



**PHASE 1 ENVIRONMENTAL ASSESSMENT
AND
DESK BASED COAL MINING RISK
ASSESSMENT
PROPOSED RETAIL DEVELOPMENT
CROSS KEYS LANE, HOYLAND
BARNSELEY

FOR

LIDL GREAT BRITAIN LTD

GDP PROJECT NUMBER 2047**



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Issue record: 1 FINAL for approval.

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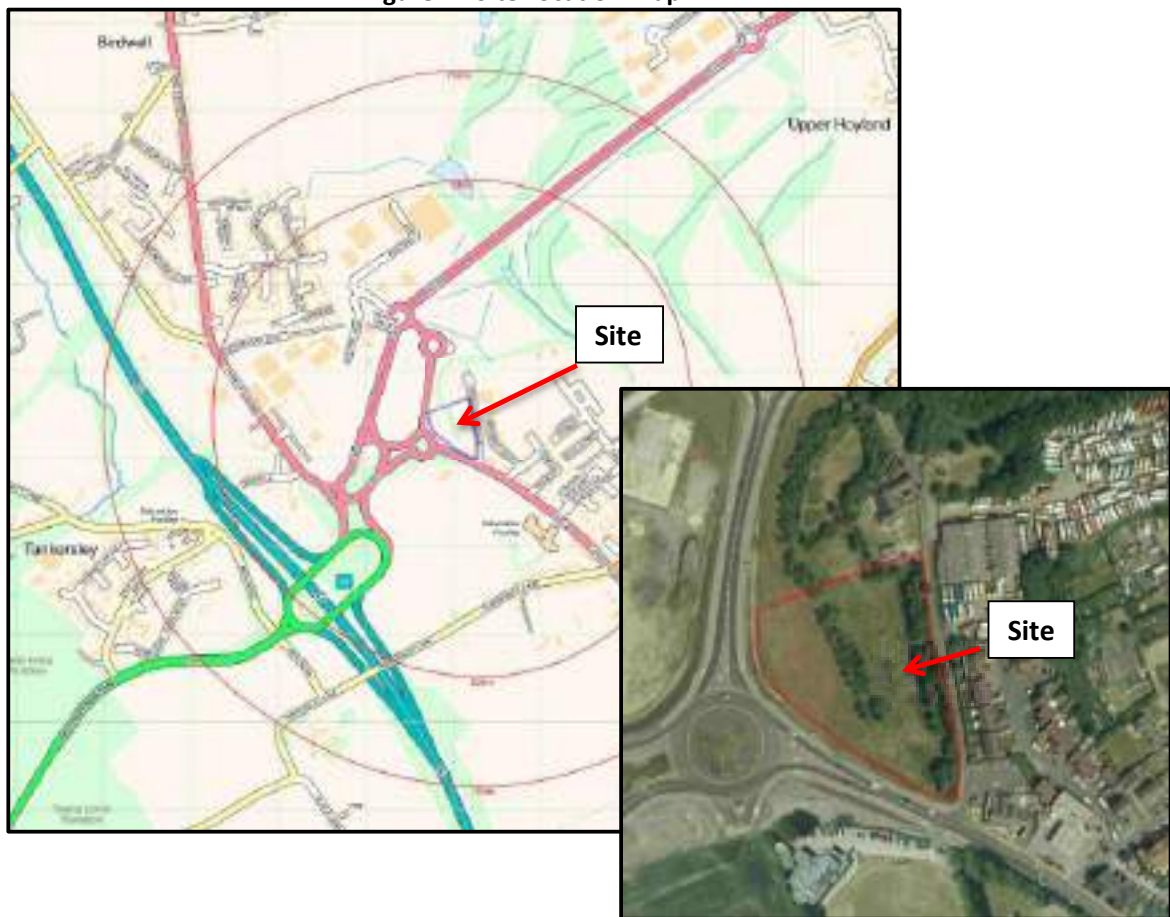
1.0 INTRODUCTION

1.1 Authorisation, Context and Purpose

GD Pickles Ltd (GDP) was instructed by Lidl Great Britain Ltd (the Client) to undertake a Phase 1 Environmental Assessment and Coal Mining Risk Assessment of land at Cross Keys Lane, Hoyland, Barnsley (the 'Site'). The Site is approximately 0.93 hectares in size and is centred on grid reference 435205 400470.

A location map and aerial image of the Site is provided in Figure 1.

Figure 1 - Site Location Map



1.2 Context & Purpose

The objectives of a Phase 1 Environmental Assessment are to assess the potential for ground contamination and its implications in consideration of the Site's use or, when being redeveloped, its proposed use. Specifically the study considers the potential for soil and

groundwater contamination at the Site, from current and historic on and off-site sources in order to assess potential risks to sensitive 'receptors' such as:

- ☼ Human health;
- ☼ 'Controlled waters';
- ☼ Building fabric and underground infrastructure.

This Assessment will adhere to the principal aims of BS10175:2011+A2:2017 '*Investigation of Potentially Contaminated sites – Code of practice*', The British Standards Institution, 2017.

Accordingly, this Assessment will:

- ☼ Assess the likelihood of contamination, its nature and its extent;
- ☼ Evaluate the environmental setting of the Site and identify sensitive receptors;
- ☼ Provide information from which likely contaminant-pathway-receptor relationships can be identified and formulate a Conceptual Site Model (CSM);
- ☼ Evaluate the potential for potential contamination from current and historical use to manifest as statutory or third party liabilities; and
- ☼ Consider the need for a site Investigation or further work to evaluate contamination risk.

It is intended that this Report be submitted to the Local Authority as part of a staged process required to discharge planning conditions pertaining to potential contamination. With respect to contamination this Report is a Phase 1 Preliminary Risk Assessment (PRA) only.

The Site is situated within a Coal Mining referral area and within a Development High Risk Area. The report thus also presents a desk based coal mining risk assessment (CMRA).

This Report will also provide a preliminary assessment of geotechnical, engineering and drainage issues pertinent to this stage of the assessment process.

1.3 Development Proposals

It is intended to develop the Site into a Lidl Store with 115 parking spaces and limited landscaping. The current development plans are presented in **Appendix 1**.

1.4 Limitations

During the preparation of this Report, GDP reviewed and evaluated information provided by a number of other sources including the Client's architects, Groundsure, The British Geological Survey (BGS), The Coal Authority and others. GDP's conclusions, opinions and recommendations are based upon this information. GDP does not warrant the accuracy of the

information provided to it and will not be responsible for any opinions which GDP has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate. The interpretation contained in this Report is only applicable to the development proposals provided to GDP at the time of writing.

2.0 PRELIMINARY RISK ASSESSMENT

2.1 Introduction

2.1.1 Objectives of Preliminary Risk Assessment

The objectives of the Preliminary Risk Assessment (PRA) are to:

- ❖ Establish the geological and hydrogeological conditions for the Site using existing available information;
- ❖ Summarise available information and identify site specific geo-environmental hazards which may place a constraint upon the proposed development;
- ❖ Produce a preliminary Conceptual Site Model (CSM) and preliminary qualitative contamination risk assessment identifying plausible potential linkages between contamination sources, pathways and receptors; and
- ❖ Provide objectives and recommendations with regards to an Intrusive Ground Investigation and other further assessments that may be required.

The assessments in this Report are underpinned by Planning and Regulatory requirements correct at time of writing.

2.1.2 Sources of Information

The following sources of information were consulted during the process of compiling this PRA;

- ❖ The Coal Authority;
- ❖ Groundsure Enviro+Geo Insight Report;
- ❖ Historical Mapping procured specifically for the Site;
- ❖ Zetica UXO website;
- ❖ British Geological Survey (BGS) website.

In addition, previous investigations have been undertaken at the site. The following reports, or parts of, were available for review.

- ❖ Mineral Report for Birdwell Roundabout and Link Road to Rockingham Roundabout (Symas Report Reference PJ/M3687/5, dated 16th August 2013);
- ❖ Desk Study Report for Junction 36 (M1), Birdwell, Barnsley, South Yorkshire (Abbeydale Report Reference 151045DS, dated September 2013);
- ❖ Technical Report on Ground Investigation at A61 Birdwell Junction Improvement, Tankersley, South Yorkshire (Sub Surface North East Limited Report Reference NE3312A, dated October 2014); and
- ❖ Technical Note Land at Rockingham Quarry, WSP Report No. 70019822-001 December 2016.

2.2 Geoenvironmental Baseline Summary

The following provides a summary of the geoenvironmental baseline study that has been undertaken using the information sources listed at Section 2.1.2. The Groundsure report and historical maps reviewed are reproduced in **Appendix 2**.

Historical maps showing the Site and its environs were procured to review the development history of the Site and assess the potential for its history, or that of the immediate surrounding area, to have the potential to have resulted in contamination on the Site.

Salient observations are described in Table 2.2a below.

Table 2.2 a Site History

Date(s)	On-Site	Off-Site
1855 1891-94 1893 1903 1905-06 1929 1931 1938	The Site is undeveloped. Field boundaries are shown running roughly east to west across the centre of the Site until 1929 and north to south in the west of the Site throughout the mapped period.	Cross Keys Inn is shown to the south east and what appears to be a house and farm complex to the north and a railway line circa 250m north all present from the first map edition. Rockingham Colliery is labelled circa 400m north and Rockingham Gas Works circa 400m west from 1891. A reservoir is first shown 1891 approximately 200m north with a Powder Magazine shown 250m north east, not shown by 1903. Filter beds are shown circa 180m north of the Site from 1903 with a structure present 180m north east present at the same time, later labelled sewage tanks by 1929. Several small quarries and ironstone or clay pits are shown over the wider area.
1948 1951-56 1955 1956 1955-56 1965-66 1973-74 1977-80 1986	No changes.	Large linear embankment features and a heap are shown from approximately 400m north east, later shown as spoil or refuse. This extends to within approximately 250m north east of the Site assumed by 1973/74. Slurry ponds are shown from 1973/74 100m north east and a motor body works and tank labelled circa 10m east of the Site which

1987 1987-92 1993		is cited in what appears to be an engineered depression/possibly former quarry. An aerial ropeway is present running north south direction approximately 50m west of the Site on the 1955, 1956 and 1965-66 maps and a crane shown approximately 150m north on the same editions. A garage is shown 80m south of the Site by 1973-1974. The reservoir formerly 200m to the north is labelled as a tip from 1987 along with the wider expanse of spoil which extends to the north and north east.
2001	A vegetated strip is present running north south down the centre of the Site and the former field boundary on the west of the Site is no longer shown.	The expanse formerly shown as 'tip' is no longer labelled as such and various areas of vegetation and a small lake and surface water courses are now shown.

Table 2.2 b Site Setting and Database Records

BASELINE STUDY AND DATABASE RECORDS		
Site Location	The Site is located at National Grid Reference 435205 400470 in the east of Brough, approximately 2km west of Hoyland and 6k south of Barnsley.	
Site Description and Topography	The Site is a broadly triangular shape bound by the recently constructed A6135 to the south west, a roundabout to the west, Sheffield Rd to the north west, vacant land and housing to the north and Cross Keys Land, beyond which are a works and housing to the east. The Site is vacant with bushes and trees around its perimeter and line of semi mature trees running north south with a slight curve through the centre of the Site within a shallow depression. Topographically the Site and surrounding area slope towards the north west. A number of blue borehole covers were noted from previous investigation but do not tally with any records reviewed to date.	
Geological Setting	Artificial Ground	Reference to the Groundsure report indicates that Artificial/Made Ground is not present on Site. However, South Yorkshire Mining Advisory Service plan (provided as part of the mineral report prepared by Symas) indicated that the western part of the site was located within the

boundary of the Rockingham Opencast mine. The edge of the opencast mine is depicted in red on the plan below and approximately coincided with the location of a bank of trees that crosses the site.



The mineral report indicated that the Rockingham opencast site was worked during the 1990s and the opencast voids were subsequently backfilled with overburden/spoil and the land returned to agricultural use/open space. The backfill is indicated to vary in thickness from less than 2m in the west to in excess of 10m in the east. As the site is located on the eastern side of the Rockingham opencast site it is anticipated that approximately 10m of backfill is likely to be present along with the opencast highwall. The report indicated that the Rockingham opencast site was compacted back to provide a developable platform, although it is indicated that creep and/or differential settlement could still occur particularly across the high wall.

According to the BGS Made ground is mapped over a wide area to the north of the site corresponding to the area of the former tip and immediately to the east in the location of the current works. Numerous areas of infilled or worked ground are mapped in proximity to the Site in all directions.

	Superficial Deposits	Superficial deposits are not mapped on the Site or surrounding area.
	Bedrock Geology	Reference to the Groundsure report and the BGS GeoIndex indicate that the Site is underlain by Pennine Middle Coal Measures. The eastern half of the site is directly underlain by a sandstone unit and the western half underlain by the general sequence of mudstone and siltstones. To the west of the site a coal outcrop is indicated orientated approximately north to south which dips below the site. The 1:50,000 scale BGS Map Sheet 87 'Barnsley', dated 2008 indicated that the coal outcrop to the west of the site to be the Swallow Wood Coal which is indicated to be between 0.2 and 3.7m thick. The Swallow Wood Coal is underlain by the Haigh Moor (Kexbrough) Rock, a named sandstone unit between 0.0 and 28m thick. Further coal seams (Top Haigh Moor Coal, Haigh Moor Coal and Low Haigh Moor Coal are indicated to be present within the lower part of the sandstone unit. The sandstone unit indicated to be present beneath the eastern part of the site is stratigraphically above the Swallow Wood Coal. Therefore, the coal seam is likely to extend beneath the site, very likely the seam taken in the Rockingham opencast site up to the mapped high wall and possibly underground from there. Approximately 100m to the southwest of the site a fault line is indicated, orientated northwest to southeast with the downthrown side to the southwest.
	Borehole Records	No publicly available borehole records are available in the vicinity.
Hydrology	The closest surface water feature is a land drain 94m north east located within the area of the former tip.	

Flooding	Reference to the Groundsure Enviro Insight report indicates the Site is not vulnerable to the risk of flooding from rivers and seas. Consideration of the potential risks from flooding fall outside the scope of this assessment.
Hydrogeology	The bedrock geology is classified as a Secondary A Aquifer. There are no licensed groundwater abstractions in the vicinity.
Mining, Ground Workings and Natural Cavities	Reference to the Groundsure report indicates: 5 BritPit record exists within 500m. These relate to surface and deep coal extraction, being located 253m west, 291m west, 430m north, 464m north and sandstone extraction 497m west. - There are 25 surface ground workings within 250m, including the slurry ponds formerly 117m north east, refuse heap listed from 132m north, disused tip from 178m north, sewage tanks 188m north east and reservoir circa 200m north; - There are 8 underground workings listed within 1km, 6 of which appear to relate to the same colliery feature listed from 268m north; 4 non-coal mining records for iron ore extraction including for the Site itself, 149m west, 402m south and 473m south west;
Coal Authority Information	According to the Coal Authority website an outcrop of coal is indicated to be present to the west of the site, orientated approximately north to south. Probable coal workings associated with this seam are indicated to be located beneath the entire site and the site is also located within a Development High Risk Area. Underground workings (at depth) are also indicated to be present across the entire area. The Consultants Coal Mining Report obtained from the Coal Authority for the site indicated that seven named coal seams had been worked beneath the property. Details of the upper two coal seams comprise: - Lidgett Coal, located 72m depth with an extracted thickness of 0.66m and dipping at 3.8 degrees to the northeast; - Low Fenton Coal, located 190m depth with an extracted thickness of 1.37m and dipping at 3.4m to the northeast. The Consultants Coal Mining Report also indicates that there are probably unrecorded shallow workings located beneath the site and that the Shallow Wood Coal Seam outcrops approximately 25m to the west of the site. The bearing of the outcrop was 346 degrees.

	The site is also indicated to be located entirely within an opencast mine licence area, with the eastern boundary of the site coinciding with the boundary of the licence area. No further details were provided.
Natural Ground Subsidence	Reference to the Groundsure report indicates: ☼ The Shrink-Swell Clays hazard is very low to negligible; ☼ The Landslides hazard rating is very low; ☼ The Ground Dissolution of Soluble Rocks Hazard is negligible; ☼ The Compressible Deposits hazard is negligible; ☼ The Collapsible Deposits hazard is very low; ☼ The Running Sands hazard is negligible.
Pollution Incidents	Reference to the Groundsure report indicates there are 4 pollution incident records within 500m of the Site. The closest was located 190m south west of the Site resulting in minor impact to land from construction wastes in 2003. The others are all over 400m from the Site also resulting in minor land impact.
Current Industrial Uses	The Groundsure report identifies 11 current Industrial Land uses within 250m of the Site, the closest being various business operations in the works complex east of the Site. These include a vehicle hire and rental, unspecified works or factories and tanks. A Petrol station and vehicle wash is listed 69m east (Jet Garage), electricity substation 139m north west, vehicle cleaning 142m east, substation 173m south east, vehicle repair 212m east and a BP filling station 213m north west among others.
Historical Industrial Sites	The Groundsure report identifies 73 potentially contaminative uses from historical mapping within 500m of the Site. Many are repeat entries for the same feature and include works, slurry ponds, refuse heaps, tip, sewage tanks, colliery, filter beds and railway sidings among others.
Historical Tank Database	The Groundsure report identifies 29 historical tanks from historical mapping within 500m of the Site. Many of these records are repeat entries of the same features, the closest being the AST identified from historical mapping located in the 'works' to the east of the Site.
Historical energy features	The nearest recorded feature is an electricity substation 267m south east.
Historical Petrol & Fuel and Garage & Motor Vehicle Repair Database	There are 10 records listed for historical garages relating to 3 discrete features located 47m south east, 458m south east and 495m west.

Current Petrol & Fuel Sites	The Jet and BP filling stations listed in the current industrial uses above are also listed under this category at 48m south east and 185m north west respectively.
Environmental Permits	- There are 7 Part B permitted installations within 500m of the Site. The closest being 30m east for vehicle respraying and 71m east at the Jet garage for unloading of petrol. - There are 9 discharge consents listed within 500m, these include sewage discharges 32m east and 3 Trade Discharges 85m north east although these licenses have been revoked.
Potentially Infilled Land, Landfills and Waste Management	Reference to the Groundsure Report indicates: - There are no active or recently closed landfills under EA regulation recorded within 500m; - There are no BGS recorded landfills within 500m; - There are no historical landfills identified from local authority records; - There is 1 historic EA landfill recorded 239m north west; - There are 2 historic waste sites derived from LA planning records located 285m north west and 474m north; - There are 4 active or recently closed licensed waste sites within 500m, the closest being 228m south west. It is noted that the made and infilled ground referred to in the geology section are not referenced in the waste and landfill records.
Radon Gas	Reference to the Groundsure report indicates the Site is not in a Radon Affected Area and no protective measures are necessary.
Environmental Designations	No sensitive designations in proximity to the Site. Land 182m south west is classified as greenbelt.
UXO	Reference to the Zetica UXO Unexploded Bomb Risk Map indicates the site lies in a Low Risk Area. Zetica state that <i>"if both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions"</i> . The client should consider whether it requires a detailed UXO risk assessment undertaking by a specialist consultant.

2.3 Additional Information

A previous site investigation report was prepared by Sub Surface NE. The purpose of the investigation was to assess the ground conditions for a new road network that has subsequently been constructed and forms the western boundary of the site. Consequently some of the exploratory holes were located within the site boundary. These include M4, TP8, DP1, DP1A, DP2A, DP3 and DP4.

Borehole M4, located in the northwestern part of the site was only drilled to a depth of 2.05m where the borehole was terminated due to an obstruction within the made ground. The made ground generally comprised clayey silty sandy fine to coarse gravel and cobble sized fragments of mudstone. Trial pit TP8 was located in the southeastern part of the site and encountered natural ground conditions beneath a thin layer of topsoil. Near surface the deposits were described as sandy gravel and cobble sized sandstone lithorelicts. At a depth of 0.7m weak thinly bedded sandstone was encountered which extended to a depth of 1.3m. Very weak mudstone was then encountered to the base of the trial pit at 2.35m. Dynamic probes DP1, DP1A, DP2A, DP3 and DP4 were all located in the southwestern part of the site. Several of the dynamic probes terminated at shallow depths, possibly due to obstructions within the made ground. However, DP2 in particular indicated that there was an increase in blow count at approximately 8.3m. This could potentially coincide with the base of the made ground.



A Technical produced by WSP in 2016 discusses the general area of the site as Plot 3 in accordance with the land designations at the time. There were ground investigations

discussed in the WSP report but GDP did not have access to the factual or interpretative reports that the WSP technical Note refers to.

The WSP report confirms the location of the deep fill and probable high wall location. The report also states that;

‘the site was backfilled and validated in accordance with an engineering specification, the consequence of this is that the ground has been prepared for development and although a degree of ground improvement may be needed it is unlikely that a deep foundation solution (i.e. piles) would be required at the site, subject to building loadings. but points out that any warranty attached has long expired. GDP concur with this statement. The highwall presents a constraint to Plot 3, as the ground conditions either side of the highwall are likely to be variable therefore it is not generally recommended to construct buildings over a highwall as it could result in differential settlement. However, infrastructure such as roads could be constructed over the highwall, but would require upgrading to mitigate against the potential settlement risks. The location of the highwall in Plot 3, along the boundary is unlikely to inhibit development as the strip on land is likely to be required as a development buffer from the adjacent properties. Coal Authority records indicate a shallow coal seam may have been worked located to the east of the highwall in Plot 3, outside the extent of the opencast. Building over abandoned shallow coal working could lead to collapse of the workings resulting in surface instability. Therefore, the area may require drilling and grouting to fill in the void space associated with the workings to facilitate safe development above’.

With regards to contamination and hazardous ground gas WSP state;

‘The backfill material and groundwater across all three plots has been tested for a variety of chemicals and recorded concentrations which are unlikely to pose unacceptable risks to sensitive receptors associated with a future commercial development, or residential development on Plot 3. Ground gas monitoring at the site has recorded elevated ground gas levels which are likely to require ground gas protection measures to be incorporated into new buildings to mitigate the potential gas ingress risks.’

3.0 QUALITATIVE CONTAMINATED LAND ASSESSMENT

3.1 Initial Conceptual Site Model

An initial Conceptual Site Model (CSM) has been developed for the Site adopting the Source-Pathway-Receptor approach. The initial CSM is developed during the preliminary risk assessment stage and is used to design the Phase 2 Intrusive Investigations.

- 🌀 **Sources (S)** are potential or known contaminant sources e.g. soil contamination resulting from a former land use;
- 🌀 **Pathways (P)** are environmental systems thorough which a contaminant could migrate e.g. air, groundwater;
- 🌀 **Receptors (R)** are sensitive environmental receptors that could be adversely affected by a contaminant. e.g. Human End User (longer- term risks) or groundworkers (shorter-term risks), surface or groundwater resources and ecology.

Where a source, relevant pathway and receptor are present, a plausible pollutant linkage is considered to exist whereby environmental harm could occur and a potential environmental liability could be realised.

The site specific potential pollutant linkages have been assessed and used to formulate the initial Conceptual Model for the site presented in Table 3.1.

Table 3.1 Initial Conceptual Model

POTENTIAL SOURCES		
CSM ID	Detailed Description	Summary Description for CSM
S1	Potentially contaminated soils associated with historical use and made ground.	S1: Soil Contamination.
S2	Contaminated groundwater resulting from soil contamination.	S2: Groundwater Contamination.
S3	Potential contamination originating from off-site sources.	S3: Off-site sourced contamination.
S4	Asbestos containing materials in made ground on Site.	S4: ACMs
S5	Potential for ground gases from on and off-Site made ground, infilling, natural geology and mine workings.	S5: Ground gas

POTENTIAL PATHWAYS		
CSM ID	Detailed Description	Summary description for CSM
P1	Human uptake pathways; ☼ Ingestion of excavated or exposed soils; ☼ Ingestion of home grown produce; ☼ Inhalation of soil/dust/volatile compounds or hazardous ground gases via migration through permeable strata/conduits; and ☼ Dermal contact with exposed soils or leachates.	P1: Human uptake
P2	Vertical migration of contaminants through the unsaturated zone	P2: Vertical Migration Unsaturated Zone
P3	Horizontal and vertical migration of contaminants within groundwater	P3: Groundwater Migration
P4	Direct contact of soils with construction materials	P4: Direct Contact Construction Materials
P5	Migration of ground gases and vapours vertically and horizontally through the ground and into buildings.	P5: Ground gas migration
POTENTIAL RECEPTORS		
CSM ID	Detailed Description	Summary description for CSM
R1	Construction/maintenance workers.	R1: Construction workers
R2	Controlled waters within the Secondary Aquifer or nearby surface water.	R2: Controlled waters
R3	End-users.	R3: End-users
R4	Construction Materials - Buried concrete and potable water supply pipes.	R4: Construction Materials
R5	Off-site property and users.	R5: Off-site receptors

3.2 Risk Evaluation

For each potential pollutant linkage identified within the Conceptual Model the potential risk has been evaluated for potential receptors using a Preliminary Qualitative Risk Assessment based on the probability of the pollution event and the severity it poses to Site users and the environment.

The preliminary assessment of risk assumes no specific remediation measures but does take account of obvious pathway disruption due to development such as proposed hardstandings, building footprints or necessary reduced level dig.

The risk evaluation assessment is summarized in Table 3.2 below.

Table 3.2 Preliminary Qualitative Risk Assessment

Potential Source	Potential Pathway	Potential Receptor	Consequence	Probability	Risk	Comments
S1 Soil Contamination	P1: Human Uptake	R1: Construction workers	Mild	Low likelihood	Low	The open cast backfill forming the west half of the site is thought to comprise mainly of colliery spoil but there is very little data so remains a plausible risk. The east of the site is thought to be natural Sandstone/weathered sandstone and is not expected to be significantly contaminated. The WSP Technical Note indicates that contamination levels were low such that the site was suitable for commercial or residential development based on assessment criteria at that time (2016).
		R3: End-users	Minor	Unlikely	Very low	
	P2: Vertical migration unsaturated zone	R3: End-users	Minor	Unlikely	Very low	
	P3: Groundwater migration	R2: Controlled waters	Mild	Low likelihood	Low	Soil contamination with the potential to impact controlled waters is not anticipated. Groundwater is expected to be found in the backfill but is often complex consisting of several perched groundwater bodies.
		R3: End-users	Mild	Unlikely	Very Low	
		R4: Construction materials	Mild	Low likelihood	Low	
	P4: Direct contact construction materials	R3: End-users	Minor	Unlikely	Very Low	Contamination with the potential to impact water pipes is not expected although the colliery spoil may contain contamination. The colliery spoil may also contain pyrite and high sulphides which could lead to aggressive ground conditions for concrete. Any buried concrete in the east of the site is likely to encounter Sandstone and should not be aggressive ground.
		R4: Construction materials	Medium	Likely	Moderate	
	P1: Human Uptake	R1: Construction workers	Mild	Unlikely	Very low	

S2: Groundwater Contamination		R3: End-users	Mild	Unlikely	Very low	Groundwater contamination is not anticipated but high sulphates could be present.
		R4: Construction materials	Mild	Low likelihood	Low	
	P3: Groundwater migration	R2: Controlled waters	Mild	Low likelihood	Low	
		R3: End-users	Mild	Unlikely	Very Low	
	P4: Direct contact construction materials	R4: Construction materials	Mild	Unlikely	Very low	
S3: Off-site sourced contamination	P1: Human Uptake	R1: Construction workers	Mild	Unlikely	Very low	There are no off Site sources of concern other than if the opencast backfill is found to be contaminated during intrusive investigations.
		R3: End-users	Minor	Unlikely	Very low	
	P3: Groundwater migration	R1: Construction workers	Mild	Unlikely	Very low	
		R3: End-users	Mild	Unlikely	Very low	
		R4: Construction materials	Mild	Unlikely	Very low	
		R2: Controlled waters	Mild	Unlikely	Very low	
	P4: Direct contact construction materials	R4: Construction materials	Mild	Unlikely	Very low	
S4: ACMs	P1: Human Uptake	R1: Construction workers	Severe	Unlikely	Moderate/ Low	Asbestos may be present in the open cast backfill but if it was engineered fill would

		R3: End-users	Severe	Unlikely	Moderate/ Low	probably not have come from an industrial source. All brownfield and some greenfield sites may contain asbestos in or on the ground and suitable assessments should be made at ground investigation stage.
S5: Ground Gas	P5: Ground gas migration	R3: End Users	Medium	Likely	Moderate	There is commonly elevated carbon dioxide associated with opencast backfill. This tends to reduce over time as anerobic conditions establish. Boreholes that reintroduce atmospheric air to the fill can sometimes trigger short-term increased generation as organic matter is exposed. The gas risk assessment should be mindful of the characteristics of colliery spoil fill. Other potential sources of ground gas were identified associated with pits etc. and potential underground mine workings.

4.0 COAL MINING RISK ASSESSMENT

Information from the Coal Authority has indicated that seven known coal seams have been worked beneath the site at depths of between 72 and 338m between 1885 and 1951. Given the depth of these worked coal seams it is considered that the risk to the proposed development is considered to be low.

However, the Coal Authority has also indicated that there are probable unrecorded shallow workings located beneath the site and as such the site falls within a Development High Risk Area (DHRA). In addition, a coal seam is indicated to outcrop approximately 25m to the west of the site. The coal seams beneath the property are indicated to dip at between 2.3 and 3.8 degrees to the east/northeast. Therefore, the coal seam is likely to be present at a depth of between 1 to 2m beneath the western boundary of the site. The width of the site is approximately 75m (west to east). Therefore, the coal seam is predicted to be at a depth of approximately 5 to 7m begl. It should be noted that the site elevation falls from southeast to northwest and therefore the depth to the coal seam is likely to be shallowest in the northwest and deepest in the southeast.

According to the BGS the coal seam is the Swallow Wood Coal which had an extractable thickness of between 0.2 and 3.7m. According to the mineral report the western part of the site was located within the boundary of an opencast site, presumably to extract the Swallow Wood Coal. The plan provided with the mineral report indicated that the eastern extent of the mine coincided with the outcrop of the sandstone unit. In addition, a bank of trees is indicated to cross the site, in the same shape as the opencast site. This does not coincide with earlier field boundaries or trees and it is possible that the trees were planted as a screen to the opencast mine. The historical site investigation undertaken at the site also confirms that the western part of the site was within the opencast site and was backfilled with what appeared to be colliery spoil (Mudstones). However, a trial pit located in the southeastern part of the site indicates that this part of the site had not been excavated as natural in situ Pennine Middle Coal Measures was reportedly encountered from surface. Information from the dynamic probes suggest that the opencast site could have been in the order of 8m deep.

The mineral report suggests that the opencast site was backfilled with compacted materials to provide a developable platform, although it was indicated that creep and/or differential settlement could still occur across the high wall. There are no records indicating any specification or verification of the fill.

The proposed development has the store located in the eastern part of the site, predominantly outside of the opencast area. However, the southwestern corner of the store may encroach onto the opencast area and therefore is likely to be located over the buried quarry (open cast) highwall.

While the coal is likely to have been completely extracted from the opencast area there is still the potential for the Swallow Wood Coal to have been extracted (by underground techniques)

from beneath the eastern part of the site. It is therefore recommended that a site investigation is undertaken at the site in order to determine the following:

- Depth and quality (geochemical and geotechnical) of backfilled materials within the opencast area;
- Accurate location of the buried highwall (and highwall zone) and in particular if this is located beneath or close to the proposed store footprint; and
- Whether the Swallow Wood Coal seam has been mined beneath the eastern part of the site.

The ground investigation should be designed to investigate mining legacy, address Phase 2 contamination requirements and obtain geotechnical information to inform the engineering design. Further details of the recommended scope of investigations is included in Section 5.0.

An enquiry to the Coal Authority for any further information relating to the opencast, particularly any mining surveyor records, should also be made.

5.0 CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

The Site straddles the highwall of the former Rockingham opencast mine. The mine was active in the 1990's and was reportedly backfilled to form a developable platform although no records of the specification or verification of the infilling are available. The west of the site lies over the backfill whilst the east of the site is thought to be underlain at shallow depth by Sandstone.

The quarry high wall runs roughly north to south with a curving shape but moves sharply westwards in the very south. A line of trees of an age that suggests they were planted at around the time of the quarrying activity currently marks the approximate line of the top of the highwall. The width of the Highwall Zone will be determined by the angle of the quarry face and the depth to the bottom of the quarry.

A coal seam is mapped to outcrop close to the western boundary of the site and was presumably removed in the opencast. However, this seam may dip below the east of the site at shallow depth and thus may have been mined in the past or even during the opencast operations when often seams were chased underground by pillar and stall methods. Coal Authority records indicate that the site lies within a Development High Risk Area and is in an area highlighted for unrecorded shallow mine workings. Underground mining at depth has occurred but is unlikely to affect the stability of the site.

Based on comments by previous investigators significant or widespread contamination is not anticipated on the Site provided the colliery spoil in the open cast backfill is predominantly re-worked natural materials which is normally the case when it was placed under controls on quality for a development platform.

ACMs may be present in the colliery spoil if this is not wholly re-worked natural soils. Made Ground should be checked for the presence of asbestos as a default.

5.2 Recommendations

Soil, Groundwater and Ground Gas

Geochemical (contamination) testing should be undertaken across the site as part of a combined environmental, geotechnical and coal mining legacy intrusive investigation. Suites of testing should include for standard metals, inorganics and organics and should include speciated PAH. Where hydrocarbons and or volatile contaminants are suspected during the investigation then speciated TPH and VOCs should also be scheduled.

Monitoring wells should be installed in boreholes to facilitate a period of ground gas monitoring to confirm the absence of problematic permanent ground gases associated with the deep colliery spoil and potential other coal mining sources. Previous investigations have indicated elevated levels of ground gasses but no records are available.

Preliminary Engineering Observations

Stabilisation of unstable ground to the east of the high wall may be required dependant on the findings of the rotary drilling and updated coal mining risk assessment.

It is normally not advised, but is possible, to build across a buried quarry highwall. On this site foundations , floor slabs and drainage would span from deep Made Ground to shallow rock.

At this site the store could be built running east to west but it is very likely that the west section spanning the high wall and across the deep fill would need to be piled or significant ground improvement undertaken to prove that differential settlement would not occur. Piling would ensure that total and differential settlement of foundations was tolerable. Piling through the fill could be difficult and a rock socket would need to be formed in the base of the quarry. If the structure was to be entirely on the fill and not across the high wall zone it may be feasible, following further investigation and almost certainly ground improvement of upper layers, to support the structure on a shallow foundation solution. If records of the filling were available then this would be extremely beneficial in assessing the potential for future settlement of the infill. It is difficult to provide confidence on the settlement potential of the deeper layers. Due to the shape of the site and access and planning constraints it is not feasible to construct the store wholly in the backfill area.

The store can be positioned orientated north to south in the east of the site so that it is mostly on shallow Sandstone. Planning requirements require that it cannot be placed close to the east boundary with Cross Keys Lane which would place the whole building footprint outside of the recorded opencast.

The existing information indicates that traditional shallow foundations should be viable except potentially for the extreme southwest corner of the building where it may overhang the suspected highwall zone. The store shape can be amended to limit (or remove) any foundations that could sit over

No significant retaining structures are envisaged based on current site drawings.

External areas to the east and north of the store will be underlain by Sandstone or engineered site build up. To the west of the store the family parking and access road may overlie the highwall zone and the remainder of the west of the site will over the opencast backfill. In the south of the site the highwall shape is complicated. Special measures may be required to

control differential settlement across the high wall zone. Some ground improvement of the upper layers of the backfill across the site may be required and would be assessed during ground investigation.

No infiltration SuDS is recommended into the or close to the opencast backfill. It is plausible that soakaways may be effective in the Sandstone in the east of the site. However, infiltrating water could flow to the open cast and cause wash out and collapse settlement along the highwall zone.

Services that cross the high wall zone will need to be designed to tolerate some differential movements as will any services passing across the backfill areas.

Asbestos

Made Ground Soils sampled at the Site should be tested for asbestos presence and asbestos quantified where found to be present.

Waste and Materials Management

Cut and fill levels are currently unknown. Some topsoil is likely to require removal from Site to facilitate development and should be sent to a recycling facility if suitable. Any waste must be disposed of by appropriately licensed contractors in accordance with current waste management legislation and Duty of Care regulations. Waste arisings should not be assumed to be inert. WAC testing of materials destined for off-Site disposal to landfill may also be required.

6.0 LIMITATIONS TO ENVIRONMENTAL ASSESSMENTS

This Report has been produced on behalf of The Client, as detailed in Section 1.0 of this Report, and no responsibility is accepted to any Third Party for all or any part.

GDP accepts no responsibility or liability for:

- a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and
- b) the consequences of this document being used by any third party with whom an agreement has not been executed.

The Client should be aware that property development carries risk and that unidentified development abnormalities should be anticipated particularly on brownfield sites with regard to in-ground risks such as contamination, asbestos, waste and underground obstructions/made ground. This Report provides an assessment of the potential and actual ground conditions found based upon the available information and in the context of the scope of works performed. It does not provide a flood, drainage, asbestos, ecological, archaeological or legal assessments or provide advice on other technical matters which may be appropriate when considering site ownership and development. The Client should satisfy itself that it has adequate information on which to make its own decision with regards the commercial and legal merit of acquiring and developing the site. All development risk rests with the developer and owner. GDP will employ all reasonable endeavours to assist the Client manage and mitigate those risks, however, no liability is accepted by GDP for any loss, damages, or consequential or third party losses which may be suffered by the Client from the inappropriate use or misinterpretation of the content of this report.

Phase I Desk Studies and Preliminary Risk Assessments

The work undertaken in producing this report comprised a study of available in-house and third party documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The assessments and opinions given in this report rely on such information and activities and are only relevant to the purpose for which the report was commissioned. Any information reviewed should not be considered exhaustive and has been accepted and used in good faith as providing accurate and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, GDP reserves the right to review and if necessary modify the opinions accordingly. It should be noted that any risks identified in a Phase 1 report are perceived risks based on the information reviewed; actual risks can usually only be quantified following a physical investigation of the site.

Phase II Intrusive Combined Geotechnical and Geoenvironmental Investigations

The investigation of the site has been carried out to provide sufficient information concerning the type and significance of contamination, geotechnical characteristics, and ground and groundwater conditions to provide a reasonable assessment of the environment risks together with engineering and development implications. If costs have been included in relation to site development professional cost advice should be sought.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site for each of the exploratory holes. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report. Whilst exploratory testing is intended to gain an accurate representation of the site, the very nature of sampling and testing is such that it cannot ensure that all localised conditions are detected.

The comments made on groundwater conditions are based on observations made at the time the site work was conducted. It should be noted that groundwater levels will vary owing to seasonal, tidal and weather related effects. The scope of the investigation was selected on the basis of the specific development proposed by the Client and may be inappropriate to another form of development or scheme.

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

Any other issues not listed in the scope of works, but subsequently identified during the completion of the Site investigation and reported herein (such as the potential presence of Schedule 2 Invasive Weeds, flood assessment studies or ecological surveys) are provided for information only and fall outside the scope of this Assessment. The Report does not constitute an archaeological, geotechnical or ecological assessment, nor does it constitute an 'asbestos inspection' or flood assessment.