CAPITA

Westbrook Walk

Phase 2 Ground Investigation & Assessment

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1. Introduction

1.1 Appointment

1.1.1 Capita Property and Infrastructure Ltd ("Capita") was commissioned by Southway Housing Trust to undertake an intrusive Phase 2 Ground Investigation and Assessment for a parcel of land off Westbrook Walk, Manchester.

1.1.2 A site location and existing site layout plan is presented on Figure1 in Appendix A.

1.2 Proposed Development

1.2.1 With reference to the Bernard Taylor Partnership Architects drawings (included in Appendix A) the site is proposed to be developed for private housing comprising 4no one bedroom bungalows and 14no one bedroom apartments with associated landscaping and car parking. The redevelopment will comprise the refurbishment of 3no of the existing bungalows and a new build of the 4th bungalow. The existing path "Westbrook Walk" (from which the subject site derives its name) will undergo upgrading works to provide full road access to the residential development from Somerford Avenue.

1.3 Background & Context

1.3.1 Capita has previously issued a "Phase 1 Geo-Environmental Desk Study" report for the subject site and proposed development. The full report reference is as follows:

- Phase 1 Geo-Environmental Desk Study for Westbrook Walk on behalf of Southway Housing Trust. Capita Ref SS019075-DS-01 November 2013.

1.3.2 The conclusion of the Desk Study Report was that in general the contamination potential for the site (including ground gas, its current condition and with no mitigation measures considered) was generally LOW.

1.3.3 In summary, the site was used as a playground during the 20th century until c1978 when a residential development was built in the present configuration.

1.3.4 The site is indicated to be underlain by Glacial Till and Triassic Sandstone. There is also the potential for Made Ground to be present given the site development history.

1.3.5 On the basis of the above, a comprehensive "Phase 2" intrusive investigation and assessment was recommended to address the development specific issues relating to the proposed development and to confirm the anticipated LOW risk status.

1.4 Objective and Scope of Work

1.4.1 The objectives of this assessment were to obtain geotechnical design parameters for the proposed residential development and to establish the nature of the shallow ground conditions from a "land contamination" perspective (including ground gas). It was therefore necessary to:

1. Characterise the geological and hydrogeological conditions beneath the site;
2. Collect sufficient information to allow a development specific geotechnical appraisal to be undertaken;
3. Quantify the level of ground contamination present within any Made Ground and shallow strata across the site and assess this in terms of the proposed development;
4. Establish the ground gas regime at the site and assess this in terms of the proposed development; and
5. Provide recommendations for further detailed investigation and/or cost effective remediation/mitigation where required.

1.4.2 To achieve the objectives the following scope of work was defined and undertaken:

- 5no dynamic 'windowless' sample boreholes including in-situ geotechnical testing;
- Installation of 3no gas and groundwater monitoring wells;
- Sampling and laboratory testing of soil for chemical and geotechnical purposes;
- Ground gas monitoring (4no visits over a month); and
- Provision of a combined factual and interpretive report.

2. Site Investigation

2.1 Intrusive Works

2.1.1 In order to achieve the project objectives, an intrusive investigation was completed across the subject site on the 5th February 2014 and comprised:

- "Windowless" dynamic sampling to form 5no boreholes with associated logging, sampling, and standard penetration testing; and
- Installation of 3no monitoring wells for gas and groundwater monitoring.

2.1.2 The investigation of the subject site was undertaken pre-demolition and as such intrusive investigation techniques were limited to the accessible garden areas around the site. The exploratory hole positions were also limited based on the manoeuvrability of the plant around the narrow path.

2.1.3 The boreholes were formed by RP Drilling Ltd under the supervision and direction of a suitably qualified and experienced Capita geo-environmental engineer and were formed to a maximum depth of 2.5mbgl. The boreholes were generally located to give a reasonable site wide coverage over the accessible areas.

2.1.4 In-situ strength tests comprising Standard Penetration Tests (SPT's) were undertaken in the boreholes at 1m intervals and at the final depth.

2.1.5 Exploratory hole locations are shown on Figure 1 in Appendix A and corresponding exploratory hole records are presented in Appendix B.

2.2 Soil Sampling

2.2.1 Soil samples comprising disturbed (glass jar and tub) samples were collected from the exploratory holes at distinct changes in lithology and across a range of depths/strata across the site in order to be tested for a range of chemical parameters, as well as any soils exhibiting palpable visual and/or olfactory signs of contamination.

2.2.2 Soil samples were selected for laboratory analysis by a Capita engineer based on a review of the site findings.

2.2.3 Samples selected for chemical analysis were transferred to laboratory prepared glass jars and/or plastic tubs and stored in pre-chilled cool boxes prior to dispatch to the laboratory.

2.3 Geotechnical Testing

2.3.1 4no soil samples were submitted for geotechnical laboratory analysis at Professional Soils Laboratory Ltd (PSL), Doncaster.

2.3.2 In order to obtain geotechnical parameters for the proposed residential development soil samples were tested for the following:

- Moisture Content; and
- Atterburg Limits.

2.3.3 The results of the geotechnical testing are presented in the laboratory reports in Appendix C.

2.4 Chemical Testing

2.4.1 In order to quantify the level of contamination at the site, 8no soil samples were selected for laboratory analysis at Envirolab, Hyde.

2.4.2 Soil samples were tested for one or more of the following:

- Metals and Semi Metals: As, Cd, Cr, Cu, Ni, Pb, Hg, Se, and Zn;
- Non-metallic Inorganics: pH and water soluble sulphate (SO_4); and
- Poly Aromatic Hydrocarbons (PAHs – 16no).

2.4.3 The results of the chemical testing are presented in the laboratory reports in Appendix D.

2.5 Gas and Groundwater Monitoring

2.5.1 Gas and groundwater monitoring wells were installed in boreholes WS101, WS103 and WS105.

2.5.2 In order to fully characterise the ground gas regime at the site in line with development proposals and current industry guidance (CIRIA C665), a programme of 4no visits over 1month has been completed between 14th February and 28th February 2014.

2.5.3 The results of the gas and groundwater monitoring are presented in Appendix E and a gas risk assessment is provided in Chapter 6.

3. Ground Conditions

3.1 Stratigraphy

3.1.1 The ground conditions encountered during the intrusive investigation largely confirmed the anticipated geology and in general comprised Topsoil over Made Ground deposits, Glacial Till and then Triassic Sandstone.

3.1.2 The following table summarises the current findings:

Lithology	Depths to base of unit (mbgl)	Thickness Range (m)
Topsoil	0.10 to 0.25	0.10 to 0.25
Made Ground - predominantly granular	0.25 to 0.45	0.05 to 0.35
Glacial Till	1.00 to 1.65	0.70 to 1.35
Sherwood Sandstone (Base not seen)	>2.5	>1.0

3.2 Topsoil

3.2.1 Topsoil was encountered in all of the boreholes to a maximum depth of 0.25mbgl. The topsoil comprised soft dark brown sandy CLAY with abundant rootlets.

3.3 Made Ground

3.3.1 Made Ground was encountered in all of the boreholes to a maximum depth of 0.45mbgl.

3.3.2 The Made Ground generally comprised loose dark grey granular GRAVEL. Gravel is angular to subangular and coarse including fragments of slate, clay pipe, clinker and sandstone.

3.4 Glacial Till

3.4.1 Glacial Till was encountered in all of the exploratory holes, beneath the Made Ground at depths of between 0.25 and 0.45mbgl.

3.4.2 The stratum generally comprised firm to stiff, grey mottled tan, gravelly sandy CLAY; generally becoming harder with depth.

3.4.3 In-situ penetration testing within the Glacial Till gave N-values ranging from 6 to 11 indicating soft to firm consistency. Field testing found the Glacial Till to become firmer with increasing depth.

3.4.4 Geotechnical classification tests undertaken on 4no samples of Glacial Till between depths of 1.0 and 1.4mbgl indicated the following:

Test	Range of Values
Natural Moisture Content	15 – 26%
Liquid Limit	27 – 56%
Plastic Limit (%)	15 – 23%
Plasticity Index (%)	12 – 33%
Fraction <0.425mm (%)	80 – 96%

3.4.5 The classification test results generally indicate sandy clay of low to high plasticity and the material has a low to medium shrinkage/swell potential on change of moisture content (BRE 240, 1993).

3.5 Sherwood Sandstone

3.5.1 Weathered strata of the Sherwood sandstone was encountered beneath Glacial Till in all of the boreholes at a depth of between 1.00 and 1.60mbgl (base not proven). The bedrock “surface” level falls away (thus increases in depth) to the north beneath the site.

3.5.2 The stratum generally comprised medium dense red medium grained SAND.

3.6 Observations

3.6.1 No palpable visual and/or olfactory evidence of gross contamination was recorded during the ground investigation.

3.7 Groundwater

3.7.1 Groundwater entries were only encountered in WS105 during hole formation. This was the deepest exploratory hole and the groundwater level is considered to lie within the Sandstone. During subsequent monitoring, rest water levels in standpipes were recorded at depths of between 1.74 and 1.96mbgl.

3.7.2 It should be appreciated that ground and groundwater conditions may vary between and away from the exploratory hole positions, and that no account can be taken in this report of such variations.

3.7.3 It should also be noted that groundwater levels may be affected by seasonal variations such as rainfall and that no account can be taken of such variations in this report due to the short monitoring period.

4. Geotechnical Appraisal

4.1 Proposed Development

4.1.1 The site is proposed to be developed for private housing comprising 4no one bedroom bungalows and 14no one bedroom apartments with associated landscaping and car parking. The existing path “Westbrook Walk” will also undergo upgrading works to provide full road access to the residential development from Somerford Avenue.

4.2 Foundations & Floor Slabs

4.2.1 Ground conditions beneath the proposed development structures were found to generally comprise a sequence of Topsoil over predominantly granular Made Ground (to a maximum depth of 0.45mbgl) underlain by cohesive Glacial Till and weathered Sherwood Sandstone.

4.2.2 The Sherwood Sandstone generally comprised competent weathered medium dense red medium grained SAND at relatively shallow depths in places. In all exploratory holes except WS105 SPT’s at 2m refused within the Sherwood Sandstone. The bedrock surface level falls away towards the north where competent Sandstone is present at around 2.3mbgl.

4.2.3 New structural foundations should be taken through the Glacial Till to the competent weathered Sandstone. Conventional shallow spread (strip) foundations should be feasible by taking foundation loads to such competent strata. Foundations could be based on either:

- An allowable net bearing pressure of 165kPa at 2mbgl (2.3mbgl north of WS105) (assuming a foundation width of 0.6m); or
- An allowable net bearing pressure of 110kPa at 1.65mbgl (assuming a foundation width of 0.9m).

4.2.4 Based on the modified plasticity index values of the Glacial Till (ranging between 12% and 33%), suspended floor slabs are required in conjunction with the aforementioned foundation solution together with an appropriate void space included below the floor slab to accommodate ‘Low to Medium Shrinkage Potential’ soils.

4.3 Pavement and Road Design

4.3.1 In consideration of the ground conditions encountered, it is likely that the pavement subgrade exposed at formation levels will comprise cohesive Glacial Till.

4.3.2 Pavement and road design should be based upon a suitable (equilibrium) CBR value for such formation soils. Reference has been made to Table 5.1 ‘Equilibrium Subgrade CBR Estimation’ in IAN 73/06 (Highways Agency, 2009) and from this it is recommended that new road pavement and road construction design should be based upon (an estimated) CBR value of about 3%.

4.3.3 However, the design value will need to be reviewed and confirmed by suitable in-situ testing at formation levels following earthwork operations and prior to pavement construction.

4.3.4 Notwithstanding this, the formation at all levels should be proof-rolled prior to pavement construction, and any soft zones thus revealed should be excavated out, with the resulting excavation in-filled with appropriately graded engineered granular fill.

4.4 Concrete Classification

4.4.1 Design/mix of buried concrete should be undertaken in accordance with the BRE Special Digest 1 (2005).

4.4.2 A summary of the soil chemical results pertinent to concrete classification is presented in the following table.

Matrix	Test	Range of Values
Soil	pH	6.34 – 7.11
	Sulphate (water sol 2:1) (mg/l)	20 - 39

4.4.3 A review of the soil chemical results indicates that sulphate and pH results fall within “Design Sulphate Class” DS-1, and the “Aggressive Chemical Environment for Concrete” (ACEC) class for the site is considered to be AC-1. Design/mix of buried concrete should be undertaken in accordance with these classifications.

4.5 Excavations and Groundwater

4.5.1 Excavations at the site should be feasible using an appropriate scale of hydraulic plant. All excavations at the site will require adequate lateral support, or battering back to a safe angle, to ensure their stability.

4.5.2 Based on the available data, there is the potential for groundwater to be encountered in shallow excavations at the site. In this scenario appropriate groundwater control/dewatering provisions (e.g. sump and pump) should be employed to keep such excavations dry and prevent deterioration/softening of the exposed clay soils/formation.

5. Contamination Assessment

5.1 Introduction

5.1.1 In line with CLR11 (DEFRA & EA, 2004), a Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of the measured concentrations of contaminants from the chemical analysis.

5.1.2 The GQRA comprises the comparison of the measured concentrations with Generic Assessment Criteria (GACs).

5.1.3 The GACs used for the assessment of soil concentrations comprise Soil Guideline Values (SGVs) and values that have been derived using the CLEA model adopting the appropriate assumptions and input parameters provided in the SR series of reports.

5.1.4 In deriving the GACs for use on Brownfield sites we have assumed a “Sandy Soil” with 1% Soil Organic Matter.

5.1.5 The GQRA has been undertaken on the basis that the proposed development site falls under the “Residential with Plant Uptake” land-use scenario as defined in SR3.

5.1.6 The relevant statistical tests have been undertaken where appropriate in accordance with guidance provided in CIEH & CLAIRE (2008).

5.1.7 The tables in Appendix F present the results of the GQRA and a summary of the findings is provided below.

5.2 Topsoil Analysis

5.2.1 2no samples of Topsoil have been analysed for their suitability for re-use on site. They have been assessed against the “Residential with Plant Uptake” GACs.

5.2.2 pH was recorded between 5.84 and 6.73 which is representative of mildly acidic to near neutral conditions and generally acceptable.

5.2.3 2no samples of Topsoil were tested for:

- Metals and semi-metals;
- Total cyanide; and
- PAHs.

5.2.4 None of the concentrations or 95th percentile concentrations of the metals exceeded their defined GACs.

5.2.5 All of the concentrations of total cyanide were recorded below the laboratory method detection limit and therefore none of the concentrations exceeded the defined GAC.

5.2.6 The majority of the concentrations and 95th percentile concentrations of the PAHs passed their defined GACs with the exception of 1no samples (WS105 at 0.1mbgl) in which Benzo(a)pyrene was found to be elevated (2.23mg/kg) and exceeding the defined GAC of 1mg/kg.

5.3 Made Ground Analysis

5.3.1 2no samples of Made Ground have been analysed for potential contaminants of concern and assessed against the “Residential with Plant Uptake” GACs.

5.3.2 pH was recorded between 7.03 and 7.44 which is representative of neutral conditions and considered acceptable.

5.3.3 2no samples of Made Ground were tested for:

- Metals and semi-metals;
- Total cyanide; and
- PAHs.

5.3.4 None of the concentrations or 95th percentile concentrations of the metals exceeded their defined GACs.

5.3.5 All of the concentrations of total cyanide were recorded below the laboratory method detection limit and therefore none of the concentrations exceeded the defined GAC.

5.3.6 All of the concentrations and 95th percentile concentrations of the PAHs passed their defined GACs.

5.4 Natural Soil Analysis

5.4.1 4no samples of Glacial Till have been analysed for pH which was recorded between 6.34 and 7.11. This is representative of near neutral to neutral conditions and generally considered acceptable.

5.5 Conclusions

5.5.1 Sampling and testing of the Made Ground and Topsoil has been undertaken at the site to quantify the level of contamination in the Made Ground/shallow soils that could potentially be exposed at the surface in the proposed development.

5.5.2 The only failure was recorded in the topsoil sample taken from WS105 which marginally failed the GAC for Benzo(a)pyrene.

5.5.3 On the basis of this assessment, the quality of the existing Topsoil and shallow Made Ground soils (in terms of their chemical suitability) does not meet Residential with Plant Uptake standards/criteria; principally due to the presence Benzo(a)pyrene in the sample from WS105.

5.5.4 The driving exposure pathways for the contaminant comprise direct exposure including soil ingestion and dermal contact. Therefore, in areas with buildings/external hardstanding or similar, no such potential pollution linkage would exist, and hence no specific remedial actions are required.

5.5.5 In garden and landscaped areas the shallow Made Ground soils will need to be replaced with a suitable cover of clean material.

5.5.6 Given the proposed development plans are likely to mimic the existing site levels a “full” 600mm cover system is considered unlikely to be required. Considering the limited thickness of Made Ground and Topsoil across the site (generally less than 0.35m) and the current/proposed site levels, this approach would remove all contaminated material rendering a “full” capping system unnecessary.

5.5.7 A superficial scrape would be feasible to strip away the Made Ground materials down to the underlying clean natural strata. A basic NHBC capping system would then be adequate, comprising minimum 150mm clean imported topsoil.

6. Ground Gas Assessment

6.1 Methodology

6.1.1 Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide within ground gas) is provided in two key documents:

- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments. British Standard Institution (BS 8485: 2007); and
- Assessing Risks posed by Hazardous Ground Gases to Buildings CIRIA (C665, 2007).

6.1.2 The assessment presented herein is primarily based on the British Standard document.

6.1.3 Hazardous ground gases can be considered as a type of land contamination, and qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be provided, based upon the qualitative risk model and gas monitoring results.

6.1.4 Based on the measured flow rates and measured hazardous gas concentrations, individual "hazardous gas flow rates" (Q_{hg}) can be derived for each monitoring point, from which the "site characteristic hazardous gas flow rate" (Q_{hgs}), and then the "Characteristic Situation" can be determined.

6.1.5 BS8485 provides guidance on the level of required gas protection based upon the characteristic situation and the type of development (e.g. non-managed property such as private housing, public buildings, commercial buildings or industrial buildings).

6.2 Ground Gas Conceptual Model

6.2.1 The proposed development comprises private houses and low-rise apartments. As such the sensitivity of the development has been deemed to be "High".

6.2.2 On-site potential sources of ground gas generation have been identified on the basis of the desk study information. These comprise Made Ground deposits which may give rise to the generation of hazardous ground gas where these materials comprise significant amounts of degradable materials/organic matter. Nevertheless the generation potential associated with Made Ground is typically low

6.2.3 The overall risk is therefore considered "Low", however a programme of gas monitoring, comprising 4no visits over a period of 1 month, has been completed to quantify the ground gas regime, allow a risk assessment to be completed and thereby confirm the anticipated low risk status.

6.3 Recorded Ground Gas Regime

6.3.1 Standpipes installed during the intrusive works have been monitored on 4no occasions between 14th February and 28th February 2014.

6.3.2 Visits #1, #3 and #4 are considered to have been undertaken at worst case (low and falling atmospheric pressure) conditions.

6.3.3 The gas monitoring dataset is presented in full in Appendix E.

6.3.4 The data collected have been compiled to complete a gas risk assessment for the site. A summary of the results together with the calculated hazardous gas flow rates is presented in the following table:

Summary of Gas Monitoring Results

Monitoring Well	Max Flow (l/hr)	Max CH_4 (%v/v)	Max CO_2 (%v/v)	Max CH_4 Q_{hg} (l/hr)	Max CO_2 Q_{hg} (l/hr)	Characteristic Situation
WS101	<0.1	<0.1	1.4	$1.0x10^{-4}$	$1.4 x10^{-3}$	1
WS103	<0.1	<0.1	7.4	$1.0x10^{-4}$	$7.4 x10^{-3}$	2
WS105	<0.1	<0.1	1.7	$1.0x10^{-4}$	$1.7 x10^{-3}$	1

Note: Where flow <0.1l/r and/or gas concentration <0.1% were recorded, a value of 0.1 has been assumed to calculate the Q_{hg}.

6.4 Assessment and Recommendations

6.4.1 The table below is reproduced from BS8485 and presents the relationship between thresholds in the monitoring data and "Characteristic Situations".

Characteristic Situations

Characteristic Situation	Hazard Potential	Q_{hgs} (l/hr)	Additional Factors
1	Very Low	<0.07	Typically ≤1% CH_4 and ≤5%CO_2
2	Low	≥0.07, <0.7	Typical measured flow rate <70l/h
3	Moderate	≥0.7,<3.5	
4	Moderate to High	≥3.5, <15	
5	High	≥15,<70	
6	Very High	≥70	

6.4.2 The following maximum results have been compared with the criteria outlined above:

- Maximum flow = <0.1 l/hr
- Maximum Methane = <0.1 %v/v
- Maximum Carbon Dioxide = 7.4 %v/v
- Maximum Q_{hg} = 0.0074 l/hr (carbon dioxide)

6.4.3 The CO_2 concentration exceeded the CS1/CS2 threshold in borehole WS103 on the third and fourth monitoring visits. Therefore the monitoring dataset indicates the site to fall into Characteristic Situation 2 (CS2).

6.4.4 No positive gas flows have been recorded, all but the aforementioned CO_2 concentrations and all of the CH_4 concentrations were within CS1. Furthermore all of the calculated Q_{hg} values were well within CS1.

6.4.5 The monitoring well response zone in WS103 was within firm to stiff Glacial Till and medium dense weathered Sandstone, and as such there is no obvious source from which the carbon dioxide was generated. It is understood that carbonate content within glacial soils can produce CO_2 however the pore space in Glacial Till soils is made of small discrete voids such that the presence of ground gas represents a relatively small volume. In reality this does not generally pose a significant risk to buildings or development constructed over such soils.

6.4.6 In consideration of the Conceptual Site Model and the above discussion, the determination of assessment of the site to be CS2 is considered overly conservative. On this basis the site has been determined Characteristic Situation 1 ('very low' gas risk) and therefore no gas protection measures will be required for the proposed buildings.

6.4.7 Notwithstanding, the construction of suspended floor slabs (and in particular the formation of a ventilated void space beneath the proposed buildings) will inherently provide additional protection against the accumulation of any CO_2 being released from natural soils beneath the proposed buildings.

7. Other Development Considerations

7.1 Waste Arisings

7.1.1 On the basis of the current information it is likely that the bulk of the Made Ground Materials would be classifiable as “Non-hazardous” and the natural soils and rock strata classifiable as “Inert” for landfill disposal.

7.1.2 An appropriate waste characterisation can only be undertaken on the material due to be disposed of via further chemical testing which should be completed prior to making disposal arrangements. In all cases where excess soils require off-site disposal, the materials need to be managed under the appropriate legislation and consideration given to any remedial techniques that could be used to improve the soil.

7.1.3 For Inert Waste disposal (and in the event of Hazardous Waste disposal), allowance will need to be made for adequate Waste Acceptance Criteria (WAC) testing with appropriate consideration of the additional time and cost associated with this.

7.2 Health, Safety & Environment

7.2.1 Despite the findings of the testing there remains a potential (albeit unlikely) for more-significantly impacted soils to be encountered; consideration should therefore be given to the level of PPE that should be provided to future site operatives.

7.2.2 All work on site should be conducted in accordance with appropriate Health and Safety guidance, with particular reference to HSG66 (HSE, 1991).

7.2.3 Care should be taken to minimise the risk of potentially contaminative incidents occurring during redevelopment. Good working practices should be adopted during construction works in order to minimise the risk of contamination occurring as a result of spillage or leakage of fuels, oils or chemicals stored or used at the site during re-development. All such materials should be sited on an impervious base within a bund and should be adequately secured. In particular, care should be taken to prevent fuel, oils or other mobile contamination sources from entering any surface water drains at the site.

7.2.4 Throughout any redevelopment works, due regard should be given to potential detrimental effects on the surroundings including noise, vibration, odour and dust.

7.3 Potable Water Supply

7.3.1 There are currently no (fully adopted) national standards for the protection of potable water supply pipes in potentially contaminated ground. However the UKWIR has published guidance in this respect and site testing should be undertaken with due recognition of this guidance.

7.3.2 On the basis of the ground conditions encountered, no specific protection measures are envisaged for the subject site however it is recommended that consultation is undertaken with the local supplier (United Utilities) to confirm this.

8. References

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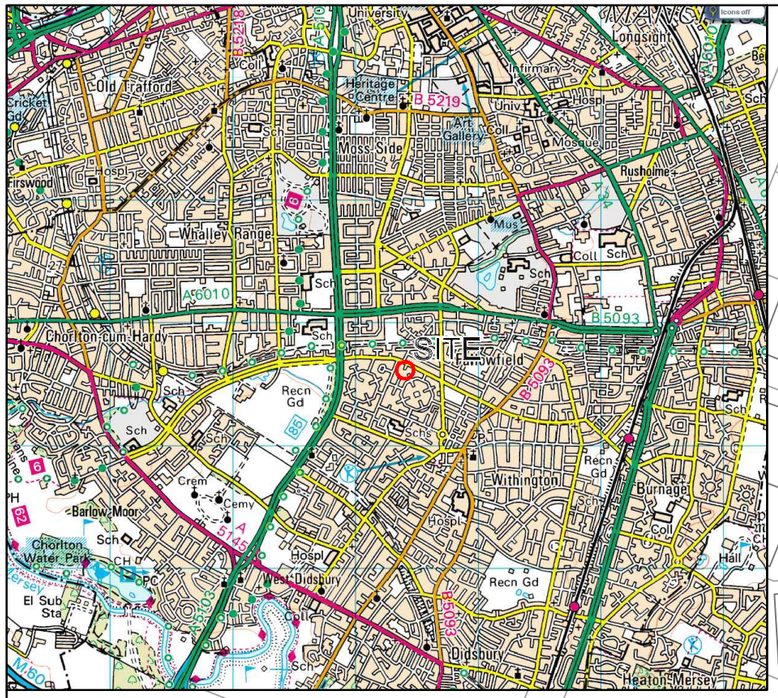
Environment Agency, 2009c. CLEA Software (Version 1.04) Handbook. Science Report – SC050021/SR4.

Environment Agency, 2009d. Contaminated Land Exposure Assessment Model (CLEA): Publication of Toxicological Reports (TOX) and Soil Guideline Values (SGV). CLEA Bulletin March 2009.

Manchester City Council Environment Protection Group, 2013. Planning Guidance in Relation to Ground Contamination: Guidance Note for Applicants, Developers, Land Owners and Consultants.

Wilson S, Oliver S, Mallett H, Hutchings H and Card G, 2008. Assessing Risks Posed by Hazardous Ground Gases to Buildings. (CIRIA) Report C665

Appendix A Figures and Drawings



GENERAL NOTES

Do not scale from this drawing. Work from figured dimensions only. All dimensions are in millimetres u.n.o.

No deviation from the details shown on this drawing will be allowed without prior permission in writing.

All drawings are to be read in conjunction with all architects, engineers and specialist drawings and details.

Key:

WS101 Capita windowless sampler probeholes

Rev	Date	Revision	By	Checked	Authorised

Client:

Southway Housing Trust

Project:

Westbrook Walk, Manchester

Title:

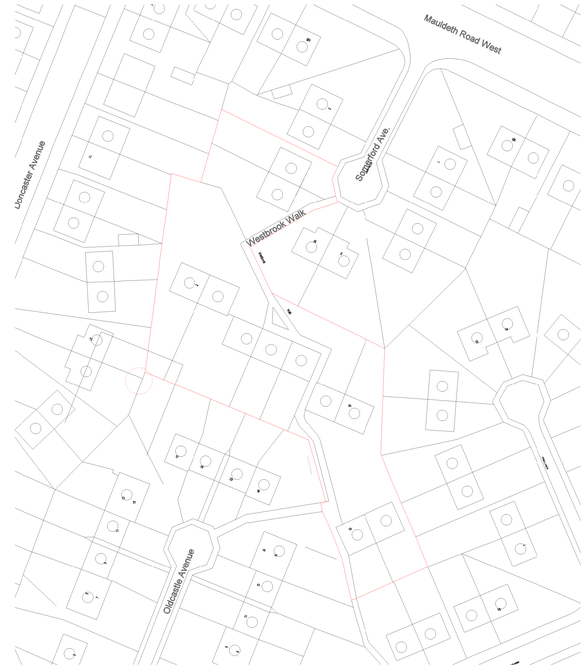
FIGURE 1:
Site Layout &
Exploratory Hole
Location Plan

CAPITA SYMONDS
STRUCTURES
Consulting Civil, Structural & Geo-Environmental Engineers
MANCHESTER
Clemence House, 9 Mellor Road
Cheadle Hulme, Cheshire, SK8 5AT
Tel: (+44) 0161 486 1521
Fax: (+44) 0161 486 1580
E-mail: capitasymonds.cheadle@capita.co.uk
Offices also at:
Bristol Cambridge
London Sheffield
Watford
Special Projects: Cheadle Hulme
www.capitasymonds.co.uk/structures

Drawn at	Scale @ A3	Date
MANCHESTER	1:500	Jan '14
Drawn	**Checked**	**Authorised**
JLA	EY	JLA

Project No.:	Drawing No.:	Revision:
SS019075	002	-





Rev	Date	Int	Description
A	6.11.13	VJS	Trees added boundaries ammended

DO NOT SCALE FROM THIS DRAWING
ALL DIMENSIONS MUST BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION

Client:
Southway Housing Trust

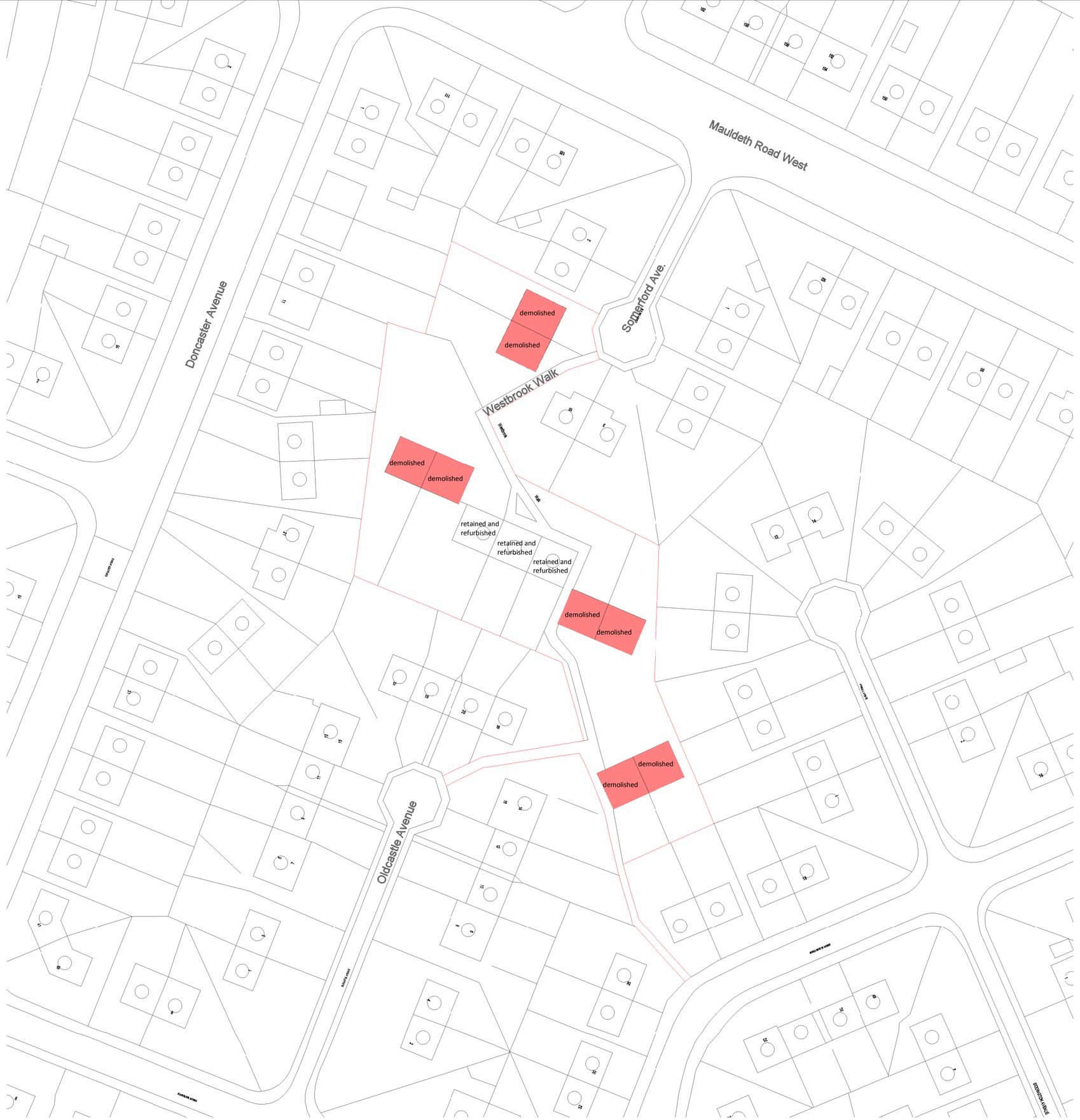
Project:
Westbrook Walk

Description:
Westbrook Walk Proposed Site plan line and level

Drawn By: VJS
Checked By: VJS
Date: 11/05/13
Scale @ A1: As indicated
Job No: 2600
Drawing No: 006
Rev: A

Bernard Taylor Partnership ARCHITECTS
Elizabeth House, 486 Didsbury Road, Heaton Mersey, Stockport, SK4 3BS
t 0161 443 1221 f 0161 442 1672 e info@bernardtaylor.co.uk
www.bernardtaylor.co.uk

DO NOT SCALE FROM THIS DRAWING
ALL DIMENSIONS MUST BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION



03 Demolished Dwellings

1 : 500

Rev	Date	Int	Description

Bernard Taylor Partnership
ARCHITECTS

Client:
Southway Housing Trust

Project:
Westbrook Walk

Description:
Buildings to be demolished

Drawn By:	Checked By:	Date:	Scale @ A2:
MA	-	11/15/13	1 : 500

Job No:	Drawing No:	Rev:
2600	004	

Elizabeth House, 486 Didsbury Road, Heaton Mersey, Stockport, SK4 3BS
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www.bernardtaylor.co.uk

Appendix B Exploratory Hole Records

CAPITA

Capita Engineering
Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire SK8 5AT
Tel : 0161 486 1521

Project Name : Westbrook Walk		Probehole Number WS101
Job Number : SS019075		
Client Name : Southway Housing Trust		Sheet 1 of 1 Scale =1:50
E Coord: -	N Coord: - G.L. : - (m) AOD	Logged By: EY
Date: 05/02/2014	Method: Dynamic Window Sampler	Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level (m) AOD	Legend	Depth (m)	Description	Water	Well Details
0.15	ES				(0.25) 0.25	Grass over soft dark brown sandy TOPSOIL, with abundant rootlets.		
					0.30	MADE GROUND: Loose granular dark grey sandy GRAVEL.		
0.80	ES				(0.70)			
1.00 - 1.45	S	N=11 (2,2,3,3,2,3)			1.00	Soft to firm brown mottled yellow gravelly sandy CLAY. (Glacial Till) 0.7m: Firm		
					(1.15)	Medium dense red medium grained SAND (Weathered Sherwood Sandstone).		
2.00 - 2.15	S	50/70mm (25,50)			2.15	End of Probehole at 2.15 m		

1 2 3 4 5 6 7

SAMPLE / TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
EV - Environmental Vial Sample
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

Water Strike
Water Level

REMARKS

Refusal at 2m

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
	No Groundwater Encountered				

Groundwater Remarks:	Drilling Crew
No Groundwater Encountered	RP Drilling

CAPITA

Capita Engineering
Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire SK8 5AT
Tel : 0161 486 1521

Project Name : Westbrook Walk		Probehole Number WS102
Job Number : SS019075		
Client Name : Southway Housing Trust		Sheet 1 of 1 Scale =1:50
E Coord: -	N Coord: - G.L. : - (m) AOD	Logged By: EY
Date: 05/02/2014	Method: Dynamic Window Sampler	Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result
0.15	ES	
0.30	ES	
0.60	ES	
1.00 - 1.45	S	N=11 (1,2,3,3,2,3)
1.00	D	
1.00	ES	
2.00 - 2.30	S	50/150mm (13,12,38,12)

Level (m) AOD	Legend	Depth (m)	Description	Water	Well Details
		(0.25) 0.25	Grass over soft dark brown gravelly sandy TOPSOIL, with abundant rootlets.		
		0.35	MADE GROUND: Loose granular dark grey coarse GRAVEL with fragments of slate and clinker.		
		(0.85)			
		1.20	Firm to stiff tan mottled grey gravelly sandy CLAY. (Glacial Till) 1.1m: Stiff		
		(1.10)	Medium dense red medium grained SAND (Weathered Sherwood Sandstone).		
		2.30	End of Probehole at 2.30 m		

1 2 3 4 5 6 7

SAMPLE / TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
EV - Environmental Vial Sample
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

Water Strike
Water Level

REMARKS

Refusal at 2m

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
	No Groundwater Encountered				

Groundwater Remarks:	Drilling Crew
No Groundwater Encountered	RP Drilling

CAPITA

Capita Engineering
Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire SK8 5AT
Tel : 0161 486 1521

Project Name : Westbrook Walk		Probehole Number WS103
Job Number : SS019075		
Client Name : Southway Housing Trust		Sheet 1 of 1 Scale =1:50
E Coord: -	N Coord: - G.L. : - (m) AOD	Logged By: EY
Date: 05/02/2014	Method: Dynamic Window Sampler	Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result
0.05	ES	
0.30	ES	
1.00 - 1.45	S	N=9 (2,1,2,2,3,2)
1.20	D	
1.20	ES	
2.00 - 2.23	S	50/100mm (12,13,36,14)

Level (m) AOD	Legend	Depth (m)	Description
		0.10	Grass over soft dark brown gravelly sandy TOPSOIL, with abundant rootlets.
		(0.25)	
		0.35	MADE GROUND: Loose granular black coarse GRAVEL with clinker.
		0.45	
		(0.90)	MADE GROUND: Loose granular red coarse GRAVEL of sandstone with fragments of clay pipe.
		1.35	Firm to stiff grey mottled tan gravelly sandy CLAY. (Glacial Till) 1.2m: Stiff
		(0.88)	
		2.23	Medium dense red medium grained SAND (Weathered Sherwood Sandstone).
			End of Probehole at 2.23 m

Water: 1 2 3 4 5 6 7

Well Details

SAMPLE / TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
EV - Environmental Vial Sample
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike
▼ Water Level

REMARKS

Refusal at 2m

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
	No Groundwater Encountered				

Groundwater Remarks:	Drilling Crew
No Groundwater Encountered	RP Drilling

CAPITA

Capita Engineering
Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire SK8 5AT
Tel : 0161 486 1521

Project Name : Westbrook Walk

Job Number : SS019075

Client Name : Southway Housing Trust

Probehole Number

WS104

Sheet 1 of 1 Scale =1:50

E Coord: - | N Coord: - | G.L. : - (m) AOD | Logged By: EY

Date: 05/02/2014 | Method: Dynamic Window Sampler | Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result
0.10	ES	
1.00 - 1.45	S	N=9 (2,2,2,3,2,2)
1.40	D	
1.40	ES	
2.00 - 2.37	S	50/220mm (5,6,12,12,26)

Level (m) AOD	Legend	Depth (m)	Description
		0.15	Grass over soft dark brown sandy TOPSOIL, with abundant rootlets.
		0.25	MADE GROUND: Loose granular red brown coarse GRAVEL with fragments of slate.
		(1.35)	Firm to stiff tan mottled grey gravelly sandy CLAY. (Glacial Till)
			1.3m: Stiff
		1.60	Medium dense red medium grained SAND (Weathered Sherwood Sandstone).
		(0.77)	
		2.37	End of Probehole at 2.37 m

Water: 1 2 3 4 5 6 7

Well Details

SAMPLE / TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
EV - Environmental Vial Sample
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration
▽ Water Strike
▼ Water Level

REMARKS

Refusal at 2m

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
	No Groundwater Encountered				

Groundwater Remarks: No Groundwater Encountered

Drilling Crew: RP Drilling

CAPITA

Capita Engineering
Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire SK8 5AT
Tel : 0161 486 1521

Project Name : Westbrook Walk

Job Number : SS019075

Client Name : Southway Housing Trust

Probehole Number
WS105

Sheet 1 of 1 Scale =1:50

E Coord: - | N Coord: - | G.L. : - (m) AOD | Logged By: EY

Date: 05/02/2014 | Method: Dynamic Window Sampler | Checked By: JLA

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level (m) AOD	Legend	Depth (m)	Description	Water	Well Details
0.10	ES				(0.20) 0.20	Grass over soft dark brown sandy TOPSOIL, with abundant rootlets.		
					0.35	MADE GROUND: Loose granular red brown coarse GRAVEL with fragments of slate.		
1.00 - 1.45	S	N=6 (1,1,1,1,2,2)			(1.30)	Firm grey mottled tan gravelly sandy CLAY. (Glacial Till)		
1.00	D							
1.00	ES				1.65			
2.00 - 2.45	S	N=16 (1,1,1,2,3,10)			(1.01)	Medium dense red medium grained SAND (Weathered Sherwood Sandstone).		
2.50 - 2.66	S	50/95mm (25,39,11)			2.66	End of Probehole at 2.66 m	2.30	

SAMPLE / TEST KEY
- B - Bulk Sample
- D - Small Disturbed Sample
- ES - Environmental Sample
- EV - Environmental Vial Sample
- W - Water Sample
- S - Standard Penetration Test
- C - Cone Penetration Test
- N - Penetration Test 'N' Value
- V - Hand Shear Vane Test, kPa
- * - Partial Seating Penetration
- ▽ Water Strike
- ▼ Water Level

REMARKS

Refusal at 2.5m

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
-	2.30			2.30	

Groundwater Remarks:

Drilling Crew: RP Drilling

Appendix C Geotechnical Laboratory Reports

PSL
Professional Soils Laboratory

LABORATORY REPORT

UKAS TESTING
4043

Contract Number: PSL14/0615

Client's Reference: Report Date: 13 February 2014

Client Name: Capita
Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire
SK8 5AT

For the attention of: Elizabeth Yeatman

Contract Title: Westbrook Walk, Manchester

Date Received: 6/2/2014
Date Commenced: 6/2/2014
Date Completed: 13/2/2014

Notes: Observations and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. 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 in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
M Beastall (Laboratory Manager)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
WS102			1.00	Brown slightly gravelly slightly sandy CLAY.
WS103			1.20	Brown gravelly very sandy CLAY.
WS104			1.40	Brown gravelly very sandy CLAY.
WS105			1.00	Brown slightly gravelly slightly sandy CLAY.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	13/02/14		13/02/14		13/02/14

WESTBROOK WALK, MANCHESTER.

Contract No: PSL14/0615

Client Ref: CS070567-03

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % Clause 3.2	Bulk Density Mg/m^3 Clause 7.2	Dry Density Mg/m^3 Clause 7.2	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	% Passing .425mm	Remarks
WS102			1.00	23				50	21	29	94	High plasticity CH.
WS103			1.20	16				27	15	12	82	Low plasticity CL.
WS104			1.40	15				30	17	13	80	Low plasticity CL.
WS105			1.00	26				56	23	33	96	High plasticity CH.

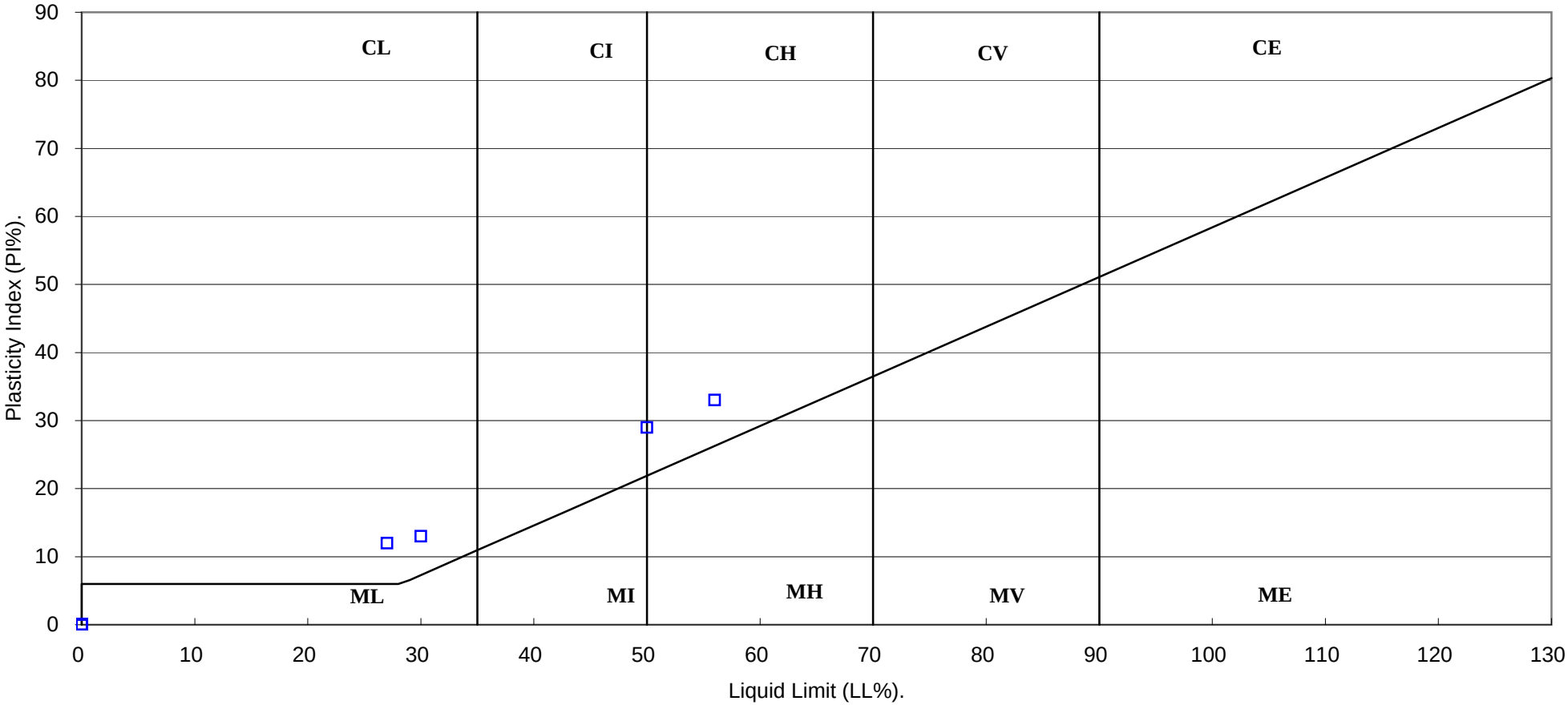
SYMBOLS : NP : Non Plastic

PSL Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	13/02/14		13/02/14		13/02/14
WESTBROOK WALK, MANCHESTER.				**Contract No:**	**PSL14/0615**
				Client Ref:	**CS070567-03**

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



PSL Professional Soils Laboratory	Compiled by	Date	Checked by	Date	Approved by	Date
		13/02/14		13/02/14		13/02/14
	WESTBROOK WALK, MANCHESTER.				Contract No:	PSL14/0615
					Client Ref:	CS070567-03

Appendix D Chemical Laboratory Reports

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 14/00609
Issue Number: 1 **Date:** 14 February, 2014

Client: Capita Property and Infrastructure, Clemence House
9 Mellor Road
Cheadle Hulme
Cheshire
UK
SK8 5AT

Project Manager: Elizabeth Yeatman
Project Name: Westbrook Walk
Project Ref: CS/070567
Order No: ZMCH/SS/070567-03
Date Samples Received: 06/02/14
Date Instructions Received: 06/02/14
Date Analysis Completed: 14/02/14

Prepared by:

Lynette Toon
Administrative Assistant

Approved by:

Liz Oliver
Client Service Manager

Envirolab Job Number: 14/00609

Client Project Name: Westbrook Walk

Client Project Ref: CS/070567

Lab Sample ID	14/00609/1	14/00609/2	14/00609/4	14/00609/6	14/00609/8	14/00609/9	14/00609/11	14/00609/12	Units	Method ref
Client Sample No										
Client Sample ID	WS101	WS101	WS102	WS102	WS103	WS103	WS104	WS105		
Depth to Top	0.15	0.80	0.30	1.00	0.30	1.20	1.40	0.10		
Depth To Bottom										
Date Sampled	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
MCERTS Sample Matrix Code	6AE	5	4ABC	5E	4A	5	5A	6E		
% Stones >10mm$_A^{\#}$	5.2	<0.1	2.3	<0.1	10.9	<0.1	<0.1	<0.1	% w/w	A-T-044
pH$_D^{M\#}$	6.73	-	7.44	-	7.03	-	-	5.84	pH	A-T-031s
pH BRE$_D^{M\#}$	-	6.34	-	6.82	-	7.11	6.39	-	pH	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	-	39	-	26	-	20	26	-	mg/l	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	-	<1	-	<1	-	-	<1	mg/kg	A-T-042sTCN
Arsenic$_D^{M\#}$	7	-	13	-	29	-	-	13	mg/kg	A-T-024
Boron (water soluble)$_D^{M\#}$	<1.0	-	<1.0	-	<1.0	-	-	<1.0	mg/kg	A-T-027s
Cadmium$_D^{M\#}$	<0.5	-	0.7	-	1.6	-	-	0.9	mg/kg	A-T-024
Copper$_D^{M\#}$	19	-	49	-	75	-	-	37	mg/kg	A-T-024
Chromium$_D^{\#}$	9	-	10	-	19	-	-	12	mg/kg	A-T-024
Chromium (hexavalent)$_D$	<1	-	<1	-	<1	-	-	<1	mg/kg	A-T-040s
Lead$_D^{M\#}$	43	-	31	-	33	-	-	59	mg/kg	A-T-024
Mercury$_D$	0.25	-	0.26	-	0.26	-	-	<0.17	mg/kg	A-T-024
Nickel$_D^{\#}$	8	-	18	-	55	-	-	15	mg/kg	A-T-024
Selenium$_D^{\#}$	<1	-	<1	-	2	-	-	<1	mg/kg	A-T-024
Zinc$_D^{M\#}$	34	-	45	-	95	-	-	161	mg/kg	A-T-024

Envirolab Job Number: 14/00609

Client Project Name: Westbrook Walk

Client Project Ref: CS/070567

Lab Sample ID	14/00609/1	14/00609/2	14/00609/4	14/00609/6	14/00609/8	14/00609/9	14/00609/11	14/00609/12	Units	Method ref
Client Sample No										
Client Sample ID	WS101	WS101	WS102	WS102	WS103	WS103	WS104	WS105		
Depth to Top	0.15	0.80	0.30	1.00	0.30	1.20	1.40	0.10		
Depth To Bottom										
Date Sampled	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14	05-Feb-14		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
MCERTS Sample Matrix Code	6AE	5	4ABC	5E	4A	5	5A	6E		
PAH 16										
Acenaphthene$_A^{M\#}$	0.07	-	<0.01	-	<0.01	-	-	0.13	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	-	<0.01	-	<0.01	-	-	0.04	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.17	-	0.07	-	<0.02	-	-	0.49	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.42	-	0.28	-	<0.04	-	-	1.85	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.57	-	0.46	-	<0.04	-	-	2.23	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.51	-	0.42	-	<0.05	-	-	1.97	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.34	-	0.30	-	<0.05	-	-	1.31	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.38	-	0.29	-	<0.07	-	-	1.91	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.63	-	0.46	-	<0.06	-	-	2.30	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.07	-	<0.04	-	<0.04	-	-	0.23	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	1.26	-	0.71	-	<0.08	-	-	5.11	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.03	-	<0.01	-	<0.01	-	-	0.07	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.28	-	0.24	-	<0.03	-	-	1.18	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	-	0.05	-	<0.03	-	-	0.06	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.66	-	0.26	-	<0.03	-	-	1.80	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	1.17	-	0.70	-	<0.07	-	-	4.12	mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	6.56	-	4.22	-	<0.08	-	-	24.8	mg/kg	A-T-019s

REPORT NOTES

Notes - Soil chemical analysis
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

Notes - General
Subscript "A" indicates analysis performed on the sample as received. "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve, unless asbestos is found to be present in which case all analysis is performed on the sample as received.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts.
All analysis is performed on the sample as received for soil samples from outside the European Union and this supercedes any "D" subscripts.
Superscript "M" indicates method accredited to MCERTS.
For complex, multi-compound analysis, quality control results do not always fall within chart limits for every compound and we have criteria for reporting in these situations. If results are in italic font they are associated with such quality control failures and may be 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.

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.

Asbestos in soil
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if present as discrete fibres/fragments. 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 a 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.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.

Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient 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.
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.

Please contact us if you need any further information.

Appendix E Gas and Groundwater Monitoring Records

Gas & Groundwater Monitoring Record Sheet

CAPITA

PROJECT: Westbrook Walk
PROJECT No: SS019075
CLIENT: Southway Housing Trust

		ATMOS PRES./TREND*	BG O_2
DATE:	14-Feb		
START:	09:50	988 mb	20.8 %
FINISH:	10:15	987 mb	20.7 %
		Falling	

INSTRUMENT: Gas Data Ltd. GFM435 Multi Gas Analyser
OPERATOR: NF

GROUND/WEATHER CONDITIONS: Damp, Overcast

Hole	SP ID	Flow	PD	CH_4 Peak	CH_4 GSV	CO_2 Peak	CO_2 GSV	Charac-teristic Situation	Min O_2	Peak H_2S	Peak CO	Water Level	SP base	Monitoring Remarks
		l/hr	mb	%vol	l/hr	%vol	l/hr		%vol	ppm	ppm	mbgl	mbgl	
WS101	SP1	<0.1	0.0	<0.1	0.0001	0.8	0.0008	1	19.7	0	0	Dry	2.10	
WS103	SP2	<0.1	0.0	<0.1	0.0001	4.7	0.0047	1	15.0	0	0	1.74	2.06	
WS105	SP3	<0.1	0.0	<0.1	0.0001	1.1	0.0011	1	19.4	0	0	1.87	2.14	

Gas & Groundwater Monitoring Record Sheet

CAPITA

PROJECT: Westbrook Walk
PROJECT No: SS019075
CLIENT: Southway Housing Trust

DATE: 19-Feb
START: 09:45
FINISH: 10:05

ATMOS PRES./TREND* **BG O_2**
1007 mb 20.7 %
1006 mb 20.6 %
Falling

INSTRUMENT: Gas Data Ltd. GFM435 Multi Gas Analyser
OPERATOR: NF

GROUND/WEATHER CONDITIONS: Damp/Cloudy

Hole	SP ID	Flow	PD	CH_4 Peak	CH_4 GSV	CO_2 Peak	CO_2 GSV	Charac-teristic Situation	Min O_2	Peak H_2S	Peak CO	Water Level	SP base	Monitoring Remarks
		l/hr	mb	%vol	l/hr	%vol	l/hr		%vol	ppm	ppm	mbgl	mbgl	
WS101	SP1	<0.1	0.0	<0.1	0.0000	1.4	0.0014	1	19.1	0	0	Dry	2.10	
WS103	SP2	<0.1	0.0	<0.1	0.0000	4.8	0.0048	1	12.8	0	0	1.76	2.07	
WS105	SP3	<0.1	0.0	<0.1	0.0000	1.1	0.0011	1	19.5	0	0	1.91	2.15	

Gas & Groundwater Monitoring Record Sheet

CAPITA

PROJECT: Westbrook Walk
PROJECT No: SS019075
CLIENT: Southway Housing Trust

DATE: 24-Feb
START: 10:00
FINISH: 10:25

ATMOS PRES./TREND*
998 mb
997 mb
Falling

BG O_2
20.7 %
20.6 %

INSTRUMENT: Gas Data Ltd. GFM435 Multi Gas Analyser
OPERATOR: NF

GROUND/WEATHER CONDITIONS: Damp & Cloudy

Hole	SP ID	Flow	PD	CH_4 Peak	CH_4 GSV	CO_2 Peak	CO_2 GSV	Charac-teristic Situation	Min O_2	Peak H_2S	Peak CO	Water Level	SP base	Monitoring Remarks
		l/hr	mb	%vol	l/hr	%vol	l/hr		%vol	ppm	ppm	mbgl	mbgl	
WS101	SP1	<0.1	0.0	<0.1	0.0001	0.7	0.0007	1	19.9	0	0	Dry	2.09	
WS103	SP2	<0.1	0.0	<0.1	0.0001	6.9	0.0069	2	7.5	0	0	1.82	2.06	
WS105	SP3	<0.1	0.0	<0.1	0.0001	1.7	0.0017	1	18.6	0	0	1.96	2.14	

Gas & Groundwater Monitoring Record Sheet

CAPITA

PROJECT: Westbrook Walk
PROJECT No: SS019075
CLIENT: Southway Housing Trust

DATE: 28-Feb
START: 09:45
FINISH: 10:05

ATMOS PRES./TREND* **BG O_2**
998 mb 20.9 %
997 mb 20.7 %
Falling

INSTRUMENT: Gas Data Ltd. GFM435 Multi Gas Analyser
OPERATOR: NF

GROUND/WEATHER CONDITIONS: Damp, Sunny & Cold

Hole	SP ID	Flow	PD	CH_4		CO_2		Charac-teristic Situation	Min O_2	Peak H_2S	Peak CO	Water Level	SP base	Monitoring Remarks
				Peak	GSV	Peak	GSV							
		l/hr	mb	%vol	l/hr	%vol	l/hr		%vol	ppm	ppm	mbgl	mbgl	
WS101	SP1	<0.1	0.0	<0.1	0.0001	1.2	0.0012	1	19.2	0	0	Dry	2.09	
WS103	SP2	<0.1	0.0	<0.1	0.0001	7.4	0.0074	2	4.3	0	0	1.87	2.07	
WS105	SP3	<0.1	0.0	<0.1	0.0001	1.7	0.0017	1	18.9	0	0	1.95	2.14	

Appendix F Generic Quantitative Risk Assessment

Key

Key statistical symbols and terms

GAC	Generic Assessment Criteria
Normality	Shapiro-Wilk test provides a reliable check on whether a test based on normailty (like the one-sample t-test) can be applied on the data set under scrutiny. Where the size of a data set is greater than n=50 a visual assessment of the normailty of the data is undertaken using a probabilty plot. **Normal**, deviation of the data set from normality is not significant. One-sample t-test can be used when testing the mean against a Critical concentration/GAC. **Not Normal**, deviation of the data set from normality has been identified as being significant. If normality of a relatively large data set appears to be normal through visual assessment but is indicated to be not normal by the Shapiro-Wilk test, then the One-side Chebychev Theorum has used when testing the mean against a Critical concentration/GAC.
No. exceeding GAC	Number of sample concentrations exceeding the defined GAC.
No. Outliers	Number of statistical Outliers determined using Grubbs Test for data sets n>2. Where the maximum value in a data set has been identified as an outlier, the test has been repeated on the second largest value (by removing the max value) and then the 3rd largest value... etc, until the maximum concetration is not reported as an Outlier.
Test	**t**, the one-sample t-test (for datasets n>1) **c**, the one-sided Chebychev Theorum or Chebychev Inequality (for data sets n>1) N.B. the tests for comparing the mean against a critical concentration can only be applied when n>1 and the sample population standard deviation>0
UCL95%	95% Upper Confidence Limit (of the true population mean)
Test Result	**FAIL**, the 95% UCL exceeds the defined GAC. **PASS**, the 95% UCL does not exceed the defined GAC
Bold Red Type	Used to highlight the "No. exceeding GAC", "no. Outliers" and "Test Result" on the Summary of Statistics Sheet. Where the test result is reported as "FAIL" the whole row for a particular contaminant is highlighted.
Filled Cells	Used to highlight exceedances (individual sample concentrations exceeding the GAC) in the Summary of Concentrations sheets.
Bold Underlined	Used to highlight maximum value outliers (as determined using an iterative Grubbs Test) in the Summary of Concentrations sheets. Outliers may also be shown in filled cells (exceedances).

Summary of Statistics

Geology:	**Made Ground/Topsoil**
Site End Use:	**Residential With Plant Uptake**
Soil Type:	**Sand - 1% SOM**

Project Number: SS019075
Client: Southway Housing Trust

Compound	GAC (mg/kg)	No. Samples	Range of values (mg/kg)	exceeding GAC	Normality	No. Outliers	Test	$UCL_{95\%}$ (of the true population mean)	Test Result
Metals									
Arsenic SGV	32	4	7 - 29	0	Normal	1	t	26.6	PASS
Boron	94	4	1 - 1	0					
Cadmium SGV	10	4	0.5 - 1.6	0	Normal	None	t	1.5	PASS
Chromium VI	34	4	1 - 1	0					
Copper	630	4	19 - 75	0	Normal	None	t	72.6	PASS
Lead	180	4	31 - 59	0	Normal	None	t	56.6	PASS
Mercury SGV	170	4	0.17 - 0.26	0	Normal	None	t	0.3	PASS
Nickel SGV	130	4	8 - 55	0	Normal	1	t	48.8	PASS
Selenium SGV	350	4	1 - 2	0	Not Normal	1	c	2.3	PASS
Vanadium	200	0							
Zinc	2200	4	34 - 161	0	Normal	None	t	151.9	PASS
Non-Metals									
Inorganic Cyanide	780	4	1 - 1	0					
TPH									
Aliphatic C5-6	17	0							
Aliphatic C6-8	33	0							
Aliphatic C8-10	7.8	0							
Aliphatic C10-12	44	0							
Aliphatic C12-16	210	0							
Aliphatic C16-21	N/A	0							
Aliphatic C21-35	N/A	0							
Aliphatic C16-35	17000	0							
Aromatic C8-10	11	0							
Aromatic C10-12	35	0							
Aromatic C12-16	91	0							
Aromatic C16-21	200	0							
Aromatic C21-35	790	0							
VOCs									
Benzene SGV	0.054	0							
Chloroethene	0.00024	0							
1,2-Dichloroethane	0.0022	0							
Ethylbenzene SGV	42	0							
Naphthalene	5.5	0							
Tetrachloroethanes	0.41	0							
Tetrachloroethene	0.53	0							
Tetrachloromethane	0.0077	0							
Toluene SGV	92	0							
1,1,1-Trichloroethane	2.6	0							
Trichloroethene	0.045	0							
Xylenes SGV	20	0							
SVOCs									
Benz[a]anthracene	7.1	4	0.04 - 1.85	0	Normal	1	t	1.6	PASS
Benzo[a]pyrene	**1**	**4**	**0.04 - 2.23**	**1**	**Normal**	**1**	**t**	**2.0**	**FAIL**
Benzo[b]fluoranthene	8.2	4	0.05 - 1.97	0	Normal	1	t	1.7	PASS
Benzo[ghi]perylene	9.8	4	0.05 - 1.31	0	Normal	1	t	1.2	PASS
Benzo[k]fluoranthene	8.8	4	0.07 - 1.91	0	Normal	1	t	1.7	PASS
Chrysene	66	4	0.06 - 2.3	0	Normal	1	t	2.0	PASS
Dibenz[ah]anthracene	1	4	0.04 - 0.23	0	Normal	2	t	0.2	PASS
Fluoranthene	620	4	0.08 - 5.11	0	Normal	1	t	4.5	PASS
Indeno[123-cd]pyrene	7.8	4	0.03 - 1.18	0	Normal	1	t	1.0	PASS
Naphthalene	5.5	4	0.03 - 0.06	0	Normal	None	t	0.1	PASS
Phenol SGV	180	0							
Pyrene	770	4	0.07 - 4.12	0	Normal	1	t	3.6	PASS

Summary of Concentrations

Geology:	**Made Ground/Topsoil**
Site End Use:	**Residential With Plant Uptake**
Soil Type:	**Sand - 1% SOM**

Project Number: SS019075

Client: Southway Housing Trust

		1	2	3	4	5	6	7	8	9	10
Compound	**GAC**	**WS101** 0.15m	**WS102** 0.30m	**WS103** 0.30m	**WS105** 0.10m						
Metals											
Arsenic SGV	32	7	13	**29**	13	-	-	-	-	-	-
Boron	94	1	1	1	1	-	-	-	-	-	-
Cadmium SGV	10	0.5	0.7	1.6	0.9	-	-	-	-	-	-
Chromium VI	34	1	1	1	1	-	-	-	-	-	-
Copper	630	19	49	75	37	-	-	-	-	-	-
Lead	180	43	31	33	59	-	-	-	-	-	-
Mercury SGV	170	0.25	0.26	0.26	0.17	-	-	-	-	-	-
Nickel SGV	130	8	18	**55**	15	-	-	-	-	-	-
Selenium SGV	350	1	1	**2**	1	-	-	-	-	-	-
Vanadium	200	-	-	-	-	-	-	-	-	-	-
Zinc	2200	34	45	95	161	-	-	-	-	-	-
Non-Metals											
Inorganic Cyanide	780	1	1	1	1	-	-	-	-	-	-
TPH											
Aliphatic C5-6	17	-	-	-	-	-	-	-	-	-	-
Aliphatic C6-8	33	-	-	-	-	-	-	-	-	-	-
Aliphatic C8-10	7.8	-	-	-	-	-	-	-	-	-	-
Aliphatic C10-12	44	-	-	-	-	-	-	-	-	-	-
Aliphatic C12-16	210	-	-	-	-	-	-	-	-	-	-
Aliphatic C16-21	N/A	-	-	-	-	-	-	-	-	-	-
Aliphatic C21-35	N/A	-	-	-	-	-	-	-	-	-	-
Aliphatic C16-35	17000	-	-	-	-	-	-	-	-	-	-
Aromatic C8-10	11	-	-	-	-	-	-	-	-	-	-
Aromatic C10-12	35	-	-	-	-	-	-	-	-	-	-
Aromatic C12-16	91	-	-	-	-	-	-	-	-	-	-
Aromatic C16-21	200	-	-	-	-	-	-	-	-	-	-
Aromatic C21-35	790	-	-	-	-	-	-	-	-	-	-
VOCs											
Benzene SGV	0.054	-	-	-	-	-	-	-	-	-	-
Chloroethene	0.00024	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	0.0022	-	-	-	-	-	-	-	-	-	-
Ethylbenzene SGV	42	-	-	-	-	-	-	-	-	-	-
Naphthalene	5.5	-	-	-	-	-	-	-	-	-	-
Tetrachloroethanes	0.41	-	-	-	-	-	-	-	-	-	-
Tetrachloroethene	0.53	-	-	-	-	-	-	-	-	-	-
Tetrachloromethane	0.0077	-	-	-	-	-	-	-	-	-	-
Toluene SGV	92	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	2.6	-	-	-	-	-	-	-	-	-	-
Trichloroethene	0.045	-	-	-	-	-	-	-	-	-	-
Xylenes SGV	20	-	-	-	-	-	-	-	-	-	-
SVOCs											
Benz[a]anthracene	7.1	0.42	0.28	0.04	**1.85**	-	-	-	-	-	-
Benzo[a]pyrene	1	0.57	0.46	0.04	**2.23**	-	-	-	-	-	-
Benzo[b]fluoranthene	8.2	0.51	0.42	0.05	**1.97**	-	-	-	-	-	-
Benzo[ghi]perylene	9.8	0.34	0.3	0.05	**1.31**	-	-	-	-	-	-
Benzo[k]fluoranthene	8.8	0.38	0.29	0.07	**1.91**	-	-	-	-	-	-
Chrysene	66	0.63	0.46	0.06	**2.3**	-	-	-	-	-	-
Dibenz[ah]anthracene	1	**0.07**	0.04	0.04	**0.23**	-	-	-	-	-	-
Fluoranthene	620	1.26	0.71	0.08	**5.11**	-	-	-	-	-	-
Indeno[123-cd]pyrene	7.8	0.28	0.24	0.03	**1.18**	-	-	-	-	-	-
Naphthalene	5.5	0.03	0.05	0.03	0.06	-	-	-	-	-	-
Phenol SGV.	180	-	-	-	-	-	-	-	-	-	-
Pyrene	770	1.17	0.7	0.07	**4.12**	-	-	-	-	-	-

Sample concentrations in mg/kg

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