at least 100m;
- No coal outcrops are recorded;

- There are no recorded on-Site geological faults, fissures, or breaklines;
- There are no records in relation to recorded coal mining subsidence;
- The accompanying large plot records unlicensed coal opencast workings associated with the ganister to the north-east;
- There are no records of mine water treatment schemes within 500m of the Site;
- There are records of mine gas remediation, and
- There are no records relating to any treatment/stabilisation works having been carried out within 50m.

3.3 Mineral Workings

There are no records relating to gypsum, tin, clay and/or ironstone mining in the area of development.

3.4 Mining Cavities

Fireclay workings are indicated at the former Bradshaw Mine, 78m to the north-east.

3.5 Natural Cavities

There are no records of any natural cavities within at least 500m.

3.6 Seams of Interest

The shallowest seams to underlie the Site given the broadly north-easterly dip of the bedrock strata are, in vertical succession, the Middle Band (Clay) Coal and the Soft Bed (Coking) Coal. General discussion about these is given below:

Middle Band (Clay) Coal

Based on information obtained from the BGS it is indicated that the shallowest seam to underlie the Site would be the Middle Band (Clay) Coal. Subject to its position being accurate, it would be anticipated to be encountered beneath the Site from around 2m bgl in the west and 13m bgl in the east; this is based on a dip rate of between 4 and 5°, general elevations of around 311m AOD at crop and 309m AOD at Site, and a distance of between 50m and 180m.

Records in the geological memoir for Barnsley are not particularly informative, but indicate that the seam lies within the measures between the Pot Clay Coal and the base of the Silkstone Coal. Exposures of the seam have been noted on both the northern and southern sides of the Little Don Valley, notably around Deepcar, but also further south at Oughtibridge. BGS data records it to be between 0.0m and 0.6m in thickness and for it typically overlie the Middle Band Rock (thin sandstone). In terms of composition, records suggest that the coal is often positioned between a couple of metres of shale and for there to be some black clay (fireclay?) beneath; the Honley Marine Band is present in the roof of the seam. No workings in the seam

are mentioned other than for where extraction occurred historically at Oughtibridge Hagg, although it is also known from other sources to have been worked beneath the fields off Broomfield Lane, Deepcar, across a wide area.

The memoir for Sheffield [21] provides summary information of the Coal Measures stratigraphy, and indicates the presence of various coals above the Pot Clay (these being the Coking, Clay, Ganister, Forty-Yards, Norton…) but concluded that all of them were "of small value". It also reports the presence of a number of important fireclays (e.g. that associated with the Middle Band Coal) and ganister (e.g. that associated with the overlying Hard Bed Coal), but provides no useful information that relates the Site's location.

Soft Bed (Coking) Coal (also known as the Halifax Soft in the South Yorkshire Coalfield)

The underlying Soft Bed (Coking) Coal has been seen to crop at various points on the southern side of the Little Don Valley and is estimated to lie at approximately 25m below the Middle Band (Clay) Coal on the basis of crop position, distance to Site, and dip rate; it has a reported variable thickness of between 0.1m to 1.2m and would be expected to lie beyond the zone of physical influence on this basis.

3.7 Mining Legacy & Legacy Risk

Mining legacy that could potentially impact upon the development has been assessed. These are summarised in Tables 3.1 and 3.2, below and overleaf:

Table 3.1 - Summary of Mining Legacy

Coal Mining Feature	Yes	No	Unknown	Comment
On-Site coal crop		x		None recorded by the MRA or BGS.
Recorded underground coal mine workings <30.0m bgl		x		None recorded by the MRA.
Recorded underground coal mine workings <30m bgl on adjacent land		x		None recorded by the MRA.
Probable unrecorded underground coal mine workings at <30.0m bgl	x			The MRA indicate the potential for there to be unrecorded shallow working.
Recorded underground ore mining at <30.0m bgl			x	None recorded in relation to the Site, although Fireclay associated with the Middle Band (Clay) Coal, which is the shallowest to underlie the Site, is known across the wider area.
Unrecorded underground ore mining at <30m bgl			x	
Mine entries (shafts and adits) on, or within 100m of the Site		x		None recorded by the MRA.

Table Contd./

Coal Mining Feature	Yes	No	Unknown	Comment
Recorded MRA mining surface (coal opencast) workings hazards		x		None recorded within influencing distance by the MRA.
Records of coal mining related subsidence		x		None recorded by the MRA.
Spontaneous combustion ('sponcom') of coal seams		x		None recorded.
Records of mine gas emissions requiring action by the MRA		x		None recorded.
Geological weakness		x		None recorded.
Remediation work to sites or mine entries		x		None recorded.

Table 3.2 - Qualitative Mining Risk Evaluation

Mining Feature	Risk Level	Comment
On-site coal crop	Very Low	No coal crop would be expected to be encountered on-Site given the indicated coal seam positions.
Recorded underground coal mine workings	Very Low	The MRA does not record the presence of any known historical working in the underlying seams. This refers to all recorded underground mining activity relative to the enquiry boundary that lie within 0.7x the depth of working (zone of likely physical influence).
Probable unrecorded underground coal mine workings at <30.0m bgl Recorded or probable underground ore mining at <30.0m bgl	Low to Moderate	The MRA have identified the potential for probable shallow unrecorded workings at a depth <30m bgl. Data provided on the interactive viewer defines an area associated with the Middle Band Coal and the older and underlying Soft Bed Coal. Although there are no obvious records of working in either of these beneath the Site, there remains the potential for extraction to have occurred, and notably in conjunction with any associated fireclay working; that commodity was historically more economically viable than the coals. It is considered that the potential for difficult ground conditions to be encountered is low to moderate, and that such risk should be confirmed through intrusive site investigation to be certain.
Recorded MRA mining surface hazards (opencast workings)	Very Low	There is no evidence to suggest that surface ground workings have occurred on-Site.
Coal mining related subsidence	Very Low	No subsidence claims within at least 50m of the Site are indicated to have been made.

Table Contd./

Mining Feature	Risk Level	Comment
Mine entries (shafts and adits) on, or within 100m of the Site	Very Low	There are no recorded mine entries within at least 100m of the Site. Although the potential for unrecorded mine entries to exist can never be completely ruled out, the likelihood of one being present on-Site is considered to be very low on the basis of available information.
Spontaneous combustion ('sponcom') of coal seams	Very Low	MRA records do not identify any of the underlying seams as being susceptible to sponcom.
Records of mine gas emissions requiring action by the MRA	Very Low	No record of mine gas emission is indicated by the MRA. This does not preclude, however, the need for measures to mitigate against any biogenic ground gases that could be derived from other sources.
Geological weakness	Low	There is the potential for some geological weakness to exist as the available geological plans record a normal fault line to pass through the western part of the Site. Such features are not often observed on sites during construction, however.

Based on the above information, the final risk level determination for the Site in relation to mining legacy is given as:

FINAL RISK LEVEL DETERMINATION: LOW to MODERATE

Based on the above information, and in accordance with current guidance [22], it is considered that any deep mining legacy would be of no particular concern to the proposed development. However, on the basis of available information at this time, the shallow nature of the Middle Band (Clay) Coal and any associated Fireclay presents a potential risk.

Although there is no evidence of historic working, and the likelihood of such working is considered to be broadly low, the condition of the coal and any other mineral reserve as may exist should be confirmed through a phase of investigation.

4 PRELIMINARY ENGINEERING APPRAISAL

4.1 Soils

Made Ground

The Site was agricultural fields prior to it being redeveloped with the infrastructure that currently exists there, and some field-area still remains within the boundary.

On the basis of available historical information and the ground conditions observed during the Site walkover, however, it is considered that made ground (i.e. that which is considered to be deleterious or of character that could be detrimental to Site end users) over and above that typically associated with a smallholding is unlikely to be encountered.

The presence of any made ground should be confirmed as part of a Site-wide investigation.

Natural Strata

No superficial deposits are indicated to be present on-Site or within the immediate vicinity. It is expected therefore that undifferentiated mudstone, siltstone, and sandstone of the Pennine Lower Coal Measures will be encountered from shallow depth.

As with most Coal Measures bedrock material, they would be expected to have weathered within their upper layers. Subject to the material type and degree of weathering that has occurred, therefore, it would be anticipated that the underlying natural strata could comprise firm becoming stiff or very stiff gravelly clays with lithorelicts of the original bedrock, thinly laminated and highly weathered siltstone and mudstone, and/or slightly clayey sand/gravel with cobbles before more 'intact' material is encountered.

The nature and strength profile of the underlying Coal Measures soils should be confirmed as part of a Site-wide investigation.

Groundwater

On the basis of available information, the Site's setting, and its indicated geology, significant shallow-depth groundwater would not be expected.

4.2 Landslip (Mass Movement Deposits)

In providing a preliminary assessment of risk associated with potential landslip, consultation was made with the data presented by GroundSure at the 1:10,000 and 1:50,000 scales.

Information presented in the report indicates that there are no records of mass movement deposits within 500m, whilst the hazard rating for slope instability (landslide potential) on-Site and within 50m is low to very low. The GroundSure data also indicates that there are no records of landslip permeability (i.e. the estimated rate of vertical movement of water from the ground surface through the unsaturated zone of any landslip deposit) within 50m.

4.3 Foundations

Although the specific foundation design for the proposed development lies outside the remit of this assessment, it is considered at this stage that various factors need to be taken into account and that further detailed ground investigation is required to provide the information from which informed decisions can be made.

Made Ground

Made ground soils are generally poor in nature, their compaction will be non-engineered, and general geotechnical instability (including, potentially, any cross-boundary instability) will exist within them. As with all non-engineered soils therefore, all made ground materials to be encountered would not be suitable founding stratum and a nil allowable bearing capacity value will need to be applied.

Natural Strata

The Site is mapped as being underlain by Coal Measures deposits that could likely exhibit variation in terms of consistency (where cohesive), strength, and thickness.

With respect to foundations, it is anticipated at this stage that traditional spread footings (e.g. trench fill) could be suitable for a dwelling of typical construction. In order to determine the most expedient foundation solution, the condition and bearing characteristics of the underlying natural soils will need to be confirmed through Site-wide ground investigation with in-situ testing and geotechnical laboratory analysis.

Once all ground investigation works have been completed, it would be advisable for a bearing capacity assessment to be completed by the Designing Engineer during the foundation design stage to ensure that the serviceability limit state of the proposed structure is not compromised in any way. This should also take account of the amount of total and/or differential settlement that could potentially occur. Furthermore, due consideration would need to be given to the chosen foundation solution and how that interacts with any shallow underground mining legacy, should that be found to exist.

4.4 Floor Slab

At this stage it is anticipated that the ground floor construction with by suspended, although the final decision will be dependent on the foundation solution to be adopted and having due consideration to the ground conditions. The proposed floor construction and the loadings that will need to be carried is outside the remit of this study and will need to be established in consultation with the Designing Engineer.

The allowance for the inclusion of ground gas precautions to Characteristic Situation 2 ('CS2') of BS8485 [23] for carbon dioxide and/or methane should be made at this time, until confirmed otherwise through Site-specific monitoring.

4.5 Heave Precautions

The combination of shrinkable soils and trees, hedgerows, and shrubs represent a potential hazard to foundations and supported structures due to the effects of volume change and ground movement.

All foundations would need to be provided in accordance with current heave precautionary guidelines [24] if they lie within the zone of influence of removed, existing, or proposed planting when in cohesive soils (which includes mudstone and siltstone). Information with respect to the plasticity indices and worst-case volume change potential of any proven or suspected cohesive soils will need to be obtained to assist with foundation design.

The need for any precautions in construction and how these interact with the foundation solution should be discussed further with the Designing Engineer once ground investigation and all necessary testing and laboratory analytical works have been completed.

4.6 Slope Stability

Global slope stability problems are not expected. However, due consideration to potential problems associated with adjacent land impacting on the Site should always be made.

4.7 Superstructure Precautions

The need for superstructure precautions (e.g. masonry reinforcement) is considered unlikely at this time, although this should be discussed further with the Designing Engineer once all ground investigation works, including that associated with mining legacy, and testing have been completed.

4.8 Excavation Stability

All excavation works should be carried out in accordance with current HSE guidance, 'Structural Stability During Excavation' [25].

Any made ground soils should be assumed to be unstable.

The instability of loose and/or weathered natural strata could be encountered in excavation, particularly during periods of wet weather, where excavations are deep, where they are left open for protracted periods of time, and/or where any shallow groundwater exists. Excavations may unduly widen if material collapse is encountered under these conditions.

Where there is the possibility of weak/unstable ground being present or passing across any boundary, a geotechnical risk assessment of the integrity/stability should be undertaken prior to excavation works being carried out. Designed and engineered temporary or permanent measures should be deployed to ensure their continued stability as necessary.

4.9 Natural Ground Subsidence

With respect to natural ground subsidence, the Site has been classified as follows:

- 'Low' risk rating for running sands, compressible deposits, and landslides hazards;
- 'Very Low' risk rating for shrink swell clay soils and collapsible deposits hazards, and a
- 'Negligible' risk rating for the ground dissolution of soluble rocks hazards.

4.10 Obstructions in Excavation

Although not thought likely to be significant at this time, there is the potential for some remnant foundations and shallow bedrock soils to be encountered in excavation. These could cause excavation problems for new foundations and/or where deep service connections (or perhaps soakaways) are required.

Excavation/breaking machinery of sufficient size and strength will need to be allowed for.

4.11 Concrete

It is anticipated that Design Sulphate Class DS1 and Design Chemical Class AC1s conditions would likely apply, although protection would be needed in accordance with current guidance [26,27] should new buried concrete products be found to be in contact with soils that exhibit elevated concentrations of sulphate. Specialist advice should be sought as required to confirm the ACEC and Design Chemical class of concrete to be adopted.

4.12 Stress Relief

Risk associated with stress relief is considered to be low.

4.13 Pavement

The existing driveway onto Site is to be retained, but it is considered that the localised excavation and replacement of any unsuitable material with suitably compacted engineered fill will be needed for new areas of parking. Since the minimum permitted design CBR is 2.5%, it is recommended at this stage that this conservative value for subgrade be used. Frost susceptibility should be expected.

4.14 Site Drainage

The drainage solution to be adopted is unknown at this time and should be explored with a competent drainage engineer. All drainage proposals will be subject to obtaining the necessary approvals. Should infiltration testing be required, this should be carried out in accordance with the method prescribed in BRE365 [28]. It should be noted, however, that it would not be appropriate for unstable, potentially unstable, or any contaminated soils to receive point-source flows of water from dedicated soakaways.

All soakaways in development would need to be 5m or more from foundations and highway.

5 PRELIMINARY ENVIRONMENTAL APPRAISAL

5.1 Introduction

Current UK legislation on contaminated land is set out in Part 2A of the Environmental Protection Act 1990 [29], which was retrospectively inserted by Section 57 of the Environment Act 1995 [30]. The Contaminated Land Regulations 2000 [31] were amended in 2005. The Environmental Protection Act 1990: Part 2A Contaminated Land, Statutory Guidance, Edition 2 (2006) promulgates the revised statutory guidance with respect to the operation of the Contaminated Land Regime following the implementation of the Contaminated Land Regulations, 2005. The definition of contaminated land is central to the operation of Part 2A.

Legislation adopts the principle of a 'suitable for use' approach for the assessment of contaminated land, the rationale being reflected in the site-specific risk assessment and determination of remedial strategy; action is only required if unacceptable risks are posed to human health or to the environment, considering the site's land use and geo-environmental setting.

The legislation places a responsibility on the LPA to determine whether the land under its jurisdiction is contaminated by consideration of whether:

- The presence of substances (potential contaminants) are present at concentrations that are causing significant harm or have the significant possibility of causing significant harm;
- There are receptors which may be harmed (e.g. the water environment, human health, buildings, fauna and flora), and
- There is in existence a pathway between the identified sources and receptors.

To qualitatively assess the level of risk at the Site, the above rationale has been applied. This approach is consistent with the preliminary risk assessment procedure defined in LCRM. The following section summarises the preliminary CSM which has been produced following the review of available pertinent third party information. The CSM summarises Groundsmiths' current understanding of the surface and sub-surface features, potential sources of contamination, likely transport pathways, and the receptors, in order to support the identification and assessment of plausible potential contaminant linkages.

5.2 Potential Sources of Contamination

A potential source is defined as 'a contaminant which is in, or under the land and has the potential to cause harm to human health or to cause contamination of controlled waters receptors'.

In reviewing the Site's history it is evident that it has had very limited use and undergone no industrialisation. OS mapping indicates that it was open farmland, since at least the first edition plans, and that the only development to have occurred relates to that which remains to date; this comprises a ramshackle collection of barns and outbuildings, with some of those modified for use as living accommodation by the previous owner. Mapping also indicates that the land surrounding the Site, and that across the wider area, has been and principally remains under agricultural end use, although it is noted that a ganister mine was once located to the north-east beyond the main through road. This, it is understood, was infilled under licence with non-

biodegradable materials (inert, industrial, commercial, and sludge wastes) between 1983 and 1994. Furthermore, potential risk from shallow underground coal and clay mining has been identified, which needs to be confirmed.

From a contaminative perspective, and on the basis of the walkover, it was evident that the buildings (other than the living space) had been for livestock and general farm materials storage; there was no evidence to suggest the presence of fuels, oils, or pesticides, and there was no evidence of contamination (staining, spillage…) caused by such substances, or drums/containers associated with such substances. Furthermore, the open areas to the Site remain either as undeveloped grass land (for cattle to graze), garden curtilage, and the planted woodland to the west.

With the above in mind, the resultant and potentially active source-pathway-receptor linkages that have been considered in relation to the Site are summarised in Table 5.1, below.

Table 5.1 - Summary of Potential Sources and Contaminants

Potential Sources	Potential Contaminants (not limited to)
Currently unforeseen contaminated made ground deposits and/or near surface underlying natural strata within the developed parts of the Site	Metals, metalloids, inorganic contaminants, phytotoxic contaminants, sulphate, PAHs (e.g. Benzo(a)pyrene), TPHCWG, Monoaromatics (BTEX), VOC and SVOC, and asbestos
On-Site sources of ground gas (e.g. any shallow underground coal/fireclay workings)	CO_2 and CH_4
Off-site sources of ground gas (e.g. infilled ganister mine workings)	

5.3 Potential Migration Pathways

Migration pathways are routes by which contaminant sources may come into contact with receptors. Potential pathways for different types of contaminants vary depending on the properties of the contaminant, the mechanism of its release and the nature of the receptor.

The principal potential contaminant pathways by which receptors might become exposed to potential contamination at the Site are summarised as follows in Table 5.2, overleaf.

Table 5.2 - Summary of Plausible Pathways

Potential Sources	Pathways
Currently unforeseen contaminated made ground deposits and/or near surface underlying natural strata within the developed parts of the Site	Direct ingestion, dermal contact, dust, fibres, and/or vapour inhalation
	Direct ingestion and/or dermal contact with liquid contaminants
	Leaching and direct contact with potable water supply pipes
	Leachable contaminants via surface run-off, vertical and lateral migration via any permeable strata with the potential to impact controlled waters receptors
	Soft landscaping in development
Sources of ground gas (identified as being associated with any shallow underground mining legacy and/or off-Site infilled ganister mine workings)	Migration of gases and/or accumulation in void spaces via transport through service conduit, any permeable made ground and/or any permeable layers and horizons within the underlying natural strata

5.4 Potential Receptors

A receptor is the potential target of the source contaminant, to which either significant harm or deterioration in quality may be caused. The potential sensitive receptors with respect to the potential contamination hazards identified above are considered in Table 5.3, below.

Table 5.3 - Summary of Potential Receptors

Potential Receptor	Comment
Human Health	Site end-users in the residential with home-grown produce end use scenario Site operatives (during construction phase only) Future workers involved with any in-ground maintenance works
Construction	Potable water supply pipes Foundations and service conduit
Controlled Waters	'Secondary A' aquifer soils

5.5 Environmental Risk Assessment

Risk assessment and the procedure of identifying sources, pathways and receptors is recognised as an approach to determine the extent and significance of contamination either within the context of Part 2A (when assessing current site status or when considering the acquisition of an existing development) or the planning process (for the redevelopment of an existing site, or

when considering the acquisition of a site for redevelopment purposes). Either way, the 'suitable for use' approach is adopted when assessing risk and the source-pathway-receptor assessment defines the conceptual model for the site.

The statutory guidance describes a risk assessment methodology in terms of 'significant contaminants' and 'contaminant linkages', using the 'source-pathway-receptor' scenarios for the site. Contaminant linkages are formed when there is a linkage between a contaminant source and a receptor by means of a pathway. The existence of a contaminant linkage is dependent on site use, as well as environmental conditions. If no contaminant linkages can be proven, then the risks may be discounted. However, it is not to say that remediation is required if contamination is proven. The identified potential contaminants and receptors have been considered in relation to the pathways that may link them. The risk classification has been estimated in accordance with those methods prescribed in CIRIA C552 [32]. Risk is regarded as a combination of the likelihood of an 'event' occurring and its severity: both elements must be considered when assessing risk. The method for risk assessment, or evaluation, is purely qualitative. As defined in CIRIA C552, the magnitude of the potential 'severity' of risk occurring may be assessed against:

- **Severe (acute)**: short term risk to human health likely to result in significant harm as defined under Environmental Protection Act 1990, Part 2A. Short term risk of pollution to sensitive water receptor (may result in death).
- **Medium (chronic)**: long term risk and significant harm to human health, contamination of sensitive water resource or significant change to an ecosystem or specific organism (may result in death).
- **Mild (chronic, but applicable to less sensitive receptors)**: contamination of non-sensitive water resource but significant damage to crops, buildings, structures and services or the environment.
- **Minor (not significant)**: harm, which may result in financial loss, or expenditure to resolve. Non-permanent effects to human health. Easily repairable effects of damage to buildings, structures, and services.

Similarly, the classification of the magnitude of the 'probability' of the risk occurring may be assessed against:

- **High Likelihood**: a contaminant linkage exists and an event appears very likely in the short term, or almost inevitable in the long term, or contamination is causing harm at the receptor. Urgent action is required.
- **Likely**: a contaminant linkage exists and it is probable that an event will occur. An event may not occur, but it is possible in the short term and likely over the long term.
- **Low Likelihood**: a contaminant linkage exists and it is possible that an event will occur. It is not certain that an event will occur over time, but it is less likely in the short term.
- **Unlikely**: a contaminant linkage exists but it is not possible to say if an event will occur even over a very long time.

Following completion of the severity and probability assessment, classifications can be compared to indicate the actual risk each contaminant linkage presents: this can only be undertaken where there is a possibility of there being an active linkage. The risk categories

which can be assigned are presented in Table 5.4, overleaf, and range between 'very high' to 'very low' (NB - it is not possible to classify an identified risk as 'no-risk').

Table 5.4 - Risk Categorisation

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Highly Likely**	Very High	High	Moderate	Moderate / Low
	Likely	High	Moderate	Moderate / Low	Low
	Low Likelihood	Moderate	Moderate / Low	Low	Very Low
	Unlikely	Moderate / Low	Low	Very Low	Very Low

Source: Table 6.5, C552 (2001).

- **Very High** – there is a high probability that severe harm could arise or that severe harm is occurring. Urgent investigation and remediation are likely to be required.
- **High** – harm is likely to occur, and that urgent investigation and remediation may be needed in the short term, but are likely over the longer term.
- **Moderate** – harm could occur. It is unlikely to be severe, most probably relatively mild. Investigation is normally required to clarify the risk with some remedial works being required in the longer term.
- **Low** – it is possible that harm could occur, but if it did, at worst it would be mild.
- **Very Low** – low possibility of harm arising, and that if it does it is not likely to be severe.

The identified potential contaminants and receptors have been considered in relation to the potential pathways that may link them. The resulting contaminant linkages are presented in Table 5.5, overleaf.

Table 5.5 - Summary of Environmental Risk (Current Site Condition without Mitigation)

Potential Sources	Potential Receptors	Plausible Pathways	Probability	Severity	Risk Rating	Comment
Currently unforeseen contaminated made ground deposits and/or near surface underlying natural strata	Human Health Site end-users, inc. maintenance and site workers (short term risk during redevelopment)	Direct ingestion, dermal contact with contaminated soil or inhalation of dust and/or vapour (Site end user)	Low Likelihood	Mild	Low	A low to very low risk is anticipated with respect to contamination within the underlying soils for Site end users and construction/other in-ground workers on the basis of the Site's status, its history, potential sources of contamination, and environmental setting. A general check on contaminant levels should however be made within the remit of a ground investigation. For asbestos, the level of risk is based to some extent on the severity rating of the contaminant and the risk profile that can be assigned at this time. A general check on the presence of any such contamination should however be made within the remit of a ground investigation.
		Inhalation of asbestos fibres in any made ground soils (Site end user)	Unlikely	Severe	Moderate / Low	
		Direct ingestion, dermal contact with contaminated soil or inhalation of dust and/or vapour (In-ground worker)	Low Likelihood	Mild	Low	
		Inhalation of asbestos fibres in any made ground soils (In-ground worker)	Unlikely	Severe	Moderate / Low	
		Direct ingestion and/or dermal contact with liquid contaminants (Site end user / In-ground worker)	Unlikely	Mild	Very Low	
	Potable Water Supply Pipes	Direct contact/leaching (tainting)	Low Likelihood	Mild	Low	Although a low risk, the need for precautions in construction (e.g. Protecta-Line) will need to be confirmed.
	Vegetation	Uptake via root system in soft landscaping	Unlikely	Mild	Very Low	The need for soils capping in soft landscaping is considered a very low risk, but will need to be confirmed.
	Foundations	Direct contact/leaching	Low Likelihood	Mild	Low	Although a low risk, the need for sulphate precautions for new buried concrete products will need to be confirmed.

Table Contd./

Potential Sources	Potential Receptors	Plausible Pathways	Probability	Severity	Risk Rating	Comment
Currently unforeseen contaminated made ground deposits and/or near surface underlying natural strata	Controlled Waters	Vertical and/or lateral migration to underlying aquifer and/or River Hipper	Unlikely	Mild	Very Low	Risk of contaminant migration to controlled waters receptors is considered to be very low given the Site's setting and underlying geology. No further assessment is considered necessary on the basis of available information.
On-Site sources of ground gas (shallow coal/clay mine workings)	Site End Users	Inhalation (via ingress and accumulation into buildings)	Low Likelihood	Mild	Low	The allowance for BS8485 Characteristic Situation 2 precautions in construction should be made until the Site's gassing regime has been confirmed.
Off-site sources of ground gas (e.g. infilled ganister mine workings)			Unlikely	Mild	Very Low	

General Soil Contaminants

It is anticipated, on the basis of available information and the preliminary risk assessment presented herein, that the on-Site soils will present an overall low to very low risk to human health in relation to the potential for elevated concentrations of inorganic and organic contaminants of concern to be present at levels above residential with home-grown produce GAC threshold values (these being DEFRA's Category 4 Screening Levels [33], the LQM/CIEH Human Health Values [34] and/or other in-house derived GAC's calculated by Groundsmiths for organic contaminants [35].

It is evident that the Site has had limited use; initially being part of the wider network of agricultural fields, which remain, and then as a smallholding for the rearing of livestock for the previous owner's butchery business. The walkover didn't identify any obvious areas of visual or olfactory contamination, although it is considered that a general check on contaminant levels should be made so that a full and proper assessment of the source-pathway-receptor linkages can be made.

Asbestos Containing Materials (ACM)

Qualitative risk modelling prescribes a perceived moderate to low risk in relation to the potential for asbestos fibres to be present within the underlying soils, although the level of risk presented is mostly driven by the severity of the contaminant and the framework in which risk can be assessed at this time.

The Site's history suggests that it would be unlikely for asbestos fibres to be present within the underlying soils, and it's considered reasonable to assume at this time that asbestos does not present any particular risk to Site-end users. The overall level of risk may very well be very low, although this should be confirmed as part of a general ground investigation.

Unforeseen Soil Contamination

As with any development site, there is the potential for contamination to be present that has not been identified at this stage. This is unavoidable, so allowance for additional investigation and assessment should be made as required.

If any currently unforeseen contamination was identified during development, a representative level of supplementary sampling and testing with risk assessment would be required, with appropriate remediation being undertaken subject to the outcome of the works. Consultation with the LPA would be required at that time.

Ground Gases

Risk from ground gases has been identified with two potential sources: any shallow underground mining legacy; and the infilled former ganister mine. The level of perceived risk associated with each of these is currently determined at this time as being low for the on-Site source, and very low for the off-Site source. The levels of risk are determined to some extent by the consequence (severity) of the contaminants that can be applied at this time, although it is possible that concentrations of carbon dioxide and/or methane could be lower than currently anticipated. Until monitoring is completed, neither of the identified sources should be

discounted. It is acknowledged, however, that the likelihood of any ground gas having migrated onto Site is more probably very low and therefore much less probable than gases that could be derived from any on-Site soils given that the Coal Measures bedrock deposits are broadly cohesive and flow-limiting in nature.

Notwithstanding this, ground gas concentrations will need to be checked via a relevant period of monitoring, with this being in accordance with BS8485. The need for any remedial measures to be implemented in construction will be dependent on the outcome of those works. Allowance for Characteristic Situation 2 precautions in construction should be made until confirmed otherwise.

Controlled Waters Receptors

A very low risk is anticipated in relation to the potential for any mobile contaminants of concern to enter into controlled waters receptors on the basis of the Site's history, contaminative potential, and underlying geology. No further assessment is considered necessary.

Potable Water

Water providers are required to maintain the safety of staff, contractors, and customers. On this basis, water providers work with a range of trigger values when laying mains pipes or services in contaminated ground, in the same way that assessment is made by contaminated land practitioners.

Testing in general accordance with UK Water Industry Research ('UKWIR') [36] published guidance should be completed so that informed decisions may be made about the potable water supply pipework to be used in development. It is recommended that this testing includes for corrosiveness (electrical conductivity and redox potential). Protection consistent with brownfield development (e.g. Protecta-Line) is unlikely to be required, but should be allowed for until confirmed otherwise.

Soils Disposal (Waste Acceptance Criteria)

Where any arisings are generated during redevelopment works, and they are intended for disposal to landfill, there is a requirement to determine if they would be classified as inert, non-hazardous or hazardous.

Technical Guidance WM3 [37], which was introduced on the 1st July 2015 and is adapted from the third edition of Technical Guidance WM2[2], sets out the requirement for classification. The classification assesses the composition of the material and determines the concentrations of hazardous substances within it, in relation to particular thresholds.

[2] Environment Agency (2011). Technical Guidance (WM2). Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Waste (2nd Edition, Version 2.3).

Given that it is a statutory requirement to ensure that wastes are characterised to meet specific acceptance criteria if disposal to landfill is to be undertaken, Waste Acceptance Criteria (WAC) testing would need to be completed in parallel with standard soils analysis. This testing would need to be undertaken on representative samples of any soils that are to be disposed of (e.g. from foundation excavations), prior to being removed from Site.

6 FURTHER WORKS

6.1 Introduction

The overall objective of this preliminary assessment was to contribute towards the understanding of the ground conditions underlying the proposed development site located at Birkland Farm, Langsett, Sheffield. Research into the history and evolution of the Site up to the present day has been undertaken, which allows a fair assessment of the risks posed to development to be made at this stage.

It is considered that the study has provided sufficient background data in terms of the historical land use to the Site and its surroundings, together with details of the general geology, hydrogeology, mining legacy, and anticipated sources of soil and ground gas contamination.

The preliminary environmental risk assessment, when considered within the context of proposed end-use, indicates that some potential contaminant linkages may present an unacceptable level of risk to human health and the built-environment in relation to the identified source-pathway-receptor linkages for the Site. On this basis, it is considered that further works are warranted prior to the Site's redevelopment so that Site-specific data can be obtained.

6.2 Objectives of Investigation

In relation to the proposed development, the objectives of an intrusive (geotechnical and environmental) ground investigation would be to:

a. Investigate further the general nature and thickness of any made ground and the depth to, condition, and nature of the underlying natural strata;

b. Determine the geotechnical parameters of the underlying natural strata via in situ testing and laboratory based analysis, as required;

c. Report the presence of any in-ground obstructions and/or other such difficulties encountered during the works;

d. Investigate the shallow-depth hydrogeological regime beneath the Site;

e. Confirm the general presence of any underlying shallow coal and/or fireclay to a terminal depth of 30m bgl and any shallow workings that may exist within it;

f. Identify the nature and concentration of any contamination within individual soil matrices as encountered across the Site, including sulphate analysis to assist with buried concrete design, and undertake Waste Acceptance Criteria testing for soils disposal purposes;

g. Investigate the general level of risk associated with any fugitive ground gases, and

h. Provide general advice in relation to any environmental or geotechnical issues associated with the Site and/or any other recommendations needed to facilitate the

proposed development, including, where necessary, identifying any additional phases of investigation, assessment, or remediation that may need to be carried out.

6.3 Proposed Methods of Investigation

It is recommended that the following works given in Table 6.1, below, be completed. The positioning of exploratory locations would be subject to any access constraints and the presence of any underground utilities which would need to be confirmed beforehand.

Table 6.1 - Phase 2 Investigation Recommendations

	Anticipated Scope	**Likely Investigation Method**	**Potential Contaminants of Concern**
Environmental Investigation (not limited to)			
1	Determine overall soil types and general contaminant levels (including sulphates for substructure concrete design) within the on-Site soils	Mechanical excavation and/or boring with sample recovery for environmental testing	A range of metals / metalloids, general inorganics, TPH, BTEX, PAH, Volatiles, and asbestos
2	WAC testing for any waste soils disposal that is to be undertaken		Full WAC Single Stage
3	Ground gas monitoring by 6 No. bi-weekly return visits	Mechanical boring with piezometer installation	CO_2, CH_4
Geotechnical Investigation (not limited to)			
4	Investigation into the thickness and strength profile of the underlying soils through in-situ testing	Mechanical excavation and/or boring (with sample recovery as required)	-
5	Determination of plasticity indices (i.e. Atterberg, Water Content etc) for cohesive soils and any other associated works required to facilitate development	Geotechnical laboratory testing	-
6	Assess the potential for any shallow mining legacy to 30m bgl and any working that it contains	Rotary openhole boring	-

6.4 Testing

Geotechnical

With respect to geotechnical works, the nature, thickness, and integrity of any on-Site made ground soils should be investigated. Similarly, the nature of the underlying natural strata would

need to be confirmed. Representative soil samples should be taken for a suite of geotechnical laboratory testing, with in situ strength testing (e.g. SPT) also being undertaken throughout the vertical soils profile to refusal (e.g. SPT N = 50) at selected but relevant positions across the Site so that bearing capacities and the depth to competent strata for foundation design may be established for the dwelling to be built.

These works will need to be undertaken in general accordance with the requirements of BS5930, BS10175, BS EN 1997-1 [38] and BS EN 1997-2 [39]. All works will need to be logged on-site by a competent engineer, with standard strata descriptions of the soils encountered being in general compliance with BS EN ISO 14688-1 [40], BS EN ISO 14688-2 [41] and BS EN ISO 14689 [42].

Mining Legacy

Given the potential risk to development from ground instability associated with probable unrecorded shallow working, it is considered necessary to confirm the presence, or not, of the Middle Band (Clay) Coal and any associated fireclay; this information would be supplementary to the need to assess general ground conditions. On this basis, it is proposed that the following mining legacy investigation should be completed:

i. Undertake drilling to a terminal depth of 30.0m bgl by rotary openhole methods across the Site area in general at up to 6 No. positions. The MRA's standard permit application procedure would apply. Where borehole positions are proposed within 50m of occupied premises these will need to be advanced by water flush to be in line with Health & Safety Executive guidelines to mitigate the potential for carbon monoxide displacement. Water flush drilling will also mitigate risk associated with the potential for spontaneous combustion, although this is considered to be a very low risk, and

ii. Whilst the MRA data does not indicate the presence of any mine gas that has required remedial measures be introduced within a distance of 500m, they do not preclude the potential for other mitigation measures that may be required to protect future Site end users from the ingress and accumulation of general biogenic ground gas (e.g. carbon dioxide and/or methane). On this basis, a phase of monitoring in accordance with current guidance will need to be completed so that an assessment of risk may be made.

Environmental

All sampling undertaken as part of the ground investigation works would need to be in general accordance with those guidelines prescribed in BS10175 and any specific requirements of the testing laboratory. All environmental soil samples would need to be collected in a combination of 500ml plastic tubs with sealable lids, 250ml glass amber jars and 60ml glass amber vials (this being subject to analytical requirements). This would also be the case for where WAC samples were taken for soils disposal purposes.

Care would need to be taken to minimise cross contamination between sampling. All of the environmental samples would need to be packed into cool boxes and transported to an MCERTS

and UKAS [43] accredited laboratory of Groundsmiths' choosing for analysis and subsequent storage / disposal. Standard retention times would apply.

The analytical strategy adopted for the environmental investigation would be designed to provide an overall and broad assessment of potential contaminants thought likely to be present within the on-Site soils as encountered.

6.5 Outline Remediation Requirements

Soil

It is currently unknown if soil remedial activities for contamination will be required within the context of the proposed development. Any remediation works to be completed would need to be undertaken in accordance with the requirements of guidance prescribed by the Yorkshire and Lincolnshire Pollution Advisory Group ('YALPAG') [44] and any other guidance prescribed by Sheffield City Council.

Where remediation is to be completed, LCRM Stage 3 proposals and verification methodology would need to be submitted to the LPA in the form of a standalone Remedial Strategy.

Ground Gas

For ground gas, it would be considered prudent to allow for Characteristic Situation 2 gas precautions in construction until proven otherwise.

For information at this time, and in accordance with BS8485, the structure as proposed would fall under 'Type A (High Risk)' designation, which is relevant for residential dwellings. The minimum gas protection score to be achieved, on the basis of Characteristic Situation and Building Type as detailed in BS8485, would therefore be 3.5. As with any soil contamination requirements, specific remediation proposals and verification methodology for any protective measures to be provided would need to be submitted to the LPA in accordance with current guidelines.

The installation of any gas membranes and associated components to be used would need to be carried out in accordance with manufacturer requirements and / or any other guidance given [45]. Independent inspection of the membrane and componentry installation by competent persons would also be required, with relevant documentary and photographic evidence being provided to the LPA in a final post-installation Validation Report.

Coal Mining

Should any risk from shallow mine workings be identified, details relating to the method of consolidation and validation to be followed would need to be submitted to the LPA (for consultation with the MRA) in the form of a standalone 'Treatment of Mine Workings Specification'. All works shall be in accordance with current UK guidelines.

7 REGULATORY APPROVAL

This preliminary risk assessment Report has been compiled in accordance with good practice guidance for the assessment and management of land that may be affected by land contamination and stability hazards.

The recommendations presented are considered reasonable on the basis of available information and the assessment of the Site as carried out by Groundsmiths. However, it remains the responsibility of the Client to ensure that the Site poses no significant risk to any sensitive receptor(s) and that it remains aligned with the proposed end-use and assessment framework adopted in this Report and any accompanying reports.

If at any time in the future, additional information comes to light that puts into doubt the accuracy of the professional opinion or third party information presented herein, be it in relation to contamination, geotechnical matters, or mining legacy, then it would be necessary to revisit this assessment.

Works undertaken cannot be guaranteed to gain approval by the regulatory authorities and / or your Warranty provider, so copies of this Report should be made available to the relevant organisations for comment and approval, prior to undertaking any irrecoverable works associated with the Site.

8 INFORMATION SOURCES

The following references have been cited in the production of this report:

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21 Eden, R.A., Stevenson, I.P. and Edwards, W. (1957). Memoirs of the Geological Survey of Great Britain. Geology of the Country around Sheffield. Explanation of one-inch geological mapsheet 100, New Series. HMSO.

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24 NHBC Standards (2019). Part 4: Foundations - Chapter 4.2 Building Near Trees.

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27 BS 8500-1 (2015+A2:2019). Concrete – Complementary British Standard to BS EN 206. Part 1 – Method of Specifying and Guidance for the Specifier.

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9 REPORTING LIMITS

The findings and opinions provided in this Report are given in good faith and are subject to the limitations and constraints imposed by the methods and information sources described. Factual information including, where stated, a visual inspection of the Site, has been obtained from a variety of sources. Groundsmiths assumes that third party data is reliable but cannot independently confirm this as the validity and accuracy of this information is outside our control. No guarantee can therefore be given as to the completeness of the information gathered during the study and no responsibility is accepted for errors or omissions in the third party information used. Groundsmiths' professional judgement and experience is however used to ensure that uncertainties are reduced to a level appropriate to the Site's conditions, the purpose of the investigation and the resources devoted to it by the Client.

Whilst every effort has been made to carry out a qualitative assessment that enables a realistic preliminary characterisation of the parameters to be identified, the possibility of variation in actual ground and groundwater conditions existing cannot be discounted. The findings and opinions presented in this Report are relevant to the time this assessment was undertaken but should not necessarily be relied upon to represent conditions at a substantially later date. Further information, ground investigation, construction activities, change of site use, or the passage of time may reveal conditions that were not indicated in the data presented and therefore could not have been considered in the preparation of this Report. Where such information might impact upon stated opinions, Groundsmiths reserve the right to modify the opinions expressed in this Report. Where opinions expressed in this Report are based on current available LCRM guidelines and/or other legislation, no liability can be accepted for the effects of any future changes to such guidelines and legislation. New information or improved practices and changes in legislation may require reinterpretation of the Report as a whole, or in part.

The conclusions and recommendations presented in this Report are based on the Site-specific assessment but utilising third party documentary information as appropriate. They are, however, limited to those that could be reasonably made at the time the assessment was undertaken. Where assessments of Site areas affected in particular ways are given, these are approximate.

This Report does not constitute an archaeological, ecological, arboriculturalist / invasive plant species, or detailed UXO survey. Any comment given in relation to these is for information only. Further assessments to assess these may be required as part of any planning condition and should therefore be undertaken by suitably qualified experts as required.

Groundsmiths reserve the right to edit and / or retract any conclusion or recommendation made in this Report should any further information, with respect to the Site, become available.

Groundsmiths disclaim any obligation to update the Report for events taking place after the time during which the assessment was carried out.

Groundsmiths do not provide or purport to provide legal advice. Should the Client require such advice then that of lawyers should be sought.

Groundsmiths accept no responsibility if any findings given in this Report are not implemented by the Client or their agents.

Groundsmiths accept no responsibility if any further works, as requested by the Local Planning Authority in the discharge of their duty of care, are not implemented by the Client or their agents.

This Report could be reassigned to a third party if they require reliance on it in the event that the Site is sold at any time in the future. An administrative fee would be applicable in such instances, payable prior to transfer.

GROUNDSMITHS
GEOTECHNICAL ENGINEERS