ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D

GEOTECHNICAL
AND
ENVIRONMENTAL
ENGINEERS

Head Office
The Old Dairy
Swanborough Farm
Swanborough
Lewes
East Sussex
BN7 3PF

SUMMERLEY CORNER
SOUTH SITE
SUMMERLEY LANE
BOGNOR REGIS
WEST SUSSEX

GEOTECHNICAL AND CONTAMINATION (PHASE I AND II) ASSESSMENT REPORT

Report No. LW23175 August 2012

[redacted]

Report prepared for the benefit of:
Grey Dune Ltd
44b Summerley Lane
Felpham
West Sussex
PO22 7HX

Managing Director
J.E.Bewick
BSc MSc CEnv CEng MICE

Company Secretary
V.Bewick
BSc MSc FRSS

Company Registration Number
242 6786

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AGS
ace
INVESTOR IN PEOPLE

ASHDOWN SITE INVESTIGATION LIMITED

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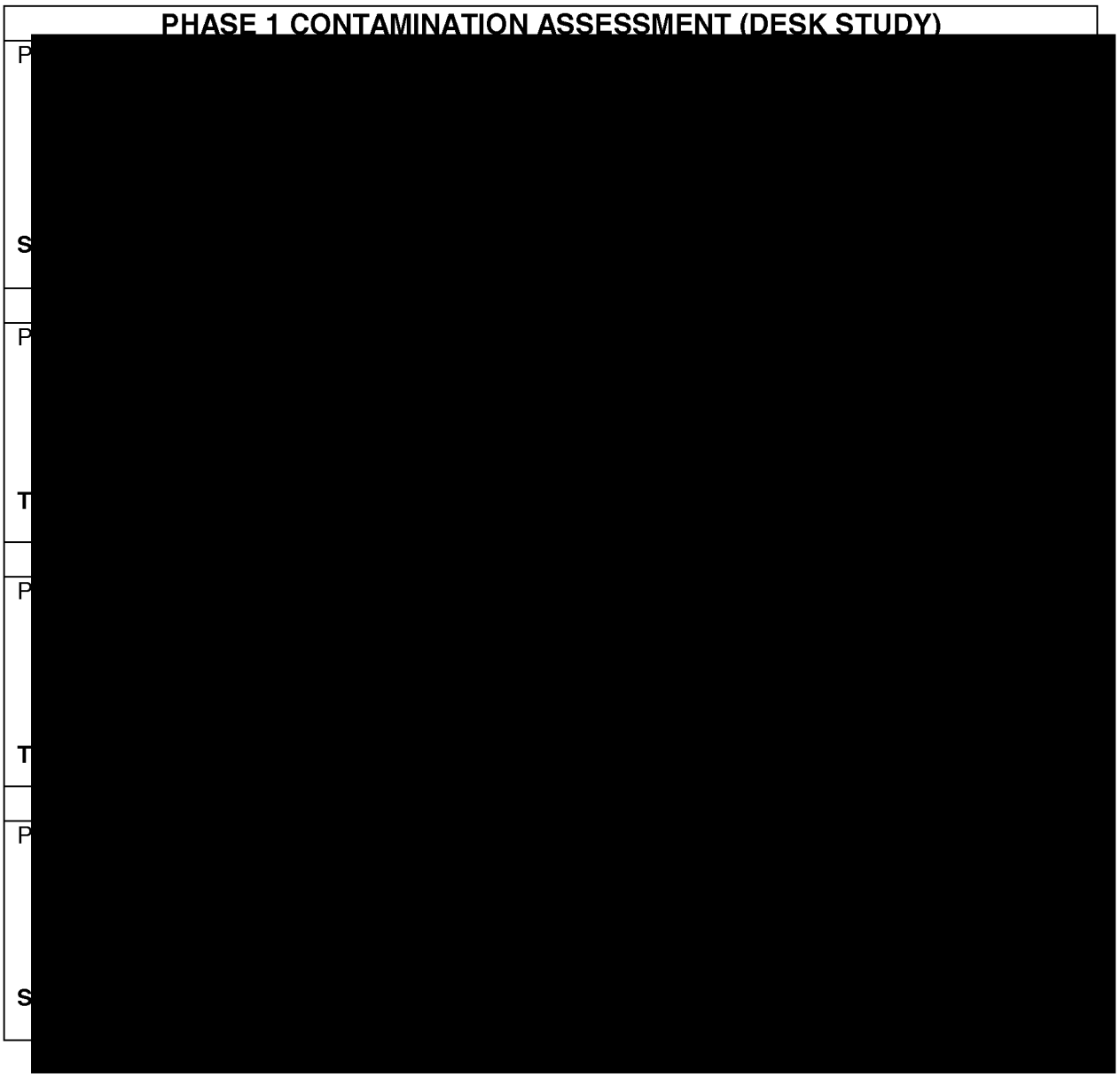

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1. INTRODUCTION

It is proposed to redevelop the site at Summerley Lane, Bognor Regis with the construction of a block of 12 apartments together with associated amenity space and car parking.

Ashdown Site Investigation Limited was commissioned to carry out a ground investigation and combined geotechnical and contamination assessment of the site by Mr Chris Moore of:

Sussex Building Consultancy Ltd
3 Northcote Road
Bognor Regis
PO21 5LZ

The instruction to proceed was received on behalf of the Client, Grey Dune Ltd, in an email dated 5th July 2012. A further instruction to install gas monitoring standpipes and associated monitoring was received in an email, from Jacqui Shilton of Grey Dune Ltd, dated 13th July 2012.

Ashdown Site Investigation was made aware by Mr Chris Moore that a below ground petrol tank was once present within the detached garage on site. Whilst it is understood that the tank was filled in by a qualified contractor 8-10 years ago, no documentary evidence of this is available.

The purpose of the investigation works was to:

i. assess the expected geology and hydrogeology underlying the site;
ii. establish the development history and most recent site use;
iii. identify potential sources of on-site and off-site contamination;
iv. establish the potential for on-site migration of contamination from off-site sources;
v. identify sensitive receptors that may be at risk from any contamination migrating from the site and develop a preliminary conceptual model;
vi. assess ground and shallow groundwater conditions prevailing at the site;
vii. provide information to assist others in undertaking design of foundations, ground floors and road pavement;
viii. test for the presence of potentially hazardous contamination and gas in the ground;
ix. provide a quantitative contamination risk assessment; and
x. provide a quantitative site specific conceptual model.

The analysis and discussions contained in this report are based on the ground conditions encountered during the recent site work together with the findings from a programme of laboratory analyses, a walkover survey, reference to historical Ordnance Survey maps and published geological and environmental information from various sources, the latter having been obtained from interrogation of database information compiled by GroundSure Limited. The possibility of a variation in ground and groundwater conditions away from the positions

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investigated should not be overlooked. Groundwater conditions can vary both seasonally and due to other effects.

Copies of the historical maps and geo-environmental data referred to in this report are included in a separate bound volume, entitled Geo-Environmental Data and Historical Maps (Ashdown Site Investigation Limited, Report Number LW23175/map, dated July 2012).

It is noted that the investigation was undertaken and the report was prepared specifically for the Client's project and the recommendations given may not be appropriate to alternative schemes. The copyright for the report and licence for its use shall remain vested in Ashdown Site Investigation Limited (the Company) who disclaim all responsibility or liability (whether at common law or under the express or implied terms of the Contract between the Company and the Client) for any loss or damage of whatever nature in the event that this report is relied on by a third party, or is issued in circumstances or for projects for which it was not originally commissioned, or where the exploratory hole records and test results contained therein are interpreted by anyone other than the Company.

The general methodology adopted for the investigation of the site follows the guidance published within:

- BS10175:2011 Investigation of Potentially Contaminated Sites - Code of Practice;
- BS5930:1999 +A2:2010 Code of Practice for Site Investigations;
- BS EN 1997-2:2007 Geotechnical Design – Part 2: Ground investigation and testing;
- CLR11 - Model Procedures for the Management of Land Contamination.

The risk assessment presented in this report follows 'source-pathway-receptor' techniques for the determination of whether a site is contaminated, which are standard practice in the UK, being intrinsic to the Contaminated Land (England) Regulations 2000 - Part 2A of the Environmental Protection Act 1990.

The report considers end users as the most sensitive human health receptors. If significant risks to construction workers are identified by the preliminary assessment attention is drawn to this. No assessment of risk from acute exposure has been undertaken in this connection.

This report is not intended to be either an ecological or archaeological assessment. An appropriate specialist should be consulted about any concerns that may arise in this regard.

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2. PHASE 1 CONTAMINATION ASSESSMENT (DESK STUDY)

2.1 Site Location and Walkover Survey

The site comprises a roughly rectangular shaped plot of land located to the south east of the junction of Summerley Lane and Southview Road, Bognor Regis, and is centred on the approximate Ordnance Survey national grid reference SZ 9577 9979. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively. Photographs taken during the walkover survey are presented in Appendix A.

Residential properties were located to the east and south of the site, with Summerley Lane and Southview Road forming the northern and western site boundaries, respectively. The ground surface across the site was generally level.

At the time of the investigation, the south-eastern corner of the site was occupied by a single storey L-shaped, brick and flint built property with gardens laid to lawns and flower beds. Most of the garden was to the front (north) of the property, with a small garden to the rear (south). A brick built garage, converted into a home-office, was located to the south of the house, with a short tarmac surfaced driveway giving access to Southview Road.

Across the northern end of the site was a tarmacadam surfaced driveway/parking area, with a single storey garage of flint construction located in the north eastern corner of the site. It is understood that an underground fuel tank was previously located within the garage but has been decommissioned. However, at the time of writing no documentary evidence of the precise location of the tank or any details regarding the decommissioning were available. It was also not possible to determine the location of the tank within the garage due to the presence of a concrete floor slab.

A strip of land running down the western site boundary was hoarded/ fenced and comprised rough ground containing various stockpiles of brick and concrete rubble and the remains of a concrete floor slab.

2.1.1 Potential Contamination Sources Identified by Walkover Survey

On Site

- Potential petroleum hydrocarbon contamination from former underground fuel tank.

Off Site

- No significant sources of contamination have been identified by the Walkover Survey.

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2.2 Geological Data Review

2.2.1 Expected Geology

The stratigraphic succession expected to underlie the site is presented in the following table. In preparing the table reference has been made to the British Geological Survey 1:50,000 series scale map the British Geological Survey lexicon of named rock units and the maps included within Appendix A (Section 1) of the accompanying Geo-Environmental Data and Historical Maps Volume.

Table 1. Expected Geological Strata

Type	Stratum	Age
Superficial Deposits	River Terrace Deposits	Quaternary
Bedrock Geology	White Chalk Subgroup (Lewes Nodular Chalk)	Cretaceous

River Terrace Deposits

The River Terrace Deposits generally comprise well graded sandy fine to coarse gravel of flint. Locally sand or gravel strata may predominate. Gravels normally include a high proportion of subangular flint and chert.

White Chalk Subgroup (Lewes Nodular Chalk)

The White Chalk Subgroup (Lewes Nodular Chalk) comprises a weak, white chalk locally with flint bands together with scattered nodular flints. It may be expected to have a deeply convoluted upper surface as a result of solution weathering. The presence of cavities in the chalk is very rare and solution features, if present, can be expected to be infilled with Quaternary deposits such as the River Terrace Deposits.

The infill material may be significantly weaker than the surrounding chalk. Solution features can comprise pipes extending to several metres deep into the chalk or conical depressions and basin shaped structures.

2.2.2 Ground Stability & Geological Features

A review of the data presented within the Geo-Environmental Data and Historical Maps Volume report has been undertaken. The following summarises the data and the assessment of potential risk that the ground hazard/feature may pose to the site. Ashdown Site Investigation Ltd (ASI Ltd) have commented, where appropriate, on the potential risk to the site from the ground hazard/feature reported by the GroundSure data.

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The GroundSure data indicates the absence of any significant landslips or faults within 500m of the site.

The site is in an area where less than 1% of properties are above the action level requiring protective measures to be included within new buildings in respect of radon gas. No radon protective measures are reported by the BGS to be necessary in the construction of new dwellings.

Table 2. Ground Workings, Mining, Extraction & Natural Cavities

Section	Remarks	ASI Ltd Assessment
Ground workings	Three entries are recorded by the dataset. The closest refers to a brick field 7m to the north recorded on the 1910 map. The other two entries refer to an unspecified heap and ground works 31m and 33m to the north west and north. All three entries are considered to be associated with the brick works identified in 1910 by the historical mapping (See Section 2.5).	As discussed further in section 2.5, backfilled brickfields are a potential source of gas generation. The brickfields referenced by the dataset may have been backfilled and therefore pose a potential ground gas generation risk.
Non-Coal Mining Cavities	Chalk mining on site is considered to be rare and infrequent .	

No significant risks from mining, natural cavities or extractions are reported influencing the site.

The maximum hazard rating of natural subsidence within the site boundary (including a 50m buffer zone) is Low. This hazard rating is based on the interrogation of the six British Geological Survey (BGS) natural ground stability datasets (GeoSure). These are reviewed individually in the table below.

Table 3. Natural Ground Subsidence Hazards

Section	Risk Assessment (GroundSure)	Remarks & ASI Ltd Assessment
Soil Volume Change Potential (Shrink-Swell)	Low	No significant risk has been identified.
Landslides	Very Low	
Ground Dissolution of Soluble Rocks	Null-Negligible	
Compressible Deposits	Negligible	
Collapsible Deposits	Low	
Running Sands	Low	

A site specific geotechnical assessment is included as Section 4 of this report.

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2.2.3 *Background Soil Chemistry*

The GroundSure GeoInsight report provides information on background soil chemistry. The following estimated mean concentrations of metals are reported.

Table 4. Background Mean Soil Concentrations of Metals

Metal	Mean Soil Concentration (mg/kg)	Remarks & ASI Ltd Assessment
Arsenic	<15	The mean soil concentrations indicated are not considered to be significantly elevated for the proposed use.
Cadmium	<1.8	
Chromium	60-90	
Nickel	15-30	
Lead	<150	

2.2.4 *Potential Contamination Sources identified by Geological Data Review*

The following potential sources of contamination have been identified from the geological data review:

On Site

- No significant sources of contamination have been identified from the geological data review.

Off Site

- Potential ground gas migration from former brickfields located to the north.

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2.3 Environmental Data Review

Records of potentially contaminative activities, authorisations, pollution incidents and land uses recorded by the regulatory authorities and compiled by Groundsure in their EnviroInsight Report have been reviewed. Data are supplied by the British Geological Survey (BGS), Environment Agency, Health Protection Agency, The Coal Authority and Local Authorities.

Locations of registered potentially hazardous industrial or other land uses, records of pollution incidents affecting controlled water, water abstraction licences and waste water discharge licences are shown on the maps presented in the accompanying Geo-Environmental Data and Historical Maps Volume report.

The information and potential risks to or from the various sources is assessed below.

Table 5. Authorisation, Incidents and Registers

Section	Remarks	ASI Ltd Assessment
Records of Part A(2) and Part B Activities and Enforcements	Two entries referring to petrol filling stations 391m and 407m to the north are recorded.	Neither entry is considered a significant risk to the development site, due to distance.

Table 6. Landfill and Other Waste Sites

Section	Remarks	ASI Ltd Assessment
Environment Agency Historic Landfill Sites	Entries in excess of 1km are recorded.	None are considered a risk due to distance.
Groundsure Local Authority Landfill Sites Data	As above, entries in excess of 1km are recorded.	None are considered a risk due to distance.

Table 7. Current Land Uses

Section	Remarks	ASI Ltd Assessment
Current Industrial Data	An electrical substation is recorded 215m to the south west and a Slipway is also noted 246m to the south.	Neither is considered a risk to the site due to nature of activity and distance.
Records of Petrol and Fuel Sites	One entry is recorded 404m to the north.	The filling station is considered too distant to pose a significant risk to the development site

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2.3.1 Potential Contamination Sources Identified by Environmental Data Review

No significant sources of contamination were identified either on or off site by the environmental data review.

2.4 Hydrogeology and Hydrology

2.4.1 Groundwater Vulnerability & Soil Classification

The Environment Agency designates aquifers in accordance with the Water Framework Directive. These designations reflect not only the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey.

The superficial River Terrace Deposits are classified as a Secondary A aquifer, whilst the underlying White Chalk Subgroup is classed as a Principal Aquifer.

Secondary A Aquifers are characterised by permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Principal Aquifers comprise deposits that have high intergranular and/or fracture permeability, usually providing a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers.

2.4.2 Abstraction Licences

No groundwater or surface water abstraction licences are indicated within 1km of the site. The closest abstractions are in excess of 1600m from the site.

2.4.3 Potable Water Abstraction Licences and Source Protection Zones (SPZs)

No potable water abstraction licences are indicated within 2km of the site.

The site does not lie within an Environment Agency Source Protection with regard to the protection of the quality of groundwater that is abstracted for potable supply.

2.4.4 Surface Water

The data indicates that there are no significant surface water features in the vicinity of the site.

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2.4.5 Flooding

The site does not lie within an Environment Agency flood plain, although it noted that Zone 2 or Zone 3 floodplains associated with the sea are located 235m to the south.

There are no flood defences, areas benefiting from flood defences or areas used for flood storage within 250m of the site.

The British Geological Survey reports a very low susceptibility to groundwater flooding within 50m of the site. The BGS consider the confidence rating of their data in this area to be high.

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2.5 Site History

Historical Ordnance Survey maps covering the area of the site have been reviewed. It is noted that each map presents information applicable at the time of the survey (or revision date) and is subject to surveying and cartographic errors and/or advances. Revisions to maps are made at irregular intervals and it is possible that significant developments may have taken place on or within the vicinity of the site that have not been revealed by the maps.

In the following table 'In Vicinity of Site' generally considers features of relevance within approximately 250m of the site boundary, but may also include more distant features if considered to be pertinent to the assessment of the development history.

Significant details depicted on the maps are identified in the following table.

Table 8. Summary of Significant Features Identified on Historical Maps

Map Details	On-site	In Vicinity of Site	Significant Potential Contamination Sources
1876 1:2,500	A large structure denoted as Summerley Barn is shown on the site. The L-shaped eastern part of the barn occupies the same footprint as the present property on site. The western part of the barn occupies the presently hoarded area.	Open fields surround the site with a small pond located 40m to the north west.	
1876 1:2,500	An additional structure is shown in the north eastern corner of the site on the footprint of the present garage.		
1910 1:10.560		A brickfield with associated excavations is shown 7m to the north west of the site.	
1912 1:2,500		The small pond to the north west is no longer shown, now being part of the brickworks.	

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Map Details	On-site	In Vicinity of Site	Significant Potential Contamination Sources
1933-1934 1:10,560 **And** **1933 1:2,500**		The brickworks are no longer shown and there has been a general increase in residential development and infrastructure around the site.	Backfilled brickfields pose a potential ground gas generation risk. Potential ground gas migration from former brickfields.
1939 1:2,500		The former brickfields to the north west are now occupied by housing.	
1960 1:2,500	An extension to the south western elevation of the building is shown.		
2012 1:2,500	The building on the western part of the site is no longer shown. The existing garage to the south of the existing property is shown at this time.		Potential metal and PAHs from demolition of former structure on western part of the site.

2.5.1 Potential Contamination Sources identified by Historical Map Review

The following potential sources of contamination have been identified from the historical map review:

On Site

- Potential metal and PAHs from demolition of former structure on western part of the site.

Off Site

- Potential ground gas migration from former brickfields located to the north west.

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2.6 Preliminary Contamination Risk Assessment

2.6.1 Basis of Preliminary Contamination Risk Assessment

An appropriate contamination risk assessment of a site considers the potential sources of contamination, the potential receptors and how the sources and receptors may be linked (the pathways).

A significant risk is only deemed to exist where a significant pollutant linkage has been identified i.e. where a potentially significant source is linked to the receptor via a significant pollutant pathway. A site is considered suitable for use where no significant pollutant linkages are present.

This preliminary risk assessment takes into account the proposals for the site, key features noted from the walkover survey, information from the database search and any potential risks identified from the review of historical Ordnance Survey maps and other data.

The assessment of risk has been carried out in line with guidance published within "Contaminated Land Risk Assessment: A guide to good practice" published by CIRIA (C552, 2001). The level of risk is determined using the risk matrix presented in the following table. Classifications of likelihood, severity and risk are provided in subsequent tables.

Table 9. Risk Assessment Matrix – Comparison of Consequence and Probability

		Likelihood of significant impact			
Severity of potential impact		**Very Low Likelihood**	**Low Likelihood**	**Moderate Likelihood**	**High likelihood**
	Very Minor	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

Table 10. Classification of Likelihood

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

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Table 11. Classification of Severity

Severity Classification	Definition
Severe	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short term risk to a particular ecosystem or organisation forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).
Moderate	Chronic damage to Human Health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem or organism forming part of such ecosystem, (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR, 2000).
Minor	Pollution of non sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the Draft Circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.
Very Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.

Table 12. Classification of Risk

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

The risk assessment has been carried out based on the site being developed for residential purposes including the provision of areas of soft landscaping (amenity areas) but no private gardens. Should the proposed end use be altered, particularly if private garden are proposed, a revised risk assessment may be required.

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2.6.2 *Preliminary Risk Assessment for Human Health*

The following potential sources of contamination that may pose a risk to end users have been identified by the risk assessment:

1) Potential petroleum hydrocarbon contamination from former underground fuel tank.
2) Potential ground gas migration from former brickfields located to the north west.
3) Potential metal and PAHs from demolition of former structure on western part of the site.

A preliminary human health risk assessment conceptual model is presented in the following table of this report and is presented diagrammatically as Figure 3.

Table 13. Preliminary Human Health (End Users) Conceptual Model – Potential Pollutant Linkages and Initial Assessment of Risk

Contaminant Source	Potential Pathway(s)	Likelihood	Severity	Initial Assessment of Risk to Human Health
Potential petroleum hydrocarbon contamination from former underground fuel tank.	• Dermal contact with soil (Indoor & Outdoor). • Direct soil and dust ingestion. • Inhalation of indoor and outdoor soil dust. • Inhalation of soil vapours.	Low	Moderate	Low/Moderate
Potential ground gas migration from former brickfields located 7m to the north.	• Inhalation of soil gases.	Low	Moderate	Low/Moderate
Potential metal and PAHs from demolition of former structure on western part of the site.	• Dermal contact with soil (Indoor & Outdoor). • Direct soil and dust ingestion. • Inhalation of indoor and outdoor soil dust.	Low	Moderate	Low/Moderate

2.6.3 *Preliminary Risk Assessment for Controlled Water*

The following potential sources of contamination that could affect controlled waters have been identified by the risk assessment:

1) Potential petroleum hydrocarbon contamination from former underground fuel tank.
2) Potential metal and PAHs from demolition of former structure on western part of the site

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A preliminary controlled water risk assessment conceptual model is presented in the following table of this report and is presented diagrammatically as Figure 3.

Table 14. Preliminary Controlled Water Conceptual Model – Potential Pollutant Linkages and Initial Assessment of Risk

Contaminant Source	Potential Pathway(s)	Likelihood	Severity	Initial Assessment of Risk to Controlled Water
Potential petroleum hydrocarbon contamination from former underground fuel tank	• Groundwater Flow	Very Low	Minor	Low
Potential metal and PAH's from demolition of former structure on western part of the site.	• Groundwater Flow	Very Low	Very Minor	Negligible

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3. FACTUAL REPORT

3.1 Ground Investigation

3.1.1 Introduction

The ground investigation comprised the excavation of a series of dynamic sampler and hand augered boreholes. The fieldwork was carried out on 16th July 2012. The exploratory hole locations are shown on the site Plan (Figure 2).

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records given in Appendix B. Notes to assist in the interpretation of the records are also contained in the appendix.

3.1.2 Investigation and Sampling Strategy

The Phase 1 contamination assessment identified the following sources of contamination:

1) Potential petroleum hydrocarbon contamination from former underground fuel tank.
2) Potential ground gas migration from former brickfields located 7m to the north.
3) Potential metal and PAHs from demolition of former structure on western part of the site.

The following table provides a summary of the rationale behind the positioning of the exploratory holes. The sampling locations were also dictated by available access.

Table 15. Sampling Location Rationale

Exploratory Hole	Reason for positioning
Boreholes WS2 and WS3	Located in the area of former underground fuel tank (exact location of the former tank is unknown).
Borehole WS1 and WS5	Located on the western part of the site to target potential made ground associated with historic building.
WS1, WS3 and WS5	Standpipes installed to target any gas migration from off site historical brickfields.
WS4, HA1, HA2 and HA3	Non-targeted contamination sampling.

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The results from the ground investigation, together with the findings of the phase 1 contamination assessment, are considered adequate to allow the preparation of a quantitative risk assessment for the site.

3.1.3 Methodology

3.1.3.1 Dynamic Sampler Boreholes

Five boreholes (designated WS1 to WS5) were drilled to depths of 3m below ground level.

The boreholes were formed by a series of 1.0m long hollow steel tubes, reducing in diameter from 100mm to 35mm, which are driven successively into the ground by means of a track-mounted drop weight. The sampler is extracted from the ground using a hydraulically operated jack and the enclosed samples recovered in 1.0m long plastic liners. The system enables sub-samples to be taken for detailed examination and laboratory testing.

3.1.3.2 Hand Auger Boreholes

Three boreholes (designated HA1 to HA3) were bored to depths of between 0.6m and 0.8m. The hand auger enables disturbed soil samples to be taken using a cutting tool twisted into the soil by hand.

3.1.4 Sampling

Disturbed samples of soil were taken at the depths shown in the exploratory hole records and were collected in either plastic bags, plastic tubs or amber jars fitted with gas tight lids. On collection the amber jars were stored in cool boxes containing cooling blocks to maintain temperatures below 4°C and were transferred to refrigerators upon return to the office until forwarded to the external accredited laboratory.

3.1.5 In Situ Testing

The depths of in situ testing, together with the test results, are given on the exploratory hole records or are summarised separately in Appendix B. Notes providing additional information on the tests that were performed are also included in Appendix B.

DPSH Dynamic Probe (Super Heavy) Testing

Dynamic probe testing was carried out adjacent to boreholes WS2, WS3 and WS5. Probing was undertaken in accordance with BS EN ISO 22476-2:2005 using a super heavy geometry.

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The DPSH configuration is similar to that of the standard penetration test (SPT) except that the blow counts are recorded over 100mm increments rather than 300mm as is the case for the SPT.

Perth Penetrometer Tests

Perth penetrometer tests were undertaken in the coarse grained soils encountered in the dynamic sample boreholes. Perth Penetrometer testing was carried out in accordance with Australian Standard AS 1289:6.3.3-1997, Method of Testing Soils for Engineering Purposes; no equivalent European or British Standard having been published to date.

Undrained Shear Strength

Undrained shear strength determinations were made in situ within the fine grained soils using a Geonor hand shear vane.

Additionally undrained shear strength determinations were made within samples of the fine grained soils held in the dynamic sampler liners using a hand penetrometer. Although samples taken by the dynamic sampling technique cannot be regarded as being undisturbed for testing purposes, penetrometer testing can provide a useful indication of the strength of the material.

California Bearing Ratio Tests

In situ testing using a hand-held Transport Road Laboratory (TRL) cone penetrometer was conducted from ground level adjacent to boreholes WS4, HA2 and HA3.

3.1.6 Installations

Gas and groundwater monitoring standpipes were installed to depths of 3m in boreholes WS1, WS3 and WS5. Descriptions of the installations are shown in the exploratory hole records given in Appendix B.

The concentrations of gases and depths to groundwater were recorded within the standpipes on three occasions between 24th July and 7th August 2012. The readings are presented in Appendix B.

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3.2 Laboratory Testing

Results from the laboratory tests are provided in Appendix C.

3.2.1 Geotechnical Testing

Geotechnical testing was undertaken by Ashdown Site Investigation Ltd in accordance with the methods given in BS1377:1990 Parts 1 to 8 'Methods of test for soils for civil engineering purposes'. Notes to assist with the interpretation of the tests are contained within Appendix C.

The types and numbers of tests carried out are detailed in the following table. The significance of the results is discussed further in Section 4.

Table 16. Geotechnical Testing

Type of test	No. of samples tested
Moisture Content	6
Atterberg Limits	6
Particle Size Distribution	3
Water Soluble sulphate and pH	2

3.2.2 Chemical Testing

Chemical testing of selected samples was scheduled by Ashdown Site Investigation Ltd, and was undertaken by a laboratory with recognised (UKAS and MCERTS) accreditation for quality control.

The types and numbers of tests undertaken are detailed in the following table. Statistical analysis of the results of the testing is presented in Section 5.

Table 17. Chemical Testing

Determinand	No. of soil samples tested	No. of water samples tested
Arsenic	7	
Cadmium	7	
Chromium	7	
Lead	7	
Mercury	7	
Nickel	7	
Selenium	7	
Copper	7	

Determinand	No. of soil samples tested	No. of water samples tested
Zinc	7	
Hexavalent Chromium	7	
Water Soluble Boron	7	
pH	9	
Organic Matter	7	
Speciated PAH	7	
Speciated Petroleum Hydrocarbons (Equivalent Carbon Weight Fractions)	5	1
Asbestos	3	
Water Soluble Sulphate	2	

3.3 Ground Conditions

3.3.1 Stratigraphy

3.3.1.1 Surface Covering

Boreholes WS1 and WS2, located within the driveway/parking area at the northern end of the site, were excavated through a surface cover of tarmacadam some 50mm and 70mm in thickness. Borehole WS5, situated within the western part of the site, was excavated through a surface cover of crushed brick and concrete, 50mm in thickness.

The remaining boreholes were carried out through topsoil some 100mm to 300mm thick. The topsoil contained a variable quantity of flint, brick and clinker.

3.3.1.2 Made Ground

Made ground, generally comprising clay and gravel containing a variable quantity of chalk, clinker, flint, brick and concrete was recorded within boreholes WS3, WS4 and HA1 to depths of between 0.4m and 0.6m below ground level.

Made ground was also present in borehole WS2 where it consisted of some 70mm of granular sub base overlying chalk fill, the whole extending to a depth of 0.25m.

No made ground was recorded in boreholes WS1, WS5, HA2 or HA3.

3.3.1.3 River Terrace Deposits

The investigation progressed into undisturbed firm to stiff and stiff sandy clay or sand/ clay deposits to depths of between 1.1m and 2.0m below ground level.

Beneath these soils the boreholes passed down into clayey sand that continued to the base of the boreholes at 3m below ground level. The dynamic probing results indicate these deposits to be in a loose condition, becoming medium dense below depths of between 1.9m and 2.8m below ground level.

These soils are considered to represent the River Terrace Deposits soils indicated on the published geological map.

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3.3.2 Stability and Groundwater Conditions

Each of the exploratory holes was recorded as being stable during the course of the investigation.

Standing water depths of between 0.75m and 2.3m below ground level were recorded on completion of the dynamic sampler boreholes. All of the hand auger boreholes, excavated to depths of less than 1.0m were noted to be dry during excavation.

Standing water depths of between 0.95m and 1.7m were recorded in the standpipes during the monitoring visits.

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4. GEOTECHNICAL ASSESSMENT

The geotechnical assessment has been prepared in connection with the development proposals shown on the drawing produced by Neil Holland Architects (Reference 505/02, dated October 2006).

In summary the drawing indicates the proposed development to comprise the demolition of the existing bungalow and garages, and the construction of a new block of 11 apartments together with associated car parking and soft landscaped areas.

At the time of writing, no details were available concerning the loads likely to be applied to the foundations.

4.1 Foundations

4.1.1 Soil Shrinkage/Heave Potential

The undisturbed sand of the River Terrace Deposits may be considered to be non plastic and hence non shrinkable.

The sandy clay soils of the River Terrace Deposits that can be expected to be present at shallow depth have been classified as clays of low plasticity and with plasticity indices in the range of 11% to 14% the soils may be expected to exhibit a low volume change potential.

It is recommended that precautions against shrinkage and heave for any foundation system constructed within or through the fine grained River Terrace Deposits should assume a low volume change potential and take into account current guidance such as that given by the National House Builders Council (NHBC).

Whilst this report has been prepared to provide advice to assist designers in undertaking detailed design, the report itself does not represent a detailed design statement. All detailed foundation design including assessment of minimum founding depths for spread foundations and requirements for placement of void formers must take into account the volume change potential of the soil and the presence of trees (previous, present and proposed).

It is strongly recommended that a detailed arboricultural survey should be undertaken for the site. The survey should be extended to include a review of historical photographs and detailed site plans (if available) to establish the species and location of any felled trees that may affect foundation design. The information obtained from the arboricultural survey, information on proposed planting schemes and the findings of this report should be provided to the structural engineers responsible for design of foundation systems.

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Whilst a tree survey was beyond the scope of the present investigation it is noted that mature trees and bushes were located around and across the site.

4.1.2 Spread Foundations

As a matter of course it is recommended that unless shown otherwise any made ground should be regarded as being variable in nature and state of compaction and, as such, unsuitable as a founding medium for shallow footings. New footings should therefore be constructed below any made ground or soils that have been disturbed by construction activities or the removal of any previously existing foundations and services.

A net allowable bearing capacity of 125kN/m^2 may be assumed for the design of spread (pad or strip) foundations up to 2m across bearing within the River Terrace Deposits. The quoted bearing capacity is expected to limit settlement to less than 25mm. Subject to any precautions required to protect against the effects of soil shrinkage or heave caused by trees, the NHBC guidelines indicate that a minimum depth to formation of 0.75m should be adopted.

The construction of new foundations must be carefully undertaken and monitored in those situations where temporary works may affect existing foundations or road frontages.

While it is likely that higher bearing capacities may be available at depth within the medium dense sand deposits, the high groundwater table recorded is likely to create significant problems during the construction, as discussed below.

Consideration could be given to supporting the proposed development on piled or vibro-concrete columns bearing within the medium dense sand present at depth. In the event that this approach is to be considered, further investigation by means of cable percussion boreholes would be required to confirm the ground conditions at depth beneath the site.

4.2 Groundwater

Standing water levels were recorded between 0.95m and 1.7m depth across the site.

As noted above, it is considered that excavations beneath the water table, and particularly within the coarse grained soils, are likely to require positive drainage (e.g. wellpointing) to maintain adequately dry working conditions and excavation stability. The potential for running sand conditions to develop together with the softening of formations should not be overlooked.

If encountered above the water table the ingress of water into excavations should be adequately managed by pumping from sumps.

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4.3 Stability of Excavations

All excavations within the River Terrace Deposits should be assumed to be subject to short term instability. Excavations below the water table are likely to be problematic without positive groundwater control, as discussed above.

Where personnel access is required to any excavation its stability should be assessed by a suitably qualified and experienced responsible person. Entry into unsupported excavations should only be permitted where they have been assessed as safe to enter but in any case it is advised that personnel access to unsupported excavations greater than 1.2m depth should be prohibited.

Particular attention must be paid to ensuring the stability of neighbouring sites as well as road frontages.

4.4 Aggressivity to Concrete

In view of the soils encountered beneath the site and its historical usage it is considered that 'brown field conditions' could be assumed, conservatively, for the purpose of assessing the aggressivity of the chemical environment for concrete classification (ACEC class). Given the occurrence of groundwater seepages, 'mobile groundwater' conditions should be assumed.

Chemical analysis of the soil indicates a sulphate content falling into Design Sulfate Class DS-1 of Table C2 of the Building Research Establishment Special Digest No 1 "Concrete in aggressive ground", 2005. The results of the pH tests indicate that the underlying soils are alkaline.

In accordance with the BRE digest, a DS-1 Design Sulfate Class and an AC-1 ACEC classification may be assumed as a minimum for the design of concrete in contact with the ground at the site.

4.5 Ground Floors

In view of the presence of shrinkable soils beneath the site it would be advisable to adopt suspended ground floors.

However, ground bearing floor slabs may be considered where made ground soils are not present or are to be removed from beneath building footprints and the depth of foundations required to protect against seasonal soil volume changes close to trees is less than 1.5m. In such circumstances further works should be undertaken to demonstrate, that close to the time of construction, no significant soil desiccation is present.

If ground bearing floors are adopted the potential for differential movement both between the floor slab and walls and across the floor slab itself to occur should be anticipated. Such floors should be fully debonded from walls and should be

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suitably reinforced to enable spanning of soft spots. Formations should be adequately proof rolled and any excessively soft materials excavated and replaced with a suitable engineered fill. The depth of any engineered fill should be limited to a maximum of 600mm.

The detailing of services through, or under, ground-bearing floors should incorporate flexible connections and, where appropriate, enhanced falls.

4.6 Pavement Design

In situ TRL cone penetrometer tests for the direct estimation of California bearing ratio indicated CBR values ranging between 2% and >10% but typically in the range 2% to 7% in the River Terrace Deposits.

The former Department of the Environment, Transport and the Regions Design Manual for Roads and Bridges, Volume 7 (Pavement Design & Maintenance), Section 2, Part 2 1994 provides a useful correlation between soil type and equilibrium (long term) CBR values. This guidance suggests a design equilibrium CBR value of 1.5% to 3% would be applicable to the natural soils for the construction of thin pavement under average construction conditions and assuming a high groundwater table.

Based upon review of the in-situ test results and the quoted guidance it is suggested that for the River Terrace Deposit soils a CBR value of 3% would be appropriate for pavement design.

All formations should be proof rolled and any very loose, bulky, soft, degradable or otherwise unsuitable materials thus identified should be removed and replaced with well compacted coarse grained fill. Prepared subgrades should be protected from severe adverse weather by ensuring they are graded to falls to prevent ponding, and they should be reasonably protected from trafficking during construction.

The subgrade should be assumed to be susceptible to frost heave.

It is expected that new roads and/or parking areas will not to be adopted by the local highway authority. If this is not the case then agreement should be reached with the local authority on the appropriate CBR value to be used in design.

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5. PHASE 2 CONTAMINATION ASSESSMENT

5.1 Introduction

In consideration of the findings of the phase 1 contamination assessment the following commonly occurring significant contaminants have been considered for assessment: arsenic, cadmium, chromium, lead (including lead compounds), mercury, nickel, copper, zinc, selenium, boron, petroleum hydrocarbons, and polycyclic aromatic hydrocarbons (PAH). The polycyclic aromatic hydrocarbons were speciated into the sixteen individual compounds specified by the United States Environmental Protection Agency (USEPA). For screening purposes certain shallow soil samples were analysed for the presence of asbestos.

In addition three standpipes were monitored for concentrations of carbon dioxide, methane, oxygen, carbon monoxide and hydrogen sulphide in view of the potential for the generation of ground gases from the nearby former off site brickfield.

Soils

The results from the majority of the analyses have been assessed by way of careful consideration of the proposed end use as well as physical features of the soil type and wider environment as part of a quantitative 'Contaminated Land Exposure Assessment' or 'CLEA model' assessment.

Quantitative risk assessment using the CLEA model is the method preferred by the regulatory authorities in the UK to assist in determining the contamination status of soils in terms of risk to human health.

Gas

Assessment of the results of the standpipe monitoring has been undertaken in general accordance with the guidance contained within CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings" (2007).

5.2 Analysis of Contamination Test Results

Results from the chemical (contamination) testing are summarised in Appendix C.

A quantitative assessment of the results of this investigation has been undertaken comparing soil contaminant concentrations on site against Soil Screening Values generated by Ashdown Site Investigation Ltd using the CLEA Model, published by the Environment Agency. For further information on the derivation of these values see the notes in Appendix D. Additional chemical data used within the CLEA model is presented within Appendix D. The data was obtained from various sources including guidance documents published by the Environment Agency and other statutory bodies.

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In view of the proposed development which will include amenity areas, but no private gardens, the soil screening values used in this assessment have been calculated using the default "Residential" land use but without the pathways associated with ingestion of site grown vegetables and ingestion of soil attached to vegetables, as set out in Science Report SC050021/SR3, January 2009. The critical receptor for this land use is considered to be a young female child resident on site from birth to age 6. Exposure routes that are considered include the potential for direct ingestion of the soil, the outdoor and indoor ingestion of dust and the potential inhalation of dust and vapours.

Statistical Analysis

Statistical analysis of the data set has been undertaken in line with guidance set out in 'Comparing Soil Contamination Data with a Critical Concentration' report, published by the CIEH/ CL:AIRE (May 2008). The report replaces the (now withdrawn) guidance set out in CLR7.

The CIEH/CL:AIRE guidance provides a framework for assessing measured contaminant concentrations on a site against user defined critical concentrations – or indicators of risk.

Under a planning scenario, the null hypothesis tested is whether the true population mean is greater than a "critical concentration". The critical concentration used within this assessment is the relevant screening value for the proposed end use.

The null hypothesis can be rejected if it can be shown (with a sufficient degree of confidence) that the true population mean lies below the critical concentration. The confidence level recommended within the guidance is 95% i.e. the statistical evidence must show that there is 95% likelihood that the true population mean lies below the critical concentration. In this instance the site is considered suitable for the proposed use.

Where there is insufficient evidence to reject the null hypothesis, further risk assessment and/or remediation may be necessary.

Guidance on comparing soil contamination data with a critical concentration are provided in Appendix D. The summary sheets from the statistical analysis are also presented in Appendix D.

5.2.1 Inorganic Contamination

The data set for the inorganic contaminants tested for comprised 7 samples of the shallow soils (topsoil, made ground and undisturbed deposits). The data set was considered to represent soils with a pH of 7 and an organic content of 1%.

The following table summarises the calculated soil screening values along with sample means and 95th percentile upper confidence limits.

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Table 18. Soil Screening Values and Upper Confidence Limits for Inorganic Contaminants

Contaminant	Soil Screening Value (mg/kg)	Sample Mean (mg/kg)	95% Upper Confidence Limit (mg/kg)	Can H_o be rejected	Evidence against H_o (%)
Arsenic	35	10.95	13.16	Yes	100
Cadmium	80	0.25	0.25	Yes	100
Chromium	627	28.70	34.94	Yes	100
Lead	246	114.68	193.98	Yes	99
Mercury	268	0.25	0.25	Yes	100
Nickel	130	20.99	25.63	Yes	100
Copper	6200	18.24	22.13	Yes	100
Zinc	40300	107.42	230.81	Yes	100
Selenium	595	0.86	1.32	Yes	100
Boron	10300	0.53	0.74	Yes	100
Chromium VI	4.3	1.00	1.00	Yes	100

The statistical analysis shows that the 95% Upper Confidence Level (95% UCL) for each of the metals tested for, are below their corresponding SSVs. Whilst it is noted that an elevated lead concentration of 312mg/kg was recorded within a sample of topsoil from WS4 at a depth of 0.1m, the overall 95% UCL for lead is below the critical SSV and is therefore acceptable.

5.2.2 Organic Contamination

5.2.2.1 Polycyclic Aromatic Hydrocarbons (PAH)

Polycyclic Aromatic Hydrocarbons (PAH) are a group of chemicals that contain two or more benzene rings fused together. In general PAH have relatively low solubility in water but are soluble in organic solvents. Due to their low vapour pressures they tend to readily adsorb onto airborne particulates.

Individual PAH compounds exhibit a range of physical properties and human toxicities and therefore, where they are present, a risk assessment cannot effectively be made against the total PAH concentration.

To allow an assessment to be made, the PAH concentrations within the soil samples were speciated to give concentrations of 16 individual PAH defined by the United States Environmental Protection Agency (USEPA).

The data set for PAH compounds comprised 7 samples of the shallow soils. The data set was considered to represent soils with a pH of 7 and an organic content of 1%.

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The following table summarises the calculated soil screening values along with sample means and 95th percentile upper confidence limits.

Table 19. Soil Screening Values and Upper Confidence Limits for PAH Compounds

Contaminant	Soil Screening Value (mg/kg)	Sample Mean (mg/kg)	95% Upper Confidence Limit (mg/kg)	Can H_o be rejected	Evidence against H_o (%)
Naphthalene	1.6	0.25	0.25	Yes	100
Acenaphthylene	1950	0.37	0.87	Yes	100
Acenaphthene	2000	0.25	0.25	Yes	100
Fluorene	1850	1.78	8.43	Yes	100
Phenanthrene	830	0.44	1.27	Yes	100
Anthracene	19000	2.56	12.20	Yes	100
Fluoranthene	970	2.10	9.83	Yes	100
Pyrene	2300	1.30	5.85	Yes	100
Benz(a)anthracene	3.7	2.25	10.51	No	84
Chrysene	8.8	1.18	5.24	No	92
Benzo(b)fluoranthene	7.0	1.04	4.50	Yes	97
Benzo(k)fluoranthene	10.1	1.18	5.22	Yes	99
Benzo(a)pyrene	1.0	0.83	3.36	No	0
Indeno(123-cd)pyrene	4.2	0.39	0.99	Yes	97
Dibenz(ah)anthracene	0.9	0.83	3.38	No	93
Benzo(ghi)perylene	46.6	0.25	0.25	Yes	100

* Based on a SOM concentration of 1%

The analysis of the dataset indicates that 95% UCL for the following four PAH compounds lie above their SSVs; Benz(a)anthracene, Chrysene, Benzo(a)pyrene and Dibenz(ah)anthracene.

Inspection of the laboratory test results indicates that the only sample to be impacted with PAHs, is a topsoil sample taken from WS4 at 0.1m. A sample of the underlying made ground from a depth of 0.30m at this position did not record any significantly elevated PAH concentrations. It is noted however that the topsoil at this position did not differ significantly in appearance from that recorded elsewhere across the site. The sample should therefore be considered to be representative of the dataset as a whole. At this stage the topsoil at the site should be considered to have been impacted with PAHs and that some remediation is likely to be required.

Whilst further testing of the topsoil may reduce the 95% UCL and delineate the PAH contamination, given the elevated concentrations that have been detected so far, it is considered likely that further testing would only confirm the need for remediation.

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5.2.2.2 Petroleum Hydrocarbons

Petroleum hydrocarbons encompass a large number of individual chemical compounds found within substances such as petrol, diesel, lubricating oil, waxes and tar based substances. Consequently they are associated with a wide range of land uses and encountered on a large number of sites investigated, from fuel filling stations and car maintenance garages to more innocuous land uses such as domestic garages and car parking areas.

Five samples of the shallow soils were tested for the total concentration of petroleum hydrocarbons. The results were speciated according to equivalent carbon weight fraction. This approach to testing was undertaken because the toxicity of the various chemical compounds of petroleum hydrocarbons varies significantly.

No petroleum hydrocarbons above the 5mg/kg detection limit of the test were recorded in any of the samples, with the exception of WS2 at 0.35m, which recorded 16mg/kg. The speciated testing shows the hydrocarbons to consist wholly of heavy carbon ranges C_{21}-C_{35}. The recorded concentration is not considered to be significantly elevated.

No visual or olfactory evidence of hydrocarbons were recorded within WS2 or WS3 which were positioned as close as possible to the approximate location of the former underground petrol tank. No visual or olfactory evidence of fuel contamination was recorded but as the exact location of the tank was not determined, and given that there is no documentary evidence of its decommissioning, there remains the possibility that some hydrocarbon contamination may be present at depth beneath or around the former tank.

Further works, including the inspection and testing of the soils beneath the concrete slab of the garage will be required and these are discussed in further detail in section 5.5 Recommendations.

A sample of groundwater from WS3, close to the reported location of the former buried tank, taken during a monitoring visit was tested for the presence of petroleum hydrocarbons to address the risk to controlled waters. The analysis recorded 77µg/l of hydrocarbons. Whilst the recorded hydrocarbon concentration in groundwater is above the UK Drinking water standard of 10µg/l, the site is not located within a SPZ and there are no potable water supplies in the vicinity of the site. The actual risk therefore to controlled waters is considered to be negligible.

5.2.3 Asbestos

No visual evidence of asbestos was identified during the site walkover survey or during the intrusive works. However as a screen, three samples of the shallow soils were examined for the presence of asbestos. No asbestos was identified in any sample.

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5.2.4 Ground gas risk assessment

Monitoring of the gas concentrations within the standpipes in the three boreholes was carried out on three occasions. A peak carbon dioxide level of 3.5% was recorded. No methane and no detectable gas flow was recorded from any of the boreholes.

The gas risk assessment for the site has been carried out generally in accordance with the guidance presented in CIRIA document C665 (2007).

The assessment is based upon the calculation of a site specific Gas Screening Value (GSV), calculated by multiplying the total concentration (percentage) of the gas recorded, by the gas flow rate (l/hr) measured within the borehole. In the absence of any detectable flow rates the GSV have been calculated assuming that a flow rate equal the limit of detection of the instrument (0.1l/hr) is present.

The following table summarises the calculated GSV for the site:

Table 20. Calculated GSV for carbon dioxide and methane

Gas	**GSV**
Carbon Dioxide	0.035x 0.1 = 0.0035
Methane	0.000 x 0.1 = 0.0000

For standard low rise housing, the NHBC have developed a characterisation system which compares the calculated GSV or typical maximum values to generic "traffic light" scenarios. These are summarised in table 8.7 of the CIRIA document.

The site is considered to be classified as "Green" and no specific gas protection measures are considered to be necessary.

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5.3 Quantitative Contamination Risk Assessment

An appropriate contamination risk assessment of a site considers the potential sources of contamination, the potential receptors and how the sources and receptors may be linked (the pathways).

A significant risk is only deemed to exist where a significant pollutant linkage has been identified i.e. where a potentially significant source is linked to the receptor via a significant pollutant pathway. A site is considered suitable for use where no significant pollutant linkages are present.

The quantitative risk assessment takes into account the findings of the intrusive works and laboratory testing along with on site observations in order to identify potentially significant risks.

The assessment of risk has been carried out in line with guidance published within "Contaminated Land Risk Assessment: A guide to good practice" published by CIRIA (C552, 2001). The level of risk is determined using the risk matrix presented in the following table. Descriptions of the classifications of likelihood, severity and risk are provided in Tables 9, 10 and 11.

Table 21. Risk Assessment Matrix – Comparison of Likelihood and Severity

		Likelihood of significant impact			
Severity of potential impact		**Very Low Likelihood**	**Low Likelihood**	**Moderate Likelihood**	**High likelihood**
	Very Minor	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

The risk assessment has been carried out based on the site being developed for residential purposes including the provision of areas of soft landscaping (ammenity areas) but no private gardens. Should the proposed end use be altered, particularly if private gardens are proposed, a revised risk assessment will be required.

5.3.1 Quantitative Contamination Risk Assessment for Human Health

The following confirmed and potential sources of contamination that may pose a risk to end users have been identified by the investigation at the site:

Confirmed Sources:

1) Elevated concentrations of PAHs within topsoil.

Potential Sources:

2) Potential petroleum hydrocarbon contamination from former underground fuel tank.

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A quantitative human health risk assessment conceptual model is presented in the following table of this report and is presented diagrammatically as Figure 4.

Table 22. Quantitative Human Health Conceptual Model - Pollutant Linkages and Assessment of Risk

Contaminant Source	Potential Pathway(s)	Likelihood	Severity	Initial Assessment of Risk to Human Health
Elevated concentrations of PAHs within topsoil.	• Dermal contact with soil (Indoor & Outdoor). • Direct soil and dust ingestion. • Inhalation of indoor and outdoor soil dust.	Low	Moderate	Low/Moderate
Potential petroleum hydrocarbon contamination from former underground fuel tank	• Inhalation of soil vapours.	Low	Moderate	Low/Moderate

5.3.2 Quantitative Contamination Risk Assessment for Controlled Water

The following potential source may pose a significant risk to controlled waters:

- Petroleum hydrocarbon contamination from former underground fuel tank.

Given that no evidence of gross petroleum hydrocarbon contamination has been identified at the site, the site does not lie within a source protection zone and in light of the low concentrations of petroleum hydrocarbons recorded in the groundwater the risk to controlled waters from the site appears to be negligible. However it is recommended that inspection of the area beneath the garage should be carried out, see Section 5.5, and a revised assessment of risk to controlled waters undertaken if significant petroleum hydrocarbon contamination is encountered.

A quantitative controlled water risk assessment conceptual model is presented in the following table of this report and is presented diagrammatically as Figure 4.

Table 23. Quantitative Controlled Water Conceptual Model - Pollutant Linkages and Assessment of Risk

Contaminant Source	Potential Pathway(s)	Likelihood	Severity	Initial Assessment of Risk to Controlled Water
Potential petroleum hydrocarbon contamination from former underground fuel tank	• Groundwater Flow	Vey Low	Minor	Negligible – subject to confirmation by inspection.

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5.4 Risks to Other Potential Receptors

The following general guidance is given with regards to other potential on site receptors, which may not necessarily be statutory drivers for remedial works.

5.4.1 Construction Workers

The possibility that petroleum hydrocarbon contamination may be present below the floor slab of the former garage unit cannot be discounted at this stage. This has the potential to pose a direct risk to construction workers. An assessment of the risks should be undertaken before commencing works and appropriate training undertaken and appropriate Personal Protective Equipment should be issued and used were necessary.

Notwithstanding the above and as a minimum and in accordance with industry best practise all ground-workers should be issued with the appropriate PPE and should be instructed in safe working methods. As a precaution instructions should also be given in the recognition of potentially hazardous materials, including oily and odorous soil and water and discoloured or fibrous substances. Any oil-like substances contacting the skin must be washed off immediately using an appropriate cleanser. Operatives should be warned to avoid contact between hands and mouth before washing. The consumption of food and smoking must be confined to designated clean areas. Suitable welfare (washing) facilities should be provided. These precautions should be taken in addition to anything highlighted by a site specific risk assessment which should be undertaken by any contractor prior to commencing work.

5.4.2 Services

The risk of damage to services from the contamination identified is considered to be low. It is considered that the service providers' requirements represent the most informed decision when it comes to the protection of their services. It is recommended that all service providers should be contacted with regard to determining any specific precautions they may require and all precautions complied with.

5.4.3 Planting

Maximum concentrations of the phytotoxic elements copper, zinc and boron of 26mg/kg, 266mg/kg and 0.8mg/kg, respectively, were recorded within the samples tested. Whilst these concentrations are not considered to pose a risk to general planting, a horticulturist should be consulted with regard to any specific planting schemes proposed.

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5.5 Recommendations

As significant risks to end users have been identified at the site it is considered that remedial measures will be required as part of the proposed development.

Various options for remediation of the site will need to be considered. The remediation works which are ultimately adopted will need to be detailed within a separate remediation strategy, along with a verification plan. This should be produced once this risk assessment report has been reviewed and approved by the local authority.

The remediation strategy should include an inspection of the soils underlying the concrete slab of the garage in the north east corner of the site, where the former underground fuel tank is understood to be located. Soils exposed at formation level and at depth in this area should be tested to confirm the absence of significant hydrocarbons. The results of the inspection and testing should be used to inform the remediation requirements, if any, for this part of the site. The remediation strategy should also allow for the inspection of stripped formations in general as it is considered likely that the topsoil at the site will have to be removed.

In addition, should materials be encountered during the course of the works that have not previously been identified or that are suspected of being 'contaminants', advice should be sought immediately on their identification and how they should be treated.

If necessary the newly identified contaminants will be subject to a revised risk assessment and remediation strategy.

5.6 Handling and Disposal of Waste and Quality of Imported Materials

5.6.1 Waste Management

Soils and other materials taken for disposal should be handled, transferred and disposed of as controlled waste in accordance with the requirements of the Waste Management, Duty of Care Regulations. Copies of waste transfer notes detailing the site address, the waste type, details of the haulage contractor and full details of the disposal site must be kept.

The Site Waste Management Plans Regulations, 2008, require a site waste management plan to be prepared and implemented by clients and principal contractors for all construction projects with an estimated cost greater than £300,000 excluding VAT. The plans must record details of the construction project, estimates of the types and quantities of waste that will be produced, and confirmation of the actual waste types generated and how they have been managed. More detailed reporting requirements apply to projects exceeding £500,000.

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5.6.2 Quality of Imported Soils

Full details of the source of any imported soils should be documented (including topsoil). Any material from a potentially contaminated (e.g. industrial) site should be rejected. It is recommended that chemical (contamination) testing results are obtained and supplied for comment prior to accepting the soils on site. As a minimum the contaminants tested for should include arsenic, cadmium, chromium, lead, mercury, nickel, selenium and polycyclic aromatic hydrocarbons. The material should be free from petroleum hydrocarbons, and contain no significant quantity of putrescible material (incl. wood or paper). Materials must comply with current CLEA guidance for the proposed end use of the site.

Topsoil should, when inspected visually, be free from propagules of aggressive weeds, fragments of glass, bricks, concrete, wire or other potentially hazardous foreign matter and bulk vegetative growth, in order to ensure negligible risk of subsequent weed problems (introduced in the soil) or traumatic injury.

It is stressed that the quality of any materials imported onto the site is critical to the successful completion of any remediation works.

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6. CONCLUSIONS

The following conclusions present a summary of the main findings of the investigation. However, no reliance should be placed on any point of the conclusions until the whole of the report has been read as other sections of the report may put into context the information contained herein.

6.1 Geotechnical Assessment

- The ground investigation confirmed the underlying soils to comprise a shallow thickness of made ground, overlying, in turn, firm to stiff sandy clay and loose to medium dense sand of the River Terrace Deposits.

- Standing water depths of between 0.95m and 1.7m below ground level were recorded during the standpipe monitoring programme.

- It is recommended that precautions against shrinkage and heave for any foundation system constructed within or through the fine grained River Terrace Deposits should assume a low volume change potential and take into account current guidance such as that given by the National House Builders Council (NHBC).

- A net allowable bearing capacity of 125kN/m^2 may be assumed for the design of spread (pad or strip) foundations up to 2m across bearing within the River Terrace Deposits. Attention is however drawn to the shallow groundwater level and consideration could be given to the use of piled foundations or ground improvement techniques.

- If encountered above the water table, the ingress of water into excavations should be adequately managed by pumping from sumps. Below the water table positive groundwater control measures are likely to be required in order to ensure sensibly dry conditions and excavations stability. The potential for running sand conditions to develop should not be overlooked.

- Entry into unsupported excavations should only be permitted where they have been assessed as safe to enter but in any case it is advised that personnel access to unsupported excavations greater than 1.2m depth should be prohibited.

- In accordance with the BRE digest, a DS-1 Design Sulfate Class and an AC-1 ACEC classification may be assumed as a minimum for the design of concrete in contact with the ground.

- Ground floors should preferably be suspended but ground bearing floor slabs may be considered where made ground soils are not present or are to be removed from beneath building footprints and the depth of foundations required to protect against seasonal soil volume changes close to trees is less than 1.5m.

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- Based upon review of the in-situ test results and the quoted guidance it is suggested that for the River Terrace Deposit soils a CBR value of 3% may be adopted for preliminary pavement design. The subgrade should be assumed to be susceptible to frost heave.

6.2 Contamination Status Assessment

- It is proposed to redevelop the site with apartments and soft landscaped amenity areas, with car parking.

- The River Terrace Deposits underlying the site are classed as a Secondary A Aquifer. The underlying White Chalk Sub group (which was not encountered during the investigation) is classified as a Principal Aquifer.

- The site does not lie within an Environment Agency Source Protection) with regard to the protection of the quality of groundwater that is abstracted for potable supply and there are no abstractions in the vicinity of the site.

- The site was occupied by a large structure denoted as Summerly Barn on the 1876 map. The south-eastern, L-shaped corner of the latter building occupies the same footprint as the present building. The western wing of the barn was demolished some time between 1991 and 2012 and is presently undeveloped and hoarded off from the remainder of the site.

- The testing undertaken has identified elevated concentrations of PAHs with the topsoil and some remedial works will be required in this connection.

- The ground gas monitoring undertaken has not identified elevated gas levels requiring protection measures to be installed into buildings on site.

- The risk to controlled waters appears to be negligible but this is subject to confirmation by inspection of the soil underlying the garage in the north eastern corner of the site.

- Specific remedial action is likely to be required to address the significant risks identified. These should be detailed in a separate remediation strategy once the present risk assessment has been reviewed and agreed by the local authority. The remediation strategy should include inspections and further testing of soils in the vicinity of the filled in tank and the inspection of stripped formations across the site.

- Quantitative conceptual models have been prepared of the complete pollutant linkages that have been identified in relation to human health and controlled waters. These are presented in Tables 22 and 23. A diagrammatic conceptual model is presented as Figure 4.

- It is advised that the local authority has ultimate jurisdiction over contamination assessment, and, as such, they must be involved in

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discussions relating to the scope of the investigation works undertaken and the conclusions drawn, along with any specific proposals for remedial action.

Ashdown Site Investigation Limited
August 2012

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APPENDIX A

Site Walkover Photographs



Photo 1 - Showing garage (North East corner of the Site).



Photo 2 - Showing single storey L-shaped brick and flint built property with gardens

ASHDOWN SITE INVESTIGATION LIMITED	SITE:SITE: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex	Photographs	LW23175

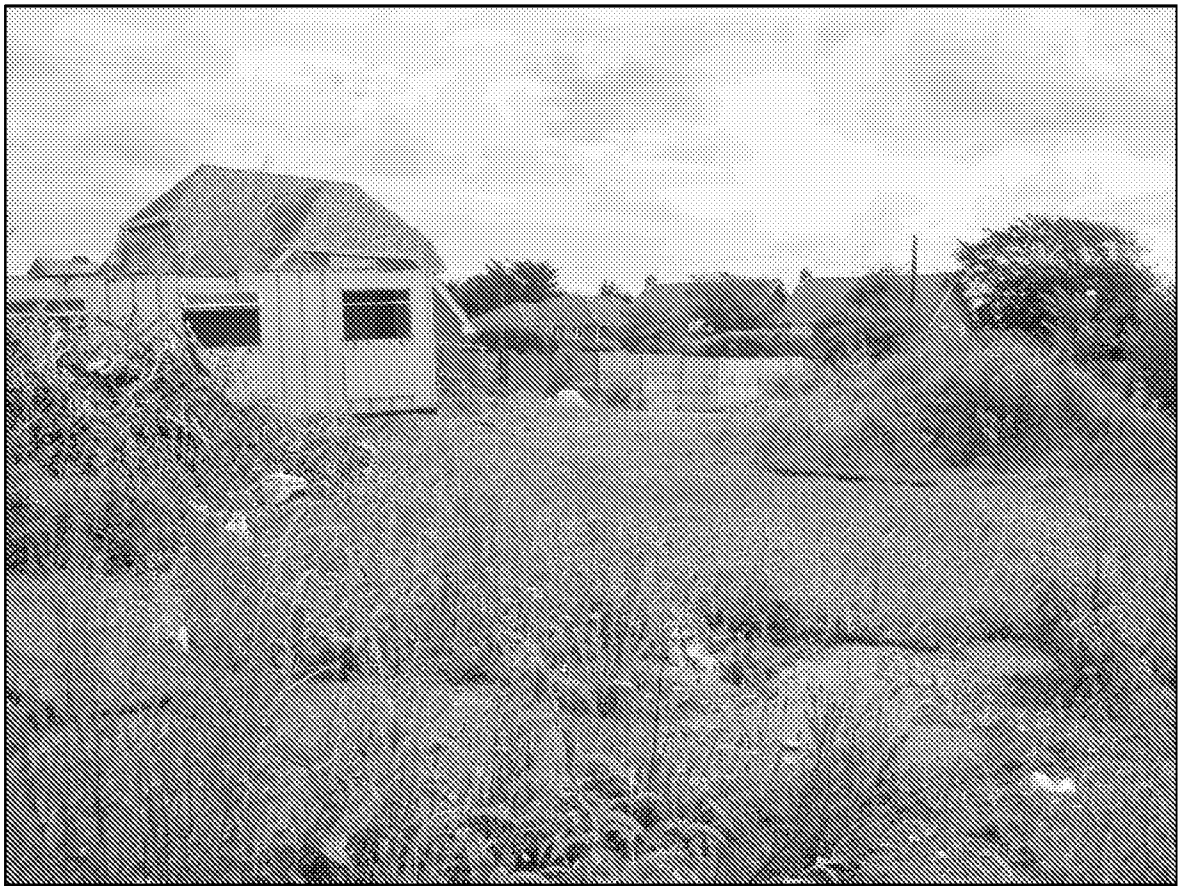

Photo 3 - Showing The western (hoarded) part of the site

APPENDIX B

Exploratory Hole Notes

In Situ Testing Notes

Exploratory Hole Records

DPSH Continuous Dynamic Probe N100 v Depth Profile

Summary of in situ TRL Cone Penetrometer (CBR) Test Results

Summary of Gas Analyses and Water Depths

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U 'Undisturbed' Sample: - also known as 'U100' or 'U4' - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo Sample not obtained.
U* Full penetration of sample not obtained.
U** Full penetration obtained but limited sample recovered.
Pi Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D Disturbed Sample.
R Root Sample.
B Bulk Disturbed Sample.
W Water Sample.
J Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T Tub Sample
E Environmental Suite (including a jar sample, tub sample and vial sample)

In situ Testing

S Standard penetration test (SPT): In the borehole record the depth of the test is that at the start of the normal 450mm penetration, the number of blows to achieve the standard penetration of 300mm (the 'N' value) is shown after the test index letter, but the seating blows through the initial 150mm penetration are not reported unless the full penetration of 450mm cannot be achieved. In the latter case, the symbols below are added to the test index letter:-
S* Seating blows only
S** Blow count includes seating blows
S++ No penetration
So 'Split spoon' SPT sampler sank under its own weight.
The test is usually completed when the number of blows reaches 50 (25 blows for seating count). The depths of both the top and bottom of the test drive are shown in the sample column on the Borehole Record. If a sample is not recovered in the sampler, a disturbed sample is over the depth of the test as boring continues.

C Standard Penetration Test (SPT) conducted usually in coarse grained soils or weak rocks using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone fitted in place of the sampler. Variations in test results are indicated by the same symbols as for the SPT (above).

V Shear Vane Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

H Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

P Perth Penetrometer Test: See Insitu Testing Notes in Appendix C for full description. Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column. In sand the number of blows is approximately equivalent to the SPT "N" value.

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002) and Part 2 Principles of classification (BS EN 14688-2:2004).

Fine Grained Soils

The consistency of fine grained soils given in the report is based on visual inspection of the samples and the strength is based on results of in situ and/or laboratory undrained shear strength tests when carried out.

The consistency is determined on the following basis:

Consistency	**Manual Test**
Very Soft	Soil exudes between fingers when squeezed in hand
Soft	Soils can be moulded by light finger pressure
Firm	Cannot be moulded by finger but rolled to 3mm threads without breaking/crumbling
Stiff	Crumbles/breaks when rolled to 3mm thick threads but can be moulded into a lump again
Very Stiff	Cannot be moulded and crumbles under pressure, can be indented by thumbnail

Based on BS EN ISO 14688-1:2002

The terms used for the designation of the undrained shear strength are as follows:

Undrained Shear Strength	
Extremely to Very Low	<20 kPa
Low	20-40 kPa
Medium	40-75 kPa
High	75-150 kPa
Very High	150-300 kPa
Extremely high	300-600 kPa

Based on BS EN ISO 14688-2:2004

Note: The undrained shear strength of the soils is measured either by laboratory testing or in the field using hand penetrometer or shear vane.

It is recognised that any coarse grained soil that has in excess of approximately 35% fine grained soil (clay and silt) can often be expected to behave as a fine grained soil despite the dominance of coarse grained material within the soil mass. To reflect this, it is the soil type that dominates the behaviour of the soil mass that appears on the exploratory hole records.

Coarse Grained Soils

The relative densities of coarse grained soils (sand and gravel) given in the report are based on field estimations and the results of the Standard Penetration Test (SPT) and equivalent correlation from other testing. The classification in terms of "N" Values is as follows:

SPT 'N' Value	**Relative Density**
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Greater than 50	Very Dense

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003).

The description of rock mass includes the type of rock, structure, discontinuities and weathering.

The unconfined compressive strength of rock material is determined on the following basis:

Term	**Field Identification**	**Unconfined Compressive Strength (MPa)**
Extremely Weak	Indented by thumbnail	Less than 1
Very Weak	Crumbles under firm blows with point of geological hammer, peeled by pocket knife	1 to 5
Weak	Peeled by pocket knife with difficulty, shallow indentations made by firm blow with geological hammer	5 to 25
Medium Strong	Cannot be peeled or scraped with knife, can be fractured with single firm blow of geological hammer	25 to 50
Strong	Requires more than one blow of geological hammer to fracture	50 to 100
Very Strong	Requires may blows of geological hammer to fracture it	100 to 250
Extremely Strong	Can only be chipped with geological hammer	Greater and 250

The terms describing discontinuity and bedding spacing are as follows:

Bedding Thickness		**Discontinuity Spacing**	
Very Thick	>2000mm	Very Wide	>2000mm
Thick	2000-600mm		
Medium	600-200mm	Wide	2000-600mm
Thin	200-60mm	Medium	600-200mm
Very Thin	60-20mm	Close	200-60mm
Thickly Laminated	20-6mm	Very Close	60-20mm
Thinly Laminated	<6mm	Extremely Close	<20mm

Chalk

Chalk description is based on BS EN ISO 14688 and BS EN ISO 14689. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.

IN-SITU TESTING NOTES

1 Standard Penetration Testing

Standard penetration testing (SPT) is carried out within a cased cable percussion borehole. The test is performed using a either a split spoon (barrel) sampler in finer grained deposits, or, in coarser grained soils or weak rocks, using a 50mm diameter, 60° apex solid cone fitted in place of the sampler.

The sampler is driven into the deposits at the base of the borehole by means of a 63.5kg hammer falling freely through 760mm.

In the borehole record the depth of the test is that at the start of the normal 450mm penetration, the number of blows to achieve the standard penetration of 300mm (the "N" value) is shown after the test index letter, but the seating blows through the initial 150mm penetration are not reported unless the full penetration of 450mm cannot be achieved.

(BS EN ISO 22476-3:2005, Geotechnical investigation and testing – Field Testing, Part 3)

2 Dynamic Probe Testing

The DPH (heavy) dynamic probing rig drives a 32mm diameter rod with a 15cm^2 area, 90° end cone into the ground by means of a 50kg hammer which falls freely through a distance of 0.5m. The number of blows per 100mm penetration (N_{100}) is recorded.

The DPSH (super heavy) dynamic probing rig drives a 35mm diameter rod with a 20cm^2 area, 90° end cone into the ground by means of a 63.5kg hammer that falls freely through a distance of 0.75m. The number of blows per 100mm penetration (N_{100}) is recorded. The results can provide a useful indication of the relative strength of the material. The dynamic probing is carried out in accordance with BS EN ISO 22476-2:2005.

A tentative correlation with the Standard Penetration Test (SPT) N value can be made summing three consecutive the N_{100} blow counts.

3 Perth Penetrometer Test

In this test a hardened stainless steel rod is driven into the deposit by a 9.5kg sliding hammer falling freely through 600mm. After an initial penetration of 150mm the number of blows required to drive the rod a further 300mm is recorded. In sand the Perth blow count gives a close correlation to the "N-value" that could be expected from a standard penetration test (SPT) made in similar materials. The results are less reliable in coarser grained materials but can give an indication of their engineering properties. The perth penetrometer test is carried out in accordance with the Australian Standard AS 1289:6.3.3-1997, Method of Testing Soils for Engineering Purposes, there is no European equivalent code.

4 Undrained Shear Strength

Undrained shear strength determinations are made in situ within the fine grained soils using a Geonor hand shear vane or (usually in the case of window sampler boreholes) a hand penetrometer. The test records the undrained shear strength (cohesion) in kN/m^2. The shear vane records a maximum shear strength of 130kN/m^2 and the hand penetrometer records a maximum shear strength of 250kN/m^2.

3 California Bearing Ratio Test

In this test a hand held Farnell cone penetrometer apparatus is pushed into the deposits for the estimation of the California bearing ratio of the subgrade (for use in pavement design). The test equipment is design for the estimation of the bearing ratio of fine grained soils (clay and silt) only and is unsuitable for use in coarse grained soils and rock.

ASHDOWN SITE INVESTIGATION LIMITED
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: WS1

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing: Sample Type	Depths: From (m)	Depths: To (m)	Vane/ Pen Test N Value	Strata: Legend	Depth / Reduced Level	Strata Descriptions
						0.00	Ground Level
	J T	0.20					Asphalt (50mm) over, Firm to stiff light orange brown and light grey slightly gravelly very silty very sandy CLAY. Gravel is fine to coarse sandstone and calcitic nodules. (River Terrace Deposits)
	D H	0.50		90			
	J T	0.60					
	H	0.90		60			
	D V	1.00		90		1.10	
	P	1.00	1.45	12			Firm to stiff/ medium dense orange brown and grey mottled CLAY/ fine to medium SAND. (River Terrace Deposits)
	D V	2.00		90			
	D V	3.00		>130		3.00	
							End of Borehole

Remarks:

Standing water level at 1.5m on completion of borehole.

Borehole stable on completion.

Standpipe installed to 3.0m depth; 3.0m to 1.0m slotted pipe with gravel surround; 1.0m to ground level plain pipe with bentonite seal; completed with gas tap and secrity cover concreted flush with ground surface.

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: LG

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: WS2

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing: Sample Type	Depths: From (m)	Depths: To (m)	Vane/ Pen Test N Value	DPSH Profile Blows/100mm (5 15 25)	Strata: Legend	Depth / Reduced Level	Strata Descriptions
							0.00	Ground Level
	J T	0.10						Asphalt (70mm) over,
	J T	0.20					0.25	Grey silty sandy fine to coarse gravel of flint and occasional crystalline rock (70mm) over,
	J T	0.35						MADE GROUND: Off white compacted chalk fill.
	D H	0.50		195				Stiff light orange brown and light grey mottled slightly gravelly silty sandy CLAY. Gravel is fine ironstone. (River Terrace Deposits)
	H	0.90		65				
	D V	1.00		>130			1.20	
	D	1.50						Loose orange brown and light grey mottled slightly gravelly clayey silty fine to medium SAND. Gravel is fine to coarse flint. (River Terrace Deposits)
								becoming medium dense below 1.9m depth.
	D	2.50					2.90	
	D	3.00					3.00	Medium dense light grey/ off white gravelly fine to medium SAND. Gravel is fine to coarse chalk and flint. (River Terrace Deposits)
								End of Borehole

Remarks:

Standing water level at 1.3m on completion of borehole, rising to 0.75m in 15 minutes.

Borehole stable on completion.

Dynamic probe carried out adjacent to borehole.

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: LG

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: WS3

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Sample Type	Depths From (m)	Depths To (m)	Vane/ Pen Test N Value	DPSH Profile Blows/100mm (5 15 25)	Legend	Depth / Reduced Level	Strata Descriptions
							0.00	Ground Level
	J T	0.10						Topsoil with occasional fine to medium gravel of brick, flint and clinker (150mm) over,
	J T	0.20					0.30	MADE GROUND; Brown and black silty clayey fine to coarse gravel of clinker and chalk with occasional brick and flint.
	J T	0.40					0.60	MADE GROUND: Light brown and off white silty gravelly clay. Gravel is fine to coarse flint, clinker and chalk with occasional cobbles of chalk.
	J T	0.70						Firm orange brown and grey mottled silty sandy CLAY. (River Terrace Deposits)
	D H	0.80		60				
	H	0.90		90				
	V	1.00		>130				
	H	1.50		75				
	D	1.80					1.90	Loose blue grey and orange brown clayey gravelly fine to coarse SAND. Gravel is fine to coarse flint. (River Terrace Deposits) becoming medium dense below 2.2m depth
	D	2.80					3.00	End of Borehole

Remarks:

Standing water level at 1.7m on completion of borehole.

Borehole stable on completion.

Dynamic probe carried out adjacent to borehole.

Standpipe installed to 3.0m depth; 3.0m to 1.0m slotted pipe with gravel surround; 1.0m to ground level plain pipe with bentonite seal; completed with gas tap and secrity cover concreted flush with ground surface.

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: LG

ASHDOWN SITE INVESTIGATION LIMITED
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: WS4

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing				Strata		
	Sample Type	Depths From (m)	Depths To (m)	Vane/ Pen Test N Value	Legend	Depth / Reduced Level	Strata Descriptions
						0.00	Ground Level
	J	0.10				0.20	Topsoil with some fine to coarse gravel of flint, clinker and brick.
	J	0.30				0.40	MADE GROUND: Brown and orange brown silty sandy gravelly clay. Gravel is fine to coarse flint, chalk, brick and clinker.
	J D	0.50					Stiff orange brown and grey mottled silty sandy CLAY. (River Terrace Deposits)
	D	1.00					
	P	1.00	1.45	22			
	D	1.90				2.00	
	D	2.50	3.00				Loose becoming medium dense blue grey and orange brown clayey gravelly fine to coarse SAND. Gravel is fine to coarse flint. (River Terrace Deposits)
						3.00	
							End of Borehole

Remarks:

Standing water level at 2.3m on completion of borehole.

Borehole stable on completion.

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: LG

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: WS5

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing: Sample Type	Depths: From (m)	Depths: To (m)	Vane/ Pen Test N Value	DPSH Profile Blows/100mm (5 15 25)	Strata: Legend	Depth / Reduced Level	Strata Descriptions
							0.00	Ground Level
	J T	0.01						Crushed brick and concrete (50mm) over,
	J T	0.15						Firm to stiff orange brown and grey brown slightly gravelly silty sandy CLAY. Gravel is fine to medium ironstone. (River Terrace Deposits)
	D H	0.50		60				
	H	0.90		60				
	D V	1.00		>130				becoming light orange brown and light grey mottled below 1.1m depth.
	D	1.90					2.00	
	V	2.00		110				Loose orange brown and grey mottled clayey SAND with horizons of fine to medium sand and occasional fine to coarse gravel of flint. (River Terrace Deposits)
	D	2.50	3.00					becoming medium dense below 2.8m depth.
							3.00	End of Borehole

Remarks:

Standing water level at 2.25m on completion of borehole.

Borehole stable on completion.

Dynamic probe carried out adjacent to borehole.

Standpipe installed to 3.0m depth; 3.0m to 1.0m slotted pipe with gravel surround; 1.0m to ground level plain pipe with bentonite seal; completed with gas tap and secrity cover concreted flush with ground surface.

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: LG

ASHDOWN SITE INVESTIGATION LIMITED
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: HA1

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing				Strata		
	Sample Type	Depths From (m)	Depths To (m)	Vane/ Pen Test N Value	Legend	Depth / Reduced Level	Strata Descriptions
						0.00	Ground Level
	J T	0.05					Topsoil with a trace of fine gravel of brick and flint (100mm) over, MADE GROUND: Brown and grey silty sandy clayey fine to coarse gravel of brick, concrete, chalk and flint with a trace of clinker.
	J T	0.20				0.45	
	J T	0.60					Stiff orange brown and grey brown silty sandy CLAY. (River Terrace Deposits)
	V	0.80		>130		0.80	
							End of Borehole

Remarks:

Borehole dry and stable on completion.

Excavation Method: Hand Auger

Borehole Diameter:

Made By: LG

ASHDOWN SITE INVESTIGATION LIMITED
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: HA2

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing				Strata		
	Sample Type	Depths From (m)	Depths To (m)	Vane/ Pen Test N Value	Legend	Depth / Reduced Level	Strata Descriptions
						0.00	Ground Level
	J T	0.00	0.25			0.25	Topsoil with occasional fine to coarse gravel of flint and clinker.
	J T	0.30	0.70				Stiff light brown silty sandy CLAY. (River Terrace Deposits)
	V	0.70		>130		0.70	
							End of Borehole

Remarks:

Borehole dry and stable on completion.

Excavation Method: Hand Auger

Borehole Diameter:

Made By: LG

ASHDOWN SITE INVESTIGATION LIMITED
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Swanborough Farm
Swanborough
Lewes, East Sussex
BN7 3PF

Borehole No.: HA3

Site Name: Summerley Corner South Site, Summerley Lane, Bognor Regis

Job No.: LW23175

Start Date: 16/07/2012 | End Date: 16/07/2012

Standpipe Installation	Samples and Testing				Strata		
	Sample Type	Depths From (m)	Depths To (m)	Vane/ Pen Test N Value	Legend	Depth / Reduced Level	Strata Descriptions
						0.00	Ground Level
	J T	0.00	0.30			0.30	Topsoil with occasional fine to coarse gravel of flint and clinker.
	J T	0.35	0.60				Stiff light brown silty sandy CLAY. (River Terrace Deposits)
	V	0.60		100		0.60	
							End of Borehole

Remarks:

Borehole dry and stable on completion.

Excavation Method: Hand Auger

Borehole Diameter:

Made By: LG

ASHDOWN SITE INVESTIGATION LTD

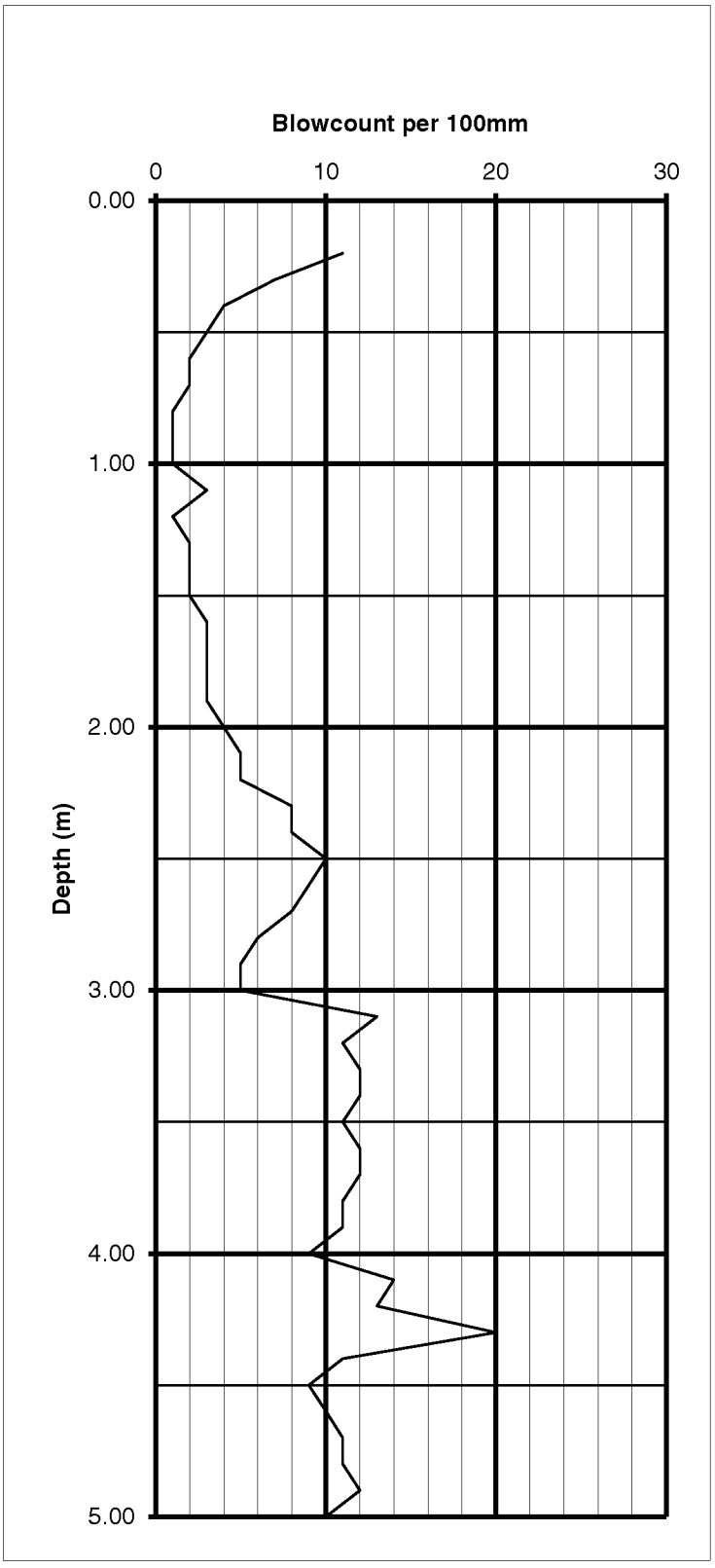
DPSH Continuous Dynamic Probe N_{100} vs Depth Profile

SITE Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Report Ref. LW23175

DP No. WS2

Depth (m)	Blows	Torque (kgm)
0.00		
0.10		
0.20	11	
0.30	7	
0.40	4	
0.50	3	
0.60	2	
0.70	2	
0.80	1	
0.90	1	
1.00	1	
1.10	3	
1.20	1	
1.30	2	
1.40	2	
1.50	2	
1.60	3	
1.70	3	
1.80	3	
1.90	3	
2.00	4	
2.10	5	
2.20	5	
2.30	8	
2.40	8	
2.50	10	
2.60	9	
2.70	8	
2.80	6	
2.90	5	
3.00	5	
3.10	13	
3.20	11	
3.30	12	
3.40	12	
3.50	11	
3.60	12	
3.70	12	
3.80	11	
3.90	11	
4.00	9	
4.10	14	
4.20	13	
4.30	20	
4.40	11	
4.50	9	
4.60	10	
4.70	11	
4.80	11	
4.90	12	
5.00	10	



Comments

ASHDOWN SITE INVESTIGATION LTD

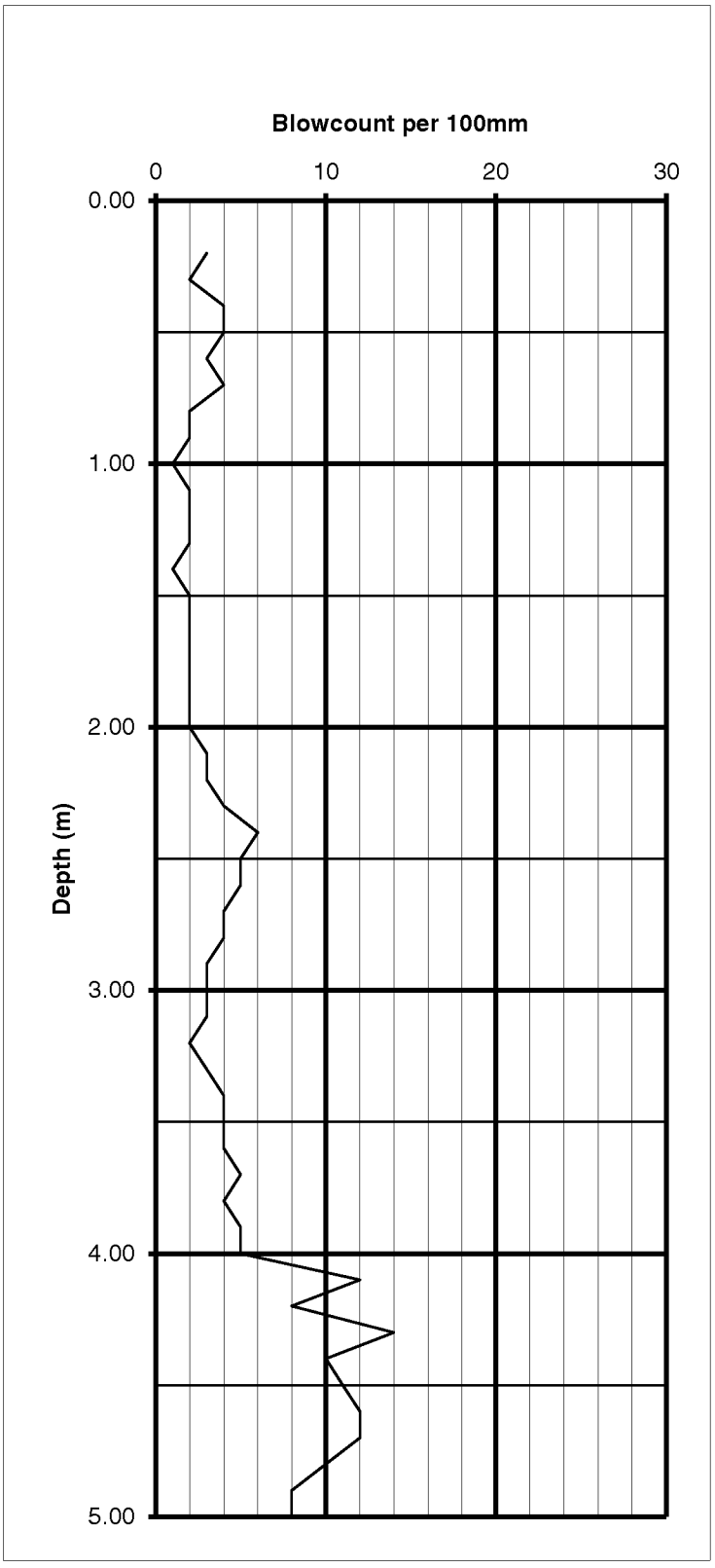
DPSH Continuous Dynamic Probe N_{100} vs Depth Profile

SITE Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Report Ref. LW23175

DP No. WS3

Depth (m)	Blows	Torque (kgm)
0.00		
0.10		
0.20	3	
0.30	2	
0.40	4	
0.50	4	
0.60	3	
0.70	4	
0.80	2	
0.90	2	
1.00	1	
1.10	2	
1.20	2	
1.30	2	
1.40	1	
1.50	2	
1.60	2	
1.70	2	
1.80	2	
1.90	2	
2.00	2	
2.10	3	
2.20	3	
2.30	4	
2.40	6	
2.50	5	
2.60	5	
2.70	4	
2.80	4	
2.90	3	
3.00	3	
3.10	3	
3.20	2	
3.30	3	
3.40	4	
3.50	4	
3.60	4	
3.70	5	
3.80	4	
3.90	5	
4.00	5	
4.10	12	
4.20	8	
4.30	14	
4.40	10	
4.50	11	
4.60	12	
4.70	12	
4.80	10	
4.90	8	
5.00	8	



Comments

ASHDOWN SITE INVESTIGATION LTD

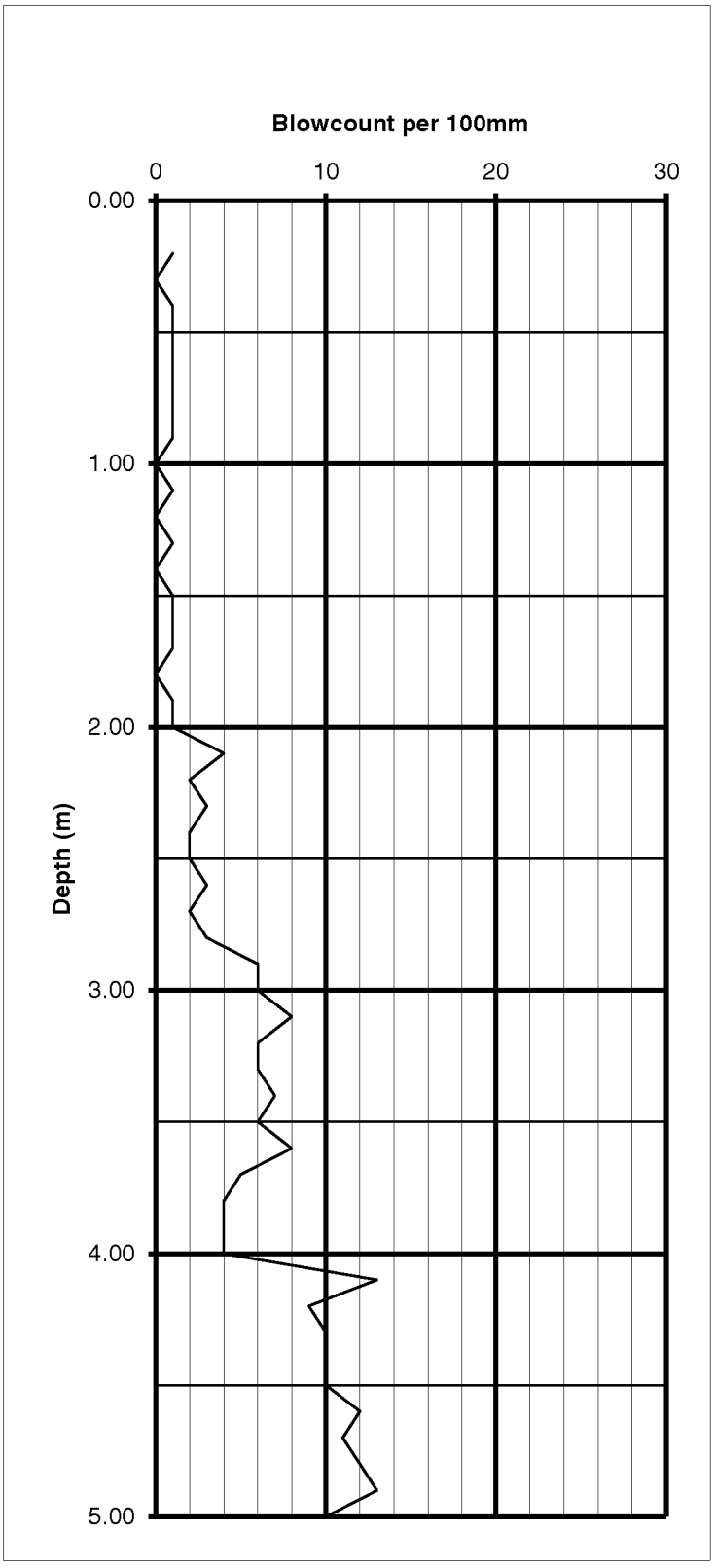
DPSH Continuous Dynamic Probe N_{100} vs Depth Profile

SITE Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Report Ref. LW23175

DP No. WS5

Depth (m)	Blows	Torque (kgm)
0.00		
0.10		
0.20	1	
0.30	0	
0.40	1	
0.50	1	
0.60	1	
0.70	1	
0.80	1	
0.90	1	
1.00	0	
1.10	1	
1.20	0	
1.30	1	
1.40	0	
1.50	1	
1.60	1	
1.70	1	
1.80	0	
1.90	1	
2.00	1	
2.10	4	
2.20	2	
2.30	3	
2.40	2	
2.50	2	
2.60	3	
2.70	2	
2.80	3	
2.90	6	
3.00	6	
3.10	8	
3.20	6	
3.30	6	
3.40	7	
3.50	6	
3.60	8	
3.70	5	
3.80	4	
3.90	4	
4.00	4	
4.10	13	
4.20	9	
4.30	10	
4.40	10	
4.50	10	
4.60	12	
4.70	11	
4.80	12	
4.90	13	
5.00	10	



Comments

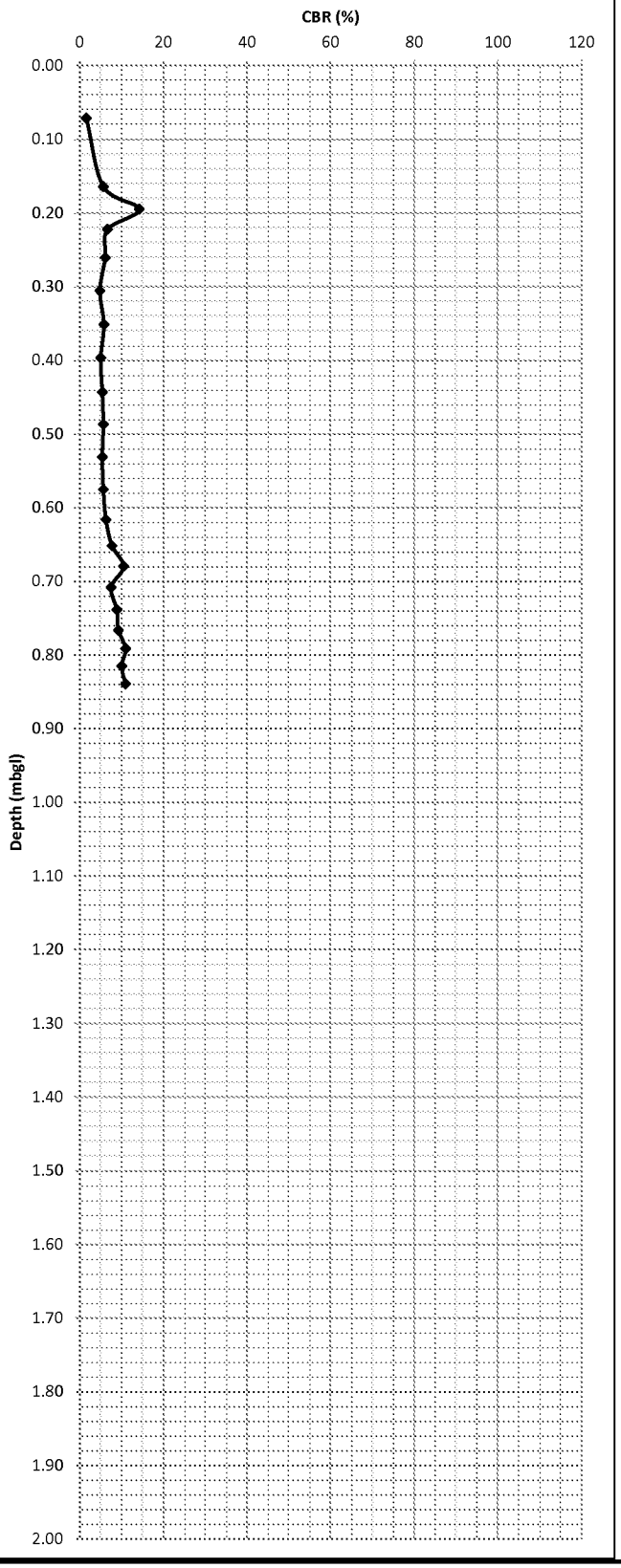
ASHDOWN SITE INVESTIGATION LTD

TRL Dynamic Cone Penetrometer Record

SITE Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex **Report Ref.** LW22176

Test Location Reference	WS4
Depth of Start of Test (mbgl)	0.00

No. Blows	Total Blows	Reading (mm)	Depth (mbgl)	CBR%
DCP Zero Reading		79	0.00	
1	1	222	0.14	2
1	2	265	0.19	6
1	3	283	0.20	14
1	4	320	0.24	7
1	5	360	0.28	6
1	6	410	0.33	5
1	7	452	0.37	6
1	8	500	0.42	5
1	9	545	0.47	5
1	10	588	0.51	6
1	11	633	0.55	5
1	12	676	0.60	6
1	13	715	0.64	6
1	14	747	0.67	8
1	15	771	0.69	10
1	16	804	0.73	7
1	17	832	0.75	9
1	18	859	0.78	9
1	19	882	0.80	11
1	20	907	0.83	10
1	21	930	0.85	11



Notes: CBR Value calculated in accordance with the TRRL equation given in TRL Road Note 8.

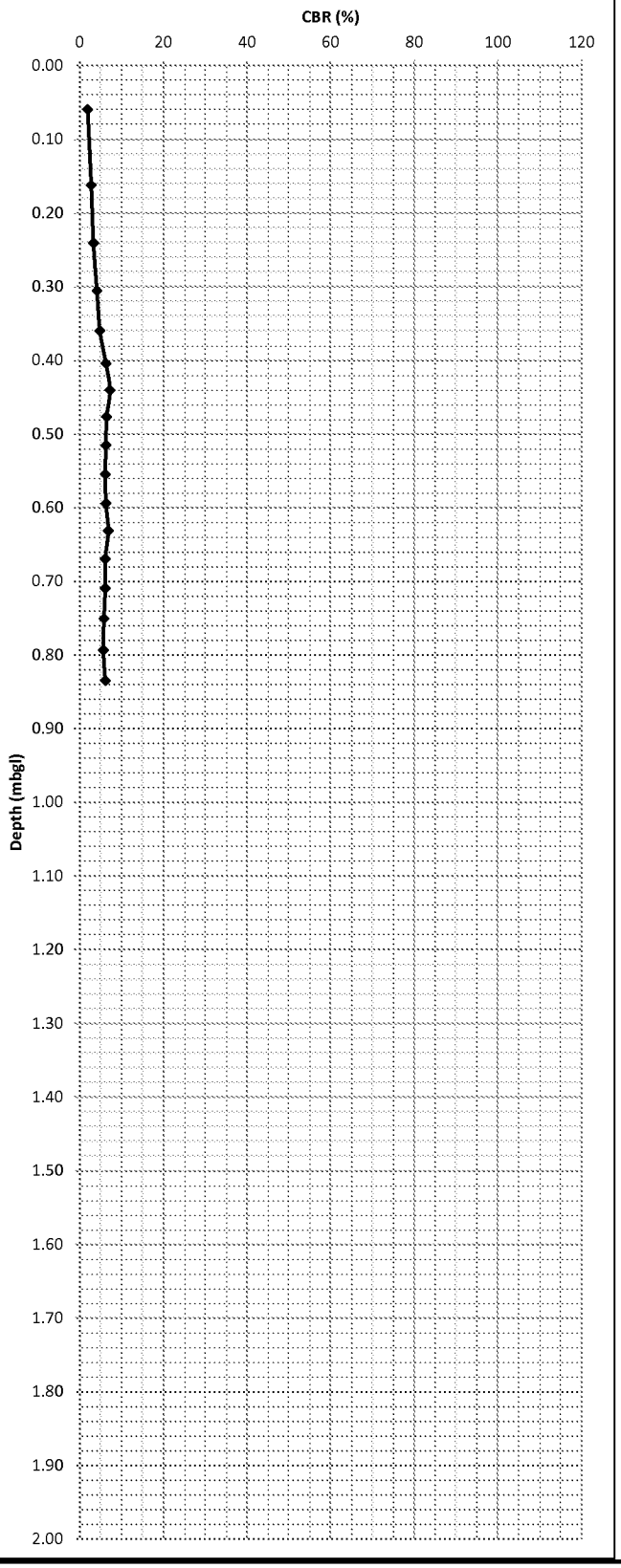
ASHDOWN SITE INVESTIGATION LTD

TRL Dynamic Cone Penetrometer Record

SITE Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex **Report Ref.** LW22176

Test Location Reference	HA2
Depth of Start of Test (mbgl)	0.00

No. Blows	Total Blows	Reading (mm)	Depth (mbgl)	CBR%
DCP Zero Reading		85	0.00	
1	1	205	0.12	2
1	2	290	0.21	3
1	3	362	0.28	3
1	4	420	0.34	4
1	5	470	0.39	5
1	6	509	0.42	6
1	7	543	0.46	7
1	8	581	0.50	6
1	9	620	0.54	6
1	10	660	0.58	6
1	11	699	0.61	6
1	12	735	0.65	7
1	13	775	0.69	6
1	14	815	0.73	6
1	15	857	0.77	6
1	16	900	0.82	6
1	17	940	0.86	6



Notes: CBR Value calculated in accordance with the TRRL equation given in TRL Road Note 8.

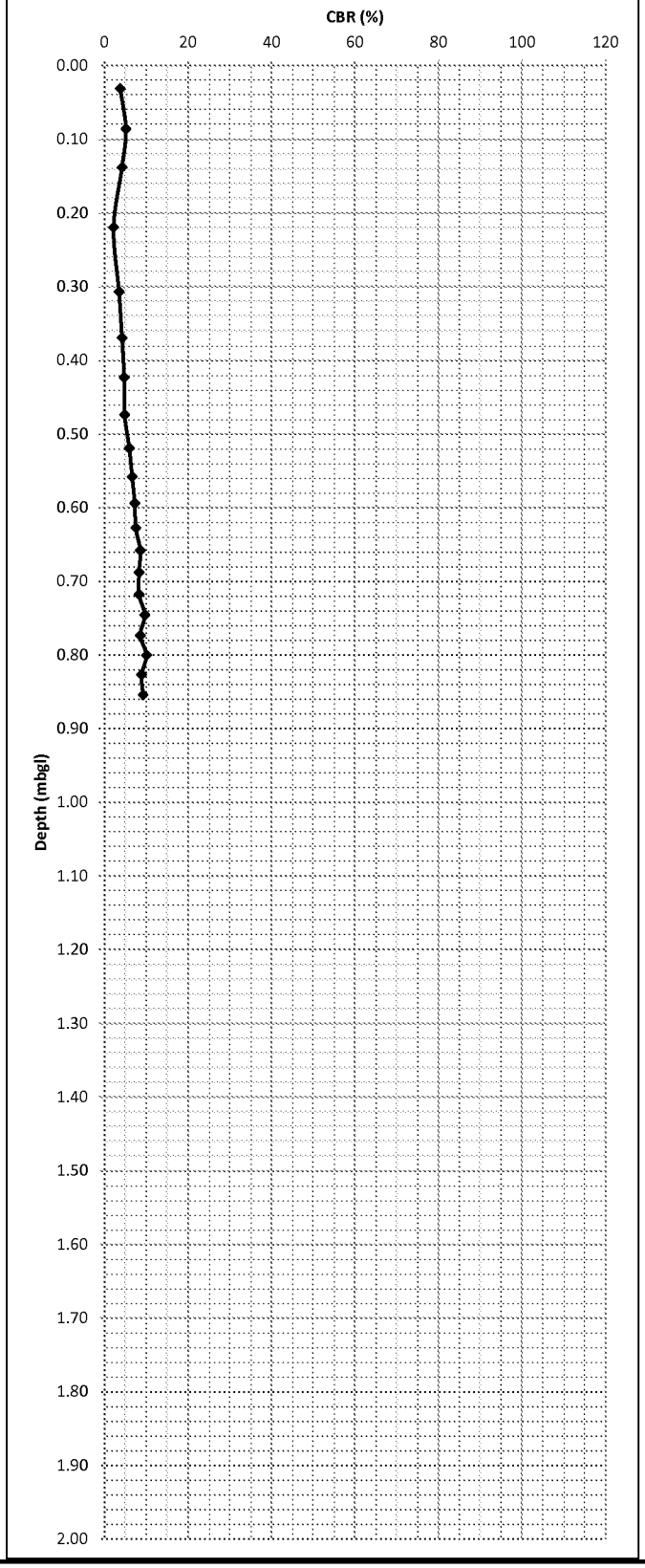
ASHDOWN SITE INVESTIGATION LTD

TRL Dynamic Cone Penetrometer Record

SITE Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex **Report Ref.** LW22176

Test Location Reference	HA3
Depth of Start of Test (mbgl)	0.00

No. Blows	Total Blows	Reading (mm)	Depth (mbgl)	CBR%
DCP Zero Reading		82	0.00	
1	1	145	0.06	4
1	2	192	0.11	5
1	3	249	0.17	4
1	4	355	0.27	2
1	5	423	0.34	3
1	6	480	0.40	4
1	7	531	0.45	5
1	8	581	0.50	5
1	9	622	0.54	6
1	10	659	0.58	7
1	11	693	0.61	7
1	12	726	0.64	7
1	13	755	0.67	9
1	14	785	0.70	8
1	15	815	0.73	8
1	16	841	0.76	10
1	17	870	0.79	9
1	18	895	0.81	10
1	19	923	0.84	9
1	20	950	0.87	9



Notes: CBR Value calculated in accordance with the TRRL equation given in TRL Road Note 8.

ASHDOWN SITE INVESTIGATION LIMITED

Site:	Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex	Report No.:	LW23175
		Sheet No.:	1 of 1

SUMMARY OF GAS ANALYSES AND WATER DEPTHS

WS1

Date	Methane (%)		Carbon Dioxide (%)		Oxygen (%)		Carbon monoxide	Hydrogen Sulphide	Gas Pressure	Emission Rate	Standing Water Depth	Atmospheric Pressure (mb)	
	Peak	Static	Peak	Static	Min.	Static	(ppm)	(ppm)	(mb)	(l/hr)	(m bgl)	On-site	Trend
24/07/12	0.0	0.0	1.5	1.5	18.2	18.2	34	0	0.0	0.0	1.15	1017	Falling
31/07/12	0.0	0.0	2.8	2.8	10.1	10.1	0	0	0.0	0.0	1.27	1015	Rising
07/08/12	0.0	0.0	3.5	3.5	6.5	6.5	0	0	0.0	0.0	1.30	1021	Rising

WS3

Date	Methane (%)		Carbon Dioxide (%)		Oxygen (%)		Carbon monoxide	Hydrogen Sulphide	Gas Pressure	Emission Rate	Standing Water Depth	Atmospheric Pressure (mb)	
	Peak	Static	Peak	Static	Min.	Static	(ppm)	(ppm)	(mb)	(l/hr)	(m bgl)	On-site	Trend
24/07/12	0.0	0.0	0.3	0.3	19.2	19.2	69	0	0.0	0.0	0.95	1017	Falling
31/07/12	0.0	0.0	1.9	0.4	18.1	19.3	7	0	0.0	0.0	1.10	1015	Rising
07/08/12	0.0	0.0	1.2	1.2	17.9	17.9	0	0	0.0	0.0	1.15	1021	Rising

WS5

Date	Methane (%)		Carbon Dioxide (%)		Oxygen (%)		Carbon monoxide	Hydrogen Sulphide	Gas Pressure	Emission Rate	Standing Water Depth	Atmospheric Pressure (mb)	
	Peak	Static	Peak	Static	Min.	Static	(ppm)	(ppm)	(mb)	(l/hr)	(m bgl)	On-site	Trend
24/07/12	0.0	0.0	1.0	1.0	14.4	14.4	0	0	0.0	0.0	1.50	1017	Falling
31/07/12	0.0	0.0	1.7	1.7	16.6	16.7	0	0	0.0	0.0	1.60	1015	Rising
07/08/12	0.0	0.0	2.1	2.1	17.1	17.1	0	0	0.0	0.0	1.70	1021	Rising

Remarks: Readings taken using an infra red gas analyser.
Emission rate measured using a flow pod attached to infra red gas analyser.

Weather Conditions:

24/07/12 – Bright & Clear
31/07/12 – Overcast
07/08/12 – Overcast

APPENDIX C

Geotechnical Laboratory Testing Notes

Laboratory Test Results

i) Geotechnical Testing

ii) Contamination Testing

GEOTECHNICAL LABORATORY TESTING NOTES

1 Index Tests

Index (Atterberg Limit) tests are undertaken on samples of fine grained soils provide the primary information for the classification of fine grained soils.

Fine grained soil is tested to determine its liquid and plastic limits, which are moisture contents that define boundaries between material consistency states. These tests are used to evaluate indices used for soil identification and to help determine the shrinkage and swelling characteristics of the soil under conditions of changing moisture content. The tests are carried out in accordance with BS1377: Part 2: 1990 + A1:1996 Classification tests.

The consistency index is derived from the Index Tests and is summarized in the following table. These divisions may be approximate, particularly for low plasticity soils.

Consistency	Consistency Index
Very Soft	<0.25
Soft	0.25 to 0.50
Firm	0.50 to 0.75
Stiff	0.75 to 1.00
Very Stiff	>1.00

Based on BN EN ISO 14688-2:2004

2 Particle Size Distribution Tests

Sieve analyses are carried out soil samples to establish their particle size distribution that can assist in the assessment of the permeability and classification of granular soils.

The tests are carried out in accordance with BS1377: Part 2: 1990 + A1:1996 Classification tests.

3 Natural Moisture/ Saturated Moisture Content Determination of Chalk

The results of natural moisture or saturated moisture content tests of disturbed samples of chalk are used to assist in the classification of the chalk to determine key geotechnical parameters of strength, density and crushing properties.

The tests are carried out in accordance with BS1377: Part 2: 1990 + A1:1996 Classification tests.

4 Soil Suction Testing

Soil suction tests are undertaken for the determination of the state of desiccation in clay soils.

The testing is carried out in accordance with the Building Research Establishment Information Paper IP4/93, dated February 1993.

5 Triaxial Compression Tests

Undrained triaxial compression tests are carried out on undisturbed samples of cohesive soil in order to assist in the determination of the undrained shear strength of the soil. The results of moisture content and density determinations are also included.

The tests are carried out in accordance with BS1377: Part 7: 1990 + A1:1994 Shear strength tests (total stress).

6 Shear Vane and Hand Penetrometer Testing

Undisturbed samples are tested in the laboratory using a Geonor Hand Shear Vane for the determination of their undrained shear strength.

The vane tests are carried out in general accordance with BS1377: Part 7: 1990 + A1:1994 Shear strength tests (total stress).

7 One Dimensional Consolidation Tests

One-dimensional consolidation tests are performed on undisturbed soil samples to ascertain their settlement characteristics.

The tests are carried out in accordance with BS1377: Part 5: 1990 + A1:1994 Compressibility, Permeability and Durability tests.

8 Dry Density / Moisture Content Relationship (Compaction) Testing

Compaction testing for the determination of the dry density / moisture content relationship is carried out on using either a 2.5kg, 4.5kg hammer or a vibrating hammer.

The tests are carried out in accordance with the British Standard BS1377: Part 4: 1990 + A1 & A2:2002 Compaction-related tests.

9 California Bearing Ratio

The soil is usually compacted at the as dug "natural" moisture content and often at moisture contents around the natural moisture content.

The California bearing ratio is determined in accordance with the British Standard BS1377: Part 4: 1990 + A1 & A2:2002 Compaction related tests.

10 Chemical Testing

Soil samples are tested for their concentration of water soluble sulphate and pH for use in concrete mix design.

Water samples are tested for total sulphate concentration and pH value.

Where a water soluble sulphate content in soils or a total sulphate content in groundwater exceeds 3000mg/l SO_4 the magnesium sulphate content of the samples is required to be determined (BRE Special Digest 1:2005).

ASHDOWN SITE INVESTIGATION LTD

Site:	Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex.	Report No: Sheet No:	LW23175 1 of 1

SOIL CLASSIFICATION SUMMARY

Sample No.	Depth (m)	Nat. Moist. Cont. (w %)	Equiv. Moist. Cont. (w_a %)	Atterberg Limits W_l %	Atterberg Limits W_p %	Atterberg Limits I_p %	Class'n	Cons. Index (I_c)	% passing 425 μm sieve	Visual Description of Sample
WS1	1.00	19	19	30	18	12	CL	0.91	99	Stiff orange brown and light grey slightly gravelly sandy CLAY. Gravel is fine to medium flint.
WS2	1.50	21	-	-	N	-	N	-	99	Very stiff brown and light grey very sandy SILT with rare fine flint gravel.
WS3	1.80	21	21	31	19	12	CL	0.83	100	Stiff brown and light grey slightly sandy CLAY.
WS4	1.00	20	20	32	19	13	CL	0.92	99	Stiff orange brown and grey mottled silty CLAY with rare fine flint gravel.
WS5	1.00	21	21	30	19	11	CL	0.79	99	Firm to stiff orange brown and grey very sandy CLAY with rare fine flint gravel.
	1.90	22	22	33	19	14	CL	0.78	98	Firm orange brown and grey slightly gravelly silty CLAY. Gravel is fine flint.

Remarks: N = Non – plastic fine soil.

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Swanborough
Lewes, East Sussex
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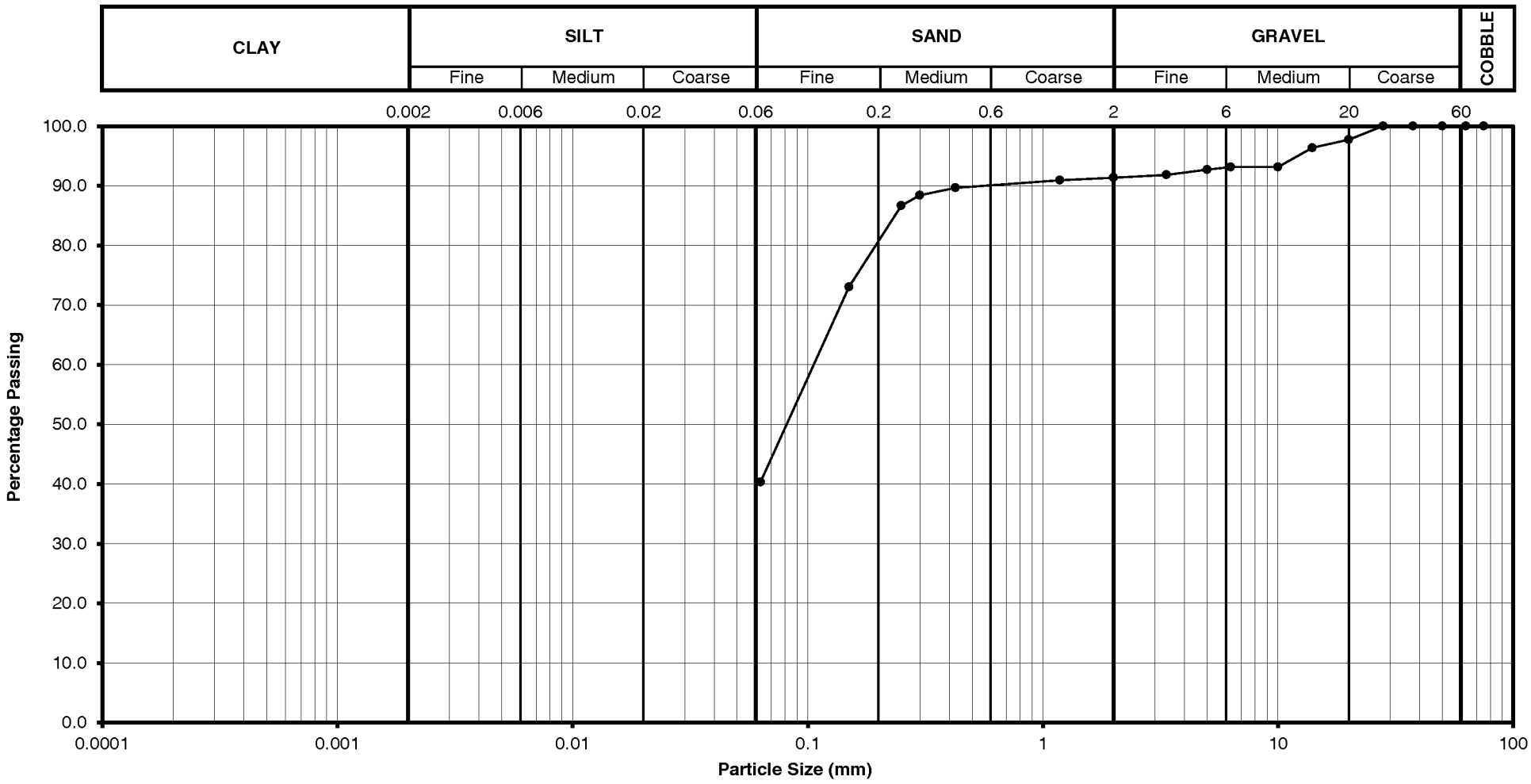
Geotechnical and Environmental Engineers

ASHDOWN SITE INVESTIGATION LIMITED

Particle Size Distribution by Wet Sieve; BS1377: Part 2 1990



Job Name	Summerley Corner South Site, Summerley Lane, Bognor Regis	**BH/ TP No.**	WS1	**Sample Description**	Slightly gravelly sandy CLAY/SILT.
Job No.	LW23175	**Sample Depth (m)**	2.00m		

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Swanborough
Lewes, East Sussex
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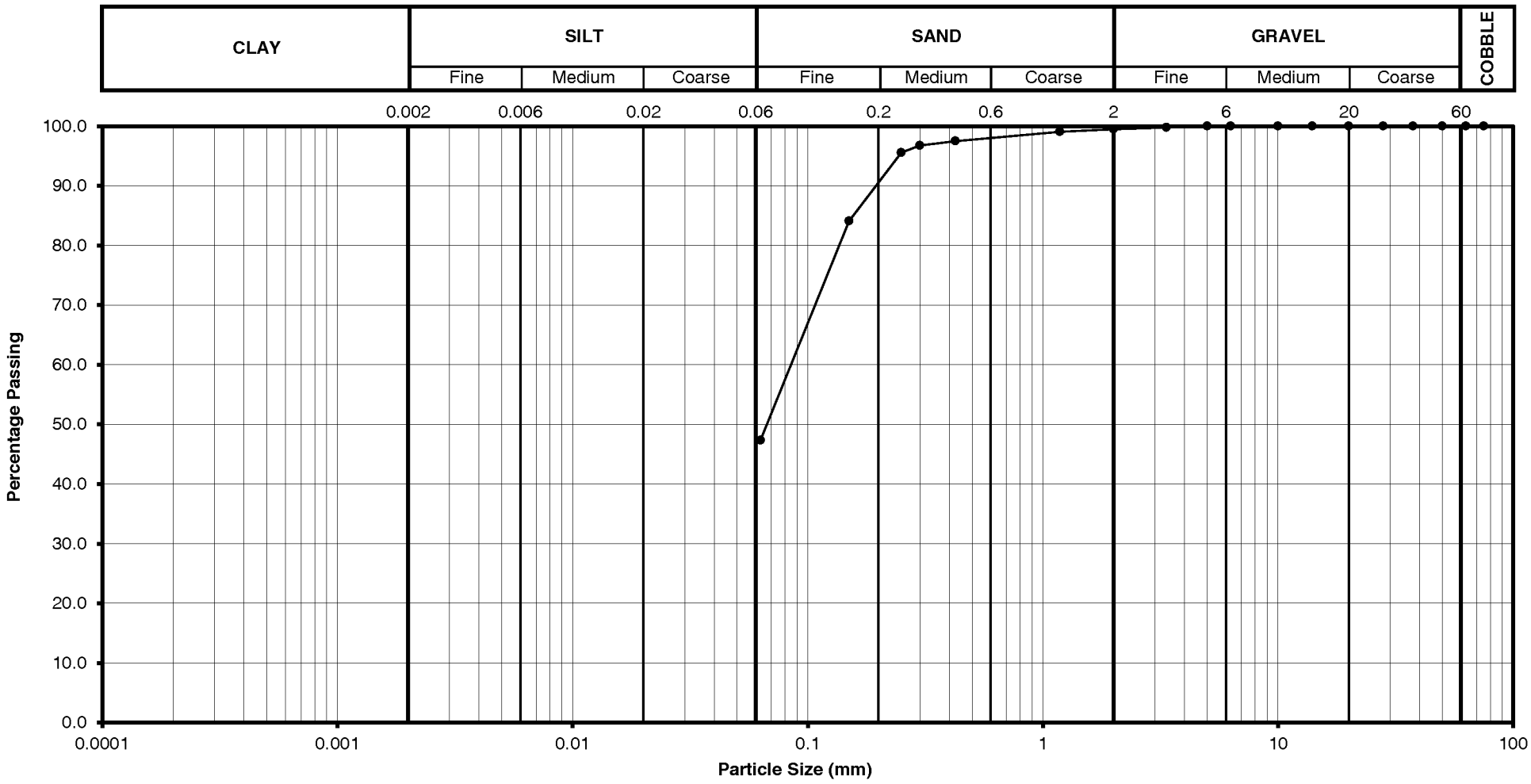
Geotechnical and Environmental Engineers

ASHDOWN SITE INVESTIGATION LIMITED

Particle Size Distribution by Wet Sieve; BS1377: Part 2 1990



Job Name	Summerley Corner South Site, Summerly Lane, Bognor Regis.	**BH/ TP No.**	WS2	**Sample Description**	Sandy CLAY/SILT.
Job No.	LW23175	**Sample Depth (m)**	1.50m		

Swanborough Farm
Swanborough
Lewes, East Sussex
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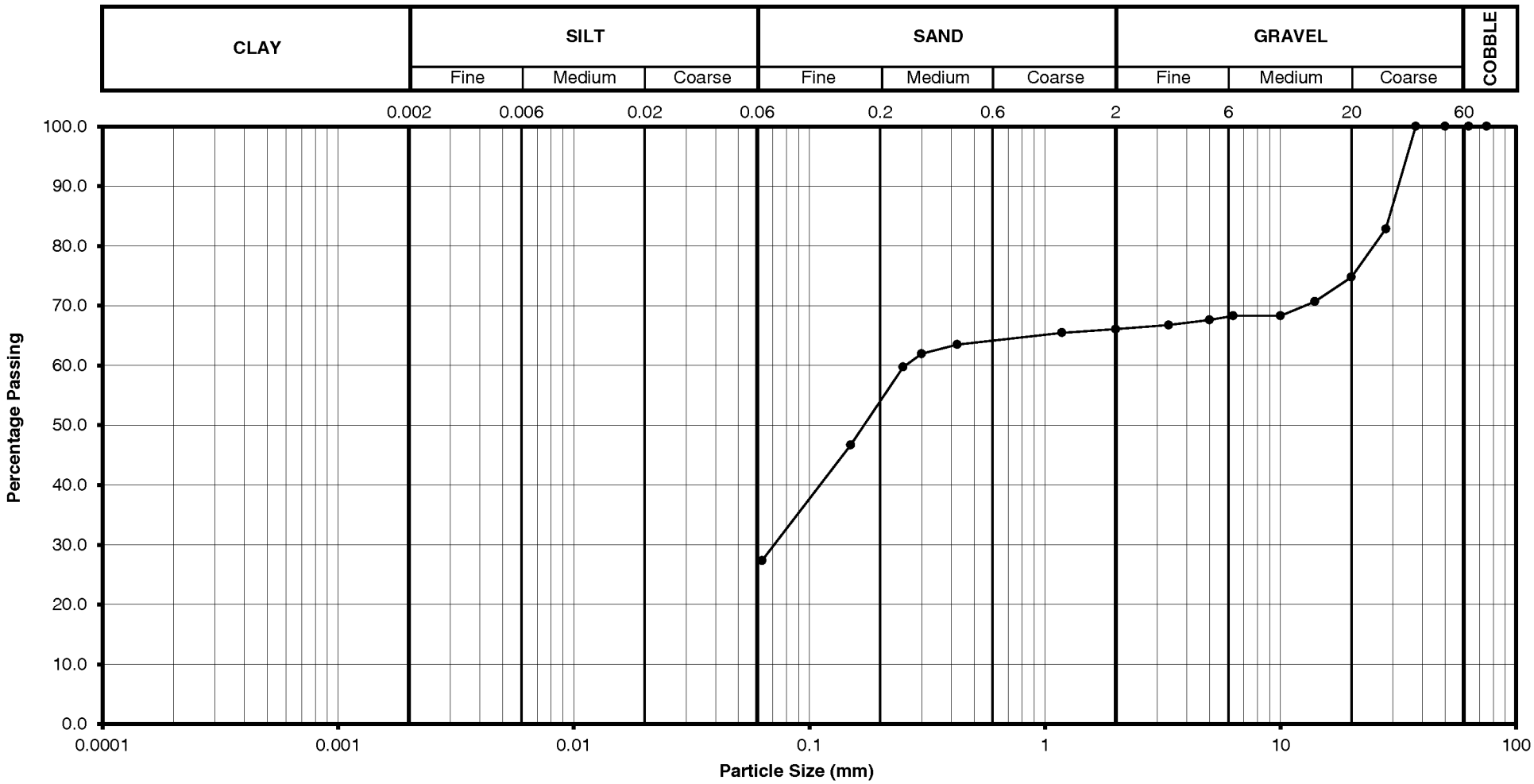
Geotechnical and Environmental Engineers

ASHDOWN SITE INVESTIGATION LIMITED

Particle Size Distribution by Wet Sieve; BS1377: Part 2 1990



Job Name	Summerley Corner South Site, Summerley Lane, Bognor Regis	**BH/ TP No.**	WS5	**Sample Description**	Very silty very gravelly SAND.
Job No.	LW23175	**Sample Depth (m)**	2.50 - 3.00m		

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex

[redacted]

UKAS TESTING 2683 2683

THE ENVIRONMENTAL LABORATOR

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Reporting Date: 24/07/12

ANALYTICAL REPORT No. AR39648

Samples Received By:-	Courier
Samples Received:-	18/07/12
Your Job No:	LW23175
Site Location:	Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex
No Samples Received:-	2

[redacted]

ARUN DISTRICT COUNCIL FP/103/13/DOC

THE ENVIRONMENTAL LABORATORY LTD

Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards On Sea, East Sussex, TN38 9BY

2683 2683

ANALYTICAL REPORT No. AR39648

Location: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Your Job No: LW23175
Your Order No: ---
Reporting Date: 24/07/12

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Soils

		Characteristic	Silty Clay loam	Clay
		TP/BH	WS3	WS5
		Depth (m)	0.40	1.00
		Our ref	42656	42657
pH Value**	(Units)		8.0	8.4
Water Soluble Sulphate	(mg/l as SO_4)		<10	<10

All results expressed on dry weight basis

** - MCERTS accredited test

SBB

ARUN DISTRICT COUNCIL FP/103/13/DOC

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
[redacted]

2683 2683

THE ENVIRONMENTAL LABORATORY LTD

SAMPLE RECEIPT AND TEST DATES

Our Analytical Report Number	AR39648
Your Job No:	LW23175
Sample Receipt Date:	18/07/12
Reporting Date:	24/07/12
Registered:	18/07/12
Prepared:	19/07/12
Analysis complete:	24/07/12

TEST METHOD SUMMARY

PARAMETER	Analysis Undertaken on	Date Tested	Method Number	Technique
pH Value**	Air dried sample	24/07/12	113	Probe
Water Soluble Sulphate	Air dried sample	23/07/12	209	Colorimetry

** - MCERTS Accredited test
Determinands not marked with * or ** are non accredited
MCERTS accreditation covers samples which are predominantly sand, clay, loam or combinations of these three soil types

Any comments, opinions, or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
[redacted]

2683 2683

THE ENVIRONMENTAL LABORATORY LTD

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Reporting Date: 25/07/12

ANALYTICAL REPORT No. AR39647

Samples Received By:-	Courier
Samples Received:-	18/06/12
Your Job No:	LW23175
Site Location:	Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex
No Samples Received:-	9

[redacted]

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THE ENVIRONMENTAL LABORATORY LTD

Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards On Sea, East Sussex, TN38 9BY
Tel: 01424 718618 Fax: 01424 729911

ANALYTICAL REPORT No. AR39647

Location: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Your Job No: LW23175

Reporting Date: 25/07/12

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Soils

		TP/BH	WS1	WS3	WS3	WS4	WS4	WS5	HA2
		Depth (m)	0.20	0.20	0.40	0.10	0.30	0.15	GL - 0.25
		Our ref	42647	42649	42650	42652	42653	42654	42655
Stone Content	(%)		<1	<1	34	10	<1	<1	<1
Arsenic**	(mg/kg)		10.3	11.3	5.1	10.2	13.6	14.2	12.0
Cadmium**	(mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium**	(mg/kg)		35	23	16	23	32	41	31
Lead**	(mg/kg)		15	169	31	312	158	21	95
Mercury**	(mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel**	(mg/kg)		29	18	11	16	27	25	20
Copper**	(mg/kg)		17	17	9	21	22	16	26
Zinc**	(mg/kg)		55	133	52	91	85	69	266
Selenium**	(mg/kg)		0.9	0.9	<0.5	1.0	1.0	1.1	0.9
Water Soluble Boron	(mg/kg)		<0.5	<0.5	<0.5	0.9	0.6	0.7	0.8
Hexavalent Chromium	(mg/kg)		<2	<2	<2	<2	<2	<2	<2
pH Value**	(Units)		8.8	8.3	8.5	7.9	8.2	7.8	7.1
Soil Organic Matter*	(%)		1.0	1.6	1.0	3.4	2.5	3.2	2.0

All results expressed on dry weight basis
** - MCERTS accredited test
* - UKAS accredited test

SBB

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Tel: 01424 718618 Fax: 01424 729911

ANALYTICAL REPORT No. AR39647

Location: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Your Job No: LW23175

Reporting Date: 25/07/12

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Soils

		TP/BH	WS1	WS3	WS3	WS4	WS4	WS5	HA2
		Depth (m)	0.20	0.20	0.40	0.10	0.30	0.15	GL - 0.25
		Our ref	42647	42649	42650	42652	42653	42654	42655
Naphthalene**	(mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene**	(mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene**	(mg/kg)		<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
Fluorene**	(mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene**	(mg/kg)		<0.5	<0.5	<0.5	10.9	<0.5	<0.5	<0.5
Anthracene**	(mg/kg)		<0.5	<0.5	<0.5	1.6	<0.5	<0.5	<0.5
Fluoranthene**	(mg/kg)		<0.5	<0.5	<0.5	15.8	0.9	<0.5	<0.5
Pyrene**	(mg/kg)		<0.5	<0.5	<0.5	12.7	0.7	<0.5	<0.5
Benz(a)anthracene**	(mg/kg)		<0.5	<0.5	<0.5	7.6	<0.5	<0.5	<0.5
Chrysene**	(mg/kg)		<0.5	<0.5	<0.5	13.6	0.9	<0.5	<0.5
Benzo(b)fluoranthene**	(mg/kg)		<0.5	<0.5	<0.5	6.8	<0.5	<0.5	<0.5
Benzo(k)fluoranthene**	(mg/kg)		<0.5	<0.5	<0.5	5.8	<0.5	<0.5	<0.5
Benzo(a)pyrene**	(mg/kg)		<0.5	<0.5	<0.5	6.7	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene**	(mg/kg)		<0.5	<0.5	<0.5	4.3	<0.5	<0.5	<0.5
Dibenz(ah)anthracene**	(mg/kg)		<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5
Benzo(ghi)perylene**	(mg/kg)		<0.5	<0.5	<0.5	4.3	<0.5	<0.5	<0.5
Total PAH**	(mg/kg)		<0.5	<0.5	<0.5	92.5	2.5	<0.5	<0.5

All results expressed on dry weight basis
** - MCERTS accredited test

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Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonard's on Sea, East Sussex, TN38 9BY
Tel: 01424 718618 Fax: 01424 729911

ANALYTICAL REPORT No. AR39647

Location: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Your Job No: LW23175

Reporting Date: 25/07/12

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Soils

		TP/BH	WS2	WS3	WS3	WS3	WS4
		Depth (m)	0.35	0.20	0.40	0.70	0.30
		Our ref	42648	42649	42650	42651	42653
C_8-C_{10}	(mg/kg)		<5	<5	<5	<5	<5
$>C_{10}$-C_{12}	(mg/kg)		<5	<5	<5	<5	<5
$>C_{12}$-C_{16}	(mg/kg)		<5	<5	<5	<5	<5
$>C_{16}$-C_{21}	(mg/kg)		<5	<5	<5	<5	<5
$>C_{21}$-C_{35}	(mg/kg)		16	<5	<5	<5	<5
Total Petroleum Hydrocarbons**	(mg/kg)		16	<5	<5	<5	<5

Accredited for TPH only, not banding
** - MCERTS Accredited test
All results expressed on dry weight basis
SBB

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Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards On Sea, East Sussex, TN38 9BY

[redacted]

UKAS TESTING 2683

ELAB

ANALYTICAL REPORT No. AR39647

Location: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Your Job No: LW23175

Reporting Date: 25/07/12

Asbestos Identification

Sample ref:	**WS3**
Depth (m)	**0.20**
Our ref:	**42649**
#Description of Sample Matrix:	Soil
***Result**	No asbestos identified

Sample ref:	**WS3**
Depth (m)	**0.40**
Our ref:	**42650**
#Description of Sample Matrix:	Soil
***Result**	No asbestos identified

Sample ref:	**WS4**
Depth (m)	**0.30**
Our ref:	**42653**
#Description of Sample Matrix:	Soil
***Result**	No asbestos identified

*= UKAS accredited
Analytical result only applies to the sample as submitted by the client
Any comments, opinions or interpretations (marked #) in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client

MP

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Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 0BY
[redacted]

2683 2683

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SAMPLE RECEIPT AND TEST DATES

Our Analytical Report Number	AR39647
Your Job No:	LW23175
Sample Receipt Date:	18/06/12
Reporting Date:	25/07/12
Registered:	18/06/12
Prepared:	19/06/12
Analysis complete:	25/07/12

TEST METHOD SUMMARY

PARAMETER	Analysis Undertaken on	Date Tested	Method Number	Technique
Arsenic**	Air dried sample	23/07/12	118	ICPMS
Cadmium**	Air dried sample	23/07/12	118	ICPMS
Chromium**	Air dried sample	23/07/12	118	ICPMS
Lead**	Air dried sample	23/07/12	118	ICPMS
Mercury**	Air dried sample	23/07/12	118	ICPMS
Nickel**	Air dried sample	23/07/12	118	ICPMS
Copper**	Air dried sample	23/07/12	118	ICPMS
Zinc**	Air dried sample	23/07/12	118	ICPMS
Selenium**	Air dried sample	23/07/12	118	ICPMS
Water Soluble Boron	Air dried sample	23/07/12	202	Colorimetry
Hexavalent Chromium	As submitted sample	23/07/12	110	Colorimetry
pH Value**	Air dried sample	24/07/12	113	Probe
Soil Organic Matter*	Air dried sample	24/07/12	111	Titration
Asbestos*	As submitted sample	22/07/12	179	See note
Speciated PAH**	As submitted sample	20/07/12	133	Gas Chromatography
Carbon Banding (TPH BCB)**	As submitted sample	20/07/12	117	Gas Chromatography

Asbestos analysis qualitative only
Note:- Documented In-house procedure based on HSG 248 2005
* = UKAS Accredited test
** - MCERTS Accredited test
Determinands not marked with * or ** are not accredited
MCERTS accreditation covers samples which are predominantly sand, clay, loam or combinations of these three soil types

Any comments, opinions, or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

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Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BA

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THE ENVIRONMENTAL LABORATORY LTD

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Reporting Date: 03/08/12

ANALYTICAL REPORT No. AR39844

Samples Received By:-	Laboratory Courier
Samples Received:-	31/07/12
Your Job No:	LW23175
Site Location:-	Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex
No Samples Received:-	1

[redacted]

Any comments, opinions, or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

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UKAS TESTING
2683

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Unit A2, Windh[redacted]

ANALYTICAL REPORT No. AR39844

Location: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex

Your Job No: LW23175

Reporting Date: 03/08/12

F.A.O. David Harris
Ashdown Site Investigation Limited
The Old Dairy, Swanborough Farm
Swanborough, Lewes,
East Sussex, BN7 9PF

Water

		TP/BH	WS3
		Our ref	43669
C_6-C_{10}	(µg/l)		<10
$>C_{10}$-C_{12}	(µg/l)		<10
$>C_{12}$-C_{16}	(µg/l)		<10
$>C_{16}$-C_{21}	(µg/l)		<10
$>C_{21}$-C_{40}	(µg/l)		77
Total Petroleum Hydrocarbons*	(µg/l)		77

* = UKAS Accredited test

GM

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Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY

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WATER SAMPLE RECEIPT AND TEST DATES

Our Analytical Report Number	AR39844
Your Ref No:	LW23175
Sample Receipt Date:	31/07/12
Reporting Date:	03/08/12
Registered:	31/07/12
Prepared:	01/08/12
Analysis complete:	03/08/12

WATER TEST METHOD SUMMARY

PARAMETER	Method Number	Technique
Basic Carbon Banding (TPH)*	178	Gas chromatography

* = UKAS Accredited test
Determinands not marked with * are non accredited

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APPENDIX D

Notes on CLEA

Guidance on Comparing Soil Contamination Data with a Critical Concentration

CLEA Model Chemical Data Inputs

Statistical Analysis Summary Sheets

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Notes on the Contaminated Land Exposure Assessment & Calculation of Soil Screening Values

Assessing risk to human health using the CLEA Model

Background to the CLEA Model

The Environment Agency and DEFRA published the Contaminated Land Exposure Assessment (CLEA) model in 2002. The methodology for the generation of assessment criteria was set out within Contaminated Land Reports (CLR) 7 to 10.

Toxicological data reports (TOX documents) for 23 individual contaminants were also published between 2002 and 2004 for use within the CLEA model.

Following the release of the TOX documents the Environment Agency published a series of Soil Guideline Values (SGVs) for the contaminants arsenic, cadmium, chromium, lead, mercury, nickel, selenium, phenol, toluene and ethylbenzene. SGVs are generic assessment criteria developed for three land uses, the assumptions for each land use were included within the CLR reports.

The generic land uses considered were:

- Residential (with and without plant uptake/vegetable growing)
- Allotments
- Commercial and Industrial

The SGVs can be used as preliminary screening values for sites which fit with the conceptual model (assumptions) of the generic land uses.

The CLEA UK version of the model was released in 2005. This model could be used to generate more detailed and site specific assessment criteria. The CLEA UK model could also be used to generate generic assessment criteria for sites which lie outside of the generic land uses.

Current Guidance

In August 2008 the CLR 7 to 10 documents were officially 'withdrawn' by the Environment Agency along with published SGV reports.

Three new guidance documents were released, replacing the withdrawn CLR7-CLR10 documents, these were:

"*Guidance on Comparing Soil Contamination Data with a Critical Concentration",* CIEH/CL:AIRE (May 2008) – replacing CLR7;
"Human health toxicological assessment of contaminants in soil (Science Report SC050021/SR2)" Environment Agency, August 2008 – replacing CLR9; and,
"Updated technical background to the CLEA model (Science Report SC050021/SR3)" , Environment Agency, August 2008 - replacing CLR10

A revised version of the CLEA UK software model (ver 1.04) was also released in conjunction with the revised guidance. The latest version of the model uses purely deterministic calculations to derive assessment criteria.

The Environment Agency website (www.environment-agency.go.uk) presents the latest guidance. They advise that the current schedule of work includes the review, revision if necessary and re-issue of the TOX reports previously published. As each new TOX report is published, the previous one will be withdrawn.

In the absence of official government figures for some of the contaminants Ashdown Site Investigation Ltd have used the CLEA model to generate Soil Screening Values (SSVs) for a number of the priority contaminants. Where possible the chemical data used to generate these figures has

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been taken from reports published by the Environment Agency, where no data exists, reference has been made to other published data.

Discussion on Adjustment of Background Daily Intake of Contaminants for Child Targets

As exposure to soils is unlikely to be the sole means through which people may be exposed to a contaminant a background exposure or Mean Daily Intake (MDI) is calculated for each contaminant. Adjustment factors for the MDI are included within Science Report SC050021/SR2 in order to take into consideration the different bodyweights and respiration rates for different age classes.

The starting principle for deriving SSVs is that they are set so that the Average Daily Exposure (ADE) from soils plus the MDI equals the Tolerable Daily Intake (TDI) for that contaminant.

Where the MDI is equal to 50% or greater than TDI then exposure from soils is to be allowed to contribute up to 50% of the TDI when deriving SSVs. When calculating an SSV, this portion of the TDI is referred to as the Tolerable Daily Soil Intake (TDSI).

ASHDOWN SITE INVESTIGATION LIMITED

Notes on the "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (CIEH & CL: AIRE, May 2008)

The Chartered Institute of Environmental Health & CL:AIRE, have published updated guidance on the statistical assessment of contaminated land data, "*Guidance on Comparing Soil Contamination Data with a Critical Concentration" (May 2008).* This is an update to previous guidance published within Contaminated Land Report CLR7 (Defra, 2002).

The CIEH/CL:AIRE guidance forms part of a package of proposed improved UK guidance highlighted in the Defra discussion paper, "*Assessing risks from land contamination –a proportionate approach. Soil guideline values: The Way Forward (CLAN 06/2006)". This discussion paper discussed* the role and use of SGVs for managing the risks associated with soil contamination.

The guidance states that its overall aim is to "increase understanding amongst stakeholders of the role that statistics can play in quantifying the uncertainty attached to estimates of the mean concentration of contaminants in soil, thereby creating a more informed basis for regulatory decision-making".

The initial question, on which the guidance is based, is whether the Site under consideration is to be assessed under the Planning System or under Part 2A of the Environmental Protection Act 1990. The key questions asked when considering contaminant concentrations vary depending on the scenario under consideration. The key questions will generally be:

- **Planning Scenario** – "can we confidently say that the level of contamination on this land is low relative to some appropriate measure of risk?" or "that the level of contamination is lower than the critical concentration" (alternative hypothesis).

- **Part 2A Scenario** – "can we confidently say that the level of contamination on this land is high relative to some appropriate measure of risk?" or "that the level of contamination is higher than the critical concentration" (alternative hypothesis).

Within the guidance, to 'answer' the relevant question above, a null hypothesis has been outlined for each scenario, which, if rejected with a high degree of confidence, means that the alternative hypothesis can be accepted. The null hypothesis for a planning scenario is that the soils contain levels of contamination above the critical concentration (i.e. the soils are assumed to be unsuitable for use until proven otherwise). Under the Part 2A scenario, the null hypothesis is that the soils contain levels of contamination below the critical concentration (i.e. the land is assumed not to fall within Part 2A legislation until proved otherwise).

For the planning scenario the null hypothesis may be rejected if it is considered that the 95th percentile of the normally distributed population as a whole lies below the critical concentration i.e. there is a 95% probability that your true population mean lies below the critical concentration. A lower probability of the true mean lying below the critical concentration may be used, but deviation from the standard 95% requires justification.

For the Part 2A scenario the null hypothesis may be rejected if it can be shown that the lower 95th percentile lies above the critical concentration. If the lower 95th percentile lies below the critical concentration but the true population mean lies above the critical concentration further assessment should be undertaken before the Site can be classified under Part 2A.

Guidance on the treatment of outliers (results that are not representative of a sample population), is also provided in the report. The guidance confirms that outliers should only be excluded from the dataset where they are either demonstrably the result of an error that can be identified and explained, or clearly indicate that more than one soil population exists within the dataset.

Where an individual result is recognised as a 'statistical outlier' or 'contamination hot-spot' within the data set (and where the critical concentration for that contaminant is exceeded), remediation work and or further investigation may be required.

CLEA Model Chemical Data Inputs

Chemical	Chemical Type	Oral HCV						Inhalation HCV					
		Type	µg kg^{-1} BW day^{-1}	Notes	Compare with oral exposure	Compare with dermal exposure	Compare with inhalation exposure	Type	µg kg^{-1} BW day^{-1}	Notes	Compare with oral exposure	Compare with dermal exposure	Compare with inhalation exposure
Chromium (III)	inorganic	TDI	150	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	TDI	0.03	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Chromium (VI)	inorganic	TDI	1	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.0001	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Lead	inorganic	TDI	3.57	Evaluation of certain food additives and contaminants (Fifty-third report of the Joint FAO/WHO Expert Committee on Food Additives). WHO Technical Report Series, No. 896, 2000.	Yes	Yes	No	TDI	0.071	EPAQS, 1998. Lead. Department of the Environment, Transport and the Regions. Expert Panel on Air Quality Standards. London: The Stationary Office. ISBN 0117534471	No	No	Yes
Copper	inorganic	TDI	160	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	TDI	0.286	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Zinc	inorganic	TDI	600	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR	0	No Inhalation HCV	No	No	No
Boron	inorganic	TDI	160	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	TDI	2.9	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Naphthalene	organic	TDI	20	TOX20	Yes	Yes	No	TDI	0.86	TOX20	No	No	Yes
Acenaphthylene	organic	TDI	60	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	No	No	No
Acenaphthene	organic	TDI	60	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	No	No	No
Fluorene	organic	TDI	40	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	No	No	No
Phenanthrene	organic	TDI	12.5	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	No	No	No
Anthracene	organic	TDI	300	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	No	No	No
Fluoranthene	organic	TDI	12.5	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	No	No	No
Pyrene	organic	TDI	30	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	Yes	NR		LQM/CIEH GAC 2nd Edition (2009)	Yes	No	No
Benz(a)anthracene	organic	ID	0.138	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.00048	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Chrysene	organic	ID	0.2	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.0007	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Benzo(b)fluoranthene	organic	ID	0.142	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.0005	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Benzo(k)fluoranthene	organic	ID	0.2	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.0007	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Benzo(a)pyrene	organic	ID	0.02	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.00007	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Indeno(123-cd)pyrene	organic	ID	0.086	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.0003	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Dibenz(ah)anthracene	organic	ID	0.018	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.000063	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes
Benzo(ghi)perylene	organic	ID	0.909	LQM/CIEH GAC 2nd Edition (2009)	Yes	Yes	No	ID	0.0032	LQM/CIEH GAC 2nd Edition (2009)	No	No	Yes

Chemical	Chemical Type	Combine oral and inhalation AC	Oral MDI for Adults		Inhalation MDI for adults		Air-water partition coefficient (K_{aw})		Diffusion coefficient in air	
			µg day^{-1}	Notes	µg day^{-1}	Notes	$cm^3\ cm^{-3}$	Notes (measured or calculated at 283K unless stated)	$m^2\ s^{-1}$	Notes (measured or calculated at 283K unless stated)
Chromium (III)	inorganic	Yes	60.2	LQM/CIEH GAC 2nd Edition (2009)	0.27	LQM/CIEH GAC 2nd Edition (2009)	NR	0	NR	0
Chromium (VI)	inorganic	Yes	6.7	LQM/CIEH GAC 2nd Edition (2009)	NR	LQM/CIEH GAC 2nd Edition (2009)	NR	0	NR	0
Lead	inorganic	Yes	31	Environment Agency, 2002. Contaminants in soil: Collation of toxicological data and intake values for humans - lead, TOX 6	2	Department of the Environment, Transport and the Regions. Air Quality Information Archive, http://www.aeat.co.uk/netcen/aqarchive/nonauto/pbdata.html	NR	Inorganic Chemical	NR	Inorganic Chemical
Copper	inorganic	Yes	7000	LQM/CIEH GAC 2nd Edition (2009)	0.68	LQM/CIEH GAC 2nd Edition (2009)	NR	Inorganic Chemical	NR	Inorganic Chemical
Zinc	inorganic	Yes	27000	LQM/CIEH GAC 2nd Edition (2009)	2.4	LQM/CIEH GAC 2nd Edition (2009)	NR	Inorganic Chemical	NR	Inorganic Chemical
Boron	inorganic	Yes	3700	LQM/CIEH GAC 2nd Edition (2009)	0.398	LQM/CIEH GAC 2nd Edition (2009)	NR	Inorganic Chemical	NR	Inorganic Chemical
Naphthalene	organic	Yes	7	TOX20	2.8	TOX20	0.00662	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000652	LQM/CIEH GAC 2nd Edition (2009)
Acenaphthylene	organic	Yes	0.14	LQM/CIEH GAC 2nd Edition (2009)	0.011	LQM/CIEH GAC 2nd Edition (2009)	0.000568	LQM/CIEH GAC 2nd Edition (2009)	0.00000597	LQM/CIEH GAC 2nd Edition (2009)
Acenaphthene	organic	Yes	0.98	LQM/CIEH GAC 2nd Edition (2009)	0.025	LQM/CIEH GAC 2nd Edition (2009)	0.000759	LQM/CIEH GAC 2nd Edition (2009)	0.00000585	LQM/CIEH GAC 2nd Edition (2009)
Fluorene	organic	Yes	0.59	LQM/CIEH GAC 2nd Edition (2009)	0.096	LQM/CIEH GAC 2nd Edition (2009)	0.000412	LQM/CIEH GAC 2nd Edition (2009)	0.00000558	LQM/CIEH GAC 2nd Edition (2009)
Phenanthrene	organic	Yes	1.54	LQM/CIEH GAC 2nd Edition (2009)	0.518	LQM/CIEH GAC 2nd Edition (2009)	0.000143	LQM/CIEH GAC 2nd Edition (2009)	0.00000534	LQM/CIEH GAC 2nd Edition (2009)
Anthracene	organic	Yes	0.08	LQM/CIEH GAC 2nd Edition (2009)	0.041	LQM/CIEH GAC 2nd Edition (2009)	0.000181	LQM/CIEH GAC 2nd Edition (2009)	0.00000536	LQM/CIEH GAC 2nd Edition (2009)
Fluoranthene	organic	Yes	0.35	LQM/CIEH GAC 2nd Edition (2009)	0.084	LQM/CIEH GAC 2nd Edition (2009)	0.0000629	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000501	LQM/CIEH GAC 2nd Edition (2009)
Pyrene	organic	Yes	0.35	LQM/CIEH GAC 2nd Edition (2009)	0.065	LQM/CIEH GAC 2nd Edition (2009)	0.0000564	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000501	LQM/CIEH GAC 2nd Edition (2009)
Benz(a)anthracene	organic	Yes	NR	index dose used	NR	index dose used	0.0000316	Environment Agency, 2008. Science Report - SC050021/SR7	0.0000046	LQM/CIEH GAC 2nd Edition (2009)
Chrysene	organic	Yes	NR	index dose used	NR	index dose used	0.00000318	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000457	LQM/CIEH GAC 2nd Edition (2009)
Benzo(b)fluoranthene	organic	Yes	NR	index dose used	NR	index dose used	0.00000205	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000436	LQM/CIEH GAC 2nd Edition (2009)
Benzo(k)fluoranthene	organic	Yes	NR	index dose used	NR	index dose used	0.00000174	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000436	LQM/CIEH GAC 2nd Edition (2009)
Benzo(a)pyrene	organic	Yes	NR	index dose used	NR	index dose used	0.00000176	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000438	LQM/CIEH GAC 2nd Edition (2009)
Indeno(123-cd)pyrene	organic	Yes	NR	index dose used	NR	index dose used	0.00000205	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000417	LQM/CIEH GAC 2nd Edition (2009)
Dibenz(ah)anthracene	organic	Yes	NR	index dose used	NR	index dose used	0.0000054	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000408	LQM/CIEH GAC 2nd Edition (2009)
Benzo(ghi)perylene	organic	Yes	NR	index dose used	NR	index dose used	0.00000286	Environment Agency, 2008. Science Report - SC050021/SR7	0.00000422	LQM/CIEH GAC 2nd Edition (2009)

Chemical	Chemical Type	Diffusion coefficient in water		Relative molecular mass		Vapour pressure		Water solubility		Organic carbon - water partition coefficient (K_{oc})	
		$m^2 s^{-1}$	Notes (measured or calculated at 283K unless stated)	g mol^{-1}	Notes	Pa	Notes (measured or calculated at 283K and standard pressure unless stated)	$mg L^{-1}$	Notes (measured or calculated at 283K unless stated)	Log ($cm^3 g^{-1}$)	Notes
Chromium (III)	inorganic	NR	0	NR	0	NR	0	585000	LQM/CIEH GAC 2nd Edition (2009)	NR	LQM/CIEH GAC 2nd Edition (2009)
Chromium (VI)	inorganic	NR	0	NR	0	NR	0	2300000	LQM/CIEH GAC 2nd Edition (2009)	NR	LQM/CIEH GAC 2nd Edition (2009)
Lead	inorganic	NR	Inorganic Chemical	NR	Inorganic Chemical	NR	Inorganic Chemical	100000	0	NR	Inorganic Chemical
Copper	inorganic	NR	Inorganic Chemical	NR	Inorganic Chemical	NR	Inorganic Chemical	1378000	LQM/CIEH GAC 2nd Edition (2009)	NR	Inorganic Chemical
Zinc	inorganic	NR	Inorganic Chemical	NR	Inorganic Chemical	NR	Inorganic Chemical	4320000	LQM/CIEH GAC 2nd Edition (2009)	NR	Inorganic Chemical
Boron	inorganic	NR	Inorganic Chemical	NR	Inorganic Chemical	NR	Inorganic Chemical	63500	LQM/CIEH GAC 2nd Edition (2009)	NR	Inorganic Chemical
Naphthalene	organic	5.16E-10	LQM/CIEH GAC 2nd Edition (2009)	128.17	LQM/CIEH GAC 2nd Edition (2009)	2.31	LQM/CIEH GAC 2nd Edition (2009)	19	LQM/CIEH GAC 2nd Edition (2009)	2.81	LQM/CIEH GAC 2nd Edition (2009)
Acenaphthylene	organic	4.82E-10	LQM/CIEH GAC 2nd Edition (2009)	152.19	LQM/CIEH GAC 2nd Edition (2009)	0.0708	LQM/CIEH GAC 2nd Edition (2009)	7.95	LQM/CIEH GAC 2nd Edition (2009)	3.26	LQM/CIEH GAC 2nd Edition (2009)
Acenaphthene	organic	4.7E-10	LQM/CIEH GAC 2nd Edition (2009)	154.21	LQM/CIEH GAC 2nd Edition (2009)	0.0737	LQM/CIEH GAC 2nd Edition (2009)	4.11	LQM/CIEH GAC 2nd Edition (2009)	3.37	LQM/CIEH GAC 2nd Edition (2009)
Fluorene	organic	4.47E-10	LQM/CIEH GAC 2nd Edition (2009)	166.22	LQM/CIEH GAC 2nd Edition (2009)	0.0156	LQM/CIEH GAC 2nd Edition (2009)	1.86	LQM/CIEH GAC 2nd Edition (2009)	3.45	LQM/CIEH GAC 2nd Edition (2009)
Phenanthrene	organic	4.32E-10	LQM/CIEH GAC 2nd Edition (2009)	178.23	LQM/CIEH GAC 2nd Edition (2009)	0.00282	LQM/CIEH GAC 2nd Edition (2009)	1.12	LQM/CIEH GAC 2nd Edition (2009)	3.74	LQM/CIEH GAC 2nd Edition (2009)
Anthracene	organic	4.36E-10	LQM/CIEH GAC 2nd Edition (2009)	178.23	LQM/CIEH GAC 2nd Edition (2009)	0.0000849	LQM/CIEH GAC 2nd Edition (2009)	0.056	LQM/CIEH GAC 2nd Edition (2009)	3.75	LQM/CIEH GAC 2nd Edition (2009)
Fluoranthene	organic	4.11E-10	LQM/CIEH GAC 2nd Edition (2009)	202.25	LQM/CIEH GAC 2nd Edition (2009)	0.000131	LQM/CIEH GAC 2nd Edition (2009)	0.23	LQM/CIEH GAC 2nd Edition (2009)	4.26	LQM/CIEH GAC 2nd Edition (2009)
Pyrene	organic	4.15E-10	LQM/CIEH GAC 2nd Edition (2009)	202.25	LQM/CIEH GAC 2nd Edition (2009)	0.0000153	LQM/CIEH GAC 2nd Edition (2009)	0.13	LQM/CIEH GAC 2nd Edition (2009)	4.21	LQM/CIEH GAC 2nd Edition (2009)
Benz(a)anthracene	organic	3.8E-10	LQM/CIEH GAC 2nd Edition (2009)	228.29	LQM/CIEH GAC 2nd Edition (2009)	0.00000124	LQM/CIEH GAC 2nd Edition (2009)	0.0038	LQM/CIEH GAC 2nd Edition (2009)	4.89	LQM/CIEH GAC 2nd Edition (2009)
Chrysene	organic	3.77E-10	LQM/CIEH GAC 2nd Edition (2009)	228.29	LQM/CIEH GAC 2nd Edition (2009)	4.52E-08	LQM/CIEH GAC 2nd Edition (2009)	0.002	LQM/CIEH GAC 2nd Edition (2009)	4.74	LQM/CIEH GAC 2nd Edition (2009)
Benzo(b)fluoranthene	organic	3.62E-10	LQM/CIEH GAC 2nd Edition (2009)	252.31	LQM/CIEH GAC 2nd Edition (2009)	6.34E-08	LQM/CIEH GAC 2nd Edition (2009)	0.002	LQM/CIEH GAC 2nd Edition (2009)	5.02	LQM/CIEH GAC 2nd Edition (2009)
Benzo(k)fluoranthene	organic	3.62E-10	LQM/CIEH GAC 2nd Edition (2009)	252.31	LQM/CIEH GAC 2nd Edition (2009)	1.64E-08	LQM/CIEH GAC 2nd Edition (2009)	0.0008	LQM/CIEH GAC 2nd Edition (2009)	5.17	LQM/CIEH GAC 2nd Edition (2009)
Benzo(a)pyrene	organic	3.67E-10	LQM/CIEH GAC 2nd Edition (2009)	252.31	LQM/CIEH GAC 2nd Edition (2009)	0.00000002	LQM/CIEH GAC 2nd Edition (2009)	0.0038	LQM/CIEH GAC 2nd Edition (2009)	5.11	LQM/CIEH GAC 2nd Edition (2009)
Indeno(123-cd)pyrene	organic	3.51E-10	LQM/CIEH GAC 2nd Edition (2009)	276.33	LQM/CIEH GAC 2nd Edition (2009)	2.12E-09	LQM/CIEH GAC 2nd Edition (2009)	0.0002	LQM/CIEH GAC 2nd Edition (2009)	4.94	LQM/CIEH GAC 2nd Edition (2009)
Dibenz(ah)anthracene	organic	3.4E-10	LQM/CIEH GAC 2nd Edition (2009)	278.35	LQM/CIEH GAC 2nd Edition (2009)	1.66E-10	LQM/CIEH GAC 2nd Edition (2009)	0.0006	LQM/CIEH GAC 2nd Edition (2009)	5.27	LQM/CIEH GAC 2nd Edition (2009)
Benzo(ghi)perylene	organic	3.56E-10	LQM/CIEH GAC 2nd Edition (2009)	276.33	LQM/CIEH GAC 2nd Edition (2009)	1.55E-10	LQM/CIEH GAC 2nd Edition (2009)	0.00026	LQM/CIEH GAC 2nd Edition (2009)	5.62	LQM/CIEH GAC 2nd Edition (2009)

Chemical	Chemical Type	Octanol - water partition coefficient (K_{ow})		Soil-water partition coefficient (K_d)		Dermal absorption fraction		Soil-plant availability correction	Root - shoot correction factor	Root - root store correction factor	Root - tuber correction factor	Root - fruit correction factor	Soil-to-plant concentration factor (green vegetables)		
		Log (dimensionless)	Notes	$cm^3 g^{-1}$	Notes	dimensionless	Notes	dimensionless	dimensionless	dimensionless	dimensionless	dimensionless	$mg\ g^{-1}$ plant (DW or FW basis) over $mg\ g^{-1}$ DW soil	Type	Notes
Chromium (III)	inorganic	NR	LQM/CIEH GAC 2nd Edition (2009)	4800	LQM/CIEH GAC 2nd Edition (2009)	0	LQM/CIEH GAC 2nd Edition (2009)	5	0.5	0.5	0.5	0.5	0.00003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)
Chromium (VI)	inorganic	NR	LQM/CIEH GAC 2nd Edition (2009)	18	LQM/CIEH GAC 2nd Edition (2009)	0	LQM/CIEH GAC 2nd Edition (2009)	5	0.5	0.5	0.5	0.5	0.0002	numeric fw	LQM/CIEH GAC 2nd Edition (2009)
Lead	inorganic	NR	Inorganic Chemical	36000	RIVM report 711701 023, 2001. Technical evaluation of the Intervention Values for Soil/sediment and Groundwater	0	Environment Agency, 2009. Science Report Final SC050021/SR3	5	0.5	0.5	0.5	0.5	0	model	CLEA to estimate
Copper	inorganic	NR	Inorganic Chemical	100	LQM/CIEH GAC 2nd Edition (2009)	0	LQM/CIEH GAC 2nd Edition (2009)	5	0.5	0.5	0.5	0.5	0.0206	numeric fw	LQM/CIEH GAC 2nd Edition (2009)
Zinc	inorganic	NR	Inorganic Chemical	38	LQM/CIEH GAC 2nd Edition (2009)	0	LQM/CIEH GAC 2nd Edition (2009)	5	0.5	0.5	0.5	0.5	0.054	numeric fw	LQM/CIEH GAC 2nd Edition (2009)
Boron	inorganic	NR	Inorganic Chemical	10	LQM/CIEH GAC 2nd Edition (2009)	0	LQM/CIEH GAC 2nd Edition (2009)	5	1	0.5	0.5	0.5	0.4	numeric fw	LQM/CIEH GAC 2nd Edition (2009)
Naphthalene	organic	3.34	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Acenaphthylene	organic	3.91	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Acenaphthene	organic	4.03	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Fluorene	organic	4.13	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Phenanthrene	organic	4.5	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Anthracene	organic	4.5	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Fluoranthene	organic	5.13	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Pyrene	organic	5.08	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Benz(a)anthracene	organic	5.91	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Chrysene	organic	5.73	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Benzo(b)fluoranthene	organic	6.08	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Benzo(k)fluoranthene	organic	6.26	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Benzo(a)pyrene	organic	6.18	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Indeno(123-cd)pyrene	organic	5.97	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Dibenz(ah)anthracene	organic	6.38	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate
Benzo(ghi)perylene	organic	6.81	LQM/CIEH GAC 2nd Edition (2009)	NR		0.13	LQM/CIEH GAC 2nd Edition (2009)	NR	NR	NR	NR	NR	0	model	CLEA to estimate

Chemical	Chemical Type	Soil-to-plant concentration factor (root vegetables)			Soil-to-plant concentration factor (tuber vegetables)			Soil-to-plant concentration factor (herbaceous fruit)			Soil-to-plant concentration factor (shrub fruit)			Soil-to-plant concentration factor (tree fruit)			Soil-to-dust transport factor ($g\ g^{-1}$ DW)	Sub-surface soil to indoor air correction factor (Dimensionless)
		mg g^{-1} plant (DW or FW basis) over mg g^{-1} DW soil	Type	Notes	mg g^{-1} plant (DW or FW basis) over mg g^{-1} DW soil	Type	Notes	mg g^{-1} plant (DW or FW basis) over mg g^{-1} DW soil	Type	Notes	mg g^{-1} plant (DW or FW basis) over mg g^{-1} DW soil	Type	Notes	mg g^{-1} plant (DW or FW basis) over mg g^{-1} DW soil	Type	Notes		
Chromium (III)	inorganic	0.00003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.00003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.00003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.00003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.00003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.5	1
Chromium (VI)	inorganic	0.0001	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.0001	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.09	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.0003	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.09	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.5	1
Lead	inorganic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Copper	inorganic	0.0206	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.0206	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.0233	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.0206	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.0206	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.5	1
Zinc	inorganic	0.054	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.054	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.143	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.054	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.054	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.5	1
Boron	inorganic	0.2	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.2	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.2	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.2	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.2	numeric fw	LQM/CIEH GAC 2nd Edition (2009)	0.5	1
Naphthalene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Acenaphthylene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Acenaphthene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Fluorene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Phenanthrene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Anthracene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Fluoranthene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Pyrene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Benz(a)anthracene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Chrysene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Benzo(b)fluoranthene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Benzo(k)fluoranthene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Benzo(a)pyrene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Indeno(123-cd)pyrene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Dibenz(ah)anthracene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1
Benzo(ghi)perylene	organic	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0	model	CLEA to estimate	0.5	1

Statistical Analysis Summary Sheets

Client/client ref:
Project ref: Summerley Corner South Site
Summerly Lane, Bognor
Site ref: LW23175
Data description:
Contaminant(s): Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Copper, Zinc, Selenium, Boron.
Test scenario: Planning

	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Selenium (mg/kg)	Boron (mg/kg)	Chromium VI (mg/kg)
Critical concentration, C	35	80	627	246	268	130	6200	40300	595	10300	4.3
Notes	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake
Sample size, n	7	7	7	7	7	7	7	7	7	7	7
Sample mean, $\bar{x}$	10.9483755	0.25	28.698231	114.68097	0.25	20.9925437	18.2353656	107.417191	0.86071148	0.53014286	1
Standard deviation, s	3.01726904	0	8.50510522	107.973171	0	6.31525499	5.30689981	74.8975356	0.27940127	0.28029118	0
Number of non-detects	0	7	0	0	7	0	0	0	1	3	7
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	Half detection limit
Outliers?	No	No	No	No	No	No	No	Yes	No	No	No
Distribution	Normal	Single value	Normal	Normal	Single value	Normal	Normal	Non-normal	Non-normal	Normal	Single value
Statistical approach	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: One-sample t	Auto: Chebychev	Auto: Chebychev	Auto: One-sample t	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, (or k2)	-21.09013691	N/A	-186.1185309	-3.217813224	N/A	-45.66824635	-3081.914578	-1419.800769	-5626.119112	-97219.74252	N/A
Upper confidence limit	13.1644181	0.25	34.944832	193.982201	0.25	25.6308024	22.1330346	230.81155	1.32102756	0.73600358	1
Evidence level	100%	100%	100%	99%	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
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc

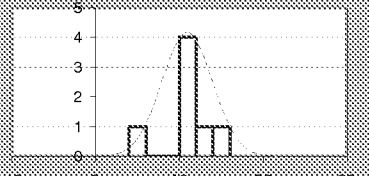
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

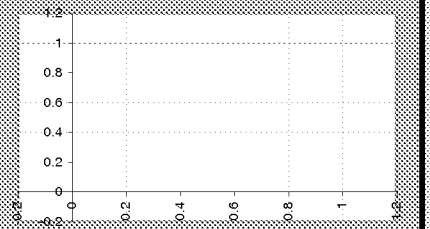
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Arsenic (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	10.948
Sample standard deviation, s	3.0173
Sample size, n	7
Critical concentration, Cc (mg/kg)	35

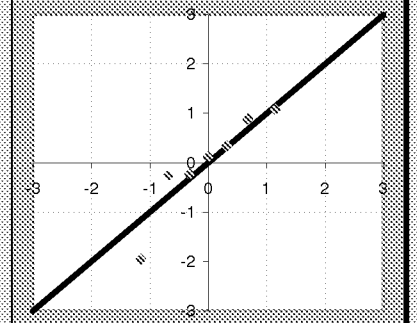
Use Normal distribution to test fo



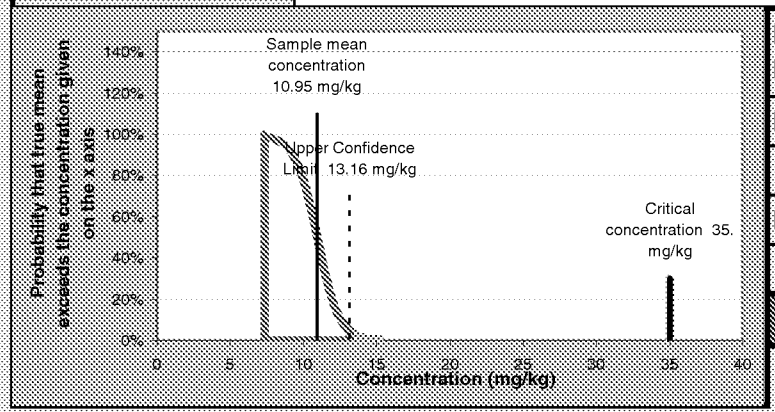
Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	0



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

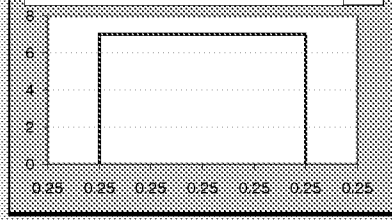
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

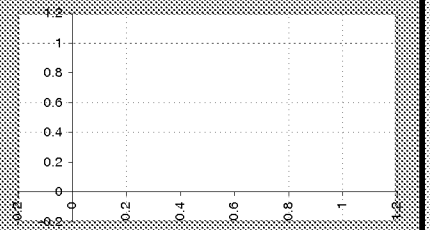
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Cadmium (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.25
Sample standard deviation, s	0
Sample size, n	7
Critical concentration, Cc (mg/kg)	80

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	7

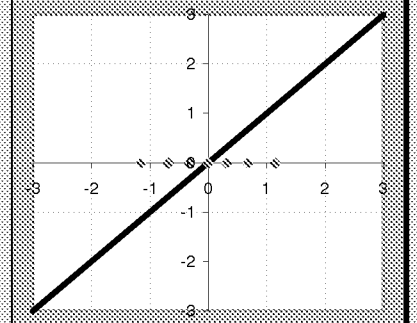


Normality test

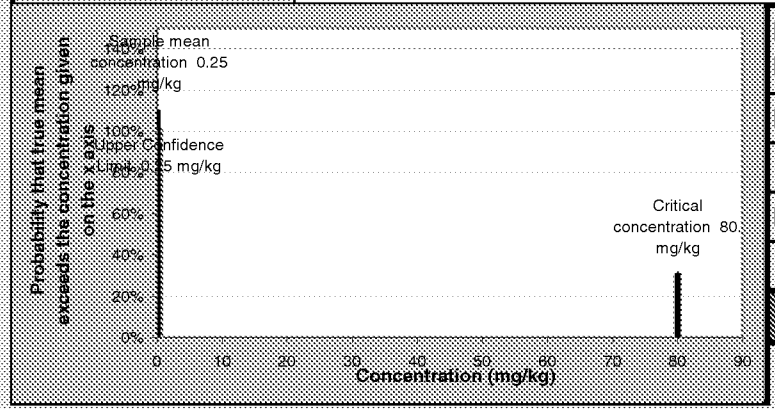
Significance level: 5%

Single value distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

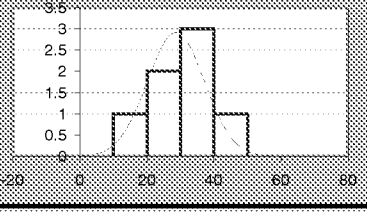
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

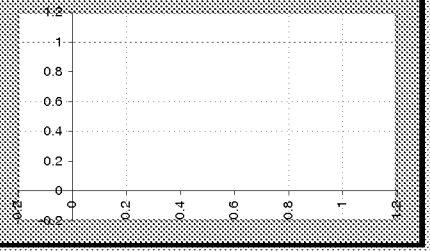
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Chromium (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	28.698
Sample standard deviation, s	8.5051
Sample size, n	7
Critical concentration, Cc (mg/kg)	627

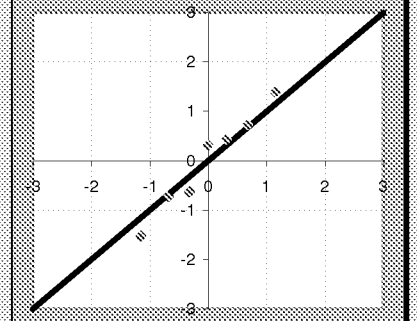
Use Normal distribution to test fo



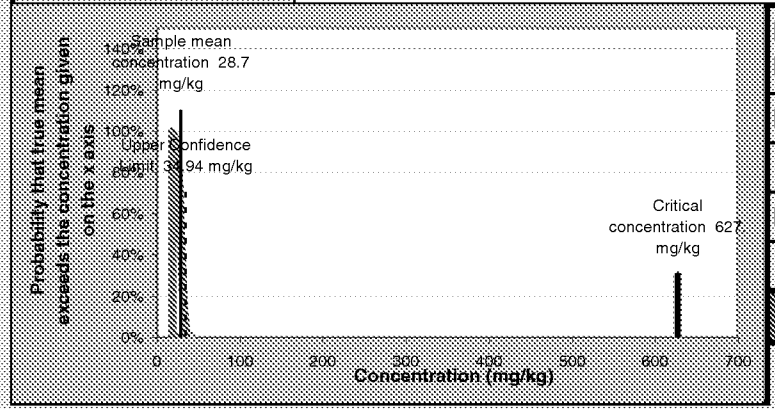
Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	0



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

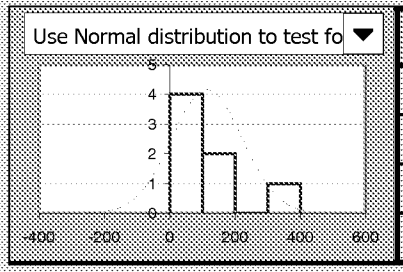
μ < Cc (re this dataset)

Test Results

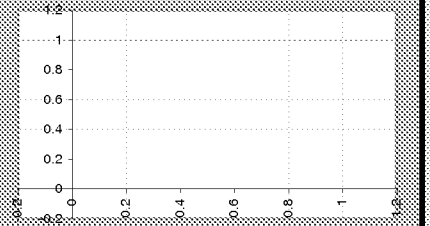
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Lead (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	114.68
Sample standard deviation, s	107.97
Sample size, n	7
Critical concentration, Cc (mg/kg)	246



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

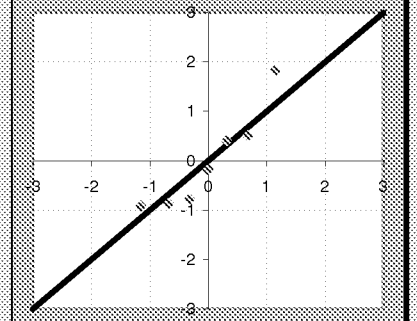


Normality test

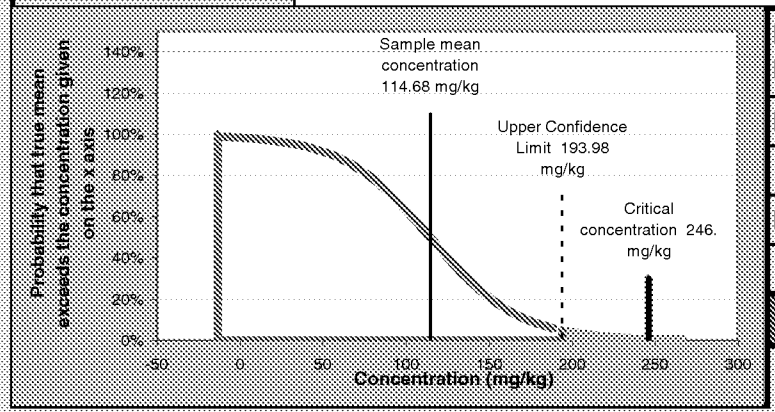
Significance level: 5%

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:	99%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

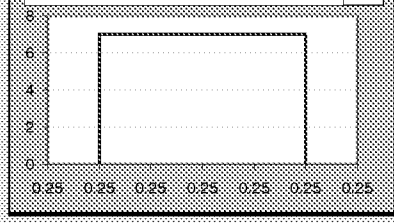
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

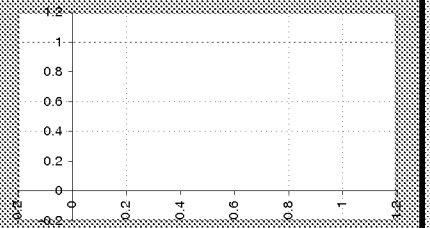
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Mercury (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.25
Sample standard deviation, s	0
Sample size, n	7
Critical concentration, Cc (mg/kg)	268

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	7

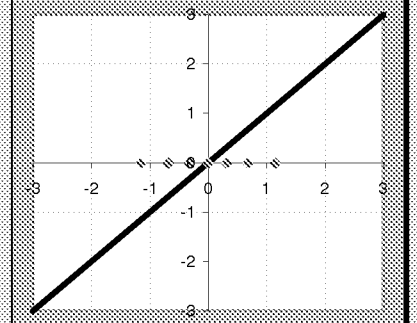


Normality test

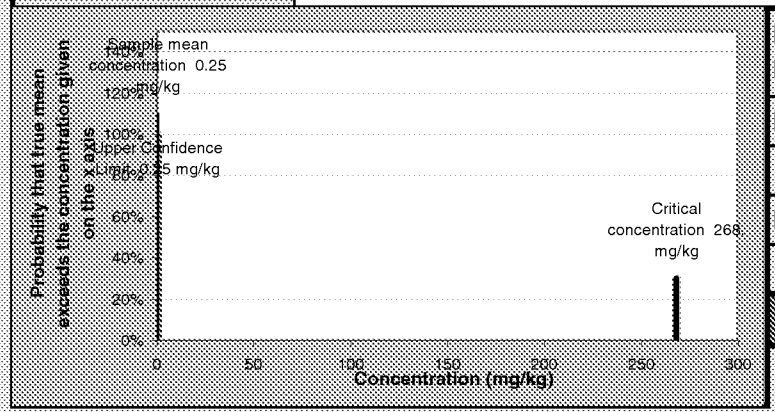
Significance level: 5%

Single value distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

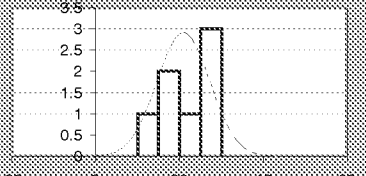
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

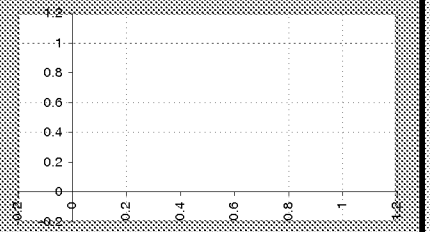
Project ref: Summerley Corner | Data description: | User details: SS

Dataset:	Nickel (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	20.993
Sample standard deviation, s	6.3153
Sample size, n	7
Critical concentration, Cc (mg/kg)	130

Use Normal distribution to test fo



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

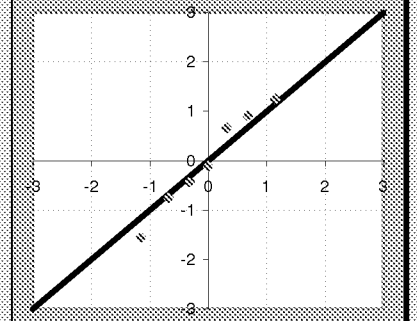


Normality test

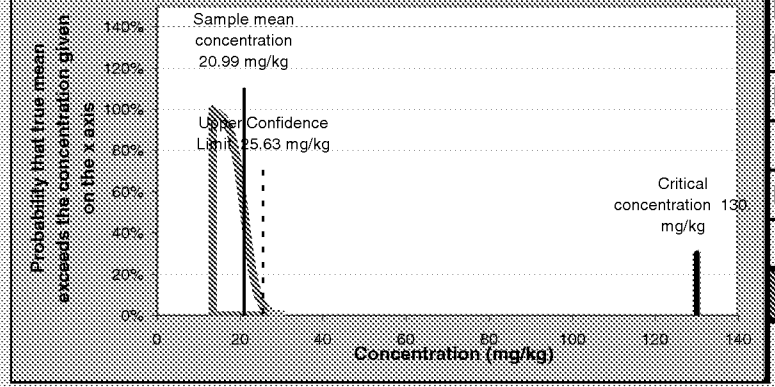
Significance level: 5%

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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

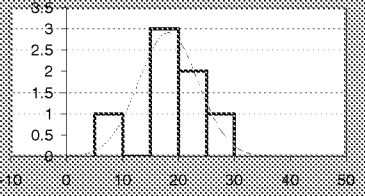
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

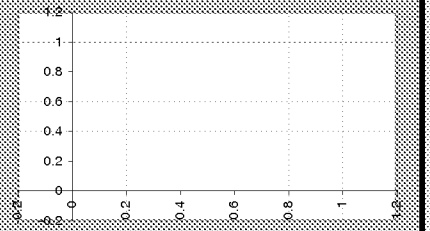
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Copper (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	18.235
Sample standard deviation, s	5.3069
Sample size, n	7
Critical concentration, Cc (mg/kg)	6200

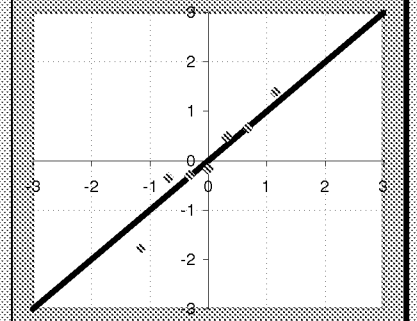
Use Normal distribution to test fo



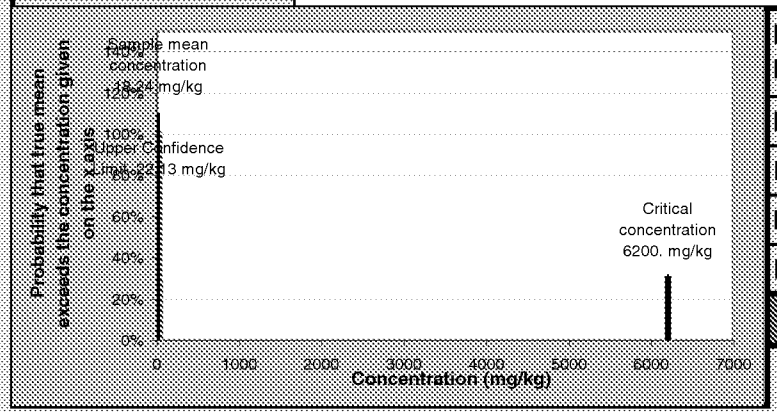
Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	0



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

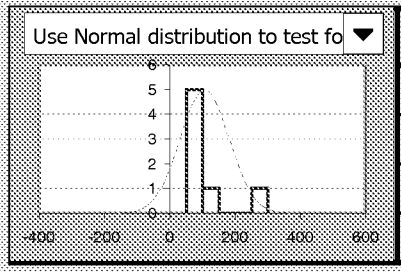
μ < Cc (re this dataset)

Test Results

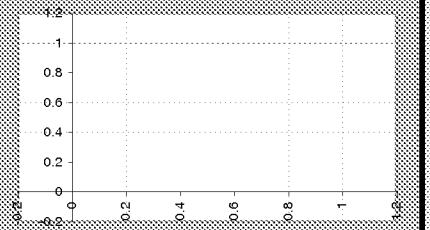
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Zinc (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	107.42
Sample standard deviation, s	74.898
Sample size, n	7
Critical concentration, Cc (mg/kg)	40300



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	0

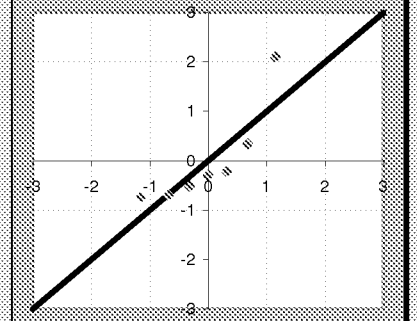


Normality test

Significance level: 5%

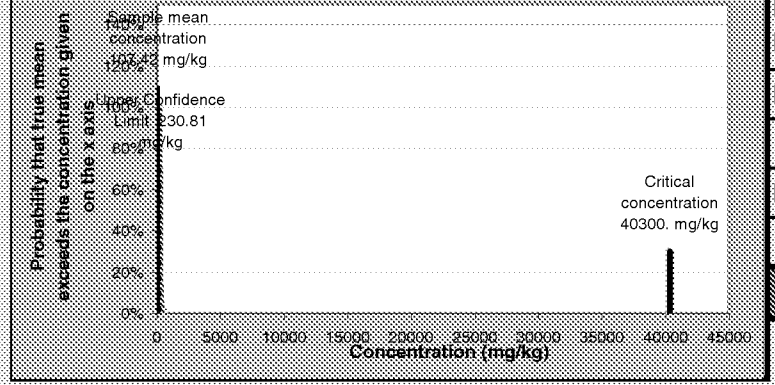
Non-normal distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

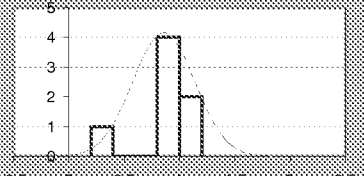
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

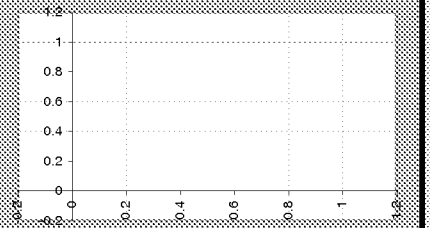
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Selenium (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.8607
Sample standard deviation, s	0.2794
Sample size, n	7
Critical concentration, Cc (mg/kg)	595

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	1

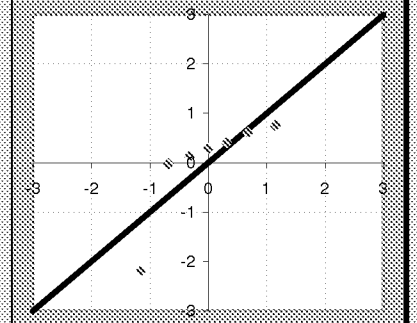


Normality test

Significance level: 5%

Non-normal distribution

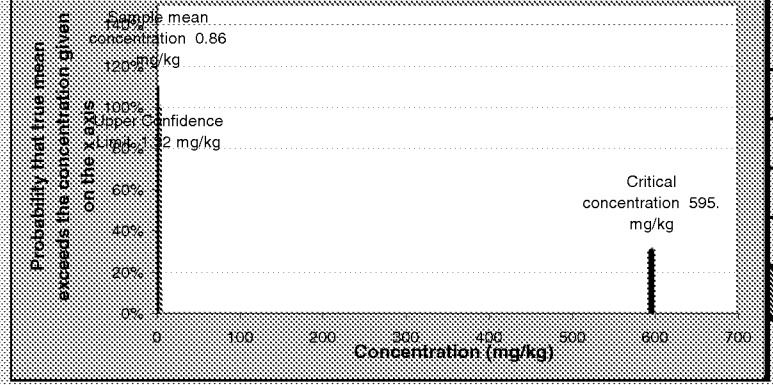
Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

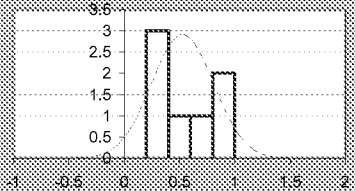
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

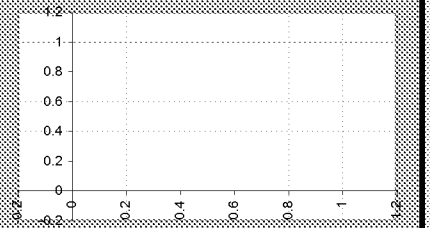
Project ref: Summerley Corner ; Data description: | User details: SS

Dataset:	Boron (mg/kg)
Sample mean, $\bar{x}$ (mg/kg)	0.5301
Sample standard deviation, s	0.2803
Sample size, n	7
Critical concentration, Cc (mg/kg)	10300

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	3

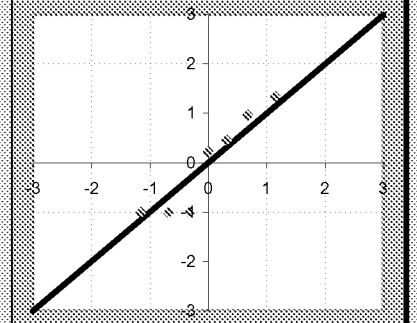


Normality test

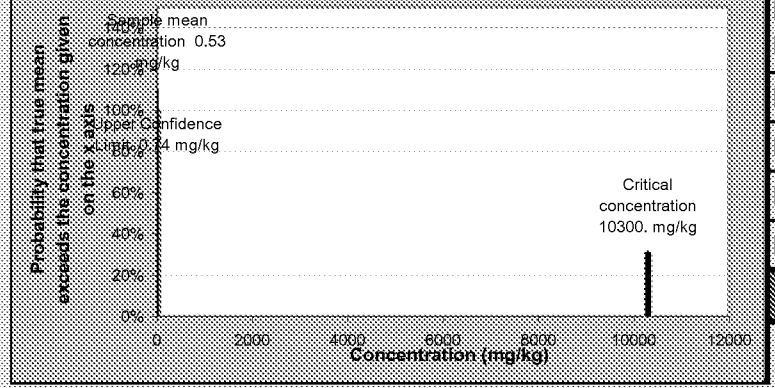
Significance level: 5%

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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

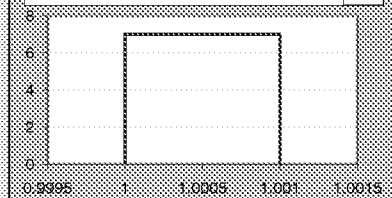
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

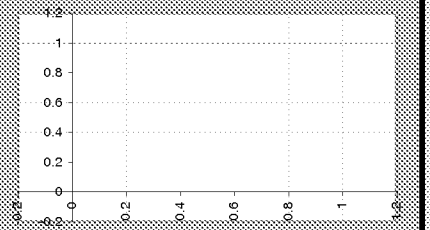
Project ref: Summerley Corner ; Data description: | User details: SS

Dataset:	Chromium VI (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	1
Sample standard deviation, s	0
Sample size, n	7
Critical concentration, Cc (mg/kg)	4.3

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	7

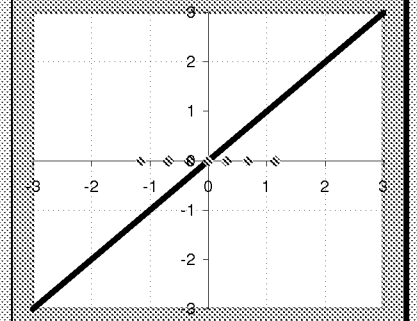


Normality test

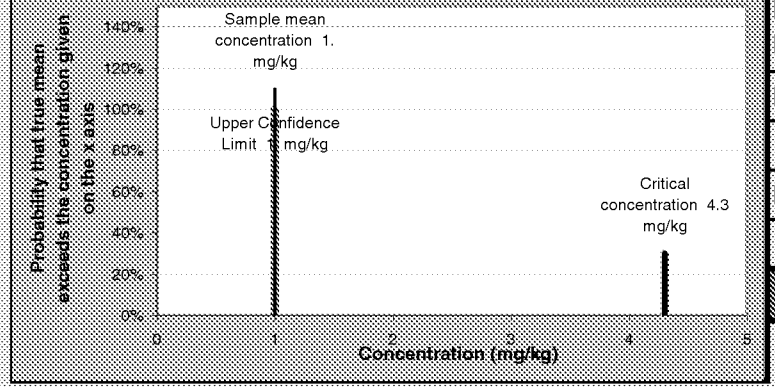
Significance level: 5%

Single value distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

Client/client ref:
Project ref: Summerley Corner South Site
Summerly Lane, Bognor
Site ref: LW23175
Data description:
Contaminant(s): Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene

	Naphthalene (mg/kg)	Acenaphthylene (mg/kg)	Acenaphthene (mg/kg)	Fluorene (mg/kg)	Phenanthrene (mg/kg)	Anthracene (mg/kg)	Fluoranthene (mg/kg)	Pyrene (mg/kg)
Critical concentration, C_c	**1.6**	**1950**	**2000**	**1850**	**830**	**19000**	**970**	**2300**
Notes	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake
Sample size, n	7	7	7	7	7	7	7	7
Sample mean, $\bar{x}$	0.25	0.25	0.36573872	0.25	1.77581453	0.43950833	2.5602629	2.10323851
Standard deviation, s	0	0	0.30621586	0	4.03692578	0.50139192	5.8498535	4.69201759
Number of non-detects	**7**	**7**	**6**	**7**	**6**	**6**	**5**	**5**
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
Outliers?	No	No	Yes	No	Yes	Yes	Yes	Yes
Distribution	Single value	Single value	Non-normal	Single value	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

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_μ (or t_w)	N/A	N/A	-17277.14198	N/A	-542.8079045	-100257.1242	-437.5502656	-1295.746075
Upper confidence limit (on true mean concentration, μ)	0.25	0.25	0.87023209	0.25	8.42668585	1.26555601	12.1979489	9.83337944
Evidence level	**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
Result	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**

Client/client ref:
Project ref: Summerley Corner South Site
Summerly Lane, Bognor
Site ref: LW23175
Data description:
Contaminant(s): Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene

	Benz(a)anthracene (mg/kg)	Chrysene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Benzo(a)pyrene (mg/kg)	Indeno(123-cd)pyrene (mg/kg)	Dibenz(ah)anthracene (mg/kg)	Benzo(ghi)perylene (mg/kg)
Critical concentration, C_c	**3.7**	**8.8**	**7**	**10.1**	**1**	**4.2**	**0.9**	**46.6**
Notes	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake	ASI Ltd SSV Residential without Plant Uptake
Sample size, n	7	7	7	7	7	7	7	7
Sample mean, $\bar{x}$	1.29508629	2.2502355	1.18175324	1.0438923	1.1772139	0.83118863	0.38822052	0.8337933
Standard deviation, s	2.76503842	5.01082342	2.46518736	2.10044159	2.45317738	1.53768059	0.36569711	1.54457189
Number of non-detects	**6**	**5**	**6**	**6**	**6**	**6**	**6**	**6**
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
Outliers?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distribution	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
Test scenario:	tion to test for outliers							
t statistic, t_μ (or t_w)	-2.301162814	-3.458323423	-6.244407325	-11.40722453	0.191125151	-5.79641646	-3.702630358	-78.3945392
Upper confidence limit (on true mean concentration, μ)	5.85051182	10.5056119	5.24317146	4.5043886	5.21884557	3.36453116	0.99070978	3.3784893
Evidence level	**84%**	**92%**	**97%**	**99%**	**0%**	**97%**	**93%**	**100%**
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	**$\mu \approx \geq C_c$**	**$\mu \approx \geq C_c$**	**$\mu < C_c$**	**$\mu < C_c$**	**$\mu \geq C_c$**	**$\mu < C_c$**	**$\mu \approx \geq C_c$**	**$\mu < C_c$**

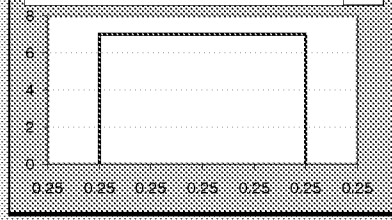
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

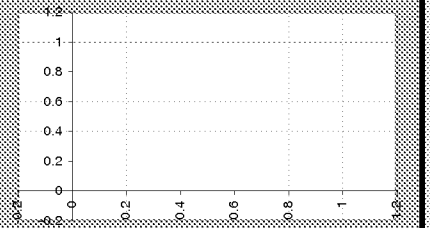
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Acenaphthylene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.25
Sample standard deviation, s	0
Sample size, n	7
Critical concentration, Cc (mg/kg)	1950

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	7

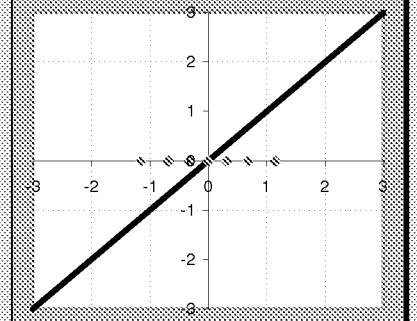


Normality test

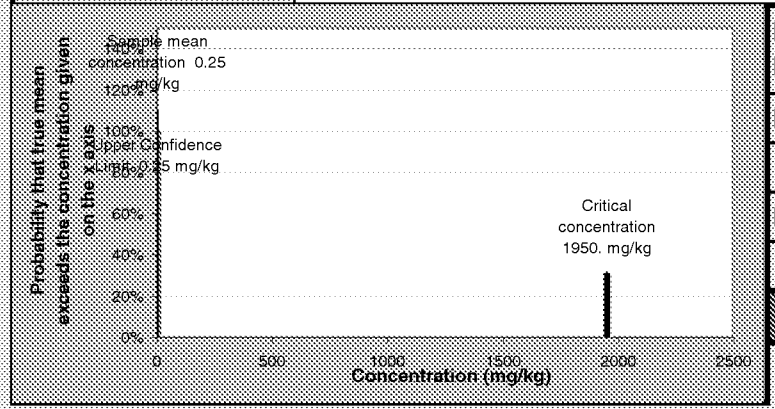
Significance level: 5%

Single value distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

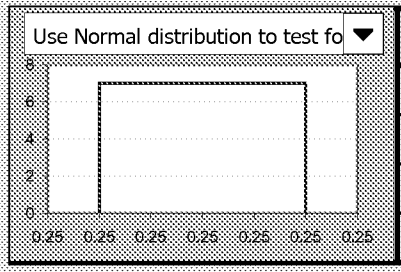
μ < Cc (re this dataset)

Test Results

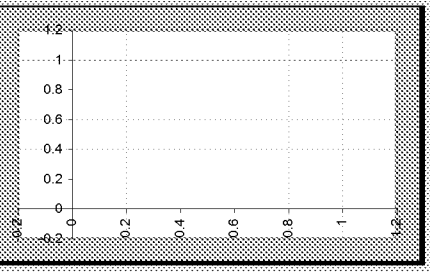
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner ; Data description: | User details: SS

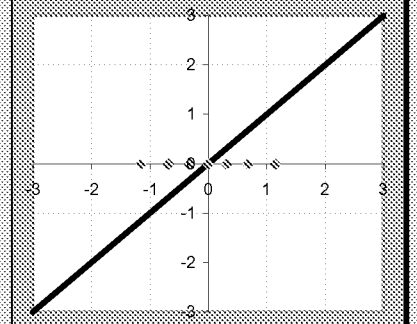
Dataset:	Naphthalene (mg/kg)
Sample mean, $\overline{x}$ (mg/kg)	0.25
Sample standard deviation, s	0
Sample size, n	7
Critical concentration, Cc (mg/kg)	1.6



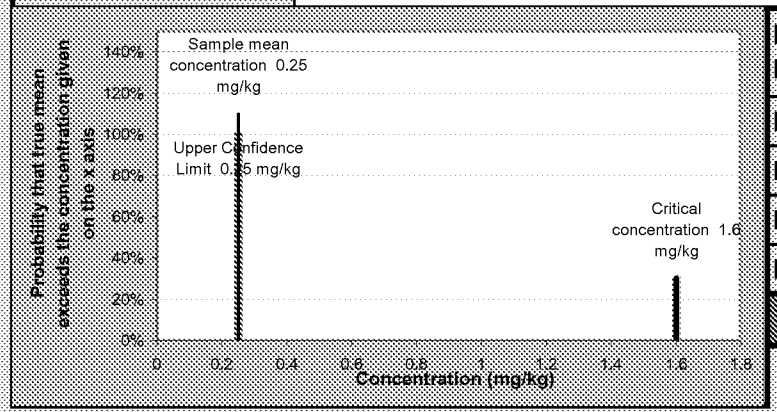
Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	7



Normality test	
Significance level:	5%
Single value distribution	
Use:	Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

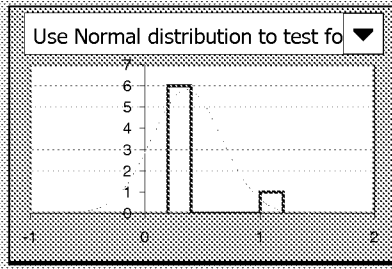
μ < Cc (re this dataset)

Test Results

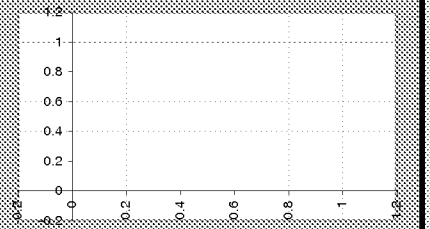
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Acenaphthene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.3657
Sample standard deviation, s	0.3062
Sample size, n	7
Critical concentration, Cc (mg/kg)	2000



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6

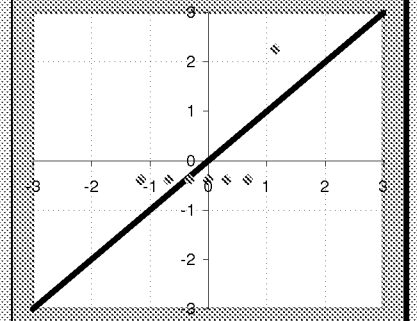


Normality test

Significance level: 5%

Non-normal distribution

Use: Auto: Chebychev

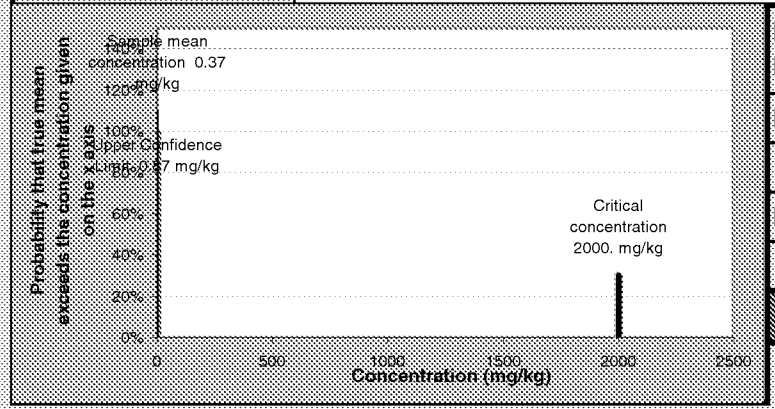


Test scenario:

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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

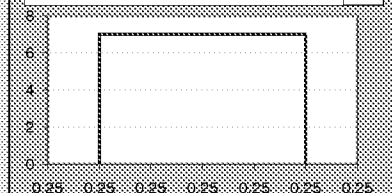
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

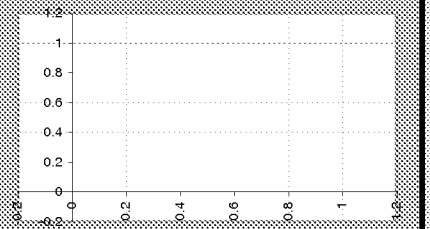
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Fluorene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.25
Sample standard deviation, s	0
Sample size, n	7
Critical concentration, Cc (mg/kg)	1850

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	7

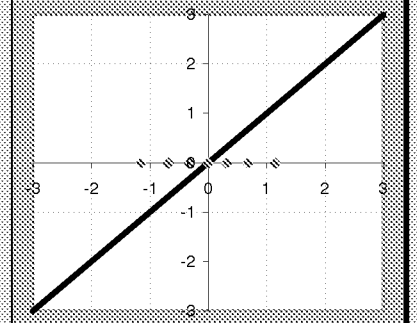


Normality test

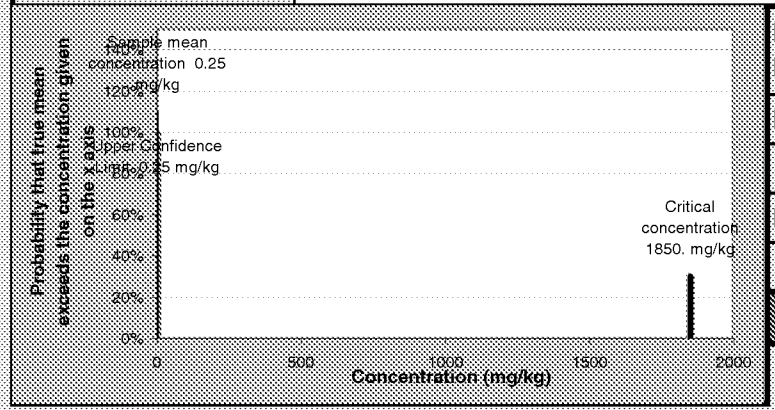
Significance level: 5%

Single value distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

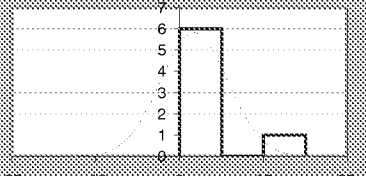
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

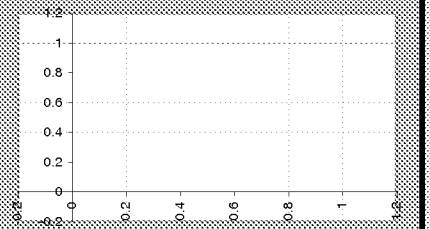
Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Phenanthrene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	1.7758
Sample standard deviation, s	4.0369
Sample size, n	7
Critical concentration, Cc (mg/kg)	830

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6

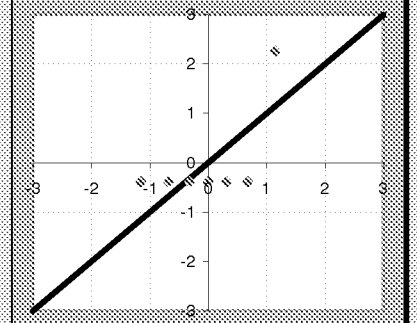


Normality test

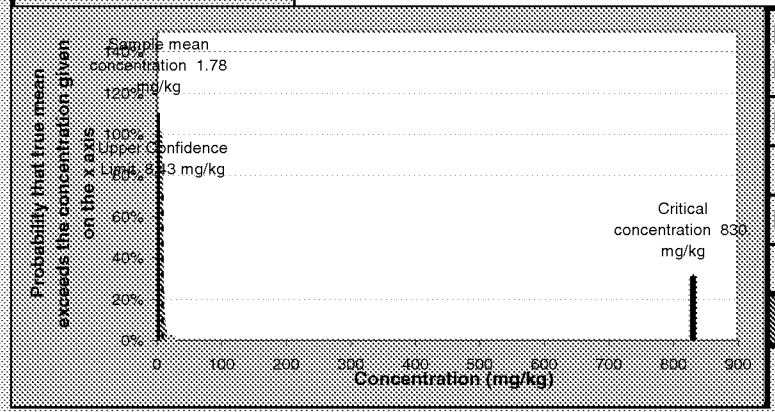
Significance level: 5%

Non-normal distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

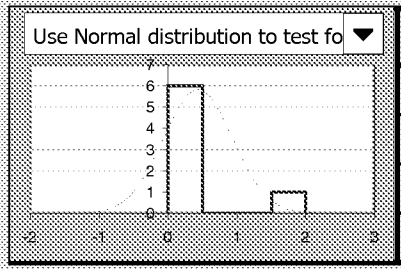
μ < Cc (re this dataset)

Test Results

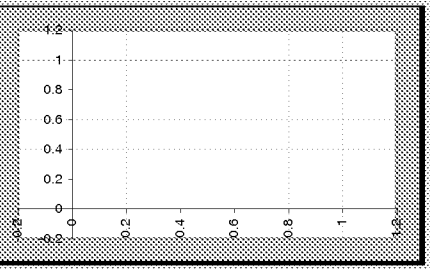
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Anthracene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.4395
Sample standard deviation, s	0.5014
Sample size, n	7
Critical concentration, Cc (mg/kg)	19000



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6

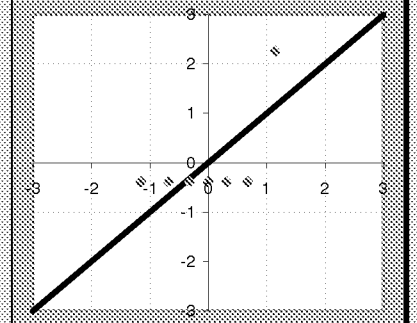


Normality test

Significance level: 5%

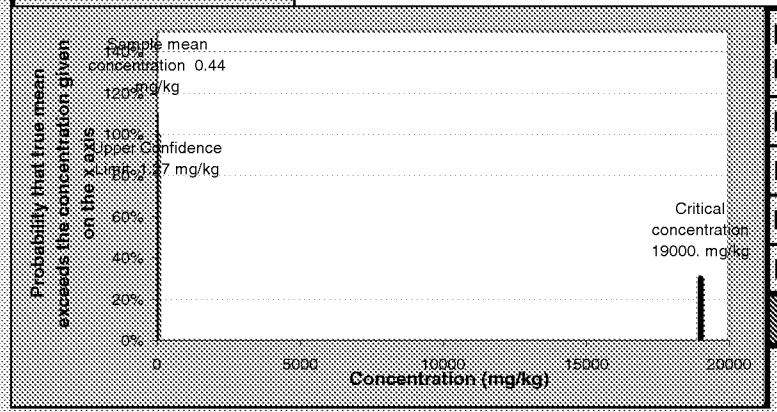
Non-normal distribution

Use: Auto: Chebychev



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:	**100%**
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

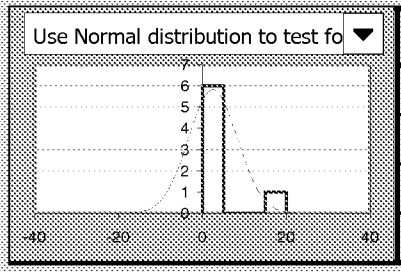
μ < Cc (re this dataset)

Test Results

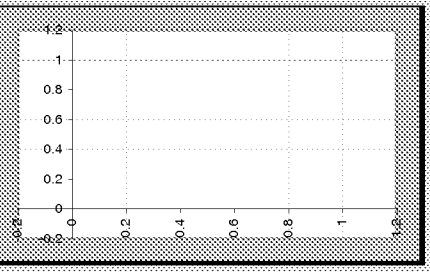
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Fluoranthene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	2.5603
Sample standard deviation, s	5.8499
Sample size, n	7
Critical concentration, Cc (mg/kg)	970



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	5

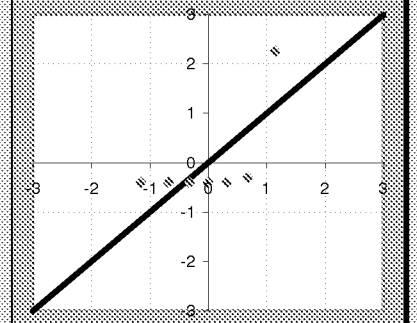


Normality test

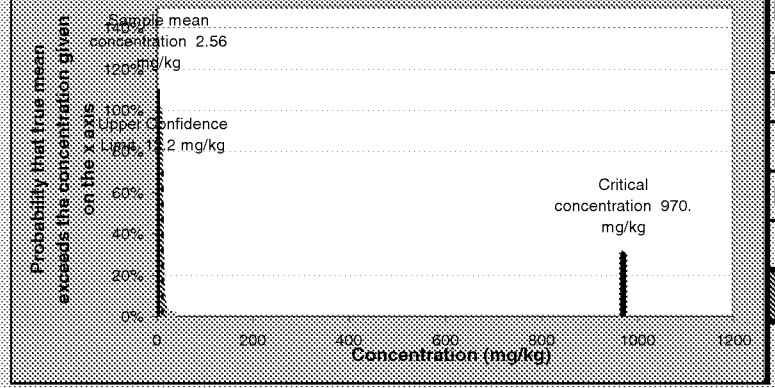
Significance level: 5%

Non-normal distribution

Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

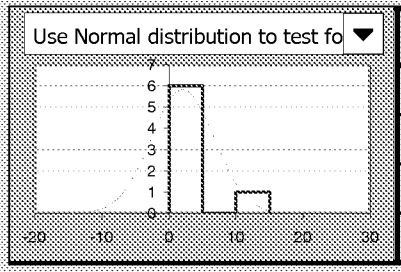
μ < Cc (re this dataset)

Test Results

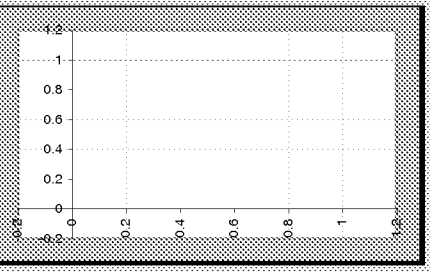
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

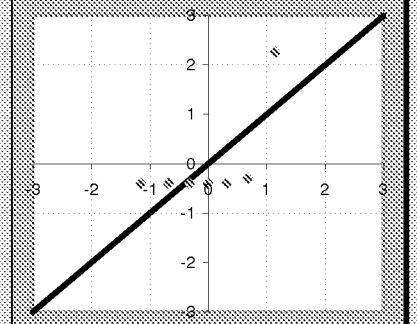
Dataset:	Pyrene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	2.1032
Sample standard deviation, s	4.692
Sample size, n	7
Critical concentration, Cc (mg/kg)	2300



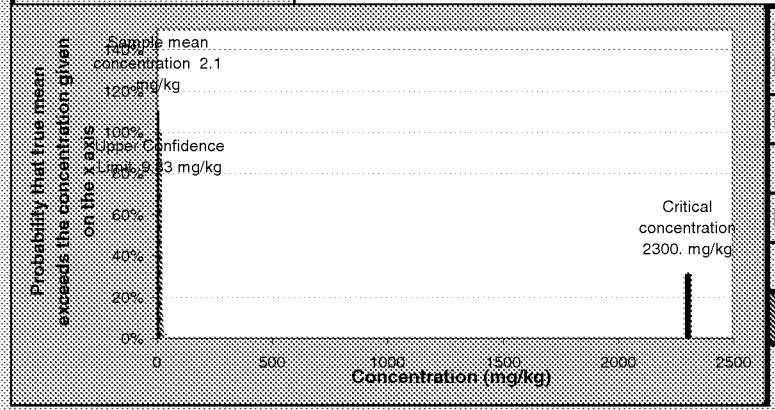
Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	5



Normality test	
Significance level:	5%
Non-normal distribution	
Use:	Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

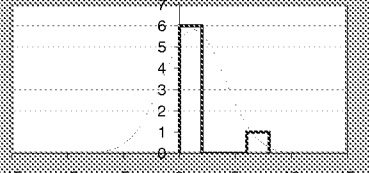
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

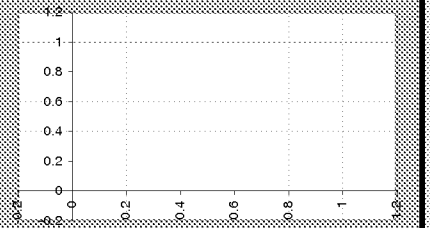
Project ref: Summerley Corner | Data description: | User details: SS

Dataset:	Benz(a)anthracene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	1.2951
Sample standard deviation, s	2.765
Sample size, n	7
Critical concentration, Cc (mg/kg)	3.7

Use Normal distribution to test fo



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6

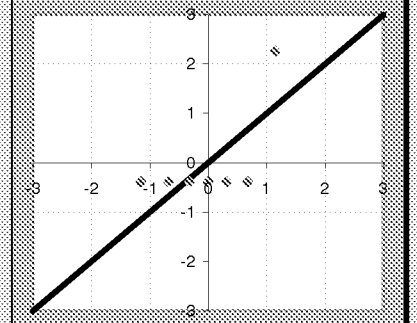


Normality test

Significance level: 5%

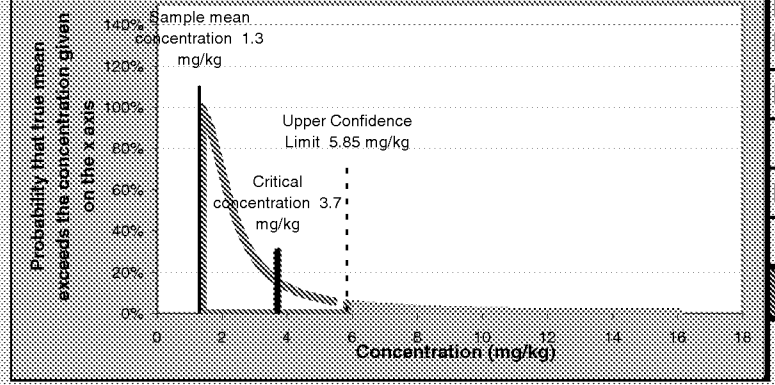
Non-normal distribution

Use: Auto: Chebychev



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:	**84%**
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No

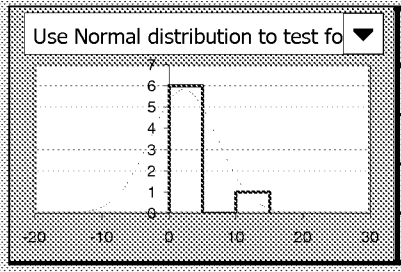
Not enough evidence

Test Results

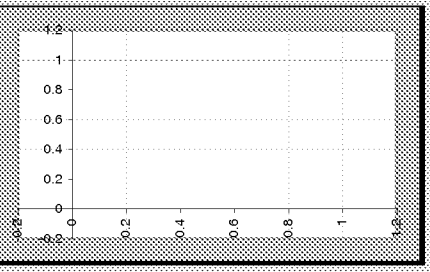
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Chrysene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	2.2502
Sample standard deviation, s	5.0108
Sample size, n	7
Critical concentration, Cc (mg/kg)	8.8



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	5

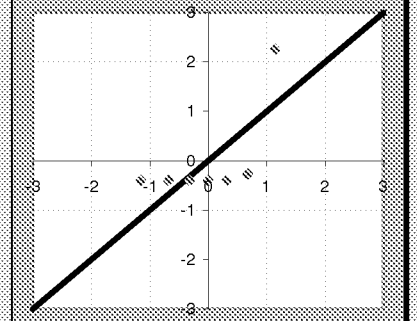


Normality test

Significance level: 5%

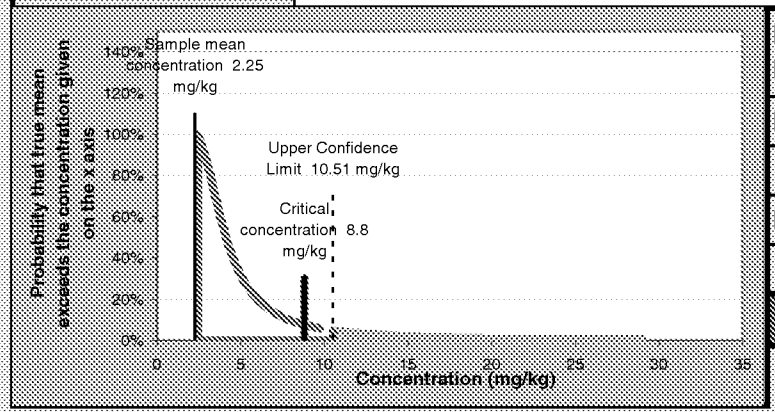
Non-normal distribution

Use: Auto: Chebychev



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:	**92%**
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No

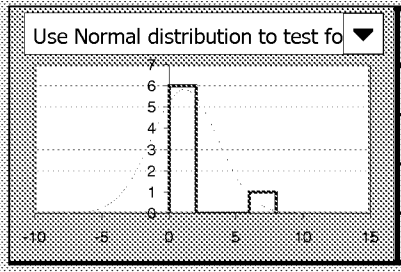
Not enough evidence

Test Results

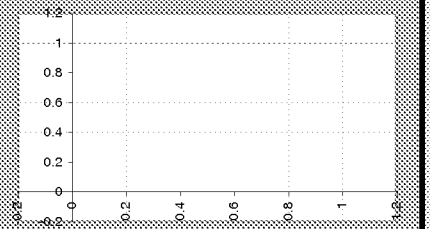
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

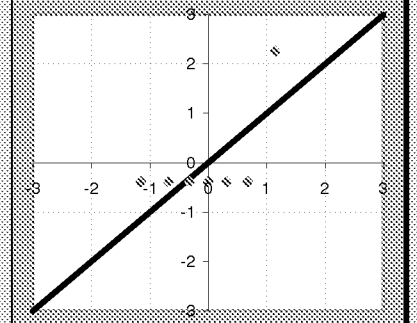
Dataset:	Benzo(b)fluoranthene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	1.1818
Sample standard deviation, s	2.4652
Sample size, n	7
Critical concentration, Cc (mg/kg)	7



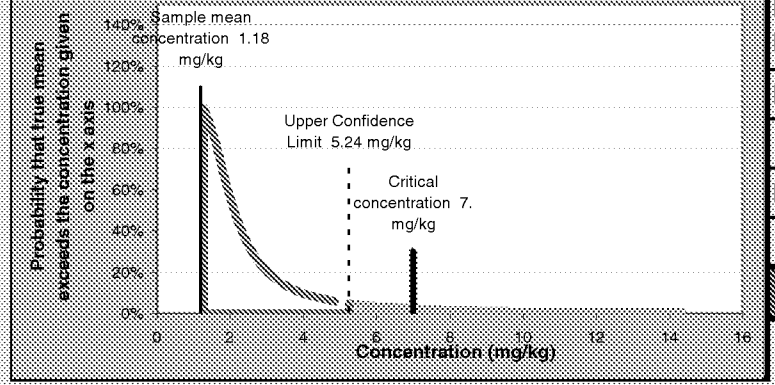
Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6



Normality test	
Significance level:	5%
Non-normal distribution	
Use:	Auto: Chebychev



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:	97%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

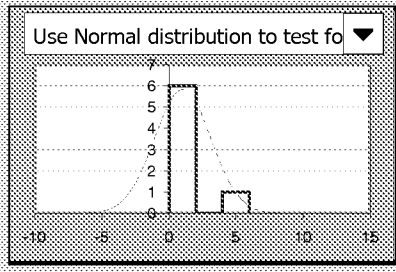
μ < Cc (re this dataset)

Test Results

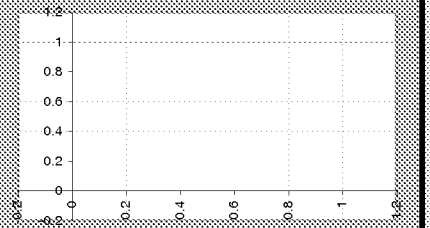
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

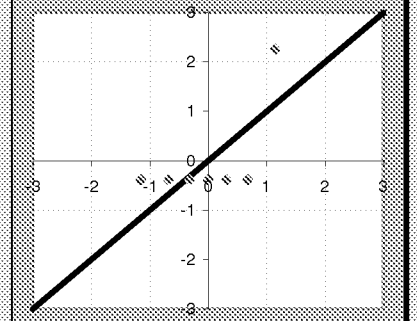
Dataset:	Benzo(k)fluoranthene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	1.0439
Sample standard deviation, s	2.1004
Sample size, n	7
Critical concentration, Cc (mg/kg)	10.1



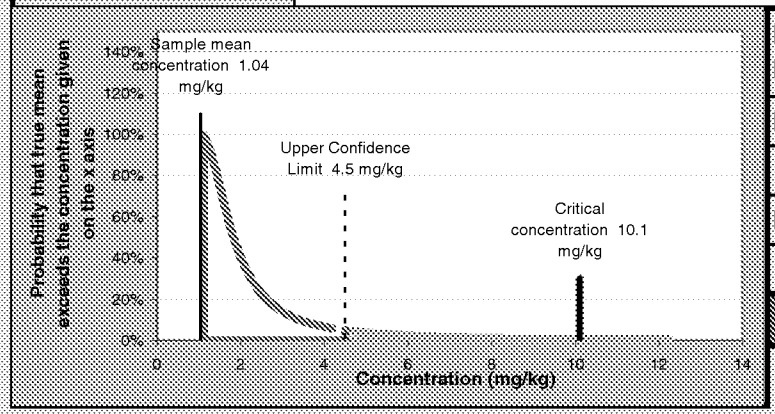
Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6



Normality test	
Significance level:	5%
Non-normal distribution	
Use:	Auto: Chebychev



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:	99%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

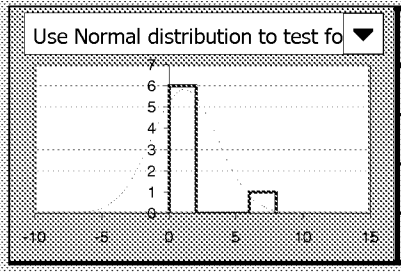
μ < Cc (re this dataset)

Test Results

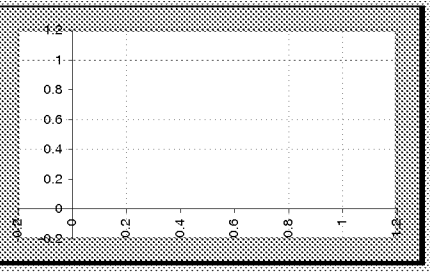
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Benzo(a)pyrene (mg/kg)
Sample mean, $\bar{x}$ (mg/kg)	1.1772
Sample standard deviation, s	2.4532
Sample size, n	7
Critical concentration, Cc (mg/kg)	1



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6

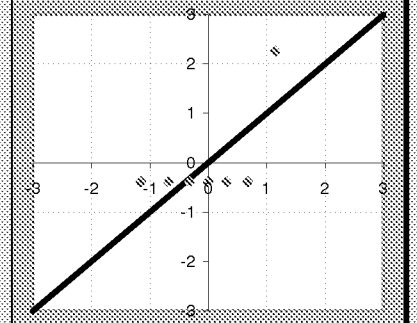


Normality test

Significance level: 5%

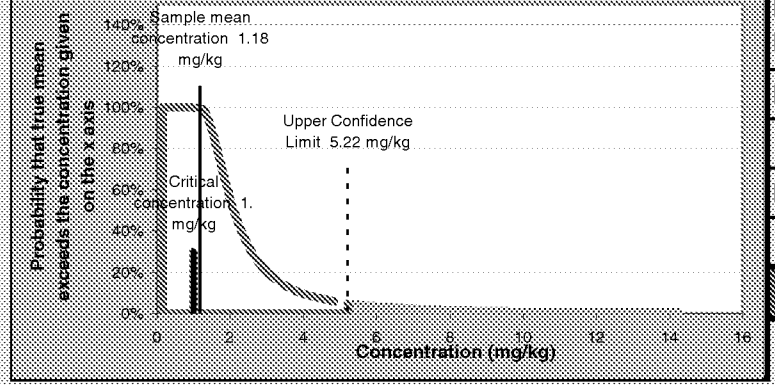
Non-normal distribution

Use: Auto: Chebychev



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:	**0%**
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No

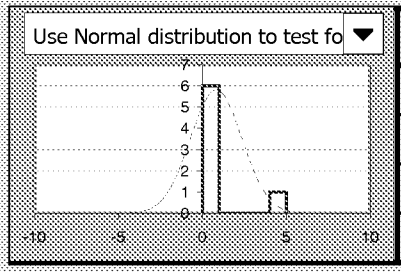
μ ≥ Cc

Test Results

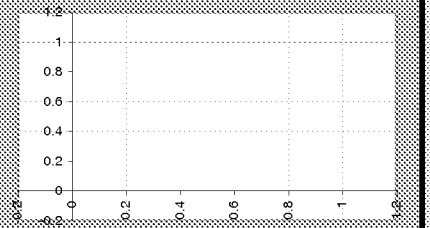
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

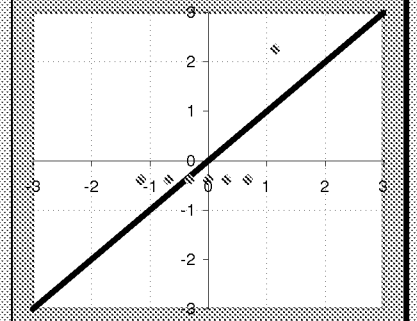
Dataset:	Indeno(123-cd)pyrene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.8312
Sample standard deviation, s	1.5377
Sample size, n	7
Critical concentration, Cc (mg/kg)	4.2



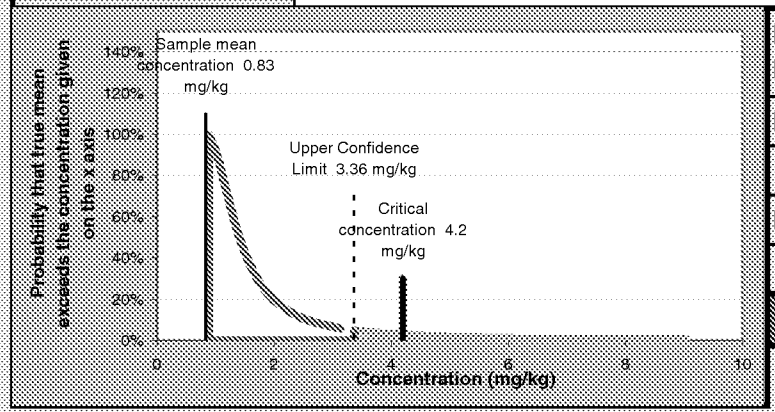
Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6



Normality test	
Significance level:	5%
Non-normal distribution	
Use:	Auto: Chebychev



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:	97%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

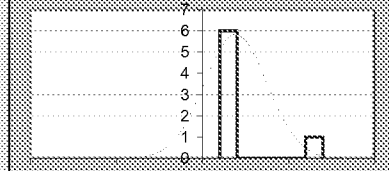
Test Results

Client/client ref: | Site ref: LW23175 | Date: 31.07.12

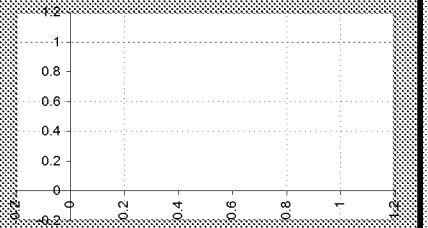
Project ref: Summerley Corner ; Data description: | User details: SS

Dataset:	Dibenz(ah)anthracene (mg/kg)
Sample mean, $\bar{x}$ (mg/kg)	0.3882
Sample standard deviation, s	0.3657
Sample size, n	7
Critical concentration, Cc (mg/kg)	0.9

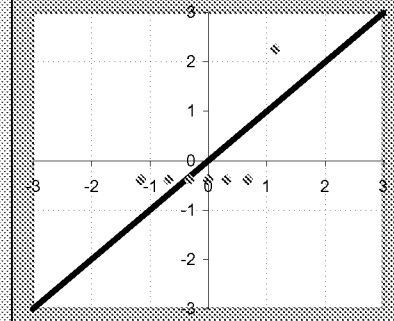
Use Normal distribution to test fo



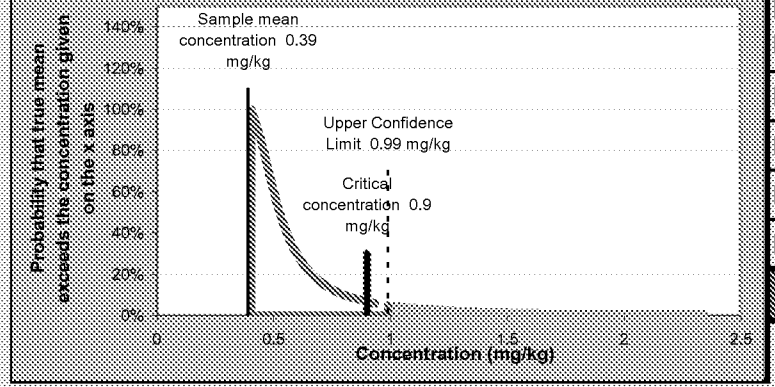
Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6



Normality test	
Significance level:	5%
Non-normal distribution	
Use:	Auto: Chebychev



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:	93%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No

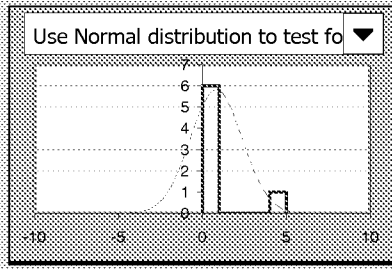
Not enough evidence

Test Results

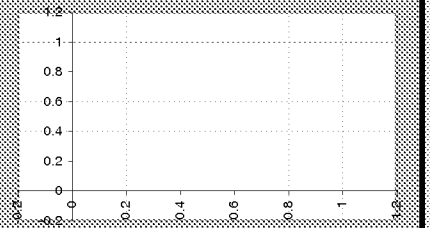
Client/client ref: | Site ref: LW23175 | Date: 31.07.12

Project ref: Summerley Corner S | Data description: | User details: SS

Dataset:	Benzo(ghi)perylene (mg/kg)
Sample mean, $\bar{X}$ (mg/kg)	0.8338
Sample standard deviation, s	1.5446
Sample size, n	7
Critical concentration, Cc (mg/kg)	46.6



Outliers & non-detects	
Outliers present?	YES
Significance level	5%
Outliers removed?	0
Non-detects	6

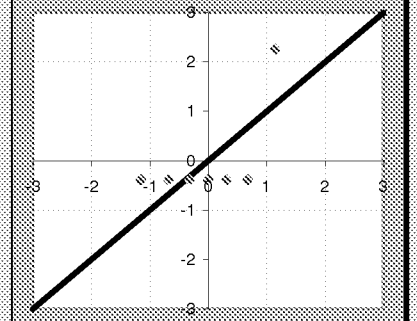


Normality test

Significance level: 5%

Non-normal distribution

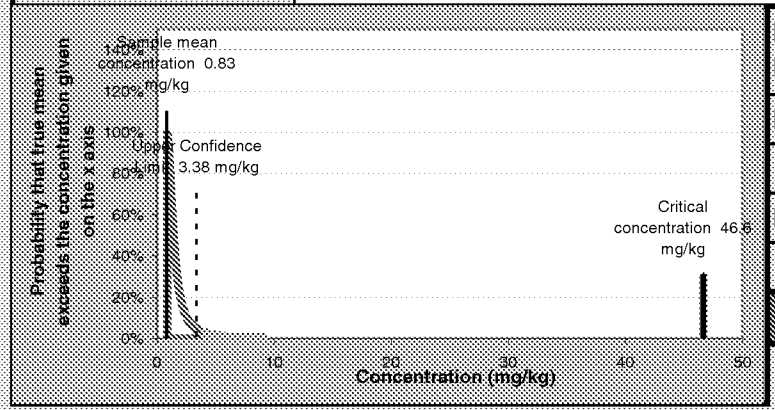
Use: Auto: Chebychev



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:	100%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	Yes

μ < Cc (re this dataset)

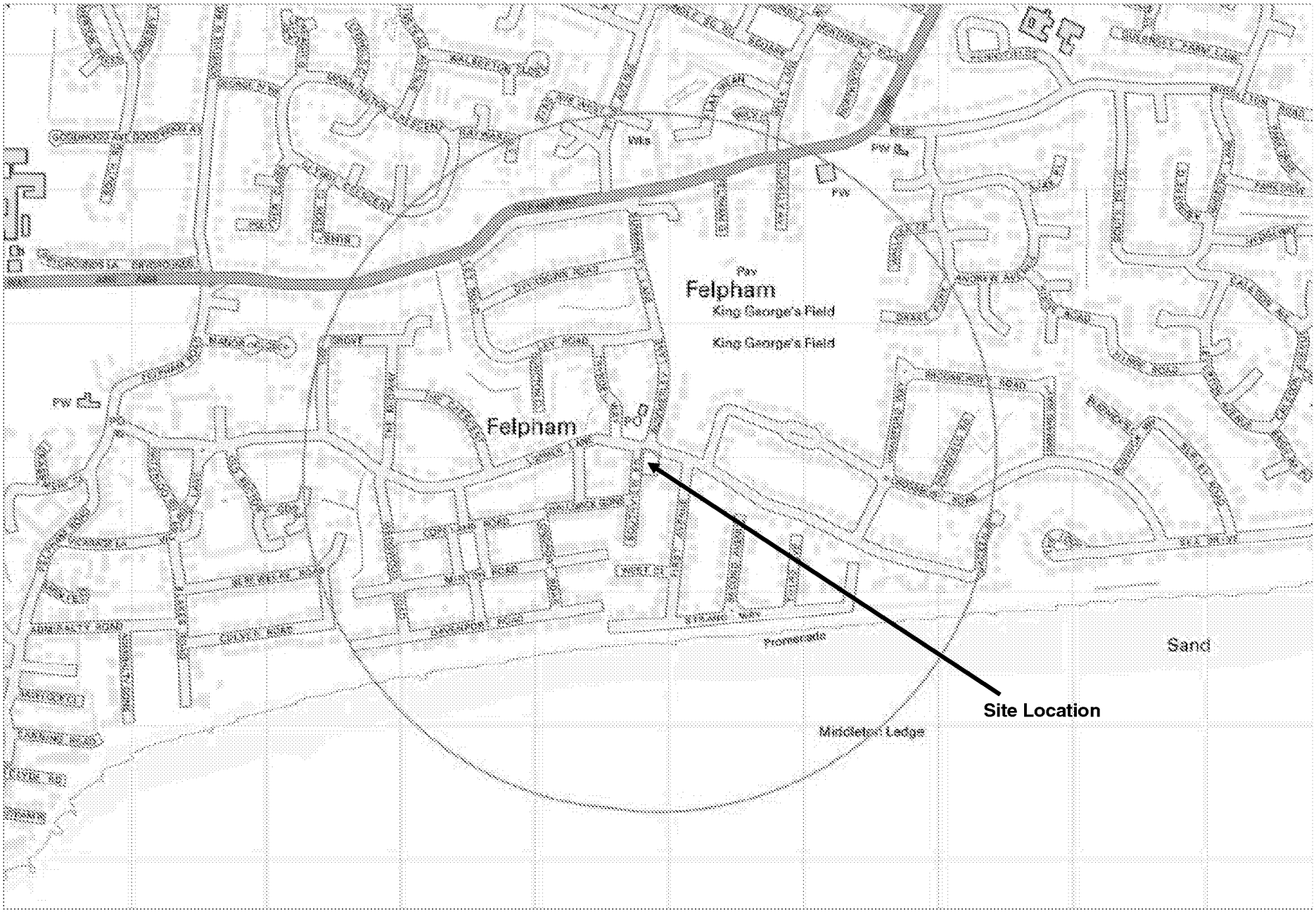
FIGURES

Figure 1 Site Location Plan

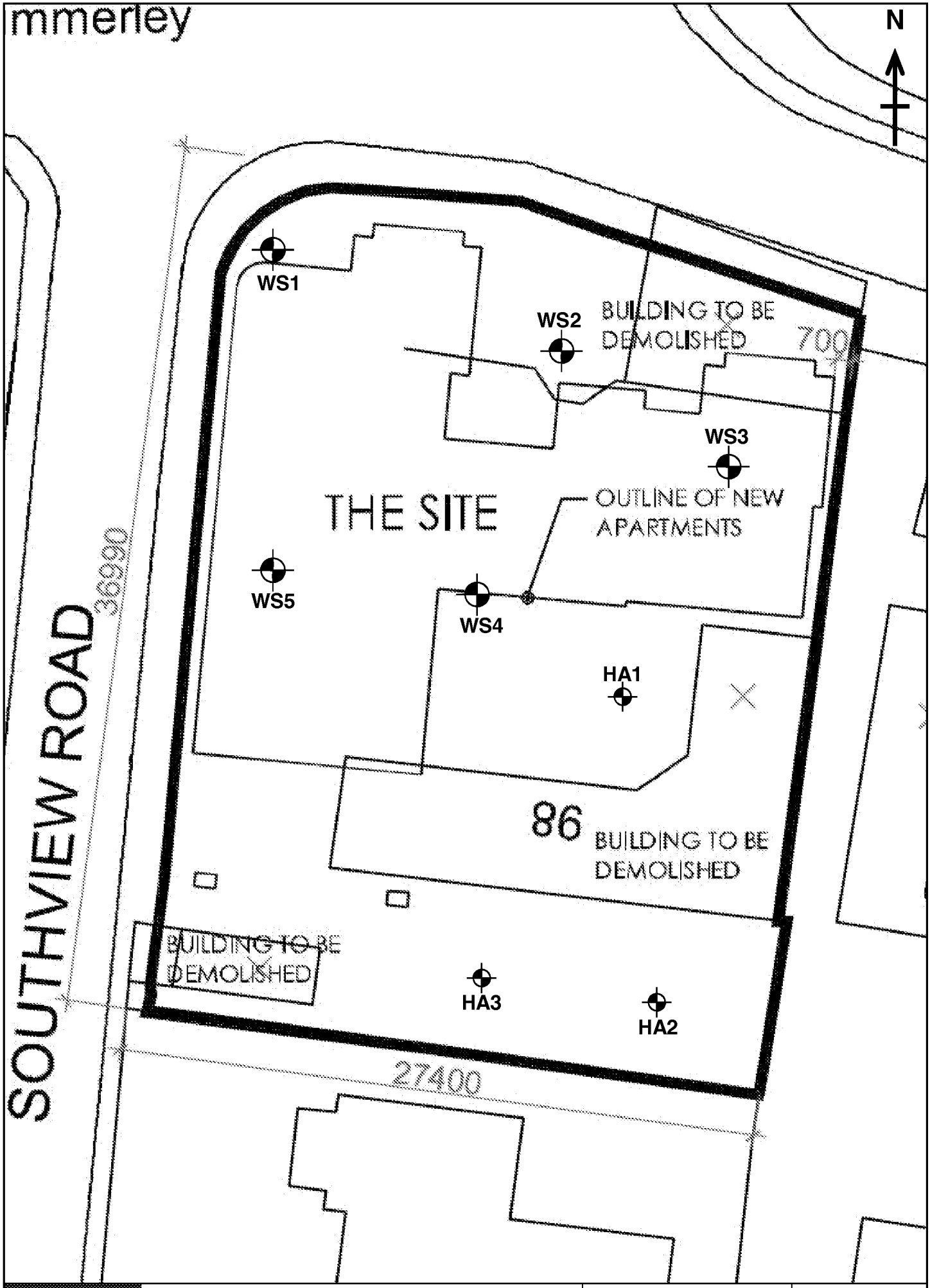
Figure 2 Site Plan

Figure 3 Preliminary Conceptual Model

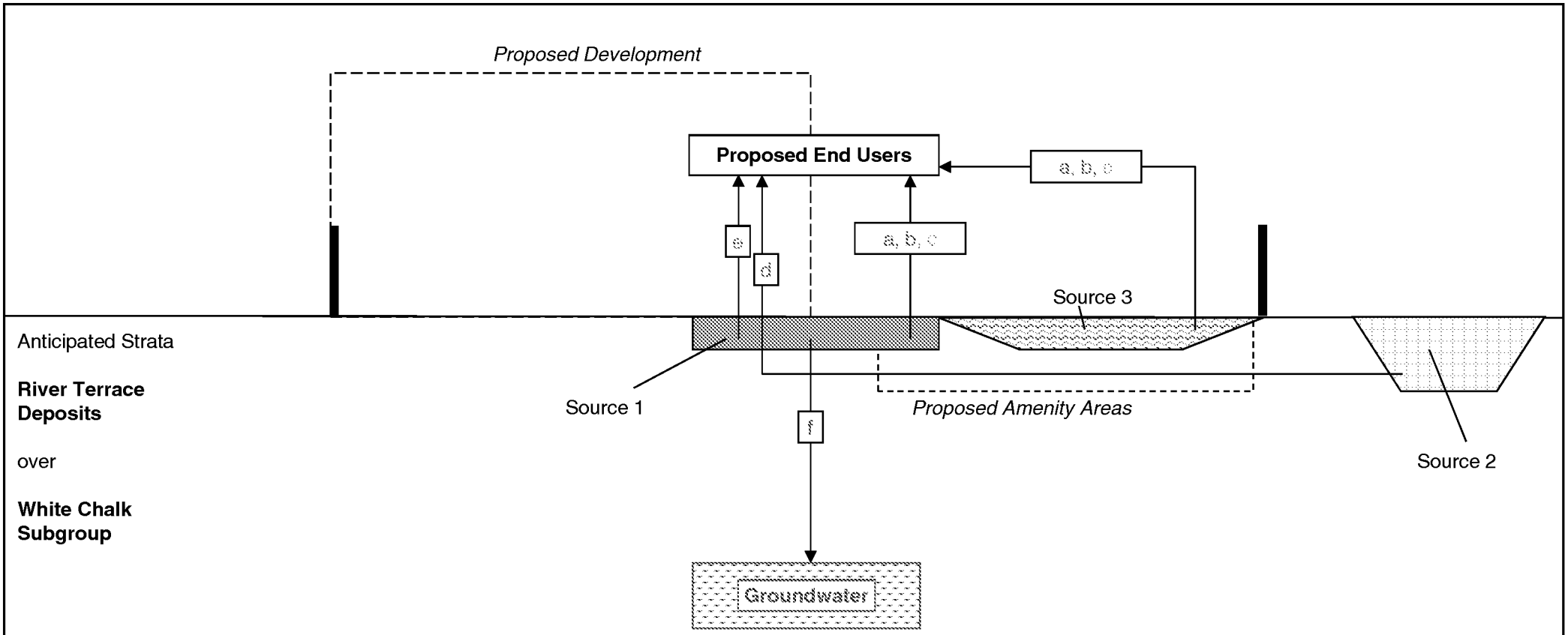
Figure 4 Quantitative Conceptual Model



ASHDOWN SITE INVESTIGATION LIMITED	SITE: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex	Site Location Plan Not To Scale	Figure 1 LW23175



ASHDOWN SITE INVESTIGATION LIMITED	SITE: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex	Site Plan Not To Scale	Figure 2 LW23175



Key

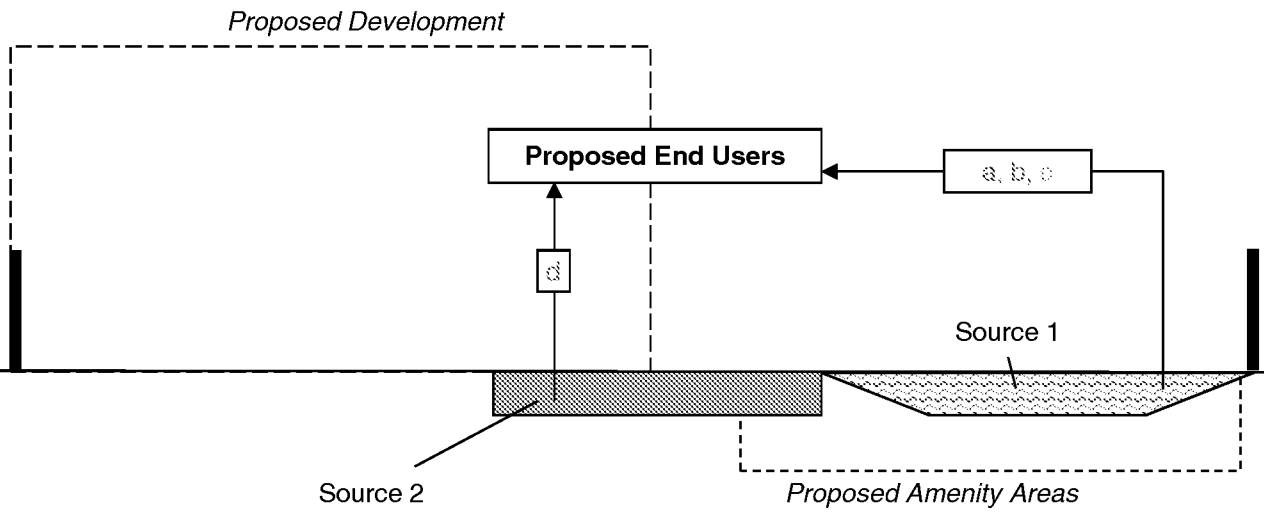
Sources

1. Former underground fuel tank – potential petroleum hydrocarbon contamination.
2. Potential ground gas migration from former brickfields located to the north.
3. Potential metal and PAHs from demolition of former structure on western part of the site.

Pathways

a. Dermal contact with soil (Indoor & Outdoor);
b. Direct soil and dust ingestion;
c. Inhalation of indoor and outdoor soil dust;
d. Inhalation of ground gases;
e. Inhalation of soil vapours; and
f. Groundwater flow

ASHDOWN SITE INVESTIGATION LIMITED	SITE: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex	Preliminary Conceptual Model. Not To Scale
		Figure 3 LW23175



Anticipated Strata

River Terrace Deposits

over

White Chalk Subgroup

Key

Confirmed Sources

1. Elevated concentrations of PAHs within topsoil.

Potential Sources

2. Potential petroleum hydrocarbon contamination from former underground fuel tank.

Pathways

a. Dermal contact with soil (Indoor & Outdoor);
b. Direct soil and dust ingestion;
c. Inhalation of indoor and outdoor soil dust;
d. Inhalation of soil vapours

ASHDOWN SITE INVESTIGATION LIMITED	SITE: Summerley Corner South Site, Summerley Lane, Bognor Regis, West Sussex	Quantitative Conceptual Model. Not To Scale	Figure 4 LW23175