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GEOENVIRONMENTAL APPRAISAL

of land at

BURY MARKET

Prepared for

BURY COUNCIL

Report No. 5237-G-R001 Rev A

Date: August 2022

EXECUTIVE SUMMARY

ID Geoenvironmental Limited were commissioned by Bury Council to undertake a geoenvironmental appraisal of land at Bury Market. A third party, Vinci Construction UK Limited (Vinci) have been appointed by Bury Council as the Design & Build Contractor for the proposed development.

The proposed project comprises the construction of a new building in the west of the site and the construction of a new canopy to Bury Market in the central and eastern sections of the site. Vinci have indicated that both the canopy structure and the new building will be constructed with piled foundations.

IDG's investigation included a review of desk study information, a coal mining assessment and a ground investigation comprising two cable percussive boreholes & five window sampling boreholes accompanied by chemical and geotechnical testing.

A summary of salient geoenvironmental issues is provided in the following table.

Issue	Remarks
Flooding	The majority of the site is located within an area of potential groundwater flooding for property situated below ground level. A small area in the west of the site is located in an area of limited potential for groundwater flooding to occur.
Radon	The site is not located in a radon affected area, as less than 1% of properties are above the Action Level. Building Control Regulations do not require radon protection measures to be installed.
Geology and Coal Mining	The BGS plan shows a fault crossing the east of the site, trending northwest-southeast. The plan shows the Arley Mine coal seam subcrops in the east of the site to the north of the fault and subcrops to the southeast of the site to the south of the fault. The geological plan indicates the coal seam dips to the west beneath the site. The Coal Authority's interactive viewer identifies a small section in the east of the site is determined a high-risk development area. The extent of the high-risk development area is consistent with the extent of an area shown on the interactive viewer as probable shallow coal mine workings. A Coal Authority mining report for the site comments that, evidence of, or the potential for, coal mining related features have been identified at the site. Given the above information a coal mining assessment was considered necessary.
Coal Mining Assessment	The assessment of the mining risk was undertaken for the high-risk development area located to the north and the south of the fault. The assessment for the north of the fault concluded a very low/negligible risk of unrecorded mine workings being present (blue hatched area on Drawing No. 5237-G-D003). The assessment to the south of the fault concluded that the risk of unrecorded shallow mineworkings can be discounted for the majority of the high-risk development area (green hatched area on Drawing No. 5237-G-D003), but a small area, close to the eastern boundary of the site (magenta hatched area on Drawing No. 5237-G-D003), has been identified where less than 10x rock cover would be provided above any possible unrecorded workings within the Arley Mine coal seam.
Former Land Uses	Historical OS plans indicate the site has had several phases of development generally associated with commercial retail use. However, two garages and a timber yard have been present in the west of the site.
Ground Conditions	The ground conditions encountered across the site typically comprised hardstanding underlain by Granular Made Ground proven to depths of 1.1m - 2.5m. Superficial Deposits were encountered beneath the Made Ground and comprised alternating layers of granular and cohesive deposits. In addition, a thin layer of organic peaty sand/sandy peat, up to 0.5m thick, was encountered directly beneath the Made Ground in WS01 and BH01. Mudstone bedrock was proven at depths of 14.1m and 14.5m in BH01 and BH02 respectively
Groundwater	Groundwater bodies have been recorded in both the upper and lower granular superficial deposits resting at levels of between 2.51m-4.57m bgl (89.83-90.42m AOD) in the upper deposit and 6.29m-7.93m bgl (86.17-87.41m AOD) in the lower deposit.
Hazardous Gas	A hazardous ground gas risk assessment has determined the site should be classified as Characteristic Situation 1. The hazardous ground gas risk assessment may need to be reassessed after any additional investigation within the footprint of the proposed new building in the west of the site.
Contamination	No evidence of contamination has been identified in soils or groundwater beneath the site. Further investigation of the ground conditions within the footprint of the proposed new building in the west of the site is recommended when access is possible.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

Issue	Remarks
Foundations	Vinci have indicated the foundations for both the proposed new building and the market canopy will be piled. The coal mining risk assessment has identified a small area in the east of the site where less than 10x rock cover is provided above the Arley Mine coal seam and any potential workings within the seam. Should any piled foundations for the market canopy in this area (shown as a magenta hatched area on Drawing No. 5237-G-D003) extend to bedrock IDG consider the risk should be categorised as low. However, should the piled foundations for the market canopy terminate at a shallower depth, within the superficial deposits and effectively rely on skin friction, IDG consider the risk from any potential unrecorded workings within the Arley Mine coal seam would be negligible. IDG recommend this report is provided to the Structural Engineer responsible for foundation design in order to determine whether an engineered foundation can be designed to mitigate the identified risk. If an appropriate engineered foundation cannot be designed, further intrusive investigation may be necessary.

Some further work is recommended, or may be required subject to comments from the Structural Engineer:

- Additional intrusive investigation to assess possible ground contamination relating to former land uses (garages and timber yard) within the footprint of the proposed new building in the west of the site when access is available.
- Further intrusive investigation comprising rotary drilling may be required to determine the presence of the Arley Mine coal seam in the magenta hatched area shown on Drawing No. 5237-G-D003, subject to the comments from the Structural Engineer responsible for design of the foundations for the market canopy.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

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Appendix A - Drawings

Drawing No.	Title
5237-G-D001	Site Location Plan
5237-G-D002	Existing Site Features
5237-G-D003	Coal Mining Risk Assessment
5237-G-D004	Potential Contamination Sources
5237-G-D005	Exploratory Hole Location Plan
Just H Architects Drawing	
AP10.02 Rev A	Proposed Site Layout

Appendix B - Historical OS Plans

Appendix C - Search Responses & Desk Study Data

From	To	Date	Content
Landmark	IDG	16/11/21	Environmental Search Response
Coal Authority	IDG	17/11/21	Coal Mining Report

Appendix D - Exploratory Records

Appendix E - Contamination Analysis & Chemical Test Results

Appendix F - Geotechnical Test Results

Appendix G – Gas Monitoring Results & Calibration Certificate

Appendix H - General Notes

01	Environmental Setting
02	Ground Investigation Fieldwork
03	Geotechnical Testing
04	Contamination Laboratory Analysis & Interpretation (including WAC)
05	Hazardous Gas

Revision History

From	Date	Comments
5237-G-R001	May 2022	Original Report
5237-G-R001 Rev A	August 2022	Hazardous ground gas risk assessment updated

FOREWORD**(Geoenvironmental Appraisal Report)**

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of ID Geoenvironmental Limited (IDG); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report presents observations and factual data obtained during our site investigation and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from IDG prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. IDG cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report (including review of any third party reports) are based on information obtained from a variety of sources as detailed within this report, and which IDG believes are reliable. All reasonable care and skill has been applied in examining the information obtained. Nevertheless, IDG cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geo-environmental consultants. IDG does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by IDG, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy.

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

This report assumes that ground levels will not change significantly from those existing at present. If this is not to be the case, then some modification may be required.

ID Geoenvironmental Limited cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

IDG reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

GEOENVIRONMENTAL APPRAISAL

of land at

BURY MARKET

1 INTRODUCTION

1.1 The Commission and Brief

1.1.1 ID Geoenvironmental Limited (IDG) have been commissioned by Bury Council (The Client) to undertake a geoenvironmental appraisal of land at Bury Market, hereafter referred to as 'the site'. A third party, Vinci Construction UK Limited (Vinci), have been appointed by Bury Council as the Design & Build Contractor for the development.

1.1.2 The agreed scope of works comprised:

- A site walkover and inspection.
- An assessment of the environmental setting and land-use history of the site and adjacent area from published geological maps and environmental database sources.
- Identification of potential receptors and derivation of site conceptual model.
- An intrusive investigation comprising window sampling and cable percussive boreholes
- Installation of monitoring wells and monitoring of groundwater levels and hazardous ground gases on six occasions over a three-month period.
- Undertaking a quantitative contamination risk assessment using generic assessment criteria.
- Identification of site development constraints and provision of recommendations for site remediation works.

1.2 The Proposed Development

1.2.1 It is understood that the project comprises the demolition of a number of buildings at the site followed by the construction of a new building in the west of the site and the construction of a new canopy to Bury Market in the central and eastern sections of the site. Vinci have indicated that both the canopy structure and the new building will require piled foundations.

1.2.2 A site layout has been provided by Bury Council (Just H Architects Drawing Ref. AP10.02 Rev A) which is presented in Appendix A.

1.2.3 IDG have classified the proposed development as Geotechnical Category 2.

1.2.4 The principal objective of this phase of investigation is to identify salient geoenvironmental issues affecting the site. Supplementary investigation to satisfy the Local Planning Authority, develop a Remediation Strategy and enable refinement of development proposals may be required.

1.3 Report Format and Limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix H, which includes background, generic information on:

- Assessment of the environmental setting of the site
- Ground investigation fieldwork
- Geotechnical Testing
- Contamination Testing
- Hazardous Gas

1.3.2 General notes and limitations relevant to all IDG investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

2 SITE DESCRIPTION AND DEVELOPMENT PROPOSALS

2.1 General

- 2.1.1 The site location is shown on Drawing No. 5237-G-D001 presented in Appendix A. Site details are summarised in the following table.

Summary of Site Location Details

Location	Bury town centre
NGR	380600, 410570
Approximate Area	1.89ha

2.2 Site Features

- 2.2.1 An IDG Engineer completed a walkover survey of the site on 23rd November 2021.
- 2.2.2 Existing site features together with a photographic record of the site at the time of the walkover survey are presented in Drawing No. 5237-G-D002 in Appendix A.
- 2.2.3 The site has an irregular shape, is relatively flat and comprises numerous buildings used for commercial/retail purposes and some office buildings.
- 2.2.4 The central and eastern sections of the site comprise blocks of single-story brick buildings with canopies extending out over tarmac hardstanding to protect shoppers from the weather.
- 2.2.5 The west of the site consists of three buildings with associated small car parks and Hilton Road.
- 2.2.6 The northwest of the site consists of Princess Parade, a paved walkway flanked by commercial retail buildings which runs to the north of the site where it enters into an area named 'The Square' which also consists of a paved area flanked by commercial/retail buildings.
- 2.2.7 No evidence of contamination was noted during the walkover survey.
- 2.2.8 IDG did not observe any invasive species such as Japanese Knotweed or Himalayan Balsam during the site walkover. However, it should be noted that IDG are not qualified ecologists and recommend that specialist ecological advice be sought prior to development.

3 SITE HISTORY

3.1 Historical Ordnance Survey (OS) Plans

- 3.1.1 In order to investigate the development history and previous land uses at the site and immediate surrounding land, site centred extracts from OS plans dating back to 1849 were examined. These plans are presented in Appendix B.
- 3.1.2 The following table provides a summary of the salient points relating to the history of the site. Significant former uses/operations are highlighted in bold text for ease of reference.

Summary of Information from Historical Plans

Date(s)	Site	Surrounding Land
1849	Site comprises several streets with terraced buildings. Timber Yard in west of the site	Several streets and with terraced housing/buildings to the north and east of the site Park present 20m west of the site Street with terraced housing immediately south of the site with open land beyond Five timber yards located within 100m of the site Smithy located 150m east

Date(s)	Site	Surrounding Land
1891	More terraced buildings constructed in the east of the site Theatre Royal Opera House present in the west of the site Timber yard no longer present in west of the site	Railway lines and goods station 200m south and southwest Additional streets and terraced buildings constructed to the south and east of the site. Iron Foundry 100m east of the site Timber ayres no longer present. Market Hall and Fish market 100m west/northwest of site. Abattoir 250m SW
1910	No significant change on site	Abattoir to the southwest of the site has expanded Former market hall west of the site demolished and replaced by Kay Gardens Market Hall built 30m west of site Fish market no longer present
1930	Theatre along the western boundary has been extended to the south	No significant changes noted
1959	The majority of buildings have been demolished. Site mainly comprises intersecting roads with open areas between them where the buildings were once present. Theatre house now named Cinema Royal Garage present to the south of the Cinema Royal and also extends offsite.	Technical college constructed 50m southwest of the site No other significant changes noted.
1973	All buildings and roads have been replaced with an open market in the east and buildings in the west. Garage present in the southwest of the site. The layout of the site is almost identical to the current layout.	The entire area has undergone significant redevelopment with the majority of the old buildings/roads within 100m of the site no longer present. Angoulene Way forms the southern boundary of the site with car parks and two large buildings beyond. Market Hall and shopping centre built immediately north of the site. Former market hall and open market to the west of the site replaced with a car park.
1992	No significant changes on site	No significant changes noted

4 GEOLOGY

4.1 British Geological Survey (BGS) Plans

1:50,000 Scale Plan

- 4.1.1 BGS Sheet 85 depicts the site to be underlain by Glaciofluvial Deposits with the bedrock beneath the site comprising Pennine Middle Coal Measures.

1:10,560 Scale Plan

- 4.1.2 BGS Lancashire Sheet 88 SW shows a fault crossing the east of the site, trending northwest-southeast. The downthrow is to the west. The amount of throw is not stated.
- 4.1.3 The plan shows the Arley Mine coal seam subcrops in the east of the site, to the north of the fault. The subcrop is shown as a dashed line which indicates it is an inferred location (i.e. not proven).
- 4.1.4 The plan also shows the Arley Mine coal seam subcropping to the southeast of the site, also dipping to the west beneath the site. At its closest point to site (i.e. 50-100m of the site boundary), the subcrop of the Arley Mine coal seam is shown as a dashed line which indicates the location of the subcrop is inferred.
- 4.1.5 The angle of dip of the bedrock in the local area is stated as being 1 in 5 to the west (approx. 11°) with this measurement being taken from a worked Arley Mine coal seam located approximately 350m south-southeast of the site.

- 4.1.6 There is also a comment provided on the plan regarding the superficial deposits that is relevant to the site in its immediate surrounding area. The comment states 'variable beds of running sand, gravel and clay'.

4.2 Coal Authority Interactive Viewer

- 4.2.1 The Coal Authority's interactive viewer identifies a small section in the east of the site is determined a high-risk development area. The extent of the high-risk development area is consistent with the extent of an area shown on the interactive viewer as probable shallow coal mine workings.

4.3 Coal Mining Report

- 4.3.1 A Coal Authority report for the site states the following:

- The property is not within a surface area that could be affected by any past recorded underground coal mining. However, the property is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked at some time in the past. The potential presence of coal workings at or close to the surface should be considered, particularly prior to any site works or future development activity, as ground movement could still be a risk.
- The property is not within a surface area that could be affected by present underground mining.
- The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.
- The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.
- There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.
- The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.
- The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.
- The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.
- There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.
- The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.
- According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. In view of the coal mining circumstances we would recommend that any planned or future development should follow detailed technical advice before beginning work on site.

- 4.3.2 Given the comments provided in the Coal Authority's mining report and the information obtained from the Coal Authority's interactive viewer, a coal mining risk assessment is considered necessary, this is presented in Section 5.

4.4 BGS Borehole Records

4.4.1 Records have been obtained from the BGS for the exploratory holes shown in the table below.

BGS Borehole Records

BGS BH Ref.	Date	Location	Final Depth (m)	Summary of Strata Encountered (m BGL)
SD81SW50	7/8/63	Adjacent to North corner of site	30.5	0.0-1.5 MADE GROUND 1.5-3.5 Soft PEAT 3.5-7.3 Clayey SAND & GRAVEL 7.3-8.4 Silty fine SAND 8.4-9.3 Soft silty CLAY 9.3-11.3 SANDSTONE 11.3-14.6 FIRECLAY 14.6-16.8 SHALE & FIRECLAY 16.8-18.9 CLAY & SHALE 18.9-19.8 SANDSTONE 19.8-20.7 SHALE 20.7-22.3 SANDSTONE 22.3-24.0 MUDSTONE 24.0-30.5 MUDSTONE with bands of Fireclay Water recorded at 4.8mbgl
SD81SW53	14/8/63	20m N of site	28.05	0.0-1.8 MADE GROUND 1.8-3.7 Soft PEAT 3.7-8.5 Sandy CLAY 8.5-10.1 Soft SAND 10.1-11.3 SHALE 11.3-13.4 SANDSTONE 13.4-18.3 SHALE & FIRECLAY 18.3-20.1 MUDSTONE 20.1-22.3 SHALE 22.3-24.4 SMUDGY COAL 24.4-28.0 FIRECLAY & SHALE Water at 4.2mbgl
SD81SW55	3/9/63	55m N of site	4.8	0.0-1.8 PEAT & CLAY 1.8-4.8 Silty SAND & GRAVEL
SD81SW34	28/10/59	99m SE of site	9.5	0.0-0.6 ASH & CLINKER 0.6-0.9 MADE GROUND 0.9-1.5 Soft sandy CLAY 1.5-2.2 SAND & GRAVEL 2.2-3.1 Very sandy CLAY 3.1-3.6 Very sandy CLAY 3.6-4.5 SAND 4.5-5.4 Sandy CLAY 5.4-7.3 Fine SAND 7.3-9.5 Sandy CLAY
SD81SW52	31/8/63	80m N of site	12.6	0.0-2.9 MADE GROUND 2.9-5.1 SAND & GRAVEL 5.1-5.8 Silty SAND 5.8-8.5 Soft/firm SILT with clay laminations 8.5-11.9 Stiff sandy CLAY 11.9-12.6 Shaley CLAY with sandstone inclusions Water at 4.2m, 4.8m & 7.3mbgl
SD81SW19	May 1924	103m E of site	11.7	0.0-4.8 GRAVEL 4.8-6.2 CLAY 6.2-6.6 GRAVEL 6.6-8.7 CLAY 8.7-9.0 BOULDER CLAY 9.0-9.1 Grey STONE 9.1-10.7 Sandy CLAY

BGS BH Ref.	Date	Location	Final Depth (m)	Summary of Strata Encountered (m BGL)
SD81SW331	27/11/96	110m NW of site	4.1	0.0-0.45 MADE GROUND 0.45-3.0 GRAVEL 3.0-3.6 SAND 3.6-5.5 GRAVEL 5.5-7.5 CLAY Water at 3.5mbgl
SD81SW335	23/11/96	243m W of site	7.5	0.0-0.45 MADE GROUND 0.45-3.0 GRAVEL 3.0-3.6 SAND 3.6-5.5 GRAVEL 5.5-7.5 CLAY
SD81SW501	2/3/93	291m SW of site	8.25	0.0-1.7 MADE GROUND 1.7-2.3 Sandy CLAY 2.3-3.8 Very sandy GRAVEL 3.8-4.0 Sandy CLAY 4.0-5.0 SAND with patches of clay 5.0-6.4 Sandy CLAY 6.5-8.25 SANDSTONE

4.4.2 Review of the ground conditions encountered in BGS boreholes indicate the presence of Made Ground up to 1.8m thick and Peat deposits up to 2m thick within 40m of the northern site boundary.

4.4.3 Other boreholes located within 105m of the site also encountered Made Ground, up to 2.9m thick.

4.5 BGS GeoSure Natural Ground Stability Hazard Datasets

4.5.1 Information from BGS relating to potential ground stability hazards is summarised in the following table.

Natural Ground Stability Hazard

Hazard	Hazard Potential	Estimated Distance from Site
Potential for shrinking or swelling clay ground stability hazards	No hazard	On-site
Potential for landslide stability hazards	Very Low	On-site
Potential for ground dissolution stability hazards	No hazard	On-site
Potential for compressible ground stability hazards	No hazard	On-site
Potential for collapsible ground stability hazards	Very Low	On-site
Potential for running sand ground stability hazards	Very Low	On-site

4.6 Brine Extraction

4.6.1 The site is not situated within the Cheshire Brine Subsidence Compensation District.

4.7 Quarrying

4.7.1 No evidence to indicate quarrying has taken place onsite or within 250m of the site.

5 COAL MINING RISK ASSESSMENT

5.1 Geology

5.1.1 The Arley Mine coal seam (known to be 2-4ft thick in the area) subcrops beneath the northeast of the site and is also shown to subcrop to the east of the site. The geological plan for the area shows the line of the coal subcrop is broken by a geological fault which trends across the east of the site in a northwest-southeast direction. The locations of the coal subcrops and the geological fault are shown on Drawing No. 5237-G-D003 presented in Appendix A.

5.1.2 Given the presence of a geological fault crossing the site, separate mining assessments are required for both sides of the fault, (i.e. north of fault and south of fault).

5.2 Mining Assessment for Area of the Site Located to the North of the Fault

5.2.1 The following information is considered relevant to the assessment:

- OS plans show properties have been present in this area of the site and its surrounding area since before 1847.
- A small part of the site to the north of the fault is located in a high-risk development area which correlates with the extent of an area of probable mineworkings as shown on the Coal Authority's interactive viewer.
- A Coal Authority mining report states the site is not within a surface area that could be affected by any past recorded underground coal mining. However, the site is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked at some time in the past.
- The geological plan for the area shows the Arley Mine coal seam subcrops on site to the north of the fault as a dashed line. The dashed nature of the line indicates it is an inferred location (i.e. not proven).
- There are no recorded mine shafts to the north of the fault, which gives an indication that the Arley Mine coal seam has not been worked to the north of the fault.
- BGS BH Ref. SD81SW50, located approximately 10m north of the site, extended to a depth of 30.5m and did not record any coal.
- BGS BH Ref. SD81SW53, located approximately 35m north of the site, recorded 'smudgy coal' at a depth of 22.3m-24.4m. The term 'smudgy coal' is synonymous with the term 'dirty coal' and indicates a very ashy coal with thick partings of blaes or fireclay and is considered unlikely to have been worked.

Assessment

5.2.2 Given the above information, IDG consider it is unlikely the Arley Mine coal seam has been worked beneath the site to the north of the fault and whilst the risk cannot be entirely discounted, IDG consider the risk to be very low/negligible.

5.2.3 Drawing No. 5237-G-D003 presented in Appendix A shows the extent of the very low/negligible risk area (blue hatched area) in relation to the extent of the high-risk development area of the site shown on the Coal Authority's website.

5.3 Mining Assessment for Area of the Site Located to the South of the Fault

5.3.1 The following information is considered relevant to the assessment:

- OS plans show properties have been present in this area of the site and its surrounding area since before 1847.
- A small section of the site to the south of the fault is located in a high-risk development area which correlates with the extent of an area of probable mineworkings shown on the Coal Authority's interactive viewer.
- A Coal Authority mining report states the site is not within a surface area that could be affected by any past recorded underground coal mining. However, the site is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked at some time in the past.
- The geological plan for the area shows to the south of the fault, the Arley Mine coal seam subcrops approximately 50m to the east of the site boundary, dipping to the west at an angle of 1 in 5 (11°).
- Between 50-100m of the site boundary, the subcrop of the Arley Mine coal seam is shown as a dashed line which indicates the location of the subcrop is inferred (i.e. not proven).
- A mine shaft is located 425m south of the site. Information provided on the geological plan indicates the Arley Mine coal seam was encountered in this shaft at a depth of 91.5ft (27.9m bgl) and is considered to have been worked from this shaft. This is supported by the subcrop of the Arley Mine coal seam in the vicinity of the shaft being shown as a

continuous black line on the geological plan, which indicates the location of the subcrop has been proven.

Assessment

- 5.3.2 Given the above information, IDG consider it is possible the Arley Mine coal seam has been worked beneath the site. However, given that buildings have been present on site prior to 1849 and the position of the coal seam at its closest location to the site being inferred i.e. not proven, IDG consider the likelihood of unrecorded workings beneath the site to be low. Therefore, given that the risk cannot be discounted, further consideration to determine the extent of the site potentially at risk is considered necessary.
- 5.3.3 IDG have subsequently undertaken an assessment to determine the point where 10 times (10x) rock cover would be present above any unrecorded workings in the Arley Mine coal seam. The 10x rock cover assessment is a generally accepted principle that where 10x rock cover exists above the coal seam, the risk of ground related instability due to upward void migration from a worked seam can be discounted.
- 5.3.4 The following assumptions have been used to determine the point at which 10x rock cover would be present above the Arley Mine coal seam:
- Worst case scenario seam thickness of 1.2m used (Arley Mine coal seam thickness known to range between 2-4ft in the coalfield)
 - Inferred line of Arley Mine coal seam subcrop taken from 1:10,560 geological plan (Sheet Ref. Lancashire 88 SW)
 - Seam dip angle of 11°
- 5.3.5 Using the above assumptions, a distance of 62m from the inferred coal subcrop has been calculated, which relates to the point where 10x rock cover (12m thickness) would be present above the coal seam and any potential unrecorded workings within it.
- 5.3.6 Drawing No. 5237-G-D003 presented in Appendix A shows where 10x rock cover has been calculated to be present above the seam (i.e. 62m from subcrop) in relation to the extent of the high risk development area of the site as shown on the Coal Authority's interactive viewer. This is presented on the drawing as:
- Section of the site shown to be in a high-risk development area but where more than 10x rock cover is present (green hatched area)
 - Section of the site shown to be in a high-risk development area where less than 10x rock cover is present (magenta hatched area)
- 5.3.7 This assessment has identified a small section along the eastern boundary of the site where less than 10x rock cover may exist above any possible unrecorded workings within the Arley Mine coal seam. IDG have calculated that at the eastern boundary of this affected area, 7x rock cover would be provided above the seam.
- 5.3.8 Given the above information, IDG consider the risk from shallow mineworkings for the majority of the high-risk development area can be discounted. However, there is a small section of the high-risk development area, close to the eastern boundary of the site, where less than 10x rock cover would be present above any potential unrecorded workings within the Arley Mine coal seam. IDG have calculated that at the eastern site boundary within this affected area, 7x rock cover would be provided above the seam.
- ## **5.4 Coal Mining Assessment Summary**
- 5.4.1 The coal mining assessment has identified part of the site is located in a high-risk development area associated with an area of indicated probable workings within the Arley Mine coal seam on the coal authority's interactive viewer.
- 5.4.2 The geological plan for the area indicates a geological fault crosses the site and is located within the extent of the high-risk development area. This resulted in an assessment of the mining risk being

undertaken for the high-risk development area located to the north and the south of the fault.

- 5.4.3 The assessment for the north of the fault concluded a very low/negligible risk of unrecorded mine workings being present.
- 5.4.4 The assessment to the south of the fault concluded that the risk from unrecorded shallow mineworkings can be discounted for the majority of the high-risk development area, but a small area, close to the eastern boundary of the site, has been identified where less than 10x rock cover would be provided above any possible unrecorded workings within the Arley Mine coal seam.
- 5.4.5 Therefore, for the magenta hatched area shown on Drawing No. 5237-G-D003, should the piled foundations for the market canopy extend to the bedrock, IDG consider there is a low risk from potential unrecorded mine workings within the Arley Mine coal seam. It is considered that this assessment of risk could be reduced if the foundations were to terminate within the superficial deposits, subject to the findings of the intrusive investigation.

6 ENVIRONMENTAL SETTING

6.1 General

- 6.1.1 Environmental information was obtained from the Landmark Group and is included in Appendix C. Notes describing how the site's environmental setting has been assessed are included in Appendix H. A summary of relevant information is presented below.

6.2 Hydrogeology

- 6.2.1 The Envirocheck report states:
- The superficial deposits beneath the site are classed as a Secondary A Aquifer of medium vulnerability
 - The bedrock beneath the site is classified as a Secondary A Aquifer
 - No groundwater abstractions within 1km of the site
 - The site is not located within a Source Protection Zone
- 6.2.2 The majority of the site is located within an area of potential groundwater flooding for property situated below ground level.
- 6.2.3 A small area in the northwest of the site is located in an area of limited potential for groundwater flooding to occur.

6.3 Hydrology

- 6.3.1 The Envirocheck report states:
- The nearest water course is located 140m northeast of the site
 - The nearest surface water feature is located 160m southwest of the site.
 - No surface water abstraction licenses within 500m of the site.
 - The site is not located in an area at risk from flooding by rivers or the sea

6.4 Pollution Incidents

- 6.4.1 No significant pollution incidents have been recorded within the vicinity of the site.

6.5 Radon

- 6.5.1 The site is not located in a radon affected area, as less than 1% of properties are above the Action Level.
- 6.5.2 Building Control Regulations do not require radon protection measures to be installed.

6.6 Landfills

- 6.6.1 Details of known or suspected areas of landfill within 250m of the proposed development site are summarised in the following table.

Landfill Sites

Location	Distance from Site	Remarks	Source of data
Peel College	242m south	No additional information provided	Envirocheck

6.7 Hazardous Substance Entries

- 6.7.1 The Envirocheck report does not indicate any:
- COMAH or NIHHS sites within the vicinity of the site.
 - Pollution incidents within the vicinity of the site.
 - Fuel Station Entries within the vicinity of the site.

6.8 Sensitive Land Uses

- 6.8.1 No sensitive land uses have been identified within the vicinity of the site.

7 PRELIMINARY CONCEPTUAL SITE MODEL

General

- 7.1.1 Based on the data presented in the preceding sections of this report, a Preliminary Conceptual Site Model has been determined as outlined below.

Potential Contamination Sources

- 7.1.2 Historical OS plans indicate the site has had several phases of development generally associated with commercial retail use which are unlikely to have caused significant contamination.
- 7.1.3 However, two garages and a timber yard have been present in the west of the site which are considered to have the potential to have caused ground contamination. The locations of the potential contamination sources are shown on Drawing No. 5237-G-D004 presented in Appendix A.
- 7.1.4 BGS borehole records indicate thick deposits of Made Ground and peat are present close to the northern boundary of the site which may extend onto site. These deposits are considered to present a low risk of hazardous ground gas.
- 7.1.5 The risk of hazardous ground gas associated with potential mineworkings within the Arley Mine coal seam beneath the site has been discounted due to the depth of the coal seam beneath the site and the provision of at least 7x rock cover above the seam.
- 7.1.6 A landfill site, named as Peel College, has been identified 242m south of the site. This landfill is not considered to represent a plausible source of hazardous ground gas given its distance from site.

Human Receptors

- 7.1.7 Following the proposed redevelopment, human receptors will include workers within the new properties, visitors using public open space areas, and residents in neighbouring properties.
- 7.1.8 In addition, future utility maintenance workers could be affected by contaminants that remain in the ground following site redevelopment.
- 7.1.9 Transient risks to construction workers from handling contaminated soils are normally addressed by the adoption of appropriate health and safety measures during the construction works, and therefore these receptors are not considered further.
- 7.1.10 Similarly, risks to residents in neighbouring properties due to airborne dust or vapours during redevelopment works should be addressed by the adoption of suitable measures.

Controlled Water Receptors

- 7.1.11 The superficial deposits beneath the site are classified as Secondary A Aquifer. The underlying bedrock is classified as a Secondary A Aquifer. There are no groundwater abstractions within 1km of the site and the site is not located within a source protection zone.
- 7.1.12 The nearest surface watercourse is an unnamed river 140m east of the site.
- 7.1.13 Based on the above, the site's environmental setting has been assessed as very low sensitivity.

Preliminary Conceptual Site Model

- 7.1.14 A Preliminary Conceptual Site Model has been prepared after consideration of all the data presented in the preceding sections of this report. Potential pollutant linkages are summarised in the following table.

Preliminary Conceptual Site Model

Potential Contamination Source	Receptors	Plausible Pathways	Evidence / Site Features
Metals in Made Ground	Human Health (future site users – commercial users)	Ingestion, direct contact, inhalation of dust	Former buildings dating from the 1800's have been demolished
PAH in Made Ground	Human Health (future site users – commercial users)	Direct contact, inhalation of dust	Former buildings dating from the 1800's have been demolished
Asbestos cement fragments & fibres in Made Ground	Human Health (future site users – commercial users)	Inhalation of dust containing asbestos fibres	Former buildings dating from the 1800's have been demolished
Hydrocarbon & VOC impacted soils	Human Health (future site users – commercial users)	Ingestion, direct contact and inhalation of vapours	Two garages and a timber yard located on site
Hazardous Gas (CO ₂ , CH ₄)	Human Health	Migration of Carbon Dioxide through granular strata and ingress into confined spaces leading to potential asphyxiating mixtures of gas	Made Ground deposits >1m thick and peat deposits up to 2m thick proven in boreholes located within 40m of the site's northern boundary
	Proposed Buildings	Migration of Methane through granular strata and ingress into confined spaces leading to potential explosive mixtures of gas	

8 GROUND INVESTIGATION DESIGN

8.1 Ground Investigation Design & Strategy

- 8.1.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Initial Ground Investigation Strategy

Exploratory Holes	Purpose
Cable Percussion Boreholes / Window Sampling Boreholes	To determine the general nature of soils underlying the site, including the: • nature, distribution and thickness of Made Ground • nature, degree and extent of contamination To install monitoring wells across the site in order to: • monitor for hazardous gas • determine groundwater levels and assess flow direction. • retrieve representative groundwater samples, to determine water quality.

8.1.2 Potential contaminants within soil and/or groundwater associated with former and current land uses at the site include:

- Metals
- Asbestos
- PAHs
- TPH (Fuels & Oils)
- VOCs & SVOCs

9 FIELDWORK

9.1 Exploratory Hole Location Constraints

9.1.1 The investigable areas of the site was severely limited due to the site's setting, i.e. town centre with trading businesses and numerous buried services present. Therefore, window sampling and cable percussive drilling were the only practical methods of investigation.

9.1.2 It should be noted that the methods of intrusive investigation adopted allow only a limited inspection of the ground (especially soils with a significant proportion of coarse material). Furthermore, assessment of the strength of cohesive soils can be limited due to disturbance caused by drilling.

9.2 Scope of Works

9.2.1 Fieldwork was supervised by IDG between 21st February and 3rd March 2022 and comprised the exploratory holes listed in the following table.

Scope of Ground Investigation Works

Technique	Exploratory Holes	Final Depth(s)	Remarks
Cable Percussive boreholes	BH01 and BH02	12m to 25m	SPTs typically at 1m centres. Monitoring wells installed
Window Sampling boreholes	WS01 – WS05	4.45 – 5.45m	SPTs typically at 1m centres. Monitoring wells installed

9.2.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix H.

9.2.3 Exploratory hole locations are shown on Drawing No. 5237-G-D005 presented in Appendix A.

10 GROUND CONDITIONS

10.1 Exploratory Hole Records

10.1.1 A complete record of strata encountered beneath the proposed development site is given on the exploratory hole logs in Appendix D. A summary of the ground conditions is provided below.

10.1.2 The exploratory hole logs include:

- Details of the samples taken
- Descriptions of the strata
- Details of groundwater conditions encountered
- Results of in-situ testing
- Details of monitoring wells installed

10.2 Ground Conditions

10.2.1 The ground conditions encountered across the site typically comprised hardstanding underlain by Granular Made Ground proven to depths of 1.1m - 2.5m.

10.2.2 Below ground obstructions comprising relict/live services were encountered at WS02 and WS04.

Superficial Deposits

- 10.2.3 Superficial Deposits were encountered beneath the Made Ground at all exploratory hole locations and comprised alternating layers of granular and cohesive Superficial Deposits. A summary is provided in the following table.

Superficial Deposits Summary

Deposit Type	Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Range of Thicknesses (m)
Upper Granular Deposit	Sand/Sand & Gravel/Sandy Gravel	1.1 - 2.8	5.9 - 6.9	3.6 - 4.1
Upper Cohesive Deposit	Silty Sandy Clay	5.9 - 6.9	7.9 - 10.2	2.0 - 3.3
Lower Granular Deposit	Sand/Sand & Gravel/Sandy Gravel	7.9 - 10.2	10.3 - 12.1	1.9 - 2.4
Lower Cohesive Deposit	Silty Sandy Clay	10.3 - 12.1	14.1 - 14.5	2.0 - 4.2

* Base of the upper granular deposit not proven in any of the WS locations.

- 10.2.4 In addition to the superficial deposits described above, a thin layer of organic peaty sand/sandy peat, up to 0.5m thick, was encountered directly beneath the Made Ground in WS01 and BH01 in the east of the site.

Bedrock

- 10.2.5 Mudstone bedrock was proven at depths of 14.1 and 14.5m in BH01 and BH02.

10.3 Visual & Olfactory Evidence of Hydrocarbon Contamination

- 10.3.1 No evidence of hydrocarbon contamination was noted in any of the exploratory holes. However, samples of materials obtained from exploratory holes located closest to potential sources of organic contamination (BH02 & WS05) were scheduled for chemical testing to determine if they were impacted by organic contaminants.

10.4 Groundwater

- 10.4.1 Groundwater bodies were encountered in both the upper and lower granular Superficial Deposits.
- 10.4.2 Monitoring wells were installed in all of the exploratory holes and these are summarised in the following table, together with the water strikes encountered during drilling and the standing water levels based on monitoring to date.

Groundwater Levels Summary

Groundwater Body	Hole ID	Depth of Water Strike Recorded During Drilling (depth after 20 mins)	Installation Response Zone Depth (m bgl)	Standing Water Levels Recorded During Monitoring (m bgl)	Standing Water Levels (m AOD)
Upper Granular Deposit	BH01	5.00 (4.5)	-	-	-
	BH02	4.8 (4.1)	-	-	-
	WS01	4.0	3.0 – 5.0	3.93 – 3.97	90.03 – 90.07
	WS02	3.2	2.0 – 5.0	3.58 – 3.70	90.30 – 90.42
	WS03	4.3	2.0 – 4.0	3.98 – 3.99	89.92 – 89.91
	WS04A	4.0	2.0 – 5.0	4.31 – 4.33	89.97 – 89.89
	WS05	4.0	3.0 – 5.0	4.27 – 4.37	89.83 – 89.93
Lower Granular Deposit	BH01	11.8 (6.9)	7.8 – 12.5	7.73 – 7.93	86.17 – 86.37
	BH02	-	7.6 – 10.4	6.29 – 6.50	87.20 – 87.41

- 10.4.3 The results of the groundwater monitoring completed to date are presented in Appendix G.

10.5 Groundwater Sampling

- 10.5.1 An IDG engineer visited the site on 28th March 2022 to carry out development of the wells in accordance with current practice. All the wells were noted to recharge relatively rapidly following

development.

- 10.5.2 An IDG engineer made a further visit to the site on 31st March 2022 to obtain representative water samples from BH02 and WS04A, which were the exploratory holes located closest to the two former garages in the west of the site.
- 10.5.3 No free product or visual or olfactory evidence of organic contamination was identified by the Engineer during purging or sampling of groundwater from the wells.
- 10.5.4 The water samples obtained were despatched to the chemical testing laboratory and analysed for Speciated TPH, BTEX, VOCs and SVOCs.

11 HAZARDOUS GROUND GAS

11.1 General

- 11.1.1 A preliminary assessment of the risks associated with hazardous ground gas at the site has been undertaken as described in Section 7 which identified offsite Made Ground and peat deposits to the north of the site as a potential source of hazardous ground gas.
- 11.1.2 Ground conditions encountered during the investigation identified Made Ground deposits up to 2.5m thick. Whilst up to 2.5m of Made Ground has been proven to be present on site it predominantly comprised stone aggregate underlain by inert granular material (coarse sandy gravel with brick cobble, with much of the sand comprised of reworked superficial deposits). No evidence of putrescible waste or deleterious materials was encountered in the Made Ground.
- 11.1.3 Localised peaty sand/sandy peat deposits up to 0.5m thick were also encountered onsite, however, given the relatively thin thickness encountered, it is considered unlikely that they would represent a source of hazardous ground gas.
- 11.1.4 IDG therefore do not consider the Made Ground or the localised thin peaty sand/sandy peat deposits present on site to represent significant sources of hazardous ground gas.
- 11.1.5 However, IDG consider the offsite sources of hazardous ground gas stated in the conceptual site model in Section 7 do represent a potential risk to the development and therefore gas monitoring wells were installed with response zones located in the granular superficial deposits to target potential hazardous ground gas migrating onto site from the offsite sources; details of the installations are shown on the exploratory records presented in Appendix D.
- 11.1.6 The generation potential of the offsite gas sources was considered to be LOW. Therefore, in accordance with guidance given in BS 8576:2013 and the proposed commercial end use, a monitoring period of six visits over a three-month period was selected.

11.2 Scope of Works

- 11.2.1 Seven gas monitoring wells were installed during the ground investigation to enable gas monitoring to be undertaken.
- 11.2.2 The locations of the monitoring wells are shown on Drawing No. 5237-G-D005 presented in Appendix A. Details of the well installations are provided on exploratory logs presented in Appendix D.
- 11.2.3 The wells were monitored on six occasions to record flow rates, hazardous gas concentrations and groundwater levels.
- 11.2.4 A standard procedure was followed for each visit comprising measurement of the following:
- Ambient oxygen concentration
 - Atmospheric pressure
 - Borehole flow rate
 - Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser, together with carbon monoxide and/or hydrogen sulphide concentrations where

- appropriate
- Ambient oxygen concentration (to provide a check for instrument drift)
- Standing water level using a dipmeter

11.2.5 Calibration certificates for the monitoring equipment used are presented in Appendix G.

11.3 Monitoring Results

11.3.1 Gas monitoring comprised six visits undertaken between 28th February 2022 and 12th July 2022 with four visits performed during a period of falling atmospheric pressure and with two of these visits also being undertaken when the atmospheric pressure was below 1000mb.

11.3.2 A complete detailed record of IDG's gas monitoring results are presented in Appendix G.

11.4 Assessment of Monitoring Results

Groundwater Levels

11.4.1 The response zone of BH02 was flooded throughout the monitoring program. Therefore, the gas monitoring data recorded in BH02 is not considered to be representative and has not been included in the assessment.

Carbon Dioxide

11.4.2 Carbon dioxide has been detected in all of the monitoring wells, from 0.1% up to a maximum concentration of 4.6%. Significant concentrations (typically >5%) have not been detected.

Methane

11.4.3 Methane was not detected in any borehole during the monitoring program.

Oxygen

11.4.4 Whilst oxygen is not considered a hazardous gas, CIRIA 665 suggests the replacement or depletion of oxygen to a concentration below 18% v/v in a confined space can pose its own physiological risks. As such IDG consider that oxygen should be assessed where gas monitoring identifies a significant depletion of oxygen.

11.4.5 Depleted oxygen concentrations (< 18%) were detected in several boreholes during the monitoring program, with a lowest oxygen value of 10.7% recorded in WS01. Very low oxygen concentrations (<10%) were not recorded in any boreholes during the monitoring program

11.4.6 These oxygen concentrations are generally considered to be associated with natural microbial action occurring within the monitoring well following oxygen ingress into the surrounding ground during the installation of the monitoring wells. Therefore, the oxygen concentrations recorded are not considered significant and can be discounted from the assessment.

Borehole Flows

11.4.7 Steady flows were not recorded in any boreholes during the monitoring program.

Calculation of Q_{HG} Values

11.4.8 IDG's gas monitoring results presented in Appendix G include an assessment and assignment of Q_{HG} values for both methane and carbon dioxide and an 'Implied Characteristic Situation' for each borehole on each monitoring visit. In addition, values have also been calculated using the site-wide worst-case scenario from the raw monitoring data (i.e. the maximum recorded concentration and maximum recorded flow) and these are presented below:

- Methane Max Q_{HG} – 0.0001l/hr
- Carbon Dioxide Max Q_{HG} – 0.0046l/hr

11.5 Site Classification

- 11.5.1 The site has been classified in accordance with the guidance presented in BS8485:2015. The following table is reproduced from Table 2 of BS8485 and shows the GSV and concentration thresholds for site classification. This has been used as the basis for classifying the gas regime at the site.

Characteristic Situation	Hazard Potential	Characteristic GSV (l/hr)	Additional Factors
CS1	Very low	<0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2)
CS2	Low	0.07 to <0.7	Typical measured flow rate <70 L/h (otherwise consider an increase to CS3)
CS3	Moderate	0.7 to <3.5	-
CS4	Moderate to high	3.5 to <15	-
CS5	High	15 to <70	-
CS6	Very high	>70	-

- 11.5.2 The Q_{HG} values calculated indicate the gas regime at the site should be classified as Characteristic Situation 1.
- 11.5.3 Please note that further investigation of the ground conditions within the footprint or the proposed building in the west of the site is recommended. Therefore, the hazardous ground gas risk assessment may need to be reassessed after any additional investigation has been undertaken. Should the ground conditions encountered be similar to those encountered during this investigation, then IDG would consider the gas data already obtained during the monitoring programme would be representative of the site and no further assessment would be required.

12 CHEMICAL ANALYSIS

12.1 General

- 12.1.1 An assessment of potential contaminants associated with the former uses of the site has been undertaken as outlined in Section 7.

12.2 Testing Scheduled

- 12.2.1 Based on the above assessment, an IDG Engineer submitted a test schedule (summarised in the following table) to a UKAS accredited laboratory.

Chemical Testing Scheduled

Type of Sample	No. of Samples	Determinands
Made Ground	8	pH, total metals & asbestos
	8	Speciated PAH
	1	Speciated TPH, BTEX
Natural Soil	4	Speciated TPH & BTEX
Groundwater	2	Speciated TPH, VOCs, SVOCs

12.3 Human Health Generic Risk Assessment

Soil Samples

- 12.3.1 The soil contamination test results are shown in Tables 1 to 3 presented in Appendix E, together with the laboratory test results. The results have been classified by comparison with the relevant LQM/CIEH S4UL (2015) UK guidance threshold values for a *commercial end use*. A 1% SOM content has been utilised for screening purposes.
- 12.3.2 Notes outlining current guidance with respect to the interpretation of analytical data are included in Appendix H.

Inorganic Contamination - Metals

- 12.3.3 No elevated concentrations of inorganic contaminants were detected in any of the samples tested.

Inorganic Contamination - Asbestos

- 12.3.4 Asbestos fibres were not identified in any of the samples screened.

Organic Contamination - Speciated PAHs

- 12.3.5 No elevated concentrations of Speciated PAHs were detected in any of the samples tested.

Organic Contamination - Speciated TPH

- 12.3.6 Samples recovered from exploratory hole locations located nearest to two potential sources of TPH contamination (former garages in the west of the site) were subjected to Speciated TPH & BTEX analysis.

- 12.3.7 No elevated concentrations of aromatic or aliphatic TPH bandings or BTEX compounds were detected.

Groundwater Samples

- 12.3.8 The groundwater test results are shown in Table 4 presented in Appendix E, together with the laboratory test results. The results have been classified by comparison to generic assessment criteria derived by the application of SoBRA's "Development of Generic Assessment Criteria from volatile contaminants in groundwater" ver. 1.0.
- 12.3.9 Notes outlining current guidance with respect to the interpretation of analytical data are included in Appendix H.
- 12.3.10 Review of Table 4 indicates no elevated concentrations of PAH, BTEX or volatile aromatic or aliphatic TPH bandings were detected in the groundwater samples.

12.4 Controlled Waters Generic Risk Assessment

- 12.4.1 Groundwater test results are summarised in Table 5 which is presented in Appendix F. The significance of the results has been assessed by comparison with the general quality of groundwater body values presented in the Water Framework Directive (England and Wales) Directions 2015.
- 12.4.2 Concentrations of benzene, fluoranthene and naphthalene were all recorded as <1ug/l which is the laboratory's indicated test method's level of detection, however this level of detection is above their respective assessment criteria.
- 12.4.3 The recorded values of <1ug/l are not considered to be an indication of organic contamination in the samples and therefore further assessment is not considered necessary.

13 CONTAMINATION AND REMEDIATION

13.1 Introduction

- 13.1.1 The Preliminary Conceptual Site Model was presented in Section 7 of this report. In order to produce a Revised Conceptual Site Model, consideration has been given to the following:
- the nature and distribution of Made Ground
 - the nature and distribution of contamination sources
 - sources of hazardous gas and initial ground gas monitoring results
- 13.1.2 The above issues have been discussed in preceding sections of this report and are summarised in the sections below.

13.2 Contaminant Sources

- 13.2.1 The results of the chemical testing have been presented in the preceding section of this report; an assessment of the significance of the results is summarised below.

Soil Contamination

- 13.2.2 No evidence of organic or inorganic contamination has been identified in the Made Ground or natural soils tested during the investigation.
- 13.2.3 However, due to access constraints, intrusive investigation within the footprint of the proposed building in the west of the site has not been possible. Therefore, further investigation of the shallow soils within the footprint of the proposed new building is recommended when access is available.

Groundwater

- 13.2.4 Samples of groundwater obtained from the upper and lower granular superficial deposits have been subjected to chemical analysis which targeted potential mobile organic contamination associated with two former garages. No contamination was recorded in either of the groundwater bodies in respect of both human health and controlled waters receptors.

Hazardous Gas

- 13.2.5 The hazardous ground gas risk assessment has determined the site should be classified as Characteristic Situation 1.
- 13.2.6 The site is not considered to be at risk from radon gas.

13.3 Revised Conceptual Site Model

- 13.3.1 Given the statements provided above it is considered that in relation to the protection of both human health and controlled waters there are no contamination sources present at the site.
- 13.3.2 Therefore, given that no significant pollutant linkages have been identified, a Remediation Strategy should not be required by the Local Planning Authority.
- 13.3.3 However, it is noted that further investigation within the footprint of the proposed new building in the west of the site is recommended to confirm the revised conceptual site model is also appropriate for this area of the site.

14 RE-USE, DISPOSAL AND IMPORT OF MATERIALS

14.1 Background

- 14.1.1 Materials are considered to be waste if they are discarded, if there is an intention to discard, or if there is a requirement to discard. Waste can only be disposed of at a site holding an environmental permit.
- 14.1.2 Soils (Made Ground or natural deposits) are considered to be waste at the point of excavation. If these “waste” soils are placed back into the ground or transferred to other sites, it could be deemed that waste has been disposed of without a permit. The person disposing of the waste and anyone who knowingly facilitates the disposal may be liable for payment of Landfill Tax. All parties involved could also be liable to penalties for non-compliance and face criminal prosecution.

14.2 Re-use of Materials

- 14.2.1 Given the extent of the proposed new development, it is considered unlikely that a large volume of material generated during construction will be able to be retained on site. It is therefore considered that a U1 Waste Exemption, obtained from the EA, would be appropriate to enable the reuse of a limited amount of Made Ground and natural materials on site (<1000 tonnes).
- 14.2.2 Should more than 1000 tonnes of Made Ground and natural materials be anticipated to be retained on site during redevelopment it is considered a Materials Management Plan (MMP) should be produced for the site in accordance with the CL:AIRE *Definition of Waste, Construction Industry Code of Practice*.

14.3 Waste Classification

14.3.1 Base on the current development proposals it is envisaged that the majority, to all of the of arisings generated from the development will be disposed of off-site.

14.3.2 Therefore, indicative waste classification information is provided in the following table.

Indicative Waste Classification

Material Type	Waste Classification	Remarks
Made Ground	Non-hazardous	
Superficial Deposits & Bedrock	Inert	WAC test may be required for material to be accepted as inert

14.4 Import of Materials

14.4.1 Development of the site may require importation of materials such crushed brick and concrete (6F5 or similar). These materials are likely to be designated 'waste' upon export from their donor sites and will be subject to waste management legislation.

14.4.2 To ensure that waste materials are not illegally deposited, materials must be imported in accordance with one of the following:

- A Waste Exemption as defined by the EA, typically *U1 Use of Waste in Construction*
- A Materials Management Plan (MMP) for the receiving site which identifies a donor site providing clean naturally occurring materials
- A Standard Rules Permit under the Environmental Permitting Regulations (England and Wales) 2010 (e.g. SR2015 No. 39 Use of waste in a deposit for recovery operation Construction, reclamation, restoration or improvement of land other than by mobile plant)
- A "bespoke" Environmental Permit where it not possible to meet the requirement of the rules of a Standard Rules Permit.

15 GEOTECHNICAL TESTING

15.1 In-Situ Testing

Standard Penetration Tests (SPT)

15.1.1 SPTs were carried out during the drilling of the boreholes in accordance with guidance contained in BS EN ISO 22476-3 and ASTM D1586. The SPT results are summarised by strata type in the following table.

Summary of SPT Results

Strata	No. of Tests	Range of 'N' Values	Average SPT 'N' value	Estimated Shear Strength/Density
Upper Granular Superficial Deposits	20	4-31	17	Medium Dense
Upper Cohesive Superficial Deposits	1	8	8	Medium shear strength
Lower Granular Superficial Deposits	3	50	50	Dense
Lower Cohesive Superficial Deposits	3	30-50	38	High Shear Strength
Mudstone	3	50	50	-

Dynamic Probing

15.1.2 Dynamic probing was undertaken upon completion of the window sample drilling in WS01-WS05 to obtain additional geotechnical information to aid foundation design. The probes extended from a depth of 5.0m at all WS locations and terminated at depths ranging between 9.3m (WS05) and 10.0m (WS01-WS03). The dynamic probe logs are presented in Appendix D.

15.1.3 Due to the nature of dynamic probing, no information regarding the composition of the material the dynamic probe passes through can be obtained. However, based on the ground conditions encountered in the cable percussive boreholes it can be inferred that the dynamic probes

progressed through the upper granular and upper cohesive superficial deposits and the lower granular superficial deposits.

15.2 Laboratory Testing

15.2.1 Samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by IDG.

15.2.2 The geotechnical laboratory test results are presented in Appendix F and summarised below.

15.3 Soil Classification Testing

15.3.1 The Atterberg limit test is used to determine arbitrarily defined boundaries between the liquid and plastic states, and between the plastic and brittle states of fine grained soils, expressed as water percentage. Testing for moisture content, liquid limit, plastic limit and plasticity index was carried out on selected soil samples in accordance with guidance contained in BS1377-2:1990.

15.3.2 The results are summarised in the following table, together with an assessment of Volume Change Potential (Shrinkability).

Plasticity Index Results

Soil Type	Plasticity Indices (Average)	Volume Change Potential
Cohesive Superficial Deposits	15-20 (18)	Low

15.3.3 For the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of low volume change potential.

15.4 Particle Size Distribution (PSD)

15.4.1 PSDs tests were carried out on samples in order to evaluate the range of grain sizes. The results of the PSD tests are summarised in the following table.

PSD Results Summary

		Sample Location	BH01	BH01	BH01	BH01	BH01
		Sample Depth	4.0m	7.0m	9.3m	13.0m	14.4m
		Material Type	Sandy Gravel	Sandy Gravel	Silty Sandy Clay	Silty Sandy Clay	Mudstone
Soil Fraction	Particle Size (mm)						
Cobbles	63 - 200		23%	0%	22%	0%	0%
Gravel	2.0 - 63		54%	68%	14%	2%	17%
Sand	0.063 - 2.0		15%	28%	25%	10%	14%
Silt	0.002 - 0.063		7%	3%	16%	75%	55%
Clay	<0.002		1%	1%	25%	13%	14%

		Sample Location	BH02	BH02	BH02	BH02
		Sample Depth	2.3m	7.0m	8.0m	11.0m
		Material Type	Sand & Gravel	Silty Sandy Clay	Silty Sandy Clay	Silty Sandy Clay
Soil Fraction	Particle Size (mm)					
Cobbles	63 - 200		0%	0%	0%	0%
Gravel	2.0 - 63		29%	19%	2%	17%
Sand	0.063 - 2.0		45%	31%	35%	19%
Silt	0.002 - 0.063		20%	37%	46%	50%
Clay	<0.002		6%	13%	17%	14%

		Sample Location	BH02	WS01	WS02	WS03
		Sample Depth	14.4m	4.0m	3.0m	2.5m
		Material Type	Mudstone	Sandy Gravel	Sandy Gravel	Sand & Gravel
Soil Fraction	Particle Size (mm)					
Cobbles	63 - 200	0%	0%	0%	0%	0%
Gravel	2.0 - 63	36%	59%	60%	51%	
Sand	0.063 - 2.0	13%	23%	26%	30%	
Silt	0.002 - 0.063	34%	14%	11%	15%	
Clay	<0.002	17%	4%	3%	44%	

15.4.2 The results of the PSDs indicate the granular superficial deposits have a variable amount of gravel resulting in descriptions varying between gravelly SAND, SAND & GRAVEL and sandy GRAVEL.

15.4.3 The results of the PSDs also indicate the cohesive superficial deposits can typically be described as gravelly sandy silty CLAY.

15.5 Soluble Sulphate and pH

15.5.1 An assessment to determine the appropriate specification for buried concrete, testing has been carried out in accordance with guidance contained in BRE Special Digest 1:2005 *Concrete in Aggressive Ground*.

15.5.2 The site has been classified as brownfield. The groundwater regime has been classified as mobile.

15.5.3 Samples of Made Ground and natural strata were submitted for testing for pH and water-soluble sulphate.

15.5.4 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the following table.

Summary of Sulphate and pH results

Soil Type	Lowest pH value	Highest Soluble Sulphate Concentration (g/l)	Design Sulphate Class	ACEC Classification
Made Ground	6.4	0.07	DS1	AC-2Z
Granular Superficial Deposit	5.7	0.06	DS1	AC-2Z
Cohesive Superficial Deposit	8.6	0.03	DS1	AC1
Mudstone	8.8	<0.01	DS1	AC1

15.5.5 The average values of pH were all greater than 5.5, therefore concentrations of chloride and nitrate are considered insignificant.

15.5.6 Therefore, in accordance with Table C2 of BRE Special Digest 1:2005, sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2Z.

15.6 Shear Strength Tests

15.6.1 Testing to determine undrained shear strength in triaxial compression was carried out on two samples of the cohesive superficial deposits. The results are summarised in the following table.

Undrained Shear Strength Testing Results

Hole ID	Depth (m)	Strata	Material Description	Apparent Undrained Cohesion (kPa)	Strength Assessment (from BS EN ISO 14688-2:2004)
BH02	6.5	Upper Cohesive Superficial Deposit	Silty sandy CLAY	191	High shear strength
BH02	12.5	Lower Cohesive Superficial Deposit	Silty sandy CLAY	69	Medium shear strength

15.7 One Dimensional Consolidation Tests

- 15.7.1 To assess the settlement characteristics of the natural cohesive strata, one-dimensional consolidation tests were carried out on two samples of cohesive superficial deposits. Laboratory certificates are included in Appendix F.
- 15.7.2 The results are provided as plots of voids ratio and Coefficient of Consolidation (c_v) against applied pressure. The Coefficient of Volume Compressibility (m_v) has been derived for each test in accordance with BS1377 at a pressure range equal to overburden (p_0) plus 100kPa. Tests are summarised in the following table.

One Dimensional Consolidation Testing Results

Hole ID	Depth (m)	Strata	Material	m_v (m^2/MN)*	Compressibility Assessment
BH02	6.5	Upper Cohesive Superficial Deposit	Silty sandy CLAY	0.08	Low compressibility
BH02	12.5	Lower Cohesive Superficial Deposit	Silty sandy CLAY	0.04	Low compressibility

* Design m_v value calculated for a stress increment of 100kN/m² in excess of the effective overburden pressure (BS1377:1990)

- 15.7.3 The results of the one dimensional consolidation tests indicate the cohesive superficial deposits have low compressibility.

16 GEOTECHNICAL ASSESSMENT

16.1 Introduction

- 16.1.1 Consideration is being given to the proposed redevelopment of the site with a new canopy for the market area located in the central and eastern sections of the site and a new building located in the west of the site. Vinci have indicated that both the market canopy structure and the new building will require piled foundations.
- 16.1.2 Geotechnical issues affecting the site are described below.

16.2 Coal Mining Assessment

- 16.2.1 The coal mining assessment has identified part of the site is located in a high-risk development area associated with an area of indicated probable workings within the Arley Mine coal seam on the coal authority's interactive viewer.
- 16.2.2 The geological plan for the area indicates a geological fault crosses the site and is located within the extent of the high-risk development area. This resulted in an assessment of the mining risk being undertaken for the high-risk development area located to the north and the south of the fault.
- 16.2.3 The assessment for the north of the fault concluded a very low/negligible risk of unrecorded mine workings being present (blue hatched area on Drawing No. 5237-G-D003).
- 16.2.4 The assessment to the south of the fault concluded that the risk of unrecorded shallow mineworkings can be discounted for the majority of the high-risk development area (green hatched area on Drawing No. 5237-G-D003). However, a small area, close to the eastern boundary of the site (magenta hatched area on Drawing No. 5237-G-D003) has been identified where less than 10x rock cover would be provided above any possible unrecorded workings within the Arley Mine coal seam.
- 16.2.5 Therefore, should any piled foundations for the market canopy in the magenta hatch area extend to bedrock (proven to be at 14.1m in BH01) IDG consider the risk should be categorised as low. Should the foundations for the market canopy terminate at a shallower depth, within the superficial deposits and effectively rely on skin friction, IDG consider the risk from unrecorded workings within the Arley Mine coal seam would be negligible.
- 16.2.6 IDG recommend that this assessment is provided to the Structural Engineer responsible for foundation design in order to determine whether an engineered foundation can be designed to

mitigate the risk in the magenta hatched area as shown on Drawing No. 5237-G-D003. If an appropriate engineered foundation cannot be designed, further intrusive investigation comprising rotary drilling to determine the presence of the Arley Mine coal seam beneath the magenta hatched area may be necessary.

16.3 Quarrying

16.3.1 No evidence has been found to indicate that the site has been affected by quarrying.

16.4 Summary of Ground Conditions

16.4.1 The ground conditions encountered across the site typically comprised hardstanding underlain by Granular Made Ground proven to depths of 1.1m - 2.5m.

16.4.2 Superficial Deposits were encountered beneath the Made Ground and comprised alternating layers of granular and cohesive deposits. A summary is provided in the following table.

Summary of Superficial Deposits Encountered

Strata	Strength Assessment	Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Range of Thicknesses (m)
Upper Granular Deposit	Medium Dense	Sand/Sand & Gravel/Sandy Gravel	1.1 - 2.8	5.9 - 6.9	3.6 - 4.1
Upper Cohesive Deposit	Medium Shear Strength	Silty Sandy Clay	5.9 - 6.9	7.9 - 10.2	2.0 - 3.3
Lower Granular Deposit	Dense	Sand/Sand & Gravel/Sandy Gravel	7.9 - 10.2	10.3 - 12.1	1.9 - 2.4
Lower Cohesive Deposit	High Shear Strength	Silty Sandy Clay	10.3 - 12.1	14.1 - 14.5	2.0 - 4.2

16.4.3 Laboratory testing has determined both the upper and lower cohesive superficial deposits are of low compressibility with m_v results of 0.04 and 0.08 m^2/MN recorded.

16.4.4 Geotechnical laboratory testing also indicates the cohesive superficial deposits are of low volume change potential.

16.4.5 In addition to the superficial deposits described above, a thin layer of organic peaty sand/sandy peat, up to 0.5m thick, was encountered directly beneath the Made Ground in WS01 and BH01.

16.4.6 Mudstone bedrock was proven at depths of 14.1m and 14.5m in BH01 and BH02 respectively.

16.4.7 Chemical analysis of the soils at the site indicates that sub-surface concrete in contact with the Made Ground and natural ground should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2Z.

16.4.8 Groundwater bodies have been recorded in both the upper and lower granular superficial deposits resting at levels of between 2.51m-4.57m bgl (89.83-90.42m AOD) in the upper deposit and 6.29m-7.93m bgl (86.17-87.41m AOD) in the lower deposit.

16.5 Piled Foundations

16.5.1 Vinci have indicated that both the market canopy structure and the new building will require piled foundations. The following general comments relating to piling are provided for initial guidance and further advice should be sought from a specialist-piling contractor.

16.5.2 The pile designer should take account of the ground conditions encountered during the investigation and the conclusions of the coal mining assessment, most notably the magenta hatched area shown on Drawing No. 5237-G-D003 where it has been calculated that less than 10x rock cover exists above any potential workings within the Arley Mine coal seam.

16.5.3 Given the presence of cohesive superficial deposits, it is essential that the potential for negative skin friction is considered in the design of the piles.

16.5.4 The installation of piles will induce some ground vibration and assessment of vibration risk to

adjacent structures and/or existing site features should be undertaken by the pile designer.

16.5.5 It is anticipated that the ground conditions upon demolition of buildings in the west of the site will result in the requirement for a piling mat (working platform) for piling works for the proposed new building.

16.5.6 Pile design should be undertaken in accordance with guidance contained in the Environment Agency's booklet *Piling into Contaminated Sites*.

16.6 Floor Construction for Proposed New Building

16.6.1 Given the widespread presence of Made Ground across the site, it is currently considered that a suspended ground floor construction should be used for the proposed new building. Confirmation will be provided upon completion of the recommended further investigation within the footprint of the proposed new building in the west of the site.

16.7 Preparatory Works

16.7.1 Where existing buildings are to be demolished, it is considered that all concrete slabs and service ducts will require breaking out prior to re-development. However, relict foundations could probably be left in-situ and an allowance made for local breaking out where these conflict with new foundations.

16.8 Excavations

16.8.1 Excavations to relatively shallow depth should remain stable in the short term; where excavations are to be left open for a significant period of time, these will require shoring to prevent collapse, especially in Made Ground and granular soils.

16.8.2 Based on the results of this investigation it is unlikely that major groundwater flows will be encountered in shallow excavations (<2m bgl)

17 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

17.1 General

17.1.1 The conclusions below are summarised from the preceding sections of this report.

17.1.2 The proposed redevelopment of the site comprises the demolition of a number of buildings followed by the construction of a new building in the west of the site and the construction of a new canopy to Bury Market in the central and eastern sections of the site. Vinci have indicated that both the canopy structure and the new building will require piled foundations.

17.1.3 It should be noted that intrusive investigation has been restricted across the site due to the site's setting, with further investigation of the ground within the footprint of the proposed building in the west of the site recommended.

17.2 Flooding

17.2.1 The majority of the site is located within an area of potential groundwater flooding for property situated below ground level.

17.2.2 A small area in the west of the site is located in an area of limited potential for groundwater flooding to occur.

17.3 Radon

17.3.1 The site is not located in a radon affected area, as less than 1% of properties are above the Action Level.

17.3.2 Building Control Regulations do not require radon protection measures to be installed.

17.4 Geology & Coal Mining

- 17.4.1 BGS Lancashire Sheet 88 SW shows a fault crossing the east of the site, trending northwest-southeast. The downthrow is to the west. The amount of throw is not stated.
- 17.4.2 The plan shows the Arley Mine coal seam subcrops in the east of the site, to the north of the fault and subcrops to the southeast of the site to the south of the fault. The geological plan indicates the coal seam dips to the west beneath the site.
- 17.4.3 The Coal Authority's interactive viewer identifies a small section in the east of the site is determined a high-risk development area. The extent of the high-risk development area is consistent with the extent of an area shown on the interactive viewer as probable shallow coal mine workings.
- 17.4.4 A Coal Authority mining report for the site comments that, evidence of, or the potential for, coal mining related features have been identified at the site.
- 17.4.5 Given the above information a coal mining assessment was considered necessary.

17.5 Coal Mining Assessment

- 17.5.1 The assessment of the mining risk was undertaken for the high-risk development area located to the north and the south of the fault.
- 17.5.2 The assessment for the north of the fault concluded a very low/negligible risk of unrecorded mine workings being present (blue hatched area on Drawing No. 5237-G-D003).
- 17.5.3 The assessment to the south of the fault concluded that the risk of unrecorded shallow mineworkings can be discounted for the majority of the high-risk development area (green hatched area on Drawing No. 5237-G-D003), but a small area, close to the eastern boundary of the site (magenta hatched area on Drawing No. 5237-G-D003), has been identified where less than 10x rock cover would be provided above any possible unrecorded workings within the Arley Mine coal seam.

17.6 Quarrying

- 17.6.1 No evidence has been found to indicate that the site has been affected by quarrying.

17.7 Former Land Uses

- 17.7.1 Historical OS plans indicate the site has had several phases of development generally associated with commercial retail use. However, two garages and a timber yard have been present in the west of the site.

17.8 Ground Conditions

- 17.8.1 The ground conditions encountered across the site typically comprised hardstanding underlain by Granular Made Ground proven to depths of 1.1m - 2.5m.
- 17.8.2 Superficial Deposits were encountered beneath the Made Ground and comprised alternating layers of granular and cohesive deposits. A summary is provided in the following table.

Summary of Superficial Deposits Encountered

Strata	Strength Assessment	Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Range of Thicknesses (m)
Upper Granular Deposit	Medium Dense	Sand/Sand & Gravel/Sandy Gravel	1.1 - 2.8	5.9 - 6.9	3.6 - 4.1
Upper Cohesive Deposit	Medium Shear Strength	Silty Sandy Clay	5.9 - 6.9	7.9 - 10.2	2.0 - 3.3
Lower Granular Deposit	Dense	Sand/Sand & Gravel/Sandy Gravel	7.9 - 10.2	10.3 - 12.1	1.9 - 2.4
Lower Cohesive Deposit	High Shear Strength	Silty Sandy Clay	10.3 - 12.1	14.1 - 14.5	2.0 - 4.2

- 17.8.3 In addition to the superficial deposits described above, a thin layer of organic peaty sand/sandy peat, up to 0.5m thick, was encountered directly beneath the Made Ground in WS01 and BH01.
- 17.8.4 Mudstone bedrock was proven at depths of 14.1m and 14.5m in BH01 and BH02 respectively.
- 17.8.5 Laboratory testing has determined both the upper and lower cohesive superficial deposits are of low compressibility with m_v results of 0.04 and 0.08 m^2/MN recorded.
- 17.8.6 Geotechnical laboratory testing also indicates the cohesive superficial deposits are of low volume change potential.

17.9 Groundwater

- 17.9.1 Groundwater bodies have been recorded in both the upper and lower granular superficial deposits resting at levels of between 2.51m-4.57m bgl (89.83-90.42m AOD) in the upper deposit and 6.29m-7.93m bgl (86.17-87.41m AOD) in the lower deposit.

17.10 Hazardous Ground Gas

- 17.10.1 The hazardous ground gas risk assessment has determined the site should be classified as Characteristic Situation 1.
- 17.10.2 The hazardous ground gas risk assessment may need to be reassessed after any additional investigation within the footprint of the proposed new building in the west of the site.

17.11 Contamination

- 17.11.1 No evidence of contamination has been identified in soils or groundwater beneath the site.
- 17.11.2 Further investigation of the ground conditions within the footprint of the proposed new building in the west of the site is recommended when access is possible.

17.12 Foundations

- 17.12.1 Vinci have indicated the foundations for both the proposed new building and the market canopy will be piled.
- 17.12.2 The coal mining risk assessment has identified a small area in the east of the site where less than 10x rock cover is provided above the Arley Mine coal seam and any potential workings within the seam.
- 17.12.3 Should any piled foundations for the market canopy in this area (shown as a magenta hatched area on Drawing No. 5237-G-D003) extend to bedrock (proven to be at 14.1m in BH01) IDG consider the risk should be categorised as low. However, should the piled foundations for the market canopy terminate at a shallower depth, within the superficial deposits and effectively rely on skin friction, IDG consider the risk from any potential unrecorded workings within the Arley Mine coal seam would be negligible.
- 17.12.4 IDG recommend this report is provided to the Structural Engineer responsible for foundation design in order to determine whether an engineered foundation can be designed to mitigate the identified risk. If an appropriate engineered foundation cannot be designed, further intrusive investigation may be necessary.
- 17.12.5 Chemical analysis of the soils at the site indicates that sub-surface concrete in contact with the Made Ground and natural ground should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2Z.

17.13 Further Works

- 17.13.1 Additional intrusive investigation to assess possible ground contamination relating to former land uses (garages and timber yard) is recommended within the footprint of the proposed new building in the west of the site when access is available.
- 17.13.2 Subject to the comments from the Structural Engineer responsible to the foundation design for the market canopy, further intrusive investigation comprising rotary drilling may be required to determine the presence of the Arley Mine coal seam in the magenta hatched area shown on Drawing No. 5237-G-D003.