

DIOCESE OF SHREWSBURY

**ST ANTHONY'S CATHOLIC PRIMARY SCHOOL,
WYTHENSHAW, MANCHESTER, M22 0NT**

REPORT ON GROUND INVESTIGATION

Contract: 2230085

Date: June 2020

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REPORT ON GROUND INVESTIGATION

Carried out at

ST ANTHONY'S CATHOLIC PRIMARY SCHOOL,

**WYTHENSHAW, DUNKERY ROAD
MANCHESTER, M22 0NT.**

Prepared for

DIOCESE OF SHREWSBURY

c/o Atkins

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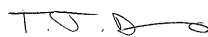
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EXECUTIVE SUMMARY

It is understood that the proposed development comprises a new school building, a new car park and access road and a Multi-Use Games Area (MUGA) at St Anthony's Catholic Primary School, Wythenshawe, Manchester.

On the instructions of Atkins, Consulting Engineers, acting on behalf of the Diocese of Shrewsbury, an investigation was undertaken to determine ground conditions to enable foundation and road/hard standing design to be carried out, together with a contamination risk assessment.

The St Anthony's Catholic Primary School is located in Wythenshawe, south Manchester and is situated about 6km south east of Altringham town centre.

The site comprises an area of grassed playing field to the immediate east of the existing school buildings.

The geological mapping indicates the site to be underlain by superficial deposits of Till, generally comprising clay with varying proportions of sand, gravel cobbles and boulders. The superficial deposits are underlain by mudstone of the Bollin Mudstone Member from the Triassic geological Period.

The site work was carried out on the 6th and 15th April 2020 and comprised five boreholes, designated WS01 to WS05, undertaken by percussive sampling using a windowless sampler rig, and four trial pits, designated TP01 to TP04, dug by mechanical excavator.

Representative disturbed samples were taken at the depths shown on the borehole and trial pit records and despatched to the laboratory for examination and testing. Samples for environmental purposes were collected in amber glass jars.

Standard Penetration Tests (SPTs), were carried out in the boreholes in the various strata to assess the relative density or consistency.

The ground investigation generally revealed Topsoil and Made Ground to depths of between 0.50m and 0.60m below ground level underlain by sandy and gravelly clay to depths of between 1.10m and 2.80m below ground level. Peaty soils were also encountered (WS05). Weathered mudstone and sandstone were encountered underlying the clay and penetrated to a maximum depth of 3.45m below ground level.

Outside the zone of influence of existing and proposed trees, it is recommended that conventional shallow spread footings should be taken through any Made Ground and upper horizons of soft ground and placed in the underlying firm clay soils (which were encountered at depths of between 1.20m and 1.40m below ground level in WS01, WS03, WS04 and WS05).

Such foundations, assuming a 0.60m wide strip foundation at the minimum depth of circa 1.20m and using a lower bound characteristic c_u value of 50kPa, an allowable bearing pressure of 115kPa, can be obtained which would provide an adequate factor of safety against shear failure. Settlements are likely to be less than 20mm.

However, the ground investigation suggests a change in ground conditions in the vicinity of WS05 with weathered mudstone underlying organic soils at 1.30m below ground level, therefore it is possible that foundations could be supported on different strata potentially resulting in differential settlements due to the different settlement characteristics of these strata. In these circumstances it recommended that a lower allowable bearing pressure of 80kPa is adopted and that nominal reinforcement be included within the foundations to minimise differential settlement.

On the basis of laboratory classification tests and for formations prepared in the clay soils, adopting a characteristic plastic index value of 17%, a subgrade CBR value of circa 2.5 is suggested with reference to HA44/91, for road and hardstanding design.

The results of chemical tests undertake on samples of the natural clay soils suggest a Design Sulphate Class of DS-2 and an ACEC class AC-1s in respect to buried concrete.

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1.0 INTRODUCTION

- 1.1 It is understood that the proposed development comprises a new school building, a car park and access road at St Anthony's Catholic Primary School, Wythenshawe, Manchester.
- 1.2 On the instructions of Atkins, Consulting Engineers, acting on behalf of the Diocese of Shrewsbury, an investigation was undertaken to determine ground conditions to enable foundation and road/hard standing design to be carried out, together with a contamination risk assessment.
- 1.3 It is recommended that a copy of this report be submitted to the relevant authorities to enable them to carry out their own site assessments and provide any comments.
- 1.4 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.
- 1.5 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.
- 1.6 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

- 2.1.1 The St Anthony's Catholic Primary School is located in Wythenshawe, south Manchester and is situated about 6km south east of Altringham town centre.
- 2.1.2 The site comprises an area of grassed playing field to the immediate east of the existing school buildings.
- 2.1.3 Dunkery Road forms the northern boundary of the site and Culmere Road the eastern boundary with further playing fields to the south.
- 2.1.4 The site can be located by National Grid Reference SJ 827862.
- 2.1.5 Site location plans are included in Appendix 1, Figures A1.1 and A1.2.

2.2 Geological Setting

- 2.2.1 Details of the geology underlying the site have been obtained from the British Geological Survey web based geological records database (contains British Geological Survey materials ©NERC 2020).
- 2.2.2 The geological mapping indicates the site to be underlain by superficial deposits of Till, generally comprising clay with varying proportions of sand, gravel cobbles and boulders.
- 2.2.3 The superficial deposits are underlain by mudstone of the Bollin Mudstone Member from the Triassic geological Period.

3.0 SITE WORK

- 3.1 The site work was carried out on the 6th and 15th April 2020 on the basis of practices set out in BS 10175:2011+A2:2017, ref. 9.1, BS 5930: 2015, ref. 9.2, and EN ISO 1997:2007, ref 9.3.
- 3.2 Five boreholes, designated WS01 to WS05, were undertaken by percussive sampling using a windowless sampler rig and four trial pits, designated TP01 to TP04, were dug by mechanical excavator at the positions shown on the exploratory hole location plan, Figure A1.3, presented in Appendix 1.
- 3.3 The depths of boreholes and trial pits, descriptions of strata encountered and comments on groundwater conditions are given in the borehole and trial pit records, Appendix 2.
- 3.4 Representative disturbed samples were taken at the depths shown on the borehole and trial pit records and despatched to the laboratory for examination and testing. Samples for environmental purposes were collected in amber glass jars.
- 3.5 Standard Penetration Tests (SPTs), were carried out in the boreholes, refs.9.4 and 9.5, in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.
- 3.6 The ground levels at the borehole and trial pit locations were not determined.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

4.1.1 Geotechnical soil analysis was undertaken of samples obtained during the investigation as follows:

- 8 No. Water Content Tests
- 8 No. Plasticity Index Tests

4.1.2 The laboratory test report is given in Appendix 3, Test Report 2230085/1.

4.2 Chemical Testing

4.2.1 The chemical analyses were carried out on five samples of natural soil and one sample of made ground. The nature of the analyses is detailed below:

- **Metals** - arsenic, boron (water soluble), cadmium, chromium (hexavalent), chromium (total), copper, lead, mercury, nickel, selenium and zinc.
- **Inorganics** – pH, cyanide (total), soil organic matter, 2:1 soluble sulphate.
- **Organics** - polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite., phenol (total).

4.2.2 The samples were also screened for the presence of asbestos.

4.2.3 The chemical test results and asbestos screening results are presented in Appendix 4, Test Reports 20/03362 and 20/03435.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Sequence

5.1.1 The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map but with the addition of Made Ground.

5.1.2 The sequence and indicative thicknesses of strata are provided below:

Strata Encountered	Depth Encountered (m bgl)		Strata Thickness (m)
	From	To	
Topsoil	0.00	0.20 – 0.50	0.20 – 0.50
Made Ground	0.00	0.20 – 0.60	0.20 – 0.60
Till	0.20 – 0.60	1.10 – 2.80	0.85 – 2.60
Peat	1.10	1.30	0.20
Weathered mudstone	1.20 – 2.80	2.30 – 3.45	0.40 – 3.45+

5.2 Topsoil

5.2.1 Topsoil comprising brown/dark brown clayey sand was encountered in TP01, TP02 and WS04.

5.3 Made Ground

5.3.1 Made Ground, including a Made Ground topsoil, was encountered in TP03, TP04, WS01 to WS03 and WS05, and generally comprised a brown slightly gravelly clayey sand and orange/yellow brown sandy gravelly clay.

5.3.2 Brown clayey gravelly sand was encountered in WS01 to WS03, TP03 and TP04, with inclusions of glass, coal and clay pipe fragments.

5.3.3 In WS01, WS05 and TP04, sandy gravelly clay was encountered, which in WS01 and TP04 underlaid an upper horizon of slightly clayey gravelly sand. Fragments of glass, brick, concrete and clay pipe were found in the clay.

5.4 Clay

5.4.1 Natural deposits of clay were encountered in all the exploratory holes, underlying topsoil or Made Ground and generally comprised orange brown/yellow brown slightly sandy gravelly clay becoming red brown, locally mottled grey, with depth.

5.5 Peat

5.5.1 A thin band of peat was encountered in WS02 between 1.10m and 1.30m below ground level.

5.6 Weathered Mudstone and Sandstone

- 5.6.1 Weathered mudstone and sandstone was encountered underlying the Till and was recovered as grey and reddish grey clayey gravel of mudstone and sandstone.

5.7 Groundwater

- 5.7.1 No definite groundwater strikes were observed in the exploratory holes during the investigation, although strata in WS01 at 2.00m below ground level and in WS02 between 1.10m and 1.30m were found to be damp.
- 5.7.2 In WS03, strata was noted as moist between 1.20m and 1.40m below ground level and at 2.60m below ground level.

6.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

6.1 Proposed Development

- 6.1.1 It is understood that the proposed development is to consist of a new single storey school building, a car park and associated access road.
- 6.1.2 Precise structural details were not available at the time of preparation of this report. The comments and discussion below do not fall within the requirements of BS EN1992-1:2004 EC7 and are offered for guidance. The comments and recommendations below should be reviewed as development details become available.

6.2 Assessment of Soil Condition

6.3 General

- 6.3.1 The ground investigation revealed Topsoil and Made Ground to depths of between 0.50m and 0.60m below ground level underlain by sandy and gravelly clay to depths of between 1.10m and 2.80m below ground level. Weathered mudstone and sandstone was encountered underlying the clay and penetrated to a maximum depth of 3.45m below ground level.

6.4 Made Ground

- 6.4.1 Geotechnical laboratory testing was not undertaken on the Made Ground

6.5 Till

- 6.5.1 Laboratory testing for the clay recorded natural moisture contents of between 13% and 32%, with an average of 21%, liquid limits of between 33% and 53%, with an average of 40%, plastic limits of between 18% and 33%, with an average of 23% and plasticity indices of between 12% and 23%, with an average of 17%. The plastic index test results are presented on the plasticity classification chart, Appendix 3, Figure A3.3.
- 6.5.2 These results indicate soils of low to high plasticity and of low to medium volume change potential, refs. 9.66, 9.7 and 9.8. Changes in moisture content will result in moderate/small changes in volume, seasonal changes being exacerbated by the presence of trees.
- 6.5.3 SPTs were undertaken and where full penetration was achieved, recorded 'N' values of between $N = 9$ and $N = 43$, with an average of 21, which when using correlations and relationships between SPT 'N' values and plasticity indices, refs. 9.9 and 9.10, suggests c_u values of between circa 50kPa and 250kPa, averaging 120kPa.
- 6.5.4 Further correlations between plasticity indices and SPT 'N' values suggests m_v values (coefficient of volume compressibility) of between $0.19\text{m}^2/\text{MN}$ and $0.04\text{m}^2/\text{MN}$, with an average $0.08\text{m}^2/\text{MN}$.

6.6 Weathered Mudstone

- 6.6.1 Weathered mudstone was encountered at depths of between 1.30m and 2.80m below ground level in the boreholes.
- 6.6.2 SPT's were undertaken but did not achieve full test penetration SPTs of 50 blows for penetrations of between 35mm and 200mm were recorded. Extrapolated 'N' values might suggest the mudstone to be extremely weak/very weak (0.6 to 5 MPa).

6.7 Foundation Options

- 6.7.1 On the basis of observations made on site together with results of in-situ and laboratory tests, together with empirical correlations, consideration could be given to the adoption of shallow spread foundations to support the proposed new school building.
- 6.7.2 Outside the zone of influence of existing and proposed trees, it is recommended that conventional shallow spread footings should be taken through any Made Ground and upper horizons of soft ground and placed in the underlying firm clay soils (which were encountered at depths of between 1.20m and 1.40m below ground level in WS01, WS03, WS04 and WS05).
- 6.7.3 Such foundations, assuming a 0.60m wide strip foundation at the minimum depth of circa 1.20m and using a lower bound characteristic c_u value of 50kPa, an allowable bearing pressure of 115kPa, can be obtained which would provide an adequate factor of safety against shear failure. Settlements are likely to be less than 20mm.
- 6.7.4 However, the ground investigation suggests a change in ground conditions in the vicinity of WS05 with weathered mudstone underlying organic soils at 1.30m below ground level, therefore it is possible that foundations could be supported on different strata potentially resulting in differential settlements due to the different settlement characteristics of these strata. In these circumstances it recommended that a lower allowable bearing pressure of 80kPa is adopted and that nominal reinforcement be included within the foundations to minimise differential settlement.
- 6.7.5 Formations levels in the natural clay and weathered mudstone should be carefully inspected and any soft clays or loose material removed and replaced with mass concrete. Formation levels should be blinded as soon as practicable following exposure and protected from adverse weather conditions.

6.8 Ground Floor Slabs

- 6.8.1 On the basis of observations on site together with the results of laboratory tests, it is recommended that consideration is given to constructing the ground floor slab on formation prepared in the natural clay soils.

6.8.2 Formations should be proof rolled and compacted and any soft or deleterious material should be removed and replaced with properly compacted granular fill.

6.8.3 Formation levels should be covered as soon as practicable following exposure and protected from adverse weather conditions.

6.9 Excavations

6.9.1 Conventional mechanical plant should be suitable for excavations at the site. Vertical sided excavations where man entry is required will need support. Excavations should be designed and constructed in accordance with Health and Safety requirements.

6.9.2 Groundwater is not anticipated in shallow excavations for foundations or services. However, it is possible that perched groundwater could be present below the Made Ground overlying the clay. It is considered that this could be dealt with by the use of a small pump.

6.10 Road and Hard Standing Design

6.10.1 The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio, CBR, scale from which the subgrade surface modulus can be estimated. Experience has indicated that the measurement of the in-situ CBR value tends to give unreliable results because of the influence of the moisture content of the materials. In practice, the correlation given by the Highways Agency, ref.9.11, is maybe more appropriate than direct determination of the CBR.

6.10.2 On the basis of laboratory classification tests and for formations prepared in the clay soils, adopting a characteristic plastic index value of 17%, a subgrade CBR value of circa 2.5 is suggested with reference to HA44/91. This assessment assumes there to be a low water table, poor construction conditions and a thin pavement construction.

6.10.3 Any areas of soft or deleterious material should be excavated and replaced with a properly compacted granular fill.

6.10.4 The process of design given in the guidance notes requires an estimate of CBR and subgrade stiffness modulus to be made at the design stage and in-situ measurement prior to construction.

6.10.5 For routine cases, all material within 450mm of the road surface should be non frost-susceptible.

6.11 Chemical Attack on Buried Concrete

6.11.1 The results of chemical tests undertake on samples of the natural clay soils indicate sulphate concentrations of between <10mg/l to 710mg/l and pH values in the range of 6.3 to 8.3.

- 6.11.2 Chemical testing undertaken on sample of Made Ground recorded a sulphate concentration of 40mg/l and a pH value of 7.9.
- 6.11.3 These results, with reference to BRE Special Digest 1, ref.9.12, suggest a Design Sulphate Class of DS-2 and an ACEC class AC-1s, assuming static groundwater. [BRE Special Digest 1 recommends that in a data set of between 5 to 9 samples at a location the mean of the highest two values (350mg/l and 710mg/l, mean 530mg/l) should be taken as the characteristic value for water soluble sulphate].

7.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

7.1 Contaminated Land

7.1.1 The statutory definition of contaminated land is given in Appendix 5.

7.2 Risk Assessment – Human Health

7.2.1 The proposed development consists of new school building, a car park and access road within the existing school boundaries. As the development is taking place within the existing school boundaries it is considered that a risk assessment has been based on guidelines for public open space (provided for recreational use and may be used for children's play area and sports grounds).

7.2.2 Guidance values used are those determined by LQM and CIEH (Copyright Land Quality Management Limited reproduced with permission: Publication Number S4UL3208), ref. 9.13, and DEFRA C4SL (Category 4 Screening Levels) for lead, ref.9.14.

7.2.3 The Generic Assessment Criteria (GAC) used within this contamination assessment have been tabulated in Appendix 5 together with the chemical test results.

7.2.4 There were no contaminants with observed concentrations above the GAC and the site can be considered as 'uncontaminated' in respect to its proposed use in respect to the natural soils.

7.2.5 If made ground materials are to be retained on site for re-use, further testing maybe required.

7.2.6 The soil samples were also screened for asbestos. No asbestos was detected.

7.3 Waste

7.3.1 Where materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

7.3.2 The chemical test results obtained as part of the contamination risk assessment could be used for an initial assessment of the soils in respect to waste classification.

7.3.3 It should be noted that individual tips might require further analysis prior to the disposal of any material from the site. Any such requirements should be clarified with the tip prior to any further analysis being undertaken.

8.0 MANAGEMENT OF CONTAMINATION

8.1 Management of Unidentified Sources of Contamination

8.1.1 There is the possibility that sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. A number of options are available for handling this material, which include:

- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.
- Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.
- Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

8.1.2 The proposed development will generally result in areas of 'hard cover'. In areas that are to be covered by buildings or hard standing, no pathway is likely to exist between any source of contamination and the human receptors by ingestion or dermal contact, therefore no further remedial action is likely to be required under these circumstances.

8.2 Consultation

8.2.1 During the development of a site, consultation may be required for a number of reasons with a number of regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks. Some Authorities now require 'Completion Certificates' to be signed off following remediation works.

8.2.2 Based on the results of any consultation, there may be specific remediation requirements imposed by one or more of the Authorities.

8.3 Risk Management During Site Works

8.3.1 During ground works, some simple measures may have to be put in place to mitigate the risk of any known or previously unidentified contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.
- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination.
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.

9.0 REFERENCES

- 9.1 British Standards Institute: BS 10175 'Code of practice for the investigation of potentially contaminated sites', BSI 2011+A2:2017.
- 9.2 British Standards Institute: BS 5930 'Code of practice for site investigations', BSI 2015.
- 9.3 ISO 1997, Part 2:2007, 'Eurocode 7 (incorporating corrigendum June 2010) – Geotechnical Design – Part 2, Ground Investigation and Design'.
- 9.4 ISO 22476 – 3:2005, 'Geotechnical Investigation and Testing – Field Testing' Part 3, Standard Penetration Test.
- 9.5 British Standard 1377:1990, Part 9, 'Methods of Test for Soils for Civil Engineering Purposes'.
- 9.6 National House-Building Council, Standards, Chapter 4.2, 2017 'Building Near Trees'.
- 9.7 BRE Digest 240, 'Low-rise buildings on shrinkable clay soils: Part 1'. September 1993.
- 9.8 Geotechnique, June 1983.
- 9.9 Stroud, M.A. 'The Standard Penetration Test in Insensitive Clays and Soft Rocks', Proceedings of European Symposium on Penetration Testing, Stockholm, 1974.
- 9.10 Stroud, M.A. and Butler, F.G. 1975 'The Standard Penetration Test and Engineering Properties of Glacial Materials', Symposium of Engineering Behaviour of Glacial Materials, Birmingham University.
- 9.11 Highways Agency HA44/91 Earthworks – Design and Preparation of Contract Documents.
- 9.12 Building Research Establishment, Special Digest 1, 'Concrete in Aggressive Ground', 2005.
- 9.13 The LQM/S4UIs for Human Health Risk Assessment, Nathanail P, McCaffery C, Gillett A, Ogden R, and Nathanail J, Land Quality Press, Nottingham, published 2015.
- 9.14 DEFRA SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination, published March 2014.
- 9.15 ISO 22475-1:2006, 'Geotechnical Investigation and Testing – Sampling Methods and Groundwater Measurements' Part 1: Technical Principles for Execution.
- 9.16 ISO 14688 Part 1:2002 and Part 2:2004, 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.
- 9.17 The Environmental Protection Act, Part IIA, Section 78, 1990.

- 9.18 Environment Act 1995, Section 57, DoE 1995.
- 9.19 CLR 11, 'Model Procedures for the Management of Contaminated Land', DEFRA and Environment Agency, 2004.
- 9.20 Environment Agency Science Report SC050021/SR2 'Human health toxicological assessment of contaminants in soil'.
- 9.21 Environment Agency Science Report SC050021/SR3, 2008, 'Updated technical background to the CLEA model'.

APPENDIX 1
DRAWINGS



Figure A1.1 - 1 to 50,000 scale

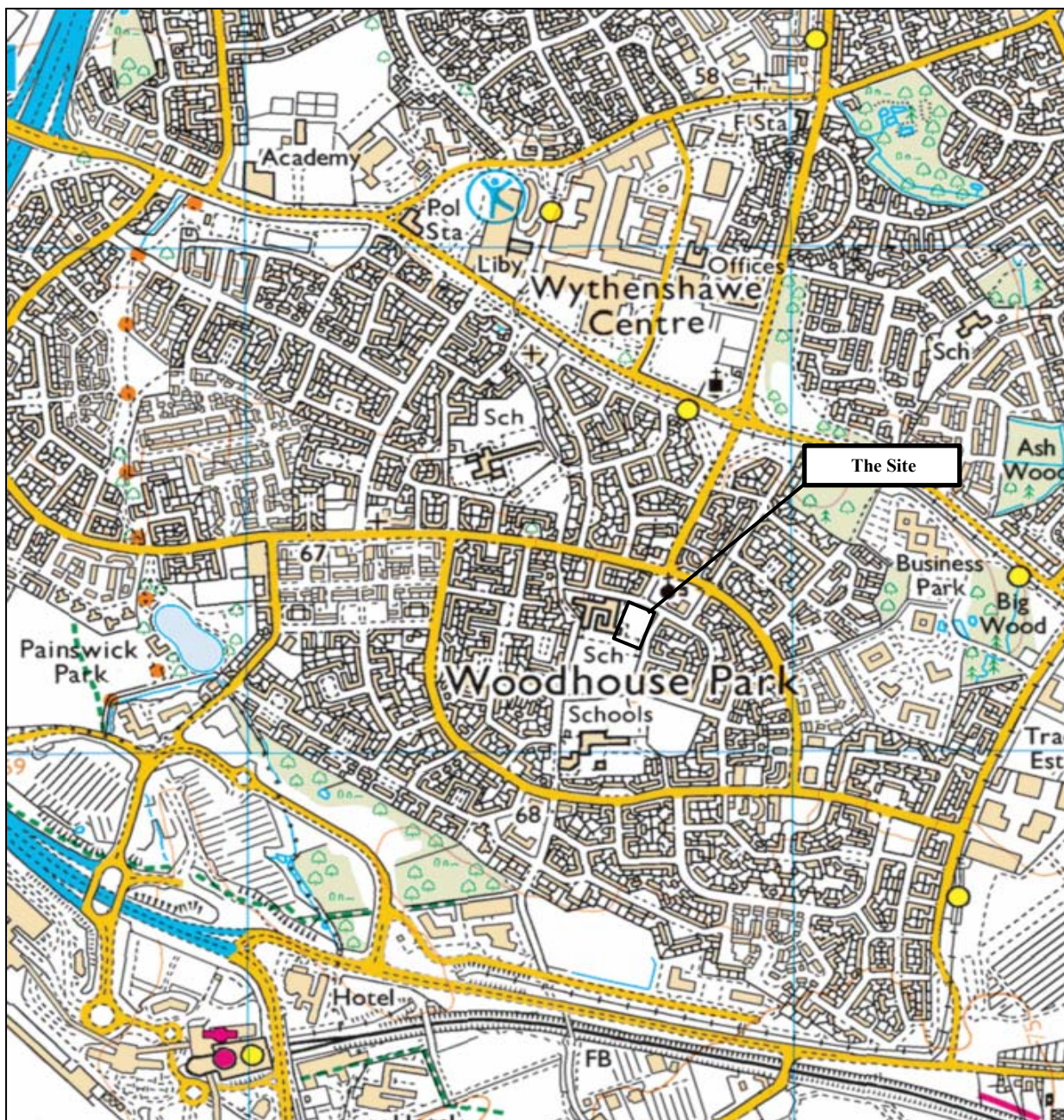


Figure A1.2 - 1 to 25,000 scale

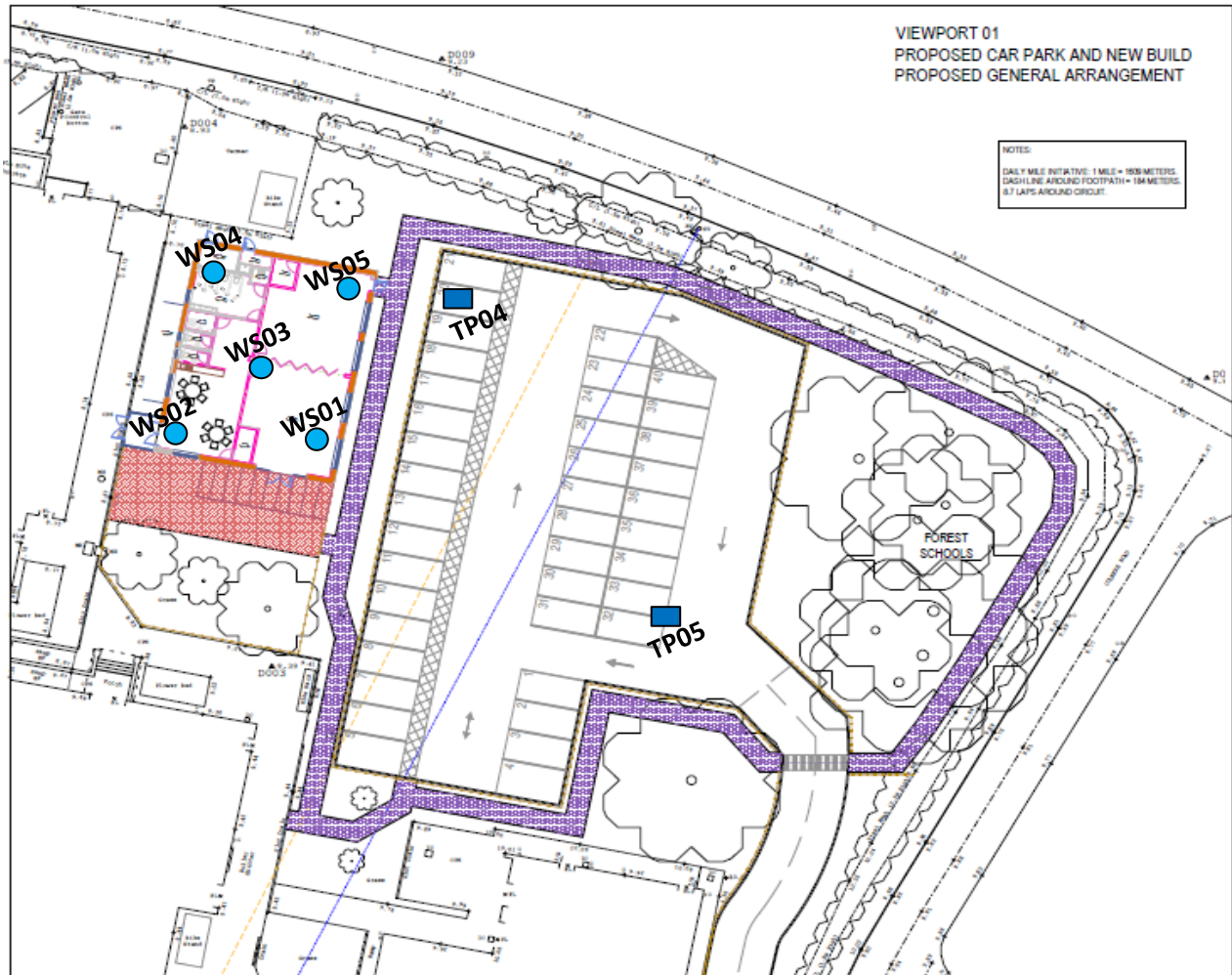


Figure A1.3 - Not to scale

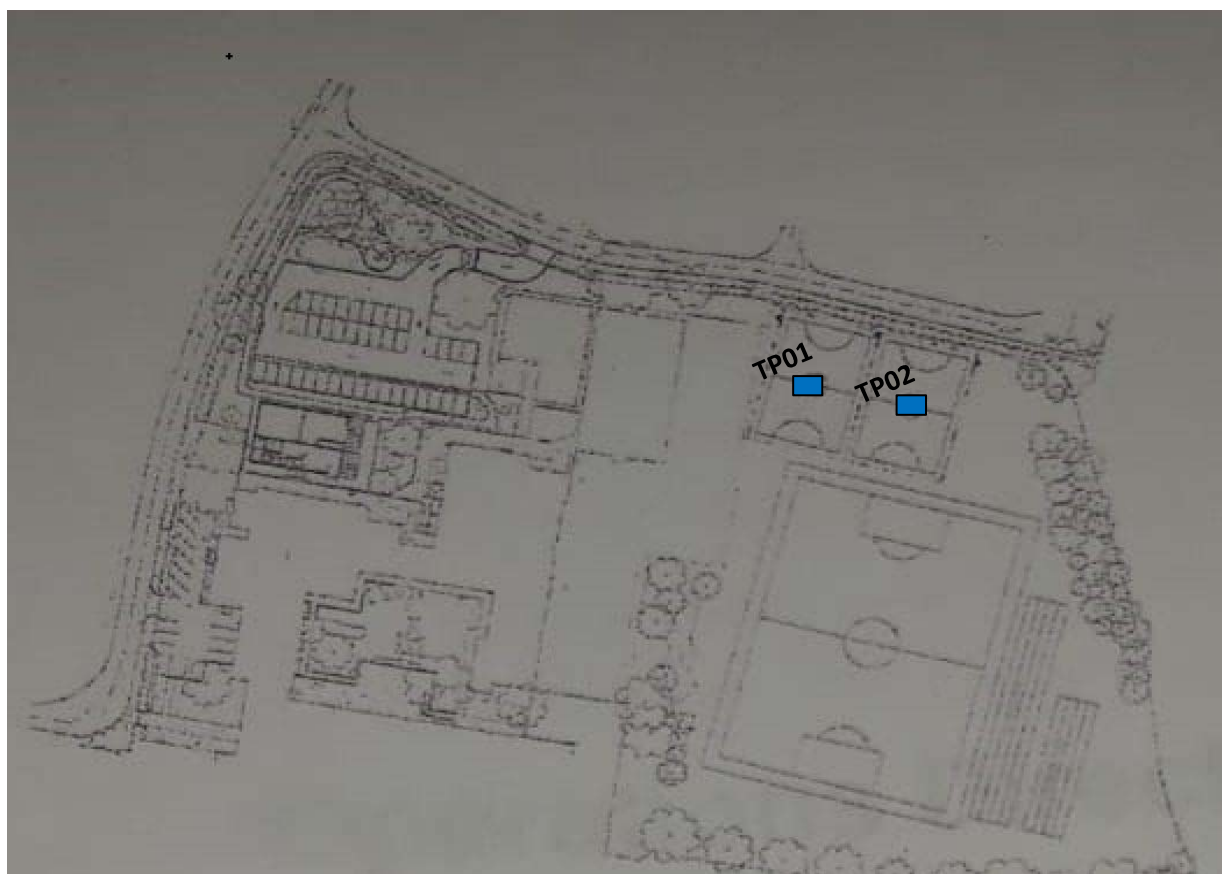


Figure A1.4 - Not to scale

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in EN ISO 1997 and BS 5930.

A2.1.2 Trial Pits

Shallow trial pits are generally dug by mechanical excavator, however, in difficult access locations or adjacent to structures, such pits may be hand dug. Pits are best used where the ground will stand unsupported and generally, the maximum depth of machine dug pits is 4m to 5m. Where personnel are required to enter pits, it is essential that side support is provided. Entry by personnel into unsupported pits deeper than 1.2m is not allowed for health and safety reasons.

Trial pits allow the in-situ condition of the ground to be examined both laterally and vertically and also allow discontinuities to be recorded. The field record should give the orientation of the pit with details of which face was logged, assessment of stability of sides of pit and groundwater as well as the strata encountered. Photographs of the pit should also be taken.

In-situ testing, such as hand penetrometer, hand vane, Macintosh probe, or similar, can be undertaken in the sides or base of pits while both disturbed and undisturbed samples recovered.

It is generally advisable to backfill the pits as soon as possible, open pits should not be left unattended.

A2.1.3 Percussive Window Sampling Rig

The percussive sampler consists of a track mounted window sampler, ref. 9.15, with tube sizes varying in diameter from 98mm to 86mm. The sample tube is driven by a drop weight, which can also be used for dynamic probing and standard SPT tests. A cutting shoe is fitted to the bottom of each tube, whilst the sample is collected in a plastic sleeve.

The borehole is extended by using progressively smaller diameter tubes.

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by EN ISO 1997, BS 1377, Part 9, 1990, and ISO 22476.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 63.5kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the 'N' value.

The 'N' value reported on the borehole logs is as measured but may be corrected for the energy ratio (E_r) of the specific test equipment.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT**.

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.
- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.
- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	1 - 4
Loose	4 - 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	Over 50

A2.3 SAMPLES

A2.3.1 General

Samples have been recovered and stored in accordance with the guidelines given in ISO 22475-1:2006, ref. 9.15 and BS 5930, ref. 9.2.

The undisturbed samples recovered from the percussive sampler were of varying diameters depending upon the depth taken and the ground conditions encountered.

ES represents sample recovered in an amber jar, generally for environmental analysis

B represents large bulk disturbed samples

D represents small disturbed sample

W represents water sample

∇ represents water strike

▼ represents level to which water rose

A2.4 DESCRIPTION OF SOILS

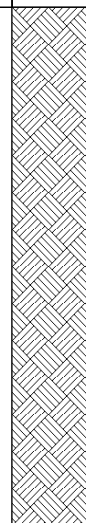
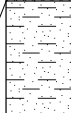
A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref. 9.16, supplemented by section 6 of BS 5930, ref. 9.2 have been used in the soil descriptions contained within this report.

Plant used: Tracked Percussive Sampler Rig	Project: St Anthony's CPS			Location ID: WS01
Dates: 06/04/2020	Client: Atkins			
Location:	Ground level:	Logged by: GR	Vertical scale: 1:50	Sheet 1 of 1 Project ID: 2230085



Plant used: Tracked Percussive Sampler Rig	Project: St Anthony's CPS	Location ID: WS02
Dates: 06/04/2020	Client: Atkins	Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level: Logged by: GR Vertical scale: 1:50 Project ID: 2230085

Samples & In Situ Testing			Strata Details				Groundwater		
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation	
0.10	ES1	SPT(S) N=2 (0,0/0,0,0,2)		0.25	MADE GROUND: Brown, clayey, slightly gravelly SAND with abundant rootlets. Gravel is angular to subangular, fine to coarse including coal, sandstone and glass (TOPSOIL). Soft, orangish brown, sandy CLAY.		1		
0.50	D3			(0.85)					
0.50	ES2				1.10				Dark brown PEAT with occasional tree roots
0.60 - 0.80	B4			1.30	Light grey, slightly clayey, sandy, angular to subangular, fine to coarse GRAVEL of laminated mudstone (Probable Weathered Mudstone).				
1.20	ES5			(2.15)					
1.20	D6								
1.20 - 1.65	B7								
1.80 - 2.00	B8								
2.00	B9								
2.00 - 2.45	D8								
2.50 - 3.00	B9								
3.00 - 3.45	D10								
				3.45	End of Borehole at 3.45m		4		
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery					Remarks:		
Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks	Service inspection pit excavated to a depth of 1.20mbgl. No groundwater strikes. Damp between 1.10m and 1.30m.		
					SPT Hammer: N/R, Energy Ratio: N/R		
					Water Strikes		
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks		
					Monitoring Installations		
Top (m)	Base (m)	Pipe Type	Dia (mm)				
Checked by:	CL	IFA DS					
Log status:	FINAL	v01.01					

Dynamic Sample Recovery					Remarks:									
Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks	Service inspection pit excavated to a depth of 1.20mbgl. Strata moist between 1.20m and 1.40m and at 2.60m..									
					SPT Hammer: N/R, Energy Ratio: N/R									
					Water Strikes					Monitoring Installations				
					Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
Checked by:		CL		IFA DS v01.01										
Log status:		FINAL												



Plant used: Tracked Percussive Sampler Rig	Project: St Anthony's CPS		Location ID: WS04		
Dates: 06/04/2020	Client: Atkins				
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: GR	Vertical scale: 1:50	Sheet 1 of 1 Project ID: 2230085

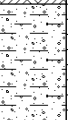
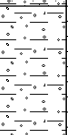
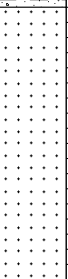
Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.10	ES1	SPT(S) N=12 (2,2/3,3,2,4)		0.20	Brown, clayey, slightly gravelly SAND with abundant rootlets. Gravel is angular to subangular, fine to coarse including coal, sandstone and mudstone (TOPSOIL). Soft, yellowish brown, sandy CLAY.			
0.40	D3			(0.40)				
0.40	ES2			0.60				
0.50	B4			(0.60)				
0.80	D6			1.20				
0.80	ES5	SPT(S) N=43 (5,5/7,8,13,15)		(0.80)	Firm, reddish grey, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse including mudstone and sandstone.		1	
1.00	B7			1.20				
1.20 - 1.65	D9			(0.80)				
1.20 - 1.80	B8			2.00				
1.80 - 2.00	D10			(0.80)				
2.00	D12	SPT(S) 50 (25 for 80mm/50 for 85mm)		2.00	Stiff/very stiff, brownish grey, gravelly CLAY. Gravel is angular to subangular, fine to coarse including laminated mudstone.		2	
2.00 - 2.45	B11			(0.80)				
2.00 - 2.80				2.80				
2.80 - 3.00	D13			(0.65)				
3.00				3.45				
3.00 - 3.45	D14				End of Borehole at 3.45m		3	
							4	
							5	
							6	
							7	
							8	
							9	
							10	

Dynamic Sample Recovery					Remarks:									
Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks	Service inspection pit excavated to a depth of 1.20mbgl. No groundwater observed.									
					SPT Hammer: N/R, Energy Ratio: N/R									
					Water Strikes					Monitoring Installations				
					Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
Checked by:	CL		IFA DS v01.01											
Log status:	FINAL													

Plant used:	Project:			Location ID:
Tracked Percussive Sampler Rig	St Anthony's CPS			
Dates:	Client:			WS05 Sheet 1 of 1
06/04/2020	Atkins			
Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
		GR	1:50	2230085



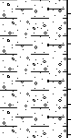
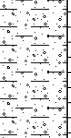
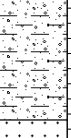
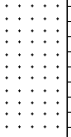
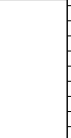
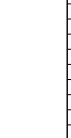
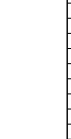
Plant used:	JCB 3CX	Project:	St Anthony's CPS		Location ID: TP01
Dates:	15/04/2020	Client:	Atkins		
Trial Pit Log	Location:	Ground level:	Logged by: GR	Vertical scale: 1:25	Sheet 1 of 1 Contract ID: 2230085

Samples & In Situ Testing			Strata Details							
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation	
0.20 0.20 0.20	B3 D2 ES1			(0.35) 0.35	Grass over brown, slightly clayey SAND with occasional rootlets (TOPSOIL).					
0.50 0.50 0.50	B6 D5 ES4			(0.40) 0.75	Firm, light brown, slightly sandy, slightly gravelly CLAY with a low cobble content. Gravel is slightly rounded, fine to coarse sandstone. Cobbles are rounded to subrounded sandstone and mudstone					
0.80 0.80 0.80	B9 D8 ES7			(0.45) 1.20	Firm, red mottled grey, silty, slightly gravelly CLAY. Gravel is subrounded to subangular, fine to coarse sandstone		1			
1.40 1.40	B11 D10			(0.40) 1.60	Firm to stiff, light grey mottled red, sandy, gravelly CLAY. Gravel is subrounded to subangular, fine to coarse sandstone					
1.80 1.80	B13 D12			(0.90) 2.50	Light grey, clayey GRAVEL. Gravel is fine to coarse, angular plates of grey (Probable Weathered Sandstone).		2			
					End of Trial Pit at 2.50m					
							3			
							4			
							5			

Termination:	Stability: Unstable	Remarks: Backfilled with arisings upon completion. Groundwater not encountered.	
Dimensions (Length m x Width m): 2.90 x 1.60			
Water Strikes			
Strike (m)	Time (mins)		Rose to (m)
Orientation: 202° from north			
Checked by:		CL	IFA TP v01.01
Status:		FINAL	



Plant used:	JCB 3CX	Project:	St Anthony's CPS			Location ID: TP02
Dates:	15/04/2020	Client:	Atkins			
Trial Pit Log	Location:	Ground level:	Logged by:	Vertical scale:	Sheet 1 of 1	
			GR	1:25	Contract ID: 2230085	

Samples & In Situ Testing			Strata Details							
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation	
0.10 0.20 0.30	ES1 D2 B3			(0.50)	Grass over dark brown, slightly clayey SAND with occasional rootlets (TOPSOIL).					
0.60	ES4			0.50	Soft to firm, grey mottled red, sandy, slightly gravelly CLAY. Gravel is subangular to angular sandstone.					
1.00 1.00	B6 D5			(1.42)			1			
2.00 2.00	B8 D7			1.92 (0.61)	Reddish grey, sandy, slightly clayey GRAVEL with a high cobble content. gravel is angular, fine to coarse plates of sandstone. Cobbles are angular, fine sandstone (Probable Weathered Sandstone)		2			
				2.53	End of Trial Pit at 2.53m					
							3			
							4			
							5			

Termination:	Stability: Stable	Remarks: Backfilled with arisings upon completion. Groundwater not encountered.		
Dimensions (Length m x Width m): 2.76 x 1.60				
Water Strikes				
Strike (m)	Time (mins)		Rose to (m)	Remarks
		Orientation: 187° from north		
Checked by:		CL		
Status:		FINAL		
		IFA TP v01.01		



Plant used: JCB 3CX Dates: 15/04/2020		Project: St Anthony's CPS Client: Atkins			Location ID: TP03 Sheet 1 of 1																																																																																																																																																																																					
Trial Pit Log		Location:		Ground level:	Logged by: GR	Vertical scale: 1:25	Contract ID: 2230085																																																																																																																																																																																			
Samples & In Situ Testing <table><thead><tr><th>Depth</th><th>Sample ID</th><th>Test Result</th><th>Level (mOD)</th><th>Depth (m) (Thickness)</th><th>Strata Description</th><th>Legend</th><th>Scale</th><th>Water Strike</th><th>Backfill/ Installation</th></tr></thead><tbody><tr><td>0.10</td><td>ES1</td><td></td><td></td><td></td><td>MADE GROUND: Grass over dark brown, slightly clayey, slightly gravelly sand. Gravel is subrounded to subangular, fine to coarse sandstone (TOPSOIL).</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>0.25</td><td>MADE GROUND: Dark brown, very clayey, gravelly SAND with a low cobble content. Gravel is subrounded to subangular, fine to coarse sandstone, brick, glass and concrete. Cobbles are angular brick.</td><td></td><td></td><td></td><td></td></tr><tr><td>0.50</td><td>B4</td><td></td><td></td><td>0.50</td><td>Firm, yellowish brown, very sandy CLAY.</td><td></td><td></td><td></td><td></td></tr><tr><td>0.50</td><td>D3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>0.50</td><td>ES2</td><td></td><td></td><td>(0.30)</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>0.80</td><td>B7</td><td></td><td></td><td>0.85</td><td>Soft to firm, reddish brown, slightly gravelly CLAY with a low cobble content. Gravel is subangular to angular, fine to coarse sandstone. Cobbles are subrounded sandstone.</td><td></td><td>1</td><td></td><td></td></tr><tr><td>0.80</td><td>D6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>0.80</td><td>ES5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>1.20</td><td>B9</td><td></td><td></td><td>(1.05)</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>1.20</td><td>D8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>1.90</td><td>Red, clayey GRAVEL. Gravel is angular, fine to coarse sandstone. Sandstone is very fine to finely inter-bedded (Probable Weathered Sandstone).</td><td></td><td>2</td><td></td><td></td></tr><tr><td>2.00</td><td>B11</td><td></td><td></td><td>(0.40)</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>2.00</td><td>D10</td><td></td><td></td><td>2.30</td><td>End of Trial Pit at 2.30m</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>3</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>4</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5</td><td></td><td></td></tr></tbody></table>									Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation	0.10	ES1				MADE GROUND: Grass over dark brown, slightly clayey, slightly gravelly sand. Gravel is subrounded to subangular, fine to coarse sandstone (TOPSOIL).									0.25	MADE GROUND: Dark brown, very clayey, gravelly SAND with a low cobble content. Gravel is subrounded to subangular, fine to coarse sandstone, brick, glass and concrete. Cobbles are angular brick.					0.50	B4			0.50	Firm, yellowish brown, very sandy CLAY.					0.50	D3									0.50	ES2			(0.30)						0.80	B7			0.85	Soft to firm, reddish brown, slightly gravelly CLAY with a low cobble content. Gravel is subangular to angular, fine to coarse sandstone. Cobbles are subrounded sandstone.		1			0.80	D6									0.80	ES5									1.20	B9			(1.05)						1.20	D8													1.90	Red, clayey GRAVEL. Gravel is angular, fine to coarse sandstone. Sandstone is very fine to finely inter-bedded (Probable Weathered Sandstone).		2			2.00	B11			(0.40)						2.00	D10			2.30	End of Trial Pit at 2.30m												3										4										5			Termination: Stability: Stable Dimensions (Length m x Width m): 2.90 x 1.60 Water Strikes <table><thead><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr></thead><tbody></tbody></table>		Strike (m)	Time (mins)	Rose to (m)	Remarks	Remarks: Backfilled with arisings upon completion. Groundwater not encountered. Orientation:195° from north Checked by:CL Status:FINAL IFA TP v01.01	
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation																																																																																																																																																																																	
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Plant used:	JCB 3CX	Project:	St Anthony's CPS		Location ID: TP04
Dates:	15/04/2020	Client:	Atkins		
Trial Pit Log	Location:	Ground level:	Logged by:	Vertical scale:	Sheet 1 of 1
			GR	1:25	Contract ID: 2230085

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
0.10	ES1			0.25	MADE GROUND: Grass over dark brown, clayey, slightly gravelly SAND. Gravel is fine to coarse, subangular sandstone (TOPSOIL).				
0.40	B3			0.35	MADE GROUND: Soft, dark brown, sandy, slightly gravelly CLAY with a medium cobble content. Gravel is subrounded to angular, fine to coarse brick, sandstone, glass and concrete. Cobbles are angular brick				
0.40	D2			0.60	Soft, yellowish brown, gravelly CLAY. Gravel is rounded to subangular, fine to coarse sandstone and quartz. Firm, reddish brown, sandy, slightly gravelly CLAY. Gravel is fine to coarse, subangular to angular sandstone.				
1.30	B5			(1.55)			1		
1.30	D4						2		
2.20	B7			2.15	Reddish grey, clayey GRAVEL. Gravel is fine to coarse, subangular to angular, fine sandstone (Probable Weathered Sandstone).				
2.20	D6			(0.30)					
				2.45	End of Trial Pit at 2.45m				
							3		
							4		
							5		

Termination:	Stability:	Remarks: Backfilled with arisings upon completion. Groundwater not encountered.			
	Stable				
Dimensions (Length m x Width m): 2.60 x 1.50					
Water Strikes					
Strike (m)	Time (mins)	Rose to (m)	Remarks	Orientation: 193° from north	
				Checked by: CL	
				Status: FINAL	IFA TP v01.01

APPENDIX 3
LABORATORY TESTS

APPENDIX 3

GENERAL NOTES ON LABORATORY TESTS ON SOILS

A3.1 GENERAL

- A3.1.1 Where applicable all tests are carried out in accordance with the relevant British Standard. The laboratory test procedures are given in the laboratory test reports.
- A3.1.2 Any discussion in this report is based on the values and results obtained from the appropriate tests. Due allowance should be made, when considering any result in isolation, of the possible inaccuracy of any such individual result. Details of the accuracy of results are included in this section, where applicable.

A3.2 SOIL CLASSIFICATION

- A3.2.1 Classification of soils is usually undertaken by means of the Plasticity Classification Chart, sometimes called the A-Line Chart. This is graphical plot of PI against LL with the A-Line defined as $PI = 0.73(LL - 20)$.
- A3.2.2 This line is defined from experimental evidence and does not represent a well-defined boundary between soil types, but forms a useful reference datum. When the values of LL and PI for inorganic clays are plotted on the chart they generally lie just above the A-Line in a narrow band parallel to it, while silts and organic clays plot below this line.
- A3.2.3 Clays and silts are divided into five zones of plasticity:
- | | |
|-----------------------------|----------------------|
| Low Plasticity (L) | LL less than 35 |
| Intermediate Plasticity (I) | LL between 35 and 50 |
| High Plasticity (H) | LL between 50 and 70 |
| Very High Plasticity (V) | LL between 70 and 90 |
| Extremely High Plasticity € | LL greater than 90 |
- A3.2.4 In general, clays of high plasticity are likely to have a lower permeability, are more compressible and consolidate over a longer period of time under load than clays of low plasticity. Clays of high plasticity are more difficult to compact as fill material.

Dunedin House
Columbia Drive
Stockton On Tees
TS17 6BJ

F.A.O.

Final Test Report - 2230085 / 1

Site: St Anthony's CPS

Job Number: 2230085

Originating Client: Atkins

Originating Reference: 2230085

Date Sampled: Not Given

Date Scheduled: 20/04/2020

Date Testing Started: 02/05/2020

Date Testing Finished: 06/05/2020

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:



Tim Robinson
Quality Technician

Report Issue Date: 06/05/2020

Site: St Anthony's CPS

Job Number: 2230085

Client: Atkins

Page: 2

**Determination of Water Content, Liquid Limit and Plastic Limit
and Derivation of Plasticity and Liquidity Index**

Borehole / Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Water Content %	Sample Passing 425 µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Water Content %						
TP01	0.50	D5	Natural	18	98	18.0	50	27	23	-0.38	CI/CH	Brown slightly gravelly slightly sandy CLAY
TP02	1.00	D5	Natural	13	87	14.0	30	18	12	-0.32	CL	Grey mottled sandy slightly gravelly CLAY
TP03	0.50	D3	Natural	32	97	33.0	53	33	20	-0.01	MH	Brown sandy SILT
TP04	0.40	D2	Natural	14	96	14.0	34	18	16	-0.23	CL	Brown gravelly CLAY
WS02	0.50	D3	Natural	27	98	28.0	41	23	18	0.25	CI	Orange brown sandy CLAY
WS03	1.40	D8	Natural	18	96	19.0	33	19	14	-0.03	CL	Red brown gravelly CLAY
WS04	0.80	D6	Natural	30	100	30.0	45	23	22	0.32	CI	Red/grey sandy slightly gravelly CLAY
WS05	0.50	D4	Natural	17	92	18.0	33	20	13	-0.15	CL	Orange brown slightly sandy slightly gravelly CLAY

Method of Preparation: BS 1377 : Part 1 : 1990 : Clause 7 Preparation of disturbed samples for testing
BS 1377 : Part 1 : 2016 : Clause 8.4.3 Preparation of samples for plasticity tests
BS 1377 : Part 2 : 1990 : Clause 4.2 Preparation of samples for plastic limit tests

Method of Test: BS 1377 : Part 2 : 1990 : Clause 3.2 Determination of moisture content
BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit
BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index



Final Test Report - 2230085 / 1

Site: St Anthony's CPS

Job Number: 2230085

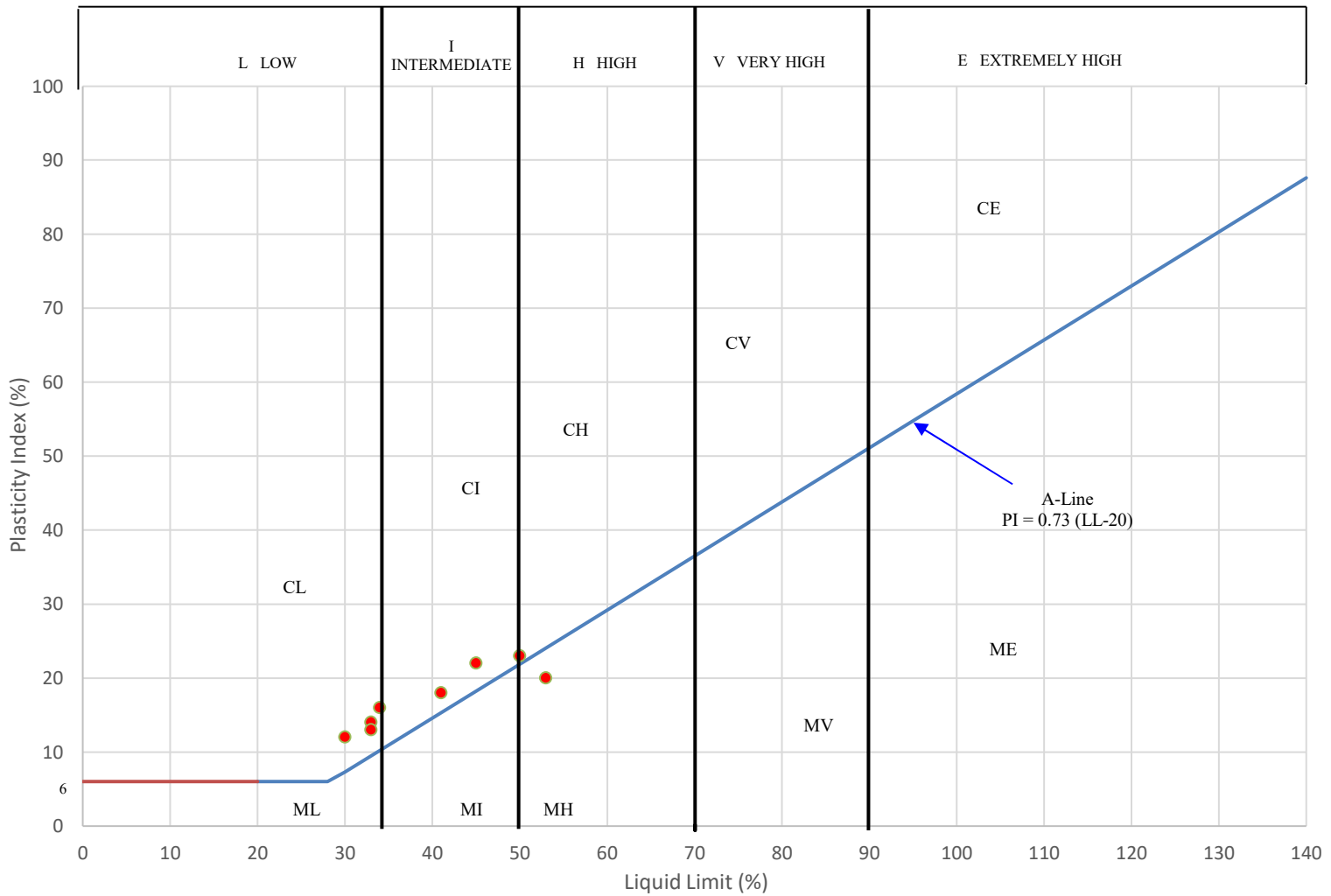
Originating Client: Atkins

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

This test report shall not be reproduced, except in full and only with the written permission of Ian Farmer Associates Ltd.

Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report Issue Date: 06/05/2020



SILTS generally plot below A Line
CLAYS generally plot above A Line

APPENDIX 4
CHEMICAL TESTS

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/03435
Issue Number: 1

Date: 28 April, 2020

Client: Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Joe Tant/Tim Downes
Project Name: St Anthony's CPS
Project Ref: 2230085
Order No: N/A
Date Samples Received: 15/04/20
Date Instructions Received: 21/04/20
Date Analysis Completed: 27/04/20

Prepared by:



Holly Neary-King
Administration & Client Services Supervisor

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 20/03435

Client Project Name: St Anthony's CPS

Client Project Ref: 2230085

Lab Sample ID	20/03435/2	20/03435/5						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02								
Depth to Top	0.50	0.60								
Depth To Bottom										
Date Sampled	15-Apr-20	15-Apr-20								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	5AE	3								
% Moisture at <40C _A	17.0	12.7						% w/w	0.1	A-T-044
% Stones >10mm _A	<0.1	<0.1						% w/w	0.1	A-T-044
pH _D ^{M#}	7.65	8.32						pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01						g/l	0.01	A-T-026s
Cyanide (total) _A ^{M#}	<1	<1						mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2						mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	0.7	3.1						% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	<1	9						mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	<1.0						mg/kg	1	A-T-027s
Cadmium _D ^{M#}	1.3	0.8						mg/kg	0.5	A-T-024s
Copper _D ^{M#}	21	5						mg/kg	1	A-T-024s
Chromium _D ^{M#}	51	28						mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1						mg/kg	1	A-T-040s
Lead _D ^{M#}	6	<1						mg/kg	1	A-T-024s
Mercury _D	<0.17	0.44						mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	51	23						mg/kg	1	A-T-024s
Selenium _D ^{M#}	1	<1						mg/kg	1	A-T-024s
Zinc _D ^{M#}	71	34						mg/kg	5	A-T-024s

Envirolab Job Number: 20/03435

Client Project Name: St Anthony's CPS

Client Project Ref: 2230085

Lab Sample ID	20/03435/2	20/03435/5						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02								
Depth to Top	0.50	0.60								
Depth To Bottom										
Date Sampled	15-Apr-20	15-Apr-20								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	5AE	3								
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD								A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A								A-T-045

Envirolab Job Number: 20/03435

Client Project Name: St Anthony's CPS

Client Project Ref: 2230085

Lab Sample ID	20/03435/2	20/03435/5						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02								
Depth to Top	0.50	0.60								
Depth To Bottom										
Date Sampled	15-Apr-20	15-Apr-20								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	5AE	3								
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01						mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01						mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02						mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04						mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04						mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	<0.05						mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05						mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07						mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	<0.06	<0.06						mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04						mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08						mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01						mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	<0.03						mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03						mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	<0.03	<0.03						mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07						mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	<0.08						mg/kg	0.01	A-T-019s

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF	Project No:	20/03435
Project:	St Anthony's CPS	Date Received:	21/04/2020 (am)
Clients Project No:	2230085	Cool Box Temperatures (°C):	14.0

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/03362
Issue Number: 1
Date: 22 April, 2020

Client: Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Joe Tant/Tim Downes
Project Name: St Anthony's CP
Project Ref: 2230085
Order No: N/A
Date Samples Received: 06/04/20
Date Instructions Received: 16/04/20
Date Analysis Completed: 21/04/20

Prepared by:



Danielle Brierley
Client Manager

Approved by:



John Gustafson
Managing Director

Envirolab Job Number: 20/03362

Client Project Name: St Anthony's CP

Client Project Ref: 2230085

Lab Sample ID	20/03362/2	20/03362/6	20/03362/8	20/03362/11				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS02	WS03	WS04						
Depth to Top	0.55	1.20	0.40	0.40						
Depth To Bottom										
Date Sampled	06-Apr-20	06-Apr-20	06-Apr-20	06-Apr-20						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	5AE	4A	5AE	5AE						
% Moisture at <40C _A	14.2	72.7	16.2	13.5				% w/w	0.1	A-T-044
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1				% w/w	0.1	A-T-044
pH _D ^{M#}	7.94	6.27	7.47	7.42				pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.04	0.35	0.21	0.71				g/l	0.01	A-T-026s
Cyanide (total) _A ^{M#}	<1	<1	<1	<1				mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2				mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	0.4	53.4	0.6	0.4				% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	3	22	4	1				mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	4.5	<1.0	<1.0				mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5	<0.5	<0.5	<0.5				mg/kg	0.5	A-T-024s
Copper _D ^{M#}	9	16	9	12				mg/kg	1	A-T-024s
Chromium _D ^{M#}	28	21	27	29				mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<2	<1	<1				mg/kg	1	A-T-040s
Lead _D ^{M#}	9	8	16	11				mg/kg	1	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17				mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	30	13	19	29				mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	1	<1	<1				mg/kg	1	A-T-024s
Zinc _D ^{M#}	42	32	31	41				mg/kg	5	A-T-024s

Envirolab Job Number: 20/03362

Client Project Name: St Anthony's CP

Client Project Ref: 2230085

Lab Sample ID	20/03362/2	20/03362/6	20/03362/8	20/03362/11				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS02	WS03	WS04						
Depth to Top	0.55	1.20	0.40	0.40						
Depth To Bottom										
Date Sampled	06-Apr-20	06-Apr-20	06-Apr-20	06-Apr-20						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	5AE	4A	5AE	5AE						
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A						A-T-045

Envirolab Job Number: 20/03362

Client Project Name: St Anthony's CP

Client Project Ref: 2230085

Lab Sample ID	20/03362/2	20/03362/6	20/03362/8	20/03362/11				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS02	WS03	WS04						
Depth to Top	0.55	1.20	0.40	0.40						
Depth To Bottom										
Date Sampled	06-Apr-20	06-Apr-20	06-Apr-20	06-Apr-20						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	5AE	4A	5AE	5AE						
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02				mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04				mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04	<0.04	<0.04				mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	<0.05	<0.05	<0.05				mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	<0.05	<0.05				mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07				mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	<0.06	<0.06	<0.06	<0.06				mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04				mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08	<0.08	<0.08				mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	<0.03	<0.03	<0.03				mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03				mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	<0.03	<0.03	<0.03	<0.03				mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07	<0.07	<0.07				mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	<0.08	<0.08	<0.08				mg/kg	0.01	A-T-019s

REPORT NOTES

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Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

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A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF	Project No:	20/03362
Project:	St Anthony's CP	Date Received:	16/04/2020 (am)
Clients Project No:	2230085	Cool Box Temperatures (°C):	15.1, 15.0

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

APPENDIX 5
CONTAMINATION ASSESSMENT

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GENERAL NOTES ON CONTAMINATION ASSESSMENT

A5.1 STATUTORY FRAMEWORK AND DEFINITIONS

A5.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 9.17, which was introduced by the Environment Act 1995, ref. 9.18;

‘Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be, caused.’

A5.1.2 The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the new legislation has been summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the last remaining guidance document, CLR 11, ref. 9.19 was published in 2004. In 2008 CLR reports 7 to 10 were withdrawn by DEFRA and the Environment Agency and updated version of CLR 9 and 10 were produced in the form of Science Reports SR2, ref. 9.20 and SR3, ref.9.21.

A5.1.3 In establishing whether a site fulfils the statutory definition of ‘contaminated land’ it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A5.1.4 A ‘pollutant linkage’ may be defined as the link between a contaminant ‘source’ and a ‘receptor’ by means of a ‘pathway’.

A5.2 ASSESSMENT METHODOLOGY

A5.2.1 The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

A5.2.2 Stages 1 and 2 develop a '*conceptual model*' based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.

A5.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. CLR 8, together with specific DoE 'Industry Profiles' provides guidance on the nature of contaminants relating to specific industrial processes. Although CLR 8 has been withdrawn, no replacement guidance has been published that lists the contaminants likely to be present on contaminated sites and as such the guidance relating to this issue of CLR 8 is considered to still be relevant.

A5.2.4 If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a contamination risk assessment to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.

A5.2.5 A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.

A5.2.6 The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values which are dependent on the proposed end-use of the development.

A5.2.7 The end-use may be defined as one of the following:

- Residential with homegrown produce – domestic low rise and low density housing with gardens where vegetable may be grown for home consumption
- Residential without homegrown produce – domestic low density and low density housing where no gardens are present.
- Allotments – specific areas where vegetables are grown for home consumption.
- Public open space in close proximity to residential housing – includes the predominantly grassed area adjacent to high density housing and the central green area around which houses are developed. This land-use includes the smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting.

- Public open space in use as general parkland – provided for recreational use and may be used for family visits and picnics, children’s play area, sports grounds and dog walking.
- Commercial – industrial premises where there is limited exposure to soil.

A5.2.8 Exposure pathways for each type of end-use are given below:

Standard Land Use	Oral Routes			Dermal Routes		Inhalation Routes			
	Direct soil & dust ingestion	Consumption of homegrown produce	Soil attached to homegrown produce	Indoor	Outdoor	Indoor dust	Outdoor dust	Indoor vapour	Outdoor vapour
Residential with homegrown produce	✓	✓	✓	✓	✓	✓	✓	✓	✓
Residential without homegrown produce	✓	X	X	✓	✓	✓	✓	✓	✓
Allotments	✓	✓	✓	X	✓	X	✓	✓	✓
Public open space – adjacent to dwellings	✓	X	X	✓	✓	✓	✓	X	✓
Public open space – parkland	✓	X	X	X	✓	X	✓	X	✓
Commercial	✓	X	X	✓	X	✓	X	✓	X

A5.2.9 Soils will be compared to Suitable 4 Use Levels (S4ULs) published by LQMAssessment Criteria. Where no S4UL is available, the assessment criteria (AC) are generated using the Contaminated Land Exposure Assessment (CLEA) Software Version 1.06. Toxicological and physico-chemical/fate and transport data used to generate the AC has been derived from a hierarchy of data sources as follows:

1. Environment Agency or Department of Environment Food and Rural Affairs (DEFRA) documents;
2. Other documents produced by UK Government or state organisations;
3. European institution documents;
4. International organisation documents;
5. Foreign government institutions.

A5.2.10 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.

A5.2.11 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.

A5.2.12 The potential receptors include:

- 1) Humans – current site occupants, construction workers, future site users and neighbouring site users.

- 2) Controlled Waters – surface water and groundwater resources
- 3) Plants – current and future site vegetation
- 4) Building materials

A5.2.13 The potential hazards to be considered in relation to contamination are:

- a) Ingestion and inhalation.
- b) Uptake of contaminants via cultivated vegetables.
- c) Dermal contact
- d) Phytotoxicity (the prevention or inhibition of plant growth)
- e) Contamination of water resources
- f) Chemical attack on building materials and services
- g) Fire and explosion

A5.2.14 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A5.3 Generic Guidance Values Used Within Contamination Risk Assessment

Public Open Space	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source	Test Results (mg/kg)
		1% SOM	2.5% SOM	6% SOM		
PAH	Acenaphthene	29000	30000	30000	LQM/CIEH S4UL	<0.01
	Acenaphthylene	29000	30000	30000	LQM/CIEH S4UL	<0.01
	Anthracene	150000	150000	150000	LQM/CIEH S4UL	<0.02
	Benzo(a)anthracene	49	56	62	LQM/CIEH S4UL	<0.04
	Benzo(a)pyrene	11	12	13	LQM/CIEH S4UL	<0.04
	Benzo(b)fluoranthene	13	15	16	LQM/CIEH S4UL	<0.05
	Benzo(ghi)perylene	1400	1500	1600	LQM/CIEH S4UL	<0.05
	Benzo(k)fluoranthene	370	410	440	LQM/CIEH S4UL	<0.07
	Chrysene	93	110	120	LQM/CIEH S4UL	<0.06
	Dibenzo(ah)anthracene	1.1	1.3	1.4	LQM/CIEH S4UL	<0.04
	Fluoranthene	6300	6300	6400	LQM/CIEH S4UL	<0.08
	Fluorene	20000	20000	20000	LQM/CIEH S4UL	<0.01
	Indeno(123-cd)pyrene	150	170	180	LQM/CIEH S4UL	<0.03
	Naphthalene	1200	1900	3000	LQM/CIEH S4UL	<0.03
	Phenanthrene	6200	6200	6300	LQM/CIEH S4UL	<0.03
	Pyrene	15000	15000	15000	LQM/CIEH S4UL	<0.07
Other Organics	Phenol	760	1500	3200	LQM/CIEH S4UL	<0.2
Other	Cyanide	10.8	10.8	10.8	PRG	<1
	Arsenic	170	170	170	LQM/CIEH S4UL	<1 to 22
	Boron	46000	46000	46000	LQM/CIEH S4UL	<1.0 to 4.5
	Cadmium	532	532	532	LQM/CIEH S4UL	<0.5 to 1.3
	Chromium III	33000	33000	33000	LQM/CIEH S4UL	21 to 51

Public Open Space	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source	Test Results (mg/kg)
		1% SOM	2.5% SOM	6% SOM		
	Chromium IV	23	23	23	LQM/CIEH S4UL	<1
	Copper	44000	44000	44000	LQM/CIEH S4UL	5 to 21
	Lead	630	630	630	DEFRA C4SL	<1 to 16
	Mercury	30	30	30	LQM/CIEH S4UL	<0.17 to 0.44
	Nickel	3400	3400	3400	LQM/CIEH S4UL	13 to 51
	Selenium	1800	1800	1800	LQM/CIEH S4UL	<1 to 1
	Zinc	170000	170000	170000	LQM/CIEH S4UL	31 to 71
SOM						0.4 to 53.4

