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GEOENVIRONMENTAL ASSESSMENT REPORT

PROPOSED COMMERCIAL DEVELOPMENT OF AHMAD TEA FACTORY, CHANDLERS FORD, EASTLEIGH, HAMPSHIRE SO53 2PZ

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Information Sheet

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OF AHMAD TEA FACTORY, CHANDLERS FORD

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TABLE OF CONTENTS

EXECUTIVE SUMMARY **1**

1. INTRODUCTION **2**

1.1 Background 2
1.2 Report Scope and Objectives 2
1.3 Context of Potentially Contaminated Land Risk Assessment 3
1.4 Previous Reports/Information Sources 4

2. GEOENVIRONMENTAL SITE SETTING **5**

2.1 General 5
2.2 Site Location and Layout 5
2.3 Previous Intrusive Site Investigation Summarised Scope 5
2.4 Site Reconnaissance 6
2.5 Sensitive Landuses 7
2.6 Site History 7
2.7 Geology 8
2.7.1 Regional Geology 8
2.7.2 Site Geology 8
2.8 Hydrogeology, Groundwater Abstraction and Discharge Consents 9
2.9 Pollution Incidents 10
2.10 Waste Management and Waste Transfer Sites 10
2.11 Local Authority Integrated Pollution Prevention and Control (LAPPC) 10
2.12 Industrial Setting and Commercial Setting 10
2.13 Radon 10
2.14 Summary of Previously Identified Ground Contamination 11
2.15 Geoenvironmental Setting Summary 11

3. GROUND CONTAMINATION RISK ASSESSMENT **13**

3.1 Objectives of Preliminary Risk Assessment 13
3.2 Potential Sources, Pathways and Receptors 13
3.2.1 Sources 13
3.2.2 Pathways 14
3.2.3 Receptors 14
3.3 Initial Conceptual Site Model 15
3.4 Conclusions and Recommendations of Preliminary Risk Assessment 17

4. FIELDWORK AND LABORATORY TESTING **18**

4.1 Site Works 18
4.2 Drive-in Sampler Boreholes 19
4.3 Chemical Anaysis 19
4.3.1 Soil and ground water Samples 19
4.4 Soil Gas and Groundwater Monitoring 21

5. SUMMARY OF GROUND CONDITIONS **22**

5.1 General 22
5.2 Soil Conditions 22
5.3 Ground Contamination Observations 23
5.4 Groundwater Conditions 23
5.5 Soil Gas Regime 24

6. ADDITIONAL GENERIC QUANTITATIVE RISK ASSESSMENT **25**

6.1 Objectives of Generic Quantitative Risk Assessment 25
6.2 Assessment of Risks to Human Health 25
6.2.1 Approach to Human Health Risk Assessment 25
6.2.2 Human Health Generic Assessment Criteria 26
6.2.3 Statistical Methodology to Risk Screening of Near Surface Soils 28
6.2.4 Made Ground Screening Assessment 29
6.2.5 Natural Soil Screening Assessment 30
6.2.6 Assessment of Risks Related to Soil Gas Regime 30
6.3 Assessment of Risks to Controlled Waters 33
6.4 Potential for Pathway Modification Associated with Piling Activities 36
6.5 Assessment of Risks to Buried Concrete and Buried Services 36
6.6 Assessment of Risks to Vegetation 37

6.7 Refined Conceptual Site Model and Plausible Pollutant Linkages 37
6.8 Ground Contamination Considerations 39
6.8.1 Potential Contamination Issues 39
6.8.2 Preliminary Recommendations for the Protection of Construction Workers 39
6.8.3 Soil Gas Protection Measures 39
6.8.4 Chemical Attack of Buried Concrete and Buried Services 40
6.8.5 Disposal of Waste Soils and Groundwater 40

7. REMEDIATION OPTIONS APPRAISAL 41

7.1 Introduction 41
7.2 Principal Identified Risk Drivers 41
7.3 Constraints Limiting Remediation Options 41
7.4 Remedial Scheme Objectives 42
7.5 Potential Feasible Remedial Options 42

8. IMPLEMENTATION PLAN 44

8.1 Introduction 44
8.2 Site Clearance and Associated Works 44
8.4 Earthworks 45
8.4.1 Excavation 45
8.4.2 Off-Site Disposal 46
8.5 Cover Layer Construction 46
8.6 Groundwater Treatment 47
8.7 Verification Plan 47
8.7.1 Residual Soil Verification and Audit Criteria 47
8.8 Site Drainage and Protection of Services 47
8.9 Gas Protection Measures 48

9. SITE MANAGEMENT 49

9.1 Remediation Works Programme 49
9.2 Site Access & Control 49
9.3 Protection of Site Workers and the General Public 49
9.4 Site Offices and Messing 49
9.5 Site Supervision 49
9.6 Decontamination Facilities and Road Cleaning 50
9.7 Air Quality Remedial Action Plans 50
9.7.1 Remedial Action Plan - Dusts 50
9.7.2 Remedial Action Plan - Odours 50

10. COMPLETION (VERIFICATION) REPORT 51

APPENDICES

APPENDIX A REPORT CONDITIONS
APPENDIX B FIGURES AND DRAWINGS
APPENDIX C EXPLORATORY HOLE RECORDS AND MONITORING DATA
APPENDIX D LABORATORY TEST RECORDS & STATISTICAL DATA SHEETS
APPENDIX E BRE COVER LAYER THICKNESS CALCULATIONS
APPENDIX F BRE CONCRETE CLASSIFICATION SHEET

GEOENVIRONMENTAL ASSESSMENT

PROPOSED COMMERCIAL DEVELOPMENT OF AHMAD TEA FACTORY, CHANDLERS FORD, HAMPSHIRE

EXECUTIVE SUMMARY

Current Site Status	The site is currently operated as Ahmad Tea Factory, involved in the blending and packaging for subsequent resale of the beverage. The majority of the site comprises building and hardstanding with vehicle access and parking areas. The site is formed of two elevations the upper elevation approximately 5m higher than the lower smaller elevation in its southern and eastern parts. The surrounding areas comprise both residential and light industrial land-uses.
Redevelopment Proposals	It is understood the site is in the process of being developed with the replacement of the existing factory building with a modern facility.
Site History	Up until the early 20th Century the site appears to have been undeveloped copse. By the 1930's the southern part of the site had been developed into a sewage works, which by the 1950's was disused. This coincided by what appears to be raising of site levels across the majority of the site and the notation of 'refuse heap' suggesting land filling activities had taken place. By 1966 the site had been redeveloped into a food depot and garage. Subsequent increase in building footprints and development of part the site as a boat building yard takes place although the garage appears to have remained. By the 1980's although the buildings appeared to have undergone change the overall footprint appears to have remained largely the same and the Rex Estate is shown on the drawings.
Geology **Hydrogeology** **Hydrology**	Beneath the site hardcovers the made ground beneath the upper elevation appears to be in the order of 5.0m thick and is underlain by alluvial deposits. The Bracklesham Beds are reported to be present beneath and comprise grey silty sandy clay. According to the Environment Agency records the site does not appear to be within a groundwater source protection zone. The only licensed abstraction held on Environment Agency records appears to relate to the Pirelli Cable Works, located 1981km to the south east. The nearest surface water feature is the Monks Brook, which lies to the east of the site and appears to flow in a southerly direction past the site. Monks Brook is channelized along the stretch adjacent to the site.
Ground Contamination Risk Assessment	Potentially contaminative on-site historical activities have been from identified from the desk-based evidence including sewage works, landfilling, fuels storage (associated with the garage) and boat building. The preliminary risk assessment identified three principal risk drivers: potential uptake of hydrocarbons and heavy metals; potential impact of groundwater and surface water from on-site sources; and risks posed by gases. On the basis of the above the previous GESL report AIGE undertook an additional site investigation in order to preliminarily assess the extent of soil and groundwater impacts at the site. Two averaging areas were identified for the purposes of the risk assessment namely the made ground and the natural soils. The site data statistical analysis returned lead with a UCL95 marginally higher than the industrial commercial GAC; although no outliers were determined by the statistical testing AIGE considered the location of the highest lead concentrations to be possibly attributable to the historical boat building activities on the site. However, these elevated concentrations fall within the footprint of the proposed buiding and therefore, no viable pathway will exist post-development.
Conclusions and Recommendations	Providing appropriate site management practices are adopted during construction works the elevated lead concentrations are not considered to pose a risk to human health. On the basis of ground gas monitoring the conclusion was that gas protection measures will be required as the site is currently classified as Characteristic Situation 3. On the basis of the soil chemical data for organics it would appear that the potential for vapours migrating through the soil are unlikely to pose a significant risk to human health. Elevated leachable hydrocarbons and were returned from the soil chemical analysis, however given the proposed hardstanding end-use the risk to controlled waters from leachable EPH is not considered to be significant. Elevated heavy metals (As, Ni and B) were returned from the groundwater samples, however further consideration is not considered necessary. Elevated hydrocarbon concentrations were returned from locations adjacent to the assumed former underground storage tanks and in one location (DS5) nearer to the Monks Brook, which does suggest possible lateral migration of hydrocarbons. The potential remedial options proposed at this stage include: • Removal of tanks and subsequently the source of hydrocarbon impact • Localised removal/remediation of hydrocarbon impacted soils if deemed necessary. • Localised in-situ groundwater treatment and monitoring. • Provision of cover layers in sensitive areas such as soft landscaping • Gas protection measures within proposed new buildings • Buried concrete to be Design Sulphate Class of DS-2 and ACEC class AC-1s sulphate class
This sheet is intended to provide a summary only of the assessment of the site. It does not provide a definitive engineering analysis and is for an introduction only.	

GEOENVIRONMENTAL ASSESSMENT

PROPOSED COMMERCIAL DEVELOPMENT OF AHMAD TEA FACTORY, CHANDLERS FORD, HAMPSHIRE

1. INTRODUCTION

1.1 Background

AIG Engineering Group Limited (AIGE) has been commissioned by Laishley to undertake a geoenvironmental assessment for the proposed commercial development of the Ahmad Tea Factory in Chandlers Ford, Eastleigh Hampshire SO53 2PZ.

This report has been produced for the use of Laishley and no liability is accepted for any reliance placed upon it by any other parties unless specifically agreed in writing.

At the time of writing it is understood the proposed commercial development is to start imminently. The proposed redevelopment of the site will comprise the demolition and clearance of existing buildings and the construction of a new manufacturing unit in the southern central part of the site with associated vehicle access and parking areas. Soft landscaped areas in the northern portion of the site are also proposed. The site has been reported to have been formerly used as a sewage treatment works and latterly, presumably following redevelopment, as a boat manufacturing facility.

Previous site assessment data undertaken by others has been included in this report and is referenced in Section 1.4. Prior to AIGE accessing the site the previous reports along with AIGE's additional site investigation proposals to the local authority for their review. No response had been received from the regulators at the start of AIGE's additional works on-site.

At the time of the additional AIGE site works the site remained an operational factory.

1.2 Report Scope and Objectives

The additional works have been undertaken by AIGE in order to provide a more comprehensive spread of data across the entire site than previously existed in support of the planning conditions 16 (ii) and (iii). The previous site assessment work had only focussed on a small area in the southern central part of the site in the locality of the proposed new buildings footprint and was considered insufficient for the purposes of undertaking a preliminary assessment of potential risks associated with the site's history.

The scope of field and laboratory work undertaken to complete this geoenvironmental assessment comprised:

- An additional intrusive investigation of the site comprising thirteen drive-in sampler boreholes.
- Monitoring of the soil gas and groundwater regimes within standpipes installed within selected drive in sampler boreholes.
- Chemical analysis of selected soil and groundwater samples at an MCERTS/UKAS accredited laboratory for a suite of contaminants including a range of heavy metals, inorganic and organic compounds.

The additional intrusive investigation works were undertaken by AIGE between 4th and 7th August 2008.

AIGE reserve the right to amend the conclusions and recommendations contained in this report in the light of any further or more detailed information that may become available.

1.3 Context of Potentially Contaminated Land Risk Assessment

Under the Town and Country Planning Legislation, in order that a site may be redeveloped, the site needs to be suitable for its intended use.

Part IIA of the Environmental Protection Act (1990) provides a legal framework for identifying and dealing with Contaminated Land. The Contaminated Land (England) Regulations (2000) were issued in accordance with the provision of the Environmental Protection Act and define Contaminated Land as that *"in such condition, by reason of substances in, on, or under the land, that significant harm is being caused, or pollution of controlled waters is being or likely to be caused"*.

In the UK, the determination of whether a specific area can be classified as Contaminated Land and the determination if that land is suitable for the intended use is by the process of risk assessment.

The methodology for undertaking risk assessment has been published by the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) and focuses on the definition of Contaminated Land whereby the process examines potential source-pathway-receptor relationships in order to determine if a pollutant linkage exists between a contamination source and a sensitive receptor. A pollutant linkage is only complete where there is a source, a receptor and a viable pathway linking the two.

The technical framework for applying a risk management process when dealing with land potentially affected by contamination is presented in the EA Publication CLR11 *"Model Procedures for the Management of Contaminated Land"* (2004). This document describes how risk assessment should be carried out in a tiered manner.

At each stage of the assessment further detail can be applied to the model to provide a detailed interpretation on a site specific basis whereby Tier 1 is a preliminary assessment of potential pollutant linkages in the form of a Conceptual Site Model, Tier 2 is a generic quantitative assessment including a comparison of found concentrations with generic assessment criteria and Tier 3 is a detailed quantitative risk assessment based on site specific conditions.

1.4 Previous Reports/Information Sources

At the time of writing the following information had been provided to AIGE to review and summaries of the information are incorporated into this report.

- Bureau Veritas Phase 1 Risk Assessment, March 2006
- GESL Ground Investigation Report, August 2006

It should be noted that prior to AIGE undertaking this additional investigation work the reports referenced above were submitted to the local authority Environmental Health Department; in order to initiate the consultation process as required under the planning conditions for the development.

Summaries of each of the previous reports listed above in relation to the current subject site are presented below:

The **Bureau Veritas Phase 1 Risk Assessment** (Bureau Veritas report) was undertaken on the Rex Estate when it was still an operational factory in 2006. The report includes historical and environmental setting data relevant to the site and the surrounding areas. The overall conclusion of the Phase 1 Risk Assessment is that a site investigation should be undertaken in the area of the proposed redevelopment.

The **GESL Ground Investigation Report** (GESL report) was undertaken specifically in the area of the proposed building footprint and included geotechnical and environmental aspects but was limited in extent from a contamination assessment viewpoint. The chemical analysis included a suite of heavy metals and relatively broad scope of organics analysis. The overall conclusion of the report relating to contamination beneath the site was presented qualitatively designating the site as low-medium risk on the basis that the proposed development would effectively "encapsulate the study area", thus no plausible linkages between the underlying soil and end-users would exist.

2. GEOENVIRONMENTAL SITE SETTING

2.1 General

A review of the available information referenced in Section 1.4 has been undertaken. The information reviewed includes via an environmental database search, historical Ordnance Survey maps, published geological and hydrological information and available previous site investigation and assessment reports for the site.

2.2 Site Location and Layout

The site is located approximately 2km to the west of Chandlers Ford town centre and the site is reported to be centred at national grid reference E:443540, N:120430. The site is located on the Rex Estate off Winchester Road approximately 200m to the south east of Chandlers Ford railway station. The site is reported to occupy an area of slightly less than a hectare and the general elevation of the site is slightly higher than immediately surrounding land. Immediately to the east is Monks Brook a channelized surface water feature. Immediately to the south west is the mainline railway lying on a north west south east axis. Industrial land use lies to the north west of the site with residential to the south beyond the railway line.

At the time of writing the site comprises an existing tea factory building with associated vehicle access and parking areas.

2.3 Previous Intrusive Site Investigation Summarised Scope

The site investigation works undertaken in 2006 by GESL comprised the following:

- GESL reported their intrusive investigation included four direct push boreholes to depths of up to four metres;
- Two cable percussive boreholes were sunk to depths of 13m bgl and 17.5m bgl with regular in-situ geotechnical testing and sampling; and,
- Installation of a single gas and groundwater monitoring standpipe to a depth of 3.0m bgl in BH1.

A summary of the installations in the boreholes reproduced from the Ground Investigation Report is shown in the table below:

Table 2.1 Installation Details

Borehole No.	Installation Type	Installation Depth (m bgl)	Strata
WS1	None	-	Hardstanding/Made Ground
WS2	None	-	Hardstanding/Made Ground
WS3	None	-	Hardstanding/Made Ground
WS4	None	-	Hardstanding/Made Ground
BH1	Single	3	Hardstanding/Made Ground/Clay
BH2	None	-	Hardstanding/Made Ground/Clay/Gravel/Clay

GESL analysed five soil samples for chemical analysis a general suite appears to have included CLEA metals and a hydrocarbons suite of testing.

2.4 Site Reconnaissance

On arrival at the site prior to the start of the site investigation works AIGE undertook a walkover of the premises in order to establish the site condition and identify any additional potential sources of contamination not identified from the information that had been provided to AIGE prior to arrival on-site. The site comprises a brick built factory premises with additional pre-fabricated buildings used as office accommodation.

It would appear the existing buildings (excluding pre-fabricated offices) have roofs constructed of asbestos cement sheet roofing and rainwater goods.

It should be noted that suspected Japanese Knotweed was identified in the far south of the site immediately adjacent to the mainline railway.

The table below presents potential historical contaminant sources that were identified during the site walkover.

Table 2.2 Potential Historical Contaminant Sources

Potentially contaminative process	Potential contamination source	Potential contaminants
Former underground fuel storage tanks	Spillage or leakage from underground tanks.	Petroleum Hydrocarbons including diesel range and petrol range organics, paraffin and oils.
Former above ground fuel storage	Spillages around tank	Diesel or heating oil (Kerosene)
Historical raising of site levels (exposed slope face)	A variety of waste materials that have become exposed following clearance and excavation of the face of the slope of the elevated area.	Asbestos, ash and dusts potentially containing inorganic and/or organic contaminants yet to be indentified. Presence of Japanese Knotweed possibly derived from imported waste materials or from the adjacent railway cutting.
Historical raising of site levels (Made ground)	Presence of ash and clinker and other waste materials (eg asbestos cement sheet) beneath currently operational areas due to be redeveloped.	Heavy metals, phytotoxic metals and organic contamination.
Possible general demolition activities within site history	Made ground	Metals, hydrocarbons, sulphate and asbestos

Prior to the investigation works AIGE requested information relating to the fuel storage tanks be provided as it was clear the garage area of the site had been used for the delivery and refuelling of vehicles and the fuel filling infrastructure appeared to still be in place including underground storage tanks (USTs), above ground storage tanks (ASTs) and vapour release/vent to atmosphere pipework.

The client provided information on the known fuel storage related structures on the site a summary of which is presented in the table below.

Table 2.3: Fuel Storage Details

Description	Contents	Volume (litres)
Tank 1	Petroleum	9092
Tank 2	Gas Oil	6819
Tank 3	Gas Oil	6819
Diesel Tank 4	Diesel	4546
Above Ground Storage Tank	Assumed heating oil	Not known*

** Tank identified at rear of factory building during site reconnaissance.*

The details of the underground storage tanks (USTs) were provided in documentation provided by the client. The records date back to 1982. It should be noted that in a letter of 19th April 1982, the then site operator, namely "South Hampshire Engineering" confirmed they no longer kept stocks of 'petroleum and other spirits' and confirmed they did not wish to renew their petroleum licence. It would appear the storage of diesel fuels continued.

However, the records are not clear on whether the tanks have been decommissioned and removed from the site. It should be noted that vent pipework is still present on-site located against the offices of the main factory building at the front of the site. Therefore, at the time of the site reconnaissance the assumption was that some or all of the tanks may remain in-situ.

At the time of the site reconnaissance extensive vegetation removal had been undertaken on the slope face to expose the bank and the waste materials deposited as evident from the historical maps. The removal of vegetation including mature trees had left the slope face exposed and the waste materials contained within identified included metal, glass, electrical wire, car components, fibrous materials and clinker, all within an ash matrix.

The slope face had been excavated to some extent and stockpiles of waste materials were evident on the site.

2.5 Sensitive Land Uses

The Bureau Veritas report confirmed there are no registered Site of Special Scientific Interest within 1 km of the site.

2.6 Site History

The extracts from historical Ordnance Survey maps included in the Bureau Veritas report were reviewed in order to determine the recorded history of the site, which may not be complete. A summary of the available information is outlined below.

The earliest map records would suggest the site was a rural, then semi-rural area until the 1930's when residential development appeared to expand significantly in the areas around the subject site. The development of the area appears to have been seeded by the appearance of the railway station by the time the 1896 map record was compiled.

Table 2.4: Summary Review of Historical Maps

Date	Site	Adjacent Land
1884-1910	The subject site is shown as Bampton Copse, would appear to be little change during this period.	Adjacent land initially appears to be woodland. The mainline railway is shown flanking the south west side of the site. Immediately west of the railway is a sand pit which is only shown on the 1867 map record. Monks Brook is shown to the north east of the site. By 1896 Chandlers Ford and the railway station are shown to the west of the site. By 1897 brickworks 900m to the north east and 600m to the west and a sand pit 800m to the north west of the site are shown.
1933, 1938 and 1946	The area of Bampton Copse has significantly reduced by the appearance of a sewage works in the south of the subject site and a building labelled as 'Club' to the north of the site.	The surrounding areas appeared to have developed significantly with mainly residential land uses.
1950, 1959-1970	By 1950 the sewage treatment works on-site appear to be disused. Raising of site levels appears to have occurred with a refuse heap noted in the southern part of the site where a significant change in slope appears to be present running from the southern part of the site all along the eastern side. By 1966 a food depot and garage are shown to be present on the site.	Little change apart from increases in housing to the north and south of the site seem to have occurred. By 1970 presumably commercial development has taken place immediately to the north of the subject site with a shopping precinct shown.
1974-1982	The building footprint appears to have increased greatly with it noted as a boat building yard, the garage remains unchanged although the building appears to be attached to the garage.	The surrounding areas show increases in housing. A concrete works appears approximately 250m to the west of the site.
1987-200	The buildings on-site appear to have possibly undergone changes although the overall footprint does not appear to have changed. The subject site is now annotates as Rex Estate. The garage is still shown.	Further increases in housing developments in the surrounding areas.

2.7 Geology

2.7.1 Regional Geology

The site is located on British Geological Survey (BGS) Sheet 315 "Southampton" (1:50,000) Solid and Drift Edition. The site is shown to be underlain by alluvium and the Wittering Formation of the Bracklesham Group, with London Clay beneath. The Upper Chalk is inferred to be present at depth.

2.7.2 Site Geology

The geology for the site summarised in the table below reproduced from the GESL report.

Table 2.5: Summary of Site Geology

Strata	Description	Recorded Thickness and Location	
		min	max
Tarmacadam[1]	A hot or cold rolled asphalt coated roadstone mix (Made Ground)	0.05m – BH1	0.10m - WS1-WS4
Made Ground	Limestone gravels	--	0.15m – BH2
Made Ground	Compact brick and fine concrete clayey sandy fill or sandy fill	0.40m – BH2	0.55m – BH11
Made Ground	Loose brown sand and gravel with intact brick and concrete. Suspect as asbestos bearing materials reported in BH1.	3.1m – BH1	3.9m – BH2
Made Ground	Brown (locally light or dark) ashy sand locally clayey or clayey gravelly sand. Ash and clinker and coarse brick inclusions.	0.4m – WS1, WS4	1.1m – WS3
Alluvial deposits	Brown clay and/or sand (gravel at base in BH2)	2.9m – BH1	5.1m – BH2
Bracklesham Beds	Grey silty sandy clay	3.4m borehole terminated - BH2	10.9m borehole terminated – BH1

The previous investigation was targeted on a relatively small part of the site in the southern most part of the elevated area in the footprint of the proposed new factory building.

The whole area is covered with a bituminous paved hard standing reported in the GESL logs as tarmacadam. Immediately beneath the hard standing a granular layer, presumably an engineered sub-base is reported to be present which comprises either limestone gravel or compacted sandy or clayey sandy fill with brick and concrete fines. The underlying made ground is reported to include ash and clinker in WS1 - WS4 with glass reported in WS4.

2.8 Hydrogeology, Groundwater Abstraction and Discharge Consents

The Environment Agency (EA) Groundwater Vulnerability Map (Sheet 44 “North West Hampshire”) indicates that the site is underlain by a Minor Aquifer. The superficial soil deposits in the locality of the site are classified as H of high leaching potential which is a worst case classification given to soils in urban areas denoted by the U therefore, such soils are given the HU designation until proven otherwise.

Reference to the EA website indicates the site does not appear to be within a source protection zone.

The Bureau Veritas report includes one Environment Agency record of a groundwater abstraction located 1981m to the south east of the site. The water is for an industrial use operated by the Pirelli Cable Works, with a permit start date of December 1965. The works is now believed to be closed.

At total of thirty three discharge consents are reported to be within 1km of the site, some of which have either lapsed or been revoked. The nearest active consent is 57m to the north of the site relating to a ‘sewage discharge’ operated by Southern Water Services Ltd.

[1] As reported by GESL a more appropriate description would be bituminous paving.

2.9 Pollution Incidents

There a total of fifty five pollution incidents recorded within 1km of the site one of which is located on or near the northern part of the site and relating to an industrial car wash related event with chemicals entering Monks Brook. This was recorded as a category 3 – minor incident by the Environment Agency. Another incident dated April 1997 was recorded by the Environment Agency 75m to the south east of the site downstream in Monks Brook, the pollutant is described as Gas Oil although the source is unknown. The recorded incidents within 200m of the site relate to fuel/oil or discoloration in the brook and its tributaries.

A river water quality monitoring point on Monks Brook is recorded within 25m of the site to the south west. In 2000 the brook was designated as River Quality B.

2.10 Waste Management and Waste Transfer Sites

Two licensed waste management facilities are recorded within 1km of the site. The nearest is 732m to the south west of the site and is reported to be a clinical waste transfer station. The other facility 921m to the south east of the site is a special waste transfer facility. Three registered waste transfer sites are recorded one of which refers to the aforementioned clinical waste site.

2.11 Local Authority Integrated Pollution Prevention and Control (LAPPC)

Eight LAPPCs are recorded to be within 1km of the site. The nearest of these eight is 240m to the south west of the site and relates to the respraying of vehicles at a Hendy Body Repair Centre.

2.12 Industrial Setting and Commercial Setting

It would appear from the site history the site has been developed for commercial industrial use since the 1930's with the appearance of the sewage works. This was followed by an expansion of activities from the garage and boat building to the expansion of the buildings and the change of industrial use to a tea factory in c.1980's.

The environmental database information included in the Bureau Veritas report includes records of 139 trade entries within 1km of the site. Some of the entries are entered as inactive. The majority are active and include a range of light industrial activities from vehicle retail and maintenance to domestic appliance service and repair. Four fuel station entries reported from the trade directory are all more than 600m from the site. There would appear to be no reference, in the information provided to AIGE, to the former garage located on the site.

2.13 Radon

The Phase I Report makes reference to the BGS, National Geoscience Information Service and states that: "No radon proactive measures are necessary in the construction of new dwellings or extensions".

2.14 Summary of Previously Identified Ground Contamination

The basis of this section is the GESL Ground Investigation Report referenced in Section 1.4. The reference to contamination in the report is limited and the overall impression of the report it was more aimed at providing geotechnical rather than environmental information. As such no mention of contamination impact apart from the possible presence of asbestos bearing materials in BH1 is referred to in the exploratory hole records.

The environmental considerations section of the report confirms five soil samples were analysed for the following analytical suite (all determinants as reported by GESL):

- Metals and metalloids arsenic, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, zinc, boron (water soluble), nickel, barium, beryllium, vanadium, chloride;
- Total hydrocarbons;
- Speciated PAH;
- Total Phenols;
- Elemental Sulphur;
- Sulphate, pH and conductivity; and,
- Fraction of Organic Carbon

However, on inspection of the test results beryllium and vanadium do not appear to be presented.

Notable concentrations of copper (maximum 4,050mg/kg @ 1.0m bgl in WS2), zinc (maximum 4,334mg/kg @ 2.0m in WS2), lead (maximum 4,823mg/kg @ 1.0m bgl in WS2) are recorded. When compared with the GACs that AIGE has adopted for industrial/commercial development the lead concentrations in four out of the five samples analysed would appear to be elevated. The remaining heavy metals including those mentioned above are not elevated. On the basis of the information provided to AIGE and current best practice a more comprehensive dataset is required.

2.15 Geoenvironmental Setting Summary

The geoenvironmental setting of the site can be summarised as follows:

- Given the industrial legacy of the site there is a potential for impact of the underlying soils and groundwater to various extents. The impacts may also be associated with the presumably uncontrolled (certainly Pre-Control of Pollution ActA) filling and raising of levels on the site prior to construction of the existing buildings;
- The site's neighbouring areas comprise mainly light industrial and residential land-uses;
- The site is understood to be proposed for redevelopment of the existing manufacturing facility through the construction of a modern tea factory building followed by the demolition and clearance of the existing building;
- The geological sequence comprises made ground onto alluvium overlying the grey silty sandy clays of the Bracklesham Beds. The inferred geology beneath the Bracklesham Beds is London Clay underlain by Upper Chalk at depth;
- The site is underlain by a Minor Aquifer of assumed relatively low permeability. The site is also shown to be underlain by soils of High Leaching Potential;
- The nearest significant surface water feature is the channelized Monks Brook;

- The subject site falls within an area designated by the Environment Agency to be subject to "extreme flood from rivers…". Although there are flood defences recorded immediately adjacent to the site presumably as part of the channelized brook;
- The Environment Agency holds fifty five records of pollution incidents to controlled waters within 1km of the site. All but one of the incidents were classified by the Environment Agency as category three minor incidents and are unlikely to have significantly impacted the subject site and its surroundings;
- Two waste management facilities and three registered waste transfer sites are is recorded to lie within 1km of the site. However, given their distance from the site they are unlikely to pose a significant risk to the subject site;
- According to currently available records the site does not lie within a radon affected area and radon protection measures would not be required; and,
- The previous GESL report based upon their site investigation undertaken in second half of 2006 confirmed the presence of elevated heavy metal and organic contamination within the made ground beneath the subject site. GESL concluded from monitoring of their single installation that no elevated gases were returned and therefore Characteristic Gas Situation 1A can be assigned to the site and therefore, no special precautions will be required.

3. GROUND CONTAMINATION RISK ASSESSMENT

3.1 Objectives of Preliminary Risk Assessment

In accordance with the requirements of CLR11 a preliminary risk assessment (Tier 1) for a site is undertaken to identify the presence of parameters required to create a risk.

To this end, a Conceptual Site Model is formulated utilising available information to determine the presence of a plausible pollutant linkage and hence the presence of significant risk to susceptible receptors such as humans, the water environment or the built environment. For a significant or identifiable risk to exist, a pollutant linkage must be present which requires each of the following to be identified:

- The presence of substances that may cause harm (SOURCE);
- The presence of a receptor which may be harmed (RECEPTOR); and,
- The existence of a means of exposing a receptor to the source (PATHWAY).

In the absence of a plausible pollutant linkage there is no risk. Therefore, the presence of measurable concentrations of contaminants does not automatically imply that the site will cause harm. In order for this to be the case a plausible pollutant linkage must be present allowing a source to adversely affect a receptor. The nature and importance of both receptors and pathways, which are relevant to any particular site, will vary according to its characteristics, intended end-use and its environmental setting.

Different contaminants are of potential concern to differing receptors and Tables 2.1 and 2.2 of CLR8 "*Potential Contaminants for the Assessment of Contaminated Land*" indicate where assessment of particular source-pathway-receptor relationships need to be considered.

The purpose of this preliminary risk assessment is to develop an initial conceptual model of the site and establish whether or not there are potentially unacceptable risks. Outlined below are the source-pathway-receptor relationships associated with the site and the potential implications in terms of the proposed residential end use.

3.2 Potential Sources, Pathways and Receptors

3.2.1 Sources

The historic use of the site as a sewage treatment works followed by raising of levels with materials including uncontrolled waste and the subsequent development of a garage and boat building yard on the site are considered the most significant potential sources of land contamination.

Potential On Site Hazard Sources

Potential hazard sources related to current and previous on-site activities can be summarised as follows:

- Heavy metals, hydrocarbons solvents, asbestos and other inorganic compounds associated with historical activities at the site and soil-gas associated with possible waste materials that may have been deposited on the site;

- Spillages and leakage of solvents, fuels, lubricants utilised and stored during current and historical activities within bulk vessels and associated with the re fuelling (garage) area of the site;
- Hydrocarbons from the storage of spare or spent engineering parts, vehicles and trailer storage within the site area;
- Potential for the presence of asbestos related materials associated demolition of previous buildings deposition of wastes on the site and the boatbuilding legacy associated with the site;
- Potential for the presence of anti-fouling products such as tributyl tin (TBT) containing products due to the boatbuilding legacy of the site; and,
- Decaying organic matter within the underlying made ground possibly producing the elevated ground gas identified within the site area.

Potential Off Site Hazard Sources

Given the site location the potential off-site hazard sources that could feasibly impact the site are limited to:

- Adjacent mainline railway; and,
- One half of a sewage digester/trickler base that lies off-site on neighbouring land of unknown ownership.

3.2.2 Pathways

The main pathways that could be feasible in terms of the proposed residential end use of the site are as follows:

- On and off-site migration through granular ground by water or gas media;
- Via disused drains, pipework and backfilled service trenches;
- Through direct skin contact with the impacted soil (if capping is removed or in newly exposed areas such as the slope face);
- Via hand to mouth activities resulting in ingestion of soil (if capping is removed or in newly exposed areas such as the slope face);
- Airborne migration of dust or soil particles leading to inhalation; (if capping is removed or in newly exposed areas such as the slope face);
- Volatilisation leading to inhalation;
- Surface water infiltration (if capping is removed) leading to downward leaching of contaminants within shallow soils; and,
- The Groundwater within the made ground, alluvium and Bracklesham Beds.

3.2.3 Receptors

The following key site-specific receptors are feasible:

- Ground underlying the site;
- Groundwater (minor aquifer in Alluvium and underlying Bracklesham Beds;
- Surface water (adjacent Monks Brook);
- Future site users of the land and associated properties;
- Groundworkers and maintenance workers (during remediation, general groundworks and post-redevelopment;
- Future planting in any landscaped and garden areas and fauna likely to come into contact; and
- Construction materials (including buried concrete and underground services).

3.3 Initial Conceptual Site Model

In accordance with the model framework presented in the CLR 11, an Initial Conceptual Site Model has been prepared to draw attention to potential geoenvironmental issues that could impact the proposed development and to determine areas to target investigations and subsequent tiers of risk assessment. Such investigations and assessments form the basis of the remainder of this report.

The Initial Conceptual Site Model in terms of present site conditions and areas needing consideration for the proposed residential development is provided in the table below:

Table 3.1: Initial Conceptual Site Model from Preliminary Risk Assessment

Source Location	Potential Contaminant	Key Affected Areas	Pathways	Key Receptors	Comment/Mitigation
Historical deposition of uncontrolled wastes	Zootoxic and Phytotoxic metals, non-metallic contamination (eg Sulphates), organic contamination (eg hydrocarbons), and potentially asbestos in bound and fibrous forms. Methane and	Made Ground/Natural Deposits/Groundwater Pollution and the exposed slope face.	Direct Contact, ingestion, inhalation Percolation of water through the fills/surface runoff Root uptake	Controlled waters (ie Minor Aquifer and Monks Brook) Humans Construction materials Flora and vegetation	Further Investigation to define distribution of contamination/extent of impacts and if necessary use of CLEA Model to assess risks. Provision of cover layers in areas of contamination and/or removal of gross contamination. Dust suppression measures during site redevelopment works.
Former fuel storage	Hydrocarbons (petrol, diesel, kerosene and oil)	Made Ground/Natural Deposits, surface & groundwater pollution	Direct Contact, ingestion, inhalation Percolation of water through the fills/surface runoff Root uptake	Controlled waters (ie Minor Aquifer, Monks Brook) Humans Construction materials Flora and vegetation	Evidence of above and below ground fuel storage. Pipeline to tanks are presumed to be underground. Historically hardstanding has probably limited infiltration of surface spillage but there is a possibility of seepage around pipelines and tanks below the surface. Further Investigation in the locality of the garage to define distribution of contamination/extent of impacts and if necessary use of CLEA Model to assess risks. Investigate the groundwater quality beneath the site and assess risks. Provision of cover layers in areas of contamination and/or removal of gross contamination. Dust suppression measures during site redevelopment works.
Former Sewage Works	biocides, process chemicals, heavy metals. Methane and carbon dioxide	Made Ground/Natural Deposits, surface & groundwater pollution	Direct Contact, ingestion, inhalation Percolation of water through the fills/surface runoff.	Controlled waters (ie Minor Aquifer and Monks Brook) Humans Flora and vegetation	Further Investigation in this locality to define distribution of contamination/extent of impacts and if necessary use of CLEA Model to assess risks. Investigate the groundwater quality beneath the site and assess risks. Provision of cover layers in areas of contamination and/or removal of gross contamination.

3.4 Conclusions and Recommendations of Preliminary Risk Assessment

Based upon available historical and background geoenvironmental information and the previous site investigation data and site reconnaissance there are several potential sources of ground and groundwater contamination identified at the site. The key potential sources mainly relate to historic landforming/tipping activities resulting in a significant thickness of made ground (c. 5.0m) and the use of part of the site for fuel storage (ie the former garage area).

Three principal risk drivers at the site have been identified as:

- The potential uptake of any hydrocarbons and heavy metals or other inorganic compounds contained in the upper layers of the made ground soil horizon. (The priority of this potential risk is expected to increase once the made ground material is excavated/disturbed and site hardstanding is removed).
- The potential impact on groundwater and surface water from leaching and/or runoff of contaminants from within the shallow soils. (The priority of this potential risk is expected to increase once the made ground material is excavated/disturbed and site hardstanding is removed).
- The potential explosive, toxic or asphyxiant risks posed by any soil gases and vapours on the site.

On the basis of the Initial Conceptual Site Model it is concluded further investigation is required. Given the limited dataset provided to date, further site investigation is required in order to provide data for the generic quantitative risk assessment (Tier 2).

4. FIELDWORK AND LABORATORY TESTING

4.1 Site Works

The additional intrusive investigation works were undertaken by AIGE between 4th and 7th August 2008, and comprised the following:

- Thirteen drive in sampler boreholes, designated DS1to DS11 (inclusive of DS2A and DS2B) to a maximum depth of 8.5m bgl;
- Installation of soil gas and groundwater monitoring standpipes within the drive in sampler boreholes; and,
- Soil sampling from the exploratory holes for subsequent laboratory analysis.

The exploratory hole locations and sampling rationale adopted were developed based on the Conceptual Site Model and the proposed redevelopment layout to determine the prevalent ground and near surface groundwater conditions as part of a spatial, non targeted and judgemental targeted sampling strategy. However, due to the nature of the works no exploratory locations were undertaken within the footprint of the existing working Tea Factory or within areas in close proximity to known live services. Details of the rationale behind each of the proposed exploratory holes are detailed below.

Table 4.1: Exploratory Hole Location Rationale

Location	Rationale
DS1	Within footprint of proposed development, in location of former sewage works (circa 5m bgl) and within area of made up ground. Evaluation of soil gases and vapour beneath the development. Location installed with dual purpose groundwater and landgas monitoring standpipe within made ground.
DS2 DS2A DS2B	In location of former sewage works (circa 5m bgl) and within area of made up ground. Undertaken to install with dual purpose groundwater and landgas monitoring standpipe within natural soils at depth to monitor cross boundary migration. However obstructions encountered at shallow depth therefore location terminated.
DS3	Within footprint of proposed development in location of possible boat building yard and within area of made up ground. Evaluation of soil gases and vapour beneath the development. Location installed with dual purpose groundwater and landgas monitoring standpipe within made ground.
DS4	Proposed area of landscaping, in location down gradient of possible former boat building yard and in area of made up ground. Location installed with dual purpose groundwater and landgas monitoring standpipe within natural soils at depth.
DS5	Located adjacent Monks Brook. Location installed with dual purpose groundwater and landgas monitoring standpipe to monitor cross boundary migration
DS6	Located at toe of the made up ground slope in close proximity to Monks Brook. Location installed with dual purpose groundwater and landgas monitoring standpipe to monitor cross boundary migration
DS7	Located adjacent to former sewage treatment beds. Location installed with dual purpose groundwater and landgas monitoring standpipe to monitor cross boundary migration.
DS8	Proposed area of landscaping. Located in area of former garage forecourt, down gradient of former pumps and potential tanks. Location installed with dual purpose groundwater and landgas monitoring standpipe within made ground.
DS9	Proposed area of landscaping. Located in area of former garage forecourt, down gradient of former potential tank. Location installed with dual purpose groundwater and landgas monitoring standpipe.
DS10	Proposed area of landscaping. Located in area of former garage forecourt, down gradient of former pumps and potential tanks. Location installed with dual purpose groundwater and landgas monitoring standpipe within made ground.
DS11	Proposed area of landscaping. Located in area of former garage forecourt, down gradient of former pumps and potential tanks. Location installed with dual purpose groundwater and landgas monitoring standpipe within natural ground.

The positions of the exploratory holes undertaken as part of the additional site investigation together with those carried out previously during the original investigation in 2006 are shown on Figure 2, included in Appendix B.

All fieldwork, including soil description and sample logging was carried out in accordance with British Standard Code of Practice BS.5930:1999 *"Code of Practice for Site Investigations"* and BS10175:2001 *"Code of Practice for the Investigation of Contaminated Land"*. The exploratory hole records were compiled using site observations and engineering descriptions of soil samples and are included in Appendix C.

4.2 Drive-in Sampler Boreholes

A total of thirteen drive-in sampler boreholes were put down across the site area in accessible locations to a maximum depth of 8.5m bgl using a track mounted hydraulic driven sampling system.

The drive-in sampler boreholes, designated DS1 to DS11 (inclusive of DS2A and DS2B), were constructed using undisturbed core-lined sampling techniques which minimises the likelihood of cross contamination occurring and allows undisturbed 1.0m samples to be taken as a continuous profile of the soil. Small disturbed samples were recovered from each of the drive in sampler boreholes to facilitate sample description and for subsequent laboratory testing.

In-situ standard penetration tests were performed within the majority of the boreholes to enable an assessment to be made of the relative density of granular soils and an indication shear strength of cohesive soils encountered. The tests were carried out in accordance with British Standard BS 1377: Part 9 (1990) Methods of Test for Soils for Civil Engineering Purposes. Additionally hand shear vanes tests were undertaken in cohesive soils where appropriate for an indication of their in situ shear strength for descriptive purposes.

Observations of the groundwater conditions encountered were made during sampling and combined 50mm diameter dual purpose soil gas and groundwater monitoring standpipes were installed within ten boreholes on completion. Installation details are shown on the relevant exploratory hole records included in Appendix C and the response zone for each monitoring standpipe is summarised in Table 4.2, below:

Table 4.2: Standpipe Response Zones

Borehole	Depth (mbgl)	Strata
DS1	1.0 to 4.0	Made Ground
DS3	0.5 to 4.0	Made Ground
DS4	7.0 to 8.5	Natural deposits
DS5	1.0 to 4.0	Natural deposits
DS6	1.0 to 4.0	Natural deposits
DS7	1.0 to 3.0	Natural deposits
DS8	1.0 to 4.0	Made Ground
DS9	2.0 to 5.0	Natural deposits
DS10	1.0 to 4.0	Made Ground
DS11	4.5 to 6.0	Natural deposits

4.3 Chemical Analysis

4.3.1 Soil and ground water Samples

A programme of chemical testing was undertaken on selected soil samples recovered from the drive in sampler boreholes to supplement the information obtained by GESL during their investigation in 2006. 27 No. selected soil samples were submitted to a

UKAS accredited chemical testing laboratory and analysed for a suite of determinands comprising either all or part of the following:

- The toxic metals arsenic, cadmium, chromium, lead, mercury and selenium;
- The phytotoxic metals copper, nickel and zinc;
- pH, water soluble sulphate;
- TPH CWG with RBCA banding (ali/aro split);
- Rapid TPH by GC-FID (C10 to C40);
- Petrol range hydrocarbons (C5 to C10);
- Benzene, toluene, ethyl benzene, m/p-xylene and o-xylene (BTEX compounds);
- PAH (EPA 16) by GC FID;
- Methyl tertiary butyl ether (MTBE);
- Tributyl Tin;
- Asbestos; and,
- Organic content.

Additionally 3 No. soil samples were submitted for leachate analysis and 7 No. water samples were also tested for a suite of determinands comprising the following:

- The toxic metals arsenic, cadmium, chromium, lead, mercury and selenium;
- The phytotoxic metals copper, nickel and zinc;
- pH, water soluble sulphate;
- Rapid TPH by GC-FID (C10 to C40);
- Petrol range hydrocarbons (C5 to C10);
- Benzene, toluene, ethyl benzene, m/p-xylene and o-xylene (BTEX compounds); and,
- PAH (EPA 16) by GC FID.

The table below details which groundwater installations have had ground water samples chemically analysed:

Table 4.3; Groundwater Sampling Undertaken

Exploratory Hole Location and associated installation	AIGE water analysis
Existing GE BH1	Limited groundwater encountered
DS1	No groundwater encountered
DS3	No groundwater encountered
DS4	√
DS5	√
DS6	√
DS7	√
DS8	No groundwater encountered
DS9	Silted up
DS10	√
DS11	√

The results of the chemical analyses undertaken are included in Appendix G.

The groundwater and soil sample results are presented in Appendix D.

4.4 Soil Gas and Groundwater Monitoring

Following completion of the exploratory boreholes, soil gas monitoring of the additional AIGE borehole installations (refer to section 4.2) and on GE BH1 was carried out on the following occasions (6th August, 7th August, 11th August and 17th August 2008) using fully calibrated GA 2000 gas analyser and MiniRAE 2000 photo-ionisation detector (PID) and dip meter. During the visits the following measurements were taken in sequence:

- Volatile organic compounds (VOC) detection;
- Differential pressure;
- Flow monitoring;
- Measurement of methane (CH_4), carbon dioxide (CO_2), oxygen (O_2);
  Carbon Monoxide (Co) and Hydrogen Sulphide (H^2s) gas concentrations; and,
- Groundwater monitoring.

Readings taken for methane, carbon dioxide and oxygen are all recorded as percentage (%) volume (v/v) in air. PID readings calibrated to detect VOCs (specifically isobutylene) are recorded in parts per million (ppm). Differential pressures and flows are recorded in Pascals (Pa) and litres per (l/h) respectively. The results of the additional gas monitoring are presented in Appendix C.

5. SUMMARY OF GROUND CONDITIONS

5.1 General

Information published by the BGS indicates the site to be underlain by Alluvium and the Wittering Formation of the Bracklesham Group, with London Clay beneath. The previously ground investigation established the presence of these deposits (Alluvium and Bracklesham Group) together with an extensive cover of Made Ground across the raised area of the site.

The recent additional ground investigation has confirmed the anticipated ground conditions detailed by the BGS and as encountered previously. Concrete and tarmac hardstanding currently cover the majority of the site. A summary of ground conditions revealed by both phases of investigation is given below.

5.2 Soil Conditions

Tarmac or Concrete was encountered in exploratory hole locations undertaken in areas of hardstanding (carpaking areas), which cover the majority of the site area. Only the site's eastern and southern areas are soft covered with an additional area located in the site's north western corner. Tarmac or concrete was encountered at thickness between 0.05 to 0.1m

Made Ground was encountered across the whole site area. The site's eastern and northern areas have been raised resulting in a thicker made ground unit ranging between 3.7 to 5.1m below the raised ground level. A slope face comprising the raised made ground deposits is located across the site area. The Made Ground units encountered within the raised area of the site generally comprised of the following:

- Made ground composed of light grey sandy silty medium sub angular gravel (Sub Base).
- Made ground composed of loose, dark grey/black locally reddish, silty locally clayey, sand and gravel. Gravel of ash, clinker flint, locally chalk, glass and brick and occasionally coal, pottery, metal and decaying organic matter;
- Made ground composed of soft dark grey black sandy gravel silt/clay. Gravel of ash, flint and occasional brick and glass; and
- Made ground composed of soft blue grey locally mottled black sandy locally very gravelly clay or silt. Gravel of flint occasional chalk and brick and locally ash pockets/lenses.

The lower elevated eastern and southern areas of the site which are generally soft covered encountered made ground between 0.2 to 0.9m in thickness. The Made Ground units encountered within this area of the site generally comprised of the following:

- Made ground composed of light grey silty sand and gravel of crushed concrete (site access road formation);
- Made ground composed of firm orange brown sandy gravelly clay. Gravel of flint and occasional brick; and,
- Made ground composed of bark chippings.

For exact locations thicknesses and descriptions of the encountered made ground please refer to the exploratory hole logs in Appendix C.

Alluvium or Possible Alluvium was encountered underlying the made ground deposits within the majority of the boreholes. The alluvial deposits comprised of soft to firm orange brown, mottled, streaked or veined grey sandy gravelly CLAY locally with decaying organic material and rootlets and greenish grey very silty SAND. However, distinction between the alluvium and Bracklesham Beds was extremely difficult due to the similarities of the two geologies

Wittering Formation (Bracklesham Beds) were considered to be represented by firm dark grey sandy SILT/CLAY or greenish grey laminated SILT and SAND. These units generally were encountered underlying the alluvium or possibly alluvial deposits. GESL considered that the Bracklesham Beds were encountered within the raised area of the site to the final depths of their cable tool boreholes (BH1 and BH2) at 13 and 17m bgl respectively.

5.3 Ground Contamination Observations

Made ground in its very nature is often associated with potentially contaminated ground. Ash and clinker fragments were commonly encountered within made ground horizons across the site, which are often associated with heavy metal and hydrocarbon (notably polycyclic aromatic hydrocarbon) contamination. Possible bonded asbestos cement sheet fragments were identified within the made ground slope face and amongst the spoils heaps located in the lower elevated site area. Additionally a stacked possible cement sheet pile was noted within the site's south eastern corner. Potential knotweed was also noted in the site's south western corner.

During the site works visual, olfactory and VOC (via PID) evidence of potential hydrocarbon contaminated soil was documented and is presented below:

Table 5.1: Evidence of Potential Contamination

Location	Depth (mbgl)	Observation
DS4	3.80 – 5.10	Strong hydrocarbon odour PID readings 80 to 130ppm
DS10	3.6 – 3.80	Strong tar odour, PID readings 20ppm
DS10	3.8 – 4.00	Black hydrocarbon staining, PID readings 50ppm
DS11	3.70 – 4.60	Local black hydrocarbon staining, PID readings 50ppm

5.4 Groundwater Conditions

Groundwater seepages were noted within the following exploratory hole locations during the AIGE fieldwork in August 2008.

Table 5.2: Recorded 2008 Groundwater Seepages

Exploratory Location	Water strike type	Depth (m)	Stratum
DS4	Seepage	5.10 m	Made Ground/ Natural Interface
DS4	Strike	6.80 m	Natural
DS5	Strike	1.80 m	Natural
DS6	Strike	1.90 m	Natural
DS7	Strike	0.90 m	Natural
DS8	Seepage	2.20 m & 3.6m	Made Ground
DS9	Seepage	2.1	Made Ground
DS9	Strike	3.00 m	Natural
DS10	Seepage	3.60 m	Natural
DS11	Seepage	3.70 m	Made Ground/ Natural Interface

Groundwater levels were noted within the following exploratory hole locations during the AIGE monitoring visits in August 2008.

Table 5.3: Recorded 2008 Groundwater Levels

Borehole	Depth (mbgl)
DS1	Dry
DS3	Dry
DS4	5.9 to 6.0
DS5	1.2 to 1.3
DS6	1.2
DS7	1.0 to 1.2
DS8	Dry
DS9	4.5
DS10	Dry to 3.6
DS11	3.8 to 3.85

Details of the borehole installations are presented in Section 4.2 and on the relevant borehole logs.

Results of the groundwater monitoring are presented in Appendix C.

It should be noted that groundwater conditions fluctuate according to seasonal and climatic factors and as such cannot be predicted with certainty.

5.5 Soil Gas Regime

The results of the additional 2008 AIGE gas monitoring indicate elevated concentrations of carbon dioxide ranging between 0.8% to 15.0%, elevated methane concentrations ranging between 0.9 to 2.6% (DS10 and DS11 only) and elevated VOCs concentrations ranging between 3ppm to 48ppm (DS10 and DS11 only). Carbon monoxide was also encountered at concentrations between 2 and 6ppm within the natural deposits. Additionally depleted oxygen concentrations (less than 18%) were also encountered. Hydrogen sulphide was not encountered at elevated concentrations. Additionally no significant flows were recorded.

Results of the soil gas monitoring are presented in Appendix C.

6. ADDITIONAL GENERIC QUANTITATIVE RISK ASSESSMENT

6.1 Objectives of Generic Quantitative Risk Assessment

In accordance with the requirements of CLR11 an additional generic quantitative risk assessment (Tier 2) has been undertaken to establish whether there are actual or potential unacceptable risk associated with ground contamination at the site. This has been carried out through a review of data obtained from both the original intrusive investigation carried out in 2006 and the findings of the additional investigation carried out by AIGE in June and July 2008, including comparison with generic assessment criteria, where appropriate, to refine the Conceptual Site Model and evaluate plausible pollutant linkages. Risks to the following two key site specific receptors identified have been assessed with respect to relevant generic assessment criteria:

- Human Health (including future site users and groundworkers); and,
- Controlled Waters (including groundwater).

6.2 Assessment of Risks to Human Health

6.2.1 Approach to Human Health Risk Assessment

In order to assess whether a potential pollutant linkage is significant with respect to human health, the Environment Agency (EA) and the Department for Environment, Food and Rural Affairs (DEFRA), published, "*The Contaminated Land Exposure Assessment Model*" (CLEA) in 2002.

To determine the degree of risk to human health, the CLEA Model considers ten 'default' human exposure pathways and four principal 'default' land use types together with a series of assumptions with regard to human exposure frequency, duration and critical human target groups to calculate a Soil Guideline Value (SGV) for each contaminant of concern. The primary purpose of the SGVs is as 'intervention values' for the assessment of human health risks in relation to land use, above which there is the significant possibility of significant harm to site users. The EA recognised that there was a need to provide practitioners with an appropriate tool able to derive site specific assessment criteria for those cases where the conceptual model for the site does not fit that of the generic scenarios. In response 'CLEA UK' software was developed and can be used to:

- Derive generic assessment criteria.
- Derive site specific assessment criteria.
- Calculate average daily exposure/health criteria ratios.

The software incorporates the UK's approach to human health risk assessment as contained in the DEFRA/EA CLR7 to CLR10 series of documents and the subsequent updates (CLEA Briefing Notes 1 to 4). It can be utilised as a tool to estimate intake (referred to as average daily exposure or ADE) by humans of contaminants from soil from various exposure pathways. It does this by combining information about contaminant properties, soil, site and building characteristics, modelling approaches for predicting the fate and transport of the contaminants through various environmental media and information about receptor characteristics and behaviour. The derived ADE is

compared with relevant toxicological benchmarks for total intakes which are either tolerable or representative of minimal risk (referred to as health criteria values or HCVs).

Assessment criteria can then be derived for contaminants of concern at a site. Assessment criteria are concentrations of contaminants in the soil to which actual representative site contaminant concentrations may be compared to determine whether or not they are likely to represent a human health risk. There are two broad categories of assessment criteria, Generic Assessment Criteria (GAC) and Site Specific Assessment Criteria (SSAC). GAC are derived for a set of 'standard assumptions' relating to land use, receptor behaviour, site, building and soil characteristics. SGVs are a subset of GAC, derived using the CLEA model by DEFRA and the EA. For the purposes of this assessment, where available, relevant SGVs have been utilised for initial screening purposes. In the absence of SGVs, GAC derived from the CLEA UK software package have been utilised. Separate consideration is also given to assessment of soil gases using guidance given in a number of relevant documents including CIRIA publications C665 (2007), C149-152 (1995), Wilson and Card (1999), Building Regulations Approved Document C and BRE *"Guidance on the Construction of Buildings on Gas contaminated Land"*.

6.2.2 Human Health Generic Assessment Criteria

The site is to be redeveloped for industrial/commercial purposes. Therefore the chemical testing results have been compared to the SGV/GACs for the industrial/commercial land use type to provide an appropriate assessment of the potential risks. The SGV/GACs were considered as Critical Concentration values for comparison with particular contaminant concentrations. The adopted assessment criteria utilised for contaminant concentrations above laboratory detection limits are listed in Table 6.1, below:

Table 6.1: GAC Utilised – Industrial/Commercial

Determinant	GAC (mg/kg)	Reference
Heavy Metals		
Arsenic	500	R&D Publication SGV1 - EA 2002
Cadmium	1400	R&D Publication SGV3 - EA 2002 based on soil pH8.9
Chromium	5000	R&D Publication SGV4 - EA 2002
Copper	45700	CLEA-UK & GAC for HHRA - Nathanail et al 2007*
Lead	750	R&D Publication SGV10 - EA 2002
Mercury	480	R&D Publication SGV5 - EA 2002
Nickel	5000	R&D Publication SGV7 - EA 2002
Zinc	188000	CLEA-UK & GAC for HHRA - Nathanail et al 2007*
Petroleum Hydrocarbons		
TPH Aliphatic >C5-C6	95.3	CLEA-UK & GAC for HHRA - Nathanail et al 2007* at 1.0% SOM
TPH Aliphatic >C6-C8	242	
TPH Aliphatic >C8-C10	65.9	
TPH Aliphatic >C10-C12	29900	
TPH Aliphatic >C12-C16	617000	
TPH Aliphatic >C16-C35	617000	
TPH Aromatic C5-C7	26.9	
TPH Aromatic >C7-C8	30.4	
TPH Aromatic >C8-C10	107	
TPH Aromatic >C10-C12	625	
TPH Aromatic >C12-C16	12200	
TPH Aromatic >C16-C21	9190	
TPH Aromatic >C21-C35	9250	
Polycyclic Aromatic Hydrocarbons		
Naphthalene	290	CLEA-UK & GAC for HHRA - Nathanail et al 2007* at 1.0% SOM
Acenaphthylene	77900	CLEA UK at 1.0% SOM
Acenaphthene	93500	
Fluorene	59000	CLEA-UK & GAC for HHRA - Nathanail et al 2007* at 1.0% SOM
Phenanthrene	62300	CLEA UK at 1.0% SOM
Anthracene	468000	
Fluoranthene	62300	
Pyrene	779000	
Benzo(a)anthracene	7790	
Chrysene	77900	
Benzo(b)fluoranthene	7790	
Benzo(k)fluoranthene	7790	
Benzo(a)pyrene	29.7	CLEA-UK & GAC for HHRA - Nathanail et al 2007* at 1.0% SOM
Dibenzo(a,h)anthracene	7410	CLEA-UK & GAC for HHRA - Nathanail et al 2007* at 1.0% SOM
Indeno(1,2,3 c-d)pyrene	29.7	CLEA UK at 1.0% SOM
Benzo(g,h,i)perylene	46700	
BTEX		
Benzene	122	
Toluene	150	R&D Publication SGV15 – EA 2004
Ethylbenzene	48000	R&D Publication SGV16 – EA 2005
o, p, x Xylene	281000	Minimum limit of the testing equipment

Note:
*** = Generic Assessment for Human Health Risk Assessment – Nathanail et al, Land Quality Press 2007**

For the assessment of organic contaminants a soil organic matter (SOM) values of 1% has been adopted based upon site specific data.

6.2.3 Statistical Methodology to Risk Screening of Near Surface Soils

The risk screening of soils is based on the statistical approach defined in "*Guidance on Comparing Soil Contamination Data with a Critical Concentration*" (CIEH & CL:AIRE May 2008), where the two main reasons of the risk assessment are defined to either:

- Establish whether the described land is suitable for a new use under the defined land use planning system – called Planning Scenario, or
- Determine whether land falls within the scope of Part 2A of the Environmental Protection Act 1990 – called Part 2A scenario.

This report is aimed to demonstrate the suitability for future industrial/commercial use of land, therefore the Planning Scenario – statistical approach has been utilised here:

In statistical terms, this is handled through the use of formal hypotheses – the Null Hypothesis ($\mathbf{H_0}$) and the Alternative Hypothesis ($\mathbf{H_1}$) where:

$\mathbf{H_0}$ – the level of contamination, represented by unbiased mean concentration of population μ is the same as, or higher than a critical concentration Cc, and

$$\mathbf{H_{0:}}\ \boldsymbol{\mu \geq Cc}$$

$\mathbf{H_1}$ – the level of contamination that is lower than the critical concentration ***Cc***, represented by unbiased mean concentration of population ***μ***

$$\mathbf{H_{1:}}\ \boldsymbol{\mu < Cc}$$

The decision relates to the confidence level with which the Null Hypothesis $\mathbf{H_0}$ can be rejected. The 95% probability is required to prove that true mean population falls below the critical concentration. This is achieved by comparing a quantity defined as the **$95^{\%}$ Upper Confidence Limit (UCL95)** of the true mean population with the critical concentration. The outcome of the statistical analysis is always expressed in terms of $\mathbf{H_0}$, where:

- H_0 is not rejected or
- H_0 is rejected in favour of H_1

Considering the Conceptual Site Model and the findings of both the original and additional intrusive site investigations, two averaging areas have been determined namely, Made Ground and Natural soils. Each of these averaging areas is discussed separately in the two sections below. It should be noted that all of the available soil chemical analysis data has been included in the statistical assessment for this site (ie previous data provided by others and the data collected by AIGE). However, where data quality is in doubt the data has been excluded from the assessment in accordance with the methodology included in the guidance.

6.2.4 Made Ground Screening Assessment

Heavy Metals

The statistical analysis of all of the available lead data for the site demonstrates a normal distribution of the data and was therefore assessed using the 'one-sample t test'. The statistical analysis shows that the Upper Confidence Limit (UCL95) at the 95% evidence level of lead is marginally higher then the critical concentration. In soil concentration terms this equates to a UCL95 soil lead concentration of 752.76mg/kg when compared with the industrial commercial GAC of 750mg/kg (the critical concentration – Cc).

The lead soil data set includes a small number of elevated concentrations when compared with the overall population. These include from the AIGE dataset:

- DS1 at 0.8m bgl (4,900mg/kg), DS3 at 1.0m bgl (1,100mg/kg)

and from the GESL dataset;

- WS1 at 0.5m bgl (1380mg/kg), WS2 at 1.0m bgl (4,823mg/kg), WS3 0.5m bgl (2,594mg/kg).

None of the above mentioned samples are outliers according to the statistical test undertaken. However, if the three highest results are treated as outliers and removed from the remaining dataset the UCL95 (in the order of 425mg/kg) is well below the Cc (750mg/kg). Therefore, they appear to have an influence on the skew of the overall dataset. The assessor considers from a conservative viewpoint that the three highest values returned from DS1, WS2 and WS3 could reflect a 'hotspot' of lead on the site possibly associated with a historical activity such as the boat building. As a consequence, site management practices should be adopted to manage the potential risk to personnel during the redevelopment of the site as they could be at risk from the exposed soil. However, the area of elevated lead concentrations is within the footprint of the proposed building and therefore once the development is completed lead is not considered to pose a risk to site users as there is no viable pathway.

The remaining heavy metals the UCL95 and unbiased mean values for each determinant were several orders of magnitude below the Cc. The distribution of the data was considered to be non-normal and therefore, the Chebychev Theorem (Chebychev) was adopted as the statistical approach. Although, Chebychev is not a true statistical test and the outcome is more conservative, given the low level heavy metal concentrations returned Chebychev is considered to be valid in this situation.

One sample from DS4 (3.0m bgl) was analysed for tributyl tin and a non-detect (<0.02mg/kg) result was returned.

Excluding lead, in all of the remaining cases 100% level of confidence was recorded, proving that the respective sample mean populations fall below the critical concentration and therefore $\mathbf{H_0}$ can be rejected in favour of $\mathbf{H_1}$. Considering the proposed end use and redevelopment proposals it is therefore unlikely that residual heavy metals beneath the general site area pose a risk to future site users.

Organics

All of the speciated petroleum hydrocarbons (SPH), speciated USEPA 16 priority polycyclic aromatic hydrocarbons (PAH) and BTEX (benzene, toluene, ethylbenzene and xylenes) data returned UCL95 and unbiased mean values several orders of magnitude below their respective Cc's (GAC's). The distribution of the data is non-normal and therefore, the Chebychev Theorem (Chebychev) was adopted as the statistical approach. Although, Chebychev is not a true statistical test and the outcome is more conservative, given the low level concentrations returned Chebychev is considered to be valid in this situation. Therefore, the aforementioned compounds are not considered to pose a risk to site users.

The outcome of the statistical analysis for each contaminant of concern corresponding to the particular averaging areas are included in Appendix D.

Asbestos

Both the previous data provided by GESL and the AIGE additional soil data did not report any presence of asbestos within the samples. Although, broken asbestos cement sheet has been identified on-site within the made ground materials.

6.2.5 Natural Soils Screening Assessment

Across the larger majority of the site made ground predominates as the main near surface strata overlying the natural strata, however natural strata was encountered at the near surface in the north and south of the site.

Heavy Metals

All of the heavy metals determinants included in the previous and additional site investigation data were found to be below their respective GACs. Therefore, no further comment on heavy metals is required.

Organics

All of the speciated petroleum hydrocarbons (SPH), speciated USEPA 16 priority polycyclic aromatic hydrocarbons (PAH) and BTEX (benzene, toluene, ethylbenzene and xylenes) data returned UCL95 and unbiased mean values several orders of magnitude below their respective Cc's (GAC's). The distribution of the data is non-normal and therefore, the Chebychev Theorem (Chebychev) was adopted as the statistical approach. Although, Chebychev is not a true statistical test and the outcome is more conservative, given the low level concentrations returned Chebychev is considered to be valid in this situation. Therefore, the aforementioned compounds are not considered to pose a risk to site users. The Null Hypothesis can be rejected.

6.2.6 Assessment of Risks Related to Soil Gas Regime

The assessment of the explosive and asphyxiant risk posed by sub-surface gases has been made with reference to guidance given in a number of relevant documents including CIRIA publications 149-152 (1995) and C665 (2007), Building Regulations Approved Document C and BRE Guidance on the Construction of Buildings on Gas Contaminated Land. Concentrations of methane, carbon dioxide and flow rate of each have been assessed against the criteria presented in CIRA C665.

On the basis of the 2006 and 2008 findings to date, elevated carbon dioxide concentrations do not appear to correlate with any identified ground contamination. However, within the proposed building footprint (BH1, DS1 and DS3) it is considered possible by AIGE that the elevated concentrations could result from natural biological activity within the Made Ground as 'organic matter' was noted on the exploratory logs locally within the unit. Additionally, the elevated concentrations within the natural alluvial deposits is also consisted to resent natural biological activity. However elevated methane and VOC concentrations were only encountered within boreholes DS10 and DS11 located down gradient of potential underground fuel tanks. The laboratory data returned suggests the presence of hydrocarbons within the soils and perched groundwater within this locality. Therefore, the on-site measurements of methane and VOC concentrations in this locality are likely to be an indication of this hydrocarbon impact contamination. Although it should be noted that the soil concentrations are below the respective GAC's for commercial/industrial use with regards to human health.

At the time of this assessment the site was proposed to be redeveloped for a commercial end use and therefore has a low sensitivity of development in relation to risks from ground gas. During 2006 and 2008 monitoring visits no detectable flows were recorded, therefore in accordance with document C665, to calculate the required Gas Screening Values (GSV) the limit of detection of the AIGE gas analyser has been utilised (0.1l/hr).

On the basis of the worst-case ground gas concentrations within the proposed building footprint to date the GSV for:

- Highest carbon dioxide recording is 13.1 (DS1) X 0.1 = 1.31l/hr.

On the basis of the carbon dioxide and oxygen concentrations detected to date (within the area of the proposed building footprint), and the type of proposed development to be constructed (commercial/industrial), following the guidance given in CIRIA publication C665 (2007), the site falls within Characteristic Situation 3 and gas protection measures are likely to be required.

Gas protection should be designed by a specialist in consultation with the foundation designer to ensure the most appropriate gas protection details for the structure.

A simple cover system (proposed development likely to comprise of extensive hardstanding) will not inhibit the movement of potential vapours. Hydrocarbons within near surface soils have been detected across the site area.

Therefore, by adopting a conservative approach it is possible to assess risks from petroleum hydrocarbons vapours to human health. Further consideration has therefore been undertaken by using the Assessment Sub Criteria (ASC) derived for indoor and outdoor inhalation of vapour exposure pathway calculated by the CLEA-UK model by Nathanail et al published in (2007) "*Generic Assessment for Human Health Risk Assessment*". Given the proposed end-use 'commercial/industrial' ASC has been utilised. The maximum aliphatic and aromatic concentrations for each fraction analysed have been compared to their respective ASCs (assuming 1% soil organic matter) as shown in the table below:

Table 6.2: Maximum Soil TPH Fractions against Industrial/Commercial ASC

Hydrocarbon Fraction	Maximum Concentration (mg/kg)	Assessment Sub Criteria (mg/kg)
Aliphatic		
C5-C6	52	95.3
C6-C8	130	242
C8-C10	50	65.9
C10-C12	35	29900
C12-C16	300	617000
C16-C35	708	617000
Aromatic		
C5-C7	<.0.01	26.9
C7-C8	5.7	30.4
C8-C10	54	107
C10-C12	6.9	625
C12-C16	100	12200
C16-C21	220	9190
C21-C35	370	9250

Although, hydrocarbon impact has been recorded within the soils across the site the table above indicates the ASCs have not been exceeded. Therefore, potential vapours migrating through the soils are unlikely to pose a significant risk to human health through inhalation for an industrial/commercial end-use.

6.3 Assessment of Risks to Controlled Waters

The results of all the soil leachate and water sample analysis detailed above have been compared to The Drinking Water Quality Standards (DWQS) which are UK standards derived from the Water Supply (Water Quality) Regulations 2000. These relate to the maximum or minimum concentration which must not be exceeded for drinking water supply (note: the site is located within a groundwater source protection zone). No maximum concentration limits specifically for petroleum based hydrocarbons in groundwater are prescribed in the current DWQS. The proceeding Water Supply (Water Quality) Regulations 1989 prescribed a DWQS limit of 0.01mg/l for dissolved or emulsified hydrocarbons. This criteria value has been utilised within this report as a preliminary assessment criteria for petroleum based hydrocarbons. In the environmental setting of the site it is considered that the DWQS are very conservative, therefore the Surface Water (Abstraction for Drinking Water) (Classification) Regulations 1996 (SWADR) have been utilised where appropriate.

The results have also been compared against Environmental Quality Standards (EQS) which have been derived primarily for the protection of flora and fauna within surface water habitats.

During the additional site investigation undertaken by AIGE three leachate and four water samples were collected from the site. The data for the leachate analysis are presented in Table 6.3 and the water analysis data are presented in Table 6.4 below.

The soil leachate analysis has returned slightly elevated zinc when compared with the most conservative EQS1, which was derived to protect the most sensitive aquatic life. However, the upper EQS2 value was not exceeded which was derived to protect less sensitive aquatic life. Although, elevated zinc could have the potential to impact the most sensitive aquatic life, given the environmental setting and the proposed mainly hard cover end-use further consideration of leachable zinc is not considered necessary.

Elevated leachable extractable petroleum hydrocarbons (EPH) and petrol range organics (PRO) were returned from all three leachate samples when compared with UK drinking water quality standards. However, when compared with the SWADR (1mg/l), which are probably more relevant to the site environmental setting the data is not elevated. Given the limited leachate data the potential for widespread leachable EPH and PRO cannot be discounted fully. However, given the site history the EPH is probably associated with the area targeted for leachate testing being used as a garage including the storage and use of fuels. Given the depth of the samples and the current hard cover use and proposed mainly hard cover end-use for the site the leachable EPH is unlikely to have a potential impact on nearby controlled waters.

50% of the 16 speciated PAHs returned slightly elevated concentrations from one or more of the three leachate samples. The total sum PAH was elevated above the UK drinking water quality standards limit of 0.0001mg/l in sample DS8 at 2.5m bgl with a concentration of 0.0015mg/l. However, given the depth of the sample and the proposed mainly hard cover end-use the risk to controlled waters from this location is not considered to be significant.

Table 6.3: Summary of Leachate Analysis Results

Determinant	Measured Concentration *(mg/l)*		Standard *(mg/l)*		No. Exceeding DWQS	No. Exceeding EQS
	Min	Max	DWQS	EQS, DQS or <LTE		
Arsenic	<0.001	0.003	0.01	0.05*	0 of 3	0 of 3
Cadmium	<0.002	<0.002	0.005	0.005*	0 of 3	<LTE
Chromium	<0.01	<0.01	0.05	0.005-0.25*	0 of 3	<LTE – 0 of 3
Copper	<0.002	0.003	2	0.001-0.028*	0 of 3	<LTE
Lead	<0.005	<0.005	0.025	0.004-0.25*	0 of 3	<LTE - 0 of 3
Mercury	<0.00005	<0.00005	0.001	0.001*	0 of 3	0 of 3
Nickel	<0.001	<0.001	0.02	0.05-0.2*	0 of 3	0 of 3
Sulphate SO4	5.4	51	250	400*	0 of 3	0 of 3
Zinc	0.083	0.17	-	0.008-0.5*	-	3 of 3 – 0 of 3
Boron	<0.1	0.17	1	2.0*	0 of 3	0 of 3
pH	6.7	7.3	-	Upper 95th % 6-9	-	-
Benzene	<0.001	<0.001	0.001	0.03*	<LTE	0 of 3
Toluene	<0.001	<0.001	-	0.05*	-	0 of 3
Ethyl benzene	<0.001	<0.001	-	0.02 -0.2*	-	0 of 3
Xylenes	<0.001	<0.001	-	0.03*	-	0 of 3
EPH C10 – C40	0.13	0.21	0.01#	1**	3 of 3	0 of 3
PRO (C6-C10)	<0.001	<0.001	0.01#	1**	-	0 of 3
Naphthalene	<0.00001	0.00004	-	0.01	-	0 of 3
Acenaphthylene	<0.00001	<0.00001	-	<LTE	-	0 of 3
Acenaphthene	<0.0001	0.00013	-	<LTE	-	1 of 3
Fluorene	<0.0001	0.0001	-	<LTE	-	2 of 3
Pyrene	0.00004	0.00073	-	<LTE		3 of 3
Dibenzo(ah)anthracene	<0.00001	<0.00001	-	<LTE	-	<LTE
PAH (Sum 16)	<0.0002	0.0015	0.0001	-	1 of 3	-

Table 6.4: Summary of Results of Chemical Water Analysis

Determinant	Measured Concentration *(mg/l)*		Standard *(mg/l)*		No. Exceeding DWQS	No. Exceeding EQS or DUTCH
	Min	Max	DWQS	EQS, DQS or <LTE		
Arsenic	<0.001	0.012	0.01	0.05*	1 of 7	0 of 7
Cadmium	<0.002	<0.002	0.005	0.005*	<LTE	<LTE
Chromium	<0.01	<0.01	0.05	0.005-0.25*	<LTE	<LTE
Copper	<0.002	<0.002	2	0.001-0.028*	<LTE	<LTE
Lead	<0.005	<0.005	0.025	0.004-0.25*	<LTE	<LTE
Mercury	<0.00005	<0.00005	0.001	0.001*	<LTE	<LTE
Nickel	<0.001	0.05	0.02	0.05-0.2*	1 of 7	0 of 7
Sulphate SO4	0.013	0.1	250	400*	0 of 7	0 of 7
Zinc	0.025	0.18	-	5**	-	0 of 7
Boron	0.26	1.9	1	2.0*	4 of 7	0 of 7
pH	6.3	6.7	-	Upper 95th % 6-9	-	-
Benzene	<0.001	0.074	0.001	0.3*	2 of 7	0 of 7
Toluene	<0.001	0.049	-	0.5*	-	0 of 7
Ethyl benzene	<0.001	0.014	-	0.02 -0.2*	-	0 of 7/0 of 7
Xylenes	<0.00	0.028	-	0.03*	-	0 of 7
EPH C10 – C40	0.18	7.7	0.01#	1**	7 of 7	2 of 7
PRO (C6-C10)	<0.001	3.1	0.01#	1**	5 of 7	1 of 7
Naphthalene	<0.00001	0.0001	-	0.01	-	0 of 7
Acenaphthylene	<0.00001	<0.00001	-	<LTE	-	<LTE
Acenaphthene	<0.00001	0.0004	-	<LTE	-	3 of 7
Fluorene	<0.00001	0.0006	-	<LTE	-	4 of 7
Pyrene	0.00003	0.0016	-	<LTE		7 of 7
Dibenzo(ah)anthracene	<0.00001	<0.00001	-	<LTE	-	<LTE
PAH (Sum 16)	<0.0002	0.0043	0.0001	-	5 of 7	-

 # based on Water Supply Water Quality Regulations (1989)
*** based on EQS criteria - maximum allowable concentration (MAC) used where applicable**
**** based on Surface Water (Abstraction for Drinking Water) (Classification) Regulations 1996**
<LTE = not exceed limit of testing equipment

Arsenic (DS10), nickel (DS4) and boron (DS4, DS5, DS10 & DS11) returned concentrations sampled from the groundwater in excess of the UK drinking water quality standards. The groundwater sampled in the aforementioned locations is likely to be from the top of the natural strata. However, given the minor aquifer status of the natural strata and the site not lying within a source protection zone further consideration of the data is not considered to be necessary.

Elevated benzene concentrations (when compared with UKDWQS) have been returned from two locations, namely DS10 and DS11. DS10 and DS11 are located in the former underground storage tank area in the north-east of the site. Therefore, could indicate some residual fuel leakage from the historical storage of fuels including petrol. However, the maximum allowable concentration (MAC) EQS of 3mg/l was not exceeded.

Elevated hydrocarbon concentrations when compared with the conservative UKDWQS were returned at elevated concentrations from all seven groundwater samples collected for EPH and five samples for PRO. However, when compared with the SWADR (1mg/l), which are probably more relevant to the site environmental setting only two locations returned elevated EPH namely, DS10 (7.7mg/l) and DS5 (2mg/l) and one location for PRO (DS10). However, the presence of elevated EPH in the UST locality and in DS5 may indicate some lateral migration of hydrocarbons towards the nearby Monks Brook.

6.4 Potential for Pathway Modification Associated with Piling Activities

Report NC/99/73 "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention" (May 2001) produced by WS Atkins on behalf of the Environment Agency addresses potential pollution scenarios that could occur as a result of piling on 'brownfield' sites. Foundation construction for future redevelopment such sites in the form of piles has the potential to initiate vertical migration of contaminants through:

- The creation of preferential pathways through any low permeability cohesive deposits to allow potential contamination of the underlying aquifers;
- The creation of preferential pathways through any low permeability cohesive deposits to allow upward migration of soil gas or contaminant vapours to the surface; and,
- The driving of solid contaminants downwards into the aquifers during pile driving.

However, there appears to be some level of hydraulic continuity between the base of the made ground and the underlying natural strata that form the Minor Aquifer. Although, details have not been made available at the time of writing it was understood that the proposed piling solution was vibro-stone columns within the made ground which is not expected to drive any made ground material down through the underlying natural strata. Therefore, it is considered unlikely that any significant new potential migratory pathways will be opened up by piling activities on the site.

6.5 Assessment of Risks to Buried Concrete and Buried Services

A generic assessment of the risk to buried concrete and buried services has been made by reference to guidance given in Building Research Establishment (BRE) Special Digest 1, "*Concrete in Aggressive Ground*" (2005), EA Technical report P5 035/TR/01 "*Assessment and Management of Risks to Buildings, Building Materials and Services*" (2001), BRE report BR255 "*Performance of Building Materials in Contaminated Land*" (1994) and Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-03 "*The Selection of Materials for Water Supply Pipes to be laid in Contaminated Land*" (2002).

Laboratory analysis has revealed pH levels within near surface soils ranging between 7.2 and 8.2 ie neutral to very slightly alkaline conditions and water soluble sulphate concentrations ranging from 0.01 to 2.2g/l. In accordance with BRE Special Digest 1, in a data set where there are 10 or more results available, the mean of the highest 20% of sulphates results and the lowest 20% of the pH results should be taken. The mean of all the results (within made ground and natural deposits) indicate the use of a Design Sulphate Class of DS-2 and an ACEC class of AC-1s (assuming static groundwater) would be appropriate. Please refer to the BRE concrete classification sheet in F.

Given the presence of hydrocarbon contamination identified locally within the near surface soils and groundwater, the potential risk of attack to buried services should be considered and special precautions would likely be required in this instance.

6.6 Assessment of Risks to Vegetation

With regard to possible risk to vegetation, concentrations of the photo-toxic species values for arsenic, chromium, cadmium, lead, copper, nickel, mercury, selenium and zinc within the areas of proposed landscaping (western and southern site boundaries) were compared to the guidelines outlined in "*The Soil Code*" published by MAFF (now DEFRA) in 1998.

Locally elevated concentrations of arsenic, cadmium, copper, lead, nickel (only marginally) and zinc exceeded the recommended guidelines values within proposed landscaped areas, notably within or close to the footprint of the proposed building. On the basis of the available information, given concentrations also encountered in other areas of the site (considered from ash content within the made ground), it is therefore considered likely that vegetation within proposed landscaped areas could be at risk from contaminants in the ground.

6.7 Refined Conceptual Site Model and Plausible Pollutant Linkages

In view of the site observations and from the results of soil and groundwater analysis undertaken to date, it is apparent that the concentrations of determinands detected at the site have the potential to pose a significant risk to human health, controlled waters and the built environment. From the risk assessments carried out it is clear that the main risks identified at the site are to construction workers. Building materials and buried concrete structures are also potentially at risk from the contamination identified and as a result the Conceptual Site Model has been refined as set out in Table 6.5, below:

Table 6.5: Refined Conceptual Site Model and Plausible Pollutant Linkages

Source Location	Potential Contaminant	Key Affected Areas	Pathways	Key Receptors	Comment/Mitigation
Made Ground	Zootoxic and Phytotoxic metals, hydrocarbons and potentially asbestos in bound form.	Majority of the site where made ground has the potential to be exposed for prolonged periods.	Direct Contact, ingestion, inhalation Percolation of water through the fills/surface runoff Root uptake	Controlled waters (ie Minor Aquifer and Monks Brook) Humans Construction materials Flora and vegetation	Provision of cover layers in areas of contamination and/or removal of gross contamination. Dust suppression measures during site redevelopment works. Adoption of appropriate PPE and working practices by workers during redevelopment works.
Former fuel storage	Hydrocarbons (petrol, diesel, kerosene and oil) Vapours	Made Ground/Natural Deposits, surface & groundwater pollution Within excavations	Direct Contact, ingestion, inhalation Percolation of water through the fills/surface runoff Root uptake Inhalation Asphyxiation	Controlled waters (ie Minor Aquifer, Monks Brook) Humans Construction materials Flora and vegetation	As part of the initial redevelopment works the further investigation and safe controlled removal of all above and below ground fuel storage tanks, pipeline (fuel lines) prior to redevelopment. Possible further targeted monitoring of affected locations or the use of quantitative methods to assess risks posed by the presence of hydrocarbons in the shallow groundwater. Provision of cover layers in areas of contamination and/or removal of gross contamination. Dust suppression measures during site redevelopment works. Adoption of appropriate PPE and working practices by workers during redevelopment works.
Made Ground	Soil gases	Made Ground/Natural Deposits, surface & groundwater pollution	Inhalation Asphyxiation .	Humans	Low-level risk from gases due to low flows measured to date. However, appropriate precautions should be taken to protect groundworkers and the proposed development.

6.8 Ground Contamination Considerations

6.8.1 Potential Contamination Issues

In view of the nature of the site environmental setting, the proposed redevelopment and on the basis of the on site observations, the concentrations of contaminants found in the exploratory hole locations are not considered significant to warrant extensive remedial action. However, it is recommended that inclusion of a cover layer in the proposed landscaped areas should be undertaken.

Metallic and petroleum hydrocarbon contamination and bound asbestos within the near surface Made Ground and natural soils has been identified which has the potential to pose unacceptable risks to construction workers and buried services/concrete.

Given the findings of the risk assessment undertaken to date, an assessment of likely risk mitigation measures required to facilitate the proposed redevelopment are provided in the following sections.

6.8.2 Preliminary Recommendations for the Protection of Construction Workers

The risk assessment undertaken to date, has identified significant plausible pollutant linkages in relation to contaminated soils which may potentially pose a risk to site workers and, therefore, appropriate health and safety precautions would need to be adopted during the proposed redevelopment.

Appropriate health and safety and welfare provisions should be in place to protect both the site personnel and the general public. This should include the adoption of clear procedures in accordance with the current health and safety guidance including those given in 'Protection of workers and the general public during development of contaminated land' HS(GS)66, HMSO 1991.

Entry into confined spaces, trenches etc should be minimised; if entry is necessary then clear procedures should be developed as set out by the Health and Safety Executive.

Where asbestos cement sheet has been identified and is uncovered during the redevelopment works appropriate measures should be in place for its safe removal and disposal should it be uncovered during redevelopment works.

Care must be taken to minimise the amount of dust generated on the site during redevelopment.

6.8.3 Soil Gas Protection Measures

In accordance with C665 (2007) guidance, the site is classified as Situation 3 (based on the worst cases) and mitigation measures with regard to soil gas are likely to be required for the proposed redevelopment.

It is recommended that gas protection measures should be designed by a geoenvironmental specialist in consultation with the foundation designer to ensure the most appropriate gas protection details for the structure. Additionally there is the potential for depleted oxygen conditions to exist in confined sub-surface spaces. It is recommended, therefore, that entry into confined spaces be minimised and if unavoidable, appropriate precautions taken to remove any residual risk.

6.8.4 Chemical Attack of Buried Concrete and Buried Services

A Design Sulphate Class of DS-2 and an ACEC Class of AC1s (assuming static groundwater) in accordance with BRE Special Digest 1, *"Concrete in Aggressive Ground"* (2005) should be adopted for the proposed redevelopment. This has been assessed using the 20% mean of all the available results within the made ground and natural deposits.

In addition, given the presence of elevated concentrations of organic contamination within the near surface soils, special precautions with regard to the protection of buried services will also be required. It is recommended that specialist suppliers are consulted in this regard.

6.8.5 Disposal of Waste Soils and Groundwater

Removal and disposal of sub-soil arisings or groundwater undertaken from the site should be carried out in a controlled manner to a licensed facility, with due regard to Duty of Care responsibilities. Even in areas where no significant chemical contamination has been recorded, the Made Ground nature of arisings will attract elevated disposal rates if removed off site. It will be the responsibility of the contractor and designated landfill to assign an appropriate classification for the material for disposal.

7. REMEDIATION OPTIONS APPRAISAL

7.1 Introduction

In line with industry guidance, and in particular EA Publication CLR11 *"Model Procedures for the Management of Contaminated Land"* (2004), the following issues have been considered within the remediation appraisal:

- The degree to which risks need to be reduced or controlled;
- The time within which the remediation strategy is required to take effect;
- Practicability of implementing and maintaining the strategy;
- Technical effectiveness of the strategy in reducing or controlling risks;
- The durability of the strategy;
- Environmental sustainability of the strategy (i.e., how well it meets other environmental objectives, for example on the use of energy and other material resources and avoids or minimises adverse environmental impacts in off-site locations, such as a landfill, or on other environmental compartments, such as air and water);
- Cost of the strategy;
- Benefits of the strategy; and,
- Legal, financial and commercial contract issues.

At the time of writing it was understood a factory building to replace the exiting industrial facility was proposed.

7.2 Principal Identified Risk Drivers

On the basis of the available information, the principal risk drivers in relation to contaminated ground at the site have been assessed to be:

- The potential uptake by dermal contact, ingestion and inhalation of heavy metals and hydrocarbons contained in the made ground, during site redevelopment.
- The potential asphyxiation effects of the soil gases present on site.
- The potential impact of primarily hydrocarbons on controlled waters (adjacent Monks Brook and underlying Minor Aquifer).

7.3 Constraints Limiting Remediation Options

Constraints limiting remediation options at this site include:

- The site situation in close proximity to the Monks Brooks;
- The assumed hydraulic continuity of the shallow groundwater with the adjacent rivers;
- The assumed lack of attenuation due to the inferred high hydraulic conductivity of the Minor Aquifer and relatively short travel times for potential contaminants; and,
- Site topography, as it lies on two levels with a very steep slope towards the southern part.

7.4 Remedial Scheme Objectives

The client's prime objectives in instigating remedial works at the site are as follows:

- To break the identified potential source-pathway-receptor linkages;
- To use environmentally sustainable options where practicable; and,
- To meet Planning Authority conditions included in the planning permission for the proposed industrial end use.

Other key management objectives of the remedial scheme include:

- To develop a remediation strategy that can be agreed with all Regulatory Authorities, client etc;
- To avoid unacceptable health and safety and environmental impacts during remediation;
- To undertake remediation works cost effectively using construction project groundworkers in accordance with good technical practice;
- To undertake remediation works utilising on-site materials wherever possible; and,
- To minimise impact of construction programme.

7.5 Potential Feasible Remedial Options

Potential options for remediation to remove identified potential pollutant linkages associated with contaminated made ground and near surface natural soils at this site include:

- Containment by means of construction of a cover barrier;
- Localised removal or remediation of hydrocarbon impacted soils;
- Ex-situ bioremediation of hydrocarbon impacted soils;
- Soil washing methods;
- In-Situ Thermal Desorption (ISTD);
- Dual phase vacuum extraction (DVE);
- Groundwater remediation via enhanced in-situ biodegradation through utilisation of an In-Situ Submerged Oxygen Curtain;
- Natural Attenuation; and
- Targeted monitoring of affected locations and/or more detailed site specific risk assessment.

Given the constraints discussed in Section 7.3 the following methods are not considered appropriate for this particular site for the following reasons:

- Soil washing, due to primarily hydrocarbon impacted soils and the predominance of hydrocarbons in the in groundwater mean that the impact could probably be remediated more effectively by other methods.
- ISTD due to the shallow groundwater the unsaturated zone is considered to be too small for this technique to operate effectively.
- Natural attenuation processes alone are unlikely to provide a timescale acceptable to the requirements of the developer. However, natural attenuation processes could be important in the reduction of risks in the long-term.

Given the constraints discussed in Section 7.3 however, it is considered that objectives discussed in Section 7.4 could simply be achieved by either removal of the source material or by pathway elimination through construction of a cover barrier between the

source and receptors. Removal of all material with elevated concentrations of contaminants on the site is not likely to be economically viable with respect to the proposed development and therefore an approach utilising the placement of a cover layer across the site is suggested.

Utilisation of appropriate gas protection measures to buildings would mitigate risks associated with asphyxiation hazards. Localised excavation and removal of the hydrocarbon contaminated soils would also mitigate this risk as well as risks associated with outdoor inhalation of vapours.

Whilst excavation and disposal could be considered, there are practical difficulties with respect to conducting excavations within the made ground at depths close to the water table. Open excavations within soils may mobilise hydrocarbons and give rise to impact of surrounding controlled waters. Excavation and disposal to landfill is also not considered to be the best option from an environmental sustainability perspective.

Dual Phase Vacuum Extraction (DVE) in isolation is a technique that would have limited application due to the identified impacts being below the groundwater table. Localised groundwater level reduction at SVE points could in practice be adopted, although this would then generate relatively large volumes of water that would require treatment and disposal. An alternative is the use of air sparging points below the water table to inject air into the areas of impact, combined with vacuum extraction points above the water table to extract volatile vapours. The vacuum extraction plant would use granular activated carbon to capture the volatile vapours in the off-gases. However, considerable surface plant in the form of air extraction and injection equipment would be required although noise is not considered to be a concern at this site. Transferring the contaminant from one media, the soil, to another, the granular activated carbon in the treatment vessels and then disposing in landfill or reprocessing the impacted carbon is not the most environmentally sustainable approach.

In-situ chemical oxidation could be used to treat the organic fractions within the groundwater could be an effective and relatively low impact initial method. Application of the compound could be undertaken post removal of the buried fuel storage tanks prior to backfilling with suitably certified materials. A longer term method could be the incorporation of an in-situ oxidation curtain to encourage biodegradation of the hydrocarbons within the groundwater.

Targeted groundwater monitoring of the identified affected areas, following removal of the underground storage tanks and in situ groundwater treatment methods. This could be supported by the application of quantitative methods (Tier 3) to provide evidence that the risks to the receptors have been managed effectively.

8. IMPLEMENTATION PLAN

8.1 Introduction

The following sections provide a detailed overview of the ground contamination remediation works proposed at the site. The remainder of this section includes:

- Outline discussions of necessary and relevant site clearance works.
- Detailed site specific risk assessment.
- Excavation and off site disposal/on-site ex-situ treatment of heavy metal and hydrocarbon impacted soils.
- Cover layer construction.
- In-situ or ex-situ clean-up of impacted groundwater in previously identified source areas.
- Gas protection measures to be incorporated within buildings.

8.2 Site Clearance and Associated Works

In view of the age of the existing buildings there is a possibility that asbestos containing materials are present within the construction (notably roofing materials). It is therefore recommended that an asbestos survey of the buildings is undertaken prior to demolition. Identified asbestos containing materials deemed to be notifiable under the Control of Asbestos at Work Regulations (1997) should be removed by specialist contractors working to strict health and safety procedures.

Asbestos containing materials should be carefully removed and subsequently transported off-site by a licenced carrier, and disposed of as special waste at a suitable licenced landfill site, in accordance with the Duty of Care requirements of Part II of the Environmental Protection Act (EPA) 1990.

Any hazardous materials identified during site clearance should be inspected and classified by an appropriately qualified person acting on behalf of a specialist waste management contractor. All such materials should be removed off site by a licenced carrier, and either disposed of at a suitably licenced landfill, treated at a licenced facility or recycled as appropriate.

During demolition works, any interceptors, sumps drain lines etc should be emptied of their liquid/solid contents and removed off site to a suitably licenced facility in accordance with Duty of Care requirements of the EPA. Once cleared of all their contents, any interceptors, drain lines etc should be removed or upgraded, and all off site exit points sealed either with imported clay, or concrete grout, if no longer required.

Underground fuel tanks (USTs) and associated fuel lines should also be removed from site in order to remove potential sources of residual contamination and to access any underlying contaminated soils not identified during the site investigation works for source removal.

It is understood from the client that the USTs have been decommissioned and concrete filled, some twelve years or so ago. This should be confirmed prior to removal. The tank should be removed following guidance given in Health and Safety Executive Guide CS 15: "*Cleaning and gas freeing of tanks containing flammable residues*" and Guide HSG 41: "*Petroleum Filling Stations Construction and Operation*" as appropriate.

All pipework connecting to the tanks should be drained and flushed, with care taken to avoid spillage. The product lines and other tank fixtures should also be carefully removed.

8.3 Earthworks

8.3.1 Excavation

Contaminated soils or suspect contaminated soils encountered in the previously identified source areas and any other areas that may be revealed following demolition and site clearance, could be excavated to break associated pollutant linkages. Excavated material should be placed onto an impermeable membrane or loaded directly into a tipper. All excavations should be inspected by a suitably qualified engineer. The excavation should continue until no more significantly contaminated material is visible at the sides and base of the excavation area. Representative samples of soil should be collected from the sides and base of each source area excavation, and submitted for targeted laboratory determination to confirm that no significantly contaminated material remains in the excavation.

Following site clearance and prior to commencement of construction works it is recommended that a strip of made ground is undertaken across the site. Subject to the findings of any more detailed risk assessment undertaken, on the basis of the available information, the minimum depths of made ground strip should be as detailed below, although natural soils where locally encountered as shallower depths will limit the excavation required:

(i) Building footprints and hardstanding – thickness of construction including sub base.

The strip process should be closely supervised by an experienced site engineer/agent and different material types should be stockpiled separately on site and accessed for their suitability for reuse. Material deemed unsuitable either visually or through additional chemical testing should be disposed of off site at a suitably licenced facility.

Following the site strip the formation should be carefully inspected. Oily areas will need to be excavated out and removed from site. Any other suspect pockets/horizons should also be removed or additional chemical testing undertaken to enable further review.

Additional excavation and retesting may be required depending on the test results of the audit testing. It is impractical to inspect all areas of ground during site investigation works, and as a consequence future excavations for development work may reveal unexpected or unusual ground conditions which may require consideration for zonal removal.

Segregation of excavated materials will be undertaken in order to separate materials that are not re-usable and those following on-site treatment processes.

8.3.2 Off-Site Disposal

The minimisation of material volumes disposed off-site will be the primary aim of the remedial strategy. However, where materials are uncovered that either contain concentrations of contaminants (eg metalloids) or hazardous materials (eg asbestos) thus prevented effective on-site treatment, these materials will be disposed off-site. Such materials will require some for of pre-treatment (eg screening) prior to off-site disposal in line with current waste legislation.

8.4 Cover Layer Construction

Generic guidance on the design of simple cover systems for land regeneration is given in Building Research Establishment (BRE) publication BR465 (2004). The design methodology comprises a mathematical model which assumes that, in the worst case, there will eventually be complete natural intermixing of cover materials with the underlying contaminated material over a thickness referred to as the mixed zone. A default mixed zone thickness value of 600mm has been adopted in the guidance on the basis of field research and literature review.
Potential soil mixing can be the result of:

- Disturbance by earthworm activity;
- Disturbance from burrowing animals;
- Effects from plant/tree roots;
- Digging during gardening activities; and,
- Intermixing of leaf fall.

The model has been used to determine a sufficient thickness of cover material, such that even with complete intermixing in the long term, the concentrations of contaminants within the mixed zone should remain below relevant Generic Assessment Criteria (GAC) values. The model has been run for the made ground averaging area as we understand the proposed landscaping will located on the elevated area in the northern part of the site.

The results of the modelling are included in Appendix E and indicate an overall required cover thicknesses of 600mm.

Minimal intermixing is anticipated in non-landscaped communal areas, including parking and access roads and consequently BRE design guidelines are not appropriate for these parts of the site.

On the basis of the available information and findings of the generic risk assessment the cover layer construction in each of the averaging areas is therefore recommended as follows:

- Landscaped areas – a minimum of 600mm of cover comprising minimum of 450mm of certified ‘clean’ site won or imported subsoil capped by 150mm of topsoil; and,
- Building footprints and hardstanding – the construction itself will act as an appropriate barrier.

The underlying ground should be suitably compacted prior to placement of the cover layer as set out in CIRIA Special Publication SP105 “*Remedial Treatment of Contaminated Land*” (1995).

If tree planting is proposed then localised over excavation will be necessary around the root ball and further advice should be sought from a horticulturist/landscaped architect to detail the depth and type of material required.

8.6 Management of Impacted Groundwater

There is a possibility impacted groundwater will be encountered during the redevelopment works. The groundwater can be extracted by means of pumping from an excavated sump within any particular area. The abstracted water will flow into a treatment chain comprising a settlement tank, interceptors followed by a granular activated carbon unit with discharge of treated water, subject to consent, to foul sewer. Vapours are captured via a knock-out pot system attached to granular activated carbon filtration vessel. This method would also be combined with the excavation of the impacted soil if required which could be undertaken first and designed to produce the required sump.

8.7 Verification Plan

8.7.1 Residual Soil Verification

Audit testing of soil samples of residual potentially hydrocarbon impacted soil should be undertaken following completion of initial and any subsequent phases of remedial excavation works prior to placement of the cover barrier or placement of sub base material as appropriate. Sampling should be at a frequency agreed with the regulators.

8.7.2 Groundwater Verification

Monitoring of the groundwater for hydrocarbons will be undertaken prior to commencement of the development works. Following commencement of the development works groundwater monitoring on a weekly basis for a four week period will be undertaken. Long-term monitoring for the subsequent twelve months will be undertaken as follows, monthly monitoring for the first quarter following tank removal and localised groundwater remediation, then scaled down to quarterly intervals for the remaining three quarters. Should the results at any stage indicate that a significant risk of off-site migration of impacted groundwater is occurring then, following consultations with regulators, appropriate additional groundwater treatment measures should be instigated.

8.8 Site Drainage and Protection of Services

In view of the locally elevated levels of contaminants identified and the site's location over a minor aquifer the Environment Agency may place some restrictions on permitted infiltration of surface water run-off at the site.

To manage the risk of environmental problems developing in the future, the location, depth and detailed design of site services and drainage should be carefully considered. Manufacturers of pipework etc should be consulted as to the suitability of their materials for the ground conditions at the site.

Backfill to all services trenches should be of appropriate inert granular materials.

8.9 Gas Protection Measures

Elevated concentrations of carbon dioxide and methane were found across the site with concentrations ranging between 0.8% and 15.0% for carbon dioxide and 0.9% to 2.6% for methane.

The assessment of the explosive and asphyxiant risk posed by sub-surface gases has been made with reference to guidance given in a number of relevant documents including CIRIA publications 149-152 (1995) and C665 (2007), Building Regulations Approved Document C, NHBC Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present (2007) and BRE Guidance on the Construction of Buildings on Gas Contaminated Land. Concentrations of methane and carbon dioxide and flow rate of each have been assessed against the criteria presented in CIRIA Report C665 (2007).

The site is classified as Situation 3 (based on the worst cases) and mitigation measures with regard to soil gas are likely to be required for the proposed redevelopment. Additionally, although hydrocarbons within near surface soils have been returned at concentrations that suggest they may not pose an inhalation risk to future end users and site workers. Notwithstanding it may be prudent to include vapour resistant membranes within the proposed development.

There is potential for depleted oxygen conditions (less than 18%) to occur in confined subsurface spaces. Entry into confined spaces should be minimised and if unavoidable appropriate precautions taken.

Any proposed gas protection should be designed by a geoenviromental specialist in consultation with the foundation designer to ensure the most appropriate gas protection details for the structure.

9. SITE MANAGEMENT

9.1 Remediation Works Programme

The remediation works detailed in above will be undertaken by groundworkers during the construction process.

9.2 Site Access & Control

Permanent site access records should be established and maintained at the main site office. The site should be sufficiently secured at all times to inhibit access by the public. Any deep excavations should also be suitably demarked and fenced.

9.3 Protection of Site Workers and the General Public

Appropriate health and safety and welfare provisions should be in place to protect both the site personnel and the general public. This should include the adoption of clear procedures in accordance with the current health and safety guidance including those given in 'Protection of workers and the general public during development of contaminated land' HS(GS)66, HMSO 1991.

Entry into confined spaces, trenches etc should be minimised; if entry is necessary then clear procedures should be developed as set out by the Health and Safety Executive.

Care must be taken to absolutely minimise the amount of dust generated on the site during the works.

9.4 Site Offices and Messing

A site office should be established within the site area. All access should be restricted via the site office, which should act as a gatehouse to monitor incoming and exiting loads, visitor's etc.

The site offices should be equipped with suitable messing facilities, toilets and washing/cleaning facilities. All pedestrian site access/exit should be reported to the site office.

All visitors should be required to sign in the visitor log-book and should be briefed on the first occasion on site about the risks associated with contamination on site and precautions that they must take. The briefing should include all contractors on site.

No eating, drinking or smoking should be allowed on site apart from in the designated site accommodation.

9.5 Site Supervision

All works should be periodically inspected by an experienced site engineer or agent. The site engineer or agent should be responsible for:

- Maintaining records of site activities;
- Supervision of remedial excavation;.
- Setting out of cover layer area;

- Supervision of construction of cover layers;
- Supervision of construction of gas protection measures; and,
- Providing advice and control with respect to safety procedures.

The site engineer/agent or appointed specialist consultants should be responsible for:

- Collection of representative audit samples for laboratory analysis.
- Sampling, analysis and acceptance of imported soil material and soil scheduled for reuse in cover layer construction.
- Validation/Verification of works towards remedial objectives.
- Compiling a verification report upon completion of works.

9.6 Decontamination Facilities and Road Cleaning

Washing/cleaning facilities should be provided for all contractors and visitors. This will be attached to the office facilities and all visitors to the site will first need to report to the site office. All personnel should be required to wash and decontaminate clothing/boots prior to departing site, if they have potentially come into contact with contaminated materials within sub surface soils.

Due to the small scale of works, restricted size of site and limited nature of earthworks anticipated, a wheel wash is not considered necessary for the remediation works. The public highway should periodically be cleaned using a road sweeper should any material be found to track from the site onto the road via vehicle tyres. The status of the highway being clear of site derived materials should be under continual review in consultation with the relevant local authority.

9.7 Air Quality Remedial Action Plans

9.7.1 Remedial Action Plan - Dusts

In the event that dust levels could become significant then water dowsing should be undertaken. If the problem persists then the following action plan should be implemented:

1. Limit excavation works and restrict vehicle movements as appropriate.
2. Local Authority Environmental Health Dept notified and agree on a way forward to achieve satisfactory dust control.
3. Dust monitoring implemented, possibly using portable dust samplers.

9.7.2 Remedial Action Plan - Odours

Odour problems are not anticipated on the basis of the site investigation; however in the event that odour problems arise, then the following action plan should be implemented:

1. Limit excavation works as appropriate.
2. Local Authority Environmental Health Dept notified and agree on a way forward to achieve satisfactory odour control.
3. Olfactory monitoring of odours should be undertaken.
4. Odour abatement products can be introduced hydrocarbon impacted materials, which can either mask the odour, or stimulate facultative bacterial growth at the surface, to effectively degrade malodorous compounds.

10. COMPLETION (VERIFICATION) REPORT

A completion (verification) report shall be prepared giving details of the remediation works once all of the works have been completed. The completion report should include a clear statement regarding the adequacy of works conducted, whether any amendments were required, what these may have been, and how they were consequently implemented. The report should also detail the nature and likely extent of residual contamination at the site.

The basic structure of the report should follow guidance given in EA Publication CLR11 *"Model Procedures for the Management of Contaminated Land"* (2004) and include as a minimum:

- Scope of remedial works undertaken;
- Records of any additional remedial works;
- Comprehensive account of additional work and adequacy of implementation;
- Locations of soil samples;
- Soil sample analysis results; and,
- Conclusions and verification that site is "suitable for use".

This report should be issued to the Regulatory Authorities following completion of remedial works at the site.

APPENDIX A

REPORT CONDITIONS

REPORT CONDITIONS

This report is produced solely for the use of Laishley and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

Some of the opinions are based on unconfirmed data and information and are presented as the best that can be obtained without extensive research. AIGE accepts no responsibility for data provided by others.

The recommendations of this report are based on the findings of small diameter boreholes and trial pits excavated at specified locations on the site. It is possible that conditions exist other than those encountered and therefore no guarantee can be given as to the extent to which the findings are representative.

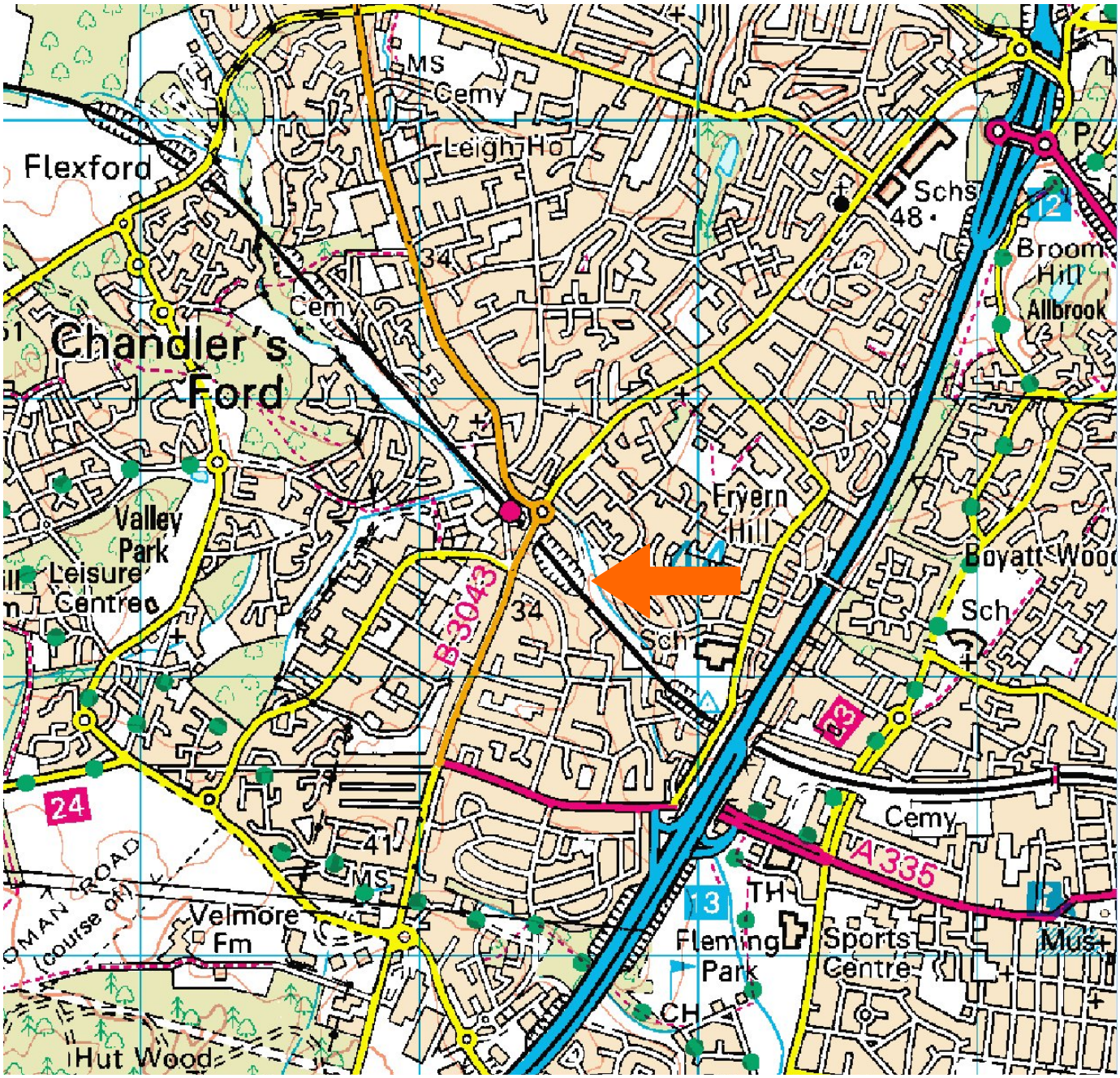
It should be noted that ground water conditions fluctuate according to seasonal and other factors that can not be predicted with certainty. In low permeability soils equilibrium groundwater levels are rarely established during the period of fieldwork.

All recommendations made are subject to any relevant statutory regulations in force concerning design methods and safe construction practice.

APPENDIX B

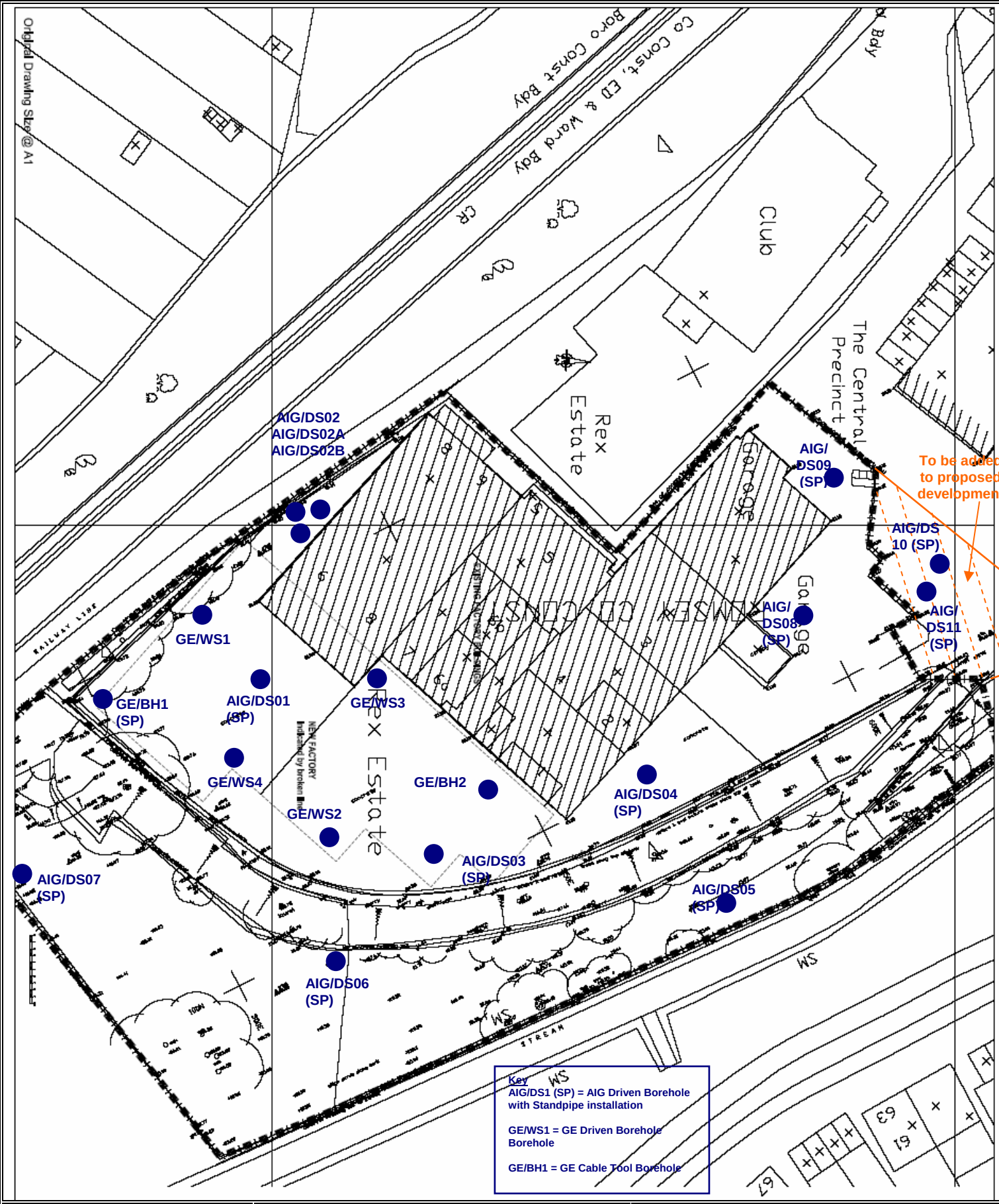
FIGURES AND DRAWINGS

Figure 1: Site Location Plan
Figure 2: Exploratory Hole Location Plan
Figure 3: Consulting Structural & Civil Engineers Proposed Layout

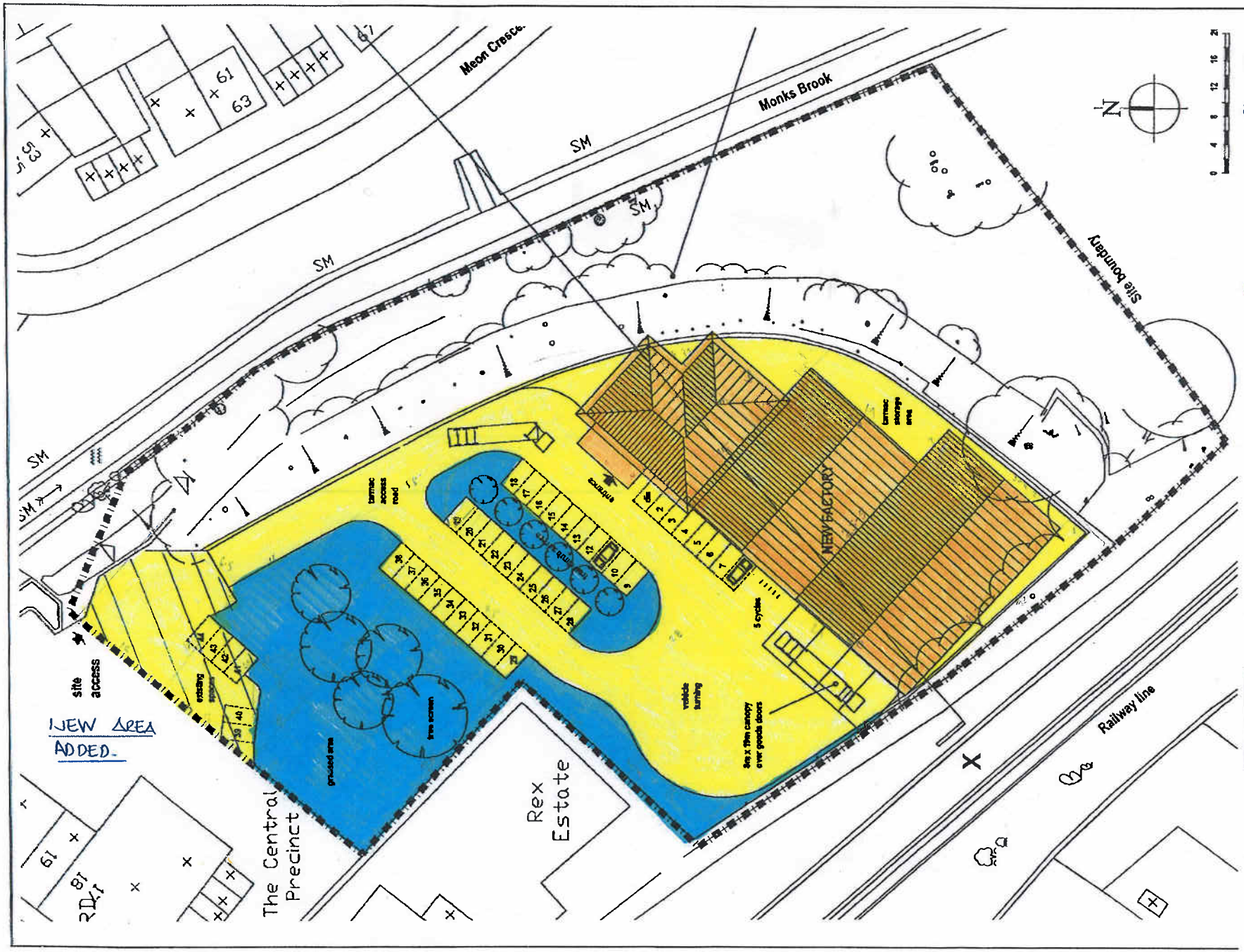


AIG Engineering Group	CLIENT: LAISHLEY
AIG ENGINEERING GROUP TEL: 01245 505600 FAX: 01245 505606	JOB TITLE: AHMAD TEA FACTORY
	DRAWING TITLE: SITE LOCATION PLAN

Copyright Licence : 100044322	DATE 8/08/08	STATUS FINAL	
	DATE 8/08/08	SCALE N.T.S.	DRG No. Figure 1



AIG Engineering Group	CLIENT: LAISHLEY	JOB TITLE: AHMAD TEA FACTORY
TEL: 01245 505600 FAX: 01245 505606	DRAWING TITLE: EXPLORATORY HOLE LOCATION PLAN	
Copyright Licence: 100044322	DATE: 8/08/08	SCALE: N.T.S.
		DRG No.: Figure 2



∴ TOTAL AREA OF STORM WATER TO DRAIN.
LESS GRASS AREA
= 4519m²

Rev	Amendment	By

CSC
CONSULTING STRUCTURAL & CIVIL ENGINEERS

ANGLO CITY HOUSE
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PROJECT
AHMAD TEA
NEW HQ BUI
CHANDLERS FO

TITLE PROPOSED SITE PLAN
SCALE 1/5
DATE JULY08 DRAWN BY AW CHECKED

JOB No	DRAWING No	REVISION
1960	02	

APPENDIX C

EXPLORATORY HOLE RECORDS AND MONITORING DATA

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Borehole No **DS1** Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 05/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
TARMAC		0.05						
MADE GROUND composed of light grey sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.15						
MADE GROUND composed of loose dark brown very clayey sand and fine gravel. Gravel of fine to medium concrete mudstone brick occasional wire and glass. (PID 0)				0.80 1.00	D C	N=8 (3,2,2,3,2,1)		
MADE GROUND composed of loose dark brown and black silty sand and fine gravel. Gravel of ash, possible clinker, chalk flint occasional brick and decaying organic matter.(PID 0)		1.50		1.60	D			
MADE GROUND composed loose reddish brown and grey very clayey silty sand and fine to medium gravel of brick ash and possible clinker. (PID 0)		3.20		3.00 3.00 3.05 3.50	C D D D	N=2 (1,0,1,1,0,0)		
				4.00	D			
Firm orange brown streaked grey sandy gravelly CLAY. Gravel of fine to coarse sub angular flint. (PID 0). (Alluvium)		4.30		4.30	D			
Medium dense/Firm orange brown and grey veined very sandy SILT or very silty fine SAND. (PID 0) (Alluvium)		5.10		5.00 5.00 5.30	C D D	N=18 (4,4,5,5,4,4)		
End of Borehole at 6.00 m		6.00		6.00	D			

Remarks: No ground water encountered.

AGS

DS1

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Borehole No
DS2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 05/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
TARMAC		0.05						
MADE GROUND composed of light grey sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.15		0.20	D			
				0.50	D			
MADE GROUND composed of loose black silty locally clayey sand and fine gravel. Gravel of fine coal, ash, flint, brick (PID 0)								
				1.50	D			
Obstruction. Probable concrete.		1.90		1.90	C	50/50mm - Abandoned		
End of Borehole at 1.91 m		1.91						

Remarks: Obstruction encountered at 1.9m. No groundwater encountered

AGS

DS2

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Borehole No
DS2A
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 05/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
TARMAC		0.05		0.00				
MADE GROUND composed of light grey sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.15						
MADE GROUND composed of loose black silty locally clayey sand and fine gravel. Gravel of fine coal, ash, flint, brick (PID 0)								
Obstruction. Probable concrete.		1.90		1.90	C	50/50mm - Abandoned		
End of Borehole at 1.91 m		1.91						

Remarks: Obstruction encountered at 1.9m. No groundwater encountered

AGS

DS2A

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Borehole No
DS2B
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 05/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m) Samp	Samples & Tests: SPT Results	Water Strikes	Well
TARMAC		0.05		0.00			
MADE GROUND composed of light grey sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.15					
MADE GROUND composed of loose black silty locally clayey sand and fine gravel. Gravel of fine coal, ash, flint, brick (PID 0)		0.40					
Obstruction. Probable concrete.		0.41					
End of Borehole at 0.41 m							

Remarks: Obstruction encountered at 0.4m. No groundwater encountered

AGS

DS2B

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Borehole No
DS3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 05/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
TARMAC		0.05						
MADE GROUND composed of light grey sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.50						
MADE GROUND composed of loose brown locally grey/black sandy silty gravel. Gravel of flint ash brick and occasional concrete and metal and fine gravel. (PID 0)				1.00	D			
MADE GROUND composed of loose black silty locally clayey sand and fine to medium gravel. Gravel of coal ash with many glass fragments and occasional flint. (PID 0)		1.50		2.00	C	N=9 (1,3,3,2,3,1)		
MADE GROUND composed of loose brown silty loaclly very clayey very sandy gravel of predominantly flint occasional ash. Loaclly a very soft sandy very gravelly silt/clay. (PID 0)		2.20		2.00 2.50	D D			
MADE GROUND composed of loose black very silty clayey gravelly silt/sand. Locally very gravelly, gravel of ash and flint. (PID 0)		3.10		3.00 3.05 3.50	D D D			
				4.00	C	N=2 (1,0,1,0,1,0)		
				4.50 4.50 4.60	D D D			
Firm locally soft greenish brown mottled black slightly sandy CLAY. Occasional decaying organic material and roots <2mm. (PID 0). (Alluvium)		5.00		5.50 5.80	D D			
Firm locally soft brown mottled grey gravelly very sandy CLAY. Gravel fine sub rounded flint. Hand Shear Vane result = 40kN/m2 @ 6.5m. (PID 0). (Possibly Alluvium).		6.00		6.00 6.50	C D	N=21 (6,5,6,5,5,5)		
End of Borehole at 7.00 m		7.00						

Remarks: No ground water encountered.

AGS

DS3

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Fax. 01245 505606

Borehole No
DS4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 05/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
Concrete		0.10						
MADE GROUND composed of brown sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.30		0.50	D			
MADE GROUND composed of dark grey sandy gravelly silt and very silty clayey sand. Gravel predominantly ash brick and occasional concrete. (PID 0)		0.90						
MADE GROUND composed of orange brown very silty locally clayey sand and fine gravel. Gravel of glass flint mudstone with much pottery and occasional metal fragments. (PID 0)				1.50	D			
MADE GROUND composed of soft locally firm bluish grey sandy locally very gravelly clay. Gravel predominantly of flint occasional chalk and brick. Occasioanl brick cobbles. (PID 0)		2.40		3.00	D			
MADE GROUND composed of black silty sand with pockets of brown mottled green clay. Broken glass bottles at 5.1m. Also pockets of decaying reed matter. Strong hydrocarbon odour. (PID 87ppm @ 5.1m 130ppm @ 4.5m 80ppm @ 4.0m)		3.80		4.00	D			
Soft greenish grey mottled orange brown streaked/specked dark grey to 5.8m sandy locally very sandy SILT/CLAY with decaying rootlets <3mm to 5.5m. Hand shear vane readings 30kN/m2 @ 5.5m 35kN/m2 @ 6m. (PID 0). (Alluvium)		5.10		5.00 5.10 5.15 5.30 5.35 5.50 6.00	D D D D D D D			
Damp orange brown mottled/streaked light grey slightly silty locally very silty SAND. Becoming very soft brown sandy SILT with depth. (PID 0). (Possible Bracklesham Beds)		6.80		7.00 7.50	D D			
End of Borehole at 8.50 m		8.50						

Remarks: Water seepage at 5.1m. Water strike at 6.8m

AGS

DS4

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Borehole No
DS5
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 06/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
MADE GROUND composed of light grey silty sand and gravel of crushed concrete (PID 0)		0.30		0.40	D			
MADE GROUND composed of firm brown sandy gravelly clay. Gravel of flint and occasional brick. (PID 0)		0.50		0.50	D			
Soft brown locally mottled light brown with black specs SILT occasional decaying rootlets (Relic Topsoil). (PID 0)		0.60		0.55	D			
				1.00	C	N=15 (1,3,4,4,4,3)		
				1.00	D			
Soft brown speckled black gravelly sandy CLAY. Gravel of fine to medium sub angular flint. Hand Shear vane results 20kN/M2 @ 1.7m. (Alluvium)		1.80						
Soft grey locally greenish grey very gravelly very sandy SILT locally very silty SAND. (Alluvium)				2.00	D			
Stiff greenish grey slightly sandy CLAY with localised fine SAND lenses. Hand shear vane result 79kN/m2 @ 2m. (Alluvium)		2.80		3.00	C	N=7 (2,1,1,2,2,2)		
Firm dark grey sandy SILT/CLAY. Hand shear vane result 58kN/m2 @ 4m. (Possibly Bracklesham Beds)		3.10		3.00	D			
End of Borehole at 4.00 m		4.00		4.00	D			

Remarks: Water strike at 1.8m

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DSS

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Borehole No
DS6
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 06/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
MADE GROUND composed of firm dark brown sandy gravelly clay. Gravel fine to medium of flint and brick glass occasional ash. (PID 0)		0.50		0.20	D			
MADE GROUND composed of firm light orange brown mottled light grey veined orange slightly sandy CLAY. Occasional active rootlets <2mm. Hand shear vane result 45kN/m2 @ 0.5m. (PID 0)		0.90		0.80 1.00	D D			
Very soft becoming firm at 1.5m orange brown and light grey slightly sandy gravelly SILT/CLAY. Gravel fine to medium sub angular of flint. (PID 0). (Alluvium)		1.90		2.00	C	N=15 (2,4,5,5,3,2)		
WET green or greenish light brown very silty gravelly SAND. Locally a very silty sandy GRAVEL. Gravel fine to coarse sub rounded of flint occasional cobbles. (PID 0). (Possible Alluvium)				2.50	D			
Firm dark grey sandy SILT/CLAY locally with fine SAND lenses. (PID 0). (Bracklesham Beds)		3.90 4.00		4.00 4.00	C D	N=14 (2,2,3,3,4,4)		
End of Borehole at 4.00 m								

Remarks: Water strike at 1.9m

AGS

DS6

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Borehole No
DS7
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 06/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
MADE GROUND composed of bark chippings. (PID 0)		0.20		0.30	D			
Firm dark brown mottled light brown sandy slightly gravelly TOPSOIL with active rootlets < 3mm. (PID 0)		0.50						
Soft light brown locally orange brown CLAY with active rootlets <3mm. (PID 0). (Alluvium)		0.90						
WET greenish grey slightly silty fine SAND. (PID 0). (Alluvium)		1.10		1.50	D			
Firm orange brown with light grey streaks sandy SILT locally a slightly gravelly to gravelly silty SAND. Gravel fine to occasionally medium sub angular of flint. (Alluvium)		1.90						
Damp brown and light greenish grey silty SAND. (Possible Bracklesahm Beds)		2.00		2.50	D			
WET greenish grey silty locally very silty SAND locally a very sandy SILT. (Possible Bracklesham Beds)								
End of Borehole at 3.00 m		3.00						

Remarks: Water strike at 0.9m

AGS

DS7

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Borehole No
DS8
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 06/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
TARMAC		0.01						
CONCRETE		0.06						
		0.20		0.30	D			
MADE GROUND composed of brown silty sand and fine sub rounded gravel (Sub Base). (PID 0)		0.50						
		0.60						
MADE GROUND composed of firm locally stiff dark grey sandy gravelly clay. Gravel of flint brick concrete coal occasional glass ash and decaying wood. (PID 0)		1.10		1.00 1.10 1.15 1.20 1.50	D D D D D			
MADE GROUND composed of brown very clayey sandy fine to medium sub angular gravel of flint. (PID 0)		1.70						
MADE GROUND composed of Firm brown mottled black slightly sandy locally gravelly clay. Gravel of flint occasional brick and ash locally thin ash lenses. (PID 0)				2.00 2.00	C D	N=3 (1,1,0,1,1,1)		
MADE GROUND composed of firm locally stiff greenish grey mottled black slightly sandy gravelly clay. Gravel of flint ash and occasional brick				2.50	D			
MADE GROUND composed of dark grey black very silty/clayey sand and fine gravel. Gravel of ash occasional flint glass and decaying wood fragments. Also unidentified white material (crystalline) at 2.5m		3.20		3.00 3.05 3.50	D D D			
MADE GROUND composed of soft greenish grey and black very gravelly sandy clay/silt. Gravel of ash clinker and occasional pottery. Locally a very silty sand and fine gravel.		3.90		4.00 4.00	C D	N=0 (0,1,0,0,0,0)		
WET soft greenish grey locally streaked and mottled black slightly sandy locally sandy SILT occasional decaying reeds and rootlets <3mm. (Alluvium)		4.80						
Firm orange brown mottled light grey very sandy locally slightly gravelly CLAY. Gravel of fine to medium flint. (Alluvium)		5.00		5.00	D			
End of Borehole at 5.00 m								

Remarks: Water seepage at 2.2m and 3.6m

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DS8

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Borehole No
DS9
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 07/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
TARMAC		0.03						
MADE GROUND composed of soft dark grey sandy gravelly clay. Gravel of flint brick ash occasional coal and glass. Occasional decaying wood fragments. (PID 0)				0.50	D			
				0.60	D			
		0.80						
MADE GROUND composed of yellow light brown slightly silty sand. (PID 0)				1.00	C	N=1 (1,0,0,0,1,0)		
				1.00	D			
		1.50		1.50	D			
MADE GROUND composed of soft dark grey mottled black sandy gravelly clay. Gravel of flint occasional glass pottery and decaying rootlets <2mm. (PID 0)		1.60						
				2.00	D			
Soft orange brown slightly mottled greenish grey locally veined orange CLAY/SILT		2.10						
Soft light brown locally laminated grey and orange very sandy SILT locally silty SAND (PID 0). (Bracklesham Beds)				2.50	D			
				3.00	C	N=23 (3,5,5,6,6,6)		
				3.50	D			
Alternating shades of green from light to dark brown slightly silty SAND. Interbedded with gravelly 0.1cm thick orange brown CLAY (PID 0). (Bracklesham Beds)		3.70						
		4.10						
WET dark green laminated dark brown locally wirth black patches at 4.3m slightly silty SAND. (Bracklesham Beds)				4.30	D			
		5.00		5.00	C	N=13 (2,3,3,3,3,4)		
End of Borehole at 5.00 m								

Remarks: Water seepage at 2.1m. Water strike at 3.0m

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DS9

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Borehole No
DS10
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 07/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
Tarmac		0.07						
MADE GROUND composed of brown sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.30						
MADE GROUND composed of soft locally firm dark brown grey slightly sandy gravelly clay. Gravel predominantly flint brick slate occasional ash pockets. (PID 0)				1.00	D			
				2.00	C	N=4 (2,1,1,1,1,1)		
				2.00	D			
MADE GROUND composed of soft black dark grey very sandy gravelly silt locally a very silty gravelly sand. Gravel of ash brick occasional concrete and flint occasional brick cobbles. (PID 0)		2.60		3.00	D			
		3.50		3.50	D			
Old news paper cuttings (note: prices shown in shillings)		3.60		3.70	D			
MADE GROUND composed of soft black very sandy silt. Strong tar odour. (PID 20)		3.80						
Soft greenish grey very sandy locally sandy SILT with black hydrocarbon stains and locally tar odour. (PID 130)		4.00		4.00	D			
End of Borehole at 4.00 m								

Remarks: Water seepage at 3.6m.

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DS10

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Borehole No
DS11
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Ahmad Tea Factory	100615		DS
Location: Chandlers Ford		Level: -	Scale 1:50
Client:		Dates: 07/08/2008	Logged By

Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests: Depth (m)	Samp	SPT Results	Water Strikes	Well
Tarmac		0.07						
MADE GROUND composed of brown sandy silty medium sub angular gravel. (Sub Base). (PID 0)		0.30						
MADE GROUND composed of firm dark brown grey slightly sandy gravelly clay. Gravel predominantly flint brick slate occasional ash pockets. (PID 0)				0.80	D			
MADE GROUND composed of black dark grey silty sand and fine gravel. Gravel of ash occasional brick pottery and glass. (PID 0)		1.60		2.00	D			
				3.50	D			
				3.50	D			
WET soft orange brown streaked/mottled greenish grey with black hydrocarbon stains (PID 50) sandy SILT		3.70		3.60	D			
				4.00	D			
WET compact grey becoming orange brown and grey silty SAND		4.60						
End of Borehole at 6.00 m		6.00		6.00	D			

Remarks: Groundwater encountered at 3.7m.

AGS

DS11

SOIL GAS AND GROUNDWATER MONITORING DATA

Site: Ahmad Tea Chandlers Ford

Job No: 100615 **Date:** 17/08/2008

Borehole	Gas Flow (l/hr)	Borehole Pressure (Pa/mbar)*	Methane (%v/v)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water (m bgl)	Standpipe Depth (mbgl)	Notes
			Peak	Steady	Peak	Steady	Minimum	Steady	PID	H_2S	CO			
BH1	0		0	0	2.3	2.3	18	18	0	0	0	2.85	3.13	
DS1	0		0	0	12.5	12.5	6.3	6.3	0	0	0	DRY	3.95	
DS3	0		0	0	1.2	1.2	18.9	18.9	0	0	0	DRY	4	
DS4	0		0	0	3	3	18.2	18.2	0	0	0	5.9	7.2	
DS5	0		0	0	2.6	2.6	14	14	0	0	2	1.2	4	
DS6	0		0	0	3.2	3.2	18.8	18.8	0	0	3	-	-	Bung stuck in well
DS7	0		0	0	3.3	3.3	16.8	16.8	0	0	3	1	2.92	
DS8	0		0	0	2	2	15	15	0	0	0	DRY	3.97	
DS9	0		0	0	15	15	4	4	0	0	3	4.5	4.65	
DS10	0		2.6	2.6	16	16	2	2	25	0	0	3.5	3.95	
DS11	0		1.5	1.5	12	12	8	8	3	0	5	3.8	4.9	

Notes:
Monitoring order is from left to right across table.
Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes.
* Delete where appropriate

Relevant Information At Time Of Monitoring				
Monitored by (name, position):				
Atmospheric Pressure (mB):	1000			
Weather:	Dry			
Temperature (°C, between -10°C to +40°C only):				
Equipment Used (AIGE Reference No.):	Infra Red Gas Analyser:		Last calibrated:	
	MiniRAE PID:		Last calibrated:	
			Last calibrated:	
Visible Signs of Vegetation Stress:				
Other Comments / Observations:				
Boreholes Sampled For Laboratory Analysis:				

SOIL GAS AND GROUNDWATER MONITORING DATA

Site: Ahmad Tea Chandlers Ford

Job No: 100615 **Date:** 11/08/2008

Borehole	Gas Flow (l/hr)	Borehole Pressure (Pa/mbar)*	Methane (%v/v)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water (m bgl)	Standpipe Depth (mbgl)	Notes
			Peak	Steady	Peak	Steady	Minimum	Steady	PID	H_2S	CO			
BH1	0		0	0	2.5	2.5	17.8	17.8	0	0	0	2.83	3.13	
DS1	0		0	0	13.1	13.1	5.9	5.9	0	0	0	DRY	3.95	
DS3	0		0	0	0.8	0.8	19	19	0	0	0	DRY	4	
DS4	0		0	0	3.1	3.1	18	18	0	0	0	5.9	7.2	
DS5	0		0	0	2.4	2.4	14.3	14.3	0	0	3	1.2	4	
DS6	0		0	0	3.2	3.2	18.7	18.8	0	0	4	-	-	Bung stuck in well
DS7	0		0	0	3	3	17.1	17.1	0	0	4	1.1	2.92	
DS8	0		0	0	1.8	1.8	14.5	14.5	0	0	0	DRY	3.97	
DS9	0		0	0	15	15	2	2	0	0	4	4.5	4.65	
DS10	0		2.4	2.4	17.4	17.4	0.2	0.2	26.7	0	0	3.6	3.95	
DS11	0		1.1	1.1	10	10	6.9	6.9	4.5	0	6	3.85	4.9	

Notes:
Monitoring order is from left to right across table.
Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes.
* Delete where appropriate

Relevant Information At Time Of Monitoring				
Monitored by (name, position):				
Atmospheric Pressure (mB):	1000			
Weather:	Dry			
Temperature (°C, between -10°C to +40°C only):				
Equipment Used (AIGE Reference No.):	Infra Red Gas Analyser:		Last calibrated:	
	MiniRAE PID:		Last calibrated:	
			Last calibrated:	
Visible Signs of Vegetation Stress:				
Other Comments / Observations:				
Boreholes Sampled For Laboratory Analysis:				

SOIL GAS AND GROUNDWATER MONITORING DATA

Site: Ahmad Tea Chandlers Ford

Job No: 100615 **Date:** 07/08/2008

Borehole	Gas Flow (l/hr)	Borehole Pressure (Pa/mbar)*	Methane (%v/v)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water (m bgl)	Standpipe Depth (mbgl)	Notes
			Peak	Steady	Peak	Steady	Minimum	Steady	PID	H_2S	CO			
BH1	0		0	0	2.1	2.1	18.5	18.5	0	0	0	2.85	3.15	
DS1	0		0	0	11.8	11.8	7	7	0	0	0	DRY	3.95	
DS3	0		0	0	1.8	1.8	18.5	18.5	0	0	0	DRY	4	
DS4	0		0	0	2.6	2.6	18.4	18.4	0	0	0	6	7.35	
DS5	0		0	0	0.8	0.8	17.9	17.9	0	0	4	1.3	4	
DS6	0		0	0	3.1	3.1	18.8	18.8	0	0	2	1.2	4	
DS7	0		0	0	1.7	1.7	8.6	8.6	0	0	3	1.2	2.92	
DS8	0		0	0	0	0	20.6	20.6	0	0	0	DRY	4	
DS9	0		0	0	1.8	1.8	18.1	18.1	0	0	5	4.5	4.9	
DS10	0		0.9	0.9	6.3	6.3	11	11	48	0	1	DRY	4	

Notes:
Monitoring order is from left to right across table.
Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes.
* Delete where appropriate

Relevant Information At Time Of Monitoring				
Monitored by (name, position):				
Atmospheric Pressure (mB):	1002 falling to 1000			
Weather:	Dry - heavy rain the night before			
Temperature (°C, between -10°C to +40°C only):				
Equipment Used (AIGE Reference No.):	Infra Red Gas Analyser:		Last calibrated:	
	MiniRAE PID:		Last calibrated:	
			Last calibrated:	
Visible Signs of Vegetation Stress:				
Other Comments / Observations:				
Boreholes Sampled For Laboratory Analysis:				

SOIL GAS AND GROUNDWATER MONITORING DATA

Site: Ahmad Tea Chandlers Ford

Job No: 100615 **Date:** 06/08/2008

Borehole	Gas Flow (l/hr)	Borehole Pressure (Pa/mbar)*	Methane (%v/v)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water (m bgl)	Standpipe Depth (mbgl)	Notes
			Peak	Steady	Peak	Steady	Minimum	Steady	PID	H_2S	CO			
BH1	0		0	0	2	2	18.7	18.7	0	0	0	2.8	3.13	
DS1	0		0	0	12.5	12.5	6.9	6.9	0	0	0	DRY	3.95	
DS3	0		0.1	0.1	3.1	3.1	15.6	15.6	0	0	0	DRY	3.98	

Notes:
Monitoring order is from left to right across table.
Monitoring should be for not less than 3 minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes.
* Delete where appropriate

Relevant Information At Time Of Monitoring				
Monitored by (name, position):				
Atmospheric Pressure (mB):	1009			
Weather:	Heavy showers			
Temperature (°C, between -10°C to +40°C only):				
Equipment Used (AIGE Reference No.):	Infra Red Gas Analyser:		Last calibrated:	
	MiniRAE PID:		Last calibrated:	
			Last calibrated:	
Visible Signs of Vegetation Stress:				
Other Comments / Observations:				
Boreholes Sampled For Laboratory Analysis:				

APPENDIX D

LABORATORY TEST RECORDS

Soil Analysis Results
Groundwater Analysis Results
Statistical Data Sheets

Certificate of Analysis

Date: 18/08/2008

2139

Certificate Number: 08-21602

Client:

AIG Engineering
Unit 9
Kingsdale Business Centre
Regina Road
Chelmsford
CM1 1PE

Our Reference: 08-21602

Client Reference:

Contract Title: Ahmad Tea Factory

Description: 3 leachate samples, 26 soil samples, 4 water samples

Date Received: 12/08/2008

Date Started: 12/08/2008

Date Completed: 18/08/2008

Test Procedures: Identified by prefix DETSn, details available upon request.

Notes:

Observations and interpretations are outside the scope of UKAS accreditation
* denotes test not included in laboratory scope of accreditation
# denotes test that holds MCERT accreditation
$ denotes tests completed by approved subcontractors
I/S denotes insufficient sample to carry out test
N/S denotes that the sample is not suitable for testing
DETSM denotes tests carried out by DETS Midlands laboratory
Solid samples will be disposed 1 month and liquids 2 weeks
after the date of issue of this test certificate
Asbestos subsamples will be kept for 6 months

Approved By:



Authorised Signatories: Rob Brown
Business Manager

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

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • Fax 01207 582444 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148016	148017	148018	148019	148021
		Sample Ref	DS1	DS1	DS1	DS2	DS3
		Depth	0.80	3.50	5.00	0.50	1.00
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
Arsenic	mg/kg	DETS 042#	61	54	9	53	24
Cadmium	mg/kg	DETS 042#	1.4	8.5	0.8	1.8	3
Chromium	mg/kg	DETS 042#	22	100	17	20	30
Copper	mg/kg	DETS 042#	4800	2400	87	200	330
Lead	mg/kg	DETS 042#	4900	230	34	220	1100
Mercury	mg/kg	DETS 081#	0.3	0.1	< 0.1	0.5	0.5
Nickel	mg/kg	DETS 042#	94	96	10	41	40
Selenium	mg/kg	DETS 042#	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	mg/kg	DETS 042#	2000	920	85	700	2000
Organic matter	%	DETS 002	5.9	5.8	0.2	16	3.3
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.05	0.95	0.26	0.09	0.13
pH		DETS 008#	7.8	7.4	7.2	7.3	7.7
Aliphatic C5-C6	mg/kg	DETS 072*	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatic C6-C8	mg/kg	DETS 072*	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatic C10-C12	mg/kg	DETS 072*	< 0.1	< 0.1		< 0.1	< 0.1
Aliphatic C12-C16	mg/kg	DETS 072*	< 0.1	19		< 0.1	< 0.1
Aliphatic C16-C21	mg/kg	DETS 072*	1.2	98		6	0.1
Aliphatic C21-C35	mg/kg	DETS 072*	20	610		50	23
Aromatic C5-C7	mg/kg	DETS 072*	< 0.01	< 0.01		< 0.01	< 0.01
Aromatic C7-C8	mg/kg	DETS 072*	< 0.01	< 0.01		< 0.01	< 0.01
Aromatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01		0.04	< 0.01
Aromatic C10-C12	mg/kg	DETS 072*	< 0.1	< 0.1		< 0.1	< 0.1
Aromatic C12-C16	mg/kg	DETS 072*	0.7	3.1		0.2	0.2
Aromatic C16-C21	mg/kg	DETS 072*	22	29		1.1	0.2
Aromatic C21-C35	mg/kg	DETS 072*	46	230		11	1.2
Aliphatic C5-C35	mg/kg	DETS 072*	21	720		56	23
Aromatic C5-C35	mg/kg	DETS 072*	69	260		12	2
TPH Ali/Aro	mg/kg	DETS 072*	89	980		68	24
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	DETS 050	0.1	0.5	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	0.6
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	0.2	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	0.4	< 0.1	< 0.1	0.3
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	0.7	< 0.1	< 0.1	0.5
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	0.4	< 0.1	< 0.1	< 0.1	1.3
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	0.3	< 0.1	< 0.1	0.2
Naphthalene	mg/kg	DETS 050	0.1	0.1	< 0.1	0.2	0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	0.6
Pyrene	mg/kg	DETS 050	0.4	< 0.1	< 0.1	< 0.1	0.9

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148016	148017	148018	148019	148021
		Sample Ref	DS1	DS1	DS1	DS2	DS3
		Depth	0.80	3.50	5.00	0.50	1.00
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
PRO (C6-C10)	mg/kg	DETS 062*			< 0.1		
EPH (C10-C40)	mg/kg	DETS 051#			< 10		
Benzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	mg/kg	DETS 062					

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148022	148023	148024	148026	148027
		Sample Ref	DS3	DS3	DS4	DS4	DS5
		Depth	2.00	5.80	5.00	5.50	0.40
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
Arsenic	mg/kg	DETS 042#	80	12	93	10	7
Cadmium	mg/kg	DETS 042#	5.1	0.8	6.3	0.7	0.7
Chromium	mg/kg	DETS 042#	46	17	30	13	12
Copper	mg/kg	DETS 042#	1100	40	260	14	24
Lead	mg/kg	DETS 042#	600	31	410	17	32
Mercury	mg/kg	DETS 081#	0.1	< 0.1	0.2	< 0.1	< 0.1
Nickel	mg/kg	DETS 042#	96	15	120	9	16
Selenium	mg/kg	DETS 042#	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	mg/kg	DETS 042#	1700	220	1300	65	62
Organic matter	%	DETS 002	7.3	0.8	7.7	1	0.9
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.12	0.1	2.2	0.08	0.06
pH		DETS 008#	7.7	7.7	7.9	7.8	7.8
Aliphatic C5-C6	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	< 0.01	
Aliphatic C6-C8	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	< 0.01	
Aliphatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01	0.45	0.08	
Aliphatic C10-C12	mg/kg	DETS 072*	1	< 0.1	< 0.1	12	
Aliphatic C12-C16	mg/kg	DETS 072*	3	0.6	< 0.1	80	
Aliphatic C16-C21	mg/kg	DETS 072*	15	4.2	2	97	
Aliphatic C21-C35	mg/kg	DETS 072*	100	53	44	210	
Aromatic C5-C7	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	< 0.01	
Aromatic C7-C8	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	< 0.01	
Aromatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01	1.1	0.09	
Aromatic C10-C12	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	6.9	
Aromatic C12-C16	mg/kg	DETS 072*	0.2	0.3	0.2	33	
Aromatic C16-C21	mg/kg	DETS 072*	7.6	3	4.7	56	
Aromatic C21-C35	mg/kg	DETS 072*	35	11	5.5	83	
Aliphatic C5-C35	mg/kg	DETS 072*	120	58	47	400	
Aromatic C5-C35	mg/kg	DETS 072*	43	15	11	180	
TPH Ali/Aro	mg/kg	DETS 072*	160	72	58	580	
Acenaphthene	mg/kg	DETS 050	0.1	< 0.1	3	< 0.1	< 0.1
Acenaphthylene	mg/kg	DETS 050	< 0.1	< 0.1	0.2	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	4.2	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	2.2	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	0.8	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	0.4	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Naphthalene	mg/kg	DETS 050	0.1	0.1	1.8	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	0.6	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	0.1	< 0.1	< 0.1

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148022	148023	148024	148026	148027
		Sample Ref	DS3	DS3	DS4	DS4	DS5
		Depth	2.00	5.80	5.00	5.50	0.40
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
PAH	mg/kg	DETS 050	< 5.0	< 5.0	13	< 5.0	< 5.0
PRO (C6-C10)	mg/kg	DETS 062*					< 0.1
EPH (C10-C40)	mg/kg	DETS 051#					< 10
Benzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	mg/kg	DETS 062#	< 0.01	< 0.01	0.04	< 0.01	< 0.01
MTBE	mg/kg	DETS 062					

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148028	148029	148030	148031	148032
		Sample Ref	DS7	DS7	DS8	DS8	DS8
		Depth	0.30	1.50	1.00	3.50	5.00
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
Arsenic	mg/kg	DETS 042#	9	8	11	12	9
Cadmium	mg/kg	DETS 042#	0.6	0.5	0.9	1.2	0.6
Chromium	mg/kg	DETS 042#	14	10	10	14	16
Copper	mg/kg	DETS 042#	14	11	110	480	19
Lead	mg/kg	DETS 042#	14	11	90	96	13
Mercury	mg/kg	DETS 081#	< 0.1	< 0.1	0.1	< 0.1	< 0.1
Nickel	mg/kg	DETS 042#	8	8	12	20	8
Selenium	mg/kg	DETS 042#	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	mg/kg	DETS 042#	44	44	130	140	39
Organic matter	%	DETS 002	0.6	< 0.1	4.6	1.7	0.5
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.02	0.02	0.04	0.11	0.03
pH		DETS 008#	7.8	7.8	8.1	8.2	7.7
Aliphatic C5-C6	mg/kg	DETS 072*			< 0.01	< 0.01	
Aliphatic C6-C8	mg/kg	DETS 072*			< 0.01	< 0.01	
Aliphatic C8-C10	mg/kg	DETS 072*			< 0.01	< 0.01	
Aliphatic C10-C12	mg/kg	DETS 072*			< 0.1	0.2	
Aliphatic C12-C16	mg/kg	DETS 072*			24	13	
Aliphatic C16-C21	mg/kg	DETS 072*			130	61	
Aliphatic C21-C35	mg/kg	DETS 072*			220	150	
Aromatic C5-C7	mg/kg	DETS 072*			< 0.01	< 0.01	
Aromatic C7-C8	mg/kg	DETS 072*			< 0.01	< 0.01	
Aromatic C8-C10	mg/kg	DETS 072*			< 0.01	< 0.01	
Aromatic C10-C12	mg/kg	DETS 072*			0.5	< 0.1	
Aromatic C12-C16	mg/kg	DETS 072*			35	17	
Aromatic C16-C21	mg/kg	DETS 072*			210	220	
Aromatic C21-C35	mg/kg	DETS 072*			370	260	
Aliphatic C5-C35	mg/kg	DETS 072*			370	220	
Aromatic C5-C35	mg/kg	DETS 072*			620	500	
TPH Ali/Aro	mg/kg	DETS 072*			990	730	
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	1.2	< 0.1
Acenaphthylene	mg/kg	DETS 050	< 0.1	< 0.1	0.3	0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	7.7	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	1	5.5	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	0.4	5.4	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	0.6	6.5	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	3	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	1.1	3.6	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	0.1	6.8	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	0.4	25	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	1.6	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	0.9	3.2	< 0.1
Naphthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	16	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	0.7	26	< 0.1

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148028	148029	148030	148031	148032
		Sample Ref	DS7	DS7	DS8	DS8	DS8
		Depth	0.30	1.50	1.00	3.50	5.00
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
PAH	mg/kg	DETS 050	< 5.0	< 5.0	5.8	110	< 5.0
PRO (C6-C10)	mg/kg	DETS 062*	< 0.1	< 0.1			< 0.1
EPH (C10-C40)	mg/kg	DETS 051#	< 10	< 10			< 10
Benzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	mg/kg	DETS 062				< 0.01	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148033	148035	148036	148037	148039
		Sample Ref	DS9	DS9	DS10	DS10	DS11
		Depth	0.60	4.30	1.00	4.00	3.50
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
Arsenic	mg/kg	DETS 042#	13	7	6	8	9
Cadmium	mg/kg	DETS 042#	0.7	0.4	0.5	0.5	0.8
Chromium	mg/kg	DETS 042#	17	9	16	10	17
Copper	mg/kg	DETS 042#	47	11	13	6	19
Lead	mg/kg	DETS 042#	530	20	15	10	26
Mercury	mg/kg	DETS 081#	0.3	< 0.1	< 0.1	< 0.1	0.1
Nickel	mg/kg	DETS 042#	11	4	12	4	11
Selenium	mg/kg	DETS 042#	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	mg/kg	DETS 042#	200	31	56	22	68
Organic matter	%	DETS 002	3.1	0.3	0.9	1.1	3.2
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.03	0.03	0.09	0.02	0.18
pH		DETS 008#	7.9	7.2	8.1	7.8	7.9
Aliphatic C5-C6	mg/kg	DETS 072*	< 0.01	< 0.01		52	2
Aliphatic C6-C8	mg/kg	DETS 072*	< 0.01	< 0.01		130	5.3
Aliphatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01		50	0.88
Aliphatic C10-C12	mg/kg	DETS 072*	0.4	< 0.1		35	1.3
Aliphatic C12-C16	mg/kg	DETS 072*	1.2	< 0.1		300	8.8
Aliphatic C16-C21	mg/kg	DETS 072*	3.2	< 0.1		330	14
Aliphatic C21-C35	mg/kg	DETS 072*	6.2	< 0.1		86	8.5
Aromatic C5-C7	mg/kg	DETS 072*	< 0.01	< 0.01		< 0.01	< 0.01
Aromatic C7-C8	mg/kg	DETS 072*	< 0.01	< 0.01		5.7	0.2
Aromatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01		54	1.1
Aromatic C10-C12	mg/kg	DETS 072*	< 0.1	< 0.1		4.3	< 0.1
Aromatic C12-C16	mg/kg	DETS 072*	< 0.1	< 0.1		100	0.6
Aromatic C16-C21	mg/kg	DETS 072*	6	< 0.1		130	0.7
Aromatic C21-C35	mg/kg	DETS 072*	34	< 0.1		33	0.9
Aliphatic C5-C35	mg/kg	DETS 072*	11	< 1		990	41
Aromatic C5-C35	mg/kg	DETS 072*	40	< 1		330	3
TPH Ali/Aro	mg/kg	DETS 072*	52	< 1.0		1300	44
Acenaphthene	mg/kg	DETS 050	0.2	0.2	0.1	3.7	0.6
Acenaphthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	2.4	0.5
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.3	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	0.3	< 0.1	< 0.1	0.4	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	1	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1	2
Naphthalene	mg/kg	DETS 050	< 0.1	< 0.1	0.1	1.6	0.4
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	1	< 0.1
Pyrene	mg/kg	DETS 050	0.3	0.4	< 0.1	0.3	< 0.1

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148033	148035	148036	148037	148039
		Sample Ref	DS9	DS9	DS10	DS10	DS11
		Depth	0.60	4.30	1.00	4.00	3.50
		Other Ref					
		Sample Type					
Test	**Units**	**DETSxx**					
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	11	< 5.0
PRO (C6-C10)	mg/kg	DETS 062*			< 0.1		
EPH (C10-C40)	mg/kg	DETS 051#			< 10		
Benzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	2.1	0.04
Toluene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	5.7	0.2
Xylene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	2.5	0.07
MTBE	mg/kg	DETS 062	< 0.01			< 0.01	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148040	148041
		Sample Ref	DS11	DS11
		Depth	4.00	5.50
		Other Ref		
		Sample Type		
Test	**Units**	**DETSxx**		
Arsenic	mg/kg	DETS 042#	12	3
Cadmium	mg/kg	DETS 042#	0.9	0.4
Chromium	mg/kg	DETS 042#	21	12
Copper	mg/kg	DETS 042#	8	6
Lead	mg/kg	DETS 042#	12	6
Mercury	mg/kg	DETS 081#	< 0.1	< 0.1
Nickel	mg/kg	DETS 042#	8	7
Selenium	mg/kg	DETS 042#	< 0.5	< 0.5
Zinc	mg/kg	DETS 042#	41	27
Organic matter	%	DETS 002	1	0.4
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.03	0.01
pH		DETS 008#	7.4	8.1
Aliphatic C5-C6	mg/kg	DETS 072*		< 0.01
Aliphatic C6-C8	mg/kg	DETS 072*		< 0.01
Aliphatic C8-C10	mg/kg	DETS 072*		< 0.01
Aliphatic C10-C12	mg/kg	DETS 072*		< 0.1
Aliphatic C12-C16	mg/kg	DETS 072*		0.2
Aliphatic C16-C21	mg/kg	DETS 072*		0.3
Aliphatic C21-C35	mg/kg	DETS 072*		0.1
Aromatic C5-C7	mg/kg	DETS 072*		< 0.01
Aromatic C7-C8	mg/kg	DETS 072*		< 0.01
Aromatic C8-C10	mg/kg	DETS 072*		< 0.01
Aromatic C10-C12	mg/kg	DETS 072*		< 0.1
Aromatic C12-C16	mg/kg	DETS 072*		0.3
Aromatic C16-C21	mg/kg	DETS 072*		0.6
Aromatic C21-C35	mg/kg	DETS 072*		< 0.1
Aliphatic C5-C35	mg/kg	DETS 072*		< 1
Aromatic C5-C35	mg/kg	DETS 072*		< 1
TPH Ali/Aro	mg/kg	DETS 072*		1.5
Acenaphthene	mg/kg	DETS 050	1.2	< 0.1
Acenaphthylene	mg/kg	DETS 050	1.5	< 0.1
Anthracene	mg/kg	DETS 050	0.6	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	0.5	< 0.1
Fluorene	mg/kg	DETS 050	0.8	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1
Naphthalene	mg/kg	DETS 050	1.1	0.1
Phenanthrene	mg/kg	DETS 050	0.7	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148040	148041
		Sample Ref	DS11	DS11
		Depth	4.00	5.50
		Other Ref		
		Sample Type		
Test	**Units**	**DETSxx**		
PAH	mg/kg	DETS 050	6.5	< 5.0
PRO (C6-C10)	mg/kg	DETS 062*	70	
EPH (C10-C40)	mg/kg	DETS 051#	< 10	
Benzene	mg/kg	DETS 062#	< 0.01	< 0.01
Ethylbenzene	mg/kg	DETS 062#	0.49	< 0.01
Toluene	mg/kg	DETS 062#	1.1	< 0.01
Xylene	mg/kg	DETS 062#	0.91	< 0.01
MTBE	mg/kg	DETS 062		< 0.01

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148025
		Sample Ref	DS4
		Depth	3.00
		Other Ref	
		Sample Type	
Test	**Units**	**DETSxx**	
Tributyltin	mg/kg Sn	$	<0.02

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

Laboratory Number	Sample Ref	Depth	Material	Result
148017	DS1	3.50	Soil	NAD
148020	DS2	1.50	Soil	NAD
148021	DS3	1.00	Soil	NAD
148022	DS3	2.00	Soil	NAD
148038	DS11	0.80	Soil	NAD

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos
NAD = No Asbestos Detected. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos

Samples are analysed using polarised light microscopy in accordance with HSG248 and documented in-house methods. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'.

Summary of Chemical Analysis
Leachate Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148046	148047	148048
		Sample Ref	DS4	DS8	DS9
		Depth	1.50	2.50	1.50
		Other Ref			
		Sample Type			
Test	**Units**	**DETSxx**			
Arsenic Dissolved	ug/l	DETS 010	< 1	3	< 1
Cadmium Dissolved	ug/l	DETS 042	< 2	< 2	< 2
Chromium Dissolved	ug/l	DETS 042	< 10	< 10	< 10
Copper Dissolved	ug/l	DETS 042	3	< 2	< 2
Lead Dissolved	ug/l	DETS 042	< 5	< 5	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05	< 0.05	< 0.05
Nickel Dissolved	ug/l	DETS 042	< 10	< 10	< 10
Zinc Dissolved	ug/l	DETS 042	83	170	94
Sulphate	mg/l	DETS 055	51	14	5.4
Boron	ug/l	DETS 020	< 100	170	< 100
pH		DETS 008	6.7	7.3	7.2
Acenaphthene	ug/l	DETS 074*	< 0.01	0.13	< 0.01
Acenaphthylene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	< 0.01	0.06	< 0.01
Benzo(a)anthracene	ug/l	DETS 074*	< 0.01	0.01	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	< 0.01	0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	< 0.01	0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	< 0.01	0.01	< 0.01
Chrysene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.01	0.13	0.01
Fluorene	ug/l	DETS 074*	0.02	0.1	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	0.01	0.04	< 0.01
Phenanthrene	ug/l	DETS 074*	0.05	0.3	0.01
Pyrene	ug/l	DETS 074*	0.06	0.73	0.04
PAH	ug/l	DETS 074*	< 0.20	1.5	< 0.20
PRO (C6-C10)	ug/l	DETS 062*	< 1	< 1	< 1
EPH (C10-C40)	ug/l	DETS 051	210	130	180
Ethylbenzene	ug/l	DETS 062	< 1	< 1	< 1
Benzene	ug/l	DETS 062	< 1	< 1	< 1
Toluene	ug/l	DETS 062	< 1	< 1	< 1
Xylene	ug/l	DETS 062	< 1	< 1	< 1

Summary of Chemical Analysis
Water Samples

Our Ref: 08-21602
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148042	148043	148044	148045
		Sample Ref	DS4	DS6	DS7	DS9
		Depth				
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic Dissolved	ug/l	DETS 010	< 1	< 1	< 1	< 1
Cadmium Dissolved	ug/l	DETS 042	< 2	< 2	< 2	< 2
Chromium Dissolved	ug/l	DETS 042	< 10	< 10	< 10	< 10
Copper Dissolved	ug/l	DETS 042	< 2	< 2	< 2	< 2
Lead Dissolved	ug/l	DETS 042	< 5	< 5	< 5	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05	< 0.05	< 0.05	< 0.05
Nickel Dissolved	ug/l	DETS 042	50	< 10	< 10	< 10
Zinc Dissolved	ug/l	DETS 042	25	65	40	180
Sulphate	mg/l	DETS 055	57	110	67	56
Boron	ug/l	DETS 020	1200	960	260	690
pH		DETS 008	6.4	6.7	6.5	6.3
Acenaphthene	ug/l	DETS 074*	0.24	< 0.01	< 0.01	< 0.01
Acenaphthylene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	0.32	0.07	< 0.01	< 0.01
Benzo(a)anthracene	ug/l	DETS 074*	0.02	0.05	< 0.01	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	< 0.01	0.09	< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	< 0.01	0.03	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	< 0.01	0.11	< 0.01	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.33	0.05	0.01	0.02
Fluorene	ug/l	DETS 074*	0.42	0.04	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	0.11	0.02	< 0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	1.2	0.27	0.01	0.02
Pyrene	ug/l	DETS 074*	1.6	1.4	0.03	0.12
PAH	ug/l	DETS 074*	4.3	2.2	< 0.20	< 0.20
PRO (C6-C10)	ug/l	DETS 062*	76	750	< 1	< 1
EPH (C10-C40)	ug/l	DETS 051	820	490	180	390
Ethylbenzene	ug/l	DETS 062	< 1	< 1	< 1	< 1
Benzene	ug/l	DETS 062	< 1	< 1	< 1	< 1
Toluene	ug/l	DETS 062	4	4	< 1	< 1
Xylene	ug/l	DETS 062	< 1	< 1	< 1	< 1

Derwentside Environmental Testing Services

Certificate of Analysis

Date: 18/08/2008

2139

Certificate Number: 08-21625

Client:

AIG Engineering
Unit 9
Kingsdale Business Centre
Regina Road
Chelmsford
CM1 1PE

Our Reference: 08-21625

Client Reference:

Contract Title: Ahmad Tea Factory

Description: 2 water samples

Date Received: 13/08/2008

Date Started: 13/08/2008

Date Completed: 18/08/2008

Test Procedures: Identified by prefix DETSn, details available upon request.

Notes:

Observations and interpretations are outside the scope of UKAS accreditation
* denotes test not included in laboratory scope of accreditation
# denotes test that holds MCERT accreditation
$ denotes tests completed by approved subcontractors
I/S denotes insufficient sample to carry out test
N/S denotes that the sample is not suitable for testing
DETSM denotes tests carried out by DETS Midlands laboratory
Solid samples will be disposed 1 month and liquids 2 weeks
after the date of issue of this test certificate
Asbestos subsamples will be kept for 6 months

Approved By:



Authorised Signatories: Rob Brown
Business Manager

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

Summary of Chemical Analysis
Water Samples

Our Ref: 08-21625
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148479	148480
		Sample Ref	DS5	DS10
		Depth		
		Other Ref		
		Sample Type		
Test	**Units**	**DETSxx**		
Arsenic Dissolved	ug/l	DETS 010	< 1	12
Cadmium Dissolved	ug/l	DETS 042	< 2	< 2
Chromium Dissolved	ug/l	DETS 042	< 10	< 10
Copper Dissolved	ug/l	DETS 042	< 2	< 2
Lead Dissolved	ug/l	DETS 042	< 5	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05	< 0.05
Nickel Dissolved	ug/l	DETS 042	< 10	< 10
Zinc Dissolved	ug/l	DETS 042	94	39
Sulphate	mg/l	DETS 055	100	13
Boron	ug/l	DETS 020	1300	1700
pH		DETS 008	6.7	6.6
Acenaphthene	ug/l	DETS 074*	0.05	0.39
Acenaphthylene	ug/l	DETS 074*	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	0.02	0.10
Benzo(a)anthracene	ug/l	DETS 074*	0.33	0.12
Benzo(a)pyrene	ug/l	DETS 074*	0.05	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	0.41	0.05
Benzo(k)fluoranthene	ug/l	DETS 074*	0.20	0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	0.28	0.15
Dibenzo(a,h)anthracene	ug/l	DETS 074*	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.01	0.11
Fluorene	ug/l	DETS 074*	0.07	0.63
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	< 0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	0.11	0.88
Pyrene	ug/l	DETS 074*	1.6	1.6
PAH	ug/l	DETS 074*	3.2	4.1
PRO (C6-C10)	ug/l	DETS 062*	220	3100
EPH (C10-C40)	ug/l	DETS 051	2000	7700
Benzene	ug/l	DETS 062	< 1	74
Ethylbenzene	ug/l	DETS 062	< 1	14
Toluene	ug/l	DETS 062	4	49
Xylene	ug/l	DETS 062	< 1	28

Certificate of Analysis

Date: 18/08/2008

2139

Certificate Number: 08-21605-1

Client:

AIG Engineering
Unit 9
Kingsdale Business Centre
Regina Road
Chelmsford
CM1 1PE

Our Reference: 08-21605-1

Client Reference:

Contract Title: Ahmad Tea Factory

Description: 1 water sample

Date Received: 12/08/2008

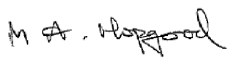
Date Started: 12/08/2008

Date Completed: 08/18/2008

Test Procedures: Identified by prefix DETSn, details available upon request.

Notes: **This report supersedes 08-21605, error in contract title amended**
Observations and interpretations are outside the scope of UKAS accreditation
* denotes test not included in laboratory scope of accreditation
# denotes test that holds MCERT accreditation
$ denotes tests completed by approved subcontractors
I/S denotes insufficient sample to carry out test
N/S denotes that the sample is not suitable for testing
DETSM denotes tests carried out by DETS Midlands laboratory
Solid samples will be disposed 1 month and liquids 2 weeks
after the date of issue of this test certificate
Asbestos subsamples will be kept for 6 months

Approved By:



Authorised Signatories: Mike Hopgood
Technical Manager

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

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • Fax 01207 582444 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Water Samples

Our Ref: 08-21605-1
Client Ref:
Contract Title: Ahmad Tea Factory

		Lab No.	148061
		Sample Ref	DS11
		Depth	
		Other Ref	
		Sample Type	
Test	**Units**	**DETSxx**	
Arsenic Dissolved	ug/l	DETS 010	2
Cadmium Dissolved	ug/l	DETS 042	< 2
Chromium Dissolved	ug/l	DETS 042	< 10
Copper Dissolved	ug/l	DETS 042	< 2
Lead Dissolved	ug/l	DETS 042	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05
Nickel Dissolved	ug/l	DETS 042	< 10
Zinc Dissolved	ug/l	DETS 042	27
Sulphate	mg/l	DETS 055	62
Boron	ug/l	DETS 020	1900
pH		DETS 008	6.5
Acenaphthene	ug/l	DETS 074*	< 0.01
Acenaphthylene	ug/l	DETS 074*	< 0.01
Anthracene	ug/l	DETS 074*	< 0.01
Benzo(a)anthracene	ug/l	DETS 074*	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	< 0.01
Chrysene	ug/l	DETS 074*	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	< 0.01
Fluoranthene	ug/l	DETS 074*	0.04
Fluorene	ug/l	DETS 074*	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	< 0.01
Naphthalene	ug/l	DETS 074*	0.02
Phenanthrene	ug/l	DETS 074*	0.05
Pyrene	ug/l	DETS 074*	0.2
PAH	ug/l	DETS 074*	0.35
PRO (C6-C10)	ug/l	DETS 062*	18
EPH (C10-C40)	ug/l	DETS 051	470
Ethylbenzene	ug/l	DETS 062	< 1
Benzene	ug/l	DETS 062	9
Toluene	ug/l	DETS 062	< 1
Xylene	ug/l	DETS 062	4

Additional Notes on Statistical Methods Used

The CIEH/CL:AIRE statistical approach does not assume that the data within the population are distributed normally, therefore the statistical test – ***Shapiro-Wilks* normality test** is used to assess the distribution of the population. If the dataset distribution proves to be normal, then the **one sample-t test** is applied to calculate the UCL95, although if the distribution of the data is highly skewed and significantly deviates from normality, then the (non-parametric) **one-sided *Chebychev Theorem*** is used to estimate the UCL95. It should be noted that the ***Chebychev Theorem*** is not strictly a true statistical test and therefore produces a more conservative outcome. Hence, in the planning scenario it is more difficult to show that contaminant concentrations are lower than the critical concentration.

In order to create the appropriate dataset for statistical calculation, there are two other factors that are considered before deciding on the distribution of the data and true mean population, these are: non-detects and outliers. If the non-detects proportion within the dataset is less than 10 to 15%, then samples at or below the LOD is assumed to contain a concentration of contaminant equal to the LOD or half of the detection limit, referred to as the Method Detection Limit (MDL). Thus, if a result is reported as <1mg/kg it is assumed to be 1mg/kg or 0.5mg/kg, depending which option is chosen. The concentration equal to LOD was applied in this assessment, thus this is a conservative approach. When the proportion of non-detects is higher than 15%, then the non-detects are still substituted for – as before, but it should be noted that the values selected may have a large effect on the outcome of testing.

The initial assessment of the outliers is conducted with the application of the statistical **Grubb's Test** (as described in the "*Guidance on Comparing Soil Contamination Data with a Critical Concentration*"). Identified outliers are not necessarily removed from the dataset. They are excluded from the population only if, they are the result of either analytical or sampling error, or if they clearly indicate that more than one soil population exists within the dataset.

When comparing site based chemical data to generic values the concept of the 'averaging area' needs to be taken into consideration. The 'averaging area' is defined as:

"*That area (together with a consideration of depth) of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions"*

The soil in the averaging area will be expected to contain variable concentrations of contaminants, which, when averaged across the area, will provide a representative indicator of how much contaminant the applicable human receptor would be exposed to. Defining an averaging area requires knowledge of the behaviour pattern of the receptor and could comprise a single garden, allotment plot or an industrial unit. The size of an appropriate averaging area needs to be decided on a site specific basis considering contaminant distribution and receptor behaviour.

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory, Chandlers Ford
Data description: General Screening:made ground
Contaminant(s): Heavy Metals:made ground
Test scenario: Planning
Date: 18 August 2008

	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead log10 (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Zinc (mg/kg)	Outliers: Chromium (mg/kg)	Outliers: Copper (mg/kg)	
Critical concentration, C_c	500	1400	5000	45700	2.875061	480	5000	8000	18800			
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical			
Sample size, n	17	17	17	17	17	17	17	17	17	0	0	0
Sample mean, $\bar{x}$	30.5411765	3.76352941	35.4529412	1291.17647	2.55561997	0.51235294	52.5529412	1.63176471	1158.41176	No Data	No Data	No Data
Standard deviation, s	27.3367669	4.22243997	27.8713141	1669.37474	0.75816585	0.99811403	39.1789344	4.30125161	1303.71973			
Number of non-detects	0	0	0	0	0	3	0	12	0			
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Detection limit	Detection Limit	Detection Limit	Detection Limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit
Outliers?	No	Yes	No	No	No	Yes	No	Yes	No			
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Normal	Non-normal	Non-normal	Non-normal	Non-normal			
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: One-sample t;	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto	Auto	Auto
Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				Evidence level required:		95%	Use Normal distribution to test for outliers				
t statistic, t_0 (or k_0)	-70.80677553	-1363.389531	-734.4236396	-109.6831439	-1.737205926	-1980.713781	-520.6585411	-7667.097866	-55.79276747			
Upper confidence limit (on true mean concentration, μ)	59.441286	8.22744346	64.9181677	3056.01988	2.87665705	1.5675474	93.9724514	6.1789975	2536.68898			
Evidence level	100%	100%	100%	100%	95%	100%	100%	100%	100%			
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level			
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ ≈Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc			
Select dataset	○ Y	◉ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

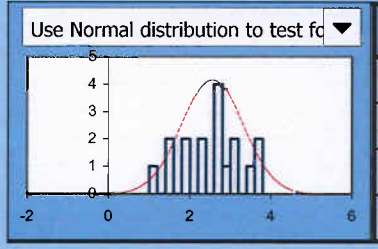
Test Results

Client/client ref: Laishley
Project ref: 100615

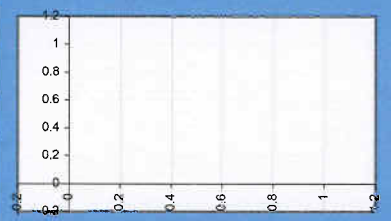
Site ref: Ahmad Tea Factory. Chandlers Ford
Data description: General Screening:made ground

Date: 18-Aug-2008
User details: Russell Garnett

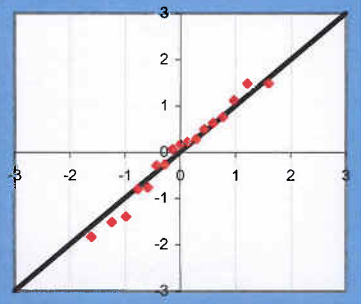
Dataset:	Lead log10 (mg/kg)
Sample mean, $\bar{x}$ (mg/kg)	2.5556
Sample standard deviation, s	0.7582
Sample size, n	17
Critical concentration, Cc (mg/kg)	2.8751



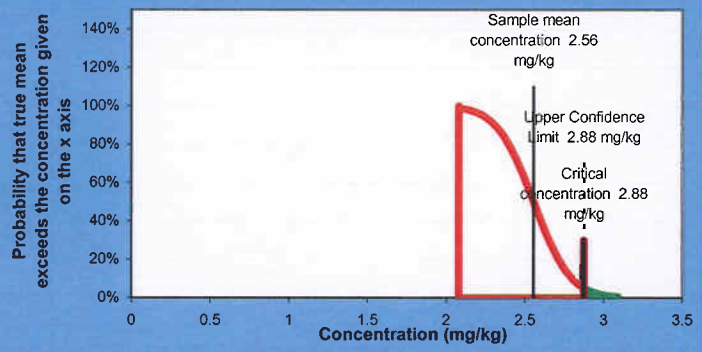
Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	0



Normality test	
Significance level:	5%
Normal distribution	
Use:	Auto: One-sample t-test



Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?
Null hypothesis:	The true mean concentration is equal to or greater than the critical concentration: μ ≥Cc
Alternative hypothesis:	The true mean concentration is less than the critical concentration: μ < Cc



Evidence against Null hypothesis:	95%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No

Not enough evidence

Back to data | Back to summary | Go to outlier test | Go to normality test

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory, Chandlers Ford
Data description: General Screening
Contaminant(s): Petroleum Hydrocarbons - Made Ground
Test scenario: Planning
Date: 18 August 2008
User details: Russell Gamett

	Aliphatic C5-C6 (mg/kg)	Aliphatic C6-C8 (mg/kg)	Aliphatic C8-C10 (mg/kg)	Aliphatic C10-C12 (mg/kg)	Aliphatic C12-C16 (mg/kg)	Aliphatic C16-C35 (mg/kg)	Aromatic C5-C7 (mg/kg)	Aromatic C7-C8 (mg/kg)	Aromatic C8-C10 (mg/kg)	Aromatic C10-C12 (mg/kg)
Critical concentration, C_c	**95.3**	**242**	**65.9**	**29900**	**29900**	**617000**	**26.9**	**30.4**	**107**	**625**
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"
Sample size, n	10	10	10	10	10	10	10	10	10	10
Sample mean, $\bar{x}$	0.209	0.539	0.141	0.35	6.94	156.22	0.01	0.029	0.231	0.14
Standard deviation, s	0.62929325	1.67284488	0.29418248	0.43779752	8.89621642	222.184302	2.1951E-10	0.06008328	0.45809873	0.12649111
Number of non-detects	**9**	**9**	**8**	**6**	**4**	0	**10**	**9**	**7**	**9**
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit
Outliers?	Yes	Yes	Yes	No	No	Yes	No	Yes	No	Yes
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev

Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				**Evidence level required:**		**95%**	Use Normal distribution to test for outliers		
t statistic, t_0 (or k_0)	-477.8442211	-456.4480151	-706.8681129	-215969.6923	-10625.88311	-8779.338994	-3.87371E+11	-1598.473684	-737.0315676	-15621.5
Upper confidence limit (on true mean concentration, μ)	1.07642089	2.84485754	0.54650257	0.95346223	19.2025881	462.479925	0.01	0.11181908	0.86244552	0.31435596
Evidence level	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc
Select dataset	○ Y	○ Y	○ Y	○ Y	○ Y	◉ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory, Chandlers Ford
Data description: General Screening
Contaminant(s): Petroleum Hydrocarbons - Made Ground
Test scenario: Planning
Date: 18 August 2008
User details: Russell Garnett

	Aromatic C12-C16 (mg/kg)	Aromatic C16-C21 (mg/kg)	Aromatic C21-C35 (mg/kg)				
Critical concentration, C_c	**12200**	**9190**	**9250**				
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"				
Sample size, n	10	10	10	0	0	0	0
Sample mean, $\bar{x}$	5.73	50.13	99.36	No Data	No Data	No Data	No Data
Standard deviation, s	11.5291948	87.4404057	134.712205				
Number of non-detects	1	0	0				
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	Yes	No	No				
Distribution	Non-normal	Non-normal	Non-normal				
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto	Auto	Auto	Auto
Test scenario:							
t statistic, t_0 (or k_0)	-3344.697369	-330.5429163	-214.8050684				
Upper confidence limit (on true mean concentration, μ)	21.6218984	170.658282	285.04796				
Evidence level	**100%**	**100%**	**100%**				
Base decision on:	evidence level	evidence level	evidence level				
Result	μ < Cc	μ < Cc	μ < Cc				
Select dataset	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data

Client/client ref: Lashley
Project ref: 100615
Site ref: Ahmad Tea Factory, Chandlers Ford
Data description: General Screening
Contaminant(s): PAH - Made Ground
Test scenario: Planning
Date: 18 August 2008
User details: Russell Garnett

	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-c,d)pyrene (mg/kg)	Napthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)	
Critical concentration, C_c	93500	77900	468000	7790	29.7	7790	7790	46700	77900	29.7	62300	59000	7410	290	62300	779000	
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	
Sample size, n	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	0
Sample mean, $\bar{x}$	0.61176471	0.5	1.73529412	3.47647059	3.67058824	3.52941176	3.02941176	3.06470588	3.65294118	0.71764706	8.12352941	0.37647059	3.08235294	1.9	4.2	7.71176471	No Data
Standard deviation, s	0.8999183	1.07877245	3.61523533	7.71310001	8.52890414	7.14420786	7.22242728	6.91420107	8.20648506	1.31159983	17.2329455	0.5333027	6.9705842	6.25559749	8.66321245	16.4915843	
Number of non-detects	7	7	11	9	9	7	11	8	10	12	6	10	7	4	9	6	
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Half detection limit
Outliers?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto

Test scenario: Planning: is true mean lower than critical concentration ($\mu < Cc$)? | Evidence level required: 95% | Use Normal distribution to test for outliers

Statistic, t_0 (or k_s)	-428380.9485	-297734.5839	-533742.925	-4182.354815	-12.58332985	-4493.771925	-4445.389476	-27846.51395	-39136.71497	-91.10804957	-14903.77752	-456141.8532	-4381.197176	-189.8886129	-29648.60493	-194757.9703	
Upper confidence limit (or the mean concentration, $\bar{x}$)	1.56314778	1.64046559	5.55727853	11.6306695	12.6872457	11.0821846	10.6648772	10.3743182	12.328741	2.10425503	26.3419975	0.94027195	10.4515729	8.51334435	13.3586467	25.1464743	
Evidence level	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	
Result	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	$\mu < Cc$	
Select dataset	◉ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory
Data description: General Screening
Contaminant(s): BTEX - Made Ground
Test scenario: Planning
Date: 18 August 2008
User details: Russell Garnett

	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	o, m, p xylenes (mg/kg)						
Critical concentration, C_c	50	41	21	20	~~21~~	~~21~~	~~19.5~~	~~20~~	~~1~~	~~50~~
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"						
Sample size, n	12	12	12	12	0	0	0	0	0	0
Sample mean, $\overline{x}$	0.005	0.00791667	0.02125	0.01333333	No Data	No Data	No Data	No Data	No Data	No Data
Standard deviation, s	1.2159E-10	0.01010363	0.05629165	0.02048651						
Number of non-detects	12	11	11	10						
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	No	Yes	Yes	Yes						
Distribution	Non-normal	Non-normal	Non-normal	Non-normal						
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto	Auto	Auto	Auto	Auto	Auto

Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				Evidence level required:		95%	Use Normal distribution to test for outliers		
t statistic, t_0 (or k_0)	-1.42434E+12	-14054.42857	-1291	-3379.58268						
Upper confidence limit (on true mean concentration, μ)	0.005	0.02063012	0.09208211	0.03911162						
Evidence level	100%	100%	100%	100%						
Base decision on:	evidence level	evidence level	evidence level	evidence level						
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc						
Select dataset	○ Y	◉ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory
Data description: General Screening
Contaminant(s): Heavy Metals - Natural
Test scenario: Planning
Date: 18 August 2008
User details: Russell Garnett

	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead Log10 (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Zinc (mg/kg)	
Critical concentration, C_c	500	1400	5000	45700	2.875061	480	5000	8000	18800	~~50~~
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	
Sample size, n	10	10	10	10	10	10	10	10	10	0
Sample mean, $\bar{x}$	8.7	0.62	13.9	21.6	1.17131161	0.05	8.1	0.25	61.8	No Data
Standard deviation, s	2.58413966	0.17511901	3.84274208	25.0208802	0.22747201	1.2418E-09	3.10733898	0	58.5999621	
Number of non-detects	0	0	0	0	0	10	0	10	0	
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	No	No	No	Yes	No	No	Yes	No	Yes	
Distribution	Normal	Normal	Normal	Non-normal	Normal	Non-normal	Normal	Single value	Non-normal	
Statistical approach	Auto: One-sample t	Auto: One-sample t	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: Chebychev	Auto: Chebychev	Auto

Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				Evidence level required:		95%	Use Normal distribution to test for outliers		
t statistic, t_0 (or k_0)	-601.2163503	-25269.83326	-4103.172247	-5773.089631	-23.68523812	-1.22224E+12	-5080.158276	N/A	-1011.184805	
Upper confidence limit (on true mean concentration, μ)	10.197978	0.72151325	16.1275665	56.0889032	1.30317292	0.05	9.90126692	0.25	142.574473	
Evidence level	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	
Select dataset	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	◉ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory, Chandlers Ford
Data description: General Screening
Contaminant(s): Petroleum Hydrocarbons - Natural
Test scenario: Planning
Date: 18 August 2008
User details: Russell Gamett

	Aliphatic C5-C6 (mg/kg)	Aliphatic C6-C8 (mg/kg)	Aliphatic C8-C10 (mg/kg)	Aliphatic C10-C12 (mg/kg)	Aliphatic C12-C16 (mg/kg)	Aliphatic C16-C35 (mg/kg)	Aromatic C5-C7 (mg/kg)	Aromatic C7-C8 (mg/kg)	Aromatic C8-C10 (mg/kg)	Aromatic C10-C12 (mg/kg)
Critical concentration, C_c	95.3	242	65.9	29900	29900	617000	26.9	30.4	107	625
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"
Sample size, n	5	5	5	5	5	5	5	5	5	5
Sample mean, $\bar{x}$	10.408	26.008	10.022	9.46	76.18	156.14	0.01	1.148	10.824	2.3
Standard deviation, s	23.2506348	58.1332953	22.348402	15.1787022	129.79161	192.794263	0	2.54464536	24.1361426	3.14960315
Number of non-detects	4	4	3	3	1	1	5	4	3	3
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit
Outliers?	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Normal	Single value	Non-normal	Non-normal	Normal
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: One-sample t-	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: One-sample t-t

Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				Evidence level required:		95%	Use Normal distribution to test for outliers		
t statistic, t_0 (or k_0)	-8.164262358	-8.308023694	-5.590869839	-4403.359293	-513.8089351	-7154.283422	N/A	-25.70474517	-8.910126083	-442.0872927
Upper confidence limit (on true mean concentration, μ)	55.7318312	139.330655	53.5870556	39.0487377	329.190426	339.948264	0.01	6.108427	57.8740037	5.30280245
Evidence level	99%	99%	97%	100%	100%	100%	100%	100%	99%	100%
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc
Select dataset	○ Y	○ Y	○ Y	○ Y	○ Y	◉ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory, Chandlers Ford
Data description: General Screening
Contaminant(s): Petroleum Hydrocarbons - Natural
Test scenario: Planning
Date: 18 August 2008
User details: Russell Garnett

	Aromatic C12-C16 (mg/kg)	Aromatic C16-C21 (mg/kg)	Aromatic C21-C35 (mg/kg)				
Critical concentration, C_c	**12200**	**9190**	**9250**				
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"				
Sample size, n	5	5	5	0	0	0	0
Sample mean, $\bar{x}$	26.74	37.94	25.44	No Data	No Data	No Data	No Data
Standard deviation, s	43.3418158	56.6748445	34.8677932				
Number of non-detects	**1**	**1**	**2**				
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	Yes	No	No				
Distribution	Non-normal	Normal	Normal				
Statistical approach	Auto: Chebychev	Auto: One-sample t	Auto: One-sample t	Auto	Auto	Auto	Auto
Test scenario:							
t statistic, t_0 (or k_s)	-628.0363742	-361.0883889	-591.5700809				
Upper confidence limit (on true mean concentration, μ)	111.228753	91.9732715	58.6826308				
Evidence level	**100%**	**100%**	**100%**				
Base decision on:	evidence level	evidence level	evidence level				
Result	**μ < Cc**	**μ < Cc**	**μ < Cc**				
Select dataset	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data

Client/client ref Lashley
Project ref 100615
Site ref Ahmad Tea Factory, Chandlers Ford
Data description General Screening
Contaminant(s) PAH - Natural
Test scenario Planning
Date 18 August 2008
User details Russell Garnett

	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-c,d)pyrene (mg/kg)	Napthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)	
Critical concentration, C_c	93500	77900	468000	7790	29.7	7790	7790	46700	77900	29.7	62300	59000	7410	290	62300	779000	
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical	
Sample size, n	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	0
Sample mean, $\bar{x}$	0.58	0.47	0.17	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.17	0.26	0.1	0.35	0.25	0.15	No Data
Standard deviation, s	1.14871909	0.80835911	0.16363917	2.4835E-09	2.4835E-09	2.4835E-09	2.4835E-09	2.4835E-09	2.4835E-09	2.4835E-09	0.14944341	0.34058773	2.4835E-09	0.54006172	0.32403703	0.10801234	
Number of non-detects	7	8	8	10	10	10	10	10	10	10	8	8	10	6	8	8	
Set non-detect values to:	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Detection limit	Half detection limit
Outliers?	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes	No	No	Yes	Yes	Yes	
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto

Test scenario: Planning: Is true mean lower than critical concentration (μ < Cc)? | Evidence level required: 95% | Use Normal distribution to test for outliers

Estimate, t_0 for μ	-257392.0193	-304740.7292	-904955.749	-9.91889E+12	-37689714589	-9.91889E+12	-9.91889E+12	-5.9463E+13	-9.919E+13	-37689714589	-1318287.359	-547798.8336	-9.43503E+12	-1696.016737	-607983.3057	-22806780.31	
Upper confidence limit for estimate concentration, μ	2.1634	1.58424613	0.39556103	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.37599353	0.72946778	0.1	1.09442371	0.69665423	0.29888474	
Evidence level	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Basis decision set	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	
Select dataset	◉ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

Client/client ref: Laishley
Project ref: 100615
Site ref: Ahmad Tea Factory
Data description: General Screening
Contaminant(s): BTEX - Natural
Test scenario: Planning
Date: 18 August 2008
User details: Russell Garnett

	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	o, m, p xylenes (mg/kg)						
Critical concentration, C_c	50	41	21	20	~~21~~	~~21~~	~~10.5~~	~~20~~	~~1~~	~~50~~
Notes	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"	Planning example from "Guidance Note on Comparing Soil Contamination Data with a Critical Concentration"						
Sample size, n	10	10	10	10	0	0	0	0	0	0
Sample mean, $\bar{x}$	0.005	0.263	0.684	0.345	No Data	No Data	No Data	No Data	No Data	No Data
Standard deviation, s	1.0976E-10	0.66320853	1.79572455	0.80884348						
Number of non-detects	10	8	8	8						
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	No	Yes	Yes	Yes						
Distribution	Non-normal	Non-normal	Non-normal	Non-normal						
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto	Auto	Auto	Auto	Auto	Auto

Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				Evidence level required:		95%	Use Normal distribution to test for outliers		
t statistic, t_0 (or k_0)	-1.44043E+12	-194.2401206	-35.77655207	-76.84375138						
Upper confidence limit (on true mean concentration, μ)	0.005	1.17716987	3.15923548	1.4599138						
Evidence level	100%	100%	100%	100%						
Base decision on:	evidence level	evidence level	evidence level	evidence level						
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc						
Select dataset	◉ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y	○ Y

Back to data | Go to outlier test | Go to normality test | Show individual summary

APPENDIX E

BRE COVER LAYER THICKNESS CALCULATIONS

Calculations based on mixed zone (M)	600	mm

Contaminant	Site Data				Expressed as a Factor of Target Guideline Value				Cover Thickness Required for Compliance to Specified Target Guideline Value	
	Contamination of Ground (Cg)	Contamination of Cover (Cc)	Target Guideline Value 1	Target Guideline Value 2	Soil / Target Guideline Value 1	Cover / Target Guideline Value 1	Soil / Target Guideline Value 2	Cover / Target Guideline Value 2	Target Guideline Value 1	Target Guideline Value 2
	Units		Units		Fraction				(mm)	
Arsenic	93	50	50	50	1.9	1.0	1.9	1.0	600	600
Cadmium (Soil pH8)	8.5	140	140	140	0.1	1.0	0.1	1.0	None	None
Chromium	100	5000	5000	5000	0.0	1.0	0.0	1.0	None	None
Chromium (VI)										
Mercury	0.5	480	480	480	0.0	1.0	0.0	1.0	None	None
Selenium										
Copper	4800	45700	45700	45700	0.1	1.0	0.1	1.0	None	None
Nickel	120	5000	5000	5000	0.0	1.0	0.0	1.0	None	None
Zinc	2000	18800	18800	18800	0.1	1.0	0.1	1.0	None	None
Lead	4900	750	750	750	6.5	1.0	6.5	1.0	600	600
Boron (Water sol)										
Sulphate (total)										
Phenols										
Sulphide										
Cyanide										
Solvent Extractable Matter										

Summary		
	Target Guideline Value 1	Target Guideline Value 2
Number of contaminants	16	16
Number of contaminants **with no** thickness calculation	8	8
Breakdown - Number for which no TV specfied	8	8
Breakdown - Number for which no soil specified	8	8
Breakdown - Number for which no cover specified	8	8
Breakdown - Number for which cover > TV	0	0
Number of contaminants **with** thickness calculation	8	8
Breakdown - Number for which no cover required	6	6
Breakdown - Number for which cover required	2	2

Overall thickness of cover required	**600**	**600**

APPENDIX F

BRE SD1 Concrete Classification

pH ranked highest to lowest	Water Soluble Sulphate ranked lowest to highest
7.2	0.01
7.2	0.02
7.3	0.02
7.4	0.02
7.4	0.03
7.7	0.03
7.7	0.03
7.7	0.03
7.7	0.04
7.8	0.05
7.8	0.06
7.8	0.08
7.8	0.09
7.8	0.09
7.8	0.1
7.9	0.11
7.9	0.12
7.9	0.13
8.1	0.18
8.1	0.26
8.1	0.95
8.2	2.2

N	22	22
mean of data set	7.7	0.2
20% of N	4.4	4.4
mean of 20%	7.607	0.047