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Phase II Interpretative Ground Assessment

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SUTCLIFFE INVESTIGATIONS

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FOREWORD (Geotechnical and Environmental Assessment)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Sutcliffe Investigation; such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their risk and the authors owe them no duty of care and skill.

The report presents observations and factual data obtained during our site investigation, and provides an assessment of Geotechnical and environmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Sutcliffe Investigation prior to significant revision of the development proposals. Primary aims of this exploratory phase of investigation were to identify salient geotechnical and environmental issues affecting the site to enable the client to obtain budget costs for the necessary site preparatory and remedial works.

The report should be read in its entirety, including all associated drawings and appendices. Sutcliffe Investigation cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report (including review of any third party reports) are based on information obtained from a variety of sources as detailed within this report, and which Sutcliffe Investigation believes are reliable. All reasonable care and skill has been applied in examining the information obtained. Nevertheless, Sutcliffe Investigation cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced Geotechnical and environmental consultants. Sutcliffe Investigations does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Sutcliffe Investigation, whilst fully appropriate, may not have encountered all significant subsurface conditions. Any opinions expressed as to the possible configuration of strata between or below exploratory holes are for guidance only and no responsibility is accepted as to its accuracy.

It should be borne in mind that the timescale over which the investigation was undertaken might not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during the wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

This report assumes that ground levels will not change significantly from those existing at present. If this is not to be the case, then some modification to this report may be required.

It should be noted that the banning of the co-disposal of hazardous and non-hazardous waste was introduced in 2011, as a result of the implementation within the UK of the Landfill Directive. This will considerably affect the current practices and procedures for the handling and disposal of wastes, in particular hazardous wastes. In addition, it will be a requirement for all wastes to be pre-treated and to comply with certain waste acceptance procedures prior to sending wastes to landfill. The full potential effects of these important changes are not known at this stage, but it is perceived that disposal costs will rise, particularly for hazardous wastes, and waste pre-treatment may, in some cases, become an 'additional' redevelopment cost with regard to the remediation of contaminated sites.

Should this report recommend that materials could be excavated and removed off site for landfill disposal, then it should be noted that the costs, timescales and implications of the pending changes to waste management legislation couldn't be predicted at this stage. Sutcliffe Investigation will not be responsible for changing practices, etc that may affect the viability of necessary remedial actions or of the implications of potential alternative treatment techniques.

Sutcliffe Investigation reserves the right to amend their conclusions and recommendations in the light of further information that may become available. General notes and limitations relevant to all Sutcliffe Investigations are described in the Foreword and should be read in conjunction with this report.

Executive Summary

INTRODUCTION	Sutcliffe Investigations was instructed by T J Thomas (the “client”) to undertake a Phase II ground assessment for the site at former Penny Black Pub, Lickers Lane, Prescott The site is centred on Grid Reference (NGR) 347547, 390575 and is approximately 0.2ha in area. This report assesses the ground based geotechnical and environmental risks, constraints and liabilities associated with the proposed development of the site. This is required in support of the discharge of contaminated land planning conditions assigned to the site and to allow the design of economic foundation solutions.
DEVELOPMENT PROPOSAL	It is understood that consideration is being given to redevelopment of the site with the development of 9No. new residential properties.
PRELIMINARY CONCEPTUAL MODEL	The earliest available historical map (1892) indicated that the site was located in a largely rural area with a boundary running through the site and a small pond noted along the southern boundary, which was no longer noted in 1927. In 1993 the site is occupied by a Public House and associated parking. The site remained relatively unchanged until the present day. The potential for significant contamination to have arisen at the site as a result of the current and former usage on site is considered to be low to moderate. Potential contaminants associated with such activities may comprise a wide range of metals, fuels, oils, acids, alkalis and asbestos. It is proposed to develop the site with houses with associated infrastructure and garden areas.
PREVIOUS WORKS	Sutcliffe's have completed a Phase I Desk Study, a synopsis of which is provided in Section 2 of this report, and have previously carried out investigation works on site in 2012. This report incorporates the findings of the 2012 investigation along with the findings of the 2016 works that have been carried out in line with the requirements of Knowsley Council. No other previous studies are known to have been undertaken to Sutcliffe's knowledge.
SITE INVESTIGATION	Site work was undertaken on 5th April 2012 & 19th August 2016 and consisted of: 4No. Window Sample Holes. 3No. Hand Auger Holes 3No. Trial Holes Contamination samples from various depth in the made ground. Leachate samples.
GROUND CONDITIONS	Made Ground: Made ground was encountered in all of the exploratory holes and extended to depths of between 0.50mbgl and 0.80mbgl; it should be noted though that the final depth of made ground was not proven in HAH2 at 0.60mbgl. The made ground generally comprised dark brown gravelly sand with rare angular fine brick fragments. Natural Ground: Natural ground was encountered within all of the exploratory holes with the exception of HAH2 and typically comprised firm brown silty sandy gravelly CLAY. Gravel is sub-angular fine and medium of various lithologies, over yellow silty gravelly SAND. Gravel is sub-rounded fine to coarse of various lithologies.
GROUNDWATER	No groundwater was encountered during the site works. The site overlies a Principal/Major Aquifer and therefore the superficial groundwaters are classified by the EA as 'controlled waters'.
ENVIRONMENTAL ASSESSMENT RISK	Long Term Human Health A single elevated level of Lead was identified as part of the tier 1 assessment, when this was run through the statistical analysis it was shown to pass the mean value test. This indicates that the identified lead contamination is an acceptable risk to long term human health and can remain on site. Additionally one sample identified Asbestos fibres within WS4 that will require remediation on site. Due to the time at which the asbestos was identified no quantification testing was undertaken and as such a delineation hot spot will be required to remove the potential risk posed by the identified asbestos to future occupiers of the site. This will require the removal of material from a circular area around WS4 with side wall testing once the excavation is complete.

	Controlled Waters Risk Assessment For controlled waters there are two assessment criteria, the Environmental Quality Standard (EQS) and the UK Drinking Water Standard (UKDWS). No exceedances of the UK DWS Leachate screening values were identified on site. The EQS Leachate screening identified concentrations of Copper within the EQS, however due to the low levels noted the risk is unlikely to be significant.												
ASBESTOS	All samples were tested for asbestos sampling. Asbestos has been noted in 1No. of the samples in WS4 at 0.40mbgl, the asbestos detected consisted of Amosite (Brown). Due to the practice used at the time of sampling the asbestos has not been quantified to assess the risk to long term human health and as such a full risk assessment cannot be carried out on the identified asbestos.												
GROUND GAS ASSESSMENT	Using RB17 – Assessing risks posed by made ground to generate ground gas it can be seen that there is low gas generation potential and the site is classified as Characteristic Situation 1, therefore no gas protective measures are required.												
RADON	The site is not in a Radon Affected Area, as less than 1% of properties are above the Action Level. No radon protective measures are necessary												
GEOTECHNICAL ASSESSMENT	General - It is understood that consideration is being given to the development of housing with associated garden areas and infrastructure. As the Made Ground identified on site extends to 0.80mbgl it is not thought suitable as bearing strata, instead we would advise that foundations be taken through the made ground onto natural strata in the form of concrete mass strip footings. Limited groundwater ingress was recorded during site investigation works and subsequent monitoring. Sub-surface concrete that is only in contact with Made Ground can be Design Sulphate Class DS-1, with an ACEC Classification of AC-1s. Ground Floor Construction - Based upon the amount of Made Ground noted on site it is not recommended that a ground-bearing slab is utilised on site. Sutcliffe Investigations therefore propose a suspended P.C Unit ground floor be adopted. Designated Concrete Mixes - The following designated mix in accordance with BRE Special Digest SD1 and BS8500: Part1: 2015 will be suitable for use on this site. <table border="1"> <thead> <tr> <th>Application</th><th>DS-1 Conditions (Made Ground and Natural) ACEC Class AC-1s</th></tr> </thead> <tbody> <tr> <td>Unreinforced strip / trench fill footings</td><td>GEN1</td></tr> <tr> <td>Reinforced strip / trench fill footing (mesh reinforcement)</td><td>RC30</td></tr> <tr> <td>Reinforced strip / trench fill footings (rebar etc)</td><td>RC30</td></tr> <tr> <td>Unreinforced concrete floor slabs</td><td>GEN2</td></tr> <tr> <td>In situ reinforced concrete floor slabs</td><td>RC30</td></tr> </tbody> </table> *Note: Although RC 30 is in line with BS8500, Sutcliffe Investigation recommend the use of RC35 for concrete used in structurally sensitive works, to provide greater certainty of compliance with strength verification tests. Tolerable mixes dispatched by a batching plant are +/- 10%, and delays on site can also result in deterioration of the concrete.	Application	DS-1 Conditions (Made Ground and Natural) ACEC Class AC-1s	Unreinforced strip / trench fill footings	GEN1	Reinforced strip / trench fill footing (mesh reinforcement)	RC30	Reinforced strip / trench fill footings (rebar etc)	RC30	Unreinforced concrete floor slabs	GEN2	In situ reinforced concrete floor slabs	RC30
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Unreinforced concrete floor slabs	GEN2												
In situ reinforced concrete floor slabs	RC30												
RECOMMENDATIONS	The following actions are recommended: - Design a Phase III Remediation & Validation Proposal for submission to planning department. - Good hygiene practices should be employed during construction work, in												

	addition, the findings of this investigation should be included within the contractors H&S file and an assessment of risks associated with short term human health completed. No consumption of food or smoking should occur without prior hand washing. If dust is encountered, dust masks should be worn and dust suppression employed.
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NOTE: The executive summary is an overview of the key findings and conclusions of the report. There may be other information contained in the body of the main report which puts into context the information presented within the executive summary. No reliance should be placed on the executive summary.

Contents

1	INTRODUCTION	1
1.1	Terms of Reference	1
1.2	Development Proposal & Legislative Context	1
	Development Proposal	1
	Legislative Context	1
1.3	Site Location and Setting	2
1.4	Site Description and Layout	3
1.5	Previous Studies	3
1.6	Objectives & Scope of Assessment	3
2	PRELIMINARY CONCEPTUAL RISK ASSESSMENT	5
2.1	Ground Model	5
2.2	Potential Contaminant Linkages	5
	Sources	5
	Receptors	5
	Pathways creating contaminant linkages	7
2.3	Risk Evaluation	7
3	GROUND INVESTIGATION	9
3.1	Design Rationale	9
3.2	Fieldwork	9
3.3	Chemical Laboratory Testing	10
4	GROUND MODEL	12
4.1	General	12
4.2	Made Ground	12
4.3	Natural Ground	12
4.4	Field Evidence of Contaminated Soils	13
4.5	Groundwater	13
4.6	Stability	13
4.7	Drainage	13

4.8	Potable Water Supply	13
4.9	Services.....	13
4.10	Geotechnical Testing and Assessment	14
	Soluble Sulphate and pH	14
4.11	Foundation Recommendations	14
	General	14
	Ground Floor Construction.....	14
	Designated Concrete Mixes.....	15
5	LONG TERM HUMAN HEALTH RISK ASSESSMENT.....	14
5.1	Soils – Long Term Human Health.....	14
	Methodology.....	14
	Selection of Soil Screening Values.....	14
	Creation of Relevant Datasets	14
	Assessment	14
	Identification of Contaminants of Concern.....	15
	Asbestos.....	16
	Discussion.....	16
	Conclusions	16
6	CONTROLLED WATERS RISK ASSESSMENT.....	18
6.1	Methodology	18
	Identification of Potential Contaminant Linkages	18
	Selection of Generic Screening Values	18
	Leachate Screening – UK DWS & EQS.....	18
	Conclusion.....	19
7	GROUND GAS RISK ASSESSMENT - QUALITATIVE	20
7.1	Methodology	20
7.2	Review of Field Data	20
7.3	Discussion	21
7.4	Groundwater Protection Measures	21
8	LAND CONTAMINATION RISKS AND REMEDIATION REQUIREMENTS	22
8.1	Discounted Contaminant Linkages	22
	Controlled Waters – Groundwater & Surface Waters	22
	Groundwater Resources.....	22
	Surface Water Resources.....	22
	Ground Gas.....	22
8.2	Remaining Potential Contaminant Linkages	22
	Long Term Human Health.....	22
8.3	Remediation Requirements.....	24

Human Health – Soils	24
Human Health – Ground Gas	24
Controlled Waters.....	24
9 RECOMMENDATIONS	25
9.1 Further works	25
REFERENCES	26
Appendix A – General Notes.....	A
Appendix B – Ciria Guidance Document C552 2001	B
Appendix C –Window Sample & Hand Auger Hole Logs.....	C
Appendix D – Analytical Certificates	D
Appendix E - Ground Gas Risk Assessment Data	E
Appendix F – Geotechnical Laboratory Certificates	F
Appendix G - Soil Screening Tables & Statistical Analysis.....	G
Drawing No 26045 – 700 – P1 – Site Investigation Plan	H
Drawing No 1757 – 125 – Ground Floor Plan	I

1 Introduction

1.1 Terms of Reference

Sutcliffe Investigations was instructed by TJ Thomas Ltd (the “client”) to undertake a Phase II ground assessment for the site at the former Penny Black Pub, Lickers Lane, Prescott.

The location of the site is presented as *Figure 1*. The site is centred on Grid Reference (NGR) 347547, 390575 and is approximately 0.2ha in area. An aerial photograph is presented as *Figure 2*.

A plan detailing the sites existing site layout is presented as *Drawing No 26045-700 – P1*.

This report assesses the ground based geotechnical and environmental risks, constraints and liabilities associated with the proposed development of the site. This is required in support of the discharge of contaminated land planning conditions assigned to the site and to allow the design of economic foundation solutions.

1.2 Development Proposal & Legislative Context

Development Proposal

It is understood that consideration is being given to redevelopment of the site with the development of 9No. new residential properties. The site will be assessed against a residential with plant uptake scenario. A proposed development plan is presented as *drawing no. 1757-125* as prepared by Larrosa Marshall.

Legislative Context

The presence of contaminants which may pose a risk to human health or the environment is a material planning consideration. For planning it should be considered whether the site is suitable for its new use, and the responsibility for securing a safe development (including cumulative effects of pollution on health, and the potential sensitivity of the proposed development to adverse effects from pollution,) rests with the developer and/or landowner. Planning is concerned with the site’s proposed use not its current use, where the amount of contamination is expected to be low relative to the level of risk. This is the opposite to Part 2A which considers high levels (significant harm) and the current use of the site.

Section 57 of the Environment Act 1995, adds Part 2A (ss.78A-18YC) to the Environmental Protection Act 1990 and contains the legislative framework for identifying and dealing with contaminated land. Where development is undertaken on land which may be affected by contamination, the National Planning Policy Framework, paragraphs 120 to 122 considers pollution and

remediation. This links the contaminated land regime within the development process.

For there to be an environmental liability associated with the site there must be a perceived source (a contaminant), a receptor (humans, living organisms or property) and a pathway between them. The potential presence of all of these aspects would result in a complete contaminant linkage.

In accordance with environmental legislation and the associated guidelines, assuming the site is to be redeveloped as housing, it should be noted that any redevelopment of the site could actually create new pathways that could increase the liabilities associated with the site. In addition, the basis of the intrusive ground assessment is to refine the preliminary conceptual model.

1.3 Site Location and Setting

The site is located at the former Penny Black Pub, Lickers Lane, Prescot L35 3SR at National Grid Reference (NGR) 347547, 390575, approximately 13.37km to the east of Liverpool City Centre and within a primarily residential area (*Figure 1*).

A location plan and aerial photograph of the site are shown as *Figure 1 & 2*.



Figure 1: General Location of Site

1.4 Site Description and Layout

The site area is currently comprises a former pub along with the associated car park. The surrounding area comprises residential housing with associated amenities and fields to the south.



Figure 2: Aerial Photograph of the Site

1.5 Previous Studies

Sutcliffe's have completed the following studies:

- Phase I Desk Study, Former Penny Black Pub, April 2012
- Phase II Geotechnical & Environmental Assessment, Former Penny Black Pub, June 2012

This report incorporates the findings of the 2012 investigation along with the findings of the 2016 post demolition works that have been carried out in line with the requirements of Knowsley Council. No other previous studies are known to have been undertaken to Sutcliffe's knowledge.

1.6 Objectives & Scope of Assessment

The aim of the intrusive ground investigation is to identify potential environmental liabilities and constraints, associated with the development of the site area in support of the following:

- A planning application and the discharge of contaminated land conditions where reasonably practicable that may have been assigned to the site and to include the design of a remediation scheme, if required.
- To assess the likelihood of reuse of materials that are site won or disposal options for surplus material.
- The preliminary design of detailed and economic foundations options inclusive of all information and specifications relating to foundation types, the location of underlying rock, (if encountered), preparation of ground, concrete grades, reuse of materials for both the proposed building, and the existing foundations.

2 Preliminary Conceptual Risk Assessment

2.1 Ground Model

The earliest available historical map (1892) indicated that the site was located in a largely rural area with a boundary running through the site and a small pond noted along the southern boundary, which was no longer noted in 1927. In 1993 the site is occupied by a Public House and associated parking. The site remained relatively unchanged until the present day.

The potential for significant contamination to have arisen at the site as a result of the current and former usage on site is considered to be low to moderate. Potential contaminants associated with such activities may comprise a wide range of metals, fuels, oils, acids, alkalis and asbestos.

It is proposed to develop the site with houses with associated infrastructure and garden areas.

2.2 Potential Contaminant Linkages

Sources

The likely contaminants from made ground associated with former site usage, infilling activity which may be present on site could include: heavy metals such as cadmium, chromium, copper, lead, nickel and zinc, asbestos, hydrocarbons and organic compounds such as Polycyclic Aromatic Hydrocarbons (PAHs). Furthermore, ground gases such as methane and carbon dioxide may be generated from areas of made ground material.

No off site sources have been identified that would represent a significant risk to the site.

The likely contaminants from previous land uses are shown below in *Table 2.1*.

Table 2.1: Potential Source(s) of contamination

Reference	Potential Sources (Onsite)	Potential Contaminants
S1	Previous pond, Public House	Localised metals, asbestos, PCBs, PAHs, ground gas.

Receptors

The most sensitive receptors identified using the conceptual site model are considered to be site and adjacent site users, construction and maintenance workers, controlled waters (aquifer), infrastructure and buried services. These are most likely to be affected by made ground and any associated contaminants and gas generated from made ground, if present on site.

Human receptors would comprise construction workers, future site users and adjacent site users. It is likely that the exposure to contamination by construction workers will be limited due to the short exposure to the potential contamination and the use of PPE. If ground gases are produced this could be a potential risk to the future site users and properties and workers in confined spaces / trenches etc.

Due to the potential for contaminants to be present on site there is the potential for contaminants to leach and migrate to the underlying Principal Aquifer. Drift material is noted to be present under the site and is classified as Unproductive Strata; this will act as an aquiclude, reducing the risk to the underlying aquifer.

Table 2.2 below details the potential receptors.

Table 2.2: Receptors

Ref	Receptor	Description
R1	Current & future site users	Site users; personnel, general workers and maintenance workers,
R2	Construction Workers	Contractors working on the development of the site. Construction workers, maintenance workers or other personnel who may be directly exposed to contaminated materials in the course of their activities).
R3	Controlled Waters	Principal Aquifer on site drainage
R4	Adjacent Site Users	Adjacent site users. Third-party land (<i>i.e.</i> the possibility of contamination migrating off-site onto third party land via contaminated groundwater, surface water run-off).
R5	Infrastructure / Buried services	Proposed buildings and buried services

Pathways creating contaminant linkages

Table 2.3: Pathways

Ref	Pathway	Description
P1	Direct contact with potential contaminants.	Dermal absorption, ingestion and inhalation of contaminants via direct contact.
P2	Ingestion of potential contaminants.	Construction workers may come into contact during the site works, however this will be for a short time and therefore limited exposure will occur. PPE can be used Construction workers may come into contact during the site works, however this will be for a short time and therefore limited exposure will occur. PPE can be used and worn as a precaution to reduce the risk.
P3	Inhalation of potential contaminants.	
P4	Leaching and migration of contaminants.	Leaching of possible contaminants could migrate into the underlying Principal Aquifer via shallow groundwater. On site drainage is also at risk from shallow contamination, if present.
P5	Vertical and lateral migration of ground gases / vapours.	There is the potential for contaminants to be present on the site, which could generate ground gas & vapours on site.

2.3 Risk Evaluation

Each potential contaminant linkage is identified in *Table 2.4* below. An evaluation of the risk that each contaminant linkage poses to the project (as identified in the *Section 2*) has been undertaken, in general accordance with CIRIA guidance document C552, 2001 (as detailed in *Appendix B*).

The evaluation and the resultant actions identified are based on the available information presented within this report.

Table 2.4: Preliminary Risk Evaluation of Potential Contaminant Linkages

1. Hazard Identification		2. Hazard Assessment				3. Risk Estimation		4. Risk Evaluation	5. Managing the Risk
Contaminant Source		Pathway		Receptor		Consequence of risk being realised	Probability of risk being realised	Classification	Action required
S1	Potentially contaminated soil on Site	P1	Dermal contact	R1/2	Site users	Medium	Low	Moderate / Low	It is possible that harm could arise to a designated receptor from an identified hazard. Investigation is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
		P2	Ingestion of soil / soil dust	R1/2	Site users	Medium	Low	Moderate / Low	
		P3	Inhalation of vapours / soil gas	R1/2	Site users	Severe	Unlikely	Moderate / Low	
		P4	Leaching and migration of contaminants	R3/5	Principal aquifer	Medium	Low	Moderate / Low	
		P5	Lateral migration of soil gas / vapours	R1	Site users	Severe	Unlikely	Moderate / Low	
				R4	Property	Severe	Unlikely	Moderate / Low	

3 Ground Investigation

3.1 Design Rationale

The aim and design of the ground assessment is to satisfy planning conditions assigned to the site by reference to the National Planning Policy Framework. This will identify elevated concentrations of determinands with the aim of assessing long term human health risks to site users and groundwater resources. In addition, the works have been designed to allow the design of economic foundation solutions for the proposed new builds.

3.2 Fieldwork

Field works were undertaken on 5th April 2012 & further sampling on the 19th August 2016 post demolition, a specialist ground investigation contractor & Sutcliffe. The investigation was carried out in general accordance with the following standards:

- *BS10175:2011 Code of Practice for the Investigation of Potentially Contaminated Sites;*
- *Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination, 2001 (Environment Agency).*
- *BS 5930:2015 Code of practice for site investigations; and,*
- *BS EN ISO 22475-1:2006 Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution.*

Window sample and hand auger hole logs collated as part of the ground investigation completed by Sutcliffe's are presented in *Appendix C*.

A summary of exploratory hole detailing rationale is shown in *Table 3.1* below.

Table 3.1: Summary of Site Activities (2012)

Exploratory Hole ID	Location Rationale	Method	Completed Depth (mbgl)	Installation Details
WS1	General Site Coverage (GW, HH)	Window Sampler	2.35	No installation
WS2	General Site Coverage (HH)	Window Sampler	2.20	No installation

Exploratory Hole ID	Location Rationale	Method	Completed Depth (mbgl)	Installation Details
WS3	General Site Coverage (HH)	Window Sampler	2.20	No installation
WS4	General Site Coverage (GW, HH)	Window Sampler	2.20	No installation
WS5	General Site Coverage (HH)	Window Sampler	1.90	No installation
HAH1	General Site Coverage (HH)	Hand Auger	0.60	No installation
HAH2	General Site Coverage (HH)	Hand Auger	0.60	No installation
HAH3	General Site Coverage (HH)	Hand Auger	0.80	No installation

GG – Ground Gas / GW – Groundwater / HH – Human Health

A plan detailing the position of sampling locations is presented as *Drawing No 26045 – 700 – P1*

3.3 Chemical Laboratory Testing

Selected soil samples were collected at various depths and horizons and submitted for chemical analysis, details of which are presented in *Table 3.2*.

Table 3.2: Summary of Soils Analysis (Total & Leachate Concentrations)

Suite Reference	Analysis Suite
Soils Suite – total	<i>Metals suite, speciated (16) polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons according to the Total Petroleum Hydrocarbon Working Group (TPHCWG), asbestos screen, total cyanide, phenols and soil organic matter.</i>
Leachate – total	<i>Metals suite, speciated (16) PAHs.</i>

Note: Whilst PCB's were identified as a potential contaminant within the Phase I Desk Study, due to the potential source (railway) being 400m from the site, in addition to PCB's low solubility/mobility PCB's were omitted from the chemical suite.

All samples were stored in airtight containers appropriately labelled, and transported in cool boxes with icepacks maintained at 4°C, under completed chain of custody documentation to Alcontrol and Envirolab laboratories.

All samples were analysed by MCERTS accredited soil analysis laboratories Alcontrol and Envirolab under UKAS accredited methods. All samples have been taken in accordance with current British Standards.

Both laboratories are appropriately accredited for the works required and are an approved supplier under the Sutcliffe's Quality Management System.

Analytical test certificates are presented in *Appendix D*.

TPH Speciated aromatic and aliphatic bands with BTEX analysis have been carried out in line with the TPHCWG. The toxicity and migration risk associated with a TPH is dependent on the specific aliphatic aromatic carbon banding. Of particular concern are the low molecular weight compounds, which are highly mobile and show a greater level of toxicity than the higher molecular weight compounds. Therefore a low TPH consisting of low molecular weight aliphatic and aromatic carbon banding compounds may present more of a risk than a high TPH consisting of heavy weight aliphatic and aromatic carbon banding compounds.

Based on the TPHCWG the aromatic band C5 – C7 is considered to consist only of Benzene and the aromatic band C7 – C8 of Toluene. Therefore the more specific BTEX analysis has been used for risk assessment rather than the aromatic bands.

4 Ground Model

4.1 General

The ground comprises topsoil/macadam over between 0.50-0.80m of made ground overlying firm brown silty sandy gravelly CLAY and gravelly silty SAND.

A summary of the strata depths and thicknesses is detailed in *Table 4.1*.

Table 4.1: Ground Conditions Encountered

Strata	Depths encountered (mbgl)		Thickness (m)		
	Min	Max	Min	Max	Average
Made Ground	0	0.80	0.30	0.65	0.55
Firm brown silty sandy gravelly CLAY.**	0.50	1.50	0.10	0.80	0.425**
Dense yellow/orange/red silty gravelly SAND.	0.70	2.20	0.30	1.30	0.76
Red weathered SANDSTONE. **	1.40	2.35	0.15	0.50	0.29**

** Final Depth of Strata not proven, average thickness on identified ground.

4.2 Made Ground

Made ground was encountered in all of the exploratory holes and extended to depths of between 0.50mbgl and 0.80mbgl; it should be noted though that the final depth of made ground was not proven in HAH2 at 0.60mbgl. The made ground generally comprised dark brown gravelly sand with rare angular fine brick fragments.

4.3 Natural Ground

Natural ground was encountered within all of the exploratory holes with the exception of HAH2 and typically comprised firm brown silty sandy gravelly CLAY. Gravel is sub-angular fine and medium of various lithologies, over yellow silty gravelly SAND. Gravel is sub-rounded fine to coarse of various lithologies.

The characteristic values for the made ground are shown below in *Table 4.2 & 4.3*.

Table 4.2: Material Properties SAND

Property	No. of Tests	Range	Average
SPT N Values	3	13-28	19.66

Table 4.3: Material Properties CLAY

Property	No. of Tests	Range	Average
SPT N Values	2	12-20	16
VANE	3	55-76	66

4.4 Field Evidence of Contaminated Soils

Field evidence of contamination was identified across site in the form of made ground encountered to depths of between 0.50-0.80m bgl.

4.5 Groundwater

No groundwater was encountered during the site works. The site overlies a Principal/Major Aquifer and therefore the superficial groundwaters are classified by the EA as 'controlled waters'.

4.6 Stability

No evidence of instability was noted in the exploratory holes that were undertaken on site, however it is noted that these were only small diameter holes and that due to the amount of made ground noted on site shoring would likely be required if any groundworks are to be left open during site works.

4.7 Drainage

It is recommended that the client / developer contact United Utilities with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

4.8 Potable Water Supply

Please note the testing suite carried out for this site is for human health purposes and may not cover the suite of contaminants required by United Utilities for pipe selection and therefore further testing may be required.

4.9 Services

It is recommended that the client / developer contact the relevant service provided to ascertain the requirements for power reinforcement and / or relocation / diversion of existing services.

4.10 Geotechnical Testing and Assessment

Soluble Sulphate and pH

It is envisaged foundations will extend through the Made Ground and into the natural strata and samples taken from the Made Ground have been submitted for pH and water-soluble sulphate (2:1 soil/water extract) analysis.

The highest water-soluble sulphate concentration and the lowest pH value for the Made Ground is shown in *Table 4.6*.

Table 4.6: Soluble sulphate and pH classification

Soil Type	Lowest pH Values	Highest Soluble Sulphate Concentration (g/l)
Made Ground	7.6	0.0365

Therefore, in accordance with Table C2 of BRE: Special Digest 1 2005, sub-surface concrete that is in contact with Made Ground should be Design Sulphate Class **DS-1**, with the ACEC classification of **AC-1s**.

A complete set of geotechnical laboratory certificates are presented in *Appendix F*.

4.11 Foundation Recommendations

General

It is understood that consideration is being given to the development of 9No. new residential properties on site. A site layout has been provided and is in *Appendix B*.

As the Made Ground identified on site extends to 0.80mbgl it is not thought suitable as bearing strata, instead we would advise that foundations be taken through the made ground onto natural strata in the form of concrete mass strip footings.

Limited groundwater ingress was recorded during site investigation works and subsequent monitoring.

Sub-surface concrete that is only in contact with Made Ground can be Design Sulphate Class DS-1, with an ACEC Classification of AC-1s.

Ground Floor Construction

Based upon the intrusive investigation on site and the amount of fill / made ground encountered, it would be Sutcliffe Investigations recommendation that this material is not adopted to bear floor slabs on, due to the potential for excessive total and differential settlements.

Designated Concrete Mixes

The following designated mix in accordance with BRE Special Digest SD1 and BS 8500: Part1: 2015 will be suitable for use on this site.

Table 4.7: Designated Concrete Mixes

Application	DS-1 Conditions (Made Ground and Natural) ACEC Class AC-1s
Unreinforced strip / trench fill footings	GEN1
Reinforced strip / trench fill footing (mesh reinforcement)	RC30
Reinforced strip / trench fill footings (rebar etc)	RC30
Unreinforced concrete floor slabs	GEN2
In situ reinforced concrete floor slabs	RC30

*Note: Although RC 30 is in line with BS8500, Sutcliffe Investigation recommend the use of RC35 for concrete used in structurally sensitive works, to provide greater certainty of compliance with strength verification tests. Tolerable mixes dispatched by a batching plant are +/- 10%, and delays on site can also result in deterioration of the concrete.

5 Long Term Human Health Risk Assessment

5.1 Soils – Long Term Human Health

Methodology

Based on the Preliminary Risk Assessment and Ground Model for this site, a Generic Quantitative Risk Assessment for human health has been undertaken in accordance with CLR and SR (SC050021 series) (DEFRA) guidance as well as CL:AIRE guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008 and comprises the following:

- *Selection of appropriate generic screening values for human health assessment.*
- *Creation of relevant datasets from which to undertake the assessment.*
- *Assessment of contamination distribution and comparison of site data to screening values using relevant statistical tests (in accordance with CIEH guidance).*
- *Assessment of risks to receptors.*
- *Determination of requirements for further investigation or remediation.*

Selection of Soil Screening Values

Soil screening values appropriate for a residential (with plant uptake scenario) were selected.

Creation of Relevant Datasets

As part of the desk study assessment and Preliminary Conceptual Model, made ground was identified as the principal potential source identified for contamination in the risk evaluation (Section 2.0). Consequently the sampling strategy targeted made ground encountered on site.

Assessment

The soil analytical data has been assessed following CL:AIRE/CIEH guidance, CLR11 Model Procedures Section 2.3, and NHBC R&D Publication 66 2008 “Guidance for the Safe Development of Housing on Land Affected by Contamination”.

The purpose of human health risk assessment for planning is to decide whether the land is suitable for the proposed end use and does not pose a risk to human health. Therefore, the key question to answer is, “Is there sufficient evidence that the true mean concentration is less than the critical concentration?”

Statistics are used to assist in answering the key question raised above and to help decide whether to support a particular hypothesis. The null hypothesis is the starting point because it is believed to be true but needs to be proved.

In terms of planning, the hypotheses are as follows:

- *Null Hypothesis (H0) - the true mean is equal to, or greater than the critical concentration.*
- *Alternative Hypothesis (H1) - the true mean is less than the critical concentration.*

The null hypothesis needs to be rejected in order to confirm that the land does not pose a human health risk and is suitable for use under the planning regime.

Identification of Contaminants of Concern

Data from the two investigations undertaken on site have been incorporated into the human health risk assessment included within the report. This data has been assessed against the current and relevant assessment criteria that has changed since the original investigation undertaken in 2012. A total of eleven samples of Made Ground were analysed for contaminant parameters; of these samples one contains contaminants that can be classified as elevated above the Generic Assessment Criteria (GAC). These samples are classified by comparison of parameters concentrations with the relevant current UK guidance threshold value for a proposed residential with plant uptake end use.

Note: While PCB's were identified within the Phase I Desk Study as a potential contaminant, due to the potential source being a former railway line over 400m from the site and given the nature of PCB's being relatively immobile no testing was undertaken as they were deemed to not be a contaminant of concern in regards to future occupiers of the site.

The samples were assessed against Tier 1 values for a residential with plant uptake end use. An elevated level of Lead is noted along with a sample containing asbestos.

Elevated levels of contamination were recorded in one samples taken from site when assessed against the 2.5% SOM Residential with plant uptake values. These are recorded below in *Table 5.1*.

Table 5.1: Statistical Analysis Results for Made Ground Stratum Top 1.00m

Contaminant	Guideline Assessment Value	95% ile	Mean Value Test	Max Value Test
Lead	200	172.17381	Pass	1 Outlier

The statistical analysis results for Lead indicate that the upper 95th percentile bound values (US95) is below the relevant UK guidance threshold value for a residential with plant uptake scenario. Lead passes with one statistical outlier, therefore the material is deemed acceptable to be retained on site.

The statistical analysis has shown that the made ground, although containing contamination, does not pose an unacceptable risk to future site uses. It is however noted that there is a sample that contains asbestos from WS4 which will have to be removed from the site.

Asbestos

All samples were tested for asbestos sampling. Asbestos has been noted in 1No. of the samples in WS4 at 0.40mbgl, the asbestos detected consisted of Amosite (Brown). Due to the practice used at the time of sampling the asbestos has not been quantified to assess the risk to long term human health and as such a full risk assessment cannot be carried out on the identified asbestos.

An Asbestos Survey has been undertaken by Asbestos Management UK. To date this report has not been supplied to Sutcliffe and it is expected that the client will issue it separately to the planners.

Discussion

The statistical analysis indicates that the identified elevated level of lead does not pose a long term risk to human health and as such the null hypothesis can be rejected, in favour of the alternative hypothesis.

Asbestos identified on site will require remediation to ensure it is removed from site to be protective of long term human health.

Conclusions

Currently due to the identified asbestos the site poses a risk to human health, and remediation works will be required as part of the development to ensure that the site is suitable for occupation and no longer poses a risk to human health.

Given the extent of the identified contamination a localised site strip will be required to a depth of 600mm in the area of WS4, with a capping layer being placed in any impacted soft landscaped areas to bring site levels back up. It would be anticipated that the remainder of the hot spot that is not formed of landscaping will be covered by hardstanding, this along with the capping system would provide a break layer to source pathway receptor linkages.

The details regarding the remedial works in the vicinity of WS4 will be documented within the Phase III Remediation & Validation Proposals. Elsewhere on site, site levels will be dictated by depth of foundation

construction beneath areas of hardstanding (roadways & building footprints),
and need to emplace a suitable growth medium in areas of soft landscaping

6 Controlled Waters Risk Assessment

6.1 Methodology

Based on the Preliminary Risk Assessment and Ground Model for this site, a Level 1 Screening Assessment has been undertaken in general accordance with Environment Agency guidance Environment Agency Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination, 2006.

The methodology comprises:

- Identification of potential contaminant linkages.
- Selection of appropriate generic screening values for controlled waters.
 - o *Screening measured concentrations of leachate against the generic screening values available for UK Drinking Water Standards (UK DWS) and Environmental Quality Standards (EQS).*
- Assessment of contaminant distribution and risk to receptors.
 - o *Identification of contaminants of concern and relevant contaminant linkages.*
 - o *Identification of potential contaminants and contaminant linkages which are no longer of concern.*

Identification of Potential Contaminant Linkages

Contaminant linkages have been identified in *Section 3.0* between the made ground and the underlying aquifer via infiltration and/or migration of dissolved phase contaminants.

Selection of Generic Screening Values

Screening values for Drinking Water Standards (DWS) have been used to assess leachability. DWS are relevant to potable receptors (Principal Aquifer).

Environmental Quality Standards (EQS) screening values have been used to assess risks to surface water resources.

Leachate Screening – UK DWS & EQS

Metals, TPHCWG and Speciated PAHs were assessed. Exceedances of relevant UK DWS and EQS screening criteria were encountered, details of which are identified in *Table 6.1*. It should be noted that several determinands have limits of detection greater than their respective screening values. Due to

the level of uncertainty associated with such results, these exceedances are not considered significant and are excluded from the table below.

Table 6.1: Leachate Exceedances Summary - EQS

Determinant	EQS Screening Value (µg/l)	Range of concentrations (µg/l)	Location and depth of outliers, if present
Copper	1 to 28	3.43-6.69	WS1 @0.50m bgl – 6.69µg/l WS4 @ 0.40m bgl – 3.43µg/l

Leachate screening tables are presented in *Appendix G*. Analytical certificates are presented in *Appendix D*.

Conclusion

Exceedances of EQS screening criteria are not considered significant given the levels recorded on site, with only low levels of Copper recorded within the EQS range.

7 Ground Gas Risk Assessment - Qualitative

7.1 Methodology

Sutcliffe have undertaken a qualitative ground gas risk assessment in accordance with “*A Pragmatic Approach to Ground Gas Risk Assessment (RB17)*”. This is based on the low risk attached to the site from potential sources of ground gas, with only on site made ground considered to be a major source. The development proposal is likely to comprise a “cut” exercise, required to achieve proposed formation levels. In consequence the risk from ground gas is considered negligible and RB17 is considered suitable to assess the risk. Full laboratory results, forensic sample description and calculations can be found in the Appendices, a summary of the results from the testing are presented in *Table 7.1* below.

Our assessment comprises the following:

- Review of results.
- Assessment of risks from ground gas.
- Development options.

7.2 Review of Field Data

Three (3) samples were collected from site for the purpose of undertaking forensic testing to obtain the Total Organic Carbon to allow the assessment of the potential for the made ground to generate ground gas. The forensic testing was undertaken by Envirolab laboratories in line with RB17 on three 1kg samples provided to them by Sutcliffe.

The findings are summarised below and the results are presented in full in *Appendix E*.

Table 7.1: Forensic & TOC Summary for Site

Forensic Descriptions & TOC	Sample Total Weight (Kg)	Fine Soil and Gravel <10mm (%)	Coarse Inert Particles >10mm (%)	TOC Fine Soil as Whole (%)	TOC Remaining Soil as Whole (%)	Average TOC (%)
TH1	1	92.10	7.90	0.22	0.00	0.22
TH2	1	91.29	8.71	0.45	0.00	0.45
TH3	1	96.09	3.91	2.20	0.00	2.20
Site Average	/	/	/	/	/	0.96

7.3 Discussion

Samples retrieved from the site revealed an average TOC value of 0.96%, the samples generally consisted of Dark brown gravelly sand with rare angular fine brick fragments.

Using the “*Pragmatic Approach to Ground Gas Risk Assessment (RB17)*” the TOC and forensic testing has given a site wide average TOC value of 0.96% with the levels of TOC ranging from 0.22% to 2.20%. This classifies the site as Characteristic Situation 1 and therefore indicates that no gas protection measures are required on this site.

Additionally due to the small amount of made ground noted on site it is anticipated that the majority, if not all, made ground will be removed to achieve formation levels across the site.

7.4 Groundwater Protection Measures

There is no evidence at this stage of significant perched water either in the made ground or in the natural stratum encountered on site that would suggest special groundwater protection measures to the building foundations are required.

8 Land Contamination Risks and Remediation Requirements

8.1 Discounted Contaminant Linkages

Controlled Waters – Groundwater & Surface Waters

Groundwater Resources

No exceedances of the UK DWS Leachate screening values were identified on site.

Surface Water Resources

The EQS Leachate screening identified concentrations of Copper within the EQS, however due to the low levels noted the risk is unlikely to be significant.

Ground Gas

Based on the results of the forensic testing there is no requirement for gas protective measures on site, with the ground gas generation potential of the made ground considered low.

8.2 Remaining Potential Contaminant Linkages

Long Term Human Health

A single elevated level of Lead was identified as part of the tier 1 assessment, when this was run through the statistical analysis it was shown to pass the mean value test. This indicates that the identified lead contamination is an acceptable risk to long term human health and can remain on site. Additionally one sample identified Asbestos fibres within WS4 that will require remediation on site. Due to the time at which the asbestos was identified no quantification testing was undertaken and as such a delineation hot spot will be required to remove the potential risk posed by the identified asbestos to future occupiers of the site. This will require the removal of material from a circular area around WS4 with side wall testing once the excavation is complete.

Construction workers may be exposed via dermal contact, ingestion and inhalation of soil / dust during the construction period. Adjacent site users may also be exposed to contaminated soils via inhalation of dust generated during the construction phase.

Table 8.1: Summary of Remaining Contaminant Linkages

1. Hazard Identification		2. Hazard Assessment				3. Risk Estimation		4. Risk Evaluation	5. Managing the Risk
Contaminant Source		Pathway		Receptor		Consequence of risk being realised	Probability of risk being realised	Classification	Action required
Table 3.1: Sources		Table 3.2: Receptors		Table 3.3: Pathways					
S1	Made Ground (on site)	P1	Direct contact	R1	Future site users,	Medium	Likely	Moderate	Asbestos has been identified within WS4 and will require removal from site. This will take the form of a hot spot in the area around WS4, with additional sampling undertaken upon its removal to show that the identified asbestos is no longer present on site.
		P2	Ingestion	R2	Construction workers	Medium	Likely	Moderate	
		P3	Inhalation of dust / vapours	R4	Adjacent site users	Medium	Unlikely	Low	
		P1	Direct contact	R5	Infrastructure / Buried Services	Mild	Unlikely	Very Low	
		P5	Vertical and lateral migration of ground gas	R1	Future site users,	Severe	Unlikely	Moderate / Low	
				R2	Construction Workers	Severe	Unlikely	Moderate / Low	
				R4	Adjacent	Severe	Unlikely	Moderate / Low	
				R5	Infrastructure / Buried Services	Severe	Unlikely	Moderate / Low	

8.3 Remediation Requirements

Human Health – Soils

Due to asbestos being identified within WS4 during the original investigation remedial works, in the form of a circular localised site strip, will be required to remove the risk posed to long term human health. It is anticipated that the hot spot removal of the identified contamination will include a strip down to 600mm below existing ground level with further sampling being undertaken upon the excavation being completed. The additional sampling will target the side walls of the excavation to determine that all asbestos material has been removed from this area of the site.

Human Health – Ground Gas

Forensic testing has indicated that the made ground material on site has a low potential to generate ground gas, based on this fact combined with the removal of the majority of the made ground there is no requirement on site for gas protection measures.

Controlled Waters

Exceedances of EQS screening criteria are not considered significant given the likely depth to groundwater, effects of natural attenuation and dilution factors. The site concentrations detected within the made grounds are not considered to pose a significant risk to the Principal aquifer or surface water features in the surrounding area.

9 Recommendations

9.1 Further works

The following actions are recommended:

- Design a Phase III Remediation & Validation Proposal for submission to planning department.
- Good hygiene practices should be employed during construction work, in addition, the findings of this investigation should be included within the contractors H&S file and an assessment of risks associated with short term human health completed. No consumption of food or smoking should occur without prior hand washing. If dust is encountered, dust masks should be worn and dust suppression employed.

References

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Appendix A – General Notes

Generic Notes – Sutcliffe Investigations

Environmental Setting

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the Correspondence Appendix of the Geoenvironmental Report.

Geology, Mining & Quarrying

In order to establish the geological setting of a site, Sutcliffe Investigations refer to BGS maps for the area and the relevant geological memoir.

A coal mining report is obtained from the Coal Authority. Further information is sourced from the Local Authority and by reference to current and historical OS plans.

Landfills

Sutcliffe Investigations obtain data from the Landmark Information Group, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite) and can move through fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Sutcliffe Investigations refer to BRE Report BR211, 1999: *“Radon: guidance on protective measures for new dwellings”*.

BR211 provides a preliminary indication of the measures required for a particular site, but it is also often necessary to request a Stage 2 Protective Measures Site Report from the BGS.

The level of protection needed is site-specific and is determined by reference to the radon potential map for the area followed by a geological assessment of the site. This information is contained in the Annexes of BR211.

Annex A – derived from statistical analysis of radon measurements in existing houses carried out by the NRPB and grouped on 5km grid.

Annex B – based on an assessment of the same radon measurements grouped by geological units. The maps show the 5km grid squares underlain completely or in part, by geological units which potentially exceed the action levels for radon protective measures. The grid squares are coded according to highest potential within the square. In many cases the actual geological radon potential varies considerably within a grid square.

Sutcliffe Investigations adopt the following procedure when assessing risk associated with radon.

Firstly, Annex A maps are reviewed to see whether the site requires full, basic or no measures. If the site is in a dark brown square, full radon protection measures are required. If the site is in a light brown square, reference should be made to Annex B.

Secondly, Annex B maps are reviewed to see whether a further geological assessment is required which may result in upgrading the result from Annex A. If a site lies within a shaded square, it may require radon protection and Sutcliffe Investigations request a Stage 2 Protective Measures Site Report from the BGS.

If the site is in a square that is not coloured or shaded in either set of maps then no radon protection is needed and therefore a BGS Report is not normally necessary.

The BGS geological assessment involves checking whether the site is on or close to a geological unit that has statistically been found to have elevated radon potential. The geological assessment is based on either 1:50,000 or the 1:250,000 scale data. The search area specified as part of the request is increased by 50m in areas where 1:50,000 data is available and by 500m in areas with 1:250,000 scale data to allow for potential inaccuracies in the position of boundaries. The BGS report indicates the highest level of protection required within the search area and its buffer zone.

When requesting a BGS report, Sutcliffe Projects select the search radius carefully, since too large a search radius may result in the inclusion of areas underlain by geological units of a higher radon potential, thereby giving rise to recommending too high a level of protection.

The report also includes (where available), a list of the geological units included in the assessment. Sutcliffe Investigations check that these actually underlie the site, rather than the buffer zone only.

On the basis of radon measurements in dwellings and on their geological interpretation, the BGS report stipulates the level of protective measures required for the proposed development site, and this could be:

1. no measures
2. basic measures or
3. full measures

Details of these measures are provided in the Hazardous Gas section of this Geoenvironmental Report.

Hydrogeology

Sutcliffe Investigations obtain information from the Environment Agency (EA) and the Landmark Information Group with respect to:

- groundwater quality
- recorded pollution incidents
- licensed groundwater abstractions

Reference is also made to the EA document "Policy and Practice for the Protection of Groundwater" (1998) and the relevant Groundwater Vulnerability Map.

Bedrock and any overlying granular Drift deposits are classified by the EA.

Major aquifers: *"Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public water supply and other purposes".*

Minor aquifers: *"Fractured or potentially fractured rocks which do not have a high primary permeability, or other formations or variable permeability. Although these aquifers will seldom produce large quantities of water for abstractions, they are important both for local supplies and in supplying base flow to rivers".*

Non-aquifers: *"Formations which are generally regarded as containing insignificant quantities of groundwater. However groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risk associated with persistent pollutants. Some non-aquifers can yield water in sufficient quantities for domestic use".*

Groundwater vulnerability is determined by 4 variables:

1. The presence and nature of overlying soil (the weathered zone affected by living organisms; soil in the UK can extend up to 2m in depth). Physical properties of the soil affect the downward passage of water and its ability to attenuate pollutants. The EA make reference to a three-fold classification of soil types:-
 - Soils of **low** leaching potential are defined as “soils in which the pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants”.
 - Soils of **intermediate** leaching potential are defined as “soils which have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-absorbed diffuse source pollutants and liquid discharges could penetrate the soil layer”.
 - Soils of high leaching potential are defined as “soils with little ability to attenuate diffuse source pollutants and in which non-absorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater”.

In urban areas and restored mineral workings the soil information is based on fewer observations than elsewhere. A worst-case vulnerability (H) is therefore assumed for these areas and for current mineral workings by the EA. All are given a designation of **HU** unless proved otherwise.
2. The presence and nature of Drift, which often overlies bedrock. Where Drift is of substantial thickness and low permeability, it can provide an effective barrier to surface pollutant migration. Permeability Drift is classified as a Minor Aquifer except where it is in probable hydraulic continuity with a Major Aquifer, where it is regarded as part of the Major Aquifer unless proven otherwise by site investigation.
3. The nature of the geological strata (bedrock). Rocks that contain groundwater in exploitable quantities are called aquifers.
4. The depth of the unsaturated zone; i.e. that part of the aquifer which lies above the water table.

The EA have also designated Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone may vary from tens to several thousand hectares.

Hydrology

Sutcliffe obtains information from the Environment Agency and the Landmark Information Group with respect to:

- Surface water quality
- Recorded pollution incidents
- Licensed abstractions (groundwater & surface waters)
- Licensed discharge consents
- Site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are six GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps provide shows natural floodplains – areas potentially at risk of flooding if a river rises above its banks or high tides and stormy seas cause flooding in coastal areas.

There are different kinds of area shown on the Flood Map:

1. Dark blue areas could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 200) or greater chance of happening each year.
2. Light blue areas show the additional extend of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance or occurring each year.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year (or 1 in 200 year as appropriate) areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist consultant who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc.

COMAH & Explosive Sites

Sutcliffe Investigations obtain information from the Landmark Information Group with respect to COMAH or explosive sites within 1km of the proposed development site. Sutcliffe Investigations' report refers to any that are present and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say and they are likely to place more weight on advice from the HSE).

Preliminary Conceptual Ground Model

The site's environmental setting (and proposed end use) is used by Sutcliffe Investigations to assess the significance of any contamination encountered during the subsequent ground investigation.

Generic Notes – Sutcliffe Geoenvironmental Investigations

2. Ground Investigation Fieldwork

General

Sutcliffe Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:1999 “*Code of practice for site investigation*”
- BS10175:2001 “*Code of practice for the identification of potentially contaminated sites*”
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 “*Sampling strategies for contaminated land*”
- “*Guidance on the protection soil sampling strategies for land contamination*” – EA R&D Technical report P5-066/TR (2001)
- AGS: 1996 “*Guide to the selection of Geotechnical Soil Laboratory Testing*”

Exploratory hole logs are represented in Appendices to this Geoenvironmental Report. These logs include details of the:

- Investigation technique adopted
- Samples taken
- Descriptions of the solid strata and any groundwater encountered
- Results of any insitu testing
- Any gas/groundwater monitoring well installed

Exploratory Hole Locations

Exploratory hole locations are selected by Sutcliffe Investigations, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation Techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 1999 and BS1377: 1990. Techniques most commonly used by Sutcliffe Investigations include:

- Machine excavated trial pits, usually equipped with a backactor and a 0.6m wide bucket
- Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing
- Window or windowless sampling boreholes. Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).
- Rotary percussive open-hole probeholes are typically drilled using a tricone rock roller bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse.

Where installed, gas/groundwater monitoring wells typically comprise a lower slotted section, surrounded by a filter pack of 10mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete.

Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

Insitu Testing

Where relative densities of granular materials given on the trial pit and window sample logs are based on visual inspection only, they do not relate to any specific bearing capacities. However, wherever possible, Sutcliffe Investigations employ a mackintosh probe to assess relative density. Mackintosh probe results can be related to approximate allowable bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as $N^* = x$.

The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling

Representative soil/fill samples are taken at regular intervals from the exploratory holes to assist in description of the ground and to allow selected laboratory testing to be performed. The type of sample taken is dependent on the nature of the stratum and the purpose of the analysis.

Where the soils encountered contain a significant proportion of coarse grained material, truly representative samples are not typically obtained – only the finer fraction is placed in sample containers. However, a visual estimate of the amount of coarse material is made on site.

NB: Coarse constituents not sampled are defined as: coarse gravel, cobble and boulder (i.e. any 'particles' with an average diameter greater than 20mm).

Occasionally, unrepresentative 'spot' samples are also taken from some exploratory locations for contaminant analysis, typically where unusual, localised pockets of materials are encountered.

Samples of soil for chemical testing are placed into 1 litre plastic tubs prior to delivery to the selected laboratory. Samples of water are taken in one litre brown glass bottles and stored in cool boxes, at a temperature of approximately 4°C, until delivery to the selected laboratory. Soil/fill samples for organic analysis are also stored in cool boxes.

Groundwater

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Long term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

Description of Strata

The soils encountered during an Sutcliffe's ground investigation are described (logged) in general accordance with BS 5930. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text.

The materials encountered in the trial pits are logged, samples taken and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

Key to Exploratory Hole Logs

Keys to logs are presented in the Appendix(ces) containing the logs. These are two keys – Symbols and Legends and Terms and Definitions.

Health and Safety

All work was carried out in accordance with the procedures detailed in the DGEL Health and Safety Manual and SUKD health and Safety Procedures.

Generic Notes – Sutcliffe Geoenvironmental Investigations

3. Geotechnical Laboratory Tests

General

Soil Samples are delivered to the laboratory for testing along with a schedule of testing drawn up by Sutcliffe Investigations. All tests are carried out in accordance with BS 1377:1990.

The test results are presented as received in an Appendix to this Geoenvironmental Report.

The following laboratory testing are routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

The additional tests are typically only scheduled where significant earthworks regrade is anticipated:

- Grading
- Compaction tests
- Particle density

Atterberg Limits & Moisture Content

The Liquid and Plastic Limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average Plasticity Index (PI) for each “type” of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth. Sutcliffe Investigations typically only consider a soil to be shrinkable if the proportion finer than 63µm is > 35%.

PI results are compared against guidance given in the NHBC Standards, Chapter 4.2 (revised April 2003) which advocates the use of modified Plasticity Index (I_p) defined as:

$$I_p = I_p * (\% < 425\mu\text{m}/100)$$

ie if PI is 30%, but the soil contains 80% < 425µm, then I_p = 30 * 80/100 = 24%

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425µm sieve is routinely reported by testing labs.

Sutcliffe Investigations apply engineering judgement where PI results are spread over a range of classifications. Consideration is given to:

- The average values for each particular soil type (ie differentiate between residual soil and alluvium)
- The number of results in each class and
- The actual values

Unless the judgement strongly indicates otherwise, Sutcliffe Investigations typically adopt a conservative approach and recommend assumption of the higher classification.

Soluble Sulphate and pH

Sulphates in soil and groundwater are the chemical agents most likely to attack sub-surface concrete, resulting in expansion and softening of the concrete to a mush. Another common cause of concrete deterioration is groundwater acidity.

The rate of chemical attack depends on the concentration of aggressive ions and their replenishment at the reaction surface. The rate of replenishment is related to the presence and mobility of groundwater.

Sutcliffe Investigations refer to BRE Special Digest 1 (SD1) "Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment" (2001). SD 1 provides definitions of:

- The nature of the site (Greenfield, brownfield or pyretic)
- The groundwater regime (static, mobile or highly mobile)
- The Design Sulphate Class (DC Class) and
- The Aggressive Chemical Environment for Concrete (ACEC Class)

Sutcliffe reports clearly state each of the above for the site being considered.

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO_4 for direct comparison with BS 5328:1997. The pH value of each sample was determined by the electrometric method.

SD1 also discusses determination of "representative" sulphate concentration from a number of tests. Essentially if <10 samples of a given soil-type have been tested, the highest measured sulphate concentration should be taken. If >10 samples have been tested, the mean of the highest 20% of the sulphate test can be taken. With respect to groundwater, the highest sulphate concentration should always be taken.

With respect to pH (soil & groundwater) the value used is the lowest value if <10 samples have been tested and the mean of the lowest 20% if >10 samples have been tested.

Generic Notes – Sutcliffe Investigations Geoenvironmental Investigations

4. Contamination Laboratory Analysis & Interpretation (including WAC)

General

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 “*Potential contaminants for the assessment of land*” and the relevant DETR Industry Profile(s).

Common Inorganic Contaminants

These include:

- Metals, most notably cadmium, copper, chromium, mercury, lead, nickel and zinc
- Semi-metals, most notably arsenic, selenium and (water soluble) boron
- Non-metals, most notably sulphur
- Inorganic anions, most notably cyanides (free & complex), sulphates, sulphides and nitrates

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction.

Complex cyanide is “bound” in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to uv digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO₄) sulphates etc.

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common Organic Contaminants

Petroleum hydrocarbons are a mixture of hydrocarbons produced from the distillation of crude oil. They include aliphatics (alkanes, alkenes and cycloalkanes), aromatics (single or multi benzene ringed compounds) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen.

Petroleum hydrocarbons can be grouped based on the carbon number range:-

GRO – Gasoline Range Organics (typically C₆ to C₁₀). Also referred to as PRO – Petroleum Range Organics

DRO – Diesel Range Organics (typically C₁₀ to C₂₈)

LRO – Lubricating Oil Range Organics (typically C₂₈ to C₄₀)

MRO – Mineral Oil Range Organics (typically C₁₈ to C₄₄)

However, it should be borne in mind that the terms “GRO” and “DRO” analysis are purely descriptive terms, the exact definition of which varies.

Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C₅ – C₄₀, whereas others define TPH as C₁₀ – C₃₀.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (eg petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons rapidly (especially within the C4 to C5 range) that will evaporate. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polyaromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present.

Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar NSO compounds are also present.

Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have more than two fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although insignificantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (Benzo(a)pyrene) and/or mobile in the environment (naphthalene).

Polychlorinated Biphenyls (PCBs)

Volatile Organic Compounds (VOCs) The volatile organic compound (VOC) headspace concentration of all soil samples was made with a photoionization detector (PID) fitted with a 10.2 eV lamp. This gives a semi-quantitative VOC concentration record as parts per million (ppm) (Vol/Vol). Prior to the VOC headspace reading, the background levels of VOCs were recorded. The PID was recalibrated with standard isobutylene in zero air after every 10 headspace readings.

Semi-Volatile Organic Compounds (sVOCs)

Phenols

Solvents, pesticides, herbicides

Dioxins & furans

Methods of Analysis (Organic Compounds)

Toluene Extractable Matter (TEM) results provide a screening test for organic contamination. The sample is air dried at 30°C and ground prior to addition of the solvent (toluene). The solvent extraction is aggressive and most organic compounds (fuels, oils, tars, humic material, animal fats and vegetable oil) are dissolved, as are some other inorganic contaminants such as sulphur. However, the volatiles (lighter fuel fraction etc) are lost during evaporation of the solvent.

Total Petroleum Hydrocarbon (TPH) by IR (also known as mineral oil by some testing laboratories) is undertaken on "as received" samples. Tetrachloroethylene is the solvent, and fluorosil is used to removed humic material, animal fats and vegetable oil. Consequently this analysis detects a wide range of "mineral" organics from volatiles (BTEX and gasoline) through diesel and oils to tars (including the very heavy, stable tars such as asphalt and bitumen).

TPH by GC-FID is more refined analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C₁₀ to C₄₀ (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a breakdown of the TPH results into diesel range organics (**DRO**) and heavier lubricating oil range organics (**LRO**).

GRO (PRO) by GC-FID analysis detects the more volatile C₆ – C₉ hydrocarbons (aliphatic and aromatic) including those organic compounds present in petrol.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentration of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked up when scheduling TPH by GC-FID. Naphthalene (the lightest PAH) is also one of the 58 US EPA VOCs.

Speciated TPH by GC-FID provides a “banded” TPH, initially split into aromatic and aliphatic fractions and then further divided into fraction specific carbon bandings based upon behavioural characteristics.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single “TPH”, “GRO” or “DRO” value. However, the carbon banded fractions can be used in risk assessment models.

If the relative proportion of each carbon banding within the “TPH” impact at a site is known, the risks posed by each individual fraction can be assessed and a simple back calculation applied to calculate an overall “TPH” screening value based upon the percentage weight fraction of each banding present in the “TPH”. Specialised analytical techniques and data interpretation skills are required to identify each carbon banding.

Current Guidance

The UK approach to the consideration of contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of so called source⇒ pathway⇒ target principles in order to establish the presence or potential presence of a pollutant linkage.

Sutcliffe Investigations adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate guidance levels, intervention levels or remedial targets.

In March 2002 DEFRA and the Environment Agency published a series of technical research papers (R & D Publications CLR 7, 8, 9 and 10) introducing the UK approach to the assessment of risk to **human health** from land contamination. This methodology and approach represents current scientific knowledge and thinking. The overall methodology also included the Contaminated Land Exposure Model (CLEA) and some Soil Guidance Values (SGV's).

At the time of writing this report, these guidelines only address seven contaminants and the development of both the CLEA model and additional SGV's is ongoing. Where published, SGV's have been utilised as intervention values for the purpose of an initial Tier 1 assessment.

Where SGV's were not published at the time of writing this report, appropriate Tier 1 human health related assessment have been based upon information that was best available at the time of the study.

With respect to the assessment of potential **phytotoxic effects** of contaminants, Sutcliffe Investigations refer to “The Soil Code” (Maff, 1998) for copper and zinc. The CLEA SGV is adopted for nickel.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, ‘Sulphate and Acid Resistance of Concrete in the Ground’, 2001.

With respect to the interpretation of the calorific values, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 “Notes on the fire hazards of contaminated land” which states that:

“In general it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn”.

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate concentrations with the appropriate water quality standard. Depending upon the specific characteristics and environmental setting of the site the appropriate standard is likely to be one of the following:

- Water Supply (Water Quality) Regulations 1989
- Environmental Quality Standards (for Freshwater)
- The Surface Waters (Abstraction for Drinking Water) Regulations

The tier 1 risk assessment of **landfill gas** is undertaken through reference to the following documents:

- Approved Document C, Building Regulations 1991
- CIRIA Report 149, “Protecting Development from Methane”, 1995

Should any Tier 1 criteria be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

- Undertake further statistical following the approach set out in Appendix A of CLR 7 in order to determine whether contaminant concentrations of inorganic contaminants within soil/fill actually present a risk (only applicable to assessing the risk to human health).
- Based on a qualitative risk assessment, advocate an appropriate level of remediation to “break” the pollutant linkage – for example the removal of the contaminated materials or the provision of a clean cover.
- Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.

However, the issue of **averaging area** requires further consideration. CLR 7 is ambiguous and could be interpreted as advocating the concept of a single garden as an appropriate averaging area.

This concept has massive implications with respect to ground investigation design and cost. To comply, investigations for residential development on brownfield sites would need to recover and analyse about 6 samples from each garden; this implies exploratory locations on a very tight grid, perhaps 5m to 10m spacings, with a huge increase in the number of samples analysed (cf test schedules currently issued by most practitioners).

In any case, Sutcliffe Investigations consider the concept of a single garden as an averaging area to be inappropriate. Statistical analysis of sample results by fill type, and/or by former use in a given sub-area of the site (i.e. with reference to the Conceptual Site Model), is considered a more appropriate methodology.

Analysis by soil/fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil/fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass; ie contamination would be normally be more pervasive and significant in granular soils than cohesive soils.

There is a suggestion in para 4.7 of CLR 7 that the approach outlined above was intended and the Environment Agency have confirmed that an averaging area can be larger than a single garden, if:

- Contaminant concentrations are within the same statistical population as determined using the maximum value test. The sample data being representative of the averaging area and the mean concentration of the averaging area.
- “Hot spots” are treated as separate zones or averaging areas (as defined by the maximum value test).
- The sampling strategy takes into account uncertainty (spatial heterogeneity) in contaminant concentration

Waste Classification & WAC

In the context of waste soils generated by remediation and/or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated ‘natural soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds).
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds).

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

From 16th July 2005, landfill operators will require Waste Acceptance Criteria (WAC) laboratory data, if soil is classified as **hazardous** and such waste must have been subjected to pre-treatment. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Sutcliffe Investigations typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated for example where redevelopment proposals include basement construction etc.

If off-site disposal of soils classified as hazardous waste were undertaken during redevelopment, then WAC analysis should be scheduled at an early stage in the remediation programme.

However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous. These contaminants can often be dealt with by alternative technologies (eg by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (eg WAC) is required.

Generic Notes – Sutcliffe Investigations

5. Hazardous Gas

General

Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency).

In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 1 – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark information Group, the Environment Agency and the Local Authority and the British Geological Survey.

Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

Sources

Potential sources of hazardous gas are:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworks associated with coal extraction
- Geological strata, including peat, organic silts, coal-bearing strata and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a “carrier” for hazardous gas
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

Generation

Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

Migration

Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

Current Guidance

Guidance on landfill gas monitoring control at landfill sites is given two technical memoranda, Waste Management Paper Nos. 26 and 27 published by the Department of the Environment.

Waste Management Paper 27, 1991 recommends that no dwellings should be constructed within 50m of any landfill that has the capacity to produce large volumes of landfill gas. No garden should extend to within 10m of the landfilled waste. However, development closer to landfill has been permitted where a comprehensive gas risk assessment has been completed (typically based on a minimum of 6 to 12 month monitoring programme) and appropriate gas exclusion measures designed.

The current advice with regard to monitoring for landfill gas is that if the trigger value of 1% volume (20% LEL) for methane and 1.5% volume for carbon dioxide is exceeded then remedial/control measures will be required.

It should be noted that the guideline limit for carbon dioxide of 1.5% volume recommended in Waste Management paper No. 27 is the short term (10 minute) occupational exposure limit for carbon dioxide quoted by the Health and Safety Executive in their publication EH40. The long term (8 hour) occupational exposure limit for carbon dioxide is 0.5% volume.

Approved Document C to the Department of the Environment's Building Regulations 1992 requires what where there may be gaseous contamination of the ground but the level of methane is unlikely to exceed 1% by volume, the ground floor of any house or similar small building shall be constructed of suspended concrete and ventilated as described in BRE Digest Report "Construction of New Buildings on Gas Contaminated Land". The document also requires specific design measures to be taken if a level of 5% volume carbon dioxide exists or is exceeded within the ground.

Although the above guidance is still relevant it has been more recently updated within the following documents published by the Construction Industry Research and Information Association (CIRIA).

CIRIA Report 149	'Protecting Development from Methane' (1995)
CIRIA Report 150	'Methane Investigation Strategies' (1995)
CIRIA Report 151	'Interpreting Measurement of Gas in the Ground' (1995)
CIRIA Report 152	'Risk Assessment for Methane and other gases from the ground' (1995)

The above documents are intended to provide advice on how to investigate and deal with the gas contaminated ground with respect to development.

CIRIA Report 149 characterised sites based on the recorded methane/carbon dioxide concentration and emission rates recorded during a suitable gas investigation. Characteristic situation 1 is deemed to be the lowest risk scenario with the risk rating increasing up to 6. The characteristic situations are classified as follows:

Gassing regime in ground			
Methane (% by volume in air)	Carbon dioxide (% by volume in air)	Emission rate ¹ (m/s)	Characteristic situation ²
< 0.1	< 1.5	not detected	1
> 0.1 – 1	> 1.5 – 5	not detected	2
> 1 - 5	< 5	not detected	3
> 5 – 20	< 20	< 0.01	4
> 20	> 20	> 0.01 – 0.05	5
> 20	> 20	> 0.05	6

Notes:

1. Emission rate values measures as equivalent total gas flow velocity from a 50mm diameter borehole: for methods of measurement see Crowhurst and Manchester (1992).
2. Highest measures parameter used as determining factor.

CIRIA Report 151 (1995) identified that there is currently inadequate guidance on trigger concentrations for ground gases. The current emphasis on using gas concentrations for trigger values particularly in Waste Management Paper 27 and the Building Regulations, should be revised to consider gas pressures, borehole flow rates and estimated surface emission rates.

It was concluded that the most important aspect of relating the gas regime below or adjacent to a site, to the risk it poses to any development, is the surface emission rate i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. This is considered further in the DETR Partners in Technology Report 'Passive venting of soil gases beneath buildings' (September 1997).

CIRIA Report 149 (1995), reference Table 28, reviewed over 100 case studies of development affected by gas to establish current UK practices for gas control. The report classified the gassing regimes found within 6 Characteristic Situations. The highest measures parameter, either methane or carbon dioxide concentration and/or emission rate were used to define the Characteristic Situation for each case history site. The report then related the typical range of mitigation measures that has been adopted at each study site to the characteristic gas situation.

To achieve a more consistent design of protection measures Table 28 of CIRIA 149 was rewritten (Wilson and Card, 1999) in terms of borehole gas volume flow rate and gas concentrations, as reproduced in the table below. This was done to reflect the importance of recognising the gas surface emission rate.

Characteristic situations based on Gas Flux

Characteristic Situation	Limiting CH ₄ Concentration (% v/v)	Limiting CO ₂ Concentrations (% v/v)	Limiting Borehole Flow Velocity (m/s)	Limiting Borehole Gas Volume Flow (litre/hour)	
				CH ₄	CO ₂
1	< 0.1	< 0.1	< 0.005	< 0.035	< 0.035
2	< 1.0	< 1.5	< 0.005	< 0.35	< 0.5
3	< 5.0	< 5.0	< 0.005	< 1.75	< 1.75
4	< 20	< 20	< 0.01	< 14	< 14
5	> 20	> 20	< 0.05	< 70	< 70
6	> 20	> 20	< 0.05	> 70	> 70

Gas Monitoring Procedure

Sutcliffe Investigations adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring.
- Gas emission rate.
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser.
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism.

Where samples of gas are required for laboratory analysis, Gresham Tubes are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

Appendix B – Ciria Guidance Document C552 2001

RISK ASSESSMENT METHODOLOGY

GENERAL

The purpose of this appendix is to describe in detail the concepts underlying the risk based approach to assessing potentially contaminated land, introduce the roles of key legislation and describe the qualitative methodology adopted for evaluating and characterising risk.

Current best practice in the UK promotes a risk-based approach to dealing with both soil and groundwater contamination. The principal aim of the approach is to ensure protection of human health and the environment in a thorough, transparent and cost-effective manner.

Fundamental to the risk-based approach is the concept that for 'Contaminated Land' to be designated, as a consequence of historic activities, a pathway for contamination must be shown to exist between a source of contamination and a receptor. The combined presence of a source, pathway and a receptor is described as a 'pollutant linkage'.

The concepts associated with a contaminant source, pathway and receptor are defined in DETR Circular 02/2000 'Contaminated Land Environmental Protection Act 1990: Part II A'. A **source** of contamination may be considered as a 'substance, which is in, on or under land that has the potential to cause harm or to cause pollution of controlled waters'. A **receptor** can be considered as either 'a living organism, a group of living organisms, an ecological system or a piece of property which is being, or could be harmed, by a contaminant or controlled waters which are being, or could be, polluted by a contaminant'. A **pathway** may be considered as one or more routes by, or through, which a receptor is being, or could be, exposed to or affected, by a contaminant. Typical pathways may include migration in groundwater, surface water run-off or infiltration, inhalation, dermal contact and ingestion.

The risks posed by an identified pollutant linkage can often be mitigated by removing the source of contamination, treating the source of contamination, blocking the relevant pathway(s) or by protecting the receptor.

PRINCIPLES OF RISK EVALUATION

The risk evaluation methodology presented below is qualitative in nature, and is therefore a subjective method. It is based upon guidance presented in CIRIA publication referenced C552, 'Contaminated land risk assessment - A guide to good practice', 2001 and involves the classification of the following.

The magnitude of the potential **consequence** (severity) of risks occurring (Table 1).

The magnitude of the **probability** (likelihood) of the risk occurring (Table 2).

These are then considered in conjunction to give a risk matrix (Table 3)

Table 1 - Classification of consequence

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health (“significant harm” as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem. (Note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR, 2000).	Concentrations of a contaminant from site exceed the generic or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services (“significant harm” as defined in the <i>Draft Circular on Contaminated Land</i> , DETR, 2000). Damage to sensitive buildings/structures/ services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discolouration of concrete.

Table 2 - Classification of probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 3 - Comparison of consequence against probability

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table 4 - Description of the classified risks and likely action required

Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

Table 5 - Response action likely to be required in relation to estimated risk

KEY

	Mitigation and remedial measures required
	Mitigation and remedial measures likely
	Remedial measures unlikely
	Remedial measures not required

Appendix C –Window Sample & Hand Auger Hole Logs



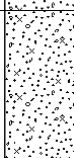
Sutcliffe Investigations

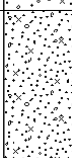
Site Former Penny Black Pub	Number WS1
Client T J Thomas Ltd	Job Number 26045LG
Engineer GF	Sheet 1/1

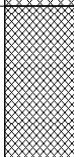
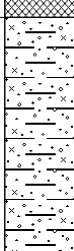
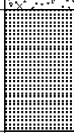
Excavation Method Dando Terrier Rig.		Dimensions		Ground Level (mOD)	
Location See Location Plan.		Dates 05/04/2012			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)
0.50-0.50	S1		P.I.D 0.0		(0.05) 0.05
0.80	CU 55kPa				(0.35) 0.40
1.00-1.45	SPT N=18		2,3/3,3,4,8		(0.20) 0.60
2.00-2.35	SPT 50/200		8,10/20,30		(0.40) 1.00
					(0.50) 1.50
					(0.70) 2.20
					(0.15) 2.35

Description	Legend	Water
Bituminous macadam.		
Grey sandy limestone gravel with fine angular fragments of brick (Subbase) (MADE GROUND)		
Dark brown gravelly sand with rare angular fine brick fragments. (MADE GROUND)		
Firm brown silty sandy gravelly CLAY. Gravel is sub angular fine and medium of various lithologies.		
Yellow silty gravelly SAND. Gravel is sub rounded fine to coarse of various lithologies.		
Dense red / orange gravelly silty SAND.		
Red weathered SANDSTONE.		
Complete at 2.35m		

Remarks Window Sample hole dry. Window Sample hole terminated at 2.35m bgl after SPT refusal on weathered SANDSTONE.	Scale (approx)	Logged By
	1:25	GF
	Figure No. 26045LG.WS1	

Sutcliffe Investigations						Site Former Penny Black Pub		Number WS2	
Excavation Method Dando Terrier Rig.		Dimensions		Ground Level (mOD)		Client T J Thomas Ltd		Job Number 26045LG	
		Location See Location Plan.		Dates 05/04/2012		Engineer GF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50-0.50	S1		P.I.D 0.0		(0.05)	Bituminous macadam.			
					0.05				
					(0.35)	Grey sandy limestone gravel with fine angular fragments of brick (Subbase) (MADE GROUND)			
0.40									
1.00-1.45	SPT N=13		2,2/2,3,3,5		(0.30)	Dark brown gravelly sand with rare angular fine brick fragments. (MADE GROUND)			
					0.70				
					(0.80)	Yellow silty gravelly SAND. Gravel is sub rounded fine to coarse of various lithologies.			
1.50									
2.00-2.20	SPT 50/50		20,38/50		(0.50)	Dense red / orange gravelly silty SAND.			
					2.00				
					(0.20)	Red weathered SANDSTONE.			
2.20									
						Complete at 2.20m			

Sutcliffe Investigations					Site Former Penny Black Pub		Number WS3		
Excavation Method Dando Terrier Rig.		Dimensions		Ground Level (mOD)		Client T J Thomas Ltd		Job Number 26045LG	
		Location See Location Plan.		Dates 05/04/2012		Engineer GF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50-0.50	S1		P.I.D 0.0		(0.20)	Grassed TOPSOIL.			
					0.20	Dark brown gravelly sand with rare angular fine to coarse fragments of concrete and ash. (MADE GROUND)			
1.00-1.45	SPT N=20		2,3/4,4,5,7		(0.60)	Firm brown silty sandy gravelly CLAY. Gravel is sub angular fine and medium of various lithologies.			
1.20	CU 67kPa				0.80				
2.00-2.20	SPT 50/50		14,28/50		(0.70)	Dense red / orange gravelly silty SAND.			
					1.50				
					(0.50)	Red weathered SANDSTONE.			
					2.00	Complete at 2.20m			
					(0.20)				
					2.20				
Remarks Window Sample hole dry. Window Sample hole terminated at 2.20m bgl after SPT refusal on weathered SANDSTONE.							Scale (approx) 1:25	Logged By GF	
							Figure No. 26045LG.WS3		

Sutcliffe Investigations						Site Former Penny Black Pub		Number WS4	
Excavation Method Dando Terrier Rig.		Dimensions		Ground Level (mOD)		Client T J Thomas Ltd		Job Number 26045LG	
		Location See Location Plan.		Dates 05/04/2012		Engineer GF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.40-0.40	S1		P.I.D 0.0		(0.05)	CONCRETE paving stone.			
					0.05				
					(0.10)				Brown medium and coarse sand (Subbase)
0.15									
					(0.55)	Dark brown sandy clay with rare gravel of ash and brick. (MADE GROUND)			
					0.70				
1.00-1.45 1.10	SPT N=12 CU 76kPa		1,2/1,2,4,5		(0.80)	Firm brown silty sandy gravelly CLAY. Gravel is sub angular fine and medium of various lithologies.			
					1.50				
					(0.30)	Dense red / orange gravelly silty SAND.			
					1.80				
2.00-2.20	SPT 83/50		10,12/33,50		(0.40)	Red weathered SANDSTONE.			
					2.20				
						Complete at 2.20m			
Remarks Window Sample hole terminated at 2.20m bgl after SPT refusal on weathered SANDSTONE. Window Sample hole dry.								Scale (approx) 1:25	Logged By GF
								Figure No. 26045LG.WS4	



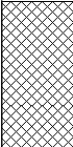
Sutcliffe Investigations

Site Former Penny Black Pub	Number WS5
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Excavation Method Dando Terrier Rig.	Dimensions	Ground Level (mOD)	Client T J Thomas Ltd	Job Number 26045LG
	Location See Location Plan.	Dates 05/04/2012	Engineer GF	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40-0.40	S1		P.I.D 0.0		(0.20) 0.20	Grassed TOPSOIL.		
					(0.30) 0.50	Dark brown sandy gravelly clay with rare angular fragments of brick (MADE GROUND)		
0.80	CU 69kPa				(0.40) 0.90	Firm brown silty sandy gravelly CLAY. Gravel is sub angular fine and medium of various lithologies.		
1.00-1.45	SPT N=28		4,4/5,7,7,9		(0.50) 1.40	Dense red / orange gravelly silty SAND.		
					(0.50) 1.90	Red weathered SANDSTONE.		
1.80-1.90	SPT 67*/100		17,50/			Complete at 1.90m		

Remarks Window Sample hole dry. Window Sample hole terminated at 1.90m bgl after SPT refusal on weathered SANDSTONE.	Scale (approx)	Logged By
	1:25	GF
	Figure No. 26045LG.WS5	

 Sutcliffe Investigations						Site Former Penny Black Pub		Trial Pit Number HAH1																																																													
Excavation Method Hand Auger.		Dimensions 200mm x 200mm		Ground Level (mOD)		Client T J Thomas Ltd		Job Number 26045LG																																																													
		Location See Location Plan.		Dates 01/01/2012		Engineer GF		Sheet 1/1																																																													
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water																																																													
0.40-0.40	S1		P.I.D 0.0			Dark brown grassed sandy loam with fine angular fragments of brick. (MADE GROUND)																																																															
					0.50 (0.10)	Firm brown silty sandy gravelly CLAY. Gravel is sub angular fine and medium of various lithologies.																																																															
					0.60	Complete at 0.60m																																																															
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Former Penny Black Pub

**Trial Pit
Number**
HAH2

Hand Auger.

210mm x 200mm

Dates	05/04/2012
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T J Thomas Ltd

Job Number
26045LG

See Location Plan.

GF

Sheet
1/1

Sample / Tests

Field Records

Depth
(m)
(Thickness)

Description

Legend

Water

0.40-0.40

S1

P.I.D 0.0

(0.60)

0.60

Dark brown grassed sandy loam with fine angular fragments of brick. (MADE GROUND)

Complete at 0.60m

Plan

Remarks

Hand Auger hole dry.
Hand Auger hole terminated at 0.60m bgl in MADE GROUND.

Scale (approx)

1:25

Logged By

GF

Figure No.

26045LG.HAH2

 Sutcliffe Investigations						Site Former Penny Black Pub		Trial Pit Number HAH3																																																													
Excavation Method Hand Auger.		Dimensions 200mm x 190mm		Ground Level (mOD)		Client T J Thomas Ltd		Job Number 26045LG																																																													
		Location See Location Plan.		Dates 05/04/2012		Engineer GF		Sheet 1/1																																																													
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water																																																												
0.40-0.40	S1		P.I.D 0.0		(0.65)	Dark brown grassed sandy loam with fine angular fragments of brick. (MADE GROUND)																																																															
					0.65 (0.15) 0.80	Firm brown silty sandy gravelly CLAY. Gravel is sub angular fine and medium of various lithologies.																																																															
					Complete at 0.80m																																																																
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								Figure No. 26045LG.HAH3																																																													

Appendix D – Analytical Certificates



Sutcliffe
18-20 Harrington Street
Liverpool
Merseyside
L2 9QA

Attention: Sara Hale

CERTIFICATE OF ANALYSIS

Date: 18 April 2012
Customer: H_SUTCLIFF_LPL
Sample Delivery Group (SDG): 120406-50
Your Reference:
Location: 26045LG
Report No: 178111

We received 8 samples on Friday April 06, 2012 and 8 of these samples were scheduled for analysis which was completed on Wednesday April 18, 2012. 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





SDG:	120406-50	Location:	26045LG	Order Number:	4195 / SH / 26045LG
Job:	H_SUTCLIFF_LPL-148	Customer:	Sutcliffe	Report Number:	178111
Client Reference:		Attention:	Sara Hale	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
5424248	HAH1		0.40	05/04/2012
5424249	HAH2		0.40	05/04/2012
5424250	HAH3		0.40	05/04/2012
5424252	WS1		0.50	05/04/2012
5424253	WS2		0.50	05/04/2012
5424254	WS3		0.50	05/04/2012
5424256	WS5		0.40	05/04/2012

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



SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		5424248	5424252	5424249	5424253	5424250	5424254	5424255	5424256
	Customer Sample Reference		HAH1	WS1	HAH2	WS2	HAH3	WS3	WS4	WS5
	AGS Reference									
	Depth (m)		0.40	0.50	0.40	0.50	0.40	0.50	0.40	0.40
	Container		250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)	250g Amber Jar (AL 400g Tub (ALE214)
% Stones Greater than 10mm	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Anions by Kone (soil)	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Anions by Kone (w)	All	NDPs: 0 Tests: 2		X					X	
Asbestos Identification (Soil)	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Boron Water Soluble	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Chromium III	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 2		X					X	
Dissolved Organic/Inorganic Carbon	All	NDPs: 0 Tests: 2		X					X	
Easily Liberated Sulphide	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
Elemental Sulphur	All	NDPs: 0 Tests: 8	X	X	X	X	X	X	X	X
EPH (DRO) (C10-C40) Aqueous (W)	All	NDPs: 0 Tests: 2		X					X	
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 2	X						X	
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 2	X						X	
Free Sulphur	All	NDPs: 0 Tests: 2		X					X	



SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container	
	5424248		HAH1				0.40		400g Tub (ALE214)	
	5424252		WS1				0.50		250g Amber Jar (AL)	
	5424249		HAH2				0.40		250g Amber Jar (AL)	
	5424253		WS2				0.50		250g Amber Jar (AL)	
5424250		HAH3				0.40		400g Tub (ALE214)		
5424254		WS3				0.50		400g Tub (ALE214)		
5424255		WS4				0.40		60g VOC (ALE215)		
5424256		WS5				0.40		250g Amber Jar (AL)		
GRO by GC-FID (S)	All	NDPs: 0 Tests: 2								X
GRO by GC-FID (W)	All	NDPs: 0 Tests: 2								
Hexavalent Chromium (s)	All	NDPs: 0 Tests: 8								
Hexavalent Chromium (w)	All	NDPs: 0 Tests: 2								
Low Level Phenols by HPLC (W)	All	NDPs: 0 Tests: 2								
Mercury Dissolved	All	NDPs: 0 Tests: 2								
Metals by iCap-OES (Soil)	Arsenic	NDPs: 0 Tests: 8								
	Cadmium	NDPs: 0 Tests: 8								
	Chromium	NDPs: 0 Tests: 8								
	Copper	NDPs: 0 Tests: 8								
	Lead	NDPs: 0 Tests: 8								
	Mercury	NDPs: 0 Tests: 8								
	Nickel	NDPs: 0 Tests: 8								
	Selenium	NDPs: 0 Tests: 8								
	Zinc	NDPs: 0 Tests: 8								



SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container	
	5424248		HAH1				0.40		400g Tub (ALE214)	
	5424252		WS1				0.50		250g Amber Jar (AL)	
	5424249		HAH2				0.40		400g Tub (ALE214)	
	5424253		WS2				0.50		250g Amber Jar (AL)	
	5424250		HAH3				0.40		400g Tub (ALE214)	
	5424254		WS3				0.50		250g Amber Jar (AL)	
	5424255		WS4				0.40		400g Tub (ALE214)	
	5424256		WS5				0.40		250g Amber Jar (AL)	
									60g VOC (ALE215)	
NRA Leachate	All	NDPs: 0 Tests: 2							400g Tub (ALE214)	
PAH by GCMS	All	NDPs: 0 Tests: 8							250g Amber Jar (AL)	
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 2							400g Tub (ALE214)	
pH	All	NDPs: 0 Tests: 8							250g Amber Jar (AL)	
pH Value	All	NDPs: 0 Tests: 2							400g Tub (ALE214)	
Phenols by HPLC (S)	All	NDPs: 0 Tests: 8							250g Amber Jar (AL)	
Sample description	All	NDPs: 0 Tests: 8							400g Tub (ALE214)	
Sulphide	All	NDPs: 0 Tests: 2							250g Amber Jar (AL)	
Total Organic Carbon	All	NDPs: 1 Tests: 7							400g Tub (ALE214)	
Total Organic Carbon (Asb)	All	NDPs: 0 Tests: 1							250g Amber Jar (AL)	
Total Sulphate	All	NDPs: 0 Tests: 8							400g Tub (ALE214)	
TPH CWG GC (S)	All	NDPs: 0 Tests: 2							250g Amber Jar (AL)	



SDG:	120406-50	Location:	26045LG	Order Number:	4195 / SH / 26045LG
Job:	H_SUTCLIFF_LPL-148	Customer:	Sutcliffe	Report Number:	178111
Client Reference:		Attention:	Sara Hale	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
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Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
5424248	HAH1	0.40	Light Brown	Silty Clay Loam	0.063 - 0.1 mm	Stones	None
5424249	HAH2	0.40	Light Brown	Silt Loam	0.063 - 0.1 mm	Stones	Vegetation
5424250	HAH3	0.40	Light Brown	Silt Loam	0.063 - 0.1 mm	Stones	Brick
5424252	WS1	0.50	Light Brown	Sandy Silt Loam	0.1 - 2 mm	Stones	Brick
5424253	WS2	0.50	Light Brown	Sandy Loam	0.1 - 2 mm	Stones	None
5424254	WS3	0.50	Light Brown	Sandy Loam	0.1 - 2 mm	Stones	None
5424255	WS4	0.40	Dark Brown	Sandy Clay Loam	0.1 - 2 mm	None	None
5424256	WS5	0.40	Dark Brown	Sandy Clay Loam	0.1 - 2 mm	Stones	Vegetation

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.



CERTIFICATE OF ANALYSIS

SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Results Legend		Customer Sample R	HAH1	HAH2	HAH3	WS1	WS2	WS3
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	HAH1	HAH2	HAH3	WS1	WS2	WS3
M	mCERTS accredited.		0.40	0.40	0.40	0.50	0.50	0.50
S	Deviating sample.		Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
aq	Aqueous / settled sample.		05/04/2012	05/04/2012	05/04/2012	05/04/2012	05/04/2012	05/04/2012
diss.filt	Dissolved / filtered sample.		06/04/2012	06/04/2012	06/04/2012	06/04/2012	06/04/2012	06/04/2012
tot.unfilt	Total / unfiltered sample.		120406-50	120406-50	120406-50	120406-50	120406-50	120406-50
*	Subcontracted test.		5424248	5424249	5424250	5424252	5424253	5424254
**	% 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							
(F)	Trigger breach confirmed							
Component	LOD/Units	Method						
Moisture content ratio, Natural	%	PM024	18	15	17	10	11	16
Stones > 10 mm	%	TM008	0	1.88	2.96	3.19	3.19	2.4
Phenol	<0.01 mg/kg	TM062 (S)	<0.01 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M
Cresols	<0.01 mg/kg	TM062 (S)	<0.01 M	0.0115 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M
Xylenols	<0.015 mg/kg	TM062 (S)	<0.015 M	<0.015 M	<0.015 M	0.022 M	<0.015 M	<0.015 M
1-Naphthol	<0.01 mg/kg	TM062 (S)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,5-Trimethylphenol	<0.01 mg/kg	TM062 (S)	<0.01 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M
Phenols, Total Detected monohydric	<0.035 mg/kg	TM062 (S)	<0.035 M	<0.035 M	<0.035 M	<0.035 M	<0.035 M	<0.035 M
Carbon, Organic (diss.filt) NRA leach	<3000 µg/l	TM090				8630		
Sulphide NRA leach	<10 µg/l	TM101				<10		
Organic Matter, Total	<0.35 %	TM132	0.648 #	4.22 #	8.65 #	1.58 #	1.95 #	1.53 #
pH	1 pH Units	TM133	8.17 M	8.2 M	8.09 M	8.14 M	7.77 M	7.85 M
Sulphur, Elemental	<10 mg/kg	TM136	<5 M	<5 M	<20 M	49.1 M	<5 M	<5 M
Chromium, Hexavalent	<0.6 mg/kg	TM151	<0.6 #	<3 #	<3 #	<1.2 #	<3 #	<3 #
Chromium, Trivalent NRA leach	<30 µg/l	TM152				<30		
Arsenic (diss.filt) NRA leach	<0.12 µg/l	TM152				4.8		
Boron (diss.filt) NRA leach	<9.4 µg/l	TM152				42.5		
Cadmium (diss.filt) NRA leach	<0.1 µg/l	TM152				<0.1		
Chromium (diss.filt) NRA leach	<0.22 µg/l	TM152				2.13		
Copper (diss.filt) NRA leach	<0.85 µg/l	TM152				6.69		
Lead (diss.filt) NRA leach	<0.02 µg/l	TM152				2.8		
Nickel (diss.filt) NRA leach	<0.15 µg/l	TM152				1.01		
Selenium (diss.filt) NRA leach	<0.39 µg/l	TM152				0.903		
Zinc (diss.filt) NRA leach	<0.41 µg/l	TM152				0.953		
Cyanide, Total	<1 mg/kg	TM153	<1 M	<1 M	<1 M	<1 M	<1 M	<1 M
EPH Range >C10 - C40 (aq) NRA leach	<46 µg/l	TM172				<46		
Sulphide, Easily liberated	<15 mg/kg	TM180	<15 #	<15 #	<15 #	<15 #	<15 #	<15 #
Chromium, Trivalent	<0.9 mg/kg	TM181	28	15.2	21.9	13.7	18.5	13.9
Arsenic	<0.6 mg/kg	TM181	6.24 M	5.83 M	12.3 M	8.31 M	7.76 M	6.4 M
Cadmium	<0.02 mg/kg	TM181	0.15 M	0.554 M	1.06 M	2.4 M	0.557 M	0.948 M
Chromium	<0.9 mg/kg	TM181	28 M	15.2 M	21.9 M	13.7 M	18.5 M	13.9 M
Copper	<1.4 mg/kg	TM181	30.9 M	36 M	107 M	32.7 M	41.5 M	30.3 M
Lead	<0.7 mg/kg	TM181	12.3 M	62.2 M	72.9 M	291 M	45 M	62.4 M
Mercury	<0.14 mg/kg	TM181	<0.14	0.155 M	<0.14	0.14	<0.14 M	<0.14
Nickel	<0.2 mg/kg	TM181	24.8 M	12.3 M	25.6 M	11.6 M	11.4 M	12.8 M

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Page 8 of 22



CERTIFICATE OF ANALYSIS

SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Results Legend		Customer Sample R	WS4	WS5			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference					
M	mCERTS accredited.						
S	Deviating sample.						
aq	Aqueous / settled sample.						
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						
(F)	Trigger breach confirmed						
Component	LOD/Units	Method					
Moisture content ratio, Natural	%	PM024	20	16			
Stones > 10 mm	%	TM008	0	8.13			
Phenol	<0.01 mg/kg	TM062 (S)	<0.01 M	<0.01 M			
Cresols	<0.01 mg/kg	TM062 (S)	<0.01 M	<0.01 M			
Xylenols	<0.015 mg/kg	TM062 (S)	<0.015 M	<0.015 M			
1-Naphthol	<0.01 mg/kg	TM062 (S)	<0.01	<0.01			
2,3,5-Trimethylphenol	<0.01 mg/kg	TM062 (S)	<0.01 M	<0.01 M			
Phenols, Total Detected monohydric	<0.035 mg/kg	TM062 (S)	<0.035 M	<0.035 M			
Carbon, Organic (diss.filt) NRA leach	<3000 µg/l	TM090	<3000				
Sulphide NRA leach	<10 µg/l	TM101	<10				
Organic Matter, Total	<0.35 %	TM132		3.88 #			
pH	1 pH Units	TM133	7.6 M	8.36 M			
Sulphur, Elemental	<10 mg/kg	TM136	16.9 M	<5 M			
Chromium, Hexavalent	<0.6 mg/kg	TM151	<1.2 #	<0.6 #			
Chromium, Trivalent NRA leach	<30 µg/l	TM152	<30				
Arsenic (diss.filt) NRA leach	<0.12 µg/l	TM152	1.96				
Boron (diss.filt) NRA leach	<9.4 µg/l	TM152	31.4				
Cadmium (diss.filt) NRA leach	<0.1 µg/l	TM152	<0.1				
Chromium (diss.filt) NRA leach	<0.22 µg/l	TM152	1.69				
Copper (diss.filt) NRA leach	<0.85 µg/l	TM152	3.43				
Lead (diss.filt) NRA leach	<0.02 µg/l	TM152	0.954				
Nickel (diss.filt) NRA leach	<0.15 µg/l	TM152	0.866				
Selenium (diss.filt) NRA leach	<0.39 µg/l	TM152	<0.39				
Zinc (diss.filt) NRA leach	<0.41 µg/l	TM152	6.19				
Cyanide, Total	<1 mg/kg	TM153	<1 M	<1			
EPH Range >C10 - C40 (aq) NRA leach	<46 µg/l	TM172	<46				
Sulphide, Easily liberated	<15 mg/kg	TM180	<15 #	<15 #			
Chromium, Trivalent	<0.9 mg/kg	TM181	24.8	19.4			
Arsenic	<0.6 mg/kg	TM181	11.3 M	6.64 M			
Cadmium	<0.02 mg/kg	TM181	0.775 M	0.701 M			
Chromium	<0.9 mg/kg	TM181	24.8 M	19.4 M			
Copper	<1.4 mg/kg	TM181	53.7 M	26.1 M			
Lead	<0.7 mg/kg	TM181	69.3 M	51.9 M			
Mercury	<0.14 mg/kg	TM181	<0.14 M	<0.14 M			
Nickel	<0.2 mg/kg	TM181	22.2 M	13.4 M			

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Page 10 of 22

CERTIFICATE OF ANALYSIS

SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

PAH by GCMS

[illegible]

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Page 12 of 22

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Page 13 of 22



CERTIFICATE OF ANALYSIS

SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

TPH CWG (S)

Results Legend		Customer Sample R	WS1	WS4			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference					
M	mCERTS accredited.						
\$	Deviating sample.						
aq	Aqueous / settled sample.						
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						
(F)	Trigger breach confirmed						
Component	LOD/Units	Method					
GRO Surrogate % recovery**	%	TM089	78	90			
GRO >C5-C12	<0.044 mg/kg	TM089	<0.044	<0.044			
Methyl tertiary butyl ether (MTBE)	<0.005 mg/kg	TM089	<0.005	<0.005			
Benzene	<0.01 mg/kg	TM089	<0.01	<0.01			
Toluene	<0.002 mg/kg	TM089	0.0033	0.0048			
Ethylbenzene	<0.003 mg/kg	TM089	<0.003	<0.003			
m,p-Xylene	<0.006 mg/kg	TM089	<0.006	<0.006			
o-Xylene	<0.003 mg/kg	TM089	<0.003	<0.003			
sum of detected mpo xylene by GC	<0.009 mg/kg	TM089	<0.009	<0.009			
sum of detected BTEX by GC	<0.024 mg/kg	TM089	<0.024	<0.024			
Aliphatics >C5-C6	<0.01 mg/kg	TM089	<0.01	<0.01			
Aliphatics >C6-C8	<0.01 mg/kg	TM089	<0.01	<0.01			
Aliphatics >C8-C10	<0.01 mg/kg	TM089	<0.01	<0.01			
Aliphatics >C10-C12	<0.01 mg/kg	TM089	<0.01	<0.01			
Aliphatics >C12-C16	<0.1 mg/kg	TM173	2.21	2.46			
Aliphatics >C16-C21	<0.1 mg/kg	TM173	3.41	3.18			
Aliphatics >C21-C35	<0.1 mg/kg	TM173	20.9	11.1			
Aliphatics >C35-C44	<0.1 mg/kg	TM173	1.16	<0.1			
Total Aliphatics >C12-C44	<0.1 mg/kg	TM173	27.7	16.7			
Aromatics >EC5-EC7	<0.01 mg/kg	TM089	<0.01	<0.01			
Aromatics >EC7-EC8	<0.01 mg/kg	TM089	<0.01	<0.01			
Aromatics >EC8-EC10	<0.01 mg/kg	TM089	<0.01	<0.01			
Aromatics >EC10-EC12	<0.01 mg/kg	TM089	<0.01	<0.01			
Aromatics >EC12-EC16	<0.1 mg/kg	TM173	<0.1	<0.1			
Aromatics >EC16-EC21	<0.1 mg/kg	TM173	<0.1	0.827			
Aromatics >EC21-EC35	<0.1 mg/kg	TM173	17.3	12.7			
Aromatics >EC35-EC44	<0.1 mg/kg	TM173	11	3.14			
Aromatics >EC40-EC44	<0.1 mg/kg	TM173	4.79	0.758			
Total Aromatics >EC12-EC44	<0.1 mg/kg	TM173	28.2	16.6			
Total Aliphatics >C5-35	<0.1 mg/kg	TM173	26.6	16.7			
Total Aromatics >C5-35	<0.1 mg/kg	TM173	17.3	13.5			
Total Aliphatics & Aromatics >C5-35	<0.1 mg/kg	TM173	43.8	30.2			
Total Aliphatics & Aromatics >C5-C44	<0.1 mg/kg	TM173	56	33.3			

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Page 15 of 22



SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Asbestos Identification - Soil

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	HAH1 NS Z 0.40 SOLID 05/04/2012 00:00:00 120406-50 5,424,248 TM048	16/04/12	Rhodri Williams	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	HAH2 NS Z 0.40 SOLID 05/04/2012 00:00:00 120406-50 5,424,249 TM048	16/04/12	Martin Cotterell	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	HAH3 NS Z 0.40 SOLID 05/04/2012 00:00:00 120406-50 5,424,250 TM048	16/04/12	Rhodri Williams	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	WS1 NS Z 0.50 SOLID 05/04/2012 00:00:00 120406-50 5,424,252 TM048	16/04/12	Martin Cotterell	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	WS2 NS Z 0.50 SOLID 05/04/2012 00:00:00 120406-50 5,424,253 TM048	16/04/12	Martin Cotterell	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected



CERTIFICATE OF ANALYSIS

SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	WS3 NS Z 0.50 SOLID 05/04/2012 00:00:00 120406-50 5,424,254 TM048	16/04/12	Rhodri Williams	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	WS4 NS Z 0.40 SOLID 05/04/2012 00:00:00 120406-50 5,424,255 TM048	16/04/12	Kevin Bowron	Loose fibres in soil	Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	WS5 NS Z 0.40 SOLID 05/04/2012 00:00:00 16/04/2012 19:55:01 120406-50 5,424,256 TM048	16/04/12	Martin Cotterell	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected



SDG:	120406-50	Location:	26045LG	Order Number:	4195 / SH / 26045LG
Job:	H_SUTCLIFF_LPL-148	Customer:	Sutcliffe	Report Number:	178111
Client Reference:		Attention:	Sara Hale	Superseded Report:	

Notification of Deviating Samples

Sample Number	Customer Sample Ref.	Depth (m)	Matrix	Test Name	Component Name	Comment
5443804	WS1	0.50	SOLID	GRO by GC-FID (S)	Benzene	Sample holding time exceeded
5443804	WS1	0.50	SOLID	GRO by GC-FID (S)	Ethylbenzene	Sample holding time exceeded
5443804	WS1	0.50	SOLID	GRO by GC-FID (S)	m,p-Xylene	Sample holding time exceeded
5443804	WS1	0.50	SOLID	GRO by GC-FID (S)	Methyl tertiary butyl ether (MTBE)	Sample holding time exceeded
5443804	WS1	0.50	SOLID	GRO by GC-FID (S)	o-Xylene	Sample holding time exceeded
5443804	WS1	0.50	SOLID	GRO by GC-FID (S)	Toluene	Sample holding time exceeded
5443805	WS4	0.40	SOLID	GRO by GC-FID (S)	Benzene	Sample holding time exceeded
5443805	WS4	0.40	SOLID	GRO by GC-FID (S)	Ethylbenzene	Sample holding time exceeded
5443805	WS4	0.40	SOLID	GRO by GC-FID (S)	m,p-Xylene	Sample holding time exceeded
5443805	WS4	0.40	SOLID	GRO by GC-FID (S)	Methyl tertiary butyl ether (MTBE)	Sample holding time exceeded
5443805	WS4	0.40	SOLID	GRO by GC-FID (S)	o-Xylene	Sample holding time exceeded
5443805	WS4	0.40	SOLID	GRO by GC-FID (S)	Toluene	Sample holding time exceeded

Note : Test results may be compromised



SDG:	120406-50	Location:	26045LG	Order Number:	4195 / SH / 26045LG
Job:	H_SUTCLIFF_LPL-148	Customer:	Sutcliffe	Report Number:	178111
Client Reference:		Attention:	Sara Hale	Superseded Report:	

Notification of NDPs (No determination possible)

Date Received : 06/04/2012 14:25:57

Sample No	Customer Sample Ref.	Depth (m)	Test	Comment
5424255	WS4	0.40	Total Organic Carbon	Unsuitable for analysis due to potential Asbestos



SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM023	Leaching test method for the Assessment of Contaminated Land: Interim NRA Guidance. National Rivers Authority R & D note 301. (1994).	Leaching Procedure for NRA Leachates		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM008	BS 1377:Part 1977	Particle size distribution of solid samples		
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		
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser		
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		
TM136	Method 17.10, Second Site property, March 2003	Determination of Sulphur by HPLC		
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		
TM172	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	EPH in Waters		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
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		
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		
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		
TM227	Standard methods for the examination of waters and wastewaters 20th Edition, AWWA/APHA Method 4500.	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate		
TM241	Methods for the Examination of Waters and Associated Materials; Chromium in Raw and Potable Waters and Sewage Effluents 1980.	The Determination of Hexavalent Chromium in Waters and Leachates using the Kone Analyser		
TM243		Mixed Anions In Soils By Kone		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM255		Determination of Low Level Phenols in Waters and Leachates by HPLC		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		
TM294		Determination of Free Sulphur in liquids by HPLC		
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.



CERTIFICATE OF ANALYSIS

SDG: 120406-50
Job: H_SUTCLIFF_LPL-148
Client Reference:

Location: 26045LG
Customer: Sutcliffe
Attention: Sara Hale

Order Number: 4195 / SH / 26045LG
Report Number: 178111
Superseded Report:

Test Completion Dates

Lab Sample No(s)	5424248	5424249	5424250	5424252	5424253	5424254	5424255	5424256
Customer Sample Ref.	HAH1	HAH2	HAH3	WS1	WS2	WS3	WS4	WS5
AGS Ref.								
Depth	0.40	0.40	0.40	0.50	0.50	0.50	0.40	0.40
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
% Stones Greater than 10mm	12-Apr-2012	12-Apr-2012	12-Apr-2012	12-Apr-2012	12-Apr-2012	12-Apr-2012	12-Apr-2012	12-Apr-2012
Anions by Kone (soil)	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
Anions by Kone (w)				16-Apr-2012			16-Apr-2012	
Asbestos Identification (Soil)	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
Boron Water Soluble	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
Chromium III	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012
Cyanide Comp/Free/Total/Thiocyanate	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
Dissolved Metals by ICP-MS				16-Apr-2012			16-Apr-2012	
Dissolved Organic/Inorganic Carbon				14-Apr-2012			14-Apr-2012	
Easily Liberated Sulphide	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
Elemental Sulphur	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012
EPH (DRO) (C10-C40) Aqueous (W)				16-Apr-2012			16-Apr-2012	
EPH CWG (Aliphatic) GC (S)				16-Apr-2012			16-Apr-2012	
EPH CWG (Aromatic) GC (S)				16-Apr-2012			16-Apr-2012	
Free Sulphur				16-Apr-2012			16-Apr-2012	
GRO by GC-FID (S)				15-Apr-2012			15-Apr-2012	
GRO by GC-FID (W)				14-Apr-2012			14-Apr-2012	
Hexavalent Chromium (s)	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
Hexavalent Chromium (w)				16-Apr-2012			16-Apr-2012	
Low Level Phenols by HPLC (W)				17-Apr-2012			17-Apr-2012	
Mercury Dissolved				16-Apr-2012			16-Apr-2012	
Metals by iCap-OES (Soil)	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012
NRA Leachate				10-Apr-2012			10-Apr-2012	
PAH by GCMS	14-Apr-2012	14-Apr-2012	14-Apr-2012	14-Apr-2012	14-Apr-2012	14-Apr-2012	14-Apr-2012	14-Apr-2012
PAH Spec MS - Aqueous (W)				16-Apr-2012			16-Apr-2012	
pH	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	13-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
pH Value				14-Apr-2012			14-Apr-2012	
Phenols by HPLC (S)	13-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	16-Apr-2012	16-Apr-2012
Sample description	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012
Sulphide				16-Apr-2012			16-Apr-2012	
Total Organic Carbon	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012	17-Apr-2012		17-Apr-2012
Total Organic Carbon (Asb)							18-Apr-2012	
Total Sulphate	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012	16-Apr-2012
TPH CWG GC (S)				16-Apr-2012			16-Apr-2012	



CERTIFICATE OF ANALYSIS

SDG:	120406-50	Location:	26045LG	Order Number:	4195 / SH / 26045LG
Job:	H_SUTCLIFF_LPL-148	Customer:	Sutcliffe	Report Number:	178111
Client Reference:		Attention:	Sara Hale	Superseded Report:	

Appendix

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.

SOLID MATRICES EXTRACTION SUMMARY				
ANALYSIS	D&C OR WET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
SOLVENTEXTRACTABLE MATTER	D&C	DCM	SOX THERM	GRAVIMETRIC
CYCLOHEXANE EXT. MATTER	D&C	CYCLOHEXANE	SOX THERM	GRAVIMETRIC
ELEMENTAL SULPHUR	D&C	DCM	SOX THERM	HPLC
PHENOLS BY GCMS	WET	DCM	SOX THERM	GC-MS
HERBICIDES	D&C	HEXANE/ACETONE	SOX THERM	GC-MS
PESTICIDES	D&C	HEXANE/ACETONE	SOX THERM	GC-MS
EPH (DRO)	D&C	HEXANE/ACETONE	END OVER END	GC-FID
EPH (MIN OIL)	D&C	HEXANE/ACETONE	END OVER END	GC-FID
EPH (CLEANED UP)	D&C	HEXANE/ACETONE	END OVER END	GC-FID
EPH CWGBY GC	D&C	HEXANE/ACETONE	END OVER END	GC-FID
PCBAROCLOR 1254/PCB CON	D&C	HEXANE/ACETONE	END OVER END	GC-MS
POLYAROMATIC HYDROCARBONS (MS)	WET	HEXANE/ACETONE	MICROWAVE TM218.	GC-MS
>C6-C40	WET	HEXANE/ACETONE	SHAKER	GC-FID
POLYAROMATIC HYDROCARBONS RAPID GC	WET	HEXANE/ACETONE	SHAKER	GC-FID
SEMI VOLATILE ORGANIC COMPOUNDS	WET	DOM/ACETONE	SONICATE	GC-MS

LIQUID MATRICES EXTRACTION SUMMARY			
ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAHMS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC-MS
EPH	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC-FID
EPH CWG	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC-FID
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC-FID
PCB7 CONGENERS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC-MS
PCBAROCLOR 1254	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC-MS
SVOC	DCM	LIQUID/LIQUID SHAKE	GC-MS
FREE SULPHUR	DCM	SOLID PHASE EXTRACTION	HPLC
PESTICIDOPP	DCM	LIQUID/LIQUID SHAKE	GC-MS
TRIAZINE HERBS	DCM	LIQUID/LIQUID SHAKE	GC-MS
PHENOLS MS	ACETONE	SOLID PHASE EXTRACTION	GC-MS
TPH by INFRARED (IR)	TCE	STIRRED EXTRACTION (STIR-BAR)	IR
MINERAL OIL by IR	TCE	STIRRED EXTRACTION (STIR-BAR)	IR
GLYCOLS	NONE	DIRECT INJECTION	GC-FID

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials or those identified as potentially asbestos containing during sample description 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).

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.

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 16/05246
Issue Number: 1

Date: 05 September, 2016

Client: Sutcliffe
18-20 Harrington Street
Liverpool
L2 9QA

Project Manager: Kelly Davies, Adrian Lewis
Project Name: Penny Black
Project Ref: 26045LG
Order No: 6251
Date Samples Received: 22/08/16
Date Instructions Received: 23/08/16
Date Analysis Completed: 05/09/16

Prepared by:



Georgia King
Client Service Manager

Approved by:



Lianne Bromiley
Senior Client Manager

Envirolab Job Number: 16/05246

Client Project Name: Penny Black

Client Project Ref: 26045LG

Lab Sample ID	16/05246/1	16/05246/2	16/05246/3						Units	Method ref
Client Sample No	Post Demo 1	Post Demo 2	Post Demo 3							
Client Sample ID	TH1	TH2	TH3							
Depth to Top	0.00	0.00	0.00							
Depth To Bottom	0.50	0.50	0.50							
Date Sampled	19-Aug-16	19-Aug-16	19-Aug-16							
Sample Type	Soil	Soil	Soil							
Sample Matrix Code	5A	5AB	5A							
% Moisture _A	14.8	11.8	13.2						% w/w	A-T-044
% Stones >10mm _A [#]	2.6	1.9	1.3						% w/w	A-T-044
pH _D ^{M#}	7.60	7.46	7.14						pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.06	0.09	0.09						g/l	A-T-026s
Sulphate (acid soluble) _D ^{M#}	<200	490	560						mg/kg	A-T-028s
Cyanide (total) _A ^{M#}	<1	<1	<1						mg/kg	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2						mg/kg	A-T-050s
Sulphide _A	<15	<15	<15						mg/kg	A-T-S2-s
Sulphur (elemental) _D ^{M#}	<5	<5	<5						mg/kg	A-T-029s
Organic matter _D ^{M#}	0.7	1.0	3.9						% w/w	A-T-032 OM
Arsenic _D ^{M#}	3	5	11						mg/kg	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	<1.0	<1.0						mg/kg	A-T-027s
Cadmium _D ^{M#}	1.4	1.4	2.2						mg/kg	A-T-024s
Copper _D ^{M#}	8	12	51						mg/kg	A-T-024s
Chromium _D ^{M#}	22	20	21						mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1						mg/kg	A-T-040s
Chromium (trivalent)	22	20	21						mg/kg	Calc
Lead _D ^{M#}	11	41	78						mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17						mg/kg	A-T-024s
Nickel _D ^{M#}	19	14	18						mg/kg	A-T-024s
Selenium _D	<1	<1	<1						mg/kg	A-T-024s
Zinc _D ^{M#}	31	60	100						mg/kg	A-T-024s

Envirolab Job Number: 16/05246

Client Project Name: Penny Black

Client Project Ref: 26045LG

Lab Sample ID	16/05246/1	16/05246/2	16/05246/3						Units	Method ref
Client Sample No	Post Demo 1	Post Demo 2	Post Demo 3							
Client Sample ID	TH1	TH2	TH3							
Depth to Top	0.00	0.00	0.00							
Depth To Bottom	0.50	0.50	0.50							
Date Sampled	19-Aug-16	19-Aug-16	19-Aug-16							
Sample Type	Soil	Soil	Soil							
Sample Matrix Code	5A	5AB	5A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil _A [#]	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A							Gravimetry

Envirolab Job Number: 16/05246

Client Project Name: Penny Black

Client Project Ref: 26045LG

Lab Sample ID	16/05246/1	16/05246/2	16/05246/3						Units	Method ref
Client Sample No	Post Demo 1	Post Demo 2	Post Demo 3							
Client Sample ID	TH1	TH2	TH3							
Depth to Top	0.00	0.00	0.00							
Depth To Bottom	0.50	0.50	0.50							
Date Sampled	19-Aug-16	19-Aug-16	19-Aug-16							
Sample Type	Soil	Soil	Soil							
Sample Matrix Code	5A	5AB	5A							
PAH 16										
Acenaphthene _A ^{M#}	0.03	<0.01	<0.01						mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01						mg/kg	A-T-019s
Anthracene _A ^{M#}	0.08	<0.02	0.06						mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.07	<0.04	0.20						mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.06	<0.04	0.14						mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.06	<0.05	0.19						mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	0.07						mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07						mg/kg	A-T-019s
Chrysene _A ^{M#}	0.09	<0.06	0.27						mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04						mg/kg	A-T-019s
Fluoranthene _A ^{M#}	0.19	<0.08	0.40						mg/kg	A-T-019s
Fluorene _A ^{M#}	0.02	<0.01	<0.01						mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.03	<0.03	0.10						mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03						mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.21	<0.03	0.24						mg/kg	A-T-019s
Pyrene _A ^{M#}	0.17	<0.07	0.36						mg/kg	A-T-019s
PAH (total 16) _A ^{M#}	1.02	<0.08	2.04						mg/kg	A-T-019s

Envirolab Job Number: 16/05246

Client Project Name: Penny Black

Client Project Ref: 26045LG

Lab Sample ID	16/05246/1	16/05246/2	16/05246/3						Units	Method ref
Client Sample No	Post Demo 1	Post Demo 2	Post Demo 3							
Client Sample ID	TH1	TH2	TH3							
Depth to Top	0.00	0.00	0.00							
Depth To Bottom	0.50	0.50	0.50							
Date Sampled	19-Aug-16	19-Aug-16	19-Aug-16							
Sample Type	Soil	Soil	Soil							
Sample Matrix Code	5A	5AB	5A							
TPH UKCWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Ali >C35-C44 _A	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Total Aliphatics _A	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Aro >C35-C44 _A	<0.1	<0.1	<0.1						mg/kg	A-T-023s
Total Aromatics _A	<0.1	<0.1	<0.1						mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	<0.1	<0.1						mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s

REPORT NOTES

Notes - Soil chemical analysis

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

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

Notes - General

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

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 supersedes any "A" subscripts.

All analysis is performed on the sample as received for soil samples which are positive for asbestos and/or if they are from outside the European Union and this supercedes any "D" subscripts.

Superscript "M" indicates method accredited to MCERTS.

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

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

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 as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

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

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

Secondary Matrix Codes:

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

E = contains roots/twigs.

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

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 - Ground Gas Risk Assessment Data

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 16/05247
Issue Number: 1

Date: 01 September, 2016

Client: Sutcliffe
18-20 Harrington Street
Liverpool
L2 9QA

Project Manager: Kelly Davies, Adrian Lewis
Project Name: Penny Black
Project Ref: 26045LG
Order No: 6252
Date Samples Received: 22/08/16
Date Instructions Received: 23/08/16
Date Analysis Completed: 01/09/16

Prepared by:

A blue ink signature of Kate Ellison.

Kate Ellison
Administrative Assistant

Approved by:

A blue ink signature of John Gustafson.

John Gustafson
Director

Envirolab Job Number: 16/05247

Client Project Name: Penny Black

Client Project Ref: 26045LG

Lab Sample ID	16/05247/1	16/05247/2	16/05247/3						Units	Method ref
Client Sample No	Forensics 1	Forensics 2	Forensics 3							
Client Sample ID	TH1	TH2	TH3							
Depth to Top	0.00	0.00	0.00							
Depth To Bottom	0.50	0.50	0.50							
Date Sampled	19-Aug-16	19-Aug-16	19-Aug-16							
Sample Type	Soil	Soil	Soil							
Sample Matrix Code	5A	5A	4A							
% of total sample Inert >10mm	7.90	8.71	3.91						% w/w	Calc
% of total sample Wood	<0.01	<0.01	<0.01						% w/w	Calc
% of total sample Vegetation	<0.01	<0.01	<0.01						% w/w	Calc
% of total sample Cloth	<0.01	<0.01	<0.01						% w/w	Calc
% of total sample Other Inert Material	<0.01	<0.01	<0.01						% w/w	Calc
% of total sample Paper	<0.01	<0.01	<0.01						% w/w	Calc
% of total sample Other Degradable Material	<0.01	<0.01	<0.01						% w/w	Calc
% of total sample Fine Soil	92.10	91.29	96.09						% w/w	Calc
Total Organic Carbon (Fine Soil) [#]	0.22	0.45	2.20						% w/w	Calc-no stones

REPORT NOTES

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Notes - General

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All analysis is performed on the sample as received for soil samples which are positive for asbestos and/or if they are from outside the European Union and this supercedes any "D" subscripts.

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

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TPH analysis of water by method A-T-007

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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 as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

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

Secondary Matrix Codes:

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

E = contains roots/twigs.

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US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

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 F – Geotechnical Laboratory Certificates

Appendix G - Soil Screening Tables & Statistical Analysis



Job Name:	Penny Black 2016
Job Number:	26045LG

ATKINS REVISED 31/03/11, CATEGORY 4 - APRIL 2014, LQM JAN 2015																					
Contaminant	Units	Category 4 Screening Values (6%)	SGV	Atkins Atrisk 1% SOM	Additional Values for 1% SOM (mg/kg) See notes	Atkins Atrisk 6% SOM	Additional Values for 6% SOM (mg/kg) See notes	RESIDENTIAL WITH PLANT UPTAKE			Post Demo 1	Post Demo 2	Post Demo 3	120406-50	120406-50	120406-50	120406-50	120406-50	120406-50	120406-50	120406-50
								LQM			TH1	TH2	TH3	5424248	5424249	5424250	5424252	5424253	5424254	5424255	5424256
								SOM 1%	SOM 2.5%	SOM 5%	0.00	0.00	0.00	HAH1 0.40m	HAH2 0.40m	HAH3 0.40m	WS1 0.50m	WS2 0.50m	WS3 0.50m	WS4 0.40m	WS5 0.40m
Arsenic (Total)	mg/kg	37	32	32		32			37		3	5	11	6.24	5.83	12.3	8.31	7.76	6.4	11.3	6.64
Boron (Soluble)	mg/kg								290		<1.0	<1.0	<1.0	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium (Total)	mg/kg	26	10	10		10			11		1.4	1.4	2.2	0.15	0.554	1.06	2.4	0.557	0.948	0.775	0.701
Chromium III	mg/kg			12800		12900			910		22	20	21	28	15.2	21.9	13.7	18.5	13.9	24.8	19.4
Chromium VI	mg/kg	21		14.2		14.5			6		<1	<1	<1	<0.6	<3	<3	<1.2	<3	<3	<1.2	<0.6
Copper (Total)	mg/kg			3970		4020			2400		8	12	51	30.9	36	107	32.7	41.5	30.3	53.7	26.1
Lead (Total)	mg/kg	200		276		342					11	41	78	12.3	62.2	72.9	291	45	62.4	69.3	51.9
Mercury (Total)	mg/kg		170	170		170			40		<0.17	<0.17	<0.17	<0.14	0.155	<0.14	0.14	<0.14	<0.14	<0.14	<0.14
Nickel (Total)	mg/kg		130	130		130			180		19	14	18	24.8	12.3	25.6	11.6	11.4	12.8	22.2	13.4
Selenium (Total)	mg/kg		350	350		350			250		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc (Total)	mg/kg			16900		17200			3700		31	60	100	25.4	82.1	150	328	74.3	131	78.7	72.5
Cyanide (Total)	mg/kg			34		34					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenols (Total)	mg/kg		420	162		420		280	550	1100	<0.2	<0.2	<0.2	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
Organic matter	%										0.7	1	3.9	0.648	4.22	8.65	1.58	1.95	1.53		3.88
Sulphate (Total) as SO3	%										<200	490	560	113	293	369	264	195	159	220	333
Sulphate as Water Soluble	g/l										0.06	0.09	0.09	0.0365	<0.008	<0.008	0.0094	<0.008	<0.008	<0.008	<0.008
Sulphide	mg/kg										<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
pH	pH units										7.6	7.46	7.14	8.17	8.2	8.09	8.14	7.77	7.85	7.6	8.36
Sulphur (Elemental)	mg/kg										<5	<5	<5	<5	<5	<20	49.1	<5	<5	16.9	<5
Asbestos											NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	Amosite	NAD
>> TPH SUITE <<																					
TPH (Total)																					
Total Aliphatic																					
>C5 to C6 aliphatic	mg/kg			30.1		259		42	78	160	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C6 to C8 aliphatic	mg/kg			69.8		14700	769	100	230	530	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C8 to C10 aliphatic	mg/kg			9.79		144		27	65	150	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C10 to C12 aliphatic	mg/kg			1390	49.9	4140	297	130	330	760	<0.1	<0.1	<0.1	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C12 to C16 aliphatic	mg/kg			5100	21	5260	126	1100	2400	4300	<0.1	<0.1	<0.1	N/S	N/S	N/S	2.21	N/S	N/S	2.46	N/S
>C16 to C35 aliphatic	mg/kg			145000		145000		65000	92000	110000	<0.1	<0.1	<0.1	N/S	N/S	N/S	24.31	N/S	N/S	14.28	N/S
>C35 to C44 aliphatic	mg/kg			145000		145000		65000	92000	110000	<0.1	<0.1	<0.1	N/S	N/S	N/S	1.16	N/S	N/S	<0.1	N/S
Total Aromatic																					
>C5 to C7 aromatic (Benzene)	mg/kg		0.33	0.0493		0.33		70	140	300	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C7 to C8 aromatic (Toluene)	mg/kg			86.9		610		130	290	660	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C8 to C10 aromatic	mg/kg			14.8		177		34	83	190	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C10 to C12 aromatic	mg/kg			57.3		389		74	180	380	<0.1	<0.1	<0.1	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C12 to C16 aromatic	mg/kg			142		687		140	330	660	<0.1	<0.1	<0.1	N/S	N/S	N/S	<0.1	N/S	N/S	<0.1	N/S
>C16 to C21 aromatic	mg/kg			272		804		260	540	930	<0.1	<0.1	<0.1	N/S	N/S	N/S	<0.1	N/S	N/S	0.827	N/S
>C21 to C35 aromatic	mg/kg			888		1220		1100	1500	1700	<0.1	<0.1	<0.1	N/S	N/S	N/S	17.3	N/S	N/S	12.7	N/S
>C35 to C44 aromatic	mg/kg			888		1220		1100	1500	1700	<0.1	<0.1	<0.1	N/S	N/S	N/S	11	N/S	N/S	3.14	N/S
>> BTEX SUITE <<																					
benzene	mg/kg	0.87	0.33	0.0493		0.33		0.87	0.17	0.37	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
toluene	mg/kg		610	86.9		610		130	290	660	<0.01	<0.01	<0.01	N/S	N/S	N/S	0.0033	N/S	N/S	0.0048	N/S
ethylbenzene	mg/kg		350	38.2		350		47	110	260	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.003	N/S	N/S	<0.003	N/S
M&P Xylene	mg/kg		230	17.2		230		56	130	310	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.006	N/S	N/S	<0.006	N/S
O-Xylene	mg/kg		250	18.9		250		60	140	330	<0.01	<0.01	<0.01	N/S	N/S	N/S	<0.003	N/S	N/S	<0.003	N/S
>> PAH SUITE <<																					
naphthalene	mg/kg			0.585		8.71		2.3	5.6	13	<0.03	<0.03	<0.03	<0.009	0.0123	0.0665	<0.009	0.0109	<0.009	0.0166	<0.009
acenaphthylene	mg/kg							170	420	920	<0.01	<0.01	<0.01	<0.012	<0.012	0.0194	<0.012	<0.012	<0.012	<0.012	<0.012
acenaphthene	mg/kg			588	157	2130	937	210	510	1100	0.03	<0.01	<0.01	<0.008	<0.008	0.0189	<0.008	<0.008	<0.008	<0.008	<0.008
fluorene	mg/kg			615	125	1930	746	170	400	860	0.02	<0.01	<0.01	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.01	<0.01
phenanthrene	mg/kg							95	220	440	0.21	<0.03	0.24	<0.015	0.0432	0.313	0.0436	0.0658	0.0402	0.097	0.0452
anthracene	mg/kg			8270	3.48	18300	20.9	2400	5400	11000	0.08	<0.02	0.06	<0.016	<0.016	0.0845	<0.016	<0.016	<0.016	<0.016	<0.016
fluoranthene	mg/kg			822	18.9	2160	113	280	560	890	0.19	<0.08	0.4	<0.017	0.0749	1.33	0.0686	0.0967	0.0783	0.17	0.101
pyrene	mg/kg			563	2.2	1550	13.2	620	1200	2000	0.17	<0.07	0.36	<0.015	0.0679	1.23	0.0614	0.086	0.0712	0.153	0.0925
benzo(a)anthracene	mg/kg			4.52	1.71	8.54		7.2	11	13	0.07	<0.04	0.2	<0.014	0.0488	0.762	0.0461	0.0568	0.0546	0.086	0.0929
chrysene	mg/kg			585	0.44	927	2.64	15	22	27	0.09	<0.06	0.27	<0.01	0.0408	0.614	0.0382	0.0507	0.0458	0.0893	0.0667
benzo(b)fluoranthene	mg/kg			7.72	1.22	9.86	7.29	2.6	3.3	3.7	0.06	<0.05	0.19	<0.015	0.0991	1.31	0.0726	0.101	0.114	0.172	0.18
benzo(k)fluoranthene	mg/kg			84.4	0.686	100	4.12	77	93	100	<0.07	<0.07	<0.07	<0.014	0.0273	0.378	0.0191	0.0293	0.0329	0.0426	0.0478
benzo(a)pyrene	mg/kg	5		0.818		0.998		2.2	2.7	3	0.06	<0.04	0.14	<0.015	0.0577	0.899	0.0434	0.0601	0.072	0.0952	0.124
dibenzo(ah)anthracene	mg/kg			0.838	0.00393	1	0.0236	0.24	0.28	0.3	<0.04	<0.04	<0.04	<0.023	<0.023	0.119	<0.023	<0.023	<0.023	<0.023	<0.023
benzo(ghi)perylene	mg/kg			96.2	0.0187	103	0.112	320	340	350	<0.05	<0.05	0.07	<0.024	0.0703	0.576	0.0396	0.0537	0.0754	0.0801	0.114
indeno(123cd)pyrene	mg/kg			7.31	0.0614	9.75	0.368	27	36	41	0.03	<0.03	0.1	<0.018	0.0404	0.482	0.0296	0.0396	0.0544	0.0587	0.0869



Job Name:	Former Penny Black Pub, Whiston
Job Number:	LG: 26045

Subcliffe		REVISED STANDARD								1	2	3	4	5	6	7	8
		RESIDENTIAL WITH PLANT UPTAKE								MG	MG	MG	MG	MG	MG	MG	MG
										120406-50	120406-50	120406-50	120406-50	120406-50	120406-50	120406-50	120406-50
		SGV	Atkins Atrisk 1% SOM	Additional Values for 1% SOM (mg/kg) See notes	Atkins Atrisk 6% SOM	Additional Values for 6% SOM (mg/kg) See notes	LQM			5424248	5424249	5424250	5424252	5424253	5424254	5424255	5424256
Contaminant	Units						SOM 1%	SOM 2.5%	SOM 5%	HAH1 0.40m	HAH2 0.40m	HAH3 0.40m	WS1 0.50m	WS2 0.50m	WS3 0.50m	WS4 0.40m	WS5 0.40m
Arsenic (Total)	mg/kg	32	32		32					6.24	5.83	12.3	8.31	7.76	6.4	11.3	6.64
Boron (Soluble)	mg/kg						291			<1	<1	<1	<1	<1	<1	<1	<1
Cadmium (Total)	mg/kg		10		10		3			0.15	0.554	1.06	2.4	0.557	0.948	0.775	0.701
Chromium III	mg/kg		12800		12900		627			28	15.2	21.9	13.7	18.5	13.9	24.8	19.4
Chromium VI	mg/kg		14.2		14.5		4.3			<0.6	<3	<3	<1.2	<3	<3	<1.2	<0.6
Copper (Total)	mg/kg		3970		4020		2330			30.9	36	107	32.7	41.5	30.3	53.7	26.1
Lead (Total)	mg/kg		276		342					12.3	62.2	72.9	291	45	62.4	69.3	51.9
Mercury (Total)	mg/kg	170	170		170					<0.14	0.155	<0.14	0.14	<0.14	<0.14	<0.14	<0.14
Nickel (Total)	mg/kg	130	130		130					24.8	12.3	25.6	11.6	11.4	12.8	22.2	13.4
Selenium (Total)	mg/kg	350	350		350					<1	<1	<1	<1	<1	<1	<1	<1
Zinc (Total)	mg/kg		16900		17200		3750			25.4	82.1	150	328	74.3	131	78.7	72.5
Cyanide (Total)	mg/kg		34		34					<1	<1	<1	<1	<1	<1	<1	<1
Phenols (Total)	mg/kg		162		420		210	390	780	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
Organic matter	%									0.648	4.22	8.65	1.58	1.95	1.53		3.88
Sulphate (Total)	mg/kg									113	293	369	264	195	159	220	333
Sulphate as Water Soluble	g/l									0.0365	<0.008	<0.008	0.0094	<0.008	<0.008	<0.008	<0.008
Sulphide	mg/kg									<15	<15	<15	<15	<15	<15	<15	<15
pH	pH units									8.17	8.2	8.09	8.14	7.77	7.85	7.6	8.36
Sulphur (Elemental)	mg/kg									<5	<5	<20	49.1	<5	<5	16.9	<5
Asbestos										No	No	No	No	No	No	Yes	No
>> TPH SUITE <<																	
Total Aliphatic																	
>C5 to C6 aliphatic	mg/kg		30.1		259		30	55	110	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C6 to C8 aliphatic	mg/kg		69.8		14700	769	73	160	370	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C8 to C10 aliphatic	mg/kg		9.79		144		19	46	110	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C10 to C12 aliphatic	mg/kg		1390	49.9	4140	297	93	230	540	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C12 to C16 aliphatic	mg/kg		5100	21	5260	126	740	1700	3000	N/S	N/S	N/S	2.21	N/S	N/S	2.46	N/S
>C16 to C21 aliphatic	mg/kg		145000		145000		45000	64000	76000	N/S	N/S	N/S	3.41	N/S	N/S	3.18	N/S
>C21 to C35 aliphatic	mg/kg		145000		145000		45000	64000	76000	N/S	N/S	N/S	20.9	N/S	N/S	11.1	N/S
>C35 to C44 aliphatic	mg/kg		145000		145000		45000	64000	76000	N/S	N/S	N/S	1.16	N/S	N/S	<0.1	N/S
Total Aromatic																	
>C5 to C7 aromatic (Benzene)	mg/kg		0.0493		0.33		65	130	280	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C7 to C8 aromatic (Toluene)	mg/kg		86.9		610		120	270	611	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C8 to C10 aromatic	mg/kg		14.8		177		27	65	151	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C10 to C12 aromatic	mg/kg		57.3		389		69	160	346	N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
>C12 to C16 aromatic	mg/kg		142		687		140	310	593	N/S	N/S	N/S	<0.1	N/S	N/S	<0.1	N/S
>C16 to C21 aromatic	mg/kg		272		804		250	480	770	N/S	N/S	N/S	<0.1	N/S	N/S	0.827	N/S
>C21 to C35 aromatic	mg/kg		888		1220		890	1100	1230	N/S	N/S	N/S	17.3	N/S	N/S	12.7	N/S
>C35 to C44 aromatic	mg/kg		888		1220		890	1100	1230	N/S	N/S	N/S	11	N/S	N/S	3.14	N/S
>C40 to C44 aromatic	mg/kg		888		1220		890	1100	1230	N/S	N/S	N/S	4.79	N/S	N/S	0.758	N/S
>> BTEX SUITE <<																	
benzene	mg/kg	0.33	0.0493		0.33					N/S	N/S	N/S	<0.01	N/S	N/S	<0.01	N/S
toluene	mg/kg	610	86.9		610					N/S	N/S	N/S	0.0033	N/S	N/S	0.0048	N/S
ethylbenzene	mg/kg	350	38.2		350					N/S	N/S	N/S	<0.003	N/S	N/S	<0.003	N/S
m,p-xylene	mg/kg	230	17.2		230					N/S	N/S	N/S	<0.006	N/S	N/S	<0.006	N/S
o-xylene	mg/kg	250	18.9		250					N/S	N/S	N/S	<0.003	N/S	N/S	<0.003	N/S
>> PAH SUITE <<																	
naphthalene	mg/kg		0.585		8.71		1.5	3.7	8.7	<0.009	0.0123	0.0665	<0.009	0.0109	<0.009	0.0166	<0.009
acenaphthylene	mg/kg						170	400	850	<0.012	<0.012	0.0194	<0.012	<0.012	<0.012	<0.012	<0.012
acenaphthene	mg/kg		588	157	2130	937	210	480	1000	<0.008	<0.008	0.0189	<0.008	<0.008	<0.008	<0.008	<0.008
fluorene	mg/kg		615	125	1930	746	160	380	780	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.01	<0.01
phenanthrene	mg/kg						92	200	380	<0.015	0.0432	0.313	0.0436	0.0658	0.0402	0.097	0.0452
anthracene	mg/kg		8270	3.48	18300	20.9	2300	4900	9200	<0.016	<0.016	0.0845	<0.016	<0.016	<0.016	<0.016	<0.016
fluoranthene	mg/kg		822	18.9	2160	113	260	460	670	<0.017	0.0749	1.33	0.0686	0.0967	0.0783	0.17	0.101
pyrene	mg/kg		563	2.2	1550	13.2	560	1000	1600	<0.015	0.0679	1.23	0.0614	0.086	0.0712	0.153	0.0925
benzo(a)anthracene	mg/kg		4.52	1.71	8.54		3.1	4.7	5.9	<0.014	0.0488	0.762	0.0461	0.0568	0.0546	0.086	0.0929
chrysene	mg/kg		585	0.44	927	2.64	6	8	9.3	<0.01	0.0408	0.614	0.0382	0.0507	0.0458	0.0893	0.0667
benzo(b)fluoranthene	mg/kg		7.72	1.22	9.86	7.29	5.6	6.5	7	<0.015	0.0991	1.31	0.0726	0.101	0.114	0.172	0.18
benzo(k)fluoranthene	mg/kg		84.4	0.686	100	4.12	8.5	9.6	10	<0.014	0.0273	0.378	0.0191	0.0293	0.0329	0.0426	0.0478
benzo(a)pyrene	mg/kg		0.818		0.998		0.83	0.94	1	<0.015	0.0577	0.899	0.0434	0.0601	0.072	0.0952	0.124
dibenzo(ah)anthracene	mg/kg		0.838	0.00393	1	0.0236	0.76	0.86	0.9	<0.023	<0.023	0.119	<0.023	<0.023	<0.023	<0.023	<0.023
benzo(ghi)perylene	mg/kg		96.2	0.0187	103	0.112	44	46	47	<0.024	0.0703	0.576	0.0396	0.0537	0.0754	0.0801	0.114
indeno(123cd)pyrene	mg/kg		7.31	0.0614	9.75	0.368	3.2	3.9	4.2	<0.018	0.0404	0.482	0.0296	0.0396	0.0544	0.0587	0.0869

Client/client ref: T J Thomas Ltd
Project ref: LG: 26045
Site ref: Former Penny Black Pub
Data description: Made Ground
Contaminant(s): Metals
Test scenario: Planning
Date: 23.05.12
User details: SH

Lead (mg/kg)											
Critical concentration, C _c	200										
	C4SI										
Notes											
Sample size, n	11	0	0	0	0	0	0	0	0	0	0
Sample mean, $\bar{x}$	72.4545455	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Standard deviation, s	75.8749809										
Number of non-detects	0										
Set non-detect values to:	Half detection limit	Detection limit	Half detection limit	Half detection limit	Detection limit	Half detection limit	Half detection limit	Detection limit	Half detection limit	Detection limit	Half detection limit
Outliers?	Yes										
Distribution	Non-normal										
Statistical approach	Auto: Chebychev	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto

Test scenario:	Planning: is true mean lower than critical concentration ($\mu < C_c$)	Evidence level required:	95%	Use Normal distribution to test for outliers
t statistic, t ₀ (or k ₀)	-5.575229297			
Upper confidence limit (on true mean concentration, μ)	172.173807			
Evidence level	97%			
Base decision on:	evidence level			
Result	$\mu < C_c$			
Select dataset	☒ Y	☐ Y	☐ Y	☐ Y

Back to data

Go to outlier test

Go to normality test

Show individual summary

Drawing No 26045 – 700 – P1 – Site Investigation Plan



DO NOT SCALE OFF THIS DRAWING

GENERAL NOTES

This drawing to read in conjunction with all relevant structural and architectural drawings and specifications.

All dimensions to be checked on site by the contractor / fabricator prior to commencement of works.

All dimensions are in millimetres unless stated otherwise.

All works to be carried out in strict accordance with the engineer's specifications, relevant British Standards and where applicable Local Authorities requirements.

For final setting out information relating to grid lines and wall positions refer to the architect's drawings.

0	16.9.16	WGB	SITE INVESTIGATION PLAN	DB
Rev	Date	Checked	Description	By

NOT WORKING DRAWING



Sutcliffe
18-20 Harrington Street, Liverpool L2 9QA
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e: sutcliffe@sutcliffe.co.uk w: www.sutcliffe.co.uk



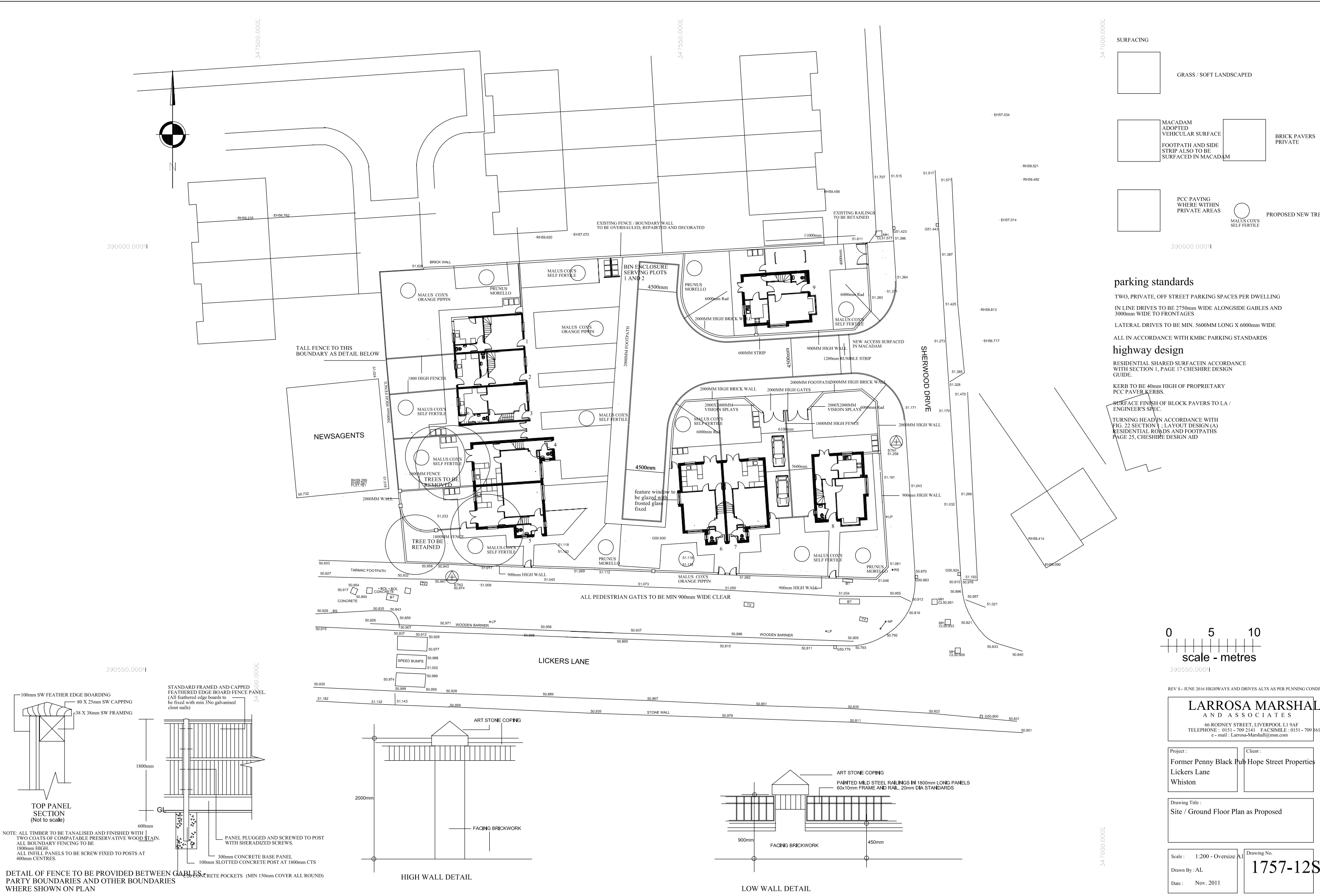
Client
TJ THOMAS

Project
**FORMER PENNY BLACK PUB,
LICKERS LANE,
WHISTON**

Drawing title
**SITE INVESTIGATION PLAN
ON EXISTING SITE LAYOUT**

Scale at A3	1:250	Drawing number
Drawn by	D.BOWEN	26045-700
Date	16.9.16	Revision suffix

Drawing No 1757 – 125 – Ground Floor Plan



SURFACING

GRASS / SOFT LANDSCAPED

MACADAM ADOPTED VEHICULAR SURFACE
FOOTPATH AND SIDE STRIP ALSO TO BE SURFACED IN MACADAM

BRICK PAVERS PRIVATE

PCC PAVING WHERE WITHIN PRIVATE AREAS

MALUS COX'S SELF FERTILE

PROPOSED NEW TREE

parking standards

TWO, PRIVATE, OFF STREET PARKING SPACES PER DWELLING

IN LINE DRIVES TO BE 2750mm WIDE ALONGSIDE GABLES AND 3000mm WIDE TO FRONTAGES

LATERAL DRIVES TO BE MIN. 5600MM LONG X 6000mm WIDE

ALL IN ACCORDANCE WITH KMBC PARKING STANDARDS

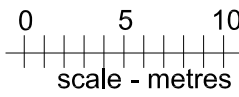
highway design

RESIDENTIAL SHARED SURFACE IN ACCORDANCE WITH SECTION 1, PAGE 17 CHESHIRE DESIGN GUIDE.

KERB TO BE 40mm HIGH OF PROPRIETARY PCC PAVER KERBS.

SURFACE FINISH OF BLOCK PAVERS TO LA / ENGINEER'S SPEC.

TURNING HEAD IN ACCORDANCE WITH FIG. 22 SECTION 1 : LAYOUT DESIGN (A) RESIDENTIAL ROADS AND FOOTPATHS PAGE 25, CHESHIRE DESIGN AID



REV S - JUNE 2016 HIGHWAYS AND DRIVES ALTS AS PER PLANNING CONDIT

LARROSA MARSHALL AND ASSOCIATES

66 RODNEY STREET, LIVERPOOL L1 9AF
TELEPHONE : 0151 - 709 2141 FACSIMILE : 0151 - 709 1618
e - mail : Larrosa-Marshall@msn.com

Project :
**Former Penny Black Pub Hope Street Properties
Lickers Lane
Whiston**

Client :

Drawing Title :
Site / Ground Floor Plan as Proposed

Scale: 1:200 - Oversize
Drawn By : AL
Date: Nov. 2011

Drawing No.
1757-12S

TOP PANEL SECTION (Not to scale)

100mm SW FEATHER EDGE BOARDING
80 X 25mm SW CAPPING
38 X 38mm SW FRAMING

NOTE: ALL TIMBER TO BE TANALISED AND FINISHED WITH TWO COATS OF COMPATIBLE PRESERVATIVE WOOD STAIN.
ALL BOUNDARY FENCING TO BE 1800mm HIGH.
ALL INFILL PANELS TO BE SCREW FIXED TO POSTS AT 400mm CENTRES.

STANDARD FRAMED AND CAPPED FEATHERED EDGE BOARD FENCE PANEL.
(All feathered edge boards to be fixed with min 3No galvanised clout nails)

1800mm

600mm

GL

PANEL PLUGGED AND SCREWED TO POST WITH SHERADIZED SCREWS.

300mm CONCRETE BASE PANEL

100mm SLOTTED CONCRETE POST AT 1800mm CTS

300mm CONCRETE POCKETS (MIN 150mm COVER ALL ROUND)

HIGH WALL DETAIL

ART STONE COPING

FACING BRICKWORK

LOW WALL DETAIL

ART STONE COPING

PAINTED MILD STEEL RAILINGS IN 1800mm LONG PANELS
60x10mm FRAME AND RAIL, 20mm DIA STANDARDS

900mm

450mm

FACING BRICKWORK