

STRATA SURVEYS LIMITED

GROUND INVESTIGATION REPORT

Report No. 15612

Proposed Primary Sub-Station

Birchall Way

Birley Fields

Issue : Final

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Report No. 15612

Proposed Primary Sub-Station

Birchall Way

Birley Fields

for

Electricity NorthWest

requested by

JAB Design
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1. INTRODUCTION

This report sets out the results of the field work and laboratory testing for a ground investigation carried out by Strata Surveys Limited for Electricity NorthWest Limited at the request of JAB Design

The works were carried out under the instruction given in the email instruction from JAB Design

The investigation was required in connection with the construction of a new primary substation.

A Desk Study Phase 1 Risk Assessment Report was prepared for the previous selected site location that lies immediately south of the new location. This report should be read in conjunction with the Phase 1 Risk Assessment Report (SSL 15153 August 2011)

The object of the investigation was to obtain information on the ground conditions and soil properties for use in the design and construction of foundations on the site and for the initial assessment of the potentially contaminated soil risk.

The ground investigation has been carried out in accordance with the relevant standards for ground investigation. Details of the relevant standards are given in the references to this report.

2. SITE DESCRIPTION

The new study area (outlined in orange) has until recently been used as the contractors compound for the works on refurbishment of social housing in the area.

The site is partially covered with crushed limestone and partially rough grassed. There is a mound of what is presumed to be construction / demolition spoil running across the southern boundary of the



The previous study site outlined in pink (SSL Report 15153) has a full Phase 1 Risk Assessment and Geo-Environmental Investigation presented in two volumes in September 2011.

3. ENVIROCHECK REPORT©

The original Envirocheck© report is appended as a separate volume to this document.

The Envirocheck© report is a compilation of

1. Historical Ordnance Survey plans from 1:105600, 1:2500 and 1:1250 scales
2. Public environmental records from Environment Agency, British Geological Survey, Manchester City Council.
3. Flooding information and river quality information from Environment Agency
4. Landfill sites from British Geological Survey and Environment Agency.
5. Hazard substances storage and uses information from HSE and Manchester City Council.
6. Geological Information from British Geological Survey
7. Sensitive land uses from Manchester City Council. Countryside Agency , English Nature and DEFRA

Industrial Land uses from Thompsons Directory and Catalist Ltd

4. HISTORICAL SETTING

The 1851 1:500 Town Plan shows the location and shows the general area in dense back to back terraced housing. With Upper Medlock Street on the east, Warde Street on the south.

The current study area at this stage is open undeveloped.

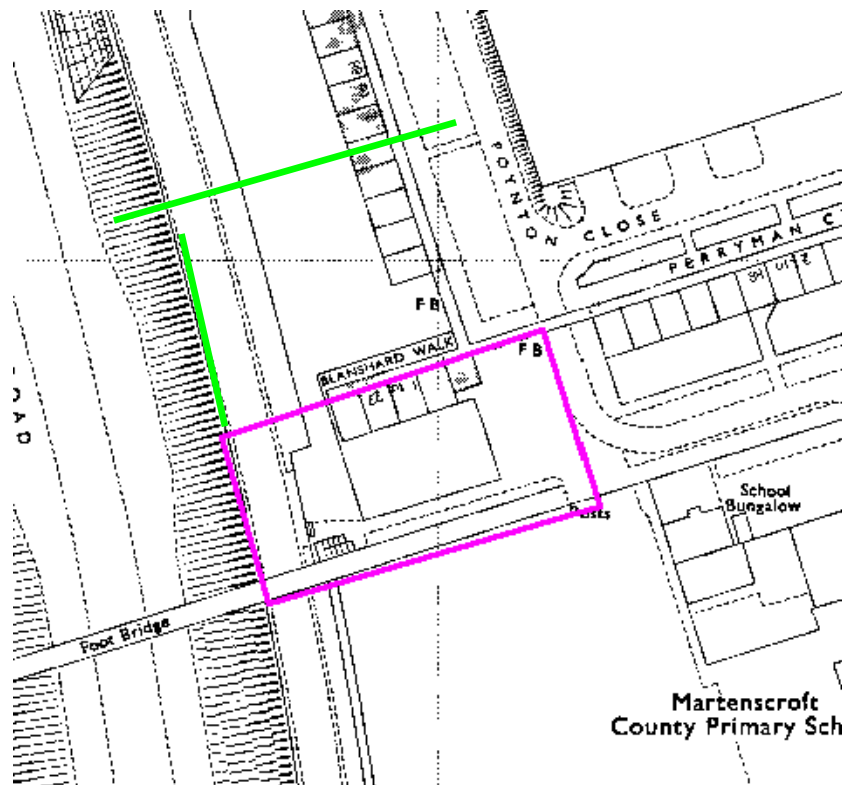


The 1893 plan shows the study site area now occupied by terraced housing.

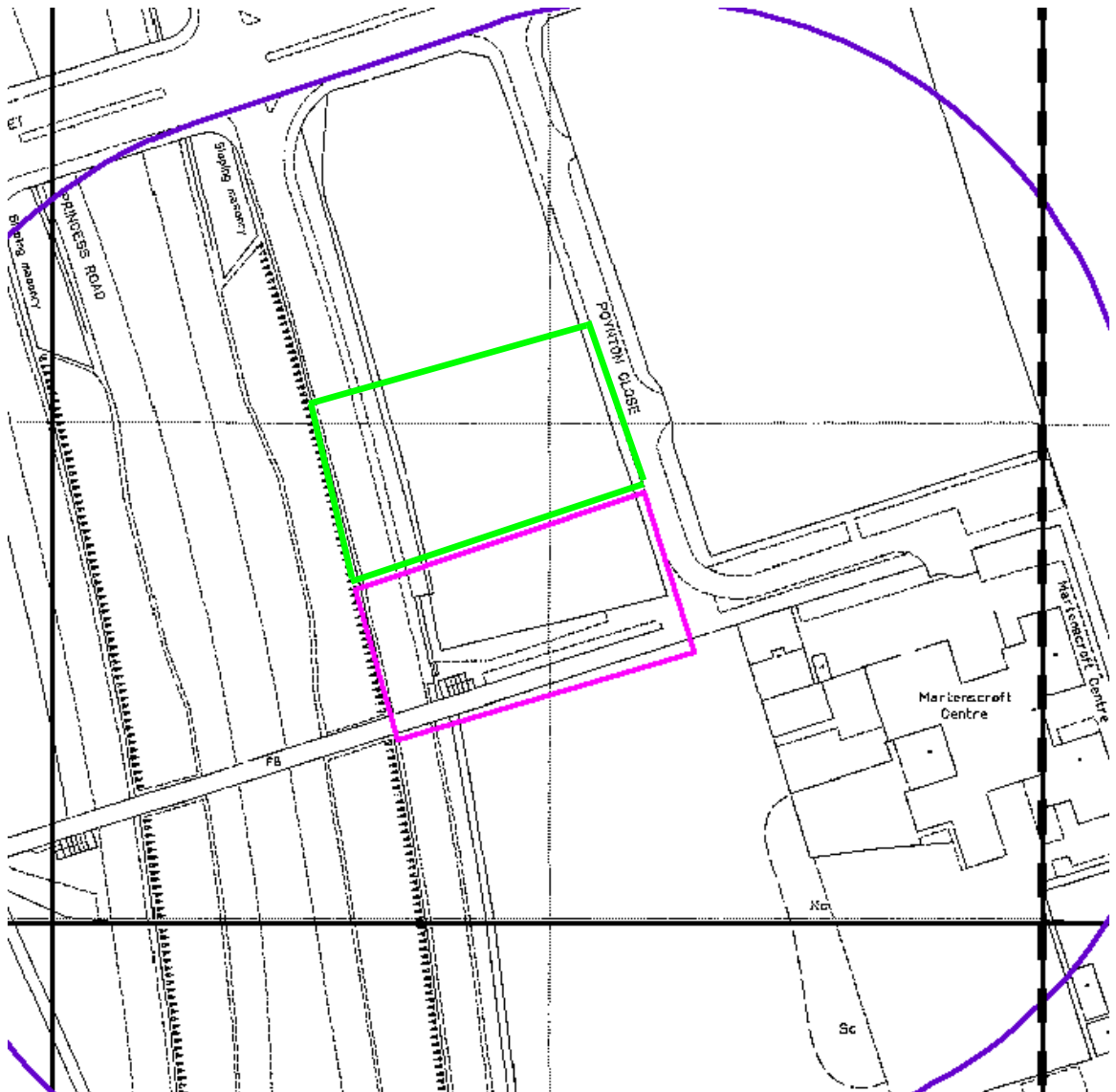


There are no changes on any plan up to 1956.

The 1973 plan shows that the whole street plan has been obliterated, along with the major part of Upper Medlock Street. The northern part of the site is housing on Blanchard Walk, the rest open. There are a line of lockup garages within the eastern part of the site. The western boundary is formed by Princess Parkway (A5103).



The 1995 map shows that the 1970s housing has been removed.



The later mapping shows no changes to the site.

5. ENVIRONMENTAL ISSUES.

There are no database references within the site boundary.

The site is in an area where less than 1% of homes are above the action level for radon, therefore no radon protection measures are necessary.

The site is not with an area of sensitive land use.

The site is not located within an area at risk from flooding from rivers with out or with defences.

The following table is an extract of the geological details of the Envirocheck© report.

Coal Mining Affected Area	Not in an area which is affected by coal mining
Shallow Mining Hazards	No Hazard
Potential for Collapsible Ground Stability Hazards	No Hazard
Potential for Compressible Ground Stability Hazards	No Hazard
Potential for Ground Dissolution Stability Hazards	No hazard
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Very Low
Potential for Shrinking or Swelling Clay Ground Stability Hazards	Very Low
Mining Instability	Low risk
Radon	Less than 1% of homes are affected by Radon. No Radon Protection measures are required.

RISK ASSESSMENT FOR GAS HAZARD

The site has been assessed using the criteria given in BS8485 “Code of Practice for characterisation and remediation from ground gas in affected developments”, CIRIA Report 659 “Assessing risks posed by hazardous ground gases” and NHBC Report 04-2007 “Guidance on the evaluation of development proposals on sites where methane and carbon dioxide are present”

The site is not located in an area that will be affected by any recorded or registered landfill site. The site has been covered with terraced housing shown on maps from the mid 19th century.

Thus there is minimal risk of harmful ground gases affecting the proposed development. It is expected that the historical development would have included cellars, infilled by demolition debris from the 1970s clearances.

RISK ASSESSMENT FOR HUMAN HEALTH

The site is to be developed for an electricity sub-station, with partially underground building, with the area provided with security fencing. Thus there will be minimal risk to human health of users of the site post development.

RISK TO CONTROLLED WATERS

The site lies on Principal Aquifer (bedrock) and source protection zone for the adjacent brewery groundwater abstraction. The previous land use has been residential and thus there is minimal risk that the historical land use will pose a risk to both the bedrock aquifer or the drift aquifer.

6. SITE GEOLOGY

The published British Geological Survey (BGS) map for Manchester Sheet Number 85 shows the site is underlain by:

- ♦ Drift Geology: Glacial Fluvial Sand and Gravel in a general sweep of Glacial Till (Boulder Clay. As noted above the site has been developed over the years as dense terraced housing and then more open housing thus there will be urban Made Ground.
- ♦ Bedrock Geology. Sherwood Sandstone (Triassic Age). Comprises Sandstone, red, yellow and brown, part pebbly; subordinate red mudstone and siltstone.
- ♦ The bedrock forms a Principal; Aquifer (EA designation).

7. FIELDWORK

The fieldwork was carried out during the period from 21st February 2013 to 23rd February 2013 and consisted of boring three 150mm diameter boreholes to depths of 6.0m below the existing ground surface level using shell, clay cutter and light cable percussion techniques. A CAT services screen was undertaken followed by a hand excavated services pit.

Undisturbed 100mm diameter samples were taken in the cohesive strata¹(OS-T/W(100mm with liner). Standard penetration tests were carried out, in accordance with BS EN ISO 22476-3:2005 (formerly BS 1377 Part 9:1990), in the granular strata and in the cohesive strata, which were too hard to sample by the 100mm diameter method. Selected disturbed samples and bulk samples were also taken and together with the undisturbed samples and samples from the standard penetration tests returned to our laboratory for inspection and testing as appropriate. Groundwater samples were obtained where ground conditions allowed.

Detailed results of the strata met, depths and levels of changes, thickness of strata, samples taken, groundwater observations and standard penetration test (SPT) (Continuous Dynamic Sampling (CDSa) N₃₀₀) values from the dynamic penetration tests are given on the borehole record sheets in Appendix 2.1. The detailed results of the Standard Penetration Test (SPT) are presented in the table in Appendix 2.2

Gas Monitoring wells were installed in boreholes BH02 with a response zone from 1.0m to 4.0m. The results of soil gas monitoring are given in Appendix 2.3.

The positions of the boreholes are given on the Borehole Location Plan in Appendix 4.

A Site Location Plan is given in Appendix 5.

Ground levels at the borehole were not available for the compilation of this report.

Appendix 1 contains statements of the Terminology used in

Soil Descriptions

Concrete in Aggressive Conditions

Standard Penetration Tests

¹ The current UK standard U100 sampler is placed into the Quality Class B-¾ BS EN 224475-1 for laboratory testing

8. LABORATORY TESTING

A testing programme was agreed with the project engineer and the tests were carried out as specified by B.S. 1377:1990 Methods of Test for Soils for Civil Engineering Purposes.

The following tests were undertaken:-

Soluble Sulphate Content of Soil	2
pH Value	2

Alcontrol Laboratories carried out chemical contamination tests on 4 selected samples.

Comprehensive – Suite 1	SOIL LOD mg/kg	2
Total Metals : As, Cd, Cr, Pb,Hg,Se,Cu,Ni,Zn	1	
Water Soluble Boron (1)	1	
Hexavalent Chromium	0.1	
Total Cyanide	2.5	
Free Cyanide	2.5	
Thiocyanate	1	
Total Sulphate2	50	
Sulphide	5	
Total Sulphur	0.01%	
pH	2dp	
PAHs - 16 USEPA Priority Pollutants by GC	0.05	
Phenols	0.01	
Suite 2 - Speciated Total Petroleum Hydrocarbon (TPH)	0.01-1	
Suite 3 - Total Petroleum Hydrocarbon (TPH)Screen	0.1	2
Suite 6 - Asbestos	Visual	2
Suite 8 - Waste Acceptance Criteria (WAC)	-	1

9. SUMMARY OF GROUND CONDITIONS

The boreholes, CDSa (continuous dynamic sampling), show the following sequence of strata.

Made Ground	Comprising the crushed limestone gravel of the contractor's compound which overlies mixed cohesive fill with broken tile, broken brick and concrete fragments. With a granular fill of sand gravel and black ash. The thickness ranges from 0.5-1.20m There is no evidence of deep infilled cellars noted on the adjacent site.
Glacial Sand	Medium dense becoming dense fine-medium subangular gravelly fine-coarse grained Sand. From a depth of 0.5m at BH01, 1.20m at BH02 and 1.40m at BH03. Extends to 3.2-4.3m.
Glacial Clay	Very stiff laminated sandy gravelly CLAY some coal fragments.

No groundwater was encountered in any of the boreholes.

Three shallow hand excavation were carried out on the spoil mound at the southern end of the site. The trial pits all encountered a heterogeneous mix of broken brick brown ash brown slightly clayey sandy topsoil.

10. GEOTECHNICAL ASSESSMENT

The proposed primary sub-station will adopt a conventional approach with the principal chamber circa 1.5-2.0m below current ground surface. The conventional construction approach will be to excavate to formation level in battered sided excavation.

The boreholes show that there is relatively deep Made Ground, possibly infilled grubbed out footings at BH02 and BH03, where there is cohesive fill with broken brick and concrete to 1.20m and 1.4m respectively. BH01 has 0.5m of granular Made Ground. There is no evidence in the boreholes of the deep brick infilled cellars noted on the adjacent site.

The Made Ground overlies medium dense slightly clayey and clayey gravelly fine-coarse grained Sand with an Standard Penetration Test N values in the range 10-39.

From a depth in the range 3.2-4.3m is stiff and very stiff laminated sandy gravelly CLAY. Triaxial tests undertaken in the Clay below the sand had a Undrained Cohesion in the range 80-160kN/m².

We consider that the conventional reinforced concrete slab can adopted. The allowable bearing pressure should be limited to 150kN/m².

The formation should be carefully inspected and where necessary proof rolled prior to placing the blinding layer. If there is deep brick filled cellars we consider that the area should be rolled to identify hotspots and then a minimum of 300mm of compacted Type1 sub-base is placed.

The borehole investigation and subsequent monitoring of the well installed in BH2 shows that there is no shallow, perched, groundwater.

The excavation stability must be assessed during excavation and the pit excavation where unstable should have the side slope flattened or trench support systems used.

Concrete in Aggressive Ground

With reference to BRE Special Digest 1 the site should be considered as brownfield with static groundwater.

The testing for sulphates shows low concentration of soluble sulfate in the Made Ground with soluble sulfate in the range 16.5-53.5mg/l and a pH in the rang 6.9-7.4.

Therefore the Site Design Sulphate Class is DS1 and the Aggressive Chemical Environment for Concrete (ACEC) is AC1s.

11. CONTAMINATION ASSESSMENT

CONTAMINATED SOIL

The current legislation for the assessment of Contaminated Land is Part IIA of the Environmental Protection Act (1990) Contaminated Land Regime and the development controls of the relevant Town and Country Planning acts. EA/DEFRA has produced four reports and assessment software to assist in the assessment of the potential harmful effects of contaminated land to the users of the land and the risk to the general environment. The EA/DEFRA has withdrawn all published SGV (Soil Guidance Values) for certain target compounds and contaminants and these are used for a Generic Risk Assessment. Updated TOX reports have been issued.

For assessment of the results of contamination tests we make reference to the AtriskSoil© commercial database for Generic Assessment Criteria (GAC). Atkins have derived AtriskSoil© Generic Assessment Criteria (Site Screening Value) based on the 2009 SC050021/SR3 "Updated background to the CLEA model and SC050021/SR2 (the TOX report) for commercial/industrial, residential without plant uptake and residential with plant uptake. We have based these on the default assumptions provided in the CLEA report which we understand will be used in development of the Soil Guideline Values by Defra and the Environment Agency.

In the assessment of the results of testing comparisons to publish Generic Assessment Criteria from EA published SGV (Soil Guidance Value) for certain target compounds and the Atkins AtriskSoil© database of Generic Assessment Criteria's (GAC).

The disposal of construction spoil that is considered waste will need to be assessed in line with current Land Fill regulations. The Landfill (England and Wales) (Amendment) Regulations 2004 have introduced a set of analysis requirements for the classification of waste into

- Inert Waste
- Non-reactive hazardous Waste
- Hazardous Waste.

If excavation spoil is to be taken off site for disposal additional testing for the Waste Acceptance Criteria will be required.

This investigation of contaminated soil must only be considered as the preliminary phase of works where there is an identified contamination hazard. The results of the analyses of a sample can only be relied on as evidence as to what is in the sample and not what may be in the surrounding or adjacent area. Additional works may be necessary to assess the hazard of any contamination on site and the local environmental impact. Additional investigation may be necessary to evaluate the extent and hence volume of any contaminated soil. The assessment of the contaminated soil must take account of the limited access as part of the of the contamination investigation.

Two soil samples were selected for routine Human Health Risk Assessment screening with one sample selected for a Total Petroleum Hydrocarbons screen and Asbestos Fibres Visual Screen. Two aggregated samples were taken from samples which were recovered from shallow excavations in to the mound located at the southern end of the site. The pits showed a heterogeneous mix of broken brick brown ash brown slightly clayey sandy topsoil. From the aggregated sample a full Waste Acceptance Criteria tests and a Asbestos Fibres Visual Screen test was undertaken.

In summary:

- No asbestos fibres were identified in the samples selected for test
- Total Petroleum Hydrocarbons C6-C40 are low 245-385mg/kg
- Benzene -Toluene - Ethyl benzene – Xylene are very low at or about laboratory Level of Detection
- PolyChlorinatedBiphenyl (PCB) is less than laboratory Level of Detection
- Total Organic Content (TOC) is high at 4.18 - 5.43% Loss on Ignition (LOI) is high at 13.5%
- Total Poly-Aromatic Hydrocarbons (PAH) is Low at 41mg/kg
- Totals Metal Content – generally low (see summary table below).
- Speciated Poly-Aromatic Hydrocarbons (PAH) results are low-moderate (see summary table below).
- Waste Acceptance Criteria results show the samples selected for test from the spoil mound are not inert due to exceedances of Organic Content (Total Organic Content (TOC) and Loss on Ignition (LOI). The other criteria of the WAC test are below published the Inert Limits. The Waste of the spoil pile will be classed as NOT-INERT. The waste carrier should confirm the suitability of the landfill site selected for disposal and confirm the landfill class of the spoil

Human Health Risk Assessment Commercial Summary. Full test certificates are presented in the Appendices.

Two Samples	Minimum and Maximum mg/kg	CLEA Commercial 6% Soil Organic Material Soil Guidelines Values (SGV) and Atkins Generic Assessment Criteria Greater than SGV or Generic Assessment Criteria mg/kg Y = value exceeds the GAC Y = value is less than GAC	
Arsenic	12-24	Y	640
Barium	104-231		
Beryllium	0.664		1010
Boron (water-soluble)	0.5 – 1.0		
Cadmium	<0.5	Y	230
Chromium	16-46	Y	213000
Chromium VI	<0.6	Y	330
Copper	41-74	Y	109000
Lead	149-259	Y	6490
Mercury	<0.14 – 0.51	Y	26
Nickel	15-18	Y	1800
Selenium	<1	Y	13000
Vanadium	20 - 24	Y	7350
Zinc	80-151	Y	<=1kg/kg
SO4(Total)	393-532		
Sulphide	<15		
Cyanide(Total)	<10	Y	34
Phenols(screen)	<1	Y	3200
pH	7.3 – 8.2	5-9 *	
Asbestos Fibres Visual Assessment	No fibres detected in 3 sample		
Total Petroleum Hydrocarbons Screen C6-C40	248-385		

	Minimum and Maximum	CLEA Commercial 6% Soil Organic Matter. Soil Guidelines Values (SGV) and Atkins Generic Assessment Criteria Y = value exceeds the GAC Y = value is less than GAC mg/kg	AtriskSoil© Generic Assessment Criteria mg/kg
Acenaphthene	0.2-0.4	Y	106000
Acenaphthylene	0.04-3.02	Y	
Anthracene	0.06-4.43	Y	545000
Benzo(a)Anthracene	0.3-6.69	Y	142
Benzo(a)Pyrene	0.3-6.0	Y	14.4
Benzo(b/k)Fluoranthene	0.4-5.3 0.12-2.3	Y	1440
Benzo(ghi)Perylene	0.2-3.0	Y	1450
Chrysene	<0.3-5.7	Y	14300
Dibenzo(ah)Anthracene	0.05-0.7	Y	14.4
Fluoranthene	0.4-18	Y	72700
Fluorene	0.03-2.6	Y	72100
Indeno(123-cd)Pyrene	0.18-2.4	Y	144
Naphthalene	0.07-0.9	Y	22700
Phenanthrene	0.3-20		
Pyrene	0.4-15	Y	545000
PAH(total)	3-97		

Benzene Toluene Ethyl benzene Xylene (BTEX) and Speciated TPH

Compound	Result for single sample mg/kg	CLEA Commercial 6% Soil Organic Matter. Soil Guidelines Values (SGV) and Atkins Generic Assessment Criteria Y = value exceeds the GAC Y = value is less than GAC	GAC mg/kg for no free phase
Benzene	<0.01	Y	95
Toluene	0.002	Y	420000
Ethylbenzene	<0.003	Y	185000
o-Xylene	<0.003	Y	320000
m- p Xylene	<0.006	Y	310000
Total Petroleum Hydrocarbons C6-C40 C10-C25 C25-C40	245-285< 86 299	DRO <10ug/kg PRO 10ug/kg MRO <10ug/kg	
Mineral Oil C10-C40	45		

PolyChlorinatedBiphenyl (PCB)

PCB Congeners 4 samples	Mg/kg
PCB 28	0.006
PCB 52	<0.003
PCB 101	<0.003
PCB 118	<0.003
PCB 153	<0.003
PCB 138	<0.003
PCB 180	<0.003

SGVs represent 'intervention values'; and provide indication that soil concentrations above this level might represent an unacceptable potential risk to the health of site-users, depending on land-use and that further investigation and possibly remediation is required (copper and zinc are known to be phytotoxic in nature and not covered under CLEA). Atkins has developed Generic Assessment Criteria applicable to the UK for common contaminants not currently covered by SGVs issued by Defra and the Environment Agency. Full justification is provided to support their use.

PLEASE NOTE

These values are provided exclusively for the use of subscribers to www.atrisksoil.co.uk. In accordance with the terms and conditions of the atrisksoil website the information is for the sole use of the user and by receiving or obtaining any information contained herein the user agrees that at all times they will keep secret and confidential and shall procure and safeguard that their directors and employees keep secret and confidential all business and trade secrets and any information of a confidential nature relating to the processes, affairs, methods, and data belonging to Atkins Limited which they may have received or obtained in the performance of or otherwise as a direct or indirect result of entering into any agreement with Atkins Limited.

SOIL GASES

The site has been assessed using the criteria given in BS8485 "Code of Practice for characterisation and remediation from ground gas in affected developments", CIRIA Report 659 "Assessing risks posed by hazardous ground gases" and NHBC Report 04-2007 "Guidance on the evaluation of development proposals on sites where methane and carbon dioxide are present"

The site was formerly residential housing dating from the late Victorian period. There have been at least two further sets of housing in the area. Latterly the site has been used as a construction compound associated with refurbishment works on the nearby social housing.

There are no recorded or registered landfill sites in the immediate locality.

We consider that there is minimal risk of harmful ground gases that would prevent the construction of the substation below ground structure.

BH02-15612 encountered Made Ground (sandy clayey matrix with broken brick and concrete to 1.20m overlying medium dense natural sand and gravel. Monitoring was undertaken 2nd April 2013 and the results show there are no harmful ground gases.

Monitoring was undertaken on 15153-BH02 on the previous investigation which over three visits showed no methane and with carbon dioxide at 0.1% on one visit. This monitoring well was installed in one of the deep brick rubble filled cellars.

We do not consider there needs to be any special precautions for the structure. Any man entry below 1.0m should be checked with a Personal Gas Safety Alarm.

STANDARD REFERENCES

British Standards Institute (1999) BS 5930:1999, Code of practice for site investigations. Incorporating Amendment No. 2:2010 as partially replaced by:

BS EN 1997-2:2007: Eurocode 7. Geotechnical design. Ground investigation and testing

BS EN ISO 22475-1:2006: Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution

BS EN ISO 14688-1:2002: Geotechnical investigation and testing. Identification and classification of soil. Identification and description

BS EN ISO 14688-2:2004: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification

BS EN ISO 14689-1:2003: Geotechnical investigation and testing. Identification and classification of rock. Identification and description

BS EN ISO 22476-2:2005: Geotechnical investigation and testing. Field testing. Dynamic probing

BS EN ISO 22476-3:2005: Geotechnical investigation and testing. Field testing. Standard penetration test

B.S. 1377:1990 Methods of Test for Soils for Civil Engineering Purposes.

APPENDIX 1

STANDARD STATEMENTS

Terminology used in Soil Descriptions

Standard Penetration Tests

Concrete in Aggressive Conditions

Terminology Used in Soil Descriptions

The procedure and principles given in BS EN ISO 14688 part 1 & 2 and the amended BS 5930 (1999) Revision Section 6 in accordance to have been adopted in producing the soils description contained in this report.

A soil's characteristics are based on the particle size grading of the coarser particles and the plasticity of the finer particles. The classification is therefore based on the following.

While describing a soil the main characteristics should be preferably stated in a standard word order, however the word order can be adjusted if required for clarity.

a) Mass characteristics	b) Material characteristics	c) Stratum Name
1a) Relative density / consistency	1b) Colour	1c) Geological formations, age and type of deposit where possible
2a) Discontinuities	2b) Particle shape, size grading and composition.	
3a) Bedding	3b) Soil name (capital e.g. SAND), based on grading and plasticity.	

Mass Characteristics

Strength scale for fine and coarse soils is as follows:-

Term used for coarse soils	SPT N Values blows/300mm	Consistency terms	Consistency description	Terms based on Measurement for fine soils	Undrained strength kPa
Very loose	0 to 4	Very soft	Finger easily pushed in up to 25mm, Exudes between fingers.	Extremely low	<10
Loose	4 to 10	Soft	Finger pushed in up to 10mm. Moulds by light finger pressure	Very low	10 – 20
Medium dense	10 to 30	Firm	Thumb makes impression easily. Cannot be moulded by fingers rolls in the hand to a 3mm thick thread without breaking or crumbling	Low	20 – 40
Dense	30 to 50	Stiff	Can be indented slightly by thumb. Crumbles in rolling a 3mm thick thread but can be remoulded into a lump	Medium	40 – 75
Very Dense	over 50	Very Stiff	Can be indented by thumb nail. Cannot be moulded but crumbles under pressure	High	75 – 150
		Hard	Can be scratched by thumbnail	Very high	150 – 300
				Extremely high/ Extremely weak mudstone	300 - 600

Relative density of sands and gravel may only be determined by the standard penetration test scale in terms of N-Values, however it should not be used for very coarse soils. The use of empirical relationships between standard penetration test 'N' values and strength of fine soils may also be useful but should not be used to provide strength descriptors on field records.

An undrained strength can be given on the field record when measurement of the undrained shear strength is made in the field by hand vane or in the laboratory by triaxial test.

Silts depending on their grading, may behave either as a coarse soil or fine soil; consistency term (density/strength) shall be used accordingly.

Description of Discontinuities and Bedding.

When describing discontinuities the type should be stated e.g. fissures, faults, shear planes and the spacing detailed as below. Their persistence, openness and surface texture (e.g. rough, smooth, polished, striated) should be described and where possible orientation and trend should be stated.

Discontinuities Scale of spacing	Mean Spacing mm	Other qualifying terms for Discontinuities	Bedding Scale of bedding	Mean Thickness mm	Other qualifying terms for Bedding
Very Widely	Over 2000	Fissured:- breaks in blocks along unpolished Discontinuities.	Very thickly bedded	Over 2000	Inter bedded Alternating layers of different types
Widely	2000 to 600	Sheared:- breaks in blocks along polished discontinuities.	Thickly bedded	2000 to 600	Interlaminated Prequalified by thickness term if in equal proportions.
Medium	600 to 200		Medium bedded	600 to 200	
Closely	200 to 60		Thinly Bedded	200 to 60	
Very Closely	60 to 20		Very thinly bedded	60 to 20	
Extremely Closely	under 20	Spacing terms also used for distance between partings, isolated beds or laminae, desiccation cracks roots etc	Thickly laminated	20 to 6	
			Thinly Laminated	under 6	Otherwise thickness of and spacing between subordinate layers defined.

Terminology Used in Soil Descriptions - cont.

Material Characteristics of Soils.

Material characteristics refer to those characteristics that can be described from visual and mutual examination of disturbed or undisturbed samples. Characteristics include colour, particle shape, particle grading and particle composition.

Colour

Colour given should be an overall impression. Colour differences can be emphasised separately by the use of terms such as spotted, mottled, streaked or multi-coloured. Details of colours are given below:-

Tertiary descriptor- Light / Dark

Secondary descriptor- Pinkish, reddish, yellowish, orangish, brownish, greenish, bluish, greyish

Primary descriptor- Pink, red, yellow, orange, brown, green, blue, white, grey, black

(Changes due to oxidization, desiccation for example should be noted.)

Particle Shape:-

The recommended terms to describe particle shape of gravel size or larger particles are as follows

Angularity	Form	Surface texture.	
Very- angular			
Angular	Flat / Tubular	rough	The surfaces of the particles may be described for example as etched, pitted, honeycombed or polished
Sub-angular	elongated	smooth	
Sub-rounded	cubic		
Rounded			
Well rounded			

Particle Grading:-Coarse: The distribution of particle sizes within sands and gravel should be described stating predominant size fraction present e.g. fine to medium SAND. Subangular elongated smooth fine gravel. Absence of these adjectives means that they are all present in roughly equal proportion.

Very Coarse: The proportion of cobbles in a boulder deposit (or visa-versa) may be quantified using the terms with a little, with some, or with much; very coarse soils with secondary finer material (coarse and fine soil) should be described likewise e.g. COBBLES with much sandy CLAY.

Finer material (coarse and fine soil) with very coarse secondary fraction should be described as follows

Fraction	Percentage by mass	Term
Boulders	< 5	Low boulder content
	5 to 20	Medium boulder content
	> 20	High boulder content
Cobbles	< 10	Low boulder content
	10 to 20	Medium boulder content
	> 20	High boulder content

It is recommended that the dominant secondary fraction comes immediately before the principal soil term. To avoid ambiguity, if any of the constituent sizes require qualifying adjectives, these should be added in separate sentences after the main description; such as the estimated percentage proportion or consistency,

e.g." Gravelly very clayey SAND. Gravel (10%) is fine of rounded quartz. Clay is firm".

Principal Soil Type and Secondary Constituents.

The soil name is based on particle size of the coarse fraction and/or the plasticity of the fine fraction

The basic soil types and their subdivisions are defined by the range of their particle sizes as shown.

Soil Group.	Particle Size	Principal Soil	Term Before	Principal Term	Term After	Approx. % Secondary Constituent
Very Coarse	>630	LARGE BOULDERS BOULDERS COBBLES		BOULDER	With a little cobbles Or gravel or sand	<5
	200				With some sand	5-20
	63			COBBLES	With much boulders	20-50
	Coarse 20 Medium 6.3 Fine 2	GRAVEL	Slightly clayey Or silty or sandy (Very gravelly*)	SAND GRAVEL		> 5 5 - 20 >20
Coarse Soils (over about 65% Sand and Gravel)	Coarse 0.63 Medium 0.2 Fine 0.063	SAND	* or describe as a fine soil depending on assessed engineering behavior	SAND and Gravel	and(sand*) or and (Gravel*)	about equal proportions
Fine Soil Over 35% silt And clay size) t	Coarse 0.02 Medium 0.0063 Fine 0.002	SILT	(Sandy*) or gravelly	CLAY** Or SILT		<35 35-65 >65
		CLAY/SILT CLAY	(Very Sandy*) or gravelly			

* describe as coarse soil depending on assessed engineering behavior. ** Can be silty CLAY or clayey SILT.

Fines soils:- contain 35% or more of fine material (omitting boulder and cobbles) is described as CLAY or SILT depending on the plasticity. With less than 35% fine material it is described as a coarse material SAND or GRAVEL. The description of plasticity may be carried out using terms provided in BS EN ISO14688-1 2002

The description of 'finer material' is made ignoring the very coarse fraction; descriptions with cumulative proportions of various fractions, excluding cobbles and boulders, exceeding 100% are incorrect.

Coarse soils:-

Very coarse soils:-

For mixtures involving very coarse soils, the principal soil type name in the fine material may also be given in capital letters, e.g. COBBLES with some sandy CLAY

The location of individual cobbles and boulders should be noted on the logs. The term large boulder does not have an upper size limit, so dimension should be stated wherever available.

Minor constituents: where soil contain minor quantities (less than about 10% in fine soil and 1% coarse) which are relevant to geology can be included before the principal soil type using 'slightly micaceous' or 'very shelly' or at the end of description using qualitative terms such as 'rare', 'occasional' or 'frequent', e.g. 'SAND with rare gravel size brick fragments'.

Man-made soils: are the soils which are placed by man and can be divided into those composed of reworked natural soils and those composed of man-made materials. 'Fill' is placed in controlled manner, and 'made ground' is placed without strict engineering control. Description of such soils should include following

a) Origin of the material	b) Presence of large objects e.g. concrete, mortar etc	c) Presence of voids/ collapsible hollow objects
d) Chemical waste and hazardous substances	e) Organic matter	f) Odours smell
g) Striking colour tints	h) Any dates readable on buried papers etc.	i) Signs of heat or combustion under ground e.g steam emerging from borehole
j) Structure, variability and mention of placement.		

Peat is classified according to the degree of decomposition and condition as given in following table

Organic Soils and Peats:-(see BS 5930. 41.3.6)

Condition	Field Test	Terms	Decomposition	Remains	Squeeze	Term	Colour	Weight % of dry mass BS EN 14688-2
Firm	Fibres compressed	Fibrous	Not	Clearly recognizable	Only water no solids	Slightly organic	Grey	2 - 6
Spongy	Very compressed and open structure	pseudo-fibrous	Moderate	Recognizable	Turbid water < 50% solids	Organic	Dark grey	6 - 20
Plastic	Can be moulded in hand and smears along fingers	amorphous	Full	Not recognizable	Paste > 50% solids	Very organic	Black	> 20
PEAT: Low density, dark coloured, distinctive odour								

Geological formation, age and type of deposit: is given on the maps of the British Geological Survey or its Antecedents and it should be written with at least capital initial letters. The geological formation should be named where this can be done with confidence (not easy to tell in a particular borehole or exposure).

References:

BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004

BS EN ISO 14688-1 & 2 2002 Geotechnical investigation and testing – Identification and classification of soil

BS 5930:1999 Revision 'Code of Practice for Site Investigation.'

Norbury D.R.; G.H Child and T.W Spink 1986:'A critical Review of Section 8(BS 5930)Soil and Rock Descriptions'. Proc 20th Regional meeting of the Engineering Group of the Geological Society. Site Investigation Practice. Assessing BS5930. Univ of Surrey pp353-369(original proceedings).

Standard Penetration Tests

The full procedure of carrying out the Standard Penetration Tests (SPT) is given in BS 1377:1990 : Methods of Tests for Soils and Civil Engineering Purposes Test 9:3.

Essentially the tests consists of driving a 50mm external diameter split barrel sampler into the soil using a 65kg hammer dropping 760mm. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration (test drive) below a seating drive of 150mm through any disturbed ground at the bottom of the borehole.

The number of blows for the 300mm test drive penetration is recorded on the borehole logs as the N - value. A full record of the number of blows required to drive the sample at 75mm intervals throughout the total 450mm drive is also tabulated along with the groundwater levels at the time of test.

The test is normally performed on sands, but may also be used in gravels, weak rocks and glacial tills in which case the driving shoe may be replaced by a cone. When attempting the standard penetration tests in very dense materials or weathered bedrock 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:

a)	Seating Drive - using standard blows the seating drive is a penetration of 150mm or 25 blows whichever is first reached
b)	Test Drive - the number of blows required for a further penetration of 300mm. If 300mm cannot be achieved in 50 blows the test can be terminated Record the number of blows per 75mm for both seating and test drives. If either the seating drive or the test drive is terminated before full penetration record the depth of penetration for the 25 blows or 50 blows respectively
c)	In soft rock the test drive should be terminated after 100 blows if a penetration of 300mm has not been achieved

The N - value obtained from the Standard Penetration Tests may be used to assess the relative density of sands and gravels in accordance with Clause 41.3.2 of BS 5930:1999 : Code of Practice for Site Investigation as follows:

Term	SPT N - values : blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

In soft strata when the sampler assembly is lowered to the bottom of the borehole on the drive rods with the drive assembly on top the sampler may penetrate under self-weight. This initial penetration should be measured and recorded. If the initial penetration exceeds 450mm omit the seating and test drives and report the N value as zero.



Continuous Dynamic Sounding

Dynamic Probe Resistance Using a 90° Cone BS1377 Part 9 Test 3.2

Table 1, Page 22 gives details of the equipment used for the two test methods, i.e. DPH (dynamic probing heavy) and DPSH (dynamic probing super heavy). The DPSH method equates to the Standard Penetration Test (SPT) and the DPH is the conventional dynamic probe test (DPT).

The test method requires the recording of the blows required to drive the 90° cones and driving rods into the soil over an interval of 100 mm. At the end of each 1.0m rod the torque resistance of the rod shall be measured and recorded.

DPSH Equipment Details

	DPSH	DPH
Driving Mass	63.5 ± 0.5 kg	50 ± 0.5 kg
Standard Drop	750 ± 20 mm	500 ± 10 mm
Anvil diameter	100 < d < 0.5 d mm	100 < d < 0.5 d mm
Maximum Mass of Anvil and Guide Rod	30 kg	18 kg
90° Cone		
Nominal Area	20 cm²	15 cm²
Cone Base Diameter (New)	50.5 ± 0.5 mm	43.7 ± 0.3 mm
Cone Mantle Length	50.5 ± 2 mm	43.7 ± 1 mm
Cone Taper	11 degrees	11 degrees
Cone Tip Length	25.3 ± 0.4 mm	21.9 ± 0.1 mm
Extension Rods		
Mass of Rod kg/m	8 kg (maximum)	6 kg (maximum)
Diameter	35 mm (maximum)	35 mm (maximum)
Length mm	Up to 2.0 ± 0.1%	Up to 2.0 ± 0.1%



Durability of Concrete in Aggressive Ground and Groundwater Conditions

Reference should be made to BRE Special Digest 1: 2005 for the detailed assessment of the potential for Sulfate and Acid attack on concrete.

Figures C4 C5 and C6 give the procedure for assessing the Aggressive Chemical Environment (ACEC) based on the nature of the site and the potential hazards on the site.

Sites are "greenfield without pyritic soil", "greenfield with pyritic soil", "brownfield without pyritic soil" and "brownfield with pyritic soil". Thus suitable samples of soil and groundwater should be selected for analyses of Soluble Sulfate (2:1 water soil extract) and pH (1:2.5 water soil extract).

The table extracts below give the relevant information from the document.

Box C7 Technical notes on limits for sulfate cases

- The division between Classes 2 and 3 for groundwater is related to the maximum solubility of calcium sulfate (1440 mg/l SO₄). Higher sulfate concentrations in groundwater confirm the presence of more soluble sulfates, usually magnesium or sodium. Other divisions between sulfate classes are drawn somewhat arbitrarily.

- The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from those in previous Digests, the correlation between old and new limits (in terms of mg/l SO₄) being as follows.

Sulfate class	New limits (mg/l SO ₄)	Old limits (mg/l SO ₄)
DS-1	< 500	< 1200
DS-2	500–1500	1200–2300
DS-3	1600–3000	2400–3700
DS-4	3100–6000	3800–6700
DS-5	> 6000	> 6700

The consequence of this adjustment is to make the ground classification based on soil tests more conservative; for example, some soils that were previously classified as DS-2 would now be considered as being DS-3.

The change stems from findings of numerous ground investigation studies carried out by BRE and others following discoveries of the thaumasite form of sulfate attack (TSA) in the concrete foundations of highway structures^[1]. In the large majority of cases, the sulfate classes based on 2:1 water/soil extract tests on soil have been found to be substantially lower than sulfate classes based on sulfate in groundwater. Not surprisingly, therefore, they were inconsistently low compared to the actual occurrence of TSA. The new limits bring sulfate classification based on 2:1 water/soil extract tests into parity with the groundwater based tests.

Assessing the aggressive chemical environment

31

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations*

Sulfate Design Sulfate Class for location	2:1 water/soil extract ^b	Groundwater	Total potential sulfate ^c	Groundwater Static water	Mobile water	ACEC Class for location
1	2 (SO ₄ mg/l)	3 (SO ₄ mg/l)	4 (SO ₄ %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5	> 5.5 ^d 2.5–5.5	AC-1s AC-1 ^d AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-3s AC-4 AC-4s AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5 2.5–3.5	≥ 2.5	AC-4s AC-5

Notes

- a Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.
- b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).
- c Applies only to locations where concrete will be exposed to sulfate ions (SO₄) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).
- d For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Explanation of suffix symbols to ACEC Class

- Suffix 's' indicates that the water has been classified as static.
- Concrete placed in ACEC Classes that include the suffix 'z' primarily have to resist acid conditions and may be made with any of the cements or combinations listed in Table D2 on page 42.

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations^a

Sulfate and magnesium						Groundwater		ACEC Class for location
Design Sulfate Class for location	2:1 water/soil extract ^b		Groundwater		Total potential sulfate ^c	Static water	Mobile water	
1	2 (SO ₄ mg/l)	3 (Mg mg/l)	4 (SO ₄ mg/l)	5 (Mg mg/l)	6 (SO ₄ %)	7 (pH) ^d	8 (pH) ^d	9
DS-1	< 500		< 400		< 0.24	≥ 2.5		AC-1s
							> 6.5 ^d	AC-1
							5.5–6.5	AC-2z
							4.5–5.5	AC-3z
							2.5–4.5	AC-4z
DS-2	500–1500		400–1400		0.24–0.6	> 5.5		AC-1s
							> 6.5	AC-2
							2.5–5.5	AC-2s
							5.5–6.5	AC-3z
							4.5–5.5	AC-4z
DS-3	1600–3000		1500–3000		0.7–1.2	> 5.5		AC-2s
							> 6.5	AC-3
							2.5–5.5	AC-3s
							5.5–6.5	AC-4
							2.5–5.5	AC-5
DS-4	3100–6000	≤ 1200	3100–6000	≤ 1000	1.3–2.4	> 5.5		AC-3s
							> 6.5	AC-4
							2.5–5.5	AC-4s
							2.5–6.5	AC-5
DS-4m	3100–6000	> 1200 ^e	3100–6000	> 1000 ^e	1.3–2.4	> 5.5		AC-3s
							> 6.5	AC-4m
							2.5–5.5	AC-4ms
							2.5–6.5	AC-5m
DS-5	> 6000	≤ 1200	> 6000	≤ 1000	> 2.4	> 5.5		AC-4s
						2.5–5.5	≥ 2.5	AC-5
DS-5m	> 6000	> 1200 ^e	> 6000	> 1000 ^e	> 2.4	> 5.5		AC-4ms
						2.5–5.5	≥ 2.5	AC-5m

Notes

a Brownfield locations are those sites, or parts of sites, that might contain chemical residues produced by or associated with industrial production (Section C5.1.3).

b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from previous Digests (Box C7).

c Applies only to locations where concrete will be exposed to sulfate ions (SO₄), which may result from the oxidation of sulfides such as pyrite, following ground disturbance (Appendix A1 and Box C8).

d An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content (Section C5.1.3).

e The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12 000 mg/l and 17 000 mg/l). This allows 'm' to be omitted from the relevant ACEC classification. Seawater (chloride content about 18 000 mg/l) and stronger brines are not covered by this table.

Explanation of suffix symbols to ACEC Class

- Suffix 's' indicates that the water has been classified as static.
- Concrete placed in ACEC Classes that include the suffix 'z' have primarily to resist acid conditions and may be made with any of the cements in Table D2 on page 42.
- Suffix 'm' relates to the higher levels of magnesium in Design Sulfate Classes 4 and 5.

APPENDIX 2 RECORDS OF FIELDWORK

APPENDIX 2.1 Boreholes

Location **Birchall Way, Birley Fields, Manchester**Borehole No. **DRAFT**Client: **JAB Design**

Project Ref.:

BH02Equipment and methods **Light Cable Percussion**Job No.: **15612**

Start Date:

End Date:

Final Depth:

Casing
Diameter
150mmDepth
3.70m**21/02/2013****21/02/2013****6.00m**

FIELD RECORDS	Samples / Tests				Description	Strata		
	Casing (Water) Depth (m)	Depth (m) from to	SAMPLE Type & No	SPT (N) {Cu}		Depth & Thickness m	Reduced Level (m)	Legend
[U80] [U100] [U100] --{21/02/2013}--		0.20	ES1		MADE GROUND (limestone chippings)	(0.10)		
		0.50	ES2		MADE GROUND (brown sandy CLAY with brick and concrete fragments. Sand is fine)	0.10		
		1.00	ES3			(1.10)		
		1.20	1.65 S 1	(10)		1.20		
		1.20	1.65 B 1	10/300mm	Medium dense to dense orange brown slightly clayey gravelly fine to coarse grained SAND. Gravel is fine to medium subrounded			
		2.00	ES4					
	2.20	2.20	2.65 S 2	(39)		(2.00)		
		2.20	3.00 B 2	39/300mm				
		3.30	3.80 U 1		Very stiff brown laminated gravelly slightly sandy CLAY. Sand is fine Gravel is fine to coarse subangular to angular	3.20		
		3.80	D 5					
		4.30	4.75 U 2			(2.80)		
		4.80	D 6					
		5.30	5.75 U 3					
		5.80	D 7					
Borehole Complete						6.00		

Remarks

- 1) CAT survey complete
- 2) Inspection pit completed - 0.50x0.50x1.20m
- 3) Borehole Dry
- 4) Monitoring well installed on completion response zone from 1.0m to 4.0m

Tip Depth

Date

Depth

Level mAD

Logged by
ATDrilled by
RC

Ground level

Co-ordinates:

Piezometer Tip 4.00m

Response Zone 1.00m 4.00m

Location **Birchall Way, Birley Fields, Manchester**Borehole No. **DRAFT**Client: **JAB Design**

Project Ref.:

BH03Equipment and methods **Light Cable Percussion**Job No.: **15612**

Start Date:

End Date:

Final Depth:

Casing Diameter
150mmDepth
4.60m**22/02/2013****22/02/2013****6.10m**

FIELD RECORDS	Samples / Tests				Description	Strata		
	Casing (Water) Depth (m)	Depth (m) from to	SAMPLE Type & No	SPT (N) {Cu}		Depth & Thickness m	Reduced Level (m)	Legend
[U50]		0.00 2.50	B 1		MADE GROUND (limestone chippings)	(0.10)		
		0.20	ES1		MADE GROUND (brown sandy CLAY with concrete brick fragments)	0.10		
		0.60	ES2			(0.70)		
						0.80		
		1.10	ES3		Made Ground (Stiff brown with grey veins streaked yellowish brown sandy gravelly clayey. Sand is fine. Gravel is fine-medium rounded quartzite)	(0.60)		
		1.20	U 1					
		1.20	ES4			1.40		
					Medium dense to dense brown clayey gravelly fine to coarse grained SAND. Gravel is subangular to subrounded			
	1.90	1.90 2.35	S 1	(18) 18/300mm				
						(2.90)		
[U100]	3.00	3.00 3.45	S 2	(45) 45/300mm				
		3.00 3.50	B 3					
[U78]	4.00	4.00 4.45	S 3	(36) 36/300mm				
		4.00 4.50	B 3					
		4.60 5.10	U 2		Stiff brown slightly sandy silty gravelly CLAY. Sand is fine Gravel is fine to medium subangular	4.30		
		5.10	D 5			(1.80)		
		5.40 5.90	U 3					
		5.90 6.10	D 6					
--{22/02/2013}--					Borehole Complete	6.10		

Remarks

- 1) CAT survey completed
- 2) Inspection Pit completed - 0.50x0.50x1.20m
- 3) Borehole dry

Tip Depth

Date

Depth

Level mAD

Logged by
ATDrilled by
RC

Ground level

Co-ordinates:

Piezometer Tip

Response Zone



RECORD SHEET SYMBOL KEY

SAMPLES/TESTS

U	Undisturbed 100mm open tube driven sample (depth records recovered length from start of test). OS-T/W(100mm with liner) * Indicates a sample with Nil Recovery {x.xx} indicates the water at the sample depth.
D	Small disturbed sample (depth records the interval of sample).
ES EW	Environmental samples (SOIL/WATER). Small disturbed samples for contamination analysis comprising glass and plastic tubs.
B	Large disturbed sample (Bulk) depth records recorded interval.
S	Standard penetration test (SPT; BS EN ISO 22476-3) recovered as a small disturbed sample. * Indicates a sample with Nil Recovery. {x.xx} indicates the water at the sample depth.
C	Solid Cone Penetration test, in rock and coarse granular soils.
W	Water sample.
L	Continuous Dynamic Sample 84mm 1.0m long

FIELD RECORD COLUMN

This column is used to present depth related information of site activity. The column will always show progress, details of water strikes and rises, field records of the SPT test and the Undisturbed sample blows. Other data may be present in this column and details of codes will be given in the remarks box at the bottom of the record sheet page.

Water Level Codes

M1 2.00	Water strike (with sequential number of the strike) recorded depth.
T1 1.90	Temporary rest level after 20 minutes with recorded depth.

Progress Codes

-{07/08/2002}	Records the date at the depth of the borehole when the borehole takes more than one day to complete. Also indicated on completion. Recorded for start of second day and subsequent shifts.
(TSL 3.00m)	Represents the water rest level at the start of the shift (AM) or the end of the borehole shown with the date of observation.

Field Records

1,2-3,4,5,6	Detailed SPT records for each 75mm test interval (incomplete penetration tests will be recorded showing blows for measured penetration).
[U60]	U100 open tube sampler blows to drive the sampler the full length

ROTARY CORE DRILLING RECORDS

Details of the rock fracture state are given in the Mechanical Log portion of the sheet SCR TCR and RQD are described in BS EN ISO 22475-1 (and BS 5930 Section 44.4.4) If is average fracture spacing over a particular lithology, Where the core is fully broken 0 indicates Non-Intact

MONITORING INSTALLATIONS

Standpipe piezometer or groundwater monitoring wells and water level information may be shown on the standard record sheet or a separate installation sheet. Bentonite seals, filter zones and installation depths are indicated. Details of installation are given in the report.

Legend symbols are those given BS5930:1999 (ISO 710-1-7) but for clarity may only the show major constituent.

Strata descriptions are compiled by visual examination of samples obtained during boring, after BS EN 14689-1:2003 and BS EN ISO 14689-1:2003: Geotechnical investigation and testing. Identification and classification of rock. Identification and description. Laboratory test results where applicable.

APPENDIX 2.2 Detailed Results of Standard Penetration Tests

APPENDIX 2.3 Hand Excavated Trial Pits

Client: JAB Design

Job No.: 15612

Site Name: Birchall Way, Birley Fields, Manchester

TP1

Dimensions – 0.50x0.50x0.50mm

Depth (m)		Stratum Description
From	To	
Ground level	0.50	Black and dark brown clayey fine to medium grained SAND with fine to medium brick, tile and concrete fragments and root material (TOPSOIL)

Sample Number	Depth (m)
ES1	0.05
ES2	0.20
ES3	0.50
B1	0.50

TP2

Dimensions – 0.50x0.50x0.50mm

Depth (m)		Stratum Description
From	To	
Ground level	0.50	Black and dark brown clayey fine to medium grained SAND with fine to medium brick fragments and root and organic material (TOPSOIL)

Sample Number	Depth (m)
ES1	0.05
ES2	0.20
ES3	0.50
B1	0.50

TP3

Dimensions – 0.50x0.50x0.50mm

Depth (m)		Stratum Description
From	To	
Ground level	0.50	Black and dark brown clayey fine to medium grained SAND with fine to medium brick, tile, plastic and concrete fragments and root and organic material (TOPSOIL)

Sample Number	Depth (m)
ES1	0.05
ES2	0.20
ES3	0.50
B1	0.50

APPENDIX 2.4 Soil Gas Monitoring Data

Client: JAB Design

Job No.: 15612



Site Name: Birchall Way Birley Fields Primary Substation

Well Number	Date / Time	CH4 %	CO2 %	O2 %	Gases Balance %	% of Lower Explosive Limit	Peak CH4 %	Peak CO2 %	Min O2 %	Atmospheric Pressure mBar	Relative Pressure mBar	H2ppm Hydrogen	COppm Carbon monoxide	H2Sppm Hydrogen Sulphide	Water Depth m	Tip Depth m	Flow l/hr	Remarks	Operator
BH02	02/04/2013 15:50	0.0	0.0	21.8	78.1	0	0.1	0.2	21.8	1016	0	0	0	0	Dry	3.00	0.2	Dry, cold very sunny. Static atmospheric pressure	NJ

CERTIFICATION OF CALIBRATION



ISSUED BY: GEOTECH LABORATORY

Date Of Calibration: 26-Mar-2013

Certificate Number: GA07859_1/10757

Page 1 of 1 Pages

Approved by Signatory

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Martin Moloney

Laboratory Inspection

Customer: *Strata Surveys Ltd*

Strata House
Holmes Chapel Road
MIDDLEWICH
Cheshire
CW10 0JB
UNITED KINGDOM

Description: Gas Analyser

Model: GA2000Plus

Serial Number: GA07859

Methane (CH4)	
Certified Gas (%)	Instrument Reading (%)
50.0	49.3
15.0	14.9
5.1	5.0

Carbon Dioxide (CO2)	
Certified Gas (%)	Instrument Reading (%)
50.0	50.2
15.0	14.4
5.0	4.7

Oxygen (O2)	
Certified Gas (%)	Instrument Reading (%)
20.9	21.0

Barometer (mbar)	
Reference	Reading
1009	1009

Additional Gas Cells		
Gas	Certified Gas (ppm)	Instrument Reading (ppm)
H ²	LOW	LOW
CO	500.0	506.0
H ² S	51.3	51.5

All concentrations are molar.

CH₄, CO₂ readings recorded at : 29.3 °C

O₂ readings recorded at : 20.9 °C

Barometric Pressure : 1009 mbar

Method of Test: The analyser is calibrated in a temperature controlled chamber using reference gases, providing traceability of measurement to recognised international standards.

End of Certificate

APPENDIX 3 LABORATORY TEST RESULTS

APPENDIX 3.1 Summary of Test Results

Location Number	Sample Type No.	Sample Depth Top m	Description	pH	SO ₄ mg/l 2:1 Extract	SO ₄ mg/l in Water
BH01	ES2	0.5	Made Ground (dark brown fine-coarse sand with fine-coarse subangular gravel)	6.9	16.5	
BH01	ES3	1.10	Light brown fine-medium sandy slightly fine-coarse gravelly CLAY> Gravel is subangular	7.4	53.5	

APPENDIX 3.2 Chemical Contamination Tests



Strata Surveys Ltd
Holmes Chapel Road
Middlewich
Cheshire
CW10 0JB

Attention: Carl Forster

CERTIFICATE OF ANALYSIS

Date: 19 March 2013
Customer: H_STADASUR_MDW
Sample Delivery Group (SDG): 130301-25
Your Reference: 15612
Location: Birchall Way Birley Fields
Report No: 216464

We received 4 samples on Thursday February 28, 2013 and 4 of these samples were scheduled for analysis which was completed on Tuesday March 19, 2013. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG:	130301-25	Location:	Birchall Way Birley Fields	Order Number:	7060
Job:	H_STADASUR_MDW-43	Customer:	Strata Surveys Ltd	Report Number:	216464
Client Reference:	15612	Attention:	Carl Forster	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
7002060	BH01		0.20	22/02/2013
7002061	BH03		0.60	22/02/2013
7002064	TP01		0.20	26/02/2013
7002069	TP02		0.60	26/02/2013

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

SDG: 130301-25
Job: H_STADASUR_MDW-43
Client Reference: 15612

Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

Order Number: 7060
Report Number: 216464
Superseded Report:

SOLID**Results Legend**

Test

No Determination
Possible**Lab Sample No(s)****Customer
Sample Reference****AGS Reference****Depth (m)****Container**

7002060

7002061

7002064

7002069

BH01

BH03

TP01

TP02

0.20

0.60

0.20

0.60

250g Amber Jar (AL)
1kg TUB

250g Amber Jar (AL)
1kg TUB

250g Amber Jar (AL)
1kg TUB

60g VOC (ALEZ15)
250g Amber Jar (AL)
1kg TUB

ANC at pH4 and ANC at pH 6

All

NDPs: 0
Tests: 1

X

Anions by Kone (w)

All

NDPs: 0
Tests: 1

X

Asbestos fibres in Soil*

All

NDPs: 0
Tests: 2

X X

Boron Water Soluble

All

NDPs: 0
Tests: 2

X X

CEN 2:1 Readings

All

NDPs: 0
Tests: 1

X

CEN 8:1 Readings

All

NDPs: 0
Tests: 1

X

Conductivity (at 20 deg.C)

All

NDPs: 0
Tests: 1

X

Cyanide
Comp/Free/Total/Thiocyanate

All

NDPs: 0
Tests: 3

X X X

Dissolved Metals by ICP-MS

All

NDPs: 0
Tests: 1

X

Dissolved Organic/Inorganic
Carbon

All

NDPs: 0
Tests: 1

X

Easily Liberated Sulphide

All

NDPs: 0
Tests: 3

X X X

Fluoride

All

NDPs: 0
Tests: 1

X

GRO by GC-FID (S)

All

NDPs: 0
Tests: 1

X

Hexavalent Chromium (s)

All

NDPs: 0
Tests: 2

X X

Loss on Ignition in soils

All

NDPs: 0
Tests: 1

X



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Order Number: 7060
Report Number: 216464
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SOLID**Results Legend**

Test

No Determination
Possible**Lab Sample No(s)****Customer
Sample Reference****AGS Reference****Depth (m)****Container**

7002060

7002061

7002064

7002069

BH01

BH03

TP01

TP02

0.20

0.60

0.20

0.60

250g Amber Jar (AL)
1kg TUB

250g Amber Jar (AL)
1kg TUB

250g Amber Jar (AL)
1kg TUB

60g VOC (ALEZ15)
250g Amber Jar (AL)
1kg TUB

Mercury Dissolved

All

NDPs: 0
Tests: 1

X

Metals by iCap-OES (Soil)

Arsenic

NDPs: 0
Tests: 3

X

X

X

Barium

NDPs: 0
Tests: 2

X

X

Beryllium

NDPs: 0
Tests: 2

X

X

Cadmium

NDPs: 0
Tests: 3

X

X

X

Chromium

NDPs: 0
Tests: 3

X

X

X

Copper

NDPs: 0
Tests: 3

X

X

X

Lead

NDPs: 0
Tests: 3

X

X

X

Mercury

NDPs: 0
Tests: 3

X

X

X

Nickel

NDPs: 0
Tests: 3

X

X

X

Selenium

NDPs: 0
Tests: 2

X

X

Vanadium

NDPs: 0
Tests: 2

X

X

Zinc

NDPs: 0
Tests: 3

X

X

X

Metals Ultra Low

All

NDPs: 0
Tests: 1

X

Mineral Oil

All

NDPs: 0
Tests: 1

X



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Order Number: 7060
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SOLID**Results Legend**

Test

No Determination
Possible**Lab Sample No(s)****Customer
Sample Reference****AGS Reference****Depth (m)****Container**

7002060

7002061

7002064

7002069

BH01

BH03

TP01

TP02

0.20

0.60

0.20

0.60

250g Amber Jar (AL)
1kg TUB

250g Amber Jar (AL)
1kg TUB

250g Amber Jar (AL)
1kg TUB

60g VOC (ALEZ15)
250g Amber Jar (AL)
1kg TUB

PAH by GCMS	All	NDPs: 0 Tests: 3	X	X	X
PAH Value of soil	All	NDPs: 0 Tests: 1			X
PCBs by GCMS	All	NDPs: 0 Tests: 1			X
pH	All	NDPs: 0 Tests: 3	X	X	X
Phenols by HPLC (S)	All	NDPs: 0 Tests: 3	X	X	X
Phenols by HPLC (W)	All	NDPs: 0 Tests: 1			X
Sample description	All	NDPs: 0 Tests: 3	X	X	X
Total Dissolved Solids (Grav)	All	NDPs: 1 Tests: 0			N
Total Dissolved Solids on Leachates	All	NDPs: 0 Tests: 1			X
Total Organic Carbon	All	NDPs: 0 Tests: 1			X
Total Organic Carbon (Asb)	All	NDPs: 0 Tests: 1			X
Total Sulphate	All	NDPs: 0 Tests: 3	X	X	X
TPH c6-40 Value of soil	All	NDPs: 0 Tests: 2	X		X



SDG:	130301-25	Location:	Birchall Way Birley Fields	Order Number:	7060
Job:	H_STADASUR_MDW-43	Customer:	Strata Surveys Ltd	Report Number:	216464
Client Reference:	15612	Attention:	Carl Forster	Superseded Report:	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2		
7002060	BH01	0.20	Light Brown	Loamy Sand	0.1 - 2 mm	Stones	Vegetation		
7002061	BH03	0.60	Dark Brown	Loamy Sand	0.1 - 2 mm	Brick	Stones		
7002069	TP02	0.60	Light Brown	Sandy Loam	0.1 - 2 mm	Concrete/Aggregate	Tile		

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.



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Client Reference: 15612

Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

Order Number: 7060
Report Number: 216464
Superseded Report:

Results Legend		Customer Sample R Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	BH01	BH03	TP01	TP02		
#	ISO17025 accredited.		0.20	0.60	0.20	0.60		
M	mCERTS accredited.		Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid		
aq	Aqueous / settled sample.		22/02/2013	22/02/2013	26/02/2013	26/02/2013		
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery		28/02/2013	28/02/2013	28/02/2013	28/02/2013		
(F)	Trigger breach confirmed		130301-25	130301-25	130301-25	130301-25		
1-4&*\$@	Sample deviation (see appendix)		7002060	7002061	7002064	7002069		
		ES1	ES2	ES2	ES3			
Component	LOD/Units	Method						
Actinolite*	-	SUB (ASB)		Not Detected #	Not Detected #	Not Detected #		
Amosite*	-	SUB (ASB)		Detected #	Not Detected #	Not Detected #		
Anthophyllite*	-	SUB (ASB)		Not Detected #	Not Detected #	Not Detected #		
Chrysotile*	-	SUB (ASB)		Detected #	Not Detected #	Not Detected #		
Crocidolite*	-	SUB (ASB)		Not Detected #	Not Detected #	Not Detected #		
Tremolite*	-	SUB (ASB)		Not Detected #	Not Detected #	Not Detected #		
None Asbestos Fibres Detected	-	SUB (ASB)		Not Detected #	Not Detected #	Not Detected #		
Loss on ignition	<0.7 %	TM018				13.5 M		
Mineral oil >C10-C40	<1 mg/kg	TM061				45.4 #		
Surrogate Value	-	TM061				45.1		
Mineral Oil Surrogate % recovery**	%	TM061				90.1		
Phenols, Total Detected monohydric	<0.035 mg/kg	TM062 (S)	<0.035 M	<0.035 M		0.0492 M		
Organic Carbon, Total	<0.2 %	TM132				5.43 #		
pH	1 pH Units	TM133	7.46 M	8.55 M		7.73 M		
Chromium, Hexavalent	<0.6 mg/kg	TM151	<0.6 #	<0.6 #				
Cyanide, Total	<1 mg/kg	TM153	<1 M	<1 M		<1 M		
TPH >C6-C40	<10 mg/kg	TM154	245 #			385 #		
TPH >C10-C25	<10 mg/kg	TM154				86.4 #		
TPH >C25-C40	<10 mg/kg	TM154				299 #		
PCB congener 28	<0.003 mg/kg	TM168				0.00663 M		
PCB congener 52	<0.003 mg/kg	TM168				<0.003 M		
PCB congener 101	<0.003 mg/kg	TM168				<0.003 M		
PCB congener 118	<0.003 mg/kg	TM168				<0.003 M		
PCB congener 138	<0.003 mg/kg	TM168				<0.003 M		
PCB congener 153	<0.003 mg/kg	TM168				<0.003 M		
PCB congener 180	<0.003 mg/kg	TM168				<0.003 M		
Sum of detected PCB 7 Congeners	<0.021 mg/kg	TM168				<0.021		
Sulphide, Easily liberated	<15 mg/kg	TM180	<15 @ #	<15 @ #		<15 ◆ #		
Arsenic	<0.6 mg/kg	TM181	14.5 M	11.7 M		24.1 M		
Barium	<0.6 mg/kg	TM181	104 #	231 #				
Beryllium	<0.01 mg/kg	TM181	0.664 M	0.664 M				
Cadmium	<0.02 mg/kg	TM181	0.515 M	0.511 M		0.993 M		

Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

SDG: 130301-25
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Order Number: 7060
Report Number: 216464
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Report Number: 216464
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Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

Order Number: 7060
Report Number: 216464
Superseded Report:

CEN 10:1 CUMULATIVE TWO STAGE BATCH TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/3

Client Reference

Mass Sample taken (kg) 0.233

Mass of dry sample (kg) 0.175

Particle Size <4mm >95%

Site Location

Birchall Way Birley Fields

Moisture Content Ratio (%) 33

Dry Matter Content Ratio (%) 75.2

Case

SDG 130301-25

Lab Sample Number(s) 7002069

Sampled Date 26-Feb-2013

Customer Sample Ref. TP02

Depth (m) 0.60

Landfill Waste Acceptance
Criteria LimitsInert Waste
LandfillStable
Non-reactive
Hazardous
Waste in Non-
Hazardous
LandfillHazardous
Waste Landfill

Solid Waste Analysis

Total Organic Carbon (%)

4.18

Loss on Ignition (%)

13.5

Sum of BTEX (mg/kg)

<0.024

Sum of 7 PCBs (mg/kg)

<0.021

Mineral Oil (mg/kg)

45.4

PAH Sum of 17 (mg/kg)

41

pH (pH Units)

7.73

ANC to pH 6 (mol/kg)

<0.03

ANC to pH 4 (mol/kg)

0.102

3

5

6

-

-

10

6

-

-

1

-

-

500

-

-

100

-

-

-

<6 or >9

-

-

-

-

-

-

-

Eluate Analysis

C₂Concⁿ in 2:1
eluateC₈Concⁿ in 8:1
eluateA₂2:1 concⁿ
leachedA₂₋₁₀Cumulative
concⁿ
leachedLimit values for compliance leaching test
using BS EN 12457-3 at L/S 10 l/kg

	mg/l	mg/kg		
Arsenic	0.00258	0.00261	0.00516	0.026
Barium	0.0631	0.0426	0.126	0.449
Cadmium	-	-	-	-
Chromium	0.000492	0.000574	0.000983	0.00565
Copper	-	-	-	-
Mercury Dissolved (CVAF)	0.0000283	0.0000372	0.0000566	0.000362
Molybdenum	0.0136	0.00657	0.0272	0.0737
Nickel	0.00185	0.000869	0.0037	0.00981
Lead	0.00107	0.00235	0.00215	0.022
Antimony	0.00705	0.00464	0.0141	0.0492
Selenium	0.00187	0.000659	0.00374	0.00797
Zinc	0.00314	0.00245	0.00628	0.0253
Chloride	3.3	<2	6.6	<20
Fluoride	0.611	0.702	1.22	6.91
Sulphate (soluble)	12.2	<2	24.4	<20
Total Dissolved Solids	212	114	424	1250
Total Monohydric Phenols (W)	<0.016	<0.016	<0.032	<0.16
Dissolved Organic Carbon	12.2	6.75	24.5	73.8

Leach Test Information

2:1

8:1

Date Prepared	07-Mar-2013	07-Mar-2013
pH (pH Units)	8.160	7.218
Conductivity (µS/cm)	264.00	143.60
Temperature (°C)	20.10	19.40
Volume Leachant (Litres)	0.292	1.400
Volume of Eluate VE1 (Litres)	0.200	

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable

Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation

Mcerts Certification does not apply to leachates

19/03/2013 15:52:36

15:52:30 19/03/2013



CERTIFICATE OF ANALYSIS

SDG: 130301-25
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Client Reference: 15612

Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
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REF : BS EN 12457/3

Client Reference

Mass Sample taken (kg) 0.233

Mass of dry sample (kg) 0.175

Particle Size <4mm >95%

Site Location

Birchall Way Birley Fields

Moisture Content Ratio (%) 33

Dry Matter Content Ratio (%) 75.2

Case

SDG 130301-25

Lab Sample Number(s) 7002069

Sampled Date 26-Feb-2013

Customer Sample Ref. TP02

Depth (m) 0.60

Landfill Waste Acceptance
Criteria LimitsInert Waste
LandfillStable
Non-reactive
Hazardous
Waste in Non-
Hazardous
LandfillHazardous
Waste Landfill

Solid Waste Analysis

Total Organic Carbon (%)	4.18
Loss on Ignition (%)	13.5
Sum of BTEX (mg/kg)	<0.024
Sum of 7 PCBs (mg/kg)	<0.021
Mineral Oil (mg/kg)	45.4
PAH Sum of 17 (mg/kg)	41
pH (pH Units)	7.73
ANC to pH 6 (mol/kg)	<0.03
ANC to pH 4 (mol/kg)	0.102

3	5	6
-	-	10
6	-	-
1	-	-
500	-	-
100	-	-
-	<6 or >9	-
-	-	-
-	-	-

Eluate Analysis

Eluate Analysis	C2	Conc ⁿ in 2:1 eluate	C8	Conc ⁿ in 8:1 eluate	A2	2:1 conc ⁿ leached	A2-10	Cumulative conc ⁿ leached	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg
	mg/l				mg/kg				
Conductivity (at 20 deg.C)		0.279		0.151		0.558		1.66	- - -
Cadmium Ultra low		0		0.0000244		0.000119		0.000284	- - -
Copper Ultra low		0.0126		0.00794		0.0252		0.0847	- - -

Leach Test Information

	2:1	8:1
Date Prepared	07-Mar-2013	07-Mar-2013
pH (pH Units)	8.160	7.218
Conductivity (µS/cm)	264.00	143.60
Temperature (°C)	20.10	19.40
Volume Leachant (Litres)	0.292	1.400
Volume of Eluate VE1 (Litres)	0.200	

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19/03/2013 15:52:36

15:52:30 19/03/2013



CERTIFICATE OF ANALYSIS

Validated

SDG:	130301-25	Location:	Birchall Way Birley Fields	Order Number:	7060
Job:	H_STADASUR_MDW-43	Customer:	Strata Surveys Ltd	Report Number:	216464
Client Reference:	15612	Attention:	Carl Forster	Superseded Report:	

Notification of NDPs (No determination possible)

Date Received : 01/03/2013 08:58:29

Sample No	Customer Sample Ref.	Depth (m)	Test	Comment
7002069	TP02	0.60	Total Dissolved Solids (Grav)	Unsuitable for analysis due to potential Asbestos



CERTIFICATE OF ANALYSIS

SDG: 130301-25
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Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

Order Number: 7060
Report Number: 216464
Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
PM114		Leaching Procedure for CEN Two Stage Batch Test 2:1/8:1 Cumulative		
SUB (ASB)				
TM018	BS 1377: Part 3 1990	Determination of Loss on Ignition		
TM021	Method 2540C, AWWA/APHA, 20th Ed., 1999	Determination of total dissolved solids in waters by gravimetry.		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM061	Method for the Determination of EPH, Massachusetts Dept. of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM062 (S)	National Grid Property Holdings Methods for the Collection & Analysis of Samples from National Grid Sites version 1 Sec 3.9	Determination of Phenols in Soils by HPLC		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser		
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter		
TM123	BS 2690: Part 121:1981	The Determination of Total Dissolved Solids in Water		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990; BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40		
TM168	EPA Method 8082, Polychlorinated Biphenyls by Gas Chromatography	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Soils		
TM180	Sulphide in waters and waste waters 1991 ISBN 01 175 7186 SCA rec. 2007 (unpublished)	The Determination Of Easily Liberated Sulphide In Soil Samples by Ion Selective Electrode Technique		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM182	CEN/TC 292 - WI 292046-characterization of waste-leaching Behaviour Tests- Acid and Base Neutralization Capacity Test	Determination of Acid Neutralisation Capacity (ANC) Using Autotitration in Soils		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM213	In-house Method	Rapid Determination of PAHs by GC-FID		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM221	Inductively Coupled Plasma - Atomic Emission Spectroscopy. An Atlas of Spectral Information: Winge, Fassel, Peterson and Floyd	Determination of Acid extractable Sulphate in Soils by IRIS Emission Spectrometer		
TM222	In-House Method	Determination of Hot Water Soluble Boron in Soils (10:1 Water:soil) by IRIS Emission Spectrometer		
TM259	by HPLC	Determination of Phenols in Waters and Leachates by HPLC		
TM307		Ultra Low Metals		
TM321		Organic matter Content of Soil By Titration		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG: 130301-25
Job: H_STADASUR_MDW-43
Client Reference: 15612

Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

Order Number: 7060
Report Number: 216464
Superseded Report:

Test Completion Dates

Lab Sample No(s)	7002060	7002061	7002064	7002069
Customer Sample Ref.	BH01	BH03	TP01	TP02
AGS Ref.				
Depth	0.20	0.60	0.20	0.60
Type	SOLID	SOLID	SOLID	SOLID
ANC at pH4 and ANC at pH 6				12-Mar-2013
Anions by Kone (w)				09-Mar-2013
Asbestos fibres in Soil*		12-Mar-2013	12-Mar-2013	12-Mar-2013
Boron Water Soluble	04-Mar-2013	11-Mar-2013		
CEN 2:1 Leachate (2 Stage)				07-Mar-2013
CEN 2:1 Readings				08-Mar-2013
CEN 8:1 Leachate (2 Stage)				08-Mar-2013
CEN 8:1 Readings				08-Mar-2013
Conductivity (at 20 deg.C)				08-Mar-2013
Cyanide Comp/Free/Total/Thiocyanate	07-Mar-2013	08-Mar-2013		08-Mar-2013
Dissolved Metals by ICP-MS				12-Mar-2013
Dissolved Organic/Inorganic Carbon				09-Mar-2013
Easily Liberated Sulphide	08-Mar-2013	08-Mar-2013		11-Mar-2013
Fluoride				09-Mar-2013
GRO by GC-FID (S)				08-Mar-2013
Hexavalent Chromium (s)	08-Mar-2013	08-Mar-2013		
Loss on Ignition in soils				12-Mar-2013
Mercury Dissolved				11-Mar-2013
Metals by iCap-OES	04-Mar-2013	11-Mar-2013		11-Mar-2013
Metals Ultra Low				19-Mar-2013
Mineral Oil				12-Mar-2013
PAH by GCMS	11-Mar-2013	08-Mar-2013		11-Mar-2013
PAH Value of soil				11-Mar-2013
PCBs by GCMS				10-Mar-2013
pH	09-Mar-2013	09-Mar-2013		09-Mar-2013
Phenols by HPLC (S)	06-Mar-2013	07-Mar-2013		08-Mar-2013
Phenols by HPLC (W)				10-Mar-2013
Sample description	01-Mar-2013	06-Mar-2013		01-Mar-2013
Total Dissolved Solids on Leachates				11-Mar-2013
Total Organic Carbon				13-Mar-2013
Total Organic Carbon (Asb)				11-Mar-2013
Total Sulphate	04-Mar-2013	11-Mar-2013		11-Mar-2013
TPH c6-40 Value of soil	05-Mar-2013			08-Mar-2013



2139

Certificate of Analysis

Date: 11/03/2013

Certificate Number: 13-77130

Client: Alcontrol Laboratories
Units 7 & 8
Hawarden Business Park
Manor Road
Hawarden
Deeside
CH5 3US

Our Reference: 13-77130

Client Reference: 130301-25

Contract Title: 130301-25

Description: 3 soil samples

Date Received: 05 March 2013

Date Started: 05 March 2013

Date Completed: 11 March 2013

Test Procedures: Asbestos Analysis (DETS 082)

Notes: Observations and interpretations are outside the scope of UKAS accreditation

Approved By: 
Rob Brown, Business Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Information in Support of the Analytical Results

Analysis

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425um sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample.

Key

- * Denotes test not included in laboratory scope of accreditation
- # Denotes test that holds MCERTS accreditation, however, MCERTS accreditation is only implied if the report carries the MCERTS logo
- \$ Denotes tests completed by an approved subcontractor
- I/S Denotes insufficient sample to carry out test
- U/S Denotes that the sample is not suitable for testing

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month

Liquids - 2 weeks

Asbestos (test portion) - 6 months

Summary of Asbestos Analysis

Soil Samples

Our Ref: 13-77130
Client Ref: 130301-25
Contract Title: 130301-25

Lab No	Sample Ref	Material Type*	Result	Comment	Analyst
491469	7020480	Soil	Chrysotile Amosite	insulation material + loose fibres	Colin Patrick
491470	7020481	Soil	NAD	na	Colin Patrick
491471	7020495	Soil	NAD	na	Colin Patrick

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. NAD = No Asbestos Detected. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETS 082 using polarised light microscopy in accordance with HSG248 and documented in-house methods. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'.

Sample Comments

DETS cannot be held responsible for the integrity of sample(s) received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating.

Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note "Guidance on Deviating Samples".

All samples received are listed below. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations.

If no sampled date (soils) or date/time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters), this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Lab No.	Sample ID	Date Sampled	Containers Received	Deviating due to holding time being exceeded for test	Deviating due to inappropriate container for test
491469	7020480 SOIL	22/02/2013	Plastic Tub 1 litre (1kg)		
491470	7020481 SOIL	26/02/2013	Plastic Tub 1 litre (1kg)		
491471	7020495 SOIL	26/02/2013	Plastic Tub 1 litre (1kg)		



SDG: 130301-25
Job: H_STADASUR_MDW-43
Client Reference: 15612

Location: Birchall Way Birley Fields
Customer: Strata Surveys Ltd
Attention: Carl Forster

Order Number: 7060
Report Number: 216464
Superseded Report:

Appendix General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 2 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill /made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
§	Sampled on date not provided
+	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than :
 -

Trace -Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX 4 BOREHOLE LOCATION PLAN

PPING STREET

POYNTON STREET

MEDLOCK STREET

BIRCHALL WAY

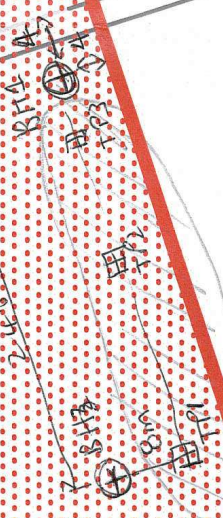
PROPOSED PRIMARY
SUBSTATION SITE

22500

24516

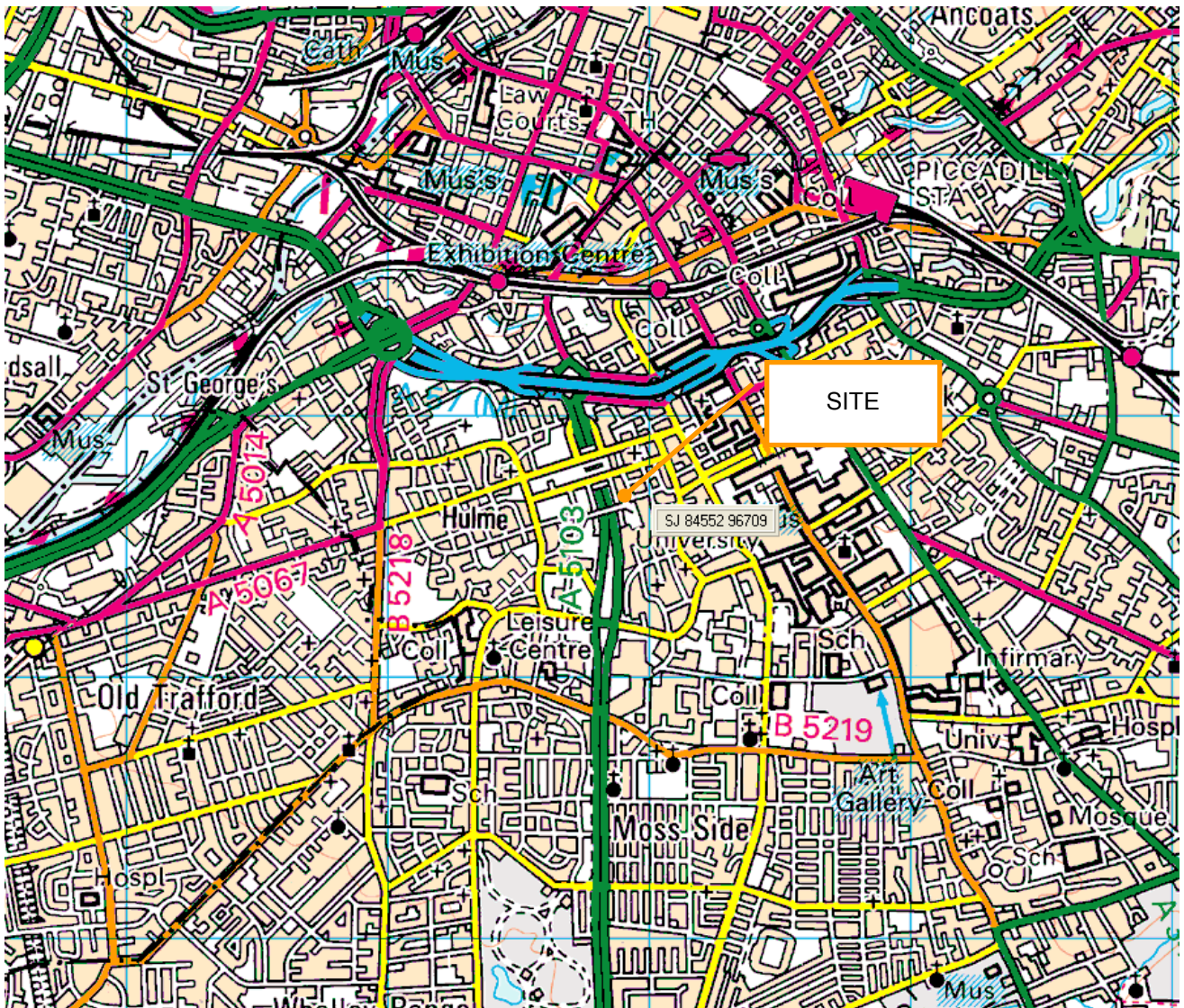
61125

BK2



Sloping masonry

APPENDIX 5 SITE LOCATION PLAN



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