APPENDIX 7

BROWNFIELD SOLUTIONS GEO-ENVIRONMENTAL ASSESSMENT

BROWNFIELD SOLUTIONS LTD

GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

ALDI STORES LTD

WESTGATE, SKELMERSDALE

Geo-Environmental Assessment Report

JM/C3788/7517 Rev A

May 2018

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EXECUTIVE SUMMARY	
Location	The site comprises a disused office building and associated car parking off Westgate, Skelmersdale. The site covers an area of approximately 1.2 hectares and is situated approximately 1.9km west of Skelmersdale Town Centre.
Site History	The site comprised open fields from 1849 to 1927, by which time a football pitch and stands had been built. By 1974 the football pitch had been demolished and a new office block had been constructed.
Geology	The site is underlain by Glacial Till deposits over the Pennine Lower Coal Measures Formation. The Blaguegate Fault is located circa 250m east of the site. Three workable coal seams exist beneath the site, the shallowest being 21.5m bgl.
Hydrogeology	The Glacial Till is classified as a Secondary Aquifer – Undifferentiated layers, whilst the bedrock is classified as a Secondary A Aquifer. There are no detailed river network entries within 500m of the site. The site is not located within a flood risk zone.
Mining	No evidence for prior mine workings were identified during the site investigation, and in the event any seams have been worked, a sufficient rock cover exists to prevent upward migration of a void.
Environmental	Main identified potential sources of contamination on site include: • Made ground associated with the current building and car parks • Electrical Substation • Former tank • Ground gas • Mine Gas Offsite sources include backfilled ponds and pits. Associated risks were generally considered to be low to moderate for human health and low for controlled waters in general respect to a commercial end use.
Ground Conditions	Made ground was encountered in all of the borehole locations, generally comprising a thin veneer less than 0.50m thick. The natural strata underlying the made ground was generally firm to stiff sandy clay recorded to a maximum depth of 9.2m bgl. Bedrock was encountered as interbedded mudstone and sandstone from 8.5m bgl to 40.0m bgl. Three coal seams were identified beneath site at depths ranging from 21.6m to 28.2m bgl, with a maximum thickness of 1.0m.
Foundations and Floor Slabs	Pads and strip foundations are considered suitable. They will need to be taken to the underside of any made ground, founding at a depth of approximately 1.50m bgl where an allowable bearing capacity of 150kN/m^2 should be assumed. If required ground bearing floor slabs may generally be adopted at the site provided that once finished levels have been established, less than 600mm of suitable, appropriately compacted granular material exists beneath the slab.
Soil Contamination	On the basis of the testing undertaken to date it appears that there are no metals or PAHs above the relevant commercial screening values (S4ULs) for human health within the made ground. Asbestos fibres were detected in four samples however they were revealed to be at trace levels.
Groundwater Contamination	The aquifers beneath the site are considered to be at low risk. The presence of low permeability cohesive strata will prevent the downward migration of leached contaminants to the underlying aquifers. The risk to surface waters is also assessed to be low, with the overall risk to controlled waters considered to be low.

Ground Gases	The results indicate gas precautionary measures are required as the proposed development fits into Characteristic Situation 2 as assessed by CIRIA C665.
Highways	CBR values of 2% - 5% are likely to be achieved in undisturbed natural soils for pavement design purposes, unless proven otherwise by in-situ testing at sub-base level by a specialist geotechnical engineer. Where the CBR value is found to be less than 2.5%, some re-engineering of the subgrade will be required prior to highway construction to achieve the required design CBR value.
Further Work	• Drilling of additional holes in NW part of site beneath building post demolition. • Tree survey by qualified aboriculturist. • Foundation design – inc test grout holes • Confirmation of Remedial Strategy Local Authority

PROJECT QUALITY CONTROL DATA SHEET

Site Name:	Westgate, Skelmersdale		
Report Name:	Geo-Environmental Assessment Report		
Report Number:	JM/C3788/7517 Rev A		
Date:	11 May 2018		
Status:	Final		
Revision:	Rev A	25/06/2018	Completed Gas Monitoring

Client: Aldi Stores Ltd	**Engineer: SWF Consulting Ltd**
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GEO-ENVIRONMENTAL ASSESSMENT REPORT FOR A SITE OFF WESTGATE, SKELMERSDALE

1.0 INTRODUCTION

1.1 Objectives

1.1.1 This report describes a Geo-environmental Assessment carried out by Brownfield Solutions Limited (BSL) for Aldi Stores Limited for a site off Westgate, Skelmersdale.

1.1.2 A previous Desk Study and Coal Mining Risk Assessment was undertaken by Brownfield Solutions Ltd for the site, referenced below.

- Brownfield Solutions Ltd, Phase 1 Desk Study Assessment Report, reference JMC/C3788/7347, dated 26th January 2018.
- Brownfield Solutions Ltd, Coal Mining Risk Assessment, reference JMC/C3788/7390, dated 26th January 2018.

1.1.3 The objectives of the assessment were to determine the sites environmental setting and likely ground conditions, highlighting potential areas of concern that may govern the sites redevelopment.

1.1.4 An initial intrusive investigation was undertaken to confirm the findings of the preliminary CSM and risk assessment and meet any objectives that had not been satisfied. The initial investigation was undertaken using rotary open boreholes, window sampling, cable percussive boreholes and hand dug trial pits.

1.1.5 The report has been completed in general accordance with CLR11 "Model Procedures for the Management of Land Contamination", BS 5930:2015 and BS 10175:2011+A1:2013.

1.2 Proposed Development

1.2.1 The proposed development will consist of a new purpose-built Aldi Superstore, with associated hardstanding car parking, soft landscaping and a smaller secondary retail unit situated on the northern part of the site. A proposed development layout plan is presented in Drawings for reference, by Harris Partnership Architects, drawing number 2269BOL-100 dated November 2017.

1.3 Limitations

1.3.1 This assessment has been carried out based on information obtained from a number of areas, BSL have assumed that this information is correct.

1.3.2 There may be other conditions prevailing on the site which are outside the scope of work and have not been highlighted by this assessment and therefore not been taken into account by this report. Responsibility cannot be accepted for such site conditions not revealed by the assessment.

1.3.3 Access was not available to drill any boreholes inside the existing building, and access was not possible to drill rotary open holes in the north west corner of the site.

1.3.4 This report has been prepared for the sole use of the client. No other third parties may rely upon or reproduce the contents of this report without the written permission of Brownfield Solutions Ltd (BSL). If any unauthorised third party comes into possession of this report they rely on it at their own risk and BSL do not owe them any Duty of Care.

2.0 THE SITE

2.1 Location & Access

2.1.1 The site covers an area of approximately 1.2 hectares and is situated approximately 1.9km west of Skelmersdale Town Centre.

2.1.2 The site is centred on National Grid Reference 346912, 405873 as shown on the Site Location Plan C3788/01.

2.1.3 Access to the site is gained off High Street to the north and Westgate to the west of the site.

2.2 Site Description

2.2.1 The site is currently a vacant office with associated car park. The main building is irregular in shape and occupies the majority of the north of the site.

2.2.2 The area surrounding the building to the north and west are surfaced in soft landscaping with trees and there are shrubs and steps down to the main office from High Street. The car park areas located to the east and south of the building are surfaced with asphalt.

2.2.3 The site is split on two levels by a retaining wall and an embankment covered in soft landscaping with steps. The southern car park is circa 1.00m lower in level than the building and eastern car park area. There are fences along the boundary surrounding the eastern car park and the main building. The southern car park is bound by fencing to the east and south and by removable concrete blocks to the west.

2.2.4 Electronic gates are situated towards the north of the site and between the eastern and southern car park area, with a small sloped and curved link road between the two.

2.2.5 The site slopes from north to south and the difference in height is circa 4.50m.

2.2.6 Anecdotal evidence indicates asbestos is present in the existing building.

3.0 DESK STUDY SUMMARY

3.1 A summary of the relevant points from the desk study undertaken by Brownfield Solutions Ltd is presented in the table below:

- The earliest map dates back to 1849, where the site consisted of undeveloped fields. By 1891 a football pitch had appeared across the centre of the site, and by 1927 two small structures had been developed south of the football pitch. By 1974 all previous structures were no longer present, and the site had been developed with a large irregular building across the majority of the centre of the site, which was extended towards the south of the site in 1978, along with the construction of an electricity substation. The map dated 2010 shows part of the building to have been demolished. No significant change occurred between 2010 and the present day.
- Geology comprises Glacial Till deposits (Secondary Undifferentiated Aquifer) over the Pennine Lower Coal Measures (Secondary A Aquifer).
- The Blaguegate Fault is located circa 250m east of the site, trending north to south with strata being downthrown to the east.
- The site is recorded as being situated within an identified coal mining area.
- There is potentially an unknown seam sub-cropping on site beneath the superficial deposits. The Skelmersdale Earthly Delf Seam potentially lies at a depth ranging between 21-28m beneath the site, whilst the Ravine Seam potentially lies at depths ranging between 42-56m beneath the site. Both named seams are considered to be of workable thickness. Additional workable seams lie at greater depth.
- There are no detailed river network entries within 500m of the site.
- The site is not located within a flood risk zone.
- The site is within an area of very low hazard from shrinking or swelling of clays, landslides, rock solubility and compressible ground.
- The site is not located in an area requiring radon precautions in foundations.
- The risks to human health from metals, inorganic and low volatile contaminants is expected to be low.
- The risk to groundwater from possible leachate contaminants in the made ground is expected to be low.
- The potential for ground gas is considered to be moderate to low, therefore gas monitoring was recommended.
- The desk study recommended a proportionate Phase II Intrusive Investigation should be carried out to confirm the risks to site end users, controlled waters and the risk to the development from instability caused by historical coal extraction.

4.0 METHOD OF INVESTIGATION

4.1 Objectives

4.1.1 The aim of the fieldwork was to:

- Investigate ground conditions on the site.
- Assess the potential contamination on the site and obtain samples for contamination screening.
- Assess the potential impact of any contamination on controlled waters.
- Assess the need for detailed investigation.
- Obtain geotechnical information on the ground conditions at the site for preliminary foundation design and preliminary pavement design purposes.
- Install standpipes to allow future monitoring.
- Give an assessment of the geo - environmental risks associated with redevelopment of the site.

4.2 Site Works

4.2.1 Eight rotary open boreholes (RO01 to RO08) were drilled to depths between 30.00m and 40.00m bgl using a tracked rotary rig and water flush from 20th to 21st March 2018.

4.2.2 Seven window sample boreholes (WS1 to WS7) were drilled to depths between 2.45m and 5.45m bgl using a tracked window sampling rig and liners (windowless) on 22nd March 2018.

4.2.3 Two cable percussive boreholes (BH1 and BH2) were drilled to depths between 8.50m and 9.95m bgl using a cable percussive rig with 6inch casing from 22nd to 23rd March 2018.

4.2.4 Four trial pits (HP1 to HP4) were excavated by hand to depths between 0.61m and 1.15m using insulated digging equipment on 20th March 2018 to determine the nature of existing foundations.

4.2.5 The approximate locations of the exploratory holes are indicated on the Exploratory Hole Location Plan, Drawing No C3788/03. The exploratory hole logs are presented in Appendix A.

4.2.6 The exploratory holes were positioned to establish general ground conditions on the site and investigate the area below the proposed store footprint and the unknown coal seam identified in the coal mining risk assessment. The trial pits were logged by an experienced geo-environmental engineer in general accordance with BS 5930 'Code of Practice for Site Investigations' 1999, BS EN 14688-1:2002 'Geotechnical Investigation and Testing – Identification and classification of soil' and BS EN ISO 14689:2002 "Geotechnical investigation and testing – Identification and classification of rock"

4.3 Sampling

4.3.1 During the drilling of the exploratory holes, representative samples were taken at regular intervals to assist in the identification of the soils and to allow subsequent laboratory testing.

4.3.2 A summary of the samples taken is presented in the table below:

Type	Number
Environmental	16
Disturbed	49
U100	2

4.3.3 The type of sample is dependent upon the stratum and the purpose of analysis in accordance with current environmental and geotechnical guidance.

4.3.4 Disturbed samples of soil for chemical testing were placed in plastic tubs and amber jars as required by the UKAS accredited laboratory and transported under secure refrigerated conditions.

4.3.5 The distribution of samples taken across the site is recorded on the exploratory logs.

4.4 Laboratory Testing

4.4.1 As part of the initial assessment for potential contamination of the site, selected samples were taken for the purpose of chemical contamination testing.

4.4.2 Based on the potential contaminants identified by the preliminary CSM, nine representative soil samples were screened for the following general suite of determinands and an UKAS approved laboratory:

Determinand	Matrix	Number
BSL Default Soil Suite: Arsenic, Cadmium, Chromium (total and hex), Copper, Nickel, Mercury, Lead, Zinc, Selenium, speciated polycyclic hydrocarbons (PAH 16), total phenol, free cyanide, organic matter and pH	Soil	9
Asbestos Screen and ID	Soil	9
Asbestos Quantification	Soil	3

4.4.3 The Chemical Laboratory Testing Results are presented in Appendix B.

4.4.4 Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS 1377 'Method of Test for Soils for Civil Engineering Purposes' 1990. The following tests were scheduled:

BS Test Number	Description	No of Samples
Part 2:	Natural Moisture Content	8
Part 2:	Plasticity Index Analysis	8
Part 3:	pH Value	10
Part 3:	Water Soluble Sulphate Content	2

BS Test Number	Description	No of Samples
Part 7:	Determination of Undrained Shear Strength in Triaxial Compression	2
Part 3:	SD1 BRE Full Suite	2

4.4.5 The Geotechnical Laboratory Testing Results are presented in Appendix C.

4.5 Monitoring

4.5.1 Four ground gas and ground water monitoring standpipes were installed in BH2, WS1, WS2 and WS4 the boreholes and subsequently two monitoring visits were undertaken. All gas monitoring was undertaken using GA 2000/5000 infrared gas meter with integral electronic flow analyser.

4.5.2 Measurements of the percentage volume in air (%v/v) of oxygen (O_2), carbon dioxide (CO_2) and methane (CH_4) were recorded in addition to the percentage Lower Explosive Limit (%LEL) of methane and the atmospheric pressure. Flow measurements on each standpipe (l/hr) were also taken. (Note: 100% LEL equates to 5% by volume).

4.5.3 The standpipes consisted of high-density polyethylene (HDPE) pipe. A bentonite seal was made around the plain pipe and a clean gravel pack was placed around the slotted pipe. A summary of the installation construction is presented in the table below:

Location	Depth	Response Zone (m bgl)	Targeted Strata	Reason
BH1	7.5	1.50 – 7.50	Natural Ground	Ground Gas
WS1	4	2.00 – 4.00	Natural Ground	Ground Gas
WS2	4	1.00 – 4.00	Natural Ground	Ground Gas
WS3	3.4	1.40 – 3.40	Natural Ground	Ground Gas
WS5	3	1.00 – 3.00	Natural Ground	Ground Gas

4.5.4 The results monitored peak and steady state conditions. Peak results are those that occur on opening the valve on the borehole tap. Steady state conditions are those that occur a period of time afterwards when the initial (accumulated) gases have been purged from the borehole.

4.5.5 Made Ground was generally shallow (generally <0.70m in thickness) therefore no standpipes were installed within the made ground.

4.5.6 Completed gas monitoring results are presented in Appendix D of this report.

5.0 GROUND CONDITIONS

5.1 Made Ground

5.1.1 Made Ground was encountered in all of the exploratory hole locations and was generally a thin veneer ranging from 0.40m to 0.70m bgl in depth with an average thickness of 0.59m.

5.1.2 The made ground generally comprised asphalt overlying sandy gravels, with gravel comprised of brick, limestone, sandstone and locally containing ash and gravel sized fragments of bituminous/tar material.

5.2 Natural Ground

5.2.1 The natural strata underlying the made ground was generally a firm, sandy clay with varying gravel content, interbedded with loose to medium dense clayey gravelly sands. Gravel typically comprised sandstone and mudstone. These strata are interpreted as Glacial Till and were recorded to depths ranging between 7.70m and 9.50m bgl.

5.2.2 In WS3 there was a loose to medium dense sand band from 2.25m to 3.05m bgl.

5.2.3 In WS6 there was no recovery from 1.20m to 2.45m bgl, which is considered to represent probable loose sand.

5.3 Bedrock

5.3.1 Bedrock was encountered as a weak light grey weathered thinly laminated mudstone interpreted as the Pennine Lower Coal Measures, with some sandstone bands, from between 7.7m and 9.50m bgl to a maximum depth of 40m bgl.

5.3.2 Due to the nature of rotary open hole drilling and the comminuted nature of the arising's, detailed soil and rock descriptions could not be made in these boreholes and only the depth to the solid geology of the Pennine Lower Coal Measures could be determined with accuracy.

5.3.3 Three coal seams of workable thickness were encountered in RO02-RO08, from 21.6m bgl with a maximum thickness of 1.0m. The shallowest coal seam is inferred to be the Unknown Seam identified in the Coal Mining Risk Assessment (Ref: JMC/C3788/7930). The seam below this is inferred to be the Skelmersdale Earthy Delf, with the deepest seam being the Ravine Plodder seam. RO01 had just two coal seams, inferred to be the Skelmersdale Earthy Delf and the Ravine Plodder seams.

5.3.4 The coals seams dip from north to south across site with the following average dips:

- Unknown Seam – 3.74°
- Skelmersdale Earthy Delf – 4.77°
- Ravine Plodder Seam – 3.10°

5.3.5 The following table summarises the findings of the rotary open boreholes:

Seam	Thickness of Coal Seam (m)	Depth Beneath Site (m)	Thickness of Intact Rock Overburden	Inferred Coal Seam
RO01	0.7	24.7	15.5	Unknown Seam
RO01	0.5	28.2	19.0	Skelmersdale Delf
RO02	1.0	22.0	13.7	Unknown Seam
RO02	0.5	24.0	15.7	Skelmersdale Delf
RO02	0.4	26.0	17.7	Ravine Plodder
RO03	1.0	23.0	13.5	Unknown Seam
RO03	0.8	25.0	15.5	Skelmersdale Delf
RO03	0.4	27.0	17.5	Ravine Plodder
RO04	0.9	24.3	15.6	Unknown Seam
RO04	0.5	26.5	17.8	Skelmersdale Delf
RO04	0.5	27.7	19.0	Ravine Plodder
RO05	1.0	23.1	15.4	Unknown Seam
RO05	0.5	24.8	17.1	Skelmersdale Delf
RO05	0.3	26.5	18.8	Ravine Plodder
RO06	1.0	22.5	14.0	Unknown Seam
RO06	0.7	24.7	16.2	Skelmersdale Delf
RO06	0.3	27.0	18.5	Ravine Plodder
RO07	1.0	21.6	12.9	Unknown Seam
RO07	0.6	23.5	14.8	Skelmersdale Delf
RO07	0.4	26.2	17.5	Ravine Plodder
RO08	1.0	21.5	13.0	Unknown Seam
RO08	0.6	23.4	14.9	Skelmersdale Delf
RO08	0.4	25.5	17.0	Ravine Plodder

5.4 Existing Foundations

5.4.1 The current foundations beneath the existing building onsite appear to be concrete strip foundations, based on the foundation inspection pits excavated. All four hand excavated trial pits proved thickness of the foundations to be 0.25-0.35m thick, and depth from ground level to foundations to be between 0.21m and 0.70m bgl. A diagram of the foundations is presented in drawings, reference C3788/05.

5.5 Groundwater

5.5.1 The hand dug trial pits did not generally encounter any groundwater, and the rotary open holes used water flush resulting in the groundwater level being unreadable. Seepages were encountered in some of the window sample and cable percussive boreholes as detailed below:

Location	Depth of Seepage (m)	Comments
WS1	2.40	Slow Seepage
WS3	2.00	Slow Seepage
BH2	8.50	Rising to 6.20m after 20 mins

5.5.2 Post site works groundwater levels have ranged between 0.15m and 2.35m bgl.

5.6 Observations

5.6.1 During the works undertaken by BSL observations for both visual and olfactory evidence of contamination were made. Aside from the presence of ash and gravel sized bituminous fragments within the made ground, no evidence was identified.

5.6.2 In all of the rotary open boreholes the strata encountered were firm and intact, with water flush remaining present throughout the entire drilling process.

5.6.3 The first location for RO08 was unable to be taken beyond 2.00m bgl due to an unknown obstruction. The new location 2m to the south east encountered no obstruction.

6.0 TEST RESULTS

6.1 Chemical Test Results - Soils

6.1.1 The samples were tested for an assessment of the chemical contamination and results were examined with reference to a selection of guidance documents as detailed in Appendix E. In this case, the construction of a new Aldi Store and retail unit requires the use of commercial S4UL screening criteria.

6.1.2 The full results can be found in Appendix B – Chemical Testing Results. A summary of the chemical testing is presented below:

- **Metals**

No elevated levels of metals were detected in any of the samples above the relevant commercial S4UL screening criteria.

- **PAHs**

Concentrations were below the relevant commercial S4UL screening criteria and were also generally below laboratory detection limits

- **Asbestos**

Loose Chrysotile and Amosite fibres have been detected in four samples to date between 0.20m and 0.50m bgl. On quantification, the asbestos level was at trace levels (i.e. <0.001% mass).

6.1.3 In the absence of any particular sources of petroleum hydrocarbon contamination onsite and offsite, alongside the lack of any visual or olfactory evidence of this contaminant, no testing has been undertaken for petroleum hydrocarbons.

6.2 Geotechnical Testing

6.2.1 Plasticity index results ranged between 12% and 25% indicating the soils to have low to medium plasticity. Associated moisture contents ranged between 12% and 21%.

6.2.2 After modification of particle size in accordance with BRE 240 the modified plasticity indexes are in the range of 11% to 25% indicating the soils to be of low to medium volume change potential.

6.2.3 The shear vane values from hand vane tests taken in natural clays recorded from the hand dug trial pits are presented below:

Location	Depth (m)	Result (kPa)	Strength
HP02	0.5	66	Firm
HP03	0.5	56	Firm
	1.0	62	Firm
HP04	0.5	95	Stiff
	1.0	113	Stiff

6.2.4 Two undrained shear strength tests were undertaken on undisturbed cohesive samples. An undrained shear strength of 90kPa was reported for the sample at 3.00-

3.45m bgl in BH1, whilst an undrained shear strength of 72kPa was reported for the sample obtained from BH2 at 8.00-8.45m bgl.

6.3 Aggressive Ground Conditions/SD1 Testing

6.3.1 Water soluble sulphate testing was undertaken on four samples of the natural strata. The results revealed soluble sulphate (SO_4) contents of 0.0084g/l to 0.19g/l. Associated pH values were obtained which ranged between 7.8 and 8.5 indicating slightly alkaline conditions.

6.3.2 The latest investigation revealed soluble sulphate extract analysis concentrations between 8.4mg/l and 187mg/l in the sandy Clay with total soil sulphate concentration recorded up to 370mg/kg recorded in this Clay.

6.3.3 Analysis of the natural strata in WS1 and WS3 beneath the proposed store footprint revealed the following tabulated results:

Determinand	Range (mg/l)
Soluble Chloride	3.2 – 26
Soluble Nitrate	<2
Soluble Magnesium	<2.5 – 7.7
Soluble Sulphate	8.4 – 187
pH	7.8 – 8.5

6.4 Waste Disposal Testing Results

6.4.1 We have reviewed the testing results and inputted them into the HazWasteOnline model which allows users to code and classify waste as defined in the EWC (European Waste Catalogue 2002) based on EC Regulation 1272/2008 on the Classification, labelling and packaging of substances and mixtures (CLP) and latest Environment Agency guidance (WM3 "Guidance on the classification and assessment of waste (1st edition 2015)-Technical Guidance").

6.4.2 This is a useful tool as waste producers have the legal responsibility to classify any waste they produce, despite most classifications in the UK being done by the waste receivers.

6.4.3 Eight environmental samples collected during the site investigation were run through the HazWasteOnline tool to determine their waste classification. Six samples returned a Hazardous Waste result as outlined in the table below.

Location	Classification	Hazard Properties	Contaminants
BH1	Non-hazardous	N/A	N/A
HP1	Non-hazardous	N/A	N/A
HP2	Non-hazardous	N/A	N/A
HP4	Non-hazardous	N/A	N/A
WS2	Non-hazardous	N/A	N/A
WS3	Non-hazardous	N/A	N/A
WS4	Non-hazardous	N/A	N/A
WS6	Non-hazardous	N/A	N/A

6.4.4 The full results are in the Waste Classification Report presented in Appendix G

6.5 Gas Monitoring Results

6.5.1 Five gas monitoring visits have been carried out to date between the dates of 6th April 2018 and 8th June 2018.

6.5.2 Peak carbon dioxide concentrations between 0.1% and 6.9% v/v have been recorded during the monitoring period, while steady state concentrations varied between 0.1% and 3.6%v/v.

6.5.3 Only one methane concentration was recorded over the ambient level of 0.1%v/v, in BH2 at a level of 0.2%v/v over the course of the gas monitoring programme. In addition, no hydrogen sulphide gas has been detected.

6.5.4 Oxygen concentrations between 3.1%v/v and 24.5% v/v have been recorded during the monitoring period. They were depleted generally in WS03 and BH02.

6.5.5 A maximum flow reading of 5.1l/hr was recorded in WS01 during the first visit. However, typical values are below 1l/hr.

6.5.6 The atmospheric pressure was between 1005mb and 1019mb during the monitoring visits.

6.5.7 Groundwater levels on the site ranged between 0.15m and 4.84m bgl during the visits.

6.5.8 Full gas monitoring results are presented in Appendix D.

7.0 GEOTECHNICAL ASSESSMENT

7.1 General

7.1.1 The site is irregular in shape and consists of a large redundant office building in the north west, with the rest of the site being mostly covered with hardstanding asphalt, except for a small amount of soft landscaping in the west.

7.1.2 The proposed development will consist of a new purpose-built0.0 Aldi Superstore, with associated hardstanding car parking, soft landscaping and a smaller secondary retail unit situated on the northern part of the site. A proposed development layout plan is presented in Drawings for reference, by Harris Partnership Architects, drawing number 2269BOL-100 dated November 2017. The foundation requirements made are based this drawing and the current site level.

7.1.3 There is currently one large building on site of brick and steel construction that will require demolition prior to the commencement of the retail development.

7.1.4 In general, the ground conditions on site consist of made ground recorded to a maximum depth of 0.70m bgl, in the form of asphalt over sandy gravels. The natural strata were recorded to be sandy clays with varying gravel content, interbedded with loose to medium dense sand bands recorded to maximum depth ranging between 7.70m and 9.50m bgl. Weak thinly laminated weathered grey mudstone belonging to the Pennine Lower Coal Measures Formation was encountered directly beneath the Glacial Till.

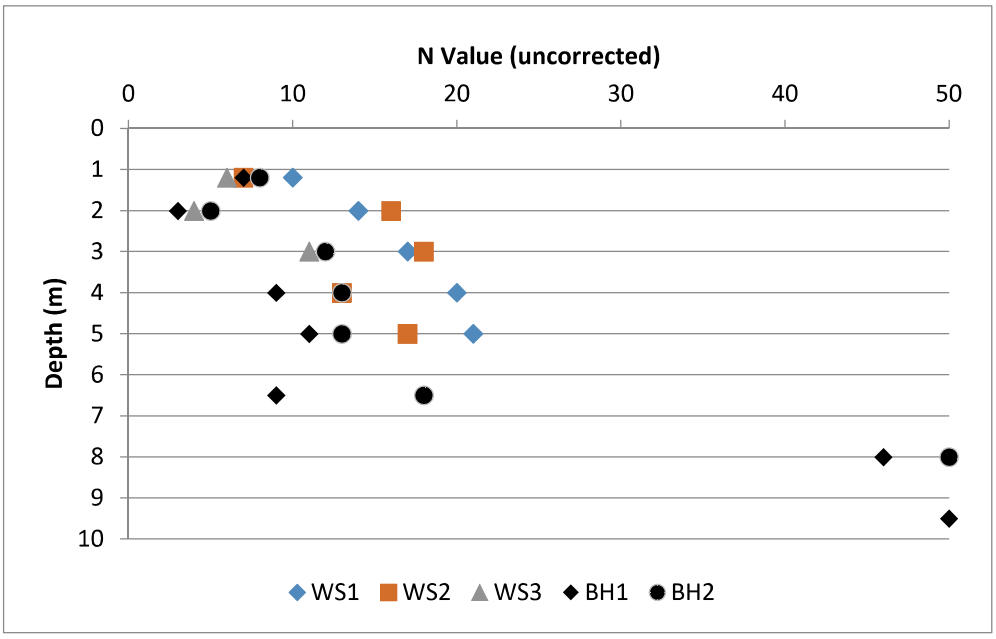
7.1.5 Rotary Open Drilling revealed the site to be underlain by mudstone down to at least 40m, with occasional sandstone bands. Three coal seams were identified interbedded within the mudstone, which are considered to be of workable thickness. The average thickness of the three coal seams were 0.95m, 0.59m and 0.39m respectively.

7.1.6 Post site work monitoring revealed groundwater levels between 0.15m and 4.84m bgl, which is considered to represent perched groundwater.

7.2 Soil Parameters

7.2.1 The test results have been evaluated to derive geotechnical soil parameters for the site. A depth vs SPT N value graph is provided below to provide a profile of the ground conditions underlying the proposed store footprint. Data from exploratory holes outside of the proposed building footprint have been excluded for clarity.

There is a positive correlation between depth and N value. In general, the deeper the strata



the higher the N value, therefore the soils generally increase in strength with depth.

7.2.2 Characterisation of the geotechnical parameters above has been undertaken to obtain a characteristic value, which is a cautious estimate of the value affecting the occurrence of the limit state.

7.2.3 Based on the anticipated and likely structural loads of the proposed store, the soils at 1.0m bgl are not considered to be suitable as a bearing stratum. Therefore, a characteristic value for SPT N value in clays at a depth of 1.50m has been used and interpreted to be 10, generally increasing with depth.

7.2.4 Based on the correlation with Stroud (1975), using the 'average' plasticity index and an f1 value of 6, this gives a characteristic undrained shear strength (Cu) value of 60kPa at 1.50m bgl.

7.3 Foundations

7.3.1 The most suitable foundations for the proposed store are considered to be pad foundations to support the steel frame of the building with strip foundations used to support the masonry walls.

7.3.2 Based on the soils strengths observed, foundations will need to be taken to the underside of any made ground and found on undisturbed natural ground: this will be at approximately 1.5m to 1.7m bgl. Based on the above parameters, for a square pad measuring 1m x 1m at 1.5m depth, an allowable bearing capacity not exceeding 150kN/m^2 should be assumed, which includes a global factor of safety of 3 and should limit settlement below 25mm. A higher bearing capacity is likely to be available in deeper soils, or wider pad foundations could be utilised, if required.

7.3.3 It is possible that a change in bearing stratum may occur across the proposed store footprints. If any sudden changes from clay to sand or gravel are encountered

reference should be made to a suitably qualified engineer, recommendations may include that the foundations should either be deepened to found on the same stratum or reinforced to reduce the potential for differential settlement.

7.3.4 The bearing stratum should be inspected for 'soft spots' within the natural clay strata, resulting for instance from localised groundwater perched within the overlying fill materials. Any such soft spots should be dealt with in accordance with good site practice.

7.3.5 If the ground conditions encountered during the construction phase differ significantly to the conditions encountered during construction, work should cease and BSL contacted for further advice.

7.3.6 During the construction phase supervision should be on a continuous basis to check the design assumptions are correct and construction conforms to design. Supervision should include inspections, Control Ground Investigations and monitoring.

7.4 Building Near Trees

7.4.1 The clay on site is of a medium volume change potential. Where foundation excavations encounter cohesive strata in the vicinity of existing, proposed or recently removed trees, foundations should be adjusted in full accordance with current guidance. All foundations should be deepened below roots of greater than 5mm diameter during excavations for footings.

7.4.2 A survey of all trees and hedges on the site and within influencing distance of the site boundary should be undertaken to identify tree species and heights. This information will be required in order to assess the effects of trees on the cohesive strata.

7.4.3 Where foundation depths due to trees already present or recently removed exceeds 1.50m there is a possibility for heave to occur on removal of the tree and a compressible material or void former is required against the inside face of all external wall foundations, unless it can be proven that cohesive soils are not desiccated in the vicinity of proposed footings.

7.5 Floor Slabs

7.5.1 If required, ground bearing floor slabs may generally be adopted at the site provided that once finished levels have been established, less than 600mm of suitable, appropriately compacted granular material exists beneath the slab.

7.5.2 Ground floor slabs should take into consideration the requirement for ground gas protection measures, which at the time of writing results suggests that protection measures will not be required, subject to ongoing monitoring.

7.6 Construction

7.6.1 Instability of excavations through natural soils is not anticipated provided they are not exposed to adverse weather conditions for any substantial period of time.

Instability of the made ground should be allowed for. All excavations should be carried out in accordance with CIRIA Report 97 'Trenching Practice'.

7.6.2 Excavation depths should generally be readily achieved using conventional plant (JCB or similar) although high specification plant (tracked 360° or similar) is recommended to maintain the build programme. Breaking equipment may also be required locally to penetrate old foundations associated with former construction.

7.6.3 The characteristic value for sulphate content in the natural clays is 0.0646g/l, with the average pH value being 8.1.

7.6.4 The site is underlain by low permeability deposits therefore the groundwater has been classified as static.

7.6.5 The results of laboratory pH and sulphate content indicate that ACEC Class AC-1 and sulphate class DS-1 conditions prevail in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005. The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

7.7 Mine Workings

7.7.1 The Coal Mining Risk Assessment identified a risk to the proposed development from unrecorded mine entries and unrecorded mine workings.

7.7.2 No evidence of unrecorded or recorded mine workings was identified during the investigation. The seams that were encountered during the drilling were intact, with full water flush returns maintained.

7.7.3 In addition, there was no evidence for unrecorded mine entries during the investigation.

7.7.4 Evidence of coal mine workings can be represented by voids, broken ground and/or loss of flush with evidence of potential workings indicated by intact coal of a suitable workable thickness and quality. An assessment should be made based on all the available evidence.

7.7.5 Three coal seams of workable thickness were encountered in RO02-RO08, from 21.6m bgl with a maximum thickness of 1.0m. The shallowest coal seam is inferred to be the Unknown Seam identified in the Coal Mining Risk Assessment (Ref: JMC/C3788/7930). The seam below this is inferred to be the Skelmersdale Earthy Delf, with the deepest seam being the Ravine Plodder seam. RO01 had just two coal seams, inferred to be the Skelmersdale Earthy Delf and the Ravine Plodder seams.

7.7.6 No evidence of coal workings in the form of broken ground and or loss of flush were recorded during the site investigation in any of the boreholes.

7.8 Treatment of Mine workings

7.8.1 CIRIA SP32 "Construction over abandoned mine workings" indicates that a void will not migrate to the surface where there is more than ten times the seam thickness of rock cover. Up to this depth, the void will begin to choke with rock from the roof (represented by broken ground).

7.8.2 Beyond 10 times the seam thickness the rock will arch and prevent upwards migration of the void.

7.8.3 The shallowest of the three unworked coal seams was at 21.5m bgl, with a maximum thickness of 1.0m. Based on CIRIA SP32 at least 10 times the seam thickness of rock exists in between the top of the coal seam and the top of the bedrock. In addition, if the seams had been worked the depth of competent rock cover is sufficient that crown holing will not affect the foundations of the proposed store.

7.8.4 It would be highly recommended to drill additional boreholes in the north western part of the site beneath the current building post demolition, and beneath the proposed smaller northern retail unit where access was prohibited during the site investigation, in order to test whether the ground at these locations matches the rest of the ground investigation report findings.

7.8.5 A further investigation should also be conducted during the construction phase to identify the unknown obstruction encountered in the first borehole attempt at RO08 at 2.00m bgl. It is worth noting that common materials unable to be drilled through are timber and steel, possibly related to a relict mining feature.

7.8.6 Subject to additional post demolition probe holes as described above, there appears to be no significant risk from shallow mine workings based on the information obtained to date.

7.9 Highways

7.9.1 CBR values of 3% - 5% are likely to be achieved in undisturbed natural soils for pavement design purposes, unless proven otherwise by in-situ testing at sub-base level by a specialist geotechnical engineer.

7.9.2 Where the CBR value is found to be less than 3%, some re-engineering of the subgrade will be required prior to highway construction to achieve the required design CBR value.

7.10 Soakaways

7.10.1 The use of soakaways within the natural ground is not feasible at the site due to the presence of relatively impermeable strata underlying the site.

8.0 ENVIRONMENTAL ASSESSMENT

8.1 General

8.1.1 The level of protection for the clean potable water supply pipes should be determined using the local water company risk assessment criteria in accordance with UKWIR.

8.2 Contamination

Soils

8.2.1 On the basis of the testing undertaken to date it appears that there are no heavy metals or PAHs above the relevant commercial screening values (S4ULs) for human health within the made ground.

8.2.2 Chrysotile and Amosite asbestos fibres have been detected in four samples to date, all of which were quantified to <0.001% total mass (at trace level).

Permanent Ground Gases

8.2.3 In order to assess the ground gas situation and the requirement for ground gas precautionary measures at the site, guidance was taken from CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' and BS8485:2015 'Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

8.2.4 The proposed commercial end use dictates that the gas monitoring results are assessed in accordance with CIRIA C665 and the Wilson and Card methodology. The Wilson and Card method uses the concept of a Gas Screening Value (GSV) which is calculated using the maximum concentration of ground gas and flow rate.

8.2.5 A maximum flow rate of 5.1l/hr has been used to calculate the GSVs. This is the worst case scenario for the site. The results obtained generated a Gas Screening Value of 0.35l/hr for carbon dioxide and 0.00l/hr for methane.

8.2.6 The GSV for carbon dioxide places the site into Characteristic Situation 2 (CS2).

8.2.7 The maximum carbon dioxide concentration has been recorded marginally above the 5.0%v/v figure in two boreholes (BH2 and WS3) on two separate visits on 11/05/18 and 08/06/18 respectively. Whilst the flow rate on both boreholes has only been between 0 and 0.1, the install is located within the lower Pennine Coal Measures and both boreholes are within the footprint of the proposed store. Therefore we place the site into Characteristic Situation 2 (CS2).

8.2.8 The site has been assessed in accordance with BS8485:2015. The proposed structure is a Type C building and categorized as CS-2, therefore it requires 2.5 points of ground gas protection measures.

8.2.9 The designer should decide with the engineer which precautions it will utilise to achieve those points in accordance with tables 5, 6 and 7 of the guidance document.

8.3 Qualitative Risk Assessment

8.3.1 The risk assessment methodology used in this instance is based on **Source – Pathway – Receptor** (SPR) philosophy. The **source** is the presence of contamination, or substance/event likely to cause harm. The **receptor** is the target that may be detrimentally affected by the source. The **pathway** is the means of the contamination to move from the source to the receptor. Where any of these three factors are removed there is deemed to be no risk.

8.3.2 The CSMs have been revised based on the findings of the site investigation and laboratory testing results. Only potential sources with a moderate/low risk level and above have been carried forward from the preliminary CSM.

Human Health

Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk
ON-SITE					
Made Ground	Ingestion, direct contact, inhalation of dusts	End-users	Unlikely	Medium	Low
Made Ground (Ground Gas)	Migration into confined spaces	End-users	Unlikely	Severe	Moderate/Low
Mine Gas	Migration into confined spaces	End-users	Unlikely	Medium	Low
Electricity substation	Ingestion, direct contact	End-users	Unlikely	Low	Low
OFF-SITE					
Infilled Ponds and Pits	Migration into confined spaces	End Users	Unlikely	Medium to severe	Moderate/Low

Human Health Justification

8.3.3 The proposed development at the site is to demolish the existing building and construct a new Aldi store in this location, along with a second smaller retail unit in the north. The rest of the site will be converted into car parking and soft landscaping.

8.3.4 The deepest made ground on site is 0.70m bgl. Ground gas monitoring carried out as part of this commission has revealed slightly elevated levels of carbon dioxide, placing the site into CS2 requiring some ground gas precautions.

8.3.5 Trace asbestos fibres have been detected in four samples to date and widespread contamination is not anticipated, therefore the risk is considered to be moderate to low. The asbestos is likely to have come from the demolition of part of the existing building, as mentioned in the historical section of the desk study.

8.3.6 There is an electricity substation on site that was first shown on the map dated 1977 by which time PCBs were banned therefore it is unlikely to have contained PCBs. Transformers are closed systems and the likelihood of significant leaks during maintenance or due to system failures is low.

8.3.7 In the absence of any particular sources of petroleum hydrocarbon contamination onsite and offsite, alongside the lack of any visual or olfactory evidence of this contaminant, no testing has been undertaken for petroleum hydrocarbons.

8.3.8 The risk to ground gas from off-site sources is classified as moderate to low, whilst no elevated gas levels have been recorded to date, the severity of ground gas is always severe. The offsite sources are not considered to be within an influencing distance of the site and the majority have been redeveloped and gross contamination is unlikely to still be present. Due to the presence of hardstanding and impermeable strata no pathway exists for any contamination that has migrated onto the site. The risks to site end users are considered to be low.

8.3.9 On the basis of the testing undertaken, no significant contamination has been identified at the site in respect to Commercial S4UL levels, and no specific mitigation measures are required.

Controlled Waters

Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk
Made Ground	Migration through groundwater or granular soils	Superficial Deposits Secondary Aquifer	Low Likelihood	Mild	Low
Made Ground	Migration through groundwater or granular soils	Bedrock Secondary Aquifer	Low likelihood	Mild	Low

Controlled Waters Justification

8.3.10 The made ground has been proven to lie directly above the superficial deposits. However, no significant concentrations of contaminants have been identified in the soils at the site. In addition, the proposed development will be covered in hardstanding which will limit infiltration and thus limit the potential for contaminants to leach downwards. Therefore, the risk to the superficial deposits (Secondary A Aquifer) is considered to be low.

8.3.11 The bedrock is classified as a Secondary A Aquifer and the site lies within a source protection zone, although the superficial deposits have been confirmed as low permeability clays, which will inhibit downward contaminant transport into the underlying bedrock. Therefore, the level of risk to the bedrock aquifer is considered to be low.

8.4 Outline Remedial Measures

8.4.1 No specific remedial measures are required in respect to soils or groundwater contamination.

8.4.2 Ground gas monitoring has revealed no significant concentrations of methane; however, carbon dioxide has been recorded at levels above 5%v/v during peak conditions. In addition, a significant flow of 5.1l/hr was detected in one of the holes. This places the site into Characteristic Situation 2, whereby atleast 2.5 points are required in accordance with BS8485:2015.

8.4.3 The designer should decide with the engineer which precautions it will utilise to achieve those points in accordance with tables 5, 6 and 7 of the guidance document.

8.4.4 The designer should produce a gas verification plan which conforms to CIRIA C735. This should define the installer and the verifier and their qualifications. It should also define what happens in the event of any non-conformances, such that irrevocable actions are avoided.

8.4.5 A watching brief should be maintained during groundworks for any unidentified sources of contamination within soils or groundwater.

8.5 Asbestos

8.5.1 The investigation of asbestos issues within structures was beyond the scope of this report. However, guidance from UK Government indicates that asbestos should be assumed to be present in buildings unless proven otherwise.

8.5.2 Any asbestos within structures will require removal prior to re-development. This will need to be done by a suitably qualified experienced and licensed contractor, who ensures that adequate PPE is provided to operatives, and that all the relevant legislation is adhered to.

8.5.3 Precautions are unlikely to be required, however a detailed method statement may be required to ensure compliance with CAR2012. Basic asbestos management good practice will be required. Typically, precautions would include:

- Ensuring soils do not dry out to become dusty
- Site personnel have the risk communicated at induction stage.

8.5.4 Additional guidance is provided within the Guidance Note in Appendix F

8.6 Health and Safety Issues

8.6.1 During the reclamation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk
ON-SITE					
Made Ground	Ingestion, direct contact, inhalation of dusts.	End-users	Likely	Low	Low
Made Ground (Ground Gas)	inhalation of gases.	End-users	Likely	Low	Low

Discussion

8.6.2 There is made ground present from ground level to a maximum depth of 0.70m bgl. It is likely that ground workers will come into contact with these soils, however as no significant contaminants were detected, the risk to groundworks is considered to be low.

8.6.3 General guidance on these matters is given in the Health and Safety Executive (HSE) document “Protection of Workers and the General Public during the Redevelopment

of Contaminated Land". In summary, the following measures are suggested to provide a minimum level of protection:

- All ground workers should be issued with the relevant protective clothing, footwear and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.
- Hand-washing and boot-washing facilities should be provided.
- Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
- Good practices relating to personal hygiene should be adopted on the site.
- The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.

8.7 Waste

8.7.1 Based on the HazWasteOnline assessment tool the made ground soils have been classified as non-hazardous.

8.7.2 If the end disposal route of any site won soil waste is landfill, then that material needs to be specifically classified prior to leaving site. Details of how material should be classified for waste disposal are presented in Appendix F, although general guidance is given below.

8.7.3 The possibility of automatic inert classification of the natural soils should be explored in accordance with Section 4.3 of the EA guidance document. The Council Decision includes a list of wastes in Section 2.1.1 of the document that are assumed to be inert and therefore acceptable at a landfill for inert waste without testing, this is the case if:

- *They are single stream waste of a single waste type (although different waste types from the list may be accepted together if they are from a single source) and*
- *There is no suspicion of material or substances such as metals, asbestos, plastics, chemicals, etc to an extent which increases the risk associated with the waste sufficiently to justify contamination and they do not contain other their disposal in other classes of landfill.*

<u>General</u>

8.7.4 The made ground soils have the potential to be classified as Inert or Non-hazardous for disposal purposes, however this would be subject to testing on the actual arising's that will constitute the waste. Hazardous soils require pre-treatment prior to disposal. Effective pre-treatment, involving separation, sorting and screening can offer cost reductions through reducing the hazardous nature and volume of soil waste. Costs for disposal of non-hazardous nature and volume of soil waste. Costs for disposal of non-hazardous/hazardous soils are significant compared to disposal of inert material.

8.7.5 If any gross hydrocarbon contaminated material is encountered during the construction phase, it is possible that this may be classified as hazardous and testing should be undertaken at that time.

8.7.6 Waste produces have the legal responsibility to classify any waste they produce, despite most classifications in the UK being done by the waste receivers.

8.7.7 Where it is necessary to dispose material off site it is recommended that materials are segregated and where necessary sufficient time is allowed to further classify the material properly, including discussion with landfill sites and waste transfer stations to find the best disposal route.

8.7.8 As a significant proportion of the soils likely to be generated on site are clean it is recommended that where possible that the soils could be recycled at a suitable local waste treatment plant or transfer station rather than a landfill disposal route.

8.8 Compliance

8.8.1 It is recommended that the approval of the Local Authority is obtained in regard to the findings of this report prior to any irrevocable action at the site.

9.0 CONCLUSIONS

9.1 Summary

Environmental

9.1.1 Made ground generally comprises asphalt over sands and gravels, over firm to stiff natural clay deposits.

9.1.2 Chemical test results of onsite soils have revealed no elevated levels of metals or PAHs in respect to commercial S4UL screening levels. Asbestos fibres were detected; however, they were only at trace level. The risk to human health from asbestos fibres is considered to be low. Therefore, the risk presented to site end-users from the made ground is considered to be low.

9.1.3 The aquifers beneath the site are considered to be at low risk. The presence of low permeability cohesive strata will prevent the downward migration of leached contaminants to the underlying aquifers. The risk to surface waters is also assessed to be low, with the overall risk to controlled waters considered to be low.

9.1.4 Five ground gas monitoring visits have been undertaken, the results indicated some gas precautionary measures are required as the proposed development has been classified as Characteristic Situation 2 as assessed by CIRIA C665, gas precautions are therefore required in accordance with BS8485, and need to be verified in accordance with CIRIA C735.

Geotechnical

9.1.5 The proposed store footprint has three coal seams underlying it of workable thickness. No evidence for prior mine workings were identified during the drilling as the coal seams encountered were intact, and no flush was lost during drilling.

9.1.6 In the event that the seams had been worked, a sufficient rock cover exists to prevent upward migration of a void. Therefore, it is considered that mine workings will not affect the proposed store extension and precautions are not required.

9.1.7 The most suitable foundations for the proposed store in this area are considered to be pad and strip foundations. The clay on the site is of low to medium volume change potential, however, based on the soils strengths observed, foundations will need to be taken to the underside of any made ground and found on undisturbed natural ground at 1.5m bgl. An allowable bearing capacity not exceeding 150kN/m^2 should be assumed, which includes a global factor of safety of 3 and should limit settlement below 25mm.

9.1.8 If required, ground bearing floor slabs may generally be adopted at the site provided that once finished levels have been established, less than 600mm of suitable, appropriately compacted granular material exists beneath the slab.

9.1.9 Ground floor slabs should take into consideration the requirement for ground gas protection measures.

9.1.10 CBR values of 2-5% are likely to be achieved in undisturbed natural strata across the site unless proven otherwise by in-situ testing at sub-base level by a specialist

engineer. Some reengineering will be required including compaction of the subgrade prior to construction to achieve minimum design CBR values of 5%.

9.1.11 The use of soakaways within the natural ground are not considered feasible within this area due to the poor drainage conditions caused by the presence of relatively impermeable strata underlying the site and the area restrictions on site.

9.2 Further Work

9.2.1 The following further work is considered necessary to progress the site to construction phase:

- Drilling of additional holes in NW part of site beneath building post demolition.
- Tree survey by qualified aboriculturist.
- Foundation design
- Design of Remedial Strategy and Gas Verification Plan
- Confirmation of Remedial Strategy by Local Authority

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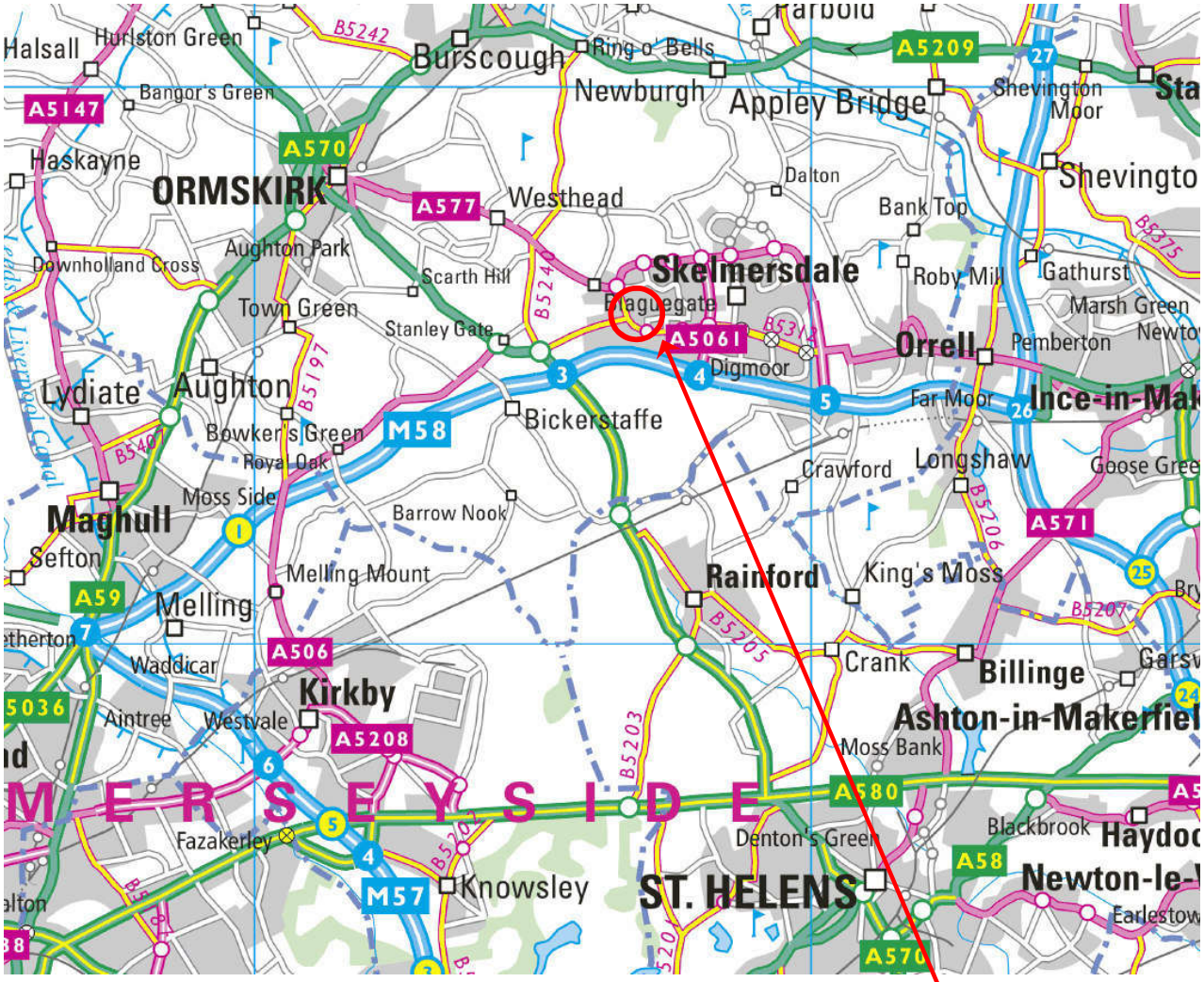
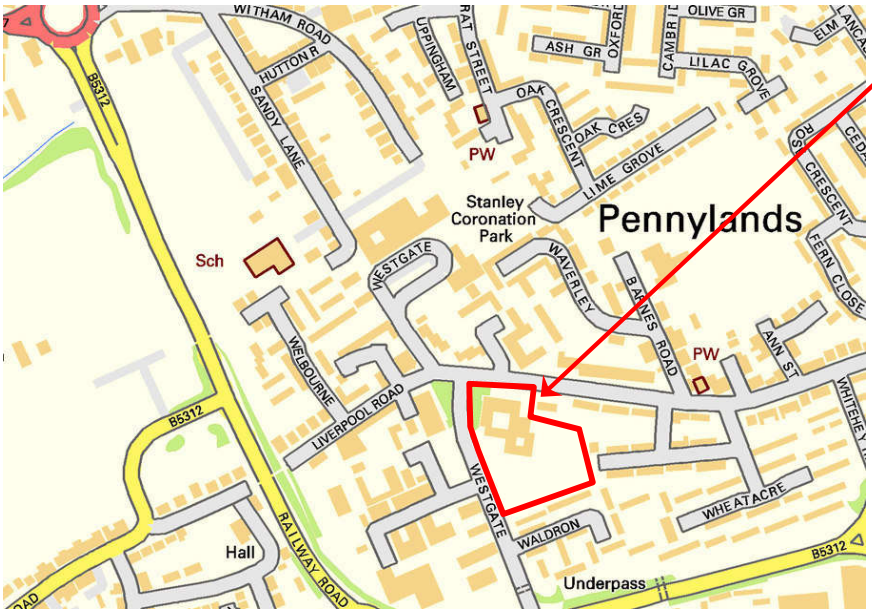
DRAWINGS





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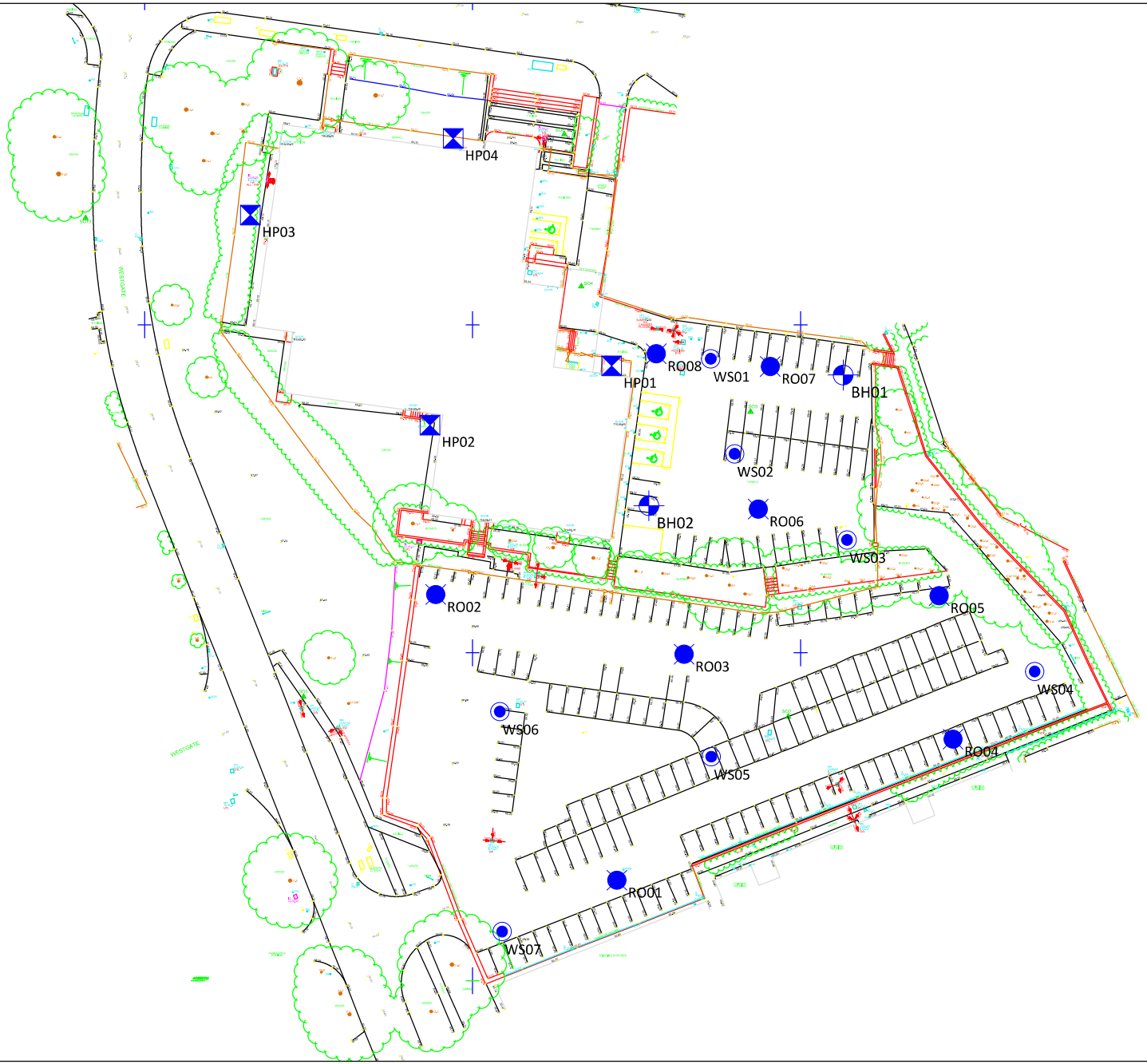
Westgate, Skelmersdale

Site Location Plan

Drawing Number C3788/01

Scale: NTS

Drawn By: JMC	Checked By: AJS



KEY

- HPXX — HAND EXCAVATED TRIAL PIT
- WSXX — WINDOW SAMPLE BOREHOLE
- BHXX — CABLE PERCUSSIVE BOREHOLE
- ROXX — ROTARY OPEN BOREHOLE

DO NOT PASTE SYMBOLS HERE! – THIS IS A VIEW PORT – SET UP KEY WITHIN MODEL VIEW AND ZOOM ALL EXTENTS TO LOCATE HERE **THEN DELETE THIS TEXT

NOTES

1. ALL DIMENSIONS TO BE CHECKED ON SITE BEFORE COMMENCING WORKS, ANY DISCREPANCIES ARE TO BE REPORTED TO THE ARCHITECT & ENGINEER FOR VERIFICATION, FIGURED DIMENSIONS ONLY ARE TO BE TAKEN FROM THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS REPORTS. THIS DRAWING IS COPYRIGHT OF BSL.
3. DRAWING NOT FOR CONSTRUCTION PURPOSES.

DESCRIPTION	REV	DATE

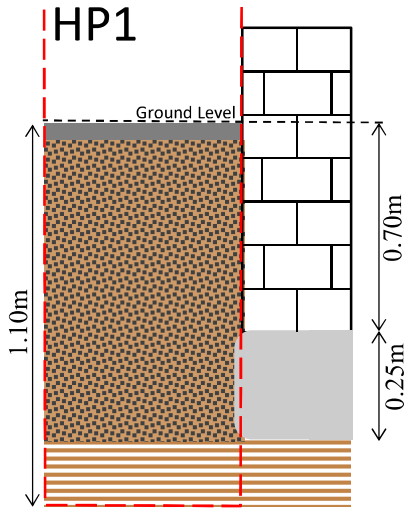
BROWNFIELD SOLUTIONS LTD

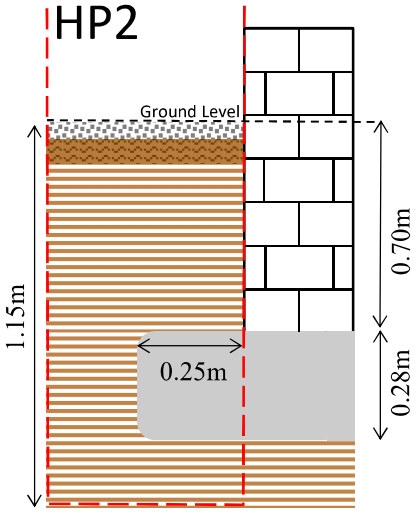
CLIENT: ALDI

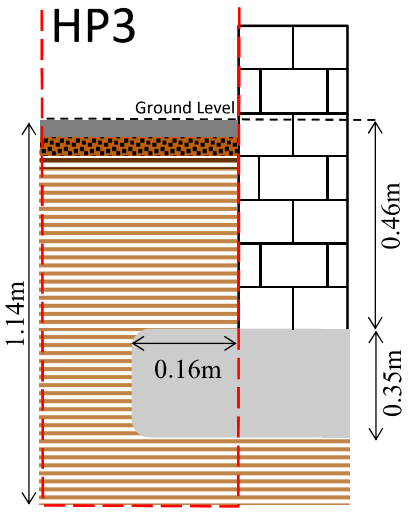
PROJECT TITLE: WESTGATE, SKELMERSDALE

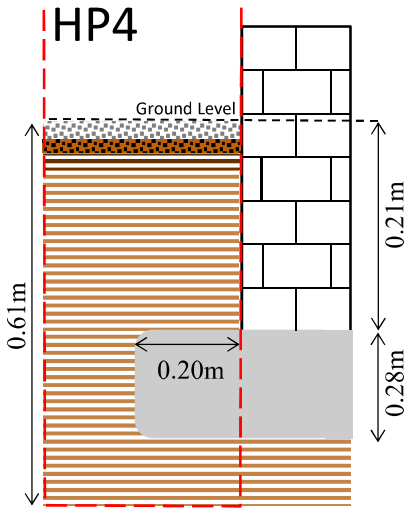
DRAWING DETAIL: EXPLORATORY HOLE LOCATION PLAN

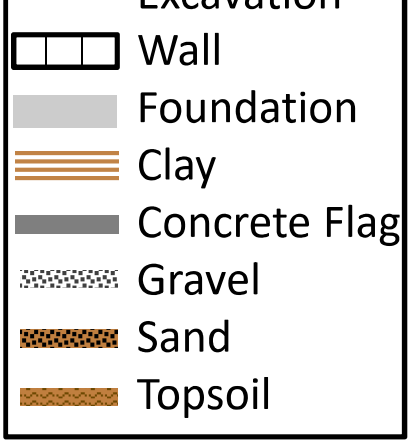
DRAWN	CHECKED
JM	AJS
DATE	SCALE
MARCH 2018	NTS
DRAWING NUMBER	REVISION
C3788/03	–











NB See trial pit logs for detailed encountered soils description

BROWNFIELD SOLUTIONS LTD
GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

ALDI
Westgate, Skelmersdale
Existing Foundations
Drawing Number C3788/05
Scale: NTS
Drawn By: JM / Checked By: AJS

APPENDIX A
Exploratory Hole Logs

Borehole Log

BROWNFIELD SOLUTIONS LTD

Borehole No. **BH1**
Sheet 1 of 1

Project Name: WESTGATE	Project No. C3788	Co-ords: -	Hole Type CP
Location: SKELMERSDALE		Level:	Scale 1:50
Client: ALDI		Dates: 22/03/2018 - 22/03/2018	Logged By JM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	D		0.10			MADE GROUND: Asphalt.
		0.50	ES					MADE GROUND: Brown/black gravelly fine to coarse sand with medium brick cobble content and rare ash. Gravel is subangular fine to coarse of brick and limestone.
		0.70	D		0.70			Firm brown sandy CLAY. Sand is fine to coarse.
		1.20 1.20	D	N=7 (1,1/2,1,2,2)				
		1.80	D		1.80			Loose brown clayey fine to coarse SAND.
		2.00 2.00	D	N=3 (1,0/1,0,1,1)				
		2.50	D		2.50			Firm brown sandy CLAY. Sand is fine to coarse.
		3.00 - 3.45	U					
		3.50	D					
		4.00 4.00	D	N=9 (1,2/2,2,3,2)				
		5.00 5.00	D	N=11 (1,2/2,3,3,3)				
		6.50 6.50	D	N=9 (1,2/2,2,2,3)				
		8.00 8.00	D	46 (3,4/46 for 295mm)				*Very Stiff from 8.00m bgl.*
					8.40			Weak light grey weathered thinly laminated MUDSTONE.
		9.50 9.50	D	50 (25 for 145mm/50 for 140mm)				
					9.95			End of borehole at 9.95 m

Remarks
1. Hand dug pit to 1.2m bgl to check for services.
2. Groundwater not encountered.
3. Hole backfilled with arisings upon completion.

AGS

Borehole Log

			Borehole No. **BH2** Sheet 1 of 1
Project Name: WESTGATE	Project No. C3788	Co-ords: -	Hole Type CP
Location: SKELMERSDALE		Level:	Scale 1:50
Client: ALDI		Dates: 22/03/2018 - 23/03/2018	Logged By JM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	D		0.10			MADE GROUND: Asphalt.
		0.50	ES					MADE GROUND: Brown/black gravelly fine to coarse sand with medium brick cobble content and rare ash. Gravel is subangular fine to coarse of brick and limestone.
		0.70	D		0.70			Soft to Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of sandstone and mudstone.
		1.20	D					
		1.20		N=8 (1,1/2,2,2,2)				
		2.00	D					
		2.00		N=5 (1,1/1,1,2,1)				
		3.00	D		3.00			Firm brown sandy CLAY. Sand is fine to coarse.
		3.00		N=12 (1,2/3,3,3,3)				
		4.00	D					
		4.00		N=13 (1,2/3,3,4,3)				
		5.00	D					
		5.00		N=13 (2,2/3,3,4,3)				
		6.50	D					*Becoming Stiff from 6.50m bgl.*
		6.50		N=18 (2,3/3,4,5,6)				
		7.00	D					
					7.60			Stiff brown very sandy CLAY. Sand is fine to coarse.
		8.00 - 8.45	U					
					8.40			Weak light grey weathered thinly laminated MUDSTONE.
		8.50	D					
		8.50		N=50 (6,7/12,12,13,13)				
					8.95			End of borehole at 8.95 m

Remarks

1. Hand dug pit to 1.2m bgl to check for services.
2. Groundwater encountered at 8.40m bgl, rising to 6.20m bgl after 20 minutes.
3. Install: 1.50m plain pipe, slotted to 7.50m bgl.

Trial Pit Log

Trialpit No **HP1**

Sheet 1 of 1

Project Name: WESTGATE	Project No. C3788	Co-ords: - Level:	Date 20/03/2018
Location: SKELMERSDALE		Dimensions (m): Depth 1.10	Scale 1:25
Client: ALDI			Logged JM

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Concrete flag.
▼	0.20	ES					MADE GROUND: Brown/black clayey gravelly fine to coarse sand with medium brick cobble content and low sandstone cobble content. Gravel is subangular fine to coarse of brick and limestone.
				1.10			End of pit at 1.10 m

1
2
3
4
5

Remarks:
1. Groundwater encountered at 0.90m bgl.
2. Hole backfilled with arisings upon completion.
3. See drawing C3788/05 for foundation details.

Stability: Stable.

Trial Pit Log

Trialpit No **HP2** Sheet 1 of 1

Project Name: WESTGATE	Project No. C3788	Co-ords: - Level:	Date 20/03/2018
Location: SKELMERSDALE		Dimensions (m): Depth 1.15	Scale 1:25
Client: ALDI			Logged JM

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.05			MADE GROUND: Grey limestone gravel.
				0.12			MADE GROUND: Grass over soft brown slightly sandy clay (topsoil) with low brick cobble content.
	0.30	ES	HVP=66				MADE GROUND: Soft brown sandy clay with low brick cobble content. Sand is fine to coarse.
				0.45			Soft to Firm brown very sandy CLAY with low brick cobble content.
				1.15			End of pit at 1.15 m

1 2 3 4 5

Remarks: 1. Hole backfilled with arisings upon completion.
2. See drawing C3788/05 for foundation details.

Stability: Stable.

Trial Pit Log

Trialpit No **HP3**
Sheet 1 of 1

Project Name: WESTGATE	Project No. C3788	Co-ords: - Level:	Date 20/03/2018
Location: SKELMERSDALE		Dimensions (m): Depth 1.14	Scale 1:25
Client: ALDI			Logged JM

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Concrete flag.
				0.14			MADE GROUND: Light brown medium to coarse sand.
	0.30	ES					MADE GROUND: Soft dark brown very sandy clay with low brick cobble content.
				0.35			Soft to Firm brown sandy gravelly CLAY. Sand is fine to medium. Gravel is subangular fine to coarse of sandstone and mudstone.
			HVP=56				
			HVP=62				
				1.14			End of pit at 1.14 m

1
2
3
4
5

Remarks: 1. Hole backfilled with arisings upon completion.
2. See drawing C3788/05 for foundation details.

Stability: Stable.

Trial Pit Log

Trialpit No **HP4**

Sheet 1 of 1

Project Name: WESTGATE	Project No. C3788	Co-ords: - Level:	Date 20/03/2018
Location: SKELMERSDALE		Dimensions (m): Depth 0.61	Scale 1:25
Client: ALDI			Logged JM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES	HVP=95	0.05			MADE GROUND: Grey limestone gravel.
				0.26			MADE GROUND: Soft to Firm dark brown slightly sandy gravelly clay. Gravel is subangular fine to coarse of sandstone, mudstone and brick.
	0.60	D	HVP=113	0.61			Stiff reddish brown mottled grey sandy CLAY.
							End of pit at 0.61 m

1
2
3
4
5

Remarks: 1. Hole backfilled with arisings upon completion.
2. See drawing C3788/05 for foundation details.

Stability: Stable.

Borehole Log

Borehole No. **WS1**

Sheet 1 of 2

Project Name: WESTGATE	Project No. C3788	Co-ords: -	Hole Type WS
Location: SKELMERSDALE		Level:	Scale 1:25
Client: ALDI		Dates: 22/03/2018 - 22/03/2018	Logged By JM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.10			MADE GROUND: Asphalt.
					0.40			MADE GROUND: Brown/black sandy gavel with high brick cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of brick and sandstone. Rare glass and tar material.
		0.50	ES		0.55			MADE GROUND: Dark brown sandy clay with medium brick cobble content.
								Sand lens from 0.50m to 0.53m bgl.
								Stiff brown mottled grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of sandstone and mudstone.
					1.10			
		1.20 1.20	D	N=10 (1,1/2,2,3,3)				Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of sandstone and mudstone.
					1.35			Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mudstone.
								Sand lens from 1.85m to 1.90m bgl.
		2.00 2.00	D	N=14 (2,2/3,3,4,4)				
		3.00 3.00	D	N=17 (1,3/3,4,5,5)	3.10			Stiff brown slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded medium to coarse of sandstone and mudstone.
								Sand lens from 3.70m to 3.74m bgl.
		4.00 4.00	D	N=20 (4,3/4,5,5,6)				
		5.00	D					Continued on next sheet

Remarks

1. Hand dug pit to 1.2m bgl to check for services.
2. Groundwater encountered at 2.50m bgl.
3. Install: 2.00m plain pipe, slotted to 4.00m bgl.

Borehole Log

Borehole No. **WS1**
Sheet 2 of 2

Project Name: WESTGATE	Project No. C3788	Co-ords: -	Hole Type WS
Location: SKELMERSDALE		Level:	Scale 1:25
Client: ALDI		Dates: 22/03/2018 - 22/03/2018	Logged By JM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00		N=21 (4,4/5,5,5,6)	5.45			End of borehole at 5.45 m

6
7
8
9
10

Remarks
1. Hand dug pit to 1.2m bgl to check for services.
2. Groundwater encountered at 2.50m bgl.
3. Install: 2.00m plain pipe, slotted to 4.00m bgl.

Borehole Log

Borehole No. **WS2**

Sheet 1 of 2

Project Name: WESTGATE	Project No. C3788	Co-ords: -	Hole Type WS
Location: SKELMERSDALE		Level:	Scale 1:25
Client: ALDI		Dates: 22/03/2018 - 22/03/2018	Logged By JM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			MADE GROUND: Asphalt.	
					0.25			MADE GROUND: Dark brown mottled black gravel. Gravel is subangular to angular fine to coarse of brick and tar.	
					0.30			MADE GROUND: Brick cobbles.	
					0.65			MADE GROUND: Dark brown stiff clay with bituminous staining and medium brick cobble content.	
		0.70	ES					Soft brown mottled grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone.	1
		1.20 1.20	D	N=7 (1,1/2,1,2,2)					
		2.00 2.00	D	N=16 (2,2/3,4,4,5)	2.10				2
		2.50	D					Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of sandstone and mudstone.	
		3.00 3.00	D	N=18 (3,3/4,4,5,5)					3
		4.00 4.00	D	N=13 (2,3/3,3,3,4)					4
		5.00	D						5
								Continued on next sheet	

Remarks

1. Hand dug pit to 1.2m bgl to check for services.
2. Groundwater not encountered.
3. Install: 1.00m plain, slotted to 4.00m bgl.