STAGE 2 GEO-ENVIRONMENTAL REPORT

FOR

LAND AT UPPER HOYLAND ROAD,

HOYLAND, NEAR BARNSLEY

ON BEHALF OF

HOYLAND DEVELOPMENTS LTD

ARP GEOTECHNICAL LTD

CHARTERED CONSULTING ENGINEERS

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CONTENTS

		Page
1.0	Executive Summary	4 - 5
2.0	Terms of Reference	6 -7
3.0	The Site	8 -9
4.0	Environmental Setting	10 - 12
5.0	Site Investigation	13
6.0	Summary of Ground Conditions	14
7.0	Contamination Analysis	15 - 22
8.0	Geotechnical Testing	23
9.0	Comments and Conclusions	24 - 29

APPENDICES

Appendix A	Site Location Plan, Aerial Photograph and Topographical Survey
Appendix B	Site Walkover Photographs
Appendix C	Borehole Location Plan and Logs
Appendix D	Laboratory Test Certificates and Screening Values
Appendix E	Risk Categorisation Tables
Appendix F	Proposed Layout Plan
Appendix G	Contamination Remediation Statement

1.0 EXECUTIVE SUMMARY

The pertinent conclusions of the report are tabulated below. However, the information below is not exhaustive, and it is recommended the report is read in its entirety.

Proposed Development	Residential dwellings with private gardens.
Existing Site Description	Farm buildings and scaffold storage yard with an access road in the northeast leading onto Upper Hoyland Road.
Site History	Farm buildings since the 1890s.
Geology	Pennine Middle Coal Measures Formation as sandstone on the northwest and undifferentiated strata on the southeast, with no drift. No faults are indicated to adversely affect the site.
Coal Mining	Stable with regard to coal mining.
Ground Gas and Radon	No recorded licenced landfills within 250m. Basic radon protection measures recommended, to prevent conveyancing difficulties.
Ground Conditions	Predominantly hardcore or bitmac cover with small patches of topsoil, over granular made ground up to 0.45m thick. Granular residual soils below, over intact sandstone.
Contamination	Elevated concentration of benzo(a)pyrene and microscopic chrysotile (white) asbestos (within bitumen, no free fibres).
Remediation Strategy	0.6m thick clean cover to made ground in soft areas, with hard break layer or robust geogrid/geotextile below. Alternatively, remove from site. Further sampling recommended once the site has been cleared of buildings and obstructions.
Foundations	Strip/trench fill foundations.
Excavations	Traditional plant considered suitable. However, breaker is likely to be required to excavate through intact rock (as shallow as 0.5m) or historical foundations.
Concrete	GEN1 designation for unreinforced foundations. For any reinforced concrete, other design-specific mixes will apply.
Soakaways	Soakaway drainage may be viable, subject to confirmation by soakaway testing. However, a drainage feasibility design is required to assess the suitability of soakaways for the site.

Road Pavement	For any areas of road pavement, including parking areas, the formation will be the granular residual soils. Below any obvious soft spots, and at equilibrium moisture content, a design California Bearing Ratio (CBR) value of 20% is considered applicable.
Level variations	Due to the level variations on the site, retaining structures may be required to accommodate proposed development levels.
Other constraints	A third party report indicates that the proposed HS2 route passes beneath the site within a tunnel. It is recommended that a HS2 legal search is obtained for advice on potential constraints which may apply to the proposed development.

2.0 TERMS OF REFERENCE

2.1 Hoyland Developments Ltd is considering developing the site at Upper Hoyland Road, Hoyland, near Barnsley, with residential properties, including private gardens. A proposed layout plan is presented in Appendix F. It was considered appropriate to provide information to aid viability assessment and design of any subsequent development.

2.2 ARP was provided with a copy of a Geo-environmental Desk Study Report (Reference APN/DS/5003-3), dated December 2016, by JPG on behalf of CRM Land and Developments, to which the Client indicated that reliance had been, or would be, obtained. The report comprised an assessment of the geological and coal mining aspects, Ordnance Survey archive maps, radon gas, indicative flood risk, hydrogeology, landfill, and other environmental issues. In addition to comments and conclusions on a range of environmental and geotechnical issues, the report also provided recommendations for intrusive investigation and assessment.

2.3 In April 2018, ARP Geotechnical Ltd made an assessment of the information contained in the desk study to determine a scope of works for the Stage 2 site investigation. Some aspects of the JPG recommendations were not considered to be necessary, and these are discussed in later sections of this report. ARP was appointed by Hoyland Developments Ltd to undertake the further works recommended by ARP, with the intrusive investigation basically comprising window sample boreholes and laboratory testing, to assess the ground conditions.

2.4 The investigation was implemented generally in accordance with BS 5930 : 2015 "Code of practice for site investigations", NHBC Standard Chapter 4.1 "Land quality - managing ground conditions", Environment Agency CLR 11 "Model Procedures for the Management of Land Contamination" and BS10175 : 2011 + A2 : 2017 "Investigation of potentially contaminated sites - Code of practice". This report is limited to the data obtained as part of this investigation. It should be noted that there is a possibility of variation in ground conditions between test locations and interpretation of strata is given for guidance only. No liability is accepted for changes to site conditions, including groundwater levels, after the preparation of this report.

2.5 The findings or contents of the Desk Study Report are not reproduced here in full, and it is recommended that this report is read in conjunction with the Desk Study Report.

2.6 The general observation and assessment of the ground surface, and the identification/classification of vegetation is made in general terms only. It would be prudent for a specialist to undertake a more detailed survey, including for any invasive/harmful weeds.

2.7 The assessment of any topsoil is carried out in terms of potential chemical effects on human health only, and no account is taken of aesthetic or horticultural properties. Such considerations should be referred to a horticulturist or landscape architect.

2.8 The report has been prepared for the use and reliance of the Client only. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Geotechnical Ltd. For the avoidance of any doubt, where ARP Geotechnical Ltd enters into a letter of reliance for the benefit of a third party, that third party will be permitted to rely on the report. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party without ARP Geotechnical Ltd.'s consent.

3.0 THE SITE

Site Location

3.1 The site, which is centred on Ordnance Survey Grid Reference SE361011, is located off Upper Hoyland Road, in Hoyland, which is approximately 2km from the southern outskirts of Barnsley.

3.2 A site location plan, aerial photograph, and topographical survey, are presented in Appendix A.

Site Description

3.3 The site currently comprises various farm buildings and a scaffold storage yard with an access road to the northeast leading onto Upper Hoyland Road. The farm buildings include two sandstone and timber stables on the northeast, with suspected asbestos roofs, and an open sided hay barn on the south and several metal shipping containers. The site is predominantly under hardstanding, comprising hardcore or bituminous surfacing, with small patches of topsoil cover.

3.4 The site slopes steeply from the southwest to the northeast, from approximately 165m AOD down to approximately 159m AOD. The access road then slopes down to the northeast towards Upper Hoyland Road at approximately 156m AOD. The site is bounded by fields to the south and southeast with residential properties along the northern and northeastern boundary. Photographs taken during the site walkover are presented in Appendix B.

3.5 At the time of the site investigation, fragments of suspected asbestos cement roofing were identified at the surface in the north of the site. In addition, a stockpile of rubble was present in the southwest corner of the site, a pile of manure present towards the south, and hay bales were stored towards the eastern boundary.

Site History

3.6 Ordnance Survey archive maps show that the current farm buildings to the north have been present since the 1890s.

4.0 ENVIRONMENTAL SETTING

4.1 The environmental setting for the site was established by the Desk Study Report undertaken by JPG Geo-environmental dated partially December 2016. The findings of the Desk Study Report, updated and amended where deemed appropriate, are summarised below.

Geology

4.2 The JPG report states the site is underlain by undifferentiated strata (mudstone, siltstone and minor sandstone) on the northwest of the site and sandstone on the southeast, presumably both of the Pennine Middle Coal Measures Formation, with no drift cover. However, publicly available digital mapping indicates the opposite situation to be the case, with the sandstone on the northwest and the undifferentiated strata on the southeast. The general strata dip is around 4 to 5 degrees to the northeast. No made ground is shown to be present on the site

4.3 There is an area of colliery spoil approximately 50m to the west. No coal seams are shown to outcrop on or near to the site. The nearest coal seam outcrop, of seams with the potential to underlie the site, is the Kent's Thin, which is up to 0.66m thick and located 425m west of the site, at an elevation of, at worst, 153m AOD. The site lies at an elevation of around 160m AOD. When the strata dip is taken into account, the seam is well in excess of 30m below the surface at the location of the site.

4.4 The nearest fault is shown to be located approximately 210m west of the site. This is not considered to affect the site.

Coal Mining

4.5 A Coal Mining Report from the Coal Authority was included within the Desk Study Report. The report is summarised below:-

- The site is in a surface area that could be affected by underground mining in 14 seams of coal at 110m to 450m depth, and last worked in 1977.
- The site is not affected by any opencast mining.
- There are no known coal mine entries on, or within 20 metres of, the site.

4.6 In view of the above, and in consideration of the sections 4.2 and 4.3 above, the site is considered to be stable with regard to coal mining.

Hydrogeology

4.7 The JPG Report indicates the Bedrock Aquifer Designation to be "Secondary A Aquifer". There are no groundwater abstractions within 500m of the site. The site is not within a groundwater Source Protection Zone

Hydrology

4.8 There are no watercourses on or adjacent to the site. However, historical maps from 2002 indicate that the nearest down gradient watercourse is located approximately 500m northeast of the site. Any surface water run-off, which is not intercepted by drainage, is likely to enter the road drainage of Upper Hoyland Road and eventually reach the watercourse to the northeast. The site is not in an area at risk from river flooding.

4.9 There are no active surface water abstractions within 500m of the site.

Other Relevant Environmental Data

4.10 There are no recorded licenced landfills within 250m of the site.

4.11 The JPG report states that site is within a radon affected area, as between 1% and 3% of the properties are above the action level for radon gas, and that no radon protection is required for the site. However, in these situations of apparent conflict, it may be prudent to provide basic radon protection to avoid conveyancing difficulties.

4.12 The site is not within an area at risk from river flooding.

Potential Contamination Sources

4.13 The Desk Study Report identified the following potential sources of contamination:-

4.13.1 Made ground associated with historical development: including metals, semi metals and non-metals, Inorganic compounds, Organic compounds (e.g. Polyaromatic Hydrocarbons PAHs and Petroleum hydrocarbons) and asbestos.

4.13.2 Hazardous gas associated with the made ground. ARP would comment that this is dependent on the nature and thickness of any made ground encountered.

5.0 SITE INVESTIGATION

5.1 A site investigation was undertaken by ARP Geotechnical Ltd on 24th April 2018. The purpose of the investigation was to produce an assessment of the site in accordance with BS10175: 2011 + A2: 2017 "Investigation of potentially contaminated sites - Code of practice", and to provide geotechnical information to aid design of the development.

5.2 The site was gridded on a maximum 25m spacing and window sample boreholes were formed and sampled on the grid, to satisfy the requirements of the British Standard. Eight window sample boreholes (WS1 - WS8) were formed to between 0.53m and 1.45m. At the time of the site investigation, the scaffold storage area in the northwestern corner was not accessible. The window sample boreholes were organised, supervised and logged by an Engineer from ARP Geotechnical Ltd.

5.3 The window sample borehole location plan and logs are included in Appendix C. It should be noted that the co-ordinates on the logs have not been surveyed in, but are automatically determined by the logging software (which incorporates mapping) following approximate positioning of each location by the Engineer. Ground levels provided have been interpolated from the topographical survey.

5.4 Chemical analysis of six soil samples for metals, inorganics, speciated PAH, TPH, phenols, and asbestos was undertaken by the UKAS accredited Derwentside Environmental Testing Services (DETS) laboratory in Consett. The test certificates are included in Appendix D.

6.0 SUMMARY OF GROUND CONDITIONS

Strata and Groundwater

6.1 The southern end of the site was under hardcore to between 0.2m and 0.4m depth, with localised topsoil to 0.1m depth. Bitmac cover to 0.1m was encountered surrounding the buildings to the north. This was underlain by made ground to a maximum depth of 0.5m. The made ground was underlain by granular residual soils recovered as very dense silty sand and gravel to 1m. Weak to very weak sandstone was encountered in window sample boreholes WS4, WS5, WS7, WS8 and WS9 and proven to a maximum depth of 1.45m. Window sample boreholes WS1, WS2, WS3 and WS6 are inferred to have terminated on intact bedrock.

6.2 All window sample boreholes were dry with the exception of WS6, where moist material was identified at 0.4m.

7.0 CONTAMINATION ANALYSIS

Screening Values - Soils

7.1 There is presently conflicting opinion with regard to the appropriate generic assessment criteria, or screening values, for soils which should be used in contamination assessment for proposed development. In March 2014, DEFRA published Category 4 Screening Levels (C4SLs) for six contaminants: arsenic, benzene, benzo (a) pyrene, cadmium, chromium VI and lead. The values are based on the toxicological benchmark of a "low level of toxicological concern" (LLTC) rather than the previous regulatory approach of "minimal or tolerable level of risk". As the C4SLs are less protective of health than the previous approach, the Chartered Institute of Environmental Health (CIEH) has advocated an alternative approach based on minimal risk, but with some adjustment of exposure parameters to more realistic scenarios than those previously used. To this end, the CIEH has collaborated with Land Quality Management to publish "Suitable 4 Use Levels" (S4ULs) "The LQM/CIEH S4ULs for Human Health Risk Assessment", November 2014 (LQM/CIEH). However, DEFRA has reiterated its intention that the C4SLs should be used in generic risk assessment for proposed development, and there is indication that other parties will collaborate, in the near future, to extend the range of C4SL determinands beyond the six published so far.

7.2 In the absence of a final resolution to the debate, soil contamination test results in this report have been compared first against the more conservative S4UL, and where a C4SL exists for the same determinand, consideration given to the use of the C4SL for any exceedances of the S4UL, within the site specific context. Where no S4UL exists for a determinand, for example lead, the C4SL has been used. The LQM/CIEH screening values have been calculated for soil organic matter contents of 1% and 2.5%, as well as 6%, and the appropriate screening value is used for the organic matter content of the soil. All the C4SL values published are for a soil organic matter content of 6%.

7.3 A table showing the screening values utilised is included in Appendix D.

Screening Values - Leachability and Groundwater

7.4 In order of preference, the Environmental Quality Standards (EQS) annual averages for freshwater have been used as generic screening values for these results. Where no EQS is available, the stringent UK Drinking Water Standards (DWS) have been used, and other sources in the absence of EQS and DWS, as indicated on the groundwater screening values table in Appendix D.

Soils Analysis

7.5 Six samples of made ground, from WS1, WS3, WS4, WS6, WS7, and WS8, were issued to DETS for the suite of testing (As, Cd, Cr (VI), Cr(III), Cu, Hg, Ni, Pb, Se, Zn, Total Sulphate, Water Soluble Sulphate, pH, Phenol-monohydric, Speciated PAH, Total TPH, Asbestos, and Organic Matter). Statistical analysis of the results was not possible given the small number of samples obtained, although appropriate for the site. Therefore, individual samples have been compared against their respective screening values.

7.6 A results summary table for determinands within the made ground found to be above screening values is given below

Location	Depth	TPH	B(a)P	Asbestos
WS1	0-0.1	1300	1.7	NAD
WS3	0.15-0.3	<10	<0.1	NAD
WS4	0.0-0.1	230	0.2	NAD
WS6	0.2-0.3	160	0.2	Chrysotile
WS7	0-0.2	23	<0.1	NAD
WS8	0.1-0.2	4600	13	NAD
Screen Values		500	5	NA
Average		NA	2.6	NA

Exceedance
Below screening value
Values are in mg/kg unless indicated otherwise
TPH = Total Petroleum Hydrocarbons
B(a)P = Benzo(a)pyrene
NAD – No Asbestos Detected

7.7 It can be seen from the table that benzo(a)pyrene was elevated in WS8, chrysotile (white) asbestos was detected in WS6 (within bitumen, no free fibres), and EPH was elevated in WS1 and WS8. However, the actual risks from EPH are dependent on the individual carbon weighted components. Therefore, the two samples from WS1 and WS8 were tested further for aliphatic/aromatic split carbon weighted speciation. The results indicate the individual determinands are all below the screening values, and the EPH concentrations in the made ground are therefore, considered to be acceptable.

7.8 The asbestos in WS6, and the benzo(a)pyrene in WS8, require further consideration in the risk assessment.

Updated Risk Assessment and Conceptual Model

7.9 The categorisations of risk adopted in this report are adapted from CIRIA Report C552 (Contaminated Land Risk Assessment: A Guide to Good Practice, 2001). This approach assesses the potential severity of any pollution event and the probability of the event occurring, to arrive at a risk category, for the various potential source - pathway - receptor linkages. The relevant tables used, with the definitions, are presented in Appendix E.

7.10 The updated source - pathway - receptor matrix is presented below, taking into account the findings of the investigation. Any pathways in italics are deemed not to be viable and the reason given.

Viable Source - Pathway - Receptor Matrix (Finished Development)

Contamination Sources	Pathways	Receptors	Severity of Consequence	Probability of Event	Risk
Benzo(a)pyrene (13mg/kg) in made ground at WS8	• Inhalation, ingestion and dermal contact with soil and dust • Fruit and vegetable intake, with soil • Vapour inhalation outdoor • Vapour inhalation indoor	**Humans:-** • Future occupants • Maintenance workers • Adjacent residents and general public	**Medium**	**Low Likelihood**	**Moderate/ Low**
	• *Migration in surface water (not considered significant for the minimal source volume)*	• Surface water (nearest downslope is 500m to northeast. There are no abstractions within 500m)	**Negligible**		
	• *Migration in groundwater (not considered significant for the minimal source volume)*	• Groundwater (Secondary A Aquifer, no abstractions within 500m)	**Negligible**		
	• Root uptake	**Vegetation:-** • Landscape areas • Private gardens	**Minor**	**Low Likelihood**	**Very Low**
	• Migration	**Services/Utilities:-** • Potable water supply	**Medium**	**Low Likelihood**	**Moderate/ Low**
Asbestos within the made ground - chrysotile	• Inhalation	• Future occupants • Maintenance workers • Adjacent residents and general public	**Severe**	**Unlikely**	**Moderate/ Low**
Possible asbestos within existing buildings	• Inhalation	• Future occupants • Maintenance workers • Adjacent residents and general public	**Severe**	**Low**	**Moderate**

7.11 It can be seen from the above matrix that several pathways to receptors are operative, with moderate to very low risk applicable and this may affect users of the finished development. Some form of remedial action is, therefore, considered necessary to allow residential development without excess risk.

Risk Based Assessment of Remedial Options

Asbestos within Existing Buildings

7.12 Provided an asbestos survey is carried out prior to any demolition or work on the existing buildings on the site, and any identified asbestos is removed and disposed to a licenced facility, then the risk to receptors is low. The work should be carried out by appropriately qualified Contractors. The asbestos survey should also include an inspection of suspected asbestos cement roof tiles identified on site. If confirmed to be asbestos, the material should be removed and disposed to a licensed facility.

Made Ground - Ingestion, Dust Inhalation, Dermal Contact, Root Uptake, and Fruit and Vegetable Intake, With Soil

7.13 This pathway is automatically blocked where buildings or hardstanding are present above the material. However, in garden areas in the north in the vicinity of WS6 and WS8, provision of a cover blanket of a minimum 0.6m thickness will be required, to reduce the risk to future users of the site to acceptable levels from these pathways. This assumes a worst case double dig scenario (i.e. 2 x spade depths). Due to the presence of asbestos fibres, to prevent inadvertent future exposure due to other forms of excavation such as tree planting or construction of ponds, a hard break layer or robust geogrid/geotextile should be provided below the base of the cover blanket.

7.14 Contamination, asbestos in particular, can be sporadic, and the made ground across the site was relatively similar in character. Therefore, there is considered to be a possibility that undetected contamination is present elsewhere in the made ground. Therefore, it is recommended that the remedial measures outlined above are used where any made ground is present on the site, unless further sampling and testing demonstrates otherwise. Alternatively, as the made ground is relatively thin (between 0.05m and 0.45 thick), it may be economical to simply remove the made ground from site.

Migration to Utilities

7.15 Any migration to utilities is unlikely to be significant. However, the local water company are likely to require details of the contaminants present on the site, to make a judgment on any requirement for protection of buried water supply pipes from chemical attack/ingress.

Risks During Construction Period

7.16 It is also necessary to consider the effects of the contamination present on the site in relation to the risks to adjacent residents, construction workers and the general public during construction. This is assessed in the following matrix.

Source	Pathway	Potential risk	Risk after employing suitable Health and Safety plan.
Existing made ground	Inhalation	Moderate	Damping down of the site during dry periods and timely placement of the existing made ground below barriers should block this pathway and reduce the risk to negligible.
Existing made ground	Ingestion	Moderate	Site fencing will exclude access to members of the public. Existing made ground will be contained within the site boundary, and placed below barriers as soon as possible. Washing facilities and a clean mess room from which work boots and overalls are excluded should be provided. These measures should block this pathway and reduce the risk to negligible.
Existing made ground	Contact	Moderate	Education of workers to use adequate hygiene and PPE should block this pathway and reduce the risk to negligible.
Existing made ground	Surface water	Low	Preventing surface water run off by minimising open exposure times of the existing made ground, and using bunds or cut off trenches as necessary should block this pathway and reduce the risk to negligible.
Asbestos in existing buildings	Inhalation	High	Provided an asbestos survey is carried out, and any identified asbestos is removed from site prior to any other works commencing, the pathway is blocked and the risk is negligible.

7.17 Provision of all the above measures will ensure that all the identified pathways for the contamination will be blocked.

Summary of Contamination Identified and Remedial Options

7.18 The site is underlain by up to 0.45m thickness of made ground, overlying granular residual soils. This in turn was underlain by very weak to weak sandstone proven to a maximum depth of 1.45m. No visual or olfactory signs of contamination were identified during the site investigation with the exception of suspected asbestos cement on the surface of the north of the site.

7.19 An elevated concentration of benzo(a)pyrene was identified in WS8 within the made ground and chrysotile (white) asbestos was detected in WS6 within the made ground (within bitumen, no free fibres). Such contamination can be sporadic and unless further sampling and testing demonstrates otherwise, there should be viewed to be a potential for its presence within the made ground elsewhere on the site.

7.20 The contamination risk assessment, and assessment of remedial options, has indicated that, provided that the following remedial measures are adopted then the risks to the identified receptors are deemed acceptable for the proposed development of residential properties with private gardens.

7.20.1 An asbestos survey should be carried out prior to any demolition or work on the existing buildings on the site, and also carried out on the site surface, as fragments of suspected asbestos roofing materials were noted to be present on the ground towards the north. Any identified asbestos should be removed and disposed to a licenced facility. The work should be carried out by appropriately qualified Contractors.

7.20.2 A stockpile of rubble is present towards the south of the site. This material is likely to require removal from site. The receiving tip may require Waste Acceptance Criteria testing and asbestos quantification. The disposal/transfer documents should be retained for inclusion in the Validation Report.

7.20.3 Where any garden or landscape areas overlie the existing made ground, a minimum 0.6m thickness of uncontaminated soils (topsoil and subsoil) should be provided. In areas of hardstanding or building footprints, the cover blanket is not required. As chrysotile (white) asbestos fibres have been identified, it is recommended that the cover blanket be underlain by a minimum 100mm thick hard break layer of coarse stone, or alternatively, a robust geogrid or geotextile. In areas of hardstanding or building footprints, the cover blanket is not required. Alternatively, the made ground could be removed to licensed landfill. The receiver may require Waste Acceptance Criteria testing to be carried out, and the transfer notes will need to be retained for inclusion in a validation report.

7.20.4 Any imported soils used as a clean cover blanket will need to be verified as suitable by inspection and testing, in accordance with guidance supplied in the document produced by the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG): "Guidance on the Verification Requirements for Cover Systems".

7.21 It is recommended that further investigation is undertaken following the demolition of the existing buildings and the area to the northwest that was not accessible during the site investigation.

7.22 The local water company are likely to require details of the contaminants present on the site, to make a judgment on any requirement for protection of buried water supply pipes from chemical attack/ingress.

7.23 A Contamination Remediation Statement is included in Appendix G.

8.0 GEOTECHNICAL TESTING

8.1 Geochemical testing (water soluble sulphate and pH) was undertaken on selected samples by DETS, comprising five samples of natural strata and one sample of made ground. In accordance with the BRE Special Digest 1 "Concrete in aggressive ground", the characteristic values for the two materials are given below:

Characteristic Values

Material	pH	SO_4
Made Ground	6.9	1,010
Natural Strata	5.9	160

SO_4 = Sulphate content in mg/l on a 2:1 water: soil extract pH = Acidity

8.2 The geochemical analyses show the natural strata to have low water soluble sulphate content and the made ground has a moderate water soluble sulphate content. Both materials have acidic pH. As static groundwater conditions are considered applicable to the site, the Aggressive Chemical Environment for Concrete (ACEC) class is AC-1s. Therefore, the use of GEN1 designated concrete will be satisfactory for unreinforced buried concrete, in accordance with BS 8500-1:2006. For any reinforced buried concrete, other design-specific mixes will apply.

9.0 COMMENTS AND CONCLUSIONS

Site Description

9.1 The site currently comprises various farm buildings and a scaffold storage yard with an access road to the northeast leading onto Upper Hoyland Road. The farm buildings include two sandstone and timber stables on the northeast, with suspected asbestos roofs, and an open sided hay barn on the south and several metal shipping containers. The site is predominantly under hardstanding, comprising hardcore or bituminous surfacing, with small patches of topsoil cover. The site slopes steeply from the southwest to the northeast, from approximately 165m AOD down to approximately 159m AOD. The access road then slopes down to the northeast towards Upper Hoyland Road at approximately 156m AOD. The site is bounded by fields to the south and southeast with residential properties along the northern and northeastern boundary.

9.2 At the time of the site investigation, fragments of suspected asbestos cement roofing were identified at the surface in the north. In addition, a stockpile of rubble was present in the southwestern corner of the site, a pile of manure present towards the south, and hay bales stored towards the eastern boundary.

Site History

9.3 Ordnance Survey archive maps show that the farm buildings to the north have been present since the 1890s.

Geology

9.4 Pennine Middle Coal Measures Formation as sandstone on the northwest and undifferentiated strata on the southeast, with no drift. No faults are indicated to adversely affect the site.

Coal Mining and Coal Recovery

9.5 The site is considered to be stable with regard to coal mining.

9.6 There will be no arisings of significant coal during proposed development works, and it will not be possible to win any coal from the site before development.

Environmental Data

9.7 The strata beneath the site are classed as a Secondary A Aquifer. There are no groundwater abstractions within 500m of the site.

9.8 The nearest surface water feature down gradient of the site is a drain, approximately 500m to the northeast. There are no active surface water abstractions within 500m of the site.

9.9 The JPG report states that the site is within a radon affected area, as between 1% and 3% of the properties are above the action level for radon gas, but that no radon protection is required for the site. In these situations of apparent conflict, it may be prudent to provide basic radon protection to avoid conveyancing difficulties. This is usually achieved by incorporating an appropriate barrier within a solid floor system, and extending the barrier through the cavity wall.

9.10 No licenced landfills are recorded within 250m of the site.

9.11 The site is not at risk from river flooding. The risks of flooding from other causes such as adverse topography or insufficient surface water drainage, are not considered here, and a separate specialist Flood Risk and Drainage Report should be commissioned if such risk needs to be quantified.

Ground Conditions Encountered

9.12 The southern end of the site was under hardcore to between 0.2m and 0.4m depth with localised topsoil to 0.1m depth. Bitmac cover to 0.1m was encountered surrounding the buildings to the north. This was underlain by made ground to a maximum depth of 0.45m. The made ground was underlain by granular residual soils recovered as very dense silty sand and gravel to 1.45m. Weak to very weak sandstone was encountered in window sample boreholes WS4, WS5, WS7, WS8 and WS9 and proven to a maximum depth of 1m. Window sample boreholes WS1, WS2, WS3 and WS6 are inferred to have terminated on intact bedrock, as shallow as around 0.53m locally.

Contamination Assessment

9.13 An elevated concentration of benzo(a)pyrene was identified within the made ground in WS8 and microscopic chrysotile (white) asbestos (within bitumen, no free fibres) was detected in WS6, within the made ground. Such contamination can be sporadic and unless further sampling and testing demonstrates otherwise, there should be viewed to be a potential for its presence within the made ground elsewhere on the site.

9.14 The contamination risk assessment confirmed that, provided remedial measures are implemented (basically comprising 0.6m clean cover soils over a hard break or barrier to any garden areas where made ground is present) the materials on the site are compatible with the proposed usage. A Contamination Remediation Statement, which includes further detail on the remediation measures for the site, is presented in Appendix G.

9.15 This Report should be issued to the local water company for it to make a judgment on any requirement for protection of buried water supply pipes from chemical attack/ingress.

Foundations

9.16 For proposed foundations, strip/trench fill foundations are considered suitable, founded on granular residual soils with an allowable bearing pressure of 150kN/m^2. A higher allowable bearing pressure of 300kN/m^2 would be applicable if founded on intact bedrock. The foundation should be taken below the depth of any existing foundations, obstructions, or basements, onto natural ground.

9.17 The founding strata are non-plastic, and, therefore, the minimum foundation depths given in NHBC Standard Chapter 4.2 "Building Near Trees" do not apply. However, to protect against fines washing subsidence in the event of a burst water supply pipe, it is recommended that a foundation depth of 0.9m is adopted in proximity to any such pipes.

9.18 The foundation should be taken below the depth of any existing foundations or obstructions, onto natural ground. The whole plan area of the foundation should be placed on similar natural material.

9.19 If bedrock is encountered on part of a foundation excavation, the rest of the plot should be deepened to ensure founding on similar material. However, if rock is not encountered by 2.5m depth on the remainder of the plot, then the Engineer should be contacted for further advice.

Excavations

9.20 It is likely that excavations into the natural strata will remain stable in the short term, requiring minimal trench support, in accordance with the prevailing statutory guidance. Instability may be anticipated within any made ground present on the site, although the maximum thickness of made ground encountered was only 0.45m.

9.21 All window sample boreholes were dry with the exception of WS6, where moist material was identified at 0.4m depth.

9.22 Excavations should be readily achieved using conventional hydraulic plant. However, excavations into intact bedrock or any buried foundations and structures are likely to require a hydraulic breaker. In some locations, bedrock was found to be present from as shallow as approximately 0.5m.

Chemical Precautions

9.23 The Aggressive Chemical Environment for Concrete (ACEC) class is AC-1s for both the natural strata and made ground. Therefore, the use of GEN1 designated concrete will be satisfactory for unreinforced buried concrete, in accordance with BS 8500-1:2006. For any reinforced buried concrete, other design-specific mixes will apply.

Road Pavement Construction

9.24 For any areas of road pavement, including parking areas, the formation will be the granular residual soils. Below any obvious soft spots, and at equilibrium moisture content, a design California Bearing Ratio (CBR) value of 20% is considered applicable.

Soakaways

9.25 Soakaway drainage may be viable, subject to confirmation by soakaway testing. However, any soakaway drainage solution for the site will depend on many factors, including potential adverse off site impacts, impermeable areas and the proposed layout. A drainage feasibility design should be carried out to determine the appropriate solution

Level variations

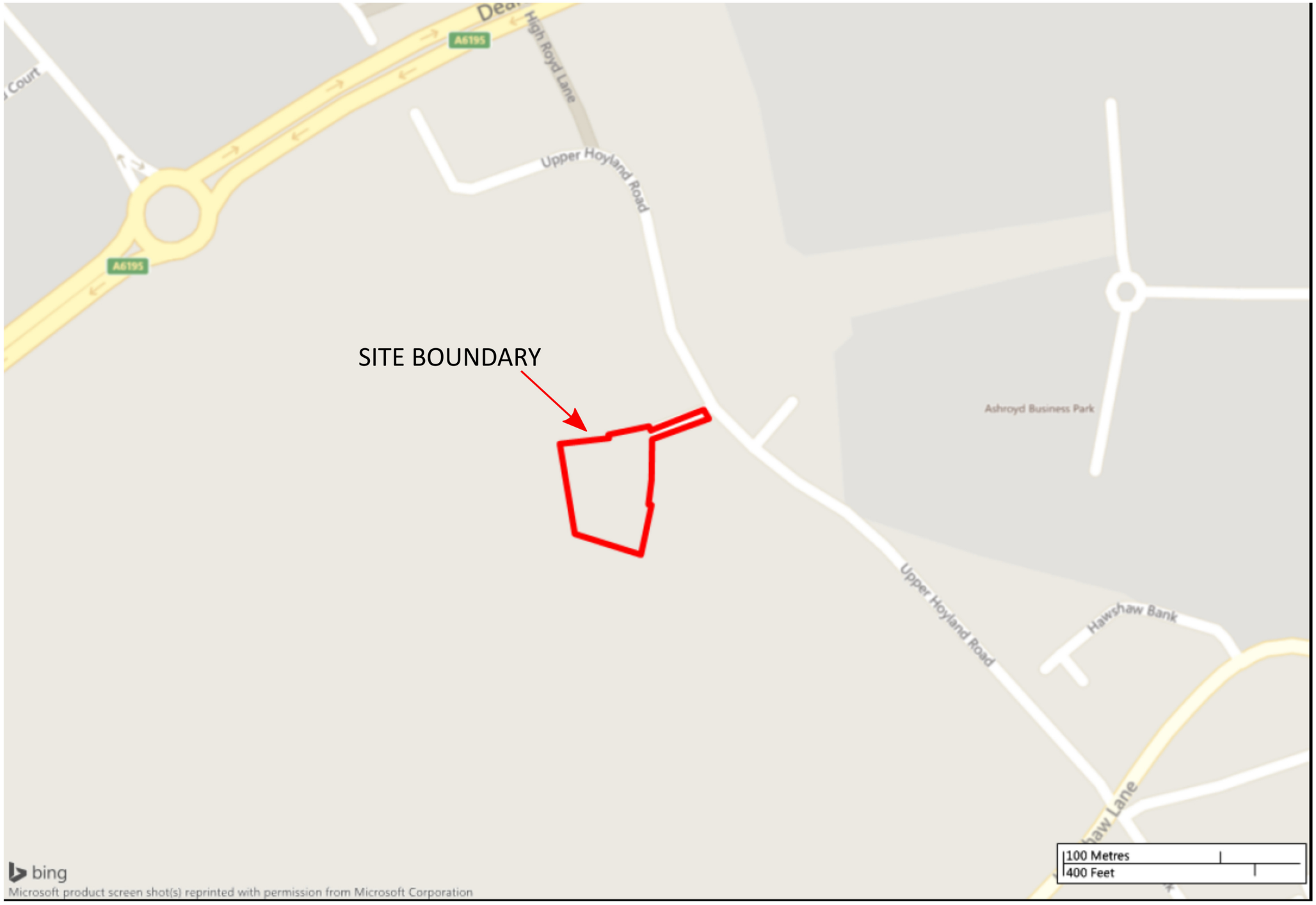
9.26 Due to the level variations on the site, retaining structures may be required to accommodate proposed development levels.

Other Constraints

9.27 The JPG report suggests that the proposed High Speed Railway "HS2" route passes beneath the site, within a proposed tunnel. It is recommended that a HS2 legal search is obtained for advice on potential constraints which may apply to the proposed development.

A P P E N D I X A

SITE LOCATION PLAN, AERIAL PHOTOGRAPH AND TOPOGRAPHICAL SURVEY



Project **UPPER HOYLAND ROAD, BARNSLEY**	Title **LOCATION PLAN**	ARP GEOTECHNICAL LTD CHARTERED CONSULTING ENGINEERS	Date **JUNE 18**	Scale **AS SHOWN**
Client **HOYLAND DEVELOPMENTS LTD**			Drawn **@ A3**	Job No. **HDE/01**
			Rev.	

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