

WREXHAM COUNTY BOROUGH COUNCIL

**BARKERS LANE CP SCHOOL,
WREXHAM, LL13 9TP**

GROUND INVESTIGATION REPORT

Contract: 42287

Date: January 2019

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GROUND INVESTIGATION REPORT

carried out at

**BARKERS LANE CP SCHOOL,
WREXHAM, LL13 9TP**

Prepared for

**WREXHAM COUNTY BOROUGH COUNCIL
Cefn Road
Wrexham
LL13 9NG**

Contract No: 42287

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EXECUTIVE SUMMARY

On the instructions of Wrexham County Borough Council (WCBC) a ground investigation was undertaken to determine ground conditions to inform design for a new school extension and new MUGA pitch and car parking facilities.

The scope of the sitework and laboratory testing was determined by WCBC.

The site is situated at Barkers Lane CP School, approximately 3km to the northeast of the town centre of Wrexham.

The geological map indicates the site to be underlain by superficial deposits comprising Glaciofluvial Sheet Deposits. Bedrock beneath the site comprises strata of the Salop Formation comprising mudstone, sandstone and conglomerate of Permian and Carboniferous period.

The site work was carried out between 2nd and 4th January 2019.

The sequence encountered generally comprised topsoil overlaying natural strata of sand and gravel with localised clay bands.

Assuming strip foundations up to 0.6m wide at the minimum depth of 0.75m in medium dense granular deposits an allowable bearing capacity about 120kN/m² may be adopted, which would provide an adequate factor of safety against shear failure and limit settlements to the order of 10mm.

On this basis foundations of width 0.60m, at a nominal depth of 0.75m, should support loads about 75kN per linear metre.

The permeabilities in the granular deposits have been recorded as 4.82×10^{-7} m/s and 1.27×10^{-6} m/s, indicating the granular deposits (sand) to generally be of poor drainage characteristics.

Design Sulphate Class may be taken as DS-1. An ACEC class for the site of AC-1 would be appropriate.

Analytical testing indicated contaminant concentrations to be below their respective Guidance Levels. No asbestos was detected. Therefore, no significant contamination risks to human health are considered to be associated with the proposed development of the site. This assessment is based on one soil sample as required by WCBC in the scope of works. Further testing may be required to determine variation across the site.

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1.0 INTRODUCTION

- 1.1 It is understood that the proposed development comprises the construction of a single storey extension to the west of the existing school building along with the construction of a new MUGA pitch and car parking facilities.
- 1.2 On the instructions of Wrexham County Borough Council (WCBC) a ground investigation was undertaken to determine ground conditions to inform design for the project. The scope of the investigation was determined by WCBC.
- 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 site is situated at Barkers Lane CP School, approximately 3km to the northeast of the town centre of Wrexham.
- 2.1.2 The site may be located by Grid Reference SJ 345 527.
- 2.1.3 The proposed development comprises extensions of the existing building replacing the existing MUGA and car parking facilities. The new proposed MUGA pitch and car parking facilities will be located on the existing playing field.
- 2.1.4 A site location plan is included in Appendix 1, Figures A1.1.

2.2 Site Description

- 2.1.1 The site is located to the west of the existing Barkers Lane CP school.
- 2.1.2 The site is 'L' shaped with an approximate site area of 1.2Ha.
- 2.1.3 The area of investigation comprised an existing MUGA pitch, car parking and grassed playing field.
- 2.1.4 Access to the site was via a gated entrance off Barkers Lane.
- 2.1.5 The site is bound to the north by A5156 Llan y Pwll Link Way, to the east by Lisburne Grove, to the south by Barkers Lane and to the west by residential properties.

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 2019).
- 2.2.2 The geological map indicates the site to be underlain by superficial deposits comprising Glaciofluvial Sheet Deposits.
- 2.2.3 Bedrock comprises strata of the Salop Formation comprising mudstone, sandstone and conglomerate of the Permian and Carboniferous period.
- 2.2.4 The site is within an urban area and, although not indicated as present on the site from the geological maps, the possibility that Made Ground exists on site cannot be discounted.

2.2 Preliminary Risk Assessment (PRA)

2.2.1 A PRA has been provided by WCBC. The principal hazards may be summarised as follows:

- Historic maps have indicated that the site has been used for agriculture up to the construction of the existing school.
- Two electricity substations are located within 100m of the site.
- The site is underlain by sands and gravels supporting a Secondary A aquifer.
- The site is underlain by two worked seams of coal at 680m to 790m depth which were last worked in 1960. No shallow workings are anticipated. Site is deemed to be outside the zone of influence of coal mining activities.
- The report indicates Full Radon Protection measures are required.

3.0 SITE WORK

- 3.1 The site work was carried out between 2nd and 4th January 2019.
- 3.2 The scope of the works was determined by WCBC. The locations and depths of exploratory holes were indicated on drawings provided by WCBC.
- 3.3 The site works were carried out on the basis of the practices set out in CLR 4, (ref. 9.1), BS 5930:2015 (ref. 9.2), BS EN ISO 14688-1:2002+A1:2013 (ref. 9.3) and BS 10175:2011, (ref. 9.4).
- 3.4 Investigation was undertaken as follows:
- BH01 to BH04: Cable percussion boreholes
 - 2 No. In situ falling head tests within boreholes (BH03 and BH04)
 - 3 No. In situ Plate Load Test (PLT)
- 3.5 A site plan showing the positions of the Exploratory Holes is presented in Appendix 1 as Figure A1.2.
- 3.6 The depths of boreholes, descriptions of strata encountered and comments on groundwater conditions are given in the records presented in Appendix 2.
- 3.7 A Cable Avoidance Tool (CAT) survey was undertaken at each exploratory hole location prior to excavation. At the location of boreholes an inspection pit was excavated by hand to a depth of 1.20m below ground level to check for buried services.
- 3.8 Representative disturbed samples were taken at the depths shown on the records. Samples for environmental analysis were collected in appropriate containers and kept in cool boxes for daily despatch to the analytical laboratory.
- 3.9 Standard penetration tests (SPT), ref. 9.3 were carried out in boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records. Energy ratio calibration certification for SPT hammers used on site are presented in Appendix 2.
- 3.10 Two variable head (falling) tests were undertaken within BH03 and BH04 at depths of 3.11m and 5.00m respectively. The results are present in Appendix 2.
- 3.11 Three plate load tests (PLT), designated CBR01 to CBR03 tests were carried out in the areas of the proposed MUGA and car parking facilities. Results are presented within Appendix 2.
- 3.12 The ground levels at the exploratory hole locations were not determined.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

- 4.1.1 The scope of testing was determined by WCBC.
- 4.1.2 Geotechnical testing schedules were prepared by Ian Farmer Associates (IFA).
- 4.1.3 Geotechnical testing was undertaken by IFA at their Washington Laboratory. Geotechnical chemical tests were undertaken by Envirolab in Hyde.
- 4.1.4 Soil samples for testing were prepared in accordance with BS1377: Part One: 1990 ref. 9.7 and representative sub-samples were taken for testing. The following tests were carried out:
 - 8 No. Particle size distribution by wet sieving
 - 5 No. Sedimentation by pipette
 - 5 No. Water soluble sulphate (Envirolab)
 - 5 No pH value (Envirolab)
- 4.1.5 The results of the soil tests are presented in Appendix 3, Test Reports 42287 and 42287A
- 4.1.6 The results of the sulphate and pH tests are presented in Appendix 3, Test Report 19/00104.

4.2 Chemical Testing

- 4.2.1 The scope of chemical testing was determined by WCBC.
- 4.2.2 Chemical testing schedules were prepared by IFA.
- 4.2.3 The chemical analyses were carried out on one sample of soil. The nature of the analyses is detailed below:
- 4.2.4 **Metal screen** - arsenic, cadmium, chromium, lead, mercury, selenium, boron (water soluble), copper, nickel and zinc
- 4.2.5 **Organic Screen** - total petroleum hydrocarbons (TPH) – C₁₀ to C₁₄ and C₁₅ to C₃₆ aliphatic hydrocarbons, polyaromatic hydrocarbons (PAH) – USEPA 16 suite, monohydric phenols
- 4.2.6 **Inorganics Screen** - cyanide (total), sulphate (water soluble)
- 4.2.7 **Others** - pH, soil moisture content, organic matter, asbestos identification
- 4.2.8 The results of chemical analysis on soil samples are presented in Appendix 4, Test Report 19/00104.

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.
- 5.1.2 The sequence encountered generally comprised topsoil overlaying natural strata of granular deposits with localised clay bands.
- 5.1.3 The general sequence of strata is shown on the nominal section; Figure A1.3.
- 5.1.4 SPT 'N' values are plotted against depth in Figure A1.4.

5.2 Topsoil

- 5.2.1 Grass over topsoil was encountered within BH01 to BH04 and CBR01 to CBR03 to depths in range of 0.20m to 0.90m.
- 5.2.2 Topsoil comprised dark orangish brown, slightly clayey, gravelly sand.
- 5.2.3 One particle size distribution test (BH01 at 0.80m) indicated fine and medium sand with secondary gravel content of 25%. Fine constituent (silt and clay) of 25% was recorded.
- 5.2.4 Laboratory analysis of topsoil indicated pH value of 7.56 and soluble SO₄ content of <10mg/l.
- 5.2.5 The base of the topsoil was proven within all exploratory holes at depths from 0.20m to 0.90m.

5.3 Natural Strata

- 5.3.1 Natural strata was encountered directly beneath topsoil at depths of 0.20m and 0.90m.
- 5.3.2 The natural strata comprised predominantly granular deposits with localised clay bands.
- 5.3.3 Clay was encountered from 2.60m and 2.90m (BH01) and 2.70m and 2.85m (BH04). The clay comprised firm, dark brown, slightly gravelly and sandy.
- 5.3.4 The granular deposits predominantly comprised sand. The material comprised dark brown to orangish brown, slightly clayey, slightly gravelly sand.
- 5.3.5 Sand and gravel was encountered within BH01 and BH02 at depths from 2.90m to 5.45m and 7.00m to 10.45m respectively.
- 5.3.6 Seven particle size distribution tests indicated fine and medium sand with secondary gravel contents in range of 7 to 42%. Fine constituents (silt and clay) in the range of 3 to 40% were recorded.
- 5.3.7 Laboratory analysis of sand indicated pH values of 6.95 to 7.89 and soluble SO₄ contents of <10mg/l.
- 5.3.8 Twenty four SPT 'N' values in range of 12 to 48 obtained within granular deposits indicate relative density of medium dense and dense. The relative density generally increases with depth.
- 5.3.9 Trial pits for CBR tests were terminated at depths of 0.30m. Boreholes were terminated at depths of 5.45m and 10.45m within granular deposits.

5.4 Groundwater

- 5.4.1 Groundwater was not encountered in any of the exploratory holes.

6.0 GEOTECHNICAL ASSESSMENT

6.1 Proposed Development

- 6.1.1 It is understood that the proposed development is to consist of the construction of a single storey extension to the west of the existing school building along with the construction of a new MUGA pitch and car parking facilities.
- 6.1.2 The proposed developments on site generally relate to exploratory hole positions as follows:
- Single storey school extension - BH01 and BH02
 - MUGA and car parking facility – BH03, BH04, CBR01 to CBR03
- 6.1.3 The comments and discussion below do not fall within the requirements of EC7 (ref. 9.3) and are offered for guidance. The comments and recommendations below should be reviewed as development details become available.
- 6.1.4 WCBC have indicated an anticipated load of 40kN/m per run along traditional 600mm wide strip foundation.

6.2 Foundations

- 6.2.1 The investigation has proved granular deposits at depths in the range of 0.20m to 0.90m.
- 6.2.2 On the basis of observations made on site together with results of in-situ and laboratory tests, it is recommended that consideration could be given to the adoption of shallow spread foundations to support the proposed structures.
- 6.2.3 It is recommended that conventional shallow spread footings should be taken through any topsoil and placed in the underlying natural granular strata at a minimum depth of 0.75m.
- 6.2.4 Due to the depth of topsoil encountered in BH01 within the vicinity of the proposed extension, it is likely that foundations may have to be locally extended to depths about 0.90m.
- 6.2.5 Assuming strip foundations up to 0.6m wide at the minimum depth of 0.75m in medium dense granular deposits an allowable bearing capacity about 120kN/m² may be adopted, which would provide an adequate factor of safety against shear failure and limit settlements to the order of 10mm.
- 6.2.6 On this basis foundations of width 0.60m, at a nominal depth of 0.75m, should support loads about 75kN per linear metre.

6.3 Ground Floor Slabs

- 6.3.1 Based on observation on site consideration may be given to constructing ground floor slabs on formation prepared in the natural granular deposits.
- 6.3.2 Any deleterious material should be removed and replaced with properly compacted granular fill.

6.4 Excavations

- 6.4.1 Based on observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to less than 1.00m may not stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations which appear unstable, and those more than 1.20m deep, in accordance with Health and Safety Regulations.
- 6.4.2 It is anticipated that standard plant will be generally suitable for excavation.

6.2 Permeability

- 6.4.1 The permeability of the ground was assessed by in-situ variable head testing carried out in BH03 and BH04. Results are presented in Appendix 2.
- 6.4.2 The tests recorded permeabilities of 4.82×10^{-7} m/s and 1.27×10^{-6} m/s within granular deposits (sand). These results indicate the granular deposits (sand) to generally be of poor drainage characteristics (Ref 9.8).

6.5 Road and Hard Standing

- 6.5.1 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.
- 6.5.2 Plate load tests were carried out at three locations across the site.
- 6.5.3 The results of the plate load tests may be summarised as follows:

Location	Modulus of subgrade reaction		CBR	Strata
	K MN/m ³	K ₇₆₂ MN/m ³	%	
CBR01	157	69	15	Sand
CBR02	115	51	8.7	
CBR02	109	48	8	

- 6.5.4 Laboratory moisture contents for material immediately below the test were in the range 14 to 17.2%.
- 6.5.5 It is considered that preliminary design of roads and hardstanding may be based on CBR values in the range of 8 to 15%.

- 6.5.6 Formations should be proof rolled, inspected and any areas of loose, soft or deleterious material should be excavated and replaced with suitably compacted granular fill.

6.6 Chemical Attack on Buried Concrete

- 6.6.1 The site has been classified in accordance with BRE Special Digest 1, ref. 9.9, as natural ground without the presence of pyrite and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1, ref. 9.9, be adopted. Relevant details of this digest are included in Appendix 5, Figure A5.6.
- 6.6.2 The results of chemical tests in the non-pyritic soils indicate a sulphate concentration in the soil of <10mg/l as a 2:1 water/soil extract, with pH values in the range of 6.95 to 7.8.
- 6.6.3 It is recommended that for conventional shallow foundations the groundwater should be regarded as mobile.
- 6.6.4 On the basis of the laboratory test results it is considered that a Design Sulphate Class for this material may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

7.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

7.1 Contaminated Land

7.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 9.10, which was introduced by the Environment Act 1995, ref 9.11, as;

- ‘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 –
- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.’

7.2 Risk Assessment

7.2.1 The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency of exposure to a substance with the potential to cause harm, and:
- The seriousness of the consequence.

7.3 Pollutant Linkage

7.3.1 The basis of an environmental risk assessment involves identifying a ‘source’ of contamination, a ‘pathway’ along which the contamination may migrate and a ‘receptor’ at risk from the contamination.

7.3.2 Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters.
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

7.3.3 A pollutant linkage indicates that all three elements have been identified. The site can only be defined as ‘Contaminated Land’ if a pollutant linkage exists and the contamination meets the criteria in Section 7.1 above.

7.3.4 The guidance proposes a four-stage approach for the assessment of contamination and the associated risks. The four stages are listed below:

- Hazard Identification
- Hazard Assessment
- Risk Assessment
- Risk Evaluation

7.3.5 The risk assessment and evaluation stages are presented in this phase 2 interpretive report, after an intrusive ground investigation has taken place.

7.4 Risk Assessment – Human Health

7.4.1 The proposed development consists of the construction of a single storey extension to the west of the existing school building along with the construction of a new MUGA pitch and car parking facilities to the northwest. On the assumption that the site will be covered with buildings and hardstanding the risk assessment has been based on guidelines for a commercial / industrial end use. Should the proposed development be changed in the future then further risk assessment may be required, particularly should a more sensitive end-use be envisaged.

7.4.2 The results of the soil analyses from the current investigation have been compared to CLEA SGVs published in Environment Agency Science Reports SC050021/SR3, ref 9.14 and SC050021, ref 9.15, where available, Generic Assessment Criteria (GAC), determined by LQM and CIEH, ref 9.16, DEFRA C4SL, ref. 9.17 as well as Assessment Criteria (AC) derived in-house using the CLEA Software Version 1.06, ref 9.17. The CLEA AC have been derived by Ian Farmer Associates in accordance with current legislation and guidance.

7.4.3 The guidance values used within this contamination assessment have been tabulated and are detailed within Appendix 6.

7.4.4 Where the concentrations determined on site are at or below the respective Guidance Level, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

7.4.5 All the contaminants concentrations are below the Guidance Level.

7.4.6 No asbestos was detected.

7.4.7 On this basis it is considered that significant contamination risks to human health would not be associated with the proposed development of the site.

- 7.4.8 This assessment is based on one soil sample as required by WCBC in the scope of works. Additional soil sampling and analysis may be required to determine variation across the site.

7.5 Protection of Services

- 7.5.1 Guidance from the UKWIR, ref 9.22, sets out the material requirements for newly laid water supply pipes within Brownfield sites. However, the exact requirements should be clarified with the relevant local water utility supplier for the site.

8.0 MANAGEMENT OF CONTAMINATION

8.1 Remediation and Verification

8.1.1 The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, ref. 9.23, is applicable to the redevelopment of sites that may be affected by contamination.

8.1.2 The risk management process set out in the Model Procedures has three main components:

- Risk assessment
- Options appraisal
- Implementation

8.1.3 This initial risk assessment has not identified any sources of contamination at the site and therefore a revised conceptual model has not been presented.

8.1.4 In the absence of a contamination source and pollutant linkage a remediation strategy would not be relevant for this site.

8.1.5 In the absence of a site remediation strategy no validation would be required.

8.2 Management of Unidentified Sources of Contamination

8.2.1 There is the possibility that other 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.

8.3 Consultation

8.3.1 During the development of a contaminated 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.
- **Environment Agency.** Where a site is within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.

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

8.4 Risk Management During Site Works

8.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of 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.

8.4.2 Where contaminated 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.

9.0 REFERENCES

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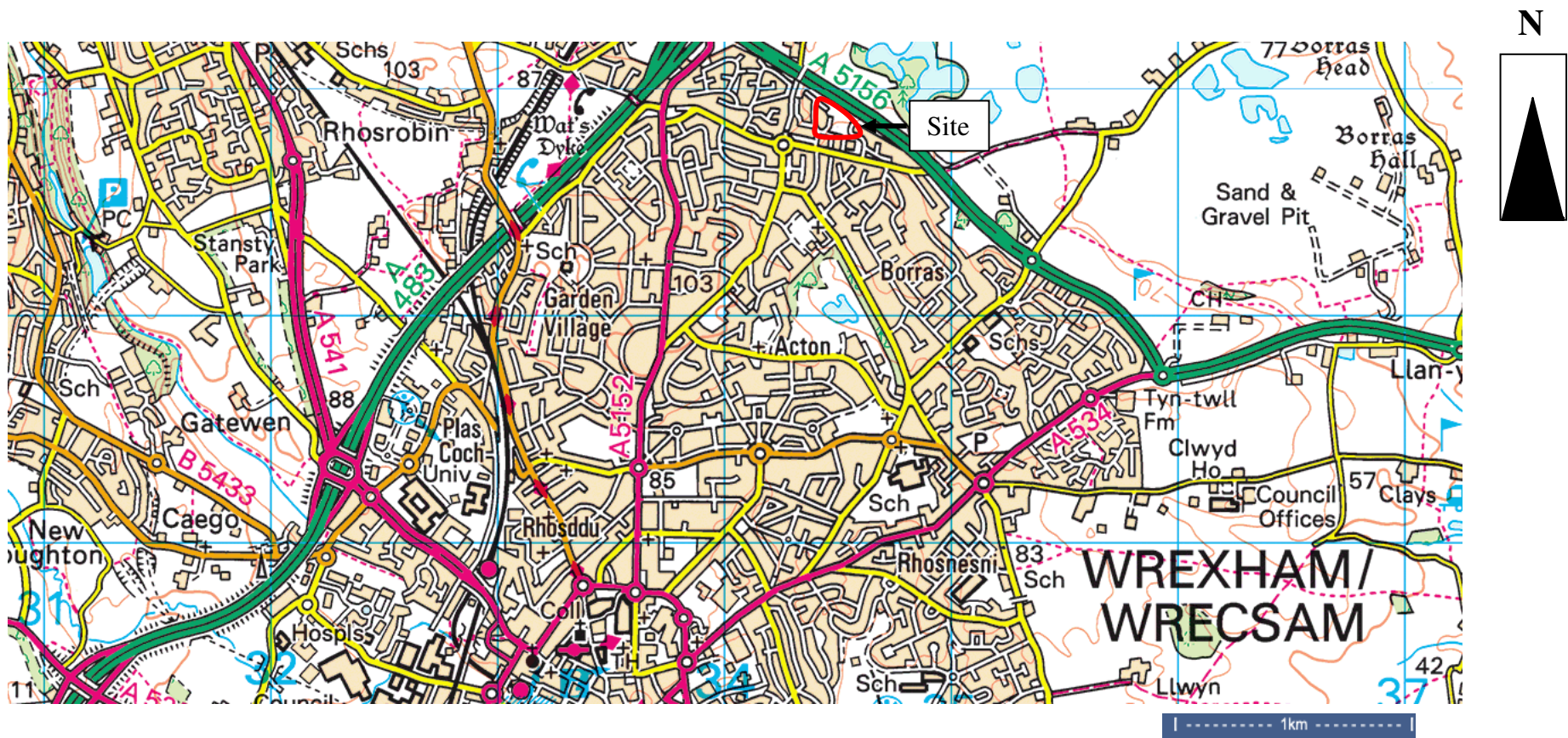
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- 9.19 An Analysis of Variance Test for Normality, Shapiro, S. S. and Wilk, M. B. 1965
- 9.20 Environment Agency Science Report SC050021/SR2 ‘Human health toxicological assessment of contaminants in soil’
- 9.21 CLR 10, ‘The Contaminated Land Exposure Assessment Model (CLEA): Technical basis and algorithms’. DEFRA/EA, March 2002.
- 9.22 UK Water Industry Research Ltd, Report 10/WM/03/21, ‘Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites’, 2010.
- 9.23 CLR 11, ‘Model Procedures for the Management of Contaminated Land’, DEFRA and Environment Agency, 2004.
- 9.24 Fakher, A., Khodaparast M. and Jones C. J. F. P., 2005, The use of the Mackintosh Probe for Site Investigation in soft soils.

For and on behalf of Ian Farmer Associates (1998) Limited

H. Hadwin
BSc (Hons) MSc FGS
Engineering Geologist

T. Downes
BSc (Hons) MSc FGS
Principal Engineering Geologist

APPENDIX 1
DRAWINGS



PROJECT: 42287 Barkers lane CP

FIGURE No. A1.1.

SCALE: As Indicated

TITLE: Site Location Plan





Title: Section line 1

Vertical Scale: 1:92

Horizontal Scale: 1:614

Engineer:

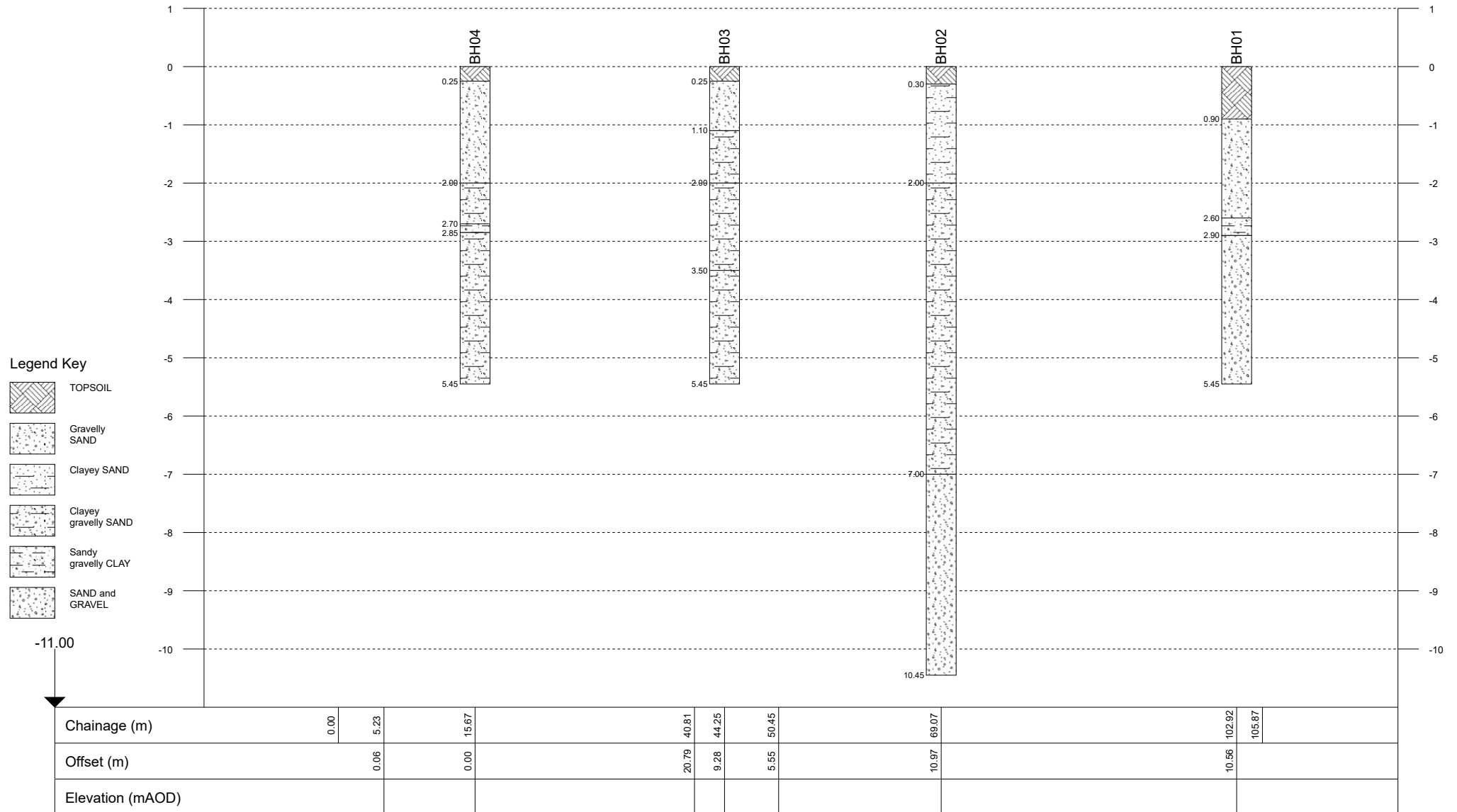


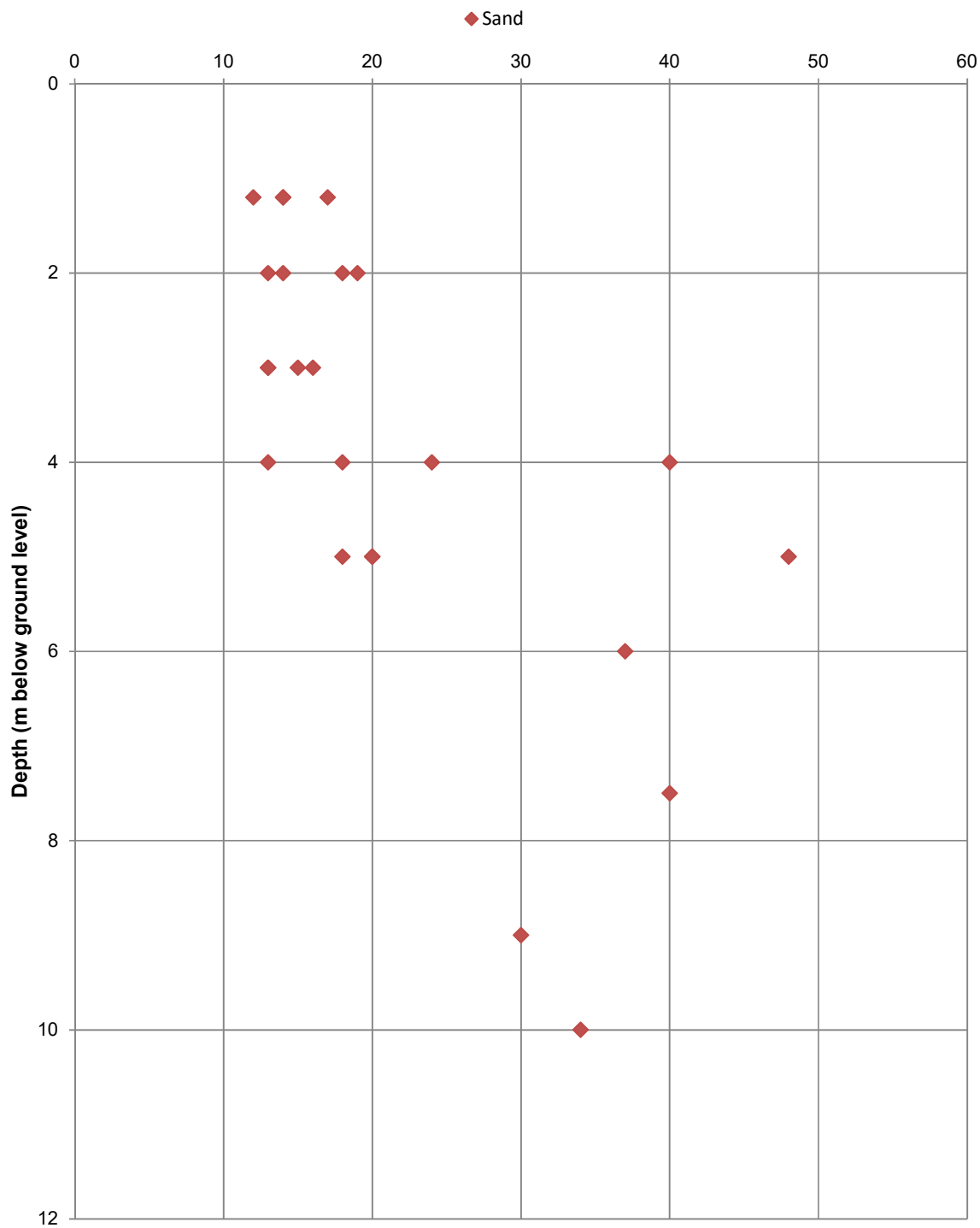
Fig A1.4 SPT 'N' value versus depth

Project ID: **42287**

Project Title: **Barkers Lane CP School, Wrexham**

Client: **Wrexham County Council**

Location:



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 ISO 1997, 9.3 and BS 5930, ref 9.2.

A2.1.2 Light Cable Percussion Boring

For routine soil exploration to depths in excess of 3m, the light cable percussion rig is generally employed for boring through soils and weak rocks, refs 9.2, 9.3 and 9.6. It consists of a powered winch and tripod frame, with running wheels that are permanently attached so that the rig may be towed behind a suitable vehicle. The rig is towed into position and set up using its own winching system.

The locations of services are checked to make sure the borehole is not situated unacceptably near any services. Regardless of the proximity of services, a CAT scan is undertaken at the borehole location and a trial hole dug to 1.20m by hand.

Boreholes are advanced in soil by the percussive action of the cable tool. The force of the cylindrical tool as it is dropped a short distance cuts a plug of cohesive soil that is removed by the tool.

In non-cohesive soils, the borehole is advanced by a 'shell', otherwise known as a 'bailer' or 'sand pump', which incorporates a clack valve. Material is transferred into the shell and retained by the clack valve. The water level in a borehole is maintained above that in the surrounding granular soil to allow for temporary reductions in the head of water as the shell is withdrawn from the borehole. Water should flow from the borehole into the surrounding soil at all times to prevent 'piping' and loosening the soil at the base of the hole. The casing is always advanced with the borehole in granular soil so that material is drawn from the base rather than the borehole sides.

Obstructions to boring are overcome by fitting a serrated chiselling ring to the base of the percussion tool. For large obstructions, a heavy chisel with a hardened cutting edge may have to be used.

Disturbed samples are taken in polythene bags, jars or tubs that are sealed against air or water loss.

Undisturbed samples are generally taken in cohesive materials at changes in strata and at one metre intervals to 5 metres then at 1.5 metre intervals to the full depths of the borehole. The general purpose open-tube sampler is suitable for firm to stiff clays, but is often used to retrieve disturbed samples of weak rocks, soft or hard clay and also clayey sand or silts. This has been adopted for routine use, and usually consists of a 100mm internal diameter tube (U100), which is capable of taking soil samples up to 450mm in length. The undisturbed samples are sealed at each end using micro-crystalline wax to prevent drying.

Standard penetration tests are generally carried out in non-cohesive soils but also in stiff clays and soft rocks at frequencies similar to that of undisturbed sampling.

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 ISO 1997, ref 9.3, BS 1377, Part 9, 1990 ref 9.7 and ISO 22476 ref 9.6.

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 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	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

A2.3 SAMPLES

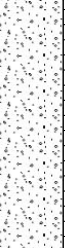
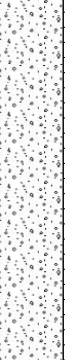
- B represents large bulk disturbed samples
- D represents small disturbed sample
- ES represents sample environmental sample
- W represents water sample
- ▽ represents water strike
- ▼ represents level to which water rose

A2.4 DESCRIPTION OF SOILS

A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref 9.3, supplemented by section 6 of BS 5930, ref. 9.2 have been used in the soil descriptions contained within this report.

	Plant used: Dando 2000		Project: Barkers Lane CP School, Wrexham			Location ID: BH01	
	Dates: 04/01/2019		Client: Wrexham County Council				
Cable Percussion Borehole Log		Location: 334541.57E 352724.20N		Ground level:	Logged by: HD	Vertical scale: 1:50	Sheet 1 of 1 Project ID: 42287

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.20	D1	SPT(S) N=17 (2,3/4,4,6,3)		(0.90)	Grass over, dark brown, very gravelly, fine to coarse SAND. Gravel is angular to rounded, fine to coarse including sandstone, mudstone and limestone. (Topsoil).			
0.50	D2							
0.80	B4							
0.80	ES3							
1.00	D5							
1.20		SPT(S) N=19 (3,3/4,5,5,5)		(1.70)	Medium dense, orangish dark brown, gravelly, fine to coarse SAND with medium cobble content. Gravel is angular to rounded, fine to coarse including sandstone, mudstone and limestone.		1	2
1.20 - 1.65	B6							
1.20 - 1.65	D7							
2.00	B8							
2.00 - 2.45	D9							
2.60 - 2.90	B10	SPT(S) N=13 (1,2/2,3,4,4)		2.60 (0.30) 2.90	Firm, orangish brown, slightly gravelly, sandy CLAY. Gravel is angular to rounded, fine to coarse including sandstone, mudstone and limestone.			3
3.00	B11							
3.00 - 3.45	D12							
3.00 - 3.45								
3.00 - 3.45								
4.00		SPT(S) N=18 (2,2/3,4,5,6)		(2.55)				4
4.00 - 4.45	B13							
4.00 - 4.45	D14							
4.00 - 4.45								
4.00 - 4.45								
5.00		SPT(S) N=20 (3,4/4,4,5,7)		5.45	End of Borehole at 5.45m			5
5.00 - 5.45	B15							
5.00 - 5.45	D16							
								6
								7
								8
								9
								10

Chiselling				Borehole Diameter		Boring Progress				Remarks: Service inspection pit hand excavated from GL to 1.20m. Coordinates estimated via Holebase map tool. SPT Hammer: N/R, Energy Ratio: N/R	
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)		
				5.45	150	04/01	12:00	5.45	4.70		
				Casing Diameter		Water Strikes				Monitoring Installations	
				Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
				4.70	150						
Checked by:		HH	IFA CP								
Log status:		DRAFT	v01.01								

Plant used: Dando 2000	Project: Barkers Lane CP School, Wrexham	Location ID: BH02
Dates: 02/01/2019	Client: Wrexham County Council	Sheet 1 of 2
Cable Percussion Borehole Log	Location: 334523.72E 352760.13N	Ground level: Logged by: HD
		Vertical scale: 1:50
		Project ID: 42287

Samples & In Situ Testing				Strata Details			Groundwater				
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation			
0.20	D1	SPT(S) N=14 (1,2/3,3,4,4)		(0.30)	Grass over, dark brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine and medium including mudstone and sandstone (Topsoil).						
0.50	D2			0.30	Medium dense, brown, slightly clayey, slightly gravelly, fine to coarse SAND.						
0.80 - 1.00	B3			(1.70)					1		
1.00	D4										
1.20	D5										
1.20 - 1.65											
2.00	B6 D7	SPT(S) N=13 (2,2/3,3,3,4)		2.00	Medium dense, brown, slightly clayey, very gravelly, fine to coarse SAND. Gravel is angular and rounded, fine to coarse including sandstone, mudstone and limestone.		2				
2.00 - 2.45											
2.00 - 2.45											
3.00	B8 D9	SPT(S) N=16 (2,3/3,4,4,5)					3				
3.00 - 3.45											
3.00 - 3.45											
4.00	B10 D11	SPT(S) N=40 (3,4/7,8,12,13)		(5.00)	Below 4.50m: dense.		4				
4.00 - 4.45											
4.00 - 4.45											
5.00	B12 D13	SPT(S) N=48 (5,6/9,10,12,17)					5				
5.00 - 5.45											
5.00 - 5.45											
6.00	B14 D15	SPT(C) N=37 (5,5/5,10,10,12)			At 6.00m: black.		6				
6.00 - 6.45											
6.00 - 6.45											
7.50	B16 D17	SPT(C) N=40 (5,6/7,9,10,14)		7.00	Dense, brown, fine to coarse SAND and angular to rounded, fine to coarse GRAVEL including sandstone, mudstone and limestone.		7				
7.50 - 7.95				(3.45)				8			
7.50 - 7.95											
9.00	B18 D19	SPT(C) N=30 (4,4/5,6,8,11)					9				
9.00 - 9.45											
9.00 - 9.45											
10.00		SPT(C) N=34 (3,6/6,9,9,10)			Continued next sheet		10				

Continued next sheet

Chiselling				Borehole Diameter		Boring Progress					Remarks:				
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	Service inspection pit hand excavated from GL to 1.20m. Coordinates estimated via Holebase map tool.				
				10.45	150	02/01	16:00	10.45	10.00	SPT Hammer: N/R, Energy Ratio: N/R					
				Casing Diameter		Water Strikes								Monitoring Installations	
				Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
				10.00	150										
Checked by:		HH	IFA CP v01.01												
Log status:		DRAFT													

Service inspection pit hand excavated from GL to 1.20m.
Coordinates estimated via Holebase map tool.
SPT Hammer: N/R, Energy Ratio: N/R



Plant used: Dando 2000	Project: Barkers Lane CP School, Wrexham		Location ID: BH02		
Dates: 02/01/2019	Client: Wrexham County Council				
Cable Percussion Borehole Log	Location: 334523.72E 352760.13N	Ground level:	Logged by: HD	Vertical scale: 1:50	Sheet 2 of 2 Project ID: 42287

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
10.00 - 10.45	B20				Dense, brown, fine to coarse SAND and angular to rounded, fine to coarse GRAVEL including sandstone, mudstone and limestone.			
10.00 - 10.45	D21			10.45	End of Borehole at 10.45m			
							11	
							12	
							13	
							14	
							15	
							16	
							17	
							18	
							19	
							20	

Chiselling				Borehole Diameter		Boring Progress				Remarks:	
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)		
										SPT Hammer: N/R, Energy Ratio: N/R	
				Casing Diameter		Water Strikes				Monitoring Installations	
				Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
Checked by: HH Log status: DRAFT				IFA CP v01.01							

	Plant used: Dando 2000		Project: Barkers Lane CP School, Wrexham			Location ID: BH03	
	Dates: 03/01/2019		Client: Wrexham County Council				
Cable Percussion Borehole Log		Location: 334528.01E 352784.63N		Ground level:	Logged by: HD	Vertical scale: 1:50	Sheet 1 of 1 Project ID: 42287

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.20	D1	SPT(S) N=14 (1,2/3,3,3,5)		0.25	Grass over, dark orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine and medium including sandstone, limestone and mudstone (Topsoil).			
0.50	D2			(0.85)	Orangish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine and medium including sandstone, limestone and mudstone.			
0.80	B3			1.10	Medium dense, orangish dark brown, gravelly, silty, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, mudstone and limestone.			
1.00	D4							
1.20	B5	SPT(S) N=14 (3,3/2,4,5,3)		(0.90)	Medium dense, dark brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is angular to rounded, fine including sandstone, mudstone, limestone and coal flecks.		2	
1.20 - 1.65	D6							
2.00	B7			2.00	Medium dense, dark brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is angular to rounded, fine including sandstone, mudstone, limestone and coal flecks.			
2.00 - 2.45	D8							
3.00	B9	SPT(S) N=15 (3,3/3,3,4,5)		(1.50)			3	
3.00 - 3.45	D10							
4.00	B11			3.50	Medium dense, brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is angular to rounded, fine to coarse including sandstone, mudstone and limestone.			
4.00 - 4.45	D12							
5.00	B13	SPT(S) N=20 (3,4/4,4,5,7)		(1.95)	Below 5.00m: orangish brown.		4	
5.00 - 5.45	D14							
5.00 - 5.45	D14	5.45	End of Borehole at 5.45m		5			
							6	
							7	
							8	
							9	
							10	

Chiselling				Borehole Diameter		Boring Progress				Remarks: Service inspection pit hand excavated from GL to 1.20m. Coordinates estimated via Holebase map tool. SPT Hammer: N/R, Energy Ratio: N/R					
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)		Water (m)				
				5.45	150	03/01	13:00	5.45	4.70						
				Casing Diameter		Water Strikes				Monitoring Installations					
				Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
				4.70	150										
Checked by:		HH	IFA CP												
Log status:		DRAFT	v01.01												

Plant used: Dando 2000	Project: Barkers Lane CP School, Wrexham			Location ID: BH04
Dates: 02/01/2019	Client: Wrexham County Council			
Location: 334540.25E 352812.08N	Ground level:	Logged by: HD	Vertical scale: 1:50	Sheet 1 of 1 Project ID: 42287



VARIABLE HEAD PERMEABILITY TEST

42287 Variable Head (Falling) Permeability Test in BH03

SITE Barkers Lane, Wrexham

CONTRACT 42287 BH03 DEPTH: mBGL 0.76

INITIAL CONDITIONS

Length of test section (L)	0.76	mBGL	Operator	HD
Base of test section	3.11	mBGL	Date	03/01/2019
Base of the casing	2.35	mBGL		
Diameter of test section (D)	0.15	m	Time	13:32
Height of casing	0.65	mAGL	Weather	Dry & Cold
Elevation of Borehole		mAOD	Calculated	
Groundwater Level	3.11	mBGL	0.76 m	

TEST CALCULATION

Shape Factor, F

F= 2.05 (i)

Cylindrical cavity $1.2 < L/D < 10$
BS EN ISO 22282-2

Permeability, K

$K = \frac{A}{F * (t_2 - t_1)} \cdot \ln(H_1/H_2)$ (ii)

L= 0.76 m
D= 0.150 m
L/D= 5.07

t1= 180 s
t2= 3600 s
H1= 0.94 m
H2= 0.77 m

A= 0.01768 m²
F= 2.0535 From (i)
K= 4.8425E-07 m/s From (ii)

Remarks

Elapsed (minutes)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
0.0	0	0.340	3.420	1.000
0.5	30	0.400	3.360	0.982
1.0	60	0.450	3.310	0.968
2.0	120	0.480	3.280	0.959
3.0	180	0.560	3.200	0.936
4.0	240	0.570	3.190	0.933
5.0	300	0.590	3.170	0.927
6.0	360	0.610	3.150	0.921
7.0	420	0.650	3.110	0.909
8.0	480	0.670	3.090	0.904
9	540	0.690	3.070	0.898
10	600	0.700	3.060	0.895
15	900	0.760	3.000	0.877
20	1200	0.820	2.940	0.860
25	1500	0.890	2.870	0.839
30	1800	0.960	2.800	0.819
40	2400	1.010	2.750	0.804
50	3000	1.050	2.710	0.792
60	3600	1.120	2.640	0.772



VARIABLE HEAD PERMEABILITY TEST

42287 Variable Head (Falling) Permeability Test in BH04

SITE Barkers Lane, Wrexham

CONTRACT 42287 BH04 DEPTH: mBGL 0.50

INITIAL CONDITIONS

Length of test section (L)	0.50	mBGL	Operator	HD
Base of test section	5.00	mBGL	Date	04/01/2019
Base of the casing	4.50	mBGL		
Diameter of test section (D)	0.15	m	Time	10:16
Height of casing	0.00	mAGL	Weather	Dry & Cold
Elevation of Borehole		mAOD	Calculated	
Groundwater Level	5.00	mBGL	0.50 m	

TEST CALCULATION

Shape Factor, F

$$F = 1.64 \quad (i)$$

Cylindrical cavity $1.2 < L/D < 10$
BS EN ISO 22282-2

Permeability, K

$$K = \frac{A}{F * (t_2 - t_1)} \cdot \ln(H_1/H_2) \quad (ii)$$

L= 0.50 m
D= 0.150 m
L/D= 3.33

t1= 120 s
t2= 3600 s
H1= 0.97 m
H2= 0.64 m

A= 0.01768 m²
F= 1.6372 From (i)
K= 1.2799E-06 m/s From (ii)

Remarks

Elapsed (minutes)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
0.0	0	0.580	4.420	1.000
0.5	30	0.620	4.380	0.991
1.0	60	0.660	4.340	0.982
2.0	120	0.710	4.290	0.971
3.0	180	0.770	4.230	0.957
4.0	240	0.800	4.200	0.950
5.0	300	0.840	4.160	0.941
6.0	360	0.880	4.120	0.932
7.0	420	0.930	4.070	0.921
8.0	480	0.990	4.010	0.907
9	540	1.030	3.970	0.898
10	600	1.080	3.920	0.887
15	900	1.240	3.760	0.851
20	1200	1.380	3.620	0.819
25	1500	1.530	3.470	0.785
30	1800	1.620	3.380	0.765
40	2400	1.780	3.220	0.729
50	3000	2.020	2.980	0.674
60	3600	2.160	2.840	0.643



Plant used:	Project: Barkers Lane CP School, Wrexham			Location ID: CBR01	
Dates: 03/01/2019	Client: Wrexham County Council				
Trial Pit Log	Location: 334542.11E 352776.91N	Ground level:	Logged by: HD	Vertical scale: 1:25	Sheet 1 of 1
					Contract ID: 42287

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
0.30	D1			0.25 0.30	Grass over, dark orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine and medium including sandstone, limestone and mudstone (Topsoil).				
					Medium dense, brownish orange, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, limestone and mudstone. End of Trial Pit at 0.30m				
							1		
							2		
							3		
							4		
							5		

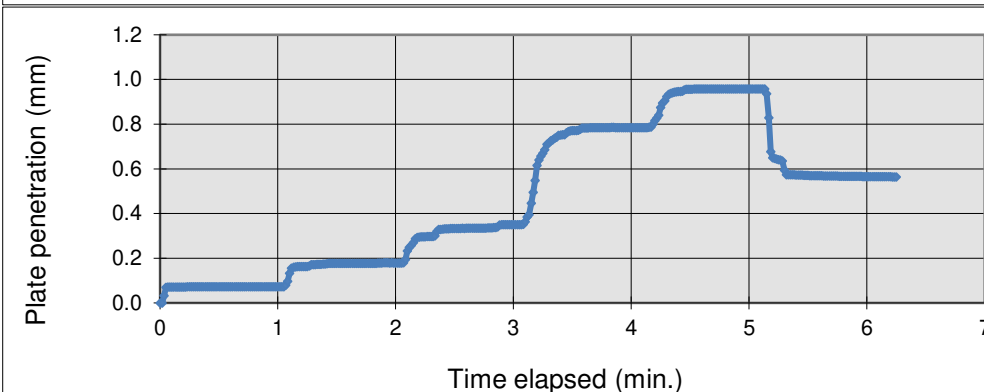
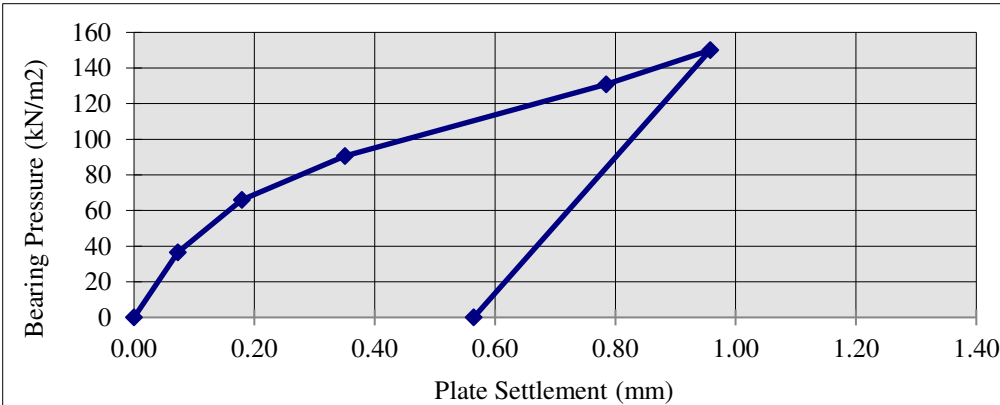
Termination:	Stability:	Remarks: Coordinates estimated via Holebase map tool.		
Dimensions (Length m x Width m):				
Water Strikes				
Strike (m)	Time (mins)		Rose to (m)	Remarks
		Checked by:	HH	IFA TP v01.01
		Status:	DRAFT	



LABORATORY TEST REPORT
DETERMINATION OF PLATE BEARING CAPACITY

Project :	Bakers Lane County Primary School	Job No.	36276
Client :	Ian Farmer Associates (1998) Ltd	Lab Ref No	36276/01
Site Address:	Bakers Lane	Date Tested	03/01/19
	Borras	Date Reported	04/01/2019
	LL13 9UN	Weather Conditions:	COLD
Originator :	Geoff Regan		

Location: CBR01



Material Type	
SAND	
Plate Diameter (mm)	
300	
Technician	
RK	
Depth (m)	
0.3	
Type of Reaction Load	
8TON	
Bearing Pressure (kN/m²)	Plate Settlement (mm)
0.0	0.00
36.5	0.07
66.0	0.18
90.5	0.35
130.9	0.78
150.1	0.96
0.0	0.56

Maximum Applied Pressure (kPa) :	150.1	K₇₆₂ (MN/m³) :	69
Maximum deformation (mm) :	0.96	Estimated CBR (%) :	15
Modulus of subgrade reaction K (MN/m³) :	157	Moisture Content (%) :	N/A

Plate Load - Tested in accordance with BS 1377 : Part 9 Cl. 4.1: 1990

Moisture Content - Tested in accordance with BS 1377: Part 2 : 1990, oven drying method

Values K₇₆₂, K and CBR(%) calculated in accordance with Interim Advice Note 73/06 (Draft HD25)

Approved Signature

James Fisher Testing Services Ltd
Phil Thorp, Laboratory Manager





Plant used:	Project: Barkers Lane CP School, Wrexham			Location ID: CBR02	
Dates: 03/01/2019	Client: Wrexham County Council				
Trial Pit Log	Location: 334541.29E 352822.47N	Ground level:	Logged by: HD	Vertical scale: 1:25	Sheet 1 of 1
					Contract ID: 42287

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
0.30	D1			0.25 0.30	Grass over, dark orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine and medium including sandstone, limestone and mudstone (Topsoil).		1		
					Medium dense, brownish orange, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, limestone and mudstone. End of Trial Pit at 0.30m				
							2		
							3		
							4		
							5		

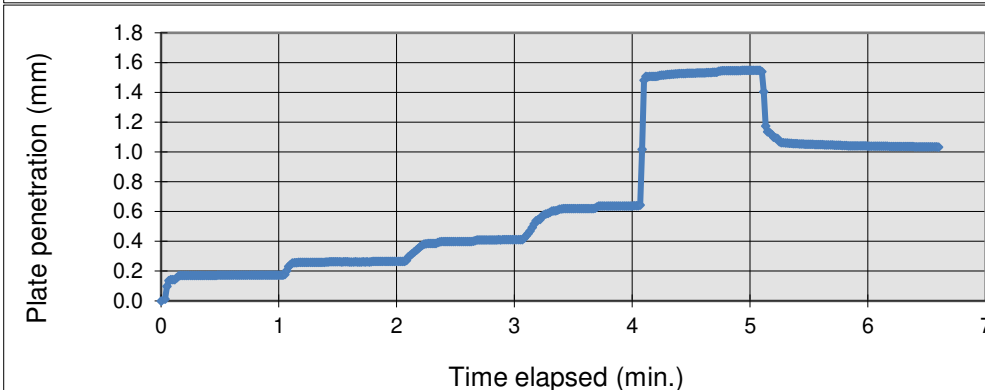
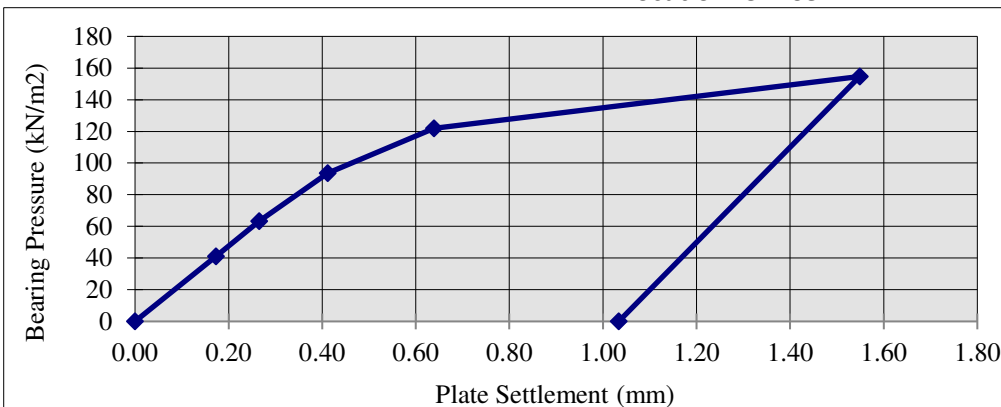
Termination:	Stability:	Remarks: Coordinates estimated via Holebase map tool.		
Dimensions (Length m x Width m):				
Water Strikes				
Strike (m)	Time (mins)		Rose to (m)	Remarks
Checked by:		HH	IFA TP v01.01	
Status:		DRAFT		



LABORATORY TEST REPORT
DETERMINATION OF PLATE BEARING CAPACITY

Project :	Bakers Lane County Primary School	Job No.	36276
Client :	Ian Farmer Associates (1998) Ltd	Lab Ref No	36276/02
Site Address:	Bakers Lane	Date Tested	03/01/19
	Borras	Date Reported	04/01/2019
	LL13 9UN	Weather Conditions:	COLD
Originator :	Geoff Regan		

Location: CBR03



Material Type	
SAND	
Plate Diameter (mm)	
300	
Technician	
RK	
Depth (m)	
0.3	
Type of Reaction Load	
8TON	
Bearing Pressure (kN/m²)	Plate Settlement (mm)
0.0	0.00
41.1	0.17
63.4	0.27
93.7	0.41
121.8	0.64
154.7	1.55
0.0	1.03

Maximum Applied Pressure (kPa) :	154.7	K₇₆₂ (MN/m³) :	51
Maximum deformation (mm) :	1.55	Estimated CBR (%) :	8.7
Modulus of subgrade reaction K (MN/m³) :	115	Moisture Content (%) :	N/A

Plate Load - Tested in accordance with BS 1377 : Part 9 Cl. 4.1: 1990

Moisture Content - Tested in accordance with BS 1377: Part 2 : 1990, oven drying method

Values K₇₆₂, K and CBR(%) calculated in accordance with Interim Advice Note 73/06 (Draft HD25)

Approved Signature

James Fisher Testing Services Ltd
Phil Thorp, Laboratory Manager





Plant used:	Project: Barkers Lane CP School, Wrexham			Location ID: CBR03	
Dates: 03/01/2019	Client: Wrexham County Council				
Trial Pit Log	Location: 334516.93E 352789.27N	Ground level:	Logged by: HD	Vertical scale: 1:25	Sheet 1 of 1
					Contract ID: 42287

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
0.30	D1			0.20	Grass over, dark orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine and medium including sandstone, limestone and mudstone (Topsoil).		1		
				0.30	Medium dense, brownish orange, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, limestone and mudstone.				
				End of Trial Pit at 0.30m					
							2		
							3		
							4		
							5		

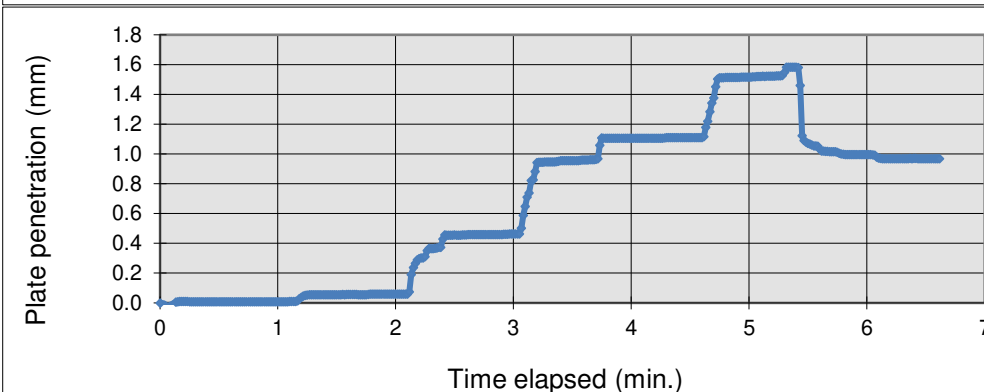
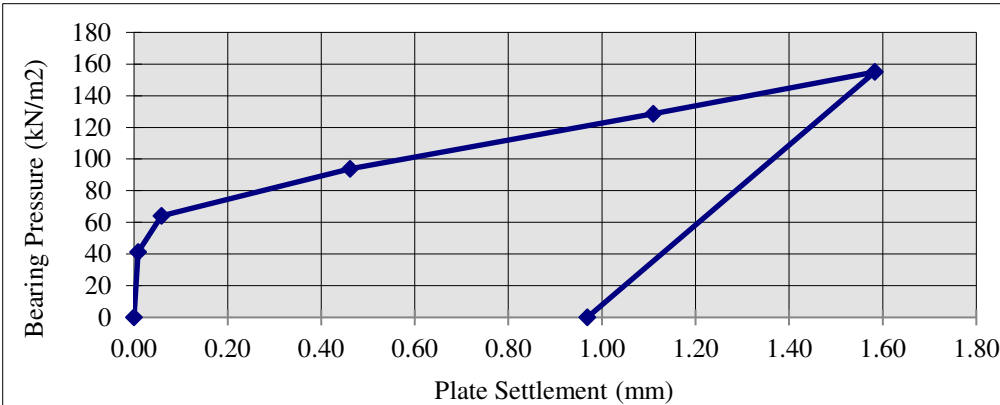
Termination:	Stability:	Remarks: Coordinates estimated via Holebase map tool.	
Dimensions (Length m x Width m):			
Water Strikes			
Strike (m)	Time (mins)		Rose to (m)
Checked by: HH		IFA TP v01.01	
Status: DRAFT			



LABORATORY TEST REPORT
 DETERMINATION OF PLATE BEARING CAPACITY

Project :	Bakers Lane County Primary School	Job No.	36276
Client :	Ian Farmer Associates (1998) Ltd	Lab Ref No	36276/03
Site Address:	Bakers Lane	Date Tested	03/01/19
	Borras	Date Reported	04/01/2019
	LL13 9UN	Weather Conditions:	COLD
Originator :	Geoff Regan		

Location: CBR02



Material Type	
SAND	
Plate Diameter (mm)	
300	
Technician	
RK	
Depth (m)	
0.3	
Type of Reaction Load	
8TON	
Bearing Pressure (kN/m²)	Plate Settlement (mm)
0.0	0.00
41.3	0.01
64.0	0.06
93.8	0.46
128.6	1.11
155.0	1.58
0.0	0.97

Maximum Applied Pressure (kPa) :	155.0	K₇₆₂ (MN/m³) :	48
Maximum deformation (mm) :	1.58	Estimated CBR (%) :	8.0
Modulus of subgrade reaction K (MN/m³) :	109	Moisture Content (%) :	N/A

Plate Load - Tested in accordance with BS 1377 : Part 9 Cl. 4.1: 1990

Moisture Content - Tested in accordance with BS 1377: Part 2 : 1990, oven drying method

Values K₇₆₂, K and CBR(%) calculated in accordance with Interim Advice Note 73/06 (Draft HD25)

Approved Signature

James Fisher Testing Services Ltd
 Phil Thorp, Laboratory Manager



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 as below:

Test Name	Procedures BS1377:1990 Part:Clause
Moisture Content	2:3
Liquid Limit	2:4
Plastic Limit and Plastic Index	2:5
Particle Size Distribution	9:2
Sedimentation	9:4
Mass Loss on Ignition	3:4
Sulphate content	3:5
pH Value	3:9
Compaction Test	4:3
California Bearing Ratio	4:7
Consolidation	5:3
Bulk Density	7:2*
Laboratory Vane Tests	7:3*
Triaxial Compression	
Total Stress Single-Stage	7:8
Total Stress Multi-Stage	7:9
Desiccation	Note 1*

Note 1 - BRE Information paper IP4 issued February 1993

* Tests are not included in UKAS accreditation

A3.1.2 Where an external laboratory carried out testing, their report, including test methods is included in this Appendix.

A3.1.3 A summary sheet of laboratory test results undertaken by Ian Farmer Laboratories is included, however where copies of the individual test results are required these will be provided on request.

A3.1.4 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 MOISTURE CONTENT

A3.2.1 Unless stated to the contrary, the moisture content of a soil sample was determined by the standard oven drying method, BS 1377, Part 1, Test 3. The result is reported to an accuracy of $\pm 0.5\%$

A3.3 CHEMICAL TESTS

A3.3.1 The total sulphate content of soil was determined using the gravimetric method detailed in BS1377: Part 3:1990, Test 5. The results are recorded to an accuracy of $\pm 0.1\%$.

A3.3.2 The water soluble sulphate content of soil was determined using the gravimetric method detailed in BS1377: Part 3: 1990, Test 5. The results are recorded to an accuracy of $\pm 0.1\text{g/l}$.

A3.3.3 The sulphate content of groundwater was determined using the gravimetric method detailed in BS1377: Part 3: 1990, Test 5. The results are record to an accuracy of $\pm 0.1\text{g/l}$.

- A3.3.4 The pH value was determined electrometrically using the procedures given in BS 1377: Part 3: 1990, Test 9. The results are recorded to an accuracy of ± 0.1 pH units.
- A3.3.5 The total sulphur content of soil was determined using the ignition in oxygen method detailed in TRL Report 447, Test 4B.
- A3.3.6 The organic content of soil was determined in accordance with the chemical method detailed in BS1377: Part 3:1990 Clause 3. The sample was prepared in accordance with Clause 3.4.2.
- A3.3.7 The organic content of soil was determined in accordance with the loss on ignition method detailed in BS1377: Part 3:1990 Clause 4. The sample was prepared in accordance with Clause 4.3.2.

F.A.O.

Test Report - 42287 / 1

Site: Barkers Lane CP School, Wrexham

Job Number: 42287

Originating Client: Wrexham County Council

Originating Reference: 42287

Date Sampled: 04/01/2019

Date Scheduled: 08/01/2019

Date Testing Started: 11/01/2019

Date Testing Finished: 24/01/2019

Remarks:

Authorised By:



Tim Robinson
Quality Technician

Date: 25/01/2019



Site: Barkers Lane CP School, Wrexham

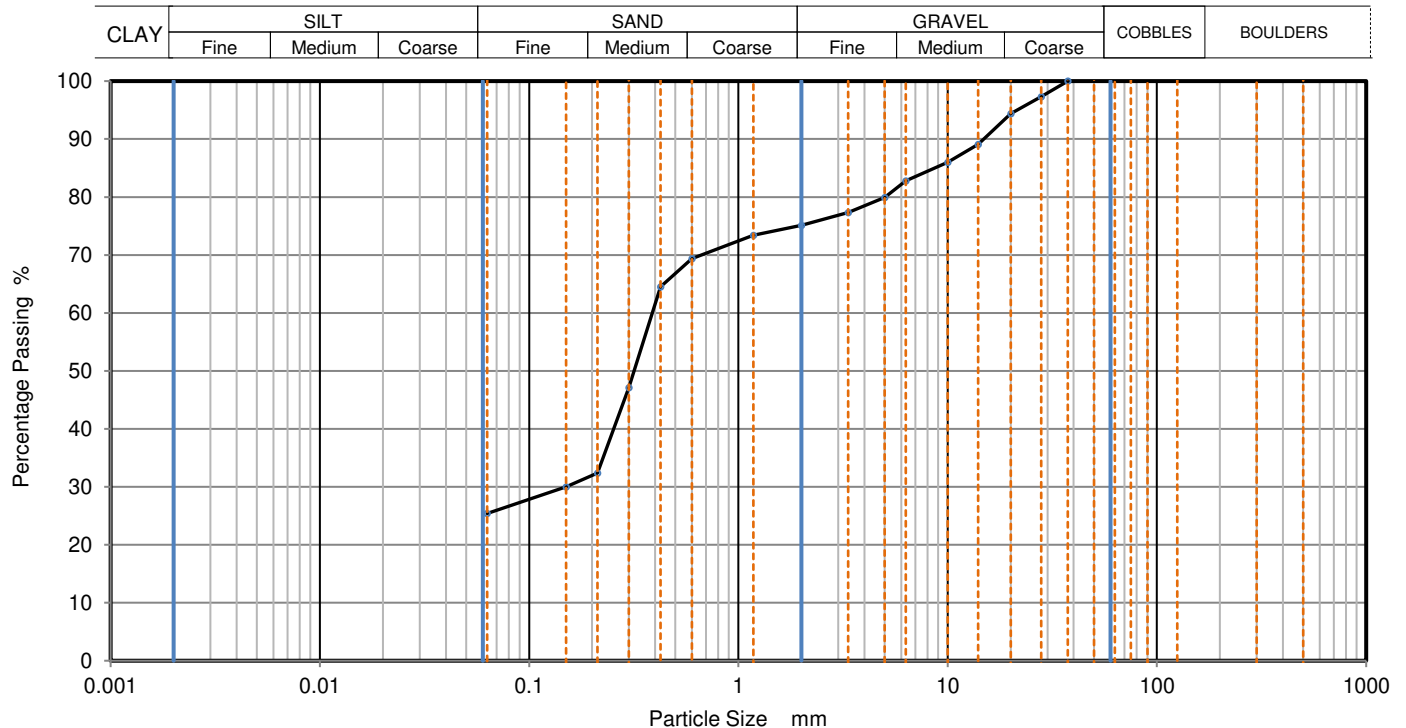
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH01	0.80	B4	Wet Sieve	Brown silty, gravelly SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
37.5	100		
28	97		
20	94		
14	89		
10	86		
6.3	83		
5	80		
3.35	77		
2	75		
1.18	73		
0.6	69		
0.425	65		
0.3	47		
0.212	32		
0.15	30		
0.063	25		

Dry Mass of sample, g

858

Sample Proportions	% dry mass
Very coarse	0
Gravel	25
Sand	50
Fines <0.063mm	25

Grading Analysis		
D100	mm	37.5
D60	mm	0.389
D30	mm	0.15
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method





Site: Barkers Lane CP School, Wrexham

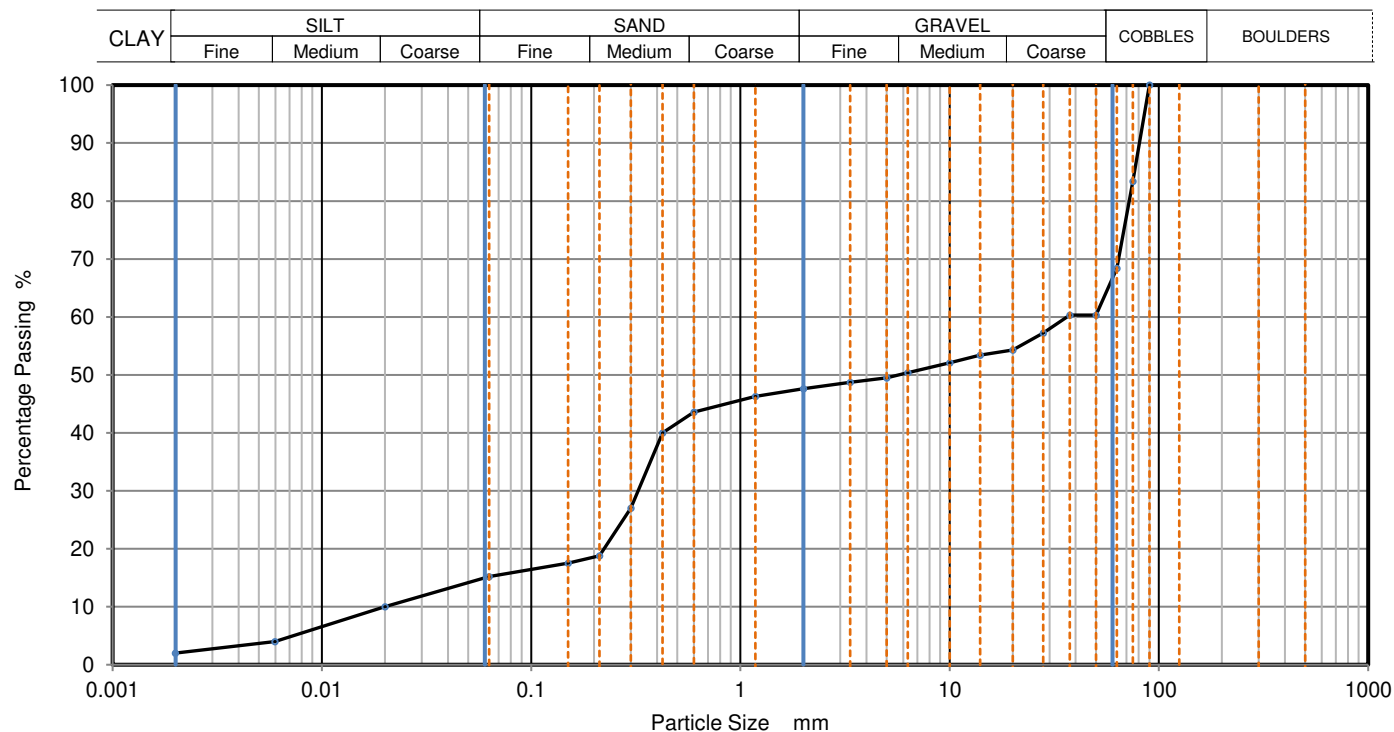
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH01	1.20	B6	Wet Sieve + Pipette	Brown silty, sandy GRAVEL



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0200	10
		0.0060	4
		0.0020	2
90	100		
75	83		
63	68		
50	60		
37.5	60		
28	57		
20	54		
14	53		
10	52		
6.3	50		
5	50		
3.35	49		
2	48		
1.18	46	Particle density (assumed) 2.65 Mg/m ³	
0.6	44		
0.425	40		
0.3	27		
0.212	19		
0.15	18		
0.063	15		

Dry Mass of sample, g

2841

Sample Proportions	% dry mass
Very coarse	32
Gravel	21
Sand	32
Silt	13
Clay	2

Grading Analysis		
D100	mm	90
D60	mm	36.4
D30	mm	0.325
D10	mm	0.0195
Uniformity Coefficient		1900
Curvature Coefficient		0.15

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method
BS1377:Part 2:1990, clause 9.4 Determination of sedimentation by pipette method





Site: Barkers Lane CP School, Wrexham

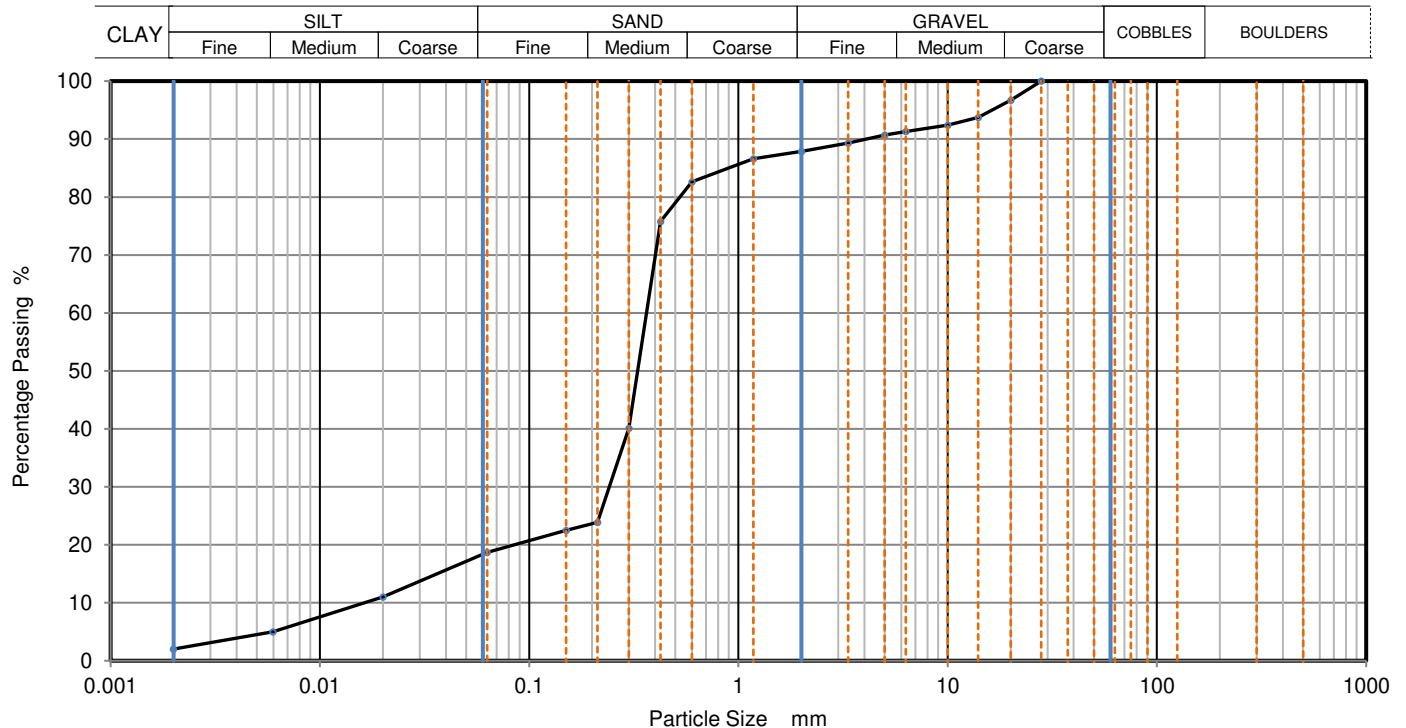
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH02	0.80	B3	Wet Sieve + Pipette	Brown gravelly, silty SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0200	11
		0.0060	5
		0.0020	2
28	100		
20	97		
14	94		
10	92		
6.3	91		
5	91		
3.35	89		
2	88		
1.18	87	Particle density (assumed) 2.65 Mg/m3	
0.6	83		
0.425	76		
0.3	40		
0.212	24		
0.15	23		
0.063	19		

Dry Mass of sample, g

1117

Sample Proportions	% dry mass
Very coarse	0
Gravel	12
Sand	69
Silt	17
Clay	2

Grading Analysis		
D100	mm	28
D60	mm	0.364
D30	mm	0.242
D10	mm	0.0157
Uniformity Coefficient		23
Curvature Coefficient		10

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method
BS1377:Part 2:1990, clause 9.4 Determination of sedimentation by pipette method





Site: Barkers Lane CP School, Wrexham

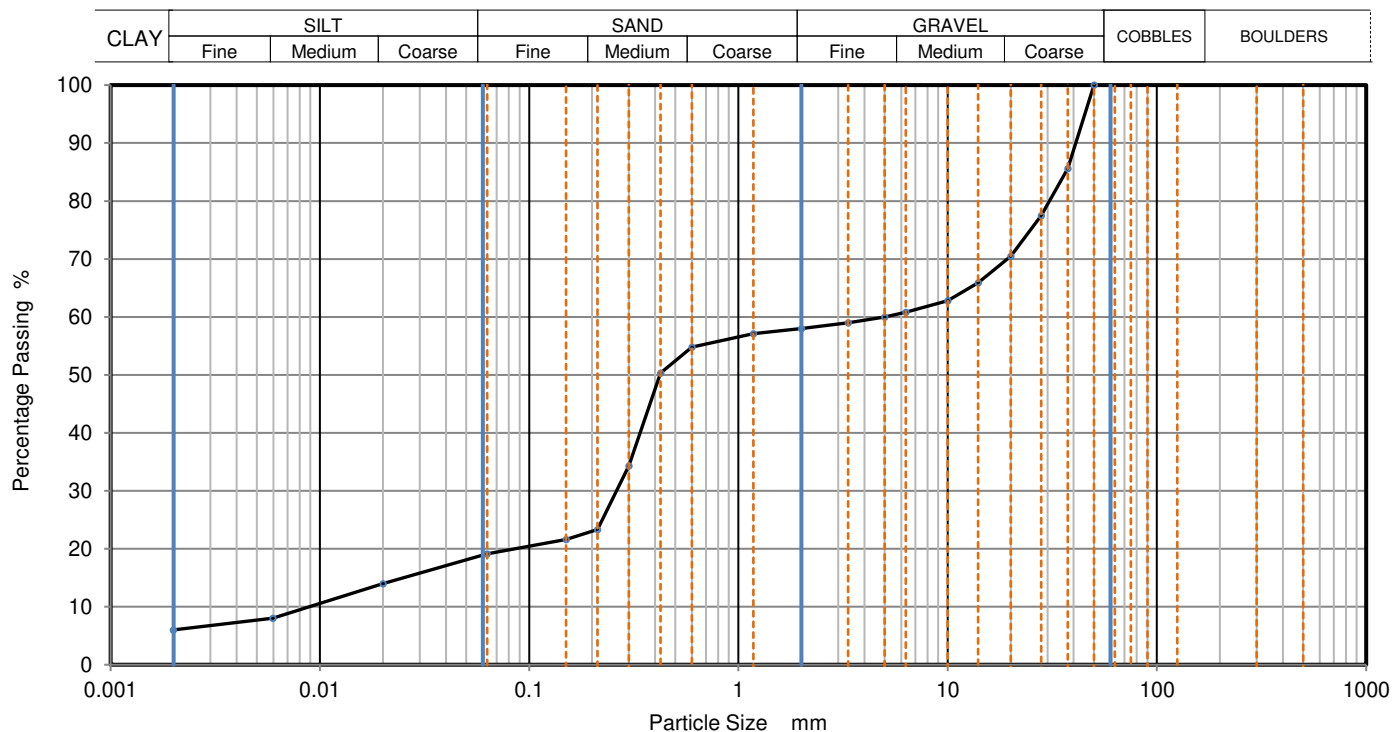
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH02	2.00	B6	Wet Sieve + Pipette	Brown slightly clayey, silty, sandy GRAVEL



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0200	14
		0.0060	8
		0.0020	6
50	100		
37.5	86		
28	78		
20	71		
14	66		
10	63		
6.3	61		
5	60		
3.35	59		
2	58		
1.18	57	Particle density (assumed) 2.65 Mg/m ³	
0.6	55		
0.425	50		
0.3	34		
0.212	23		
0.15	22		
0.063	19		

Dry Mass of sample, g

2804

Sample Proportions	% dry mass
Very coarse	0
Gravel	42
Sand	39
Silt	13
Clay	6

Grading Analysis		
D100	mm	50
D60	mm	4.97
D30	mm	0.262
D10	mm	0.00855
Uniformity Coefficient		580
Curvature Coefficient		1.6

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method
BS1377:Part 2:1990, clause 9.4 Determination of sedimentation by pipette method





Site: Barkers Lane CP School, Wrexham

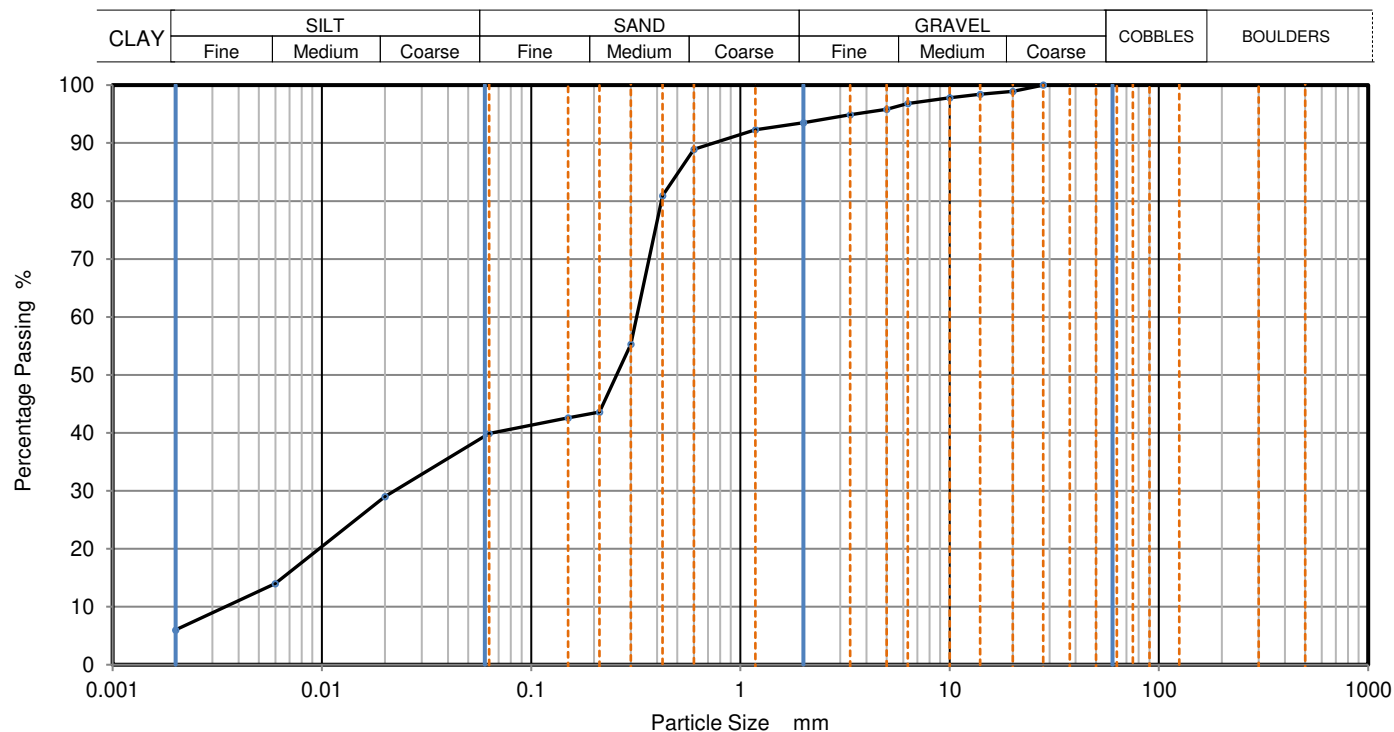
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH03	1.20	B5	Wet Sieve + Pipette	Brown slightly clayey, slightly gravelly, silty SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0200	29
		0.0060	14
		0.0020	6
28	100		
20	99		
14	98		
10	98		
6.3	97		
5	96		
3.35	95		
2	94		
1.18	92	Particle density (assumed) 2.65 Mg/m3	
0.6	89		
0.425	81		
0.3	55		
0.212	44		
0.15	43		
0.063	40		

Dry Mass of sample, g

1542

Sample Proportions	% dry mass
Very coarse	0
Gravel	7
Sand	54
Silt	34
Clay	6

Grading Analysis		
D100	mm	28
D60	mm	0.32
D30	mm	0.0224
D10	mm	0.00343
Uniformity Coefficient		93
Curvature Coefficient		0.46

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method
BS1377:Part 2:1990, clause 9.4 Determination of sedimentation by pipette method





Site: Barkers Lane CP School, Wrexham

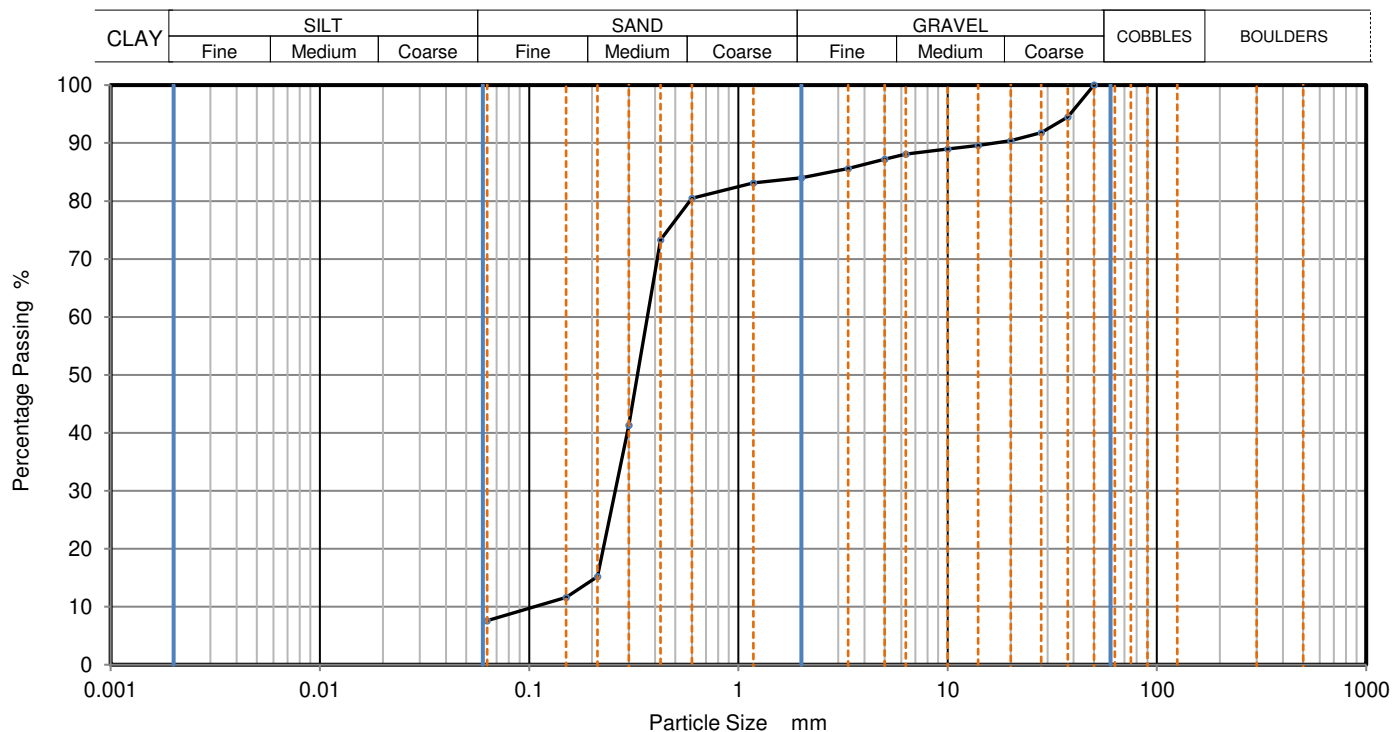
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH03	3.00	B9	Wet Sieve	Brown slightly silty, gravelly SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
50	100		
37.5	95		
28	92		
20	90		
14	90		
10	89		
6.3	88		
5	87		
3.35	86		
2	84		
1.18	83		
0.6	81		
0.425	73		
0.3	41		
0.212	15		
0.15	12		
0.063	8		

Dry Mass of sample, g

1560

Sample Proportions	% dry mass
Very coarse	0
Gravel	16
Sand	76
Fines <0.063mm	8

Grading Analysis		
D100	mm	50
D60	mm	0.368
D30	mm	0.258
D10	mm	0.107
Uniformity Coefficient		3.5
Curvature Coefficient		1.7

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method





Site: Barkers Lane CP School, Wrexham

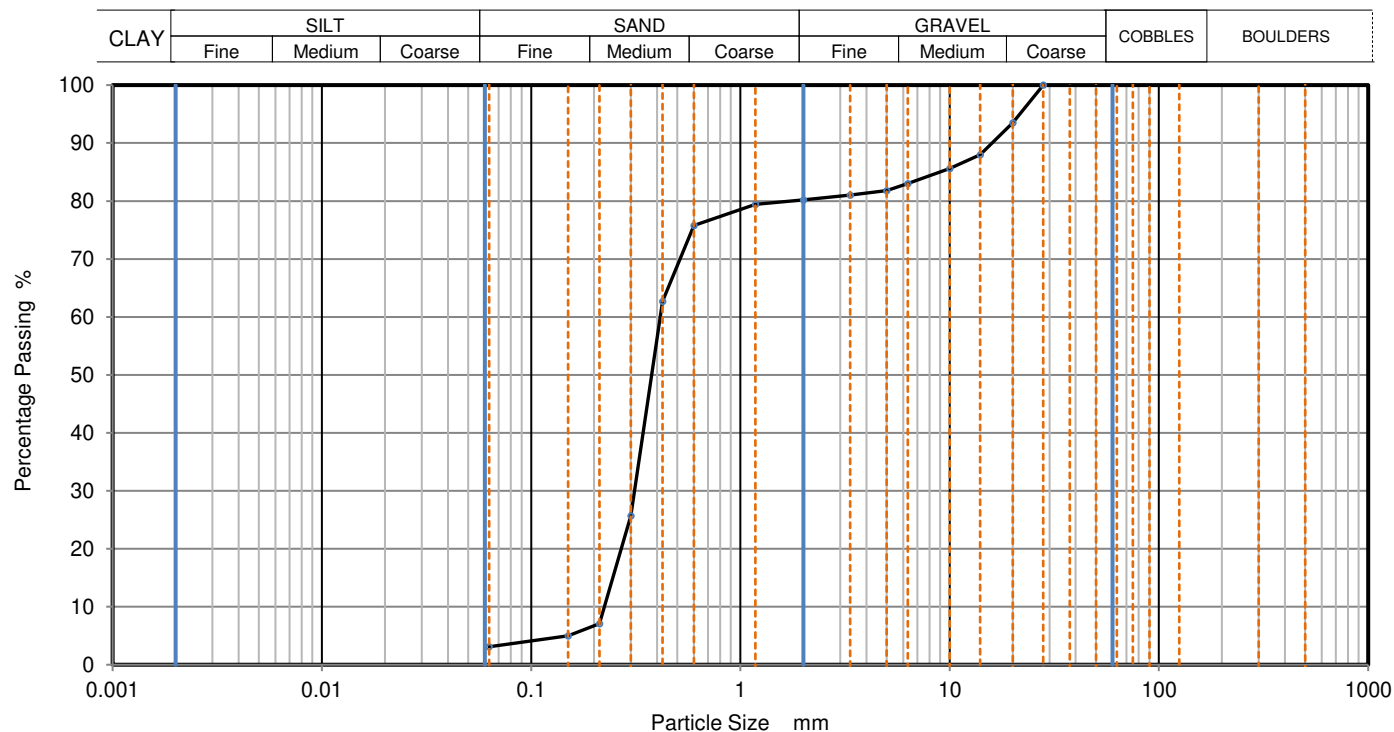
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH04	1.20	B5	Wet Sieve	Brown gravelly SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
28	100		
20	94		
14	88		
10	86		
6.3	83		
5	82		
3.35	81		
2	80		
1.18	79		
0.6	76		
0.425	63		
0.3	26		
0.212	7		
0.15	5		
0.063	3		

Dry Mass of sample, g

1664

Sample Proportions	% dry mass
Very coarse	0
Gravel	20
Sand	77
Fines <0.063mm	3

Grading Analysis		
D100	mm	28
D60	mm	0.414
D30	mm	0.312
D10	mm	0.224
Uniformity Coefficient		1.9
Curvature Coefficient		1.1

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method





Site: Barkers Lane CP School, Wrexham

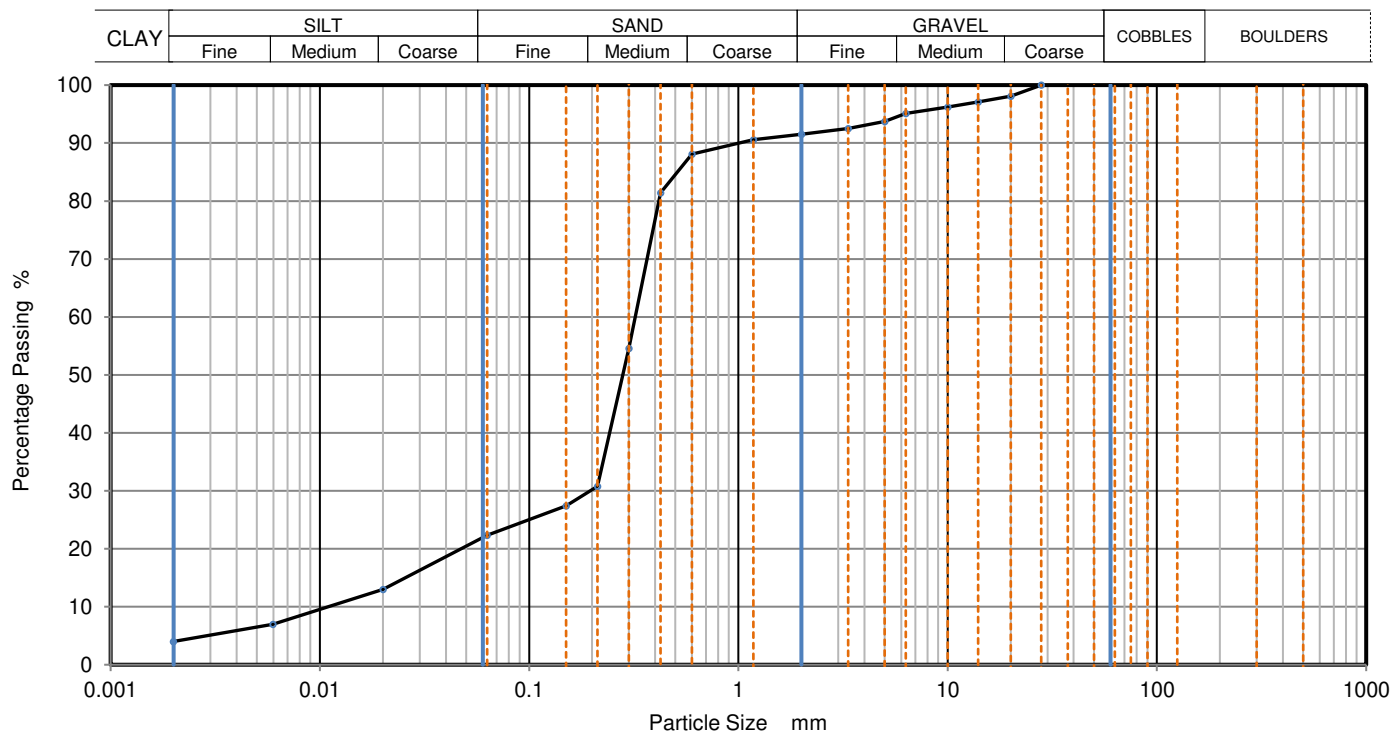
Job Number: 42287

Client: Wrexham County Council

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH04	4.00	B10	Wet Sieve + Pipette	Brown slightly gravelly, silty SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0200	13
		0.0060	7
		0.0020	4
28	100		
20	98		
14	97		
10	96		
6.3	95		
5	94		
3.35	93		
2	92		
1.18	91	Particle density (assumed) 2.65 Mg/m3	
0.6	88		
0.425	81		
0.3	55		
0.212	31		
0.15	27		
0.063	22		

Dry Mass of sample, g

1476

Sample Proportions	% dry mass
Very coarse	0
Gravel	9
Sand	69
Silt	18
Clay	4

Grading Analysis		
D100	mm	28
D60	mm	0.322
D30	mm	0.196
D10	mm	0.0109
Uniformity Coefficient		30
Curvature Coefficient		11

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method
BS1377:Part 2:1990, clause 9.4 Determination of sedimentation by pipette method





Test Report - 42287 / 1

Site: Barkers Lane CP School, Wrexham

Job Number: 42287

Originating Client: Wrexham County Council

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Date: 25/01/2019

F.A.O.

Test Report - 42287A / 1

Site: Barkers Lane CP School, Wrexham

Job Number: 42287A

Originating Client: Wrexham County Council

Originating Reference: 42287

Date Sampled: 03/01/2019

Date Scheduled: 08/01/2019

Date Testing Started: 11/01/2019

Date Testing Finished: 14/01/2019

Remarks:

Authorised By:



Tim Robinson
Quality Technician

Date: 14/01/2019

Page: 2

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Test Report - 42287A / 1

Site: Barkers Lane CP School, Wrexham

Job Number: 42287A

Originating Client: Wrexham County Council

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Date: 14/01/2019

APPENDIX 4
CHEMICAL TESTS

FINAL ANALYTICAL TEST REPORT

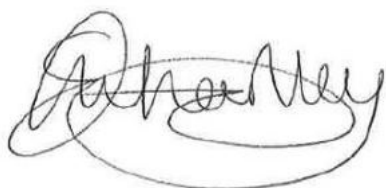
Envirolab Job Number: 19/00104
Issue Number: 1

Date: 18 January, 2019

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

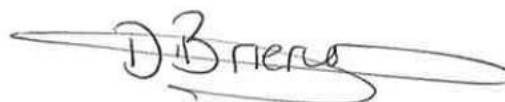
Project Manager: Hannah Hadwin
Project Name: Barkers Lane
Project Ref: 42287
Order No: 45906
Date Samples Received: 08/01/19
Date Instructions Received: 09/01/19
Date Analysis Completed: 18/01/19

Prepared by:



Elisha Hartley
Admin Assistant

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 19/00104

Client Project Name: Barkers Lane

Client Project Ref: 42287

Lab Sample ID	19/00104/1	19/00104/2	19/00104/3	19/00104/4	19/00104/5				Units	Method ref
Client Sample No	3	7	4	6	4					
Client Sample ID	BH01	BH01	BH02	BH03	BH04					
Depth to Top	0.80	1.20	0.50	1.20	1.00					
Depth To Bottom		1.65		1.65						
Date Sampled	04-Jan-19	04-Jan-19	02-Jan-19	03-Jan-19	03-Jan-19					
Sample Type	Soil - ES	Soil - D	Soil - D	Soil - D	Soil - D					
Sample Matrix Code	6A	4A	4A	4A	1					
% Moisture at <40C _A	10.8	-	-	-	-				% w/w	A-T-044
% Stones >10mm _A	19.6	16.7	7.1	<0.1	<0.1				% w/w	A-T-044
pH BRE _D ^{M#}	7.56	7.89	7.52	6.95	7.16				pH	A-T-031s
Sulphate BRE (water sol 2:1) _D ^{M#}	<10	<10	<10	<10	<10				mg/l	A-T-026s
Cyanide (total) _A ^{M#}	<1	-	-	-	-				mg/kg	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	-	-	-	-				mg/kg	A-T-050s
Organic matter _D ^{M#}	2.2	-	-	-	-				% w/w	A-T-032 OM
Arsenic _D ^{M#}	2	-	-	-	-				mg/kg	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	-	-	-	-				mg/kg	A-T-027s
Cadmium _D ^{M#}	0.7	-	-	-	-				mg/kg	A-T-024s
Copper _D ^{M#}	20	-	-	-	-				mg/kg	A-T-024s
Chromium _D ^{M#}	12	-	-	-	-				mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	-	-	-	-				mg/kg	A-T-040s
Lead _D ^{M#}	56	-	-	-	-				mg/kg	A-T-024s
Mercury _D	<0.17	-	-	-	-				mg/kg	A-T-024s
Nickel _D ^{M#}	10	-	-	-	-				mg/kg	A-T-024s
Selenium _D [#]	<1	-	-	-	-				mg/kg	A-T-024s
Zinc _D ^{M#}	45	-	-	-	-				mg/kg	A-T-024s

Envirolab Job Number: 19/00104

Client Project Name: Barkers Lane

Client Project Ref: 42287

Lab Sample ID	19/00104/1	19/00104/2	19/00104/3	19/00104/4	19/00104/5				Units	Method ref
Client Sample No	3	7	4	6	4					
Client Sample ID	BH01	BH01	BH02	BH03	BH04					
Depth to Top	0.80	1.20	0.50	1.20	1.00					
Depth To Bottom		1.65		1.65						
Date Sampled	04-Jan-19	04-Jan-19	02-Jan-19	03-Jan-19	03-Jan-19					
Sample Type	Soil - ES	Soil - D	Soil - D	Soil - D	Soil - D					
Sample Matrix Code	6A	4A	4A	4A	1					
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	-	-	-	-					A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	-	-	-	-					

Envirolab Job Number: 19/00104

Client Project Name: Barkers Lane

Client Project Ref: 42287

Lab Sample ID	19/00104/1	19/00104/2	19/00104/3	19/00104/4	19/00104/5				Units	Method ref
Client Sample No	3	7	4	6	4					
Client Sample ID	BH01	BH01	BH02	BH03	BH04					
Depth to Top	0.80	1.20	0.50	1.20	1.00					
Depth To Bottom		1.65		1.65						
Date Sampled	04-Jan-19	04-Jan-19	02-Jan-19	03-Jan-19	03-Jan-19					
Sample Type	Soil - ES	Soil - D	Soil - D	Soil - D	Soil - D					
Sample Matrix Code	6A	4A	4A	4A	1					
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	-	-	-	-				mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	-	-	-	-				mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	-	-	-	-				mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.05	-	-	-	-				mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.05	-	-	-	-				mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.05	-	-	-	-				mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	-	-	-	-				mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	-	-	-	-				mg/kg	A-T-019s
Chrysene _A ^{M#}	0.06	-	-	-	-				mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	-	-	-	-				mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	-	-	-	-				mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	-	-	-	-				mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.04	-	-	-	-				mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	-	-	-	-				mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	-	-	-	-				mg/kg	A-T-019s
Pyrene _A ^{M#}	0.07	-	-	-	-				mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	0.32	-	-	-	-				mg/kg	A-T-019s

REPORT NOTES

General:

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

All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.

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.

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.

APPENDIX 5
DESIGN CONSIDERATIONS

APPENDIX 5

GEOTECHNICAL DESIGN CONSIDERATIONS

A5.1 ASSESSMENT OF GRANULAR SOIL CONDITION

A5.1.1 SPT 'N' values reported on the borehole logs are as measured in the field with no corrections applied.

A5.1.2 However for general design in sands the 'N' values should be normalised to 60% by the following equation:-

A5.1.3 $N_{60} = E_r/60.N$ where:-

N is the blow count and

E_r is the energy ratio of the specific test equipment

A5.1.4 Further corrections for rod length and overburden pressure in sands may be applied in accordance with BS EN ISO 22476-3, ref 9.6.

A5.1.2 FACTORS OF SAFETY

A5.1.2.1 Cohesive and Non-cohesive Soils

For cohesive and non-cohesive soils a factor of safety of 3 may be used to obtain the allowable or safe carrying capacity of piles from the ultimate carrying capacity.

APPENDIX 6
CONTAMINATION ASSESSMENT

APPENDIX 6

GENERAL NOTES ON CONTAMINATION ASSESSMENT

A6.1 STATUTORY FRAMEWORK AND DEFINITIONS

A6.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 9.10, which was introduced by the Environment Act 1995, ref 9.11;

‘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.’

A6.1.2 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 legislation was originally 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 final guidance document, CLR 11, ref 9.23 was published in 2004. CLR7 to 10 were withdrawn in 2008, with CLR 9 and 10 effectively replaced by the Environment Agency in the form of Science Reports SR2, ref 9.20 and SR3, ref 9.14. CLR11 remains valid and sets out the framework of the investigation process.

A6.1.3 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.

A6.1.4 A ‘pollutant linkage’ may be defined as the link between a contaminant ‘source’ and a ‘receptor’ by means of a ‘pathway’.

A6.2 ASSESSMENT METHODOLOGY

A6.2.1 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.

- A6.2.2 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, ref 9.24. 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.
- A6.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref 9.12. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. In the absence of specific information on contamination anticipated to be encountered, specific DoE 'Industry Profiles' provide guidance on the nature of contaminants relating to a variety of industrial processes and should be used as the basis for determining which contaminants are more likely to be present on a site.
- A6.2.4 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, ref 9.1. 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 generic quantitative risk assessment (GQRA) to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.
- A6.2.5 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.
- A6.2.6 All site works should be in general accordance with the British Standards, BS 5930:2010, ref. 9.2, ISO 1997, ref 9.3 and BS 10175:2011, ref 9.4.
- A6.2.7 The GQRA screens the results of the chemical analysis against generic guidance values, appropriate to the end-use of the site. Soils will be compared to Soil Guideline Values (SGV) where published, Generic Assessment Criteria (GAC) developed by LQM/CIEH, ref 9.16, or internal screening values generated using the Contaminated Land Exposure Assessment (CLEA) Software, Version 1.06, ref 9.17. 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.
- A6.2.8 For many of the contaminants considered, input data has been drawn from the relevant SGV where available, or existing toxicological reports published by the Environment Agency which have not yet been withdrawn/replaced. Fate and transport data has been derived in the first instance from Environment Agency (2008), ref 9.13.

- A6.2.9 Recommendations for tolerable intakes of lead are based on evaluation of the relationship between exposure and blood lead levels. The existing toxicological report for lead considers a health criteria value based on an uptake dose, whereas the CLEA model estimates exposure in terms of an intake dose. At present, the CLEA model is not considered appropriate for determining a screening value for lead. In the absence of a current published assessment criterion, the SGV for lead reported in R&D Publication CLR 10 ref 9.21 have been used in this assessment. This will be updated in due course in light of any further published information.
- A6.2.10 Chemical laboratory test results are processed as follows. A statistical analysis of the results is conducted, as detailed in CIEH and CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref 9.18. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.
- A6.2.11 Initially the distribution of the data set is tested using the Shapiro-Wilk normality test, ref 9.19 to determine if the data set is, or is not, normally distributed. Where the distribution of the data is shown to be normal, the mean value test is applied to determine whether the mean characteristics of the selected soil unit present a significant possibility of significant harm to human health. Where the data is not normally distributed a method based on the Chebychev Theorem can be applied to test the same hypothesis. The significance of the data is further tested using the maximum value test. This determines whether the highest recorded contaminant concentrations are from the same statistical distribution or whether they may represent a 'hot spot'.
- A6.2.12 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.
- A6.2.13 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.
- A6.2.14 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
- A6.2.15 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
- A6.2.16 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A6.3 Generic Guidance Values Used Within Contamination Risk Assessment

Residential End Use without Homegrown Produce

Residential without Homegrown Produce	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
		1% SOM	2.5% SOM	6% SOM	
PAH	Acenaphthene	3000(57.0)	4700(141)	6000(336)	LQM/CIEH S4UL
	Acenaphthylene	2900(86.1)	4600(212)	6000(506)	LQM/CIEH S4UL
	Anthracene	31000(1.17)	35000	37000	LQM/CIEH S4UL
	Benzo(a)anthracene	11	14	15	LQM/CIEH S4UL
	Benzo(a)pyrene	3.2	3.2	3.2	LQM/CIEH S4UL
	Benzo(b)fluoranthene	3.9	4	4	LQM/CIEH S4UL
	Benzo(ghi)perylene	360	360	360	LQM/CIEH S4UL
	Benzo(k)fluoranthene	110	110	110	LQM/CIEH S4UL
	Chrysene	30	31	32	LQM/CIEH S4UL
	Dibenzo(ah)anthracene	0.31	0.32	0.32	LQM/CIEH S4UL
	Fluoranthene	1500	1600	1600	LQM/CIEH S4UL
	Fluorene	2800(30.9)	3800(76.5)	4500(183)	LQM/CIEH S4UL
	Indeno(123-cd)pyrene	45	46	46	LQM/CIEH S4UL
	Naphthalene	2.3	5.6	13	LQM/CIEH S4UL
	Phenanthrene	1300(36.0)	1500	1500	LQM/CIEH S4UL
	Pyrene	3700	3800	3800	LQM/CIEH S4UL
Other Organics	Phenol	750	1300	2300	LQM/CIEH S4UL
Metals	Arsenic	40	40	40	LQM/CIEH S4UL
	Beryllium	1.7	1.7	1.7	LQM/CIEH S4UL
	Boron	11000	11000	11000	LQM/CIEH S4UL
	Cadmium	85	85	85	LQM/CIEH S4UL
	Chromium (III)	910	910	910	LQM/CIEH S4UL
	Chromium (VI)	21	21	21	LQM/CIEH S4UL
	Copper	7100	7100	7100	LQM/CIEH S4UL
	Lead	310	310	310	EA C4SL
	Mercury	1.2	1.2	1.2	LQM/CIEH S4UL
	Nickel	180	180	180	LQM/CIEH S4UL
	Selenium	430	430	430	LQM/CIEH S4UL
	Vanadium	1200	1200	1200	LQM/CIEH S4UL
	Zinc	40000	40000	40000	LQM/CIEH S4UL

Residential without Homegrown Produce	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
	1% SOM	2.5% SOM	6% SOM	
Aliphatic				
EC 5-6	42	78	160	LQM/CIEH S4UL
EC >6-8	100	230	530	LQM/CIEH S4UL
EC >8-10	27	65	150	LQM/CIEH S4UL
EC >10-12	130 (48)	330 (118)	760 (283)	LQM/CIEH S4UL
EC >12-16	1100 (24)	2400 (59)	4300 (142)	LQM/CIEH S4UL
EC >16-35	65000 (8.48)	92000 (21)	110000	LQM/CIEH S4UL
EC >35-44	65000 (8.48)	92000 (21)	110000	LQM/CIEH S4UL
Aromatic				
EC 5-7 (benzene)	370	690	1400	LQM/CIEH S4UL
EC >7-8 (toluene)	860	1800	3900	LQM/CIEH S4UL
EC >8-10	47	110	270	LQM/CIEH S4UL
EC >10-12	250	590	1200	LQM/CIEH S4UL
EC >12-16	1800	2300 (419)	2500	LQM/CIEH S4UL
EC >16-21	1900	1900	1900	LQM/CIEH S4UL
EC >21-35	1900	1900	1900	LQM/CIEH S4UL
EC >35-44	1900	1900	1900	LQM/CIEH S4UL
Aliphatic and Aromatic				
EC >44-70	1900	1900	1900	LQM/CIEH S4UL
BTEX				
Benzene	0.38	0.70	1.4	LQM/CIEH S4UL
Toluene	880	1900	3900	LQM/CIEH S4UL
Ethylbenzene	83	190	440	LQM/CIEH S4UL
m Xylenes	79	180	430	LQM/CIEH S4UL
p Xylenes				
o Xylene	88	210	480	LQM/CIEH S4UL

SOM = Soil Organic Matter

Values in brackets indicate the solubility or vapour saturation limit where this is exceeded by the GAC

sol = S4UL's presented exceed the solubility saturation limit

vap = S4ULS's presented exceed the vapour saturation limit

