

Ground Investigation



Geotechnical & Environmental Consultants

Ground Investigation Report

At

**Land North of Goldring Close and South of Beech
Grove, Mengham, Hayling Island, PO11 9PN**

For

Pro Vision Planning & Design

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REPORT 12952/GIR

Ground Investigation Report

**Job Title: Land North of Goldring Close and South of Beech Grove, Mengham,
Hayling Island, PO11 9PN**

Client: Pro Vision Planning & Design

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Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.



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Commission

Soils Limited was commissioned by Pro Vision Planning & Design to carry out a Ground Investigation on land north of Goldring Close and south of Beech Grove, Mengham, Hayling Island, Hampshire, PO11 9PN. The scope of the investigation was as outlined in Soils Limited quotation reference Q12824/RA, dated 11th April 2012.

This report comprises the Phase II Ground Investigation and incorporates the results, discussion and conclusions to the intrusive investigation. This report must be read in conjunction with the Phase I Desk Study undertaken on the above site by Soils Limited (report ref: 12952/DS, dated May 2011).

The following sections make up the report made on the investigation and comprise:

Section 1 Introduction

- Objective of the Investigation;
- Location;
- Proposed Development;
- Limitations and Disclaimers.

Section 2 Site Works

- Intrusive Works;
- Ground Conditions;
- Roots;
- Groundwater.

Section 3

Discussion of Geotechnical In-Situ and Laboratory Testing

- Dynamic Probe Tests;
- Atterberg Limit Tests;
- Particle Size Distribution Tests;
- California Bearing Ratio Tests;
- Sulphate and pH Tests;
- Soil Infiltration Tests (BRE365).

Section 4

Foundation Design

- General;
- Foundation Scheme;
- Subsurface Concrete;
- Excavations;
- Proposed Roads / Pavements;
- Surface Water Drainage.

Section 5

Conceptual Site Model and Chemical Analysis of Soil Samples

- Conceptual Site Model;
- Sampling Strategy;
- Determination of Contaminants of Concern for Soil Samples.

Section 6

Quantitative Risk Assessment - Soil

- Assessment Criteria;
- Representative Contamination Concentration;
- Tier 1 Quantitative Risk Assessment;
- Biogas;
- Duty of Care;
- Excavated Material;
- Re-use of Excavated material On-site;
- Imported Material;
- Discovery Strategy.

Figures

- Figure 1: Site Location Plan;
- Figure 2: Trial Hole Layout Plan.

Appendices

- Appendix A: Fieldwork
- Appendix B: Geotechnical Laboratory Analysis
- Appendix C: Chemical Laboratory Analysis
- Appendix D: Soil Guideline Values and General Assessment Criteria
- Appendix E: Information Provided by the Client

Standards

The site works were performed in accordance with the methods given in BS 5930+A2:2010, BRE Digest365:1991, BS EN ISO 22476-2:2005 and BS EN 1997-2:2007 plus associated National Annexes.

The geotechnical laboratory testing was performed by K4 Soils Laboratories in accordance with methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accreditation.

For the preparation of this report, the relevant BS codes of practice were adopted for the laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892), which are pending.

The chemical analyses were undertaken by QTS Environmental Ltd in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial hole.

Section 1 Introduction

1.1 Objective of the Investigation

The overall objective was understood to be to supply the client and their designers with information regarding ground conditions, to assist them in preparing a scheme for redevelopment that was appropriate to the conditions present on the site and safe for end-users and for workers during the redevelopment phase.

The investigation was to be undertaken to provide parameters for the design of foundations by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes.

Soil samples were to be taken for chemical laboratory testing to enable recommendations for the safe redevelopment of the site and the protection of site workers, end users and the public from any contamination identified.

1.2 Location

The site was located in Mengham, Hayling Island, Hampshire and the approximate Land Ranger Grid Reference at the centre of the site was SU 725 953. The general site location and layout is presented on Figure 1 and Figure 2. The site area was approximately 4.59ha.

At the time of the investigation the site was sub-divided into a number of paddocks for grazing horses.

1.3 Proposed Development

The proposed development, at the time of reporting, was understood to comprise a housing development of 131 dwellings (including 5No. 2-bed flats, 44No. 2-bed houses, 67No. 3-bed houses and 15No. 4-bed houses). The development was also understood to include private and communal soft landscaping, car parking areas, access roads and general infrastructure.

1.4 Limitations and Disclaimers

This Phase II Ground Investigation report relates to land north of Goldring Close and south of Beech Grove, Mengham, Hayling Island, Hampshire, PO11 9PN and was prepared for the sole benefit of Pro Vision Planning & Design (The "Client") and was prepared solely for the scheme described in Section 1.3.

Soils Limited disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporation of our General

Terms and Condition of Business and taking account of the resources devoted to us by agreement with the Client.

This report is personal and confidential to the client and Soils Limited accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly its own risk.

The Client may not assign the benefit of the report or any part to any third party without the consent of Soils Limited.

The ground and groundwater may exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation prior to the casting of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data on any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995 as *"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused"*.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets remains with Soils Limited. License is for the sole use of the client and may not be assigned, transferred or given to a third party.

Section 2 Site Works

2.1 Intrusive Works

The works proposed comprised the following items:

- The excavation of up to 27No. machine excavated trial pits;
- 3No. soakaway tests within three of the machine excavated trial pits;
- A series of standalone Dynamic Probes;
- Logging, sampling and *in-situ* testing as appropriate to the ground conditions encountered in the trial holes.

Locations were selected by Soils Limited based on the proposed development layout drawing provided by the client where access could be gained and no shallow services were encountered.

Fieldwork was undertaken between 26th and 27th April 2012 and comprised;

Eighteen trial pits (TP1 to TP9, TP12 to TP13, TP15 to TP16, TP18 to TP19, TP24 to TP25 and TP27) were excavated using a JCB 3CX backhoe excavator (or equivalent) at locations selected by Soils Limited, where access could be gained and no live services were identified, to a maximum depth of 2.20m bgl (TP16).

The proposed trial pits TP10 to TP11, TP14, TP17, TP20 to TP23 and TP26 were not excavated due to the presence of horses and time constraints associated with slow plant movements due to multiple fences (paddocks).

It was not possible to progress trial pits to greater depths due to the presence of groundwater and/or collapse of the pit walls.

Three locations (TP6, TP7 and TP8) were excavated in order to facilitate soil infiltration tests in accordance with BRE 365 to determine the suitability of the underlying soils for surface water disposal.

Dynamic Probing 'Super Heavy' (DPSH-B) was undertaken using a Premier Rig at eleven standalone locations (DP1 to DP11) to depths of between 4.00 and 6.00m bgl.

Whilst trial pits or dynamic probe holes are not typically suitable for the installation of monitoring wells a single dual-purpose biogas and groundwater monitoring well was installed within DP11 as this was located outside of the areas used by grazing horses and the hole remained open long enough for the pipework to be inserted.

Please note; it will be necessary to install additional wells across the site to facilitate future biogas or groundwater monitoring.

The approximate location of all of the trial holes is presented on Figure 2.

2.2 Ground Conditions

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level directly adjacent to the individual trial hole.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the *in-situ* weathering profile, it has been described as Topsoil both on the logs and within this report. Where the soil has, in general, been found to have the same composition as the 'Topsoil' but also incorporated a minor constituent, e.g. less than an estimated 5%, of possibly non-naturally occurring material, or is of uncertain origin, the soil has been described as Topsoil/Made Ground both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the logs and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion the succession of conditions encountered in the trial holes in descending order can be summarised as follows below:

Topsoil River Terrace Deposits Portsmouth Sand Member / Whitecliff Sand Member (not encountered)

The 1:50,000 Geological Survey of Great Britain (England and Wales), showed the River Terrace Deposits to be overlying the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated), though this was not encountered in the trial holes.

2.2.1 Topsoil

Topsoil was encountered within all eighteen of the machine excavated trial holes to depths ranging between 0.05m and 0.40m bgl (maximum in TP1, TP19 and TP25). Surfacing at each trial hole location comprised grass / turf and the topsoil was typically described as light brown to brown silty clay with occasional sub-rounded flint gravel.

2.2.2 River Terrace Deposits

Overlain by Topsoil soils of the River Terrace Deposits were encountered in all locations. The River Terrace Deposits were variable in composition but generally comprised orange-brown and grey-brown mottled, sandy, locally (and variably) gravelly CLAY.

Locally the River Terrace Deposits comprised bands of clayey, sandy flint GRAVEL or clayey, gravelly SAND.

Generally a slight increase in the granular content (sand and gravel) of the soils of the River Terrace Deposits was recorded on the southern half of the site.

The base of the River Terrace Deposits was not proven in any of the trial holes (maximum depth of 2.20m bgl in TP16).

2.2.3 Portsmouth Sand Member / Whitecliff Sand Member

Whilst soils of the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) were not encountered within the trial pits excavated the dynamic probes suggested a change in geology below depths ranging between 1.50m bgl (DP8) and 3.20m bgl (DP1) that may have represented a change from the River Terrace Deposits to the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated).

For full and complete information within each trial hole, please refer to the trial hole logs appended within Appendix A.

2.3 Roots

Roots were observed within seventeen of the eighteen trial pits excavated during the intrusive investigation at depths ranging between 0.50m and 1.50m bgl. The table below summarises the root observations in each location.

Summary of Root Observations During Intrusive Works				
Location	Root Depth (m bgl)	Description	Depth of Trial Pit (m bgl)	Strata
TP1	1.30*	Roots and rootlets	1.30	River Terrace Deposits
TP2	0.90	Roots and rootlets	1.60	River Terrace Deposits
TP3	0.70	Roots and rootlets	1.30	River Terrace Deposits
TP4	0.80	Roots and rootlets	1.60	River Terrace Deposits
TP5	0.90	Roots and rootlets	1.60	River Terrace Deposits
TP6	0.70*	Roots and rootlets	0.70	River Terrace Deposits
TP7	0.80	Roots and rootlets	1.10	River Terrace Deposits
TP8	0.80	Roots and rootlets	1.50	River Terrace Deposits
TP9	0.50	Roots and rootlets	1.20	River Terrace Deposits
TP12	1.10	Roots and rootlets	1.30	River Terrace Deposits
TP13	1.30*	Roots and rootlets	1.30	River Terrace Deposits
TP15	1.00	Roots and rootlets	1.30	River Terrace Deposits
TP16	1.50	Roots and rootlets	2.20	River Terrace Deposits
TP18	1.20	Roots and rootlets	1.50	River Terrace Deposits
TP19	1.50*	Roots and rootlets	1.50	River Terrace Deposits
TP24	-	None observed	1.50	-
TP25	0.90	Roots and rootlets	1.50	River Terrace Deposits
TP27	1.00	Roots and rootlets	1.70	River Terrace Deposits

* denotes roots/rootlets observed to full depth of trial pit

Trees were present around the site boundaries and within the north western portion of the southern half of the site and also separated the northern part of the site from the southern part but were not present across the site as a whole. However, it was not known if trees had been cleared from the site in the recent past.

Roots may be found to greater depths at other locations on the site or around the site particularly close to trees and/or trees that have been removed around the site.

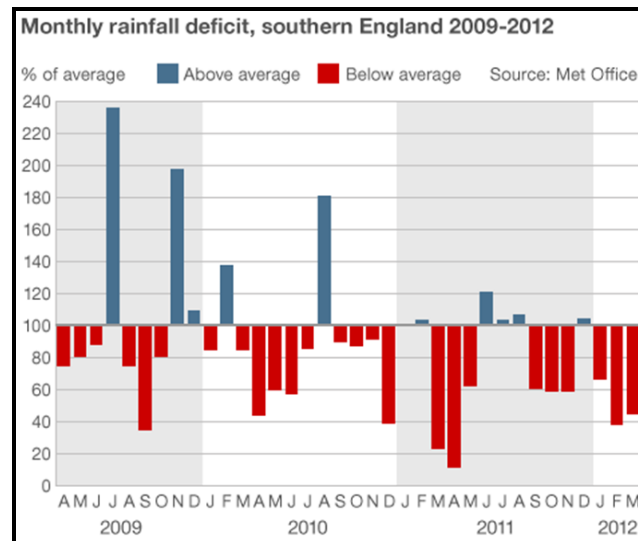
2.4 Groundwater

Groundwater was encountered within sixteen of the seventeen machine excavated trial pits at depths of between 0.70 and 1.50m bgl. TP1 and TP27 were dry. The table below summarises water strikes observed during the intrusive investigation.

Summary of Groundwater Strikes During Intrusive Works				
Location	Depth (m bgl)	Observations	Depth of Trial Pit (m bgl)	Strata
TP1	-	Dry	1.30	River Terrace Deposits
TP2	1.30	Seepage	1.60	River Terrace Deposits
TP3	1.00	Seepage	1.30	River Terrace Deposits
TP4	1.30	Seepage	1.60	River Terrace Deposits
TP5	1.20	Seepage	1.60	River Terrace Deposits
TP6	0.70	Damp	0.70	River Terrace Deposits
TP7	1.00	Standing	1.10	River Terrace Deposits
TP8	1.40	Standing	1.50	River Terrace Deposits
TP9	0.90	Seepage	1.20	River Terrace Deposits
TP12	0.75	Standing	1.30	River Terrace Deposits
TP13	1.00	Seepage	1.30	River Terrace Deposits
TP15	0.80	Seepage	1.30	River Terrace Deposits
TP16	1.50	Seepage	2.20	River Terrace Deposits
TP18	1.20	Seepage	1.50	River Terrace Deposits
TP19	1.00	Seepage	1.50	River Terrace Deposits
TP24	0.90	Standing	1.50	River Terrace Deposits
TP25	1.15	Standing	1.50	River Terrace Deposits
TP27	-	Dry	1.70	River Terrace Deposits

Changes in groundwater level do occur for a number of reasons including seasonal effects and variations in drainage. The site investigation was conducted in April 2012, when groundwater levels should be close to the annual maximum which typically occurs around March.

Leading up to the intrusive works southern England was experiencing significantly lower than average rainfall resulting in groundwater levels being uncharacteristically low. The figure overleaf shows the monthly rainfall deficit in southern England between 2009 and 2012.



The investigation itself was undertaken during a period of heavy rainfall that made precise measurement of groundwater seepages very difficult. Measurement of groundwater levels in standpipes installed within boreholes would be necessary to determine precise and long-term groundwater levels.

It is anticipated that in the long-term groundwater levels may rise as a result of factors such as climate change.

Section 3

Discussion of Geotechnical In-Situ and Laboratory Testing

3.1 Dynamic Probe Tests

'Super Heavy' Dynamic Probing (DPSH-B) was undertaken at 11No. locations across the site. DP1 to DP11 were sunk to maximum depths of between 4.00m and 6.00m bgl.

Window samples recover soil samples for logging and laboratory testing but they do not give any engineering data. Probing involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 63.5kg hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published that permit engineering parameters to be generated.

Dynamic probe holes were undertaken at standalone locations however the ground conditions were inferred from nearby machine excavated trial pits.

The dynamic probe results were converted to equivalent SPT "N" values based on dynamic energy. The inferred cohesion / state of compaction of the soils within the River Terrace Deposits and underlying Portsmouth Sand member / Whitecliff Sand Member was based on the equivalent SPT "N" blow counts, derived from the dynamic probe tests, in the tables below and was based on the relationship suggested by Stroud;

(ref: Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Coarse (granular) soils are classified based on the relationship given below.

Classification	S.P.T. "N" blow count (blows/300mm)
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	Greater than 50

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

Fine (cohesive) soils are classified based on the relationship given overleaf.

Classification	Undrained Cohesive Strength C_u (KPa)
Extremely low	<10
Very low	10 - 20
Low	20 - 40
Medium	40 - 75
High	75 - 150
Very high	150 - 300
Extremely high	> 300

(Ref: EN ISO 14688-2:2004 Clause 5.3.)

An interpretation of the equivalent SPT 'N' blow counts is given in the table below and over page.

Interpretation of Dynamic Probe Blow Counts				
Strata	Equivalent SPT 'N' Blow Counts	Soil Type / Strength		DP
		Cohesive	Granular	
River Terrace Deposits (0.50 to 1.40m bgl)	3 - 8	Very low to Medium ($C_u = 14$ to 42)	-	DP1
River Terrace Deposits (1.40 to 2.10m bgl)	11 - 31	Medium to Very high ($C_u = 56$ to 155)	-	
River Terrace Deposits (2.10 to 3.20m bgl)	8 - 28	Medium to High ($C_u = 42$ to 141)	-	
Possible Portsmouth / Whitecliff Sand Member (3.20 to 4.00m bgl)	3 - 14	Very low to Medium ($C_u = 14$ to 71)	Very loose to Medium dense	
River Terrace Deposits (0.50 to 1.20m bgl)	3 - 6	Very low to Low ($C_u = 14$ to 28)	-	DP2
River Terrace Deposits (1.20 to 2.20m bgl)	6 - 45	Low to Very high ($C_u = 28$ to 225)	-	
Possible Portsmouth / Whitecliff Sand Member (2.20 to 4.00m bgl)	3 - 34	Very low to Very high ($C_u = 14$ to 169)	Very loose to Dense	
River Terrace Deposits (0.50 to 1.10m bgl)	3 - 6	Very low to Low ($C_u = 14$ to 28)	-	DP3
River Terrace Deposits (1.10 to 1.40m bgl)	11 - 23	-	Medium dense	
River Terrace Deposits (1.40 to 2.10m bgl)	3 - 8	Very low to Medium ($C_u = 14$ to 42)	-	
Possible Portsmouth / Whitecliff Sand Member (2.10 to 4.00m bgl)	3 - 25	Very low to High ($C_u = 14$ to 127)	Very loose to Medium dense	
River Terrace Deposits (0.50 to 1.10m bgl)	11 - 39	-	Medium dense to Dense	DP4
River Terrace Deposits (1.10 to 2.20m bgl)	3 - 23	Very low to High ($C_u = 14$ to 113)	-	
Possible Portsmouth / Whitecliff Sand Member (2.20 to 4.00m bgl)	6 - 28	Low to High ($C_u = 28$ to 141)	Loose to Medium dense	

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Strata	Equivalent SPT "N" Blow Counts	Soil Type / Strength		DP
		Cohesive	Granular	
River Terrace Deposits (0.50 to 1.20m bgl)	3 - 6	Very low to Low ($C_u = 14$ to 28)	-	DP5
River Terrace Deposits (1.20 to 2.40m bgl)	8 - 37	Medium to Very high ($C_u = 42$ to 183)	Loose to Dense	
Possible Portsmouth / Whitecliff Sand Member (2.40 to 5.00m bgl)	3 - 54	Very low to Very high ($C_u = 14$ to 268)	Very loose to Very dense	
River Terrace Deposits (1.00 to 2.80m bgl)	25 - >50	-	Medium dense to Very dense	DP6
Possible Portsmouth / Whitecliff Sand Member (2.80 to 5.00m bgl)	3 - 34	Very low to Very high ($C_u = 14$ to 169)	Very loose to Dense	
River Terrace Deposits (0.50 to 0.90m bgl)	8 - 14	Medium ($C_u = 42$ to 71)	-	DP7
River Terrace Deposits (0.90 to 2.40m bgl)	11 - 68	Medium to Extremely high ($C_u = 56$ to >300)	Medium dense to Very dense	
Possible Portsmouth / Whitecliff Sand Member (2.40 to 5.00m bgl)	6 - 48	Low to Very high ($C_u = 28$ to 240)	Loose to Dense	
River Terrace Deposits (0.50 to 1.50m bgl)	14 - 48	-	Medium dense to Dense	DP8
Possible Portsmouth / Whitecliff Sand Member (1.50 to 5.00m bgl)	3 - 28	Very low to High ($C_u = 14$ to 141)	Very loose to Medium dense	
River Terrace Deposits (0.50 to 0.70m bgl)	3 - 8	Very low to Medium ($C_u = 14$ to 42)	-	DP9
River Terrace Deposits (0.70 to 2.40m bgl)	17 - >50	-	Medium dense to Very dense	
Possible Portsmouth / Whitecliff Sand Member (2.40 to 6.00m bgl)	6 - 45	Low to Very high ($C_u = 28$ to 226)	Loose to Dense	
River Terrace Deposits (0.50 to 1.00m bgl)	3 - 17	Very low to High ($C_u = 14$ to 85)	Very loose to Medium dense	DP10
River Terrace Deposits (1.00 to 2.00m bgl)	6 - 8	Low to Medium ($C_u = 28$ to 42)	Loose	
Possible Portsmouth / Whitecliff Sand Member (2.00 to 6.00m bgl)	8 - 34	Medium to Very high ($C_u = 42$ to 169)	Loose to Dense	
River Terrace Deposits (0.50 to 1.80m bgl)	3 - 17	Very low to High ($C_u = 14$ to 85)	-	DP11
Possible Portsmouth / Whitecliff Sand Member (1.80 to 5.00m bgl)	6 - 31	Low to Very high ($C_u = 28$ to 155)	Loose to Dense	

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

Soils types were inferred from the results of the probes (including torque readings) and from the machine excavated trial pits closest to each individual probe.

Whilst soils of the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) were not encountered within the trial pits excavated the dynamic probes suggested a change in geology below depths ranging between 1.50m bgl (DP8) and 3.20m bgl (DP1). This inferred change in geology may have represented a change from the River Terrace Deposits to the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) albeit the torque readings on the probes suggested a cohesive soil.

The cohesive soils of the River Terrace Deposits ranged from **very low to extremely high strength**, typically low to medium at depths greater than ~1.00m bgl.

Where encountered, the granular soils of the River Terrace Deposits ranged from **loose to very dense**, typically medium dense to dense.

The inferred soils of the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) ranged from **very low to very high strength** for cohesive soil and **very loose to very dense**, typically loose becoming dense with depth, for granular soil.

A full set of Dynamic Probe test results are presented in Appendix A.

3.2 Atterberg Limit Tests

A summary of the results of Atterberg Limit tests performed on six samples of the cohesive River Terrace Deposits is presented in the table below.

Atterberg Limit Tests Results Summary						
Location and Depth (m bgl)	Moisture Content (%)	Modified PI (%)	Passing 425 µm sieve (%)	Soil Class	Volume Change Potential Range	
					BRE	NHBC
TP2 at 1.50	20	13	90	CL	Low	Low
TP5 at 1.10	24	17	92	CI	Low	Low
TP7 at 0.80	25	28	97	CI	Medium	Medium
TP9 at 1.10	23	5	95	ML	Low	None
TP15 at 0.60	20	10	43	CI	Low	Low
TP15 at 1.00	21	9	85	CL	Low	None

(The Atterberg Limit Tests were undertaken in accordance with BS 1377: Part 2:1990 clauses 3.2, 4.4 and 5).

NB: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
 NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2 (based on Atterberg results)
 Soil Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240.

The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.

The soils of the River Terrace Deposits tested expressed **low to medium volume change potential** in accordance with BRE 240 and **no volume change potential to medium volume change potential** in accordance with NHBC Chapter 4.2.

The samples from TP9 and TP15 that showed no volume change potential (in accordance with NHBC Chapter 4.2) contained significant proportions of coarse (granular) material.

The test results are given in Appendix B.

3.3 Particle Size Distribution Tests

A summary of the results of the Particle Size Distribution tests performed five samples from the coarse grained River Terrace Deposits is given in the table below.

Particle Size Distribution Tests Results					
Location	Stratum	Laboratory Soil Description	Volume Change Potential		Passing 63µm sieve (%)
			BRE	NHBC	
TP12 at 1.20m bgl	River Terrace Deposits	Slightly clayey sandy GRAVEL	No	No	7
TP16 at 1.50m bgl	River Terrace Deposits	Slightly clayey slightly sandy GRAVEL	No	No	10
TP18 at 1.10m bgl	River Terrace Deposits	Clayey gravelly SAND	Yes	No	21
TP24 at 0.80m bgl	River Terrace Deposits	Slightly clayey sandy GRAVEL	Yes	No	17
TP25 at 1.40m bgl	River Terrace Deposits	Slightly clayey gravelly SAND	No	No	15

(The Particle Size Distribution tests were undertaken in accordance with BS 1377: Part 2:1990 clause 9)

NB: Volume Change Potential refers to BRE Digest 240 and NHBC Standards Chapter 4.2 (based on Particle Size Distribution test results)

Volume Change Potential – BRE 240 states that a soil has a volume change potential when the clay fraction exceeds 15%. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.

The test results confirmed the engineer's descriptions and showed that the granular soils of the River Terrace Deposits typically **did not possess a volume change potential** as defined by NHBC Standards Chapter 4.2 however two samples from TP18 and TP24 showed **volume change potential** in accordance with BRE 240.

Full results are given in Appendix B.

3.4 California Bearing Ratio (CBR) Tests

Seven samples of the near surface soils of the River Terrace Deposits (between 0.50 and 0.60m bgl)) were tested in the laboratory in order to provide an indication of likely California Bearing Ratio (CBR). Locations were selected from areas of proposed access roads, as shown on the development plan provided by the client.

The results are summarised in the table below.

Summary of CBR Test Results				
Sample	Laboratory Description	Moisture Content	CBR Value (Top)	CBR Value (Base)
TP2 at 0.50m bgl	Slightly gravelly slightly sandy silty CLAY	24	2	2
TP3 at 0.70m bgl	Clayey GRAVEL	15	1	1
TP4 at 0.60m bgl	Slightly gravelly silty sandy CLAY	24	2	2
TP8 at 0.70m bgl	Slightly silty CLAY	23	2	2
TP13 at 0.70m bgl	Slightly gravelly silty CLAY	25	1	1
TP18 at 0.60m bgl	Slightly gravelly silty CLAY	25	2	2
TP27 at 0.50m bgl	Slightly sandy slightly gravelly CLAY	22	1	1

(The CBR tests were made in accordance with B.S.1377: Part 4:1990 Clause 7.4)

The results of the near surface soils (between 0.50m bgl and 0.70m bgl) of the River Terrace Deposits tested to possess **low CBR values of between 1 and 2%** which are indicative of the high moisture contents recorded within the samples.

It is anticipated that significantly increased CBR values would be achieved on the same material at lower moisture contents (such as those that would be anticipated in the summer months).

The test results are given in Appendix B.

3.5 Sulphate and pH Tests

Three samples from the River Terrace Deposits were submitted for water soluble sulphate (2:1) and pH testing and a range of other chemical tests in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

Results showed water soluble sulphate (2:1) contents of <0.01g/l and pH values to range between 6.9 and 7.8. The significance of the sulphate and pH test results is discussed later in this report.

The test results are given in Appendix B.

3.6 Soil Infiltration Tests (BRE 365)

In-situ soil infiltration tests were undertaken within the River Terrace Deposits in TP6, TP7 and TP8 to examine the potential for adopting soakaway drainage for the proposed redevelopment. Due to the particularly wet ground conditions along with the presence of numerous horses in separate paddock areas it was not possible to provide site wide coverage for the infiltration tests.

A summary of the soakaway tests performed can be seen in the table below.

Summary of BRE 365 Soil Infiltration Tests					
Trial Hole	Test No.	Soakaway Base Level Geology	Trial Pit Base Level (m)	Infiltration Rate (m/sec)	Duration of Test (mins)
TP6	1	River Terrace Deposits	0.70	Negligible	105
TP7	1	River Terrace Deposits	1.00	Negligible	175
TP8	1	River Terrace Deposits	1.50	Negligible	180

Whilst minimal infiltration was observed within each test it was insufficient to enable extrapolation of the data and therefore an estimate of infiltration rate could not be calculated. ***Negligible infiltration*** was therefore recorded at each of the test locations.

Infiltration tests were undertaken following the principles of BRE Digest 365 Soakaway design: 1991. BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away. Due to the negligible infiltration observed it was not possible to perform additional tests at each location.

Full results of the soakaway tests undertaken are provided in Appendix A.

Section 4 Foundation Design

4.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented in the following sections.

4.1.1 Fill and Made Ground (including Topsoil)

The terms *Fill* and *Made Ground* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. The former may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:1986, Clause 2.2.2.3.5 Made Ground and Fill, includes the caveat that '*all made ground should be treated as suspect, because of the likelihood of extreme variability*'.

A result of the inherent variability, particularly of uncontrolled Fill and/or Made Ground, is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Fill / Made Ground and or Topsoil and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Topsoil was encountered within seventeen trial holes to depths ranging between 0.20m and 0.40m bgl (maximum in TP13). Surfacing at each trial hole location comprised grass / turf and the topsoil was typically described as dark brown sandy silt with variable quantities of gravel and roots.

Please note; whilst Made Ground was not encountered in any of the trial holes excavated during the intrusive works it is possible that Made Ground exists in other areas of the site including service trenches, infilled ground etc, if present.

4.1.2 River Terrace Deposits

Overlain by Topsoil soils of the River Terrace Deposits were encountered in all locations. The River Terrace Deposits were variable in composition but generally comprised orange-brown and grey-brown mottled, sandy, locally (and variably) gravelly CLAY.

Locally the River Terrace Deposits comprised bands of clayey, sandy flint GRAVEL or clayey, gravelly SAND.

Generally a slight increase in the granular content (sand and gravel) of the soils of the River Terrace Deposits was recorded on the southern half of the site.

The base of the River Terrace Deposits was not proven in any of the trial holes (maximum depth of 2.20m bgl in TP16).

Based on the results of in-situ testing (dynamic probes) the cohesive soils of the River Terrace Deposits ranged from **very low to extremely high** strength. The granular soils of the River Terrace Deposits ranged from **loose to very dense**, typically medium dense to dense.

The results of the geotechnical laboratory particle size distribution tests carried out on five samples showed that the granular soils of the River Terrace Deposits typically **did not possess a volume change potential** as defined by NHBC Standards Chapter 4.2 however two samples from TP18 and TP24 showed **volume change potential** in accordance with BRE 240. However, as the samples did not contain a significant portion of clay (between 7% and 21% in the samples tested) then the samples of the granular River Terrace Deposits could be described as **non-plastic**.

The cohesive soils of the River Terrace Deposits possessed **low to medium volume change potential** in accordance with BRE guidance and **no volume change potential to medium volume change potential** in accordance with NHBC Standards Chapter 4.2.

River Terrace Deposits are normally consolidated and typically express moderate bearing potential and settlement characteristics depending upon their clay content. Soils of the River Terrace Deposits are considered an appropriate bearing stratum for the proposed development using strip footings depending upon the proposed loads.

4.1.3 Portsmouth Sand Member / Whitecliff Sand Member

Whilst soils of the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) were not encountered within the trial pits excavated the dynamic probes suggested a change in geology below depths ranging between 1.50m bgl (DP8) and 3.20m bgl (DP1) that may have represented a change from the River Terrace Deposits to the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated).

Based on the results of in-situ testing (dynamic probes) the inferred soils of the Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) ranged from **very low to very high strength** for cohesive soil and **very loose to very dense**, typically loose becoming dense with depth, for granular soil.

4.1.4 Roots

Roots were observed within seventeen of the eighteen trial pits excavated during the intrusive investigation at depths ranging between 0.50m and 1.50m bgl. The table presented in section 2.3 provides a summary of all root observations recorded during the intrusive works.

Trees were present around the site boundaries and within the north western portion of the southern half of the site and also separated the northern part of the site from the southern part but were not present across the site as a whole. However, it was not known if trees had been cleared from the site in the recent past.

Please note; roots may be found to greater depths at other locations on the site or around the site particularly close to existing trees and/or trees that have been removed around the site.

4.1.5 Groundwater

Groundwater was encountered within sixteen of the seventeen machine excavated trial pits at depths of between 0.70 and 1.50m bgl. TP1 and TP27 were dry. The table presented in section 2.4 provides a summary of all groundwater strikes recorded during the intrusive works.

The investigation itself was undertaken during a period of heavy rainfall that made precise measurement of groundwater seepages very difficult. Measurement of groundwater levels in standpipes installed within boreholes would be necessary to determine precise and long-term groundwater levels.

Depending upon the type and depth of proposed foundations adopted it is anticipated that groundwater may be encountered within excavations associated with the proposed development.

4.2 Foundation Scheme

The proposed development, at the time of reporting, was understood to comprise a housing development of 131 dwellings (including 5No. 2-bed flats, 44No. 2-bed houses, 67No. 3-bed houses and 15No. 4-bed houses). The development was also understood to include private and communal soft landscaping, car parking areas, access roads and general infrastructure.

Proposed foundation loads were not known to Soils Limited at the time of reporting.

4.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on 'best practice' for the design and construction of foundations on shrinkable soils. The NHBC Standards Chapter 4.2 gives guidance for the design and construction of foundations on shrinkable soils.

The results of the geotechnical laboratory tests showed that the predominantly cohesive soils of the River Terrace Deposits possessed volume change potential (ranging between none and medium) in accordance with BRE 240 and NHBC Chapter 4.2.

It was concluded that a worst case BRE 240 and NHBC Standards Chapter 4.2 classification of **medium volume change potential** should be adopted for the site of the proposed construction.

The designer must take account of trees, saplings, hedgerows and hedgerow species that are either existing, have been or are to be removed, or are to be planted as a part of the site landscaping.

A full survey should be carried out to confirm exact position and species of trees present, the survey must include areas of dense undergrowth as well as immature species such as hawthorn as well as other species of saplings. If the date of any tree felling or shrub clearance cannot be determined it should be assumed that this has been done recently. An arboriculturists advice must be sought regarding any tree stumps to estimate the species and height when felled.

It is recommended that appropriate NHBC guidance be consulted for the design of the proposed development.

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building.

It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur. Should large trees be in close proximity to or be removed from the footprint of the proposed building that an alternative foundation solution, such as piles, will be required.

The BRE Digest 240 sets out best practise in respect of the design of foundations taken into shrinkable soils. In predominantly clayey soils, moisture content recovery can take in excess of 20 years to complete.

The BRE Digest 240 suggests that *"Two courses of action are open:*

- *Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.*
- *Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting*

ground movements or the superstructure can be designed to accommodate movement without damage."

The design of foundations suitable to withstand movements is presented in BRE Digest 241 "Low-rise buildings on shrinkable clay soils: Part 2" and NHBC Standards Chapter 4.2; Building near trees.

4.2.3 Conclusions and Recommendations

The foundation design must be suitable for the conditions present at the site. A shallow foundation scheme bearing into the soils of the River Terrace Deposits is considered appropriate for the anticipated two-storey development depending upon the proposed foundation loads.

Foundations **must not** be constructed within any Topsoil or Made Ground, if encountered, due to the likely variability and potential for large load-induced settlements **both total and differential**.

Where strip footings are considered they must be taken through any Topsoil or Made Ground and into / onto the underlying into the natural (predominantly cohesive) soils of the River Terrace Deposits to ensure a uniform and moisture stable bearing stratum is achieved across the site.

Foundations **must not** be placed within any live root penetrated or desiccated cohesive soils. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils.

Based on the ground conditions encountered within the machine excavated trial pits and the 'worst case' dynamic probe results taken from DP3 and geotechnical testing an **allowable bearing capacity of 85kN/m²** could be achieved within near surface cohesive (clay) soils of the River Terrace Deposits at a depth of 1.00m bgl limiting settlements to <25mm (based on an indicative 1m x 5m strip).

Increases in allowable bearing capacities would be anticipated for other parts of the site, particularly across the southern portion of the site where an increase in granular content was observed, or if foundations are taken deeper.

Please note: adopting deeper foundations would require construction below the groundwater table thus making construction difficult and locally piling may be required. Long-term groundwater monitoring should be undertaken to establish the groundwater equilibrium and to determine groundwater fluctuation.

Please note that, whilst predominantly cohesive in nature, the soils of the River Terrace Deposits were variable with bands of granular soils encountered that were not laterally continuous across the site.

Ensuring a consistent founding stratum will mitigate the potential risk of differential settlement, however, given the ground conditions shown in the trial holes it was apparent that this may not be wholly achievable and reinforced trench fill would be required in order to limit the risk of potentially damaging differential settlement.

For the allowable bearing value given, settlements should not exceed those stated provided that excavation bases are carefully bottomed out and blinded, or concreted as soon after excavation as is possible and kept dry.

Special care must be taken during foundation excavation in order to establish that any soft/loose spots found within the soils of the River Terrace Deposits are removed from the base of the excavations.

Excavations must be either concreted or blinded as soon after excavation as possible. Failure to protect the base of excavations if they are to be left open prior to constructing foundations could result in markedly higher settlements.

Any surface water ingress must be prevented from entering foundation trenches. Groundwater is likely to present a hazard for the construction of foundations depending upon the depth of footings and the time of year of construction. It is likely that the groundwater was at its highest at the time of the investigation and a period of groundwater monitoring carried out in wells (that could be installed within boreholes) may open up the possibility of adopting greater bearing capacities at depth (i.e. groundwater may be found to be significantly lower during the summer months).

Foundations must not be less than 450mm in width.

Foundations must not be cast over foundations of former structures and other hard spots.

4.3 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class DS-1 of the BRE Special Digest 1, 2005, '*Concrete in Aggressive Ground*' for the samples tested. Table C2 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) site classification of AC-1. For the classification given above, the *mobile* case was adopted for the natural soils as groundwater was encountered at shallow depths during the intrusive investigation. Particular consideration should be given where disturbance of potentially pyrite bearing natural soils could result in additional sulphate as this may result in an increase in the ACEC classification for the site.

The pH of the soil tested ranged between 6.9 and 7.8.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1, 2005, '*Concrete in Aggressive Ground*' taking into account the pH of the soils.

4.4 Excavations

Shallow excavations (<1.00m bgl) through Topsoil and the upper soils of the River Terrace Deposits are likely to remain stable in the short-term albeit some overdig and/or localised collapse may occur.

Long, deep excavations (>1.00m bgl) are liable to collapse, particularly when taken below the groundwater table.

In the absence of long-term groundwater monitoring and due to the shallow groundwater table encountered (between 0.70m bgl and 1.50m bgl) during the intrusive investigation it will be necessary to include allowance for dewatering of excavations.

Unsupported earth faces formed during excavation may be liable to collapse without warning, particularly where progressing through granular horizons and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose before excavations are entered by personnel.

4.5 Proposed Roads / Pavements

Laboratory California Bearing Ratio (CBR) tests carried out on seven samples recovered from the near surface soils of the River Terrace Deposits.

The laboratory tests indicated CBR values of between 1 and 2% for the River Terrace Deposits at the moisture contents of the tested samples. The low CBR values recorded were likely to be due to the high moisture contents of each sample given the saturated nature of the ground at the time of the investigation (due to heavy rainfall). It is considered that a significant increase in CBR values would be achievable when pavement construction is undertaken during drier periods (such as in the summer months).

As CBR values are highly variable due to changes in moisture content **in-situ testing must be undertaken** immediately prior to the installation of pavements/roads.

Any soft spots at formation level should be dug out and replaced with a suitably compacted granular fill. Prior to construction the formation level should be proof rolled.

Frost susceptibility should also be given consideration; the Design Manual for Road and Bridges: 1994: Volume 7: Pavement Design and Maintenance recommends that, for routine cases, all materials within 450mm of the pavement surface should be non-frost-susceptible.

4.6 Surface Water Drainage

In-situ soil infiltration tests were undertaken within the River Terrace Deposits in TP6, TP7 and TP8 to examine the potential for adopting soakaway drainage for the proposed redevelopment. Due to the particularly wet ground conditions along with the presence of numerous horses in separate paddock areas it was not possible to provide site wide coverage for the infiltration tests.

The results of the soakaway tests can be seen in the table presented in section 3.6.

Given the negligible infiltration rates and the high groundwater table observed during the investigation it is considered that conventional soakaways would not perform to a satisfactory standard. Shallow soakaway systems and permeable pavements may be a viable drainage solution for the proposed development if suitable alternatives are not available however careful consideration should be given to appropriate attenuation for the anticipated surface water run-off from the proposed development.

Consultation with the Environment Agency must be undertaken if soakaways are to be adopted for the site as soakaways may not be permitted if constructed within 1m of the phreatic surface. Early consultation with the Environment Agency is recommended.

Section 5

Conceptual Site Model & Chemical Analysis of Soil Samples

5.1 Conceptual Site Model

The Desk Study (Report ref: 12952/DS, May 2012) identified a very low risk of contamination from off-site sources. The site's present use as horse grazing (paddocks) could be considered as a potentially contaminating practice through horse excrement and urine. However, given that horse manure is widely used as a garden fertiliser it was not considered to represent a hazard to the site therefore no risk of contamination from historical and active practices on-site was indicated.

The Conceptual Site Model developed in the Desk Study is presented below.

Tabulated Conceptual Site Model			
Potential Sources	Potential Migration Pathway	Potential Absorption Pathway	Potential Receptor
ON SITE: None	Via soils. Via groundwater in porous soils. Via anthropogenic pathways such as service trenches.	Dermal Exposure to uncovered ground. Dust or volatiles from uncovered ground becoming airborne and inhaled. Dust from the ground outside, collecting inside the building where occupants are subject to dermal exposure or contaminants become airborne and are inhaled.	Construction workers (particularly during foundation construction). Service and Maintenance Operatives. Site Occupiers. Groundwater.
OFF SITE: Historical and contemporary industries within tidally influenced environs: - heavy metals (Ba, Cd, Cr, CU, Pb, Hg, Ni, V, Zn); - semi-metals and non-metals (As, B, Se); - organic compounds such as Polyaromatic Hydrocarbons (PAH), TPH, Extractable Petroleum Hydrocarbons (EPH), Volatile Organic Compounds (VOC), Semi-Volatile Organic Compounds (SVOC), BTEX. - solvents - lubrication oils	Via soils. Via groundwater in porous soils. Via anthropogenic pathways such as service trenches.	Dermal Exposure to uncovered ground. Dust or volatiles from uncovered ground becoming airborne and inhaled. Dust from the ground outside, collecting inside the building where occupants are subject to dermal exposure or contaminants become airborne and are inhaled.	Construction workers (particularly during foundation construction). Service and Maintenance Operatives. Site Occupiers. Groundwater.
Risk: Very Low			

In addition, as a **biogas risk was posed to the site** from a nearby landfill site that will require a biogas risk assessment to be undertaken.

The investigation techniques adopted for the investigation (trial pits and dynamic probes) are not typically suitable for the installation of monitoring wells. However, a single dual-purpose biogas and groundwater monitoring well was installed within DP11 as this was located outside of the areas used by grazing horses and the hole remained open long enough for the pipework to be inserted.

Please note; it will be necessary to install additional wells across the site to facilitate future biogas monitoring in order to produce a biogas risk assessment.

5.2 Sampling Strategy

The strategy for the selection of the locations of exploratory positions was based on:

- The conceptual source, pathway and receptor model;
- Contaminative activities identified by the Conceptual Site Model.

CLR4 (DOE 1994) and EA R&D P5-066/TR were used to inform the decision regarding the number of sampling locations appropriate to the investigation.

A non-targeted sampling strategy is appropriate when there is:

- No adequate information available regarding the likely locations of contamination;
- No sensitive areas where there is a need for a high degree of confidence.

A targeted sampling strategy is appropriate when there is:

- Adequate information available regarding the likely locations of contamination;
- Sensitive areas where there is a need for a high degree of confidence.

Both a targeted and non-targeted sampling pattern was adopted with samples from proposed soft landscaped areas (including gardens) being selected for testing as well as shallow soils to provide site wide coverage.

The human health receptors relevant to the sampling depths were as follows:

Near surface / deeper samples	Direct ingestion, dermal contact and dust inhalation. Protection of end-users and maintenance workers e.g. Landscape Gardeners. Site neighbours and the wider public. Protection of shallow rooted plants. Groundwater.
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Given the limited number of tests for the size of the site the report should be considered as a scoping study. Further testing may be required to confirm the findings presented in the following sections.

5.3 Determination of Contaminants of Concern for Soil Samples

The driver for the determination of the analysis suite was the information obtained from the Conceptual Site Model and intrusive investigation. In this instance as no significant contaminative practices have been identified on the site an analysis suite comprising a broad range of commonly found contaminants including herbicides and pesticides was adopted.

The full analysis suite comprised:

*Fibrous Material Screen

pH

Water Soluble Sulphate

Sulphide

Organic Matter

Total Phenols

Total Cyanide

Metals & Semi-Metals: Cd, Cr, Pb, Hg, Ni, Se, CN, Cu, Zn, V, B, As

Organics:

- USEPA 16 speciated Poly Aromatic Hydrocarbons (PAHs);

*Fibrous material screening aims at identifying fibres or fibrous material, which are indicative of the presence of asbestos. Should fibres or fibrous material be detected the sample is characterised as "positive" and is subsequently submitted for further analysis for confirmation and speciation if required.

As no evidence of hydrocarbon contamination was identified in the soil samples recovered (in the form of staining or odours) or from the groundwater (in the form of oily sheens or odours) samples were not tested for the presence of Total Petroleum Hydrocarbons (TPHs).

Eight near surface / shallow samples (between 0.20 and 0.30m bgl) recovered from TP5, TP6, TP7, TP9, TP12, TP19, TP24 and TP27 were submitted for chemical laboratory testing.

The results of the soil chemical testing for Human Health are discussed in Sections 6.3 of this report.

Section 6

Qualitative Risk Assessment - Soil

6.1 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix D.

6.2 Representative Contamination Concentration

At the time of reporting, May 2012, the proposed development was understood to comprise a housing development of 131 dwellings (including 5No. 2-bed flats, 44No. 2-bed houses, 67No. 3-bed houses and 15No. 4-bed houses). The development was to include private and communal soft landscaping.

The results of the comparison of the representative contaminants concentration for human health receptor to the Soil Guideline Values (SGV), ATRISK^{soil} Soil Screening Values (SSV) and General Assessment Criteria (GAC) are presented in the table below and are assessed against the **"Residential"** land-use scenario as this was the most appropriate to the proposed development.

Summary of Chemical Analysis of Soil Samples	
Substance	Sample Location Where relevant guideline value was exceeded for <i>Residential</i> Scenario
Arsenic	None
Beryllium	None
W/S Boron	None
Cadmium	None
Chromium	None
Copper	None
Lead	None
Mercury (inorganic)	None
Nickel	None
Selenium	None
Vanadium	None
Zinc	None
PAH (USEPA 16 speciated)	None
Pesticides / Herbicides	None
Fibrous Material*	Negative

* Fibrous material screening was undertaken by the sample preparers in sample reception at QTS Ltd's laboratory. They were trained to look for fibrous material though cannot actually determine whether it was asbestos. If they saw fibres, they report fibres as 'Positive'. The sample would then have to go to a specialist laboratory for confirmation and speciation. If they do not see fibres, they report fibres as 'Negative'.

To assess the potential toxicity to the human health receptor from the concentrations of organic compounds tested for, Soil Organic Matter (SOM) tests were undertaken on the samples submitted for chemical testing, which revealed SOM values ranging between 2.20% and 4.90%. For each soil sample tested, the Soil Organic Matter recorded was used to derive the appropriate GAC for organic determinants.

6.3 Tier 1 Quantitative Risk Assessment

The Tier 1 Quantitative risk assessment established that there was a risk to the human health receptors of maintenance workers when the results were screened against the Residential scenario;

The soil risk assessment established that there was **no risk** to the human health receptors of construction workers or future end users or to groundwater from the samples tested as none of the other determinants was in excess of the relevant DEFRA SGV, ATRISK^{soil} SSV or LQM CIEH GAC.

The results of the contamination testing are presented in Appendix C.

6.4 Biogas

A risk of biogas was established from the Desk Study due to the presence of a registered landfill site 83m to the east of the site that was known to contain biodegradable waste.

The investigation techniques adopted for the investigation (trial pits and dynamic probes) were not ideally suited for the installation of monitoring wells. However, a single dual-purpose biogas and groundwater monitoring well was installed within DP11 as this was located outside of the areas used by grazing horses and the hole remained open long enough for the pipework to be inserted. Further monitoring wells **must** be installed across the site to facilitate future biogas monitoring in order to produce a biogas risk assessment.

6.5 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust were generated as a result of construction activities. The site should be securely fenced at all times to prevent unauthorised access.

Washing facilities should be provided and eating restricted to mess huts.

6.6 Excavated Material

Excavated material must be classified with the Environment Agency for disposal at an appropriately licensed disposal facility. The requirements of Duty of Care and Health and Safety Guidance must be complied with.

Both Producers and Waste Management companies must ensure compliance with the new Waste Acceptance Criteria (WAC) prior to landfill in Hazardous, stable non-reactive cells and inert sites. These regulations govern the operation of landfill in England and

Wales. Basic characterisation is the responsibility of the waste producer and compliance checking is generally the responsibility of the landfill operator. Therefore landfill operators will be unlikely to accept waste that does not meet the Waste Acceptance Criteria for their class of site.

There is an obligation to 'treat' all soils destined for landfill, including non-hazardous waste. This treatment must now be documented and presented to the landfill operator or waste may be refused entry. Note that all liquids are banned from landfill.

For the purposes of legal compliance, 'treatment' must comprise three things (the 'three-point test'):

1. It must be a physical, thermal, chemical or biological process.
2. It must change the characteristics of the waste.
3. It must do so in order to:
 - (a) reduce its volume, or
 - (b) reduce its hazardous nature, or
 - (c) facilitate its handling, or enhance its recovery.

6.7 Re-use of Excavated Material On-Site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a 'Qualified Person' as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

6.8 Imported Material

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

6.9 Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation. For instance, there may have been underground storage tanks (UST's) not identified during the Desk Study and/or Ground Investigation for which there is no historical or contemporary evidence. Such occurrences may be discovered during the demolition and construction phases for the redevelopment of the site.

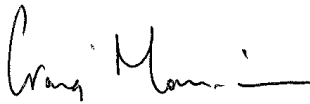
Groundworkers should be instructed to report to the Site Manager any evidence for such contamination. This may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

Should a new source of contamination be suspected or identified then the Local Authority will be informed.

The following figures and appendices complete this report:

Figure 1 Site Location Map
Figure 2 Trial Hole Location Plan

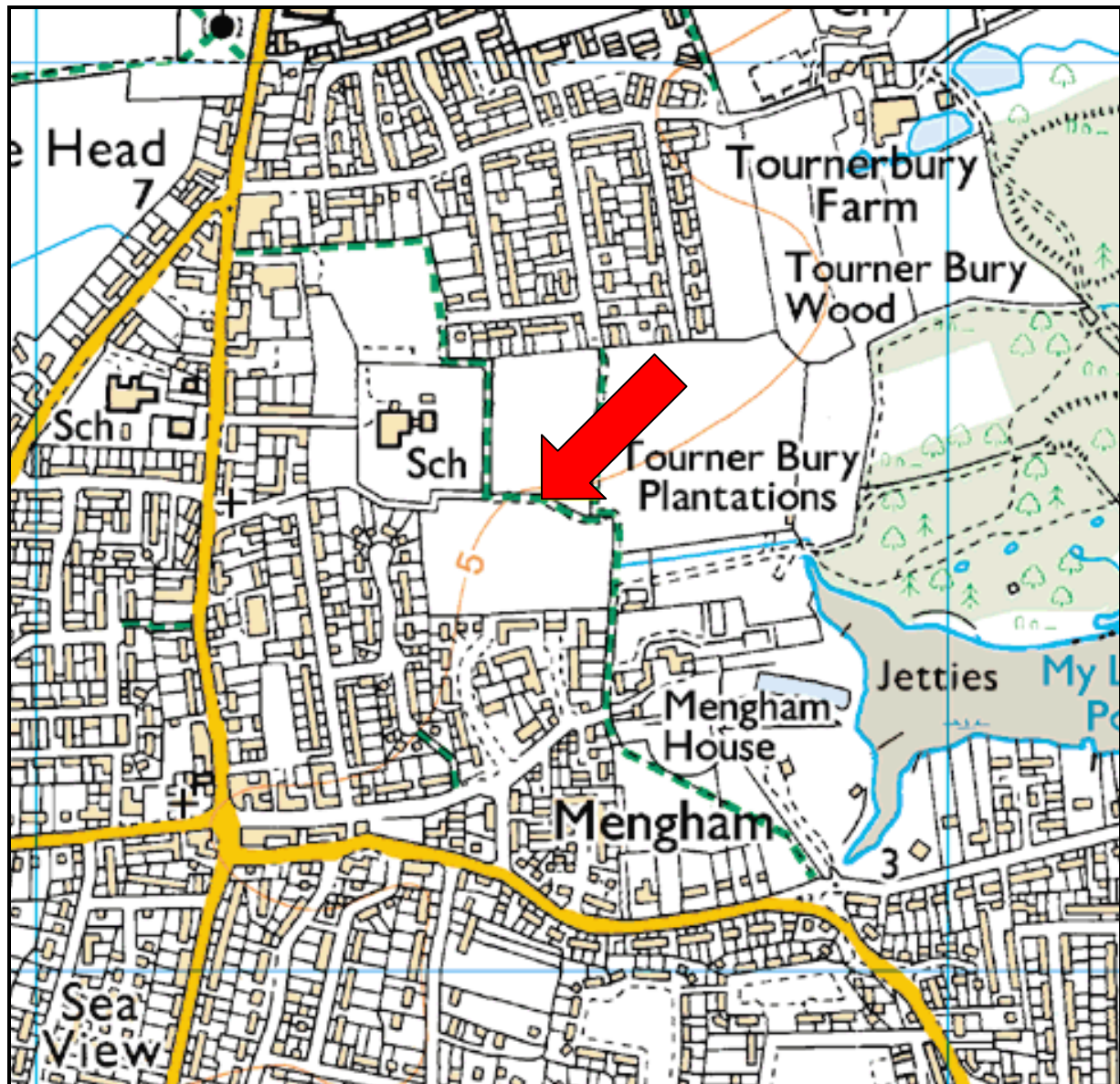
Appendix A Field Work
Appendix B Geotechnical Laboratory Analysis
Appendix C Chemical Laboratory Analysis
Appendix D Soil Guideline Values and General Assessment Criteria
Appendix E Information Provided by the Client



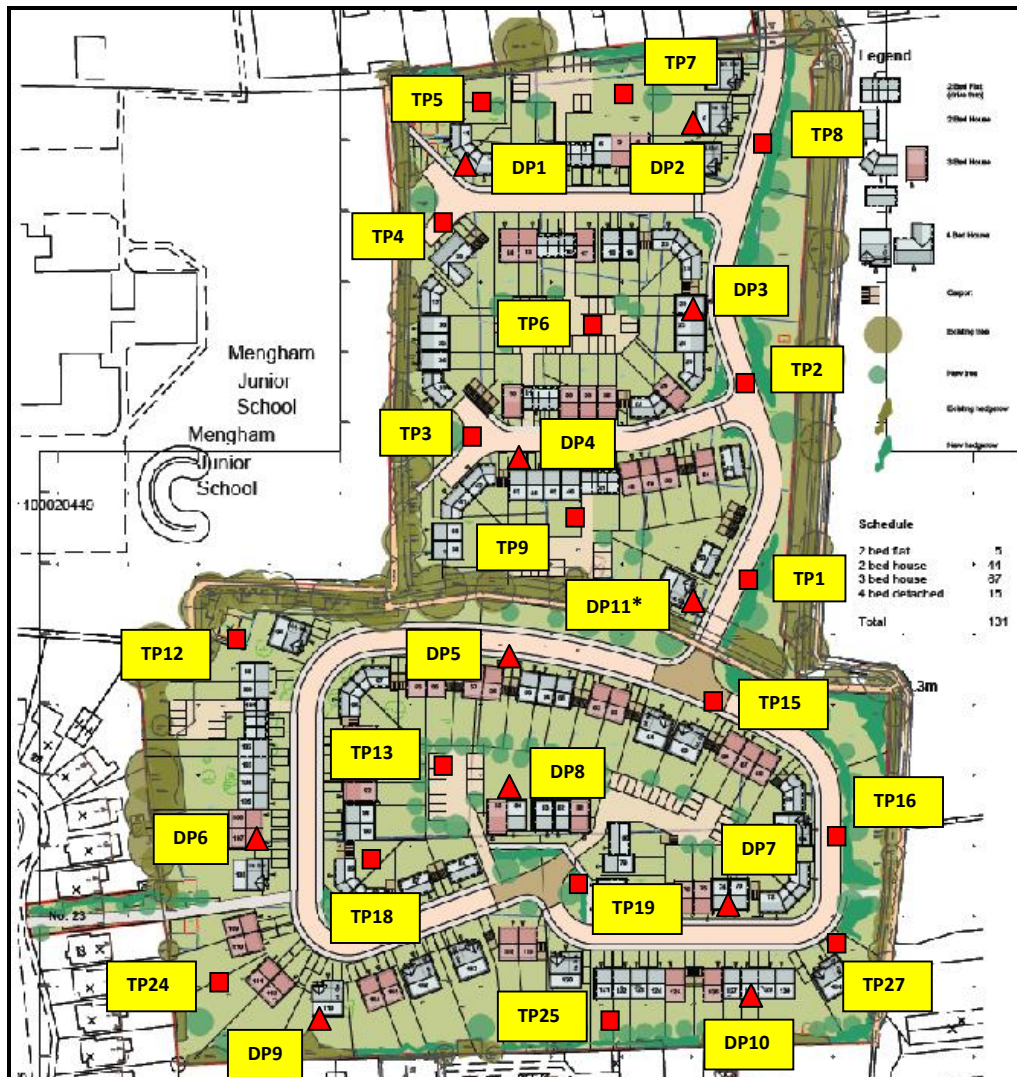
C. Morrison BSc. FGS. MIEEnvSc.



Eur Ing. R. B. Higginson B.Sc., PG. Dip., C.Eng., MICE., FGS.
Geotechnical Advisor



PROJECT:	DATE:	 <i>Geotechnical & Environmental Consultants</i>
Land North of Goldring Close and South of Beech Grove, Mengham, Hayling Island, PO11 9PN	May 2012	
CLIENT:	SCALE:	
Pro Vision Planning & Design	Not to scale	
TITLE:	REF:	
Figure 1: Site Location Plan	12952	



- Trial Pit Location
- ▲ Dynamic Probe Location (* denotes dual-purpose well)

PROJECT: Land North of Goldring Close and South of Beech Grove, Mengham, Hayling Island, PO11 9PN	DATE: May 2012	 <i>Geotechnical & Environmental Consultants</i>
CLIENT: Pro Vision Planning & Design	SCALE: Not to scale	
TITLE: Figure 2: Trial Hole Layout Plan	REF: 12952	

Appendix A
Field Work

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	JCB 3CX
	Shoring/Support:	None
	Trial Pit Length: -	Trial Pit Width: -

[illegible]

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Dry	Stability: Stable	General Remarks: Roots observed to 1.3m bgl
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Trial Pit: TP 2

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth	Description
0.20 -	D					0.30	TOPSOIL Turf over light brown silty clay with rare sub-rounded flint gravel
0.50 -	B					0.80	RIVER TERRACE DEPOSITS Grey orange brown mottled slightly gravelly slightly sandy silty CLAY
1.20 -	D					1.10	RIVER TERRACE DEPOSITS Grey sandy clayey GRAVEL
1.50 -	D					1.40	RIVER TERRACE DEPOSITS Orange grey mottled slightly gravelly sandy CLAY
						1.60	End of Trial Pit at 1.60 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated

2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 1.3m bgl, standing at 1.4m bgl after 20 minutes	Stability: Stable	General Remarks: Roots observed to 0.9m bgl
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Trial Pit: TP 3

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.30 -	D					0.10 0.10	TOPSOIL Turf over brown silty clay
0.70 -	B					0.50 0.60	RIVER TERRACE DEPOSITS Pale grey brown clayey GRAVEL / gravelly CLAY
1.20 -	D					0.50 1.10	RIVER TERRACE DEPOSITS Grey sandy clayey GRAVEL
						0.20 1.30	RIVER TERRACE DEPOSITS Orange grey sandy slightly gravelly CLAY
							End of Trial Pit at 1.30 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated

2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 1.0m bgl, standing at 1.1m bgl after 5 minutes	Stability: Stable	General Remarks: Roots observed to 0.7m bgl
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Trial Pit: TP 4

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.30 -	D					0.10 0.10	TOPSOIL Turf over brown silt clay
0.60 -	B					1.00	RIVER TERRACE DEPOSITS Light brown silty sandy CLAY with occasional fine orange sand and sub-rounded gravel
1.20 -	D					1.10 0.20	RIVER TERRACE DEPOSIT Grey sandy CLAY with occasional gravel
1.50 -	D					1.30 0.30	RIVER TERRACE DEPOSIT Orange brown mottled sandy CLAY
						1.60	End of Trial Pit at 1.60 m

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.		
Groundwater Observations: Seepage at 1.3m bgl, standing at 1.3m bgl after 10 minutes	Stability: Stable	General Remarks: Roots observed to 0.8m bgl

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Trial Pit: TP 5

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.30 -	D					0.20	TOPSOIL Turf over brown silty clay
0.70 -	D					1.20	RIVER TERRACE DEPOSITS Orange brown and grey mottled sandy silty slightly gravelly CLAY
1.10 -	D					1.40	RIVER TERRACE DEPOSITS Grey sandy gravelly CLAY
1.50 -	D					1.60	End of Trial Pit at 1.60 m

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.		
Groundwater Observations: Seepage at 1.2m bgl,	Stability: Stable	General Remarks: Roots observed to 0.9m bgl



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Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.60	Trial Pit Width: 0.40

[illegible]

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Damp at 0.70m bgl,	Stability: Stable	General Remarks: Roots observed to 0.7m bgl. Hole terminated at 0.7m bgl for soakage test
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Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.
--

Sheet 1 of 1

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Trial Pit: TP 8

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 1.70	Trial Pit Width: 0.40

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.30 -	D					0.05 0.05	TOPSOIL Turf over brown silty clay
0.70 -	B					0.45 0.50	RIVER TERRACE DEPOSITS Light brown silty CLAY
1.50 -	D					0.90 1.40 0.10	RIVER TERRACE DEPOSITS Orange grey mottled sandy silty CLAY
						1.50	RIVER TERRACE DEPOSITS Grey sandy gravelly CLAY
							End of Trial Pit at 1.50 m

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.		
Groundwater Observations: Standing at 1.4m bgl,	Stability: Stable	General Remarks: Roots observed to 0.8m bgl

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Trial Pit: TP 9

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.30 -	D					0.10 0.10	Turf over brown silty CLAY
						0.40	RIVER TERRACE DEPOSITS Light brown silty CLAY
0.70 -	B					0.50	RIVER TERRACE DEPOSITS Grey sandy gravelly CLAY
						0.50	RIVER TERRACE DEPOSITS Yellow brown and orange grey mottled sandy gravelly CLAY
1.10 -	D					1.00 0.20	RIVER TERRACE DEPOSITS Yellow brown and orange grey mottled sandy gravelly CLAY
						1.20	End of Trial Pit at 1.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated

2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 0.9m bgl, Standing at 0.9m bgl after 15 minutes	Stability: Unstable: stopped at 1.2m bgl due to sides collapsing	General Remarks: Roots observed to 0.5m bgl.
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Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.
--

Sheet 1 of 1

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Trial Pit: TP 13

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.20 -	D					0.30	TOPSOIL Turf over brown silty clay with rare flint gravel
0.70 -	B					0.60	RIVER TERRACE DEPOSITS Grey orange and light brown mottled locally sandy silty slightly gravelly CLAY
1.00 -	D					0.20	RIVER TERRACE DEPOSITS Grey clayey sandy GRAVEL
1.20 -	D					0.20	RIVER TERRACE DEPOSITS Orange grey clayey gravelly SAND
End of Trial Pit at 1.30 m							

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.		
Groundwater Observations: Seepage at 1.0m bgl. Standing at 1.10m bgl after 10 minutes	Stability: Stable	General Remarks: Rootlets observed to 1.3m bgl

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth	Description
0.20 -	D					0.30	TOPSOIL Turf over brown silty clay with occasional sub-rounded flint gravel
0.60 -	D					0.50	RIVER TERRACE DEPOSITS Grey clayey sandy GRAVEL / gravelly CLAY
1.00 -	D					0.50	RIVER TERRACE DEPOSITS Orange grey slightly gravelly clayey SAND / sandy CLAY
						1.30	End of Trial Pit at 1.30 m

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 0.8m bgl. Standing at 1.10m bgl after 10 minutes	Stability: Stable	General Remarks: Roots observed to 1.0m bgl
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Trial Pit: TP 16

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.20 -	D					0.30	TOPSOIL Turf over dark brown silty clay
0.60 -	D					0.40	RIVER TERRACE DEPOSITS Firm grey brown and orange slightly sandy silty CLAY
1.00 -	D					0.50	RIVER TERRACE DEPOSITS Grey orange mottled sandy CLAY with abundant fine to coarse flint gravel with depth and becoming very sandy with depth
1.50 -	D					0.40	RIVER TERRACE DEPOSITS Orange brown slightly clayey sandy GRAVEL
2.00 -	D					0.60	RIVER TERRACE DEPOSITS Firm grey slightly silty CLAY
						2.20	End of Trial Pit at 2.20 m

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.		
Groundwater Observations: Seepage at 1.5m bgl. Standing at 1.80m bgl after 10 minutes	Stability: Stable	General Remarks: Rootlets observed to 1.5m bgl

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Trial Pit: TP 18

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.20 -	D					0.30	TOPSOIL Turf over brown silty clay
0.60 -	D					0.50	RIVER TERRACE DEPOSITS Grey and orange brown mottled slightly gravelly locally sandy silty CLAY
1.10 -	D					0.70	RIVER TERRACE DEPOSITS Pale grey brown clayey gravelly SAND. Gravel is fine to coarse sub-rounded flint
1.50 -	D					1.50	End of Trial Pit at 1.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated

2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 1.2m bgl.	Stability: Stable	General Remarks: Roots observed to 1.2m bgl
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Trial Pit: TP 19

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.30 -	D					0.40	TOPSOIL Turf over brown silty clay
0.70 -	D					0.80	RIVER TERRACE DEPOSITS Brown grey sandy clayey GRAVEL becoming more sandy with depth and less clayey
1.30 -	D					1.50	RIVER TERRACE DEPOSITS Orange brown mottled sandy CLAY with occasional gravel and ferruginous nodules
End of Trial Pit at 1.50 m							

General Notes:

1. All linear dimensions are in metres unless otherwise stated

2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 1.0m bgl. Standing at 1.0 bgl after 20 minutes	Stability: Stable	General Remarks: Roots observed to 1.5m bgl
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Trial Pit: TP 24

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: 0.00	Trial Pit Width: 0.00

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.20 -	D					0.30	TOPSOIL Turf over brown silty clay with rare flint gravel
0.50 -	D					0.40	RIVER TERRACE DEPOSITS Orange brown sandy silty CLAY
0.80 -	D					0.70	RIVER TERRACE DEPOSITS Orange grey brown slightly clayey sandy GRAVEL
1.40 -	D					1.50	End of Trial Pit at 1.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated

2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Standing at 1.9 bgl	Stability: Stable	General Remarks: No roots observed
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Trial Pit: TP 25

Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.20 -	D					0.40	TOPSOIL Turf over brown silty clay with rare flint gravel
0.70 -	D					0.40	RIVER TERRACE DEPOSITS Orange brown slightly sandy silty CLAY
1.10 -	D					0.80	RIVER TERRACE DEPOSITS Orange grey sandy clayey GRAVEL
1.40 -	D					1.30	RIVER TERRACE DEPOSITS Grey brown and orange brown slightly clayey gravelly SAND
						1.50	End of Trial Pit at 1.50 m

General Notes: 1. All linear dimensions are in metres unless otherwise stated 2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data. 3. Trial pit logged from the ground surface below 1.2 m depth.		
Groundwater Observations: seepage at 1.3m bgl. Standing at 1.15m bgl after 10 minutes	Stability: Stable	General Remarks: Roots observed to 0.9m bgl



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Site: Mengham, Hayling Island	Start Date: 26/04/2012	Ground Level: -
Client: Pro Vision	End Date: 26/04/2012	Easting: -
Project No: 12952	Logged By: PL	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.20 -	D					0.30	TOPSOIL Turf over brown silty clay
0.50 -	D					0.40	RIVER TERRACE DEPOSITS Light brown slightly sandy CLAY with occasional flint gravel
1.00 -	D					0.70	RIVER TERRACE DEPOSITS Grey orange mottled sandy silty CLAY
1.50 -	D					1.00	
						1.70	End of Trial Pit at 1.70 m

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Dry	Stability: Stable	General Remarks: Roots observed to 1.0m bgl
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Soakaway Calculations

Facsimile: 01737 812 557

Soakaway Calculations

Facsimile: 01737 812 557

Soakaway Calculations

Facsimile: 01737 812 557

DYNAMIC PROBING					Probe NoDP 1																																																																																																																																																																																																																																																																																																																																																																																																									
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<i>DYNAMIC PROBING</i>	Probe No DP 3
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<i>Client</i> Pro Vision	Sheet 1 of 1
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Sheet 1 of 1

<i>Site</i>	Mengham, Hayling Island	<i>Location No</i>	12952
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<i>E</i> -	<i>N</i> -	<i>Level</i> -	<i>Date</i> 26/04/2012
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Date **26/04/2012**

Depth (m)	Readings Blows/100mm					Diagram (N100 Values)	Torque (Nm)
	1	2	3	4	5		
1	1	1	1	1	2		
	1	1	1	2	2		
	8	8	6	4	3		
	1	3	3	3	2		
	2	1	1	1	1		
2	2	2	2	2	3		
	4	4	5	5	5		
	8	8	8	8	9		
3							
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Soils

<i>DYNAMIC PROBING</i>	Probe No DP 4
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<i>Client</i> Pro Vision	Sheet 1 of 1
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Sheet 1 of 1

<i>Site</i>	Mengham, Hayling Island	<i>Location No</i>	12952
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<i>E</i> -	<i>N</i> -	<i>Level</i> -	<i>Date</i> 26/04/2012
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Date **26/04/2012**

Diagram (N100 Values)

Depth (m)

Readings
Blows/100mm

Torque
(N/m)

Depth (m)	Readings (Blows/100mm)	Diagram (N100 Values)	Torque (N/m)
0	1	1	45
0.3	3	3	45
0.4	4	4	45
1	14	14	45
1.2	12	12	45
1.4	9	9	45
1.6	4	4	45
1.8	8	8	45
2	1	1	45
2.2	2	2	45
2.4	1	1	45
2.6	2	2	45
2.8	2	2	45
3	3	3	45
3.2	3	3	45
3.4	4	4	45
3.6	4	4	45
3.8	6	6	45
4	6	6	45
4.2	7	7	45
4.4	7	7	45
4.6	7	7	45
4.8	8	8	45
5	9	9	45
5.2	9	9	45
5.4	10	10	45
5.6	10	10	45

Soils

Soils

DYNAMIC PROBING					Probe NoDP 5																																																																																																																																																																																																																																																																																																																											
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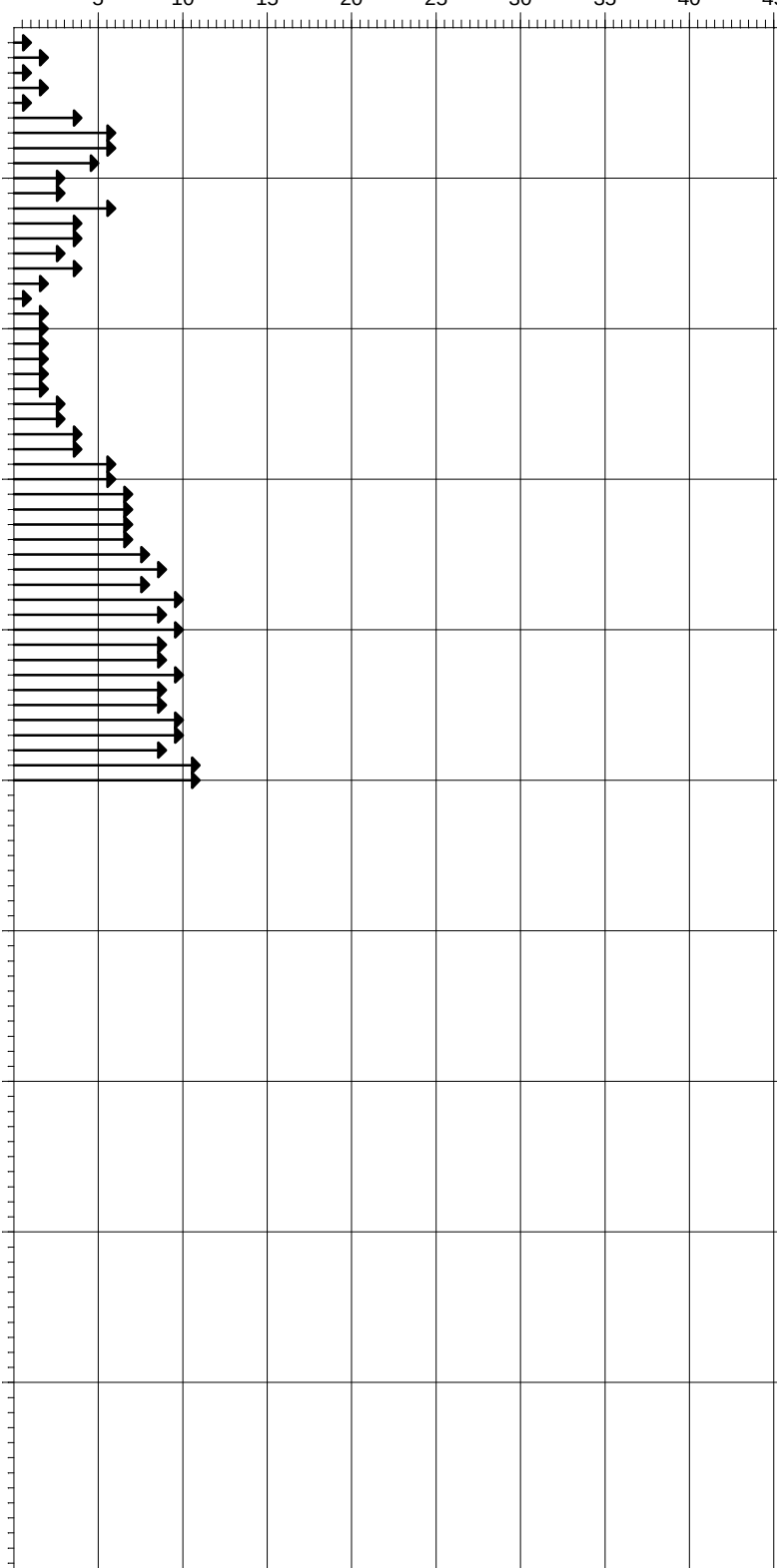
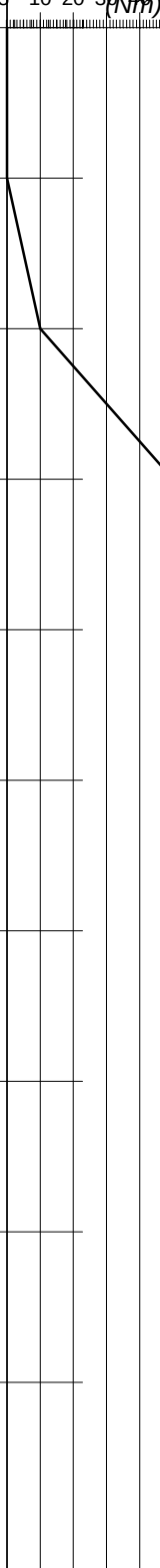
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DYNAMIC PROBING					Probe No DP 11																
Client Pro Vision					Sheet 1 of 1																
Site Mengham, Hayling Island					Location No 12952																
E -		N -		Level -		Date 26/04/2012															
Depth (m)	Readings Blows/100mm					Diagram (N100 Values)										Torque (Nm)					
	1	2	1	2	1																
	4	6	6	5	3																
	3	6	4	4	3																
	4	2	1	2	2																
	2	2	2	2	3																
	3	4	4	6	6																
	7	7	7	7	8																
	9	8	10	9	10																
	9	9	10	9	9																
	10	10	9	11	11																
	6																				
	7																				
	8																				
	9																				
					Fall Height 750					Cone Diameter 50					Logger						
					Hammer Wt 63.50					Final Depth 4.900					Soils						
					Probe Type DPSH					Log Scale 1:50											

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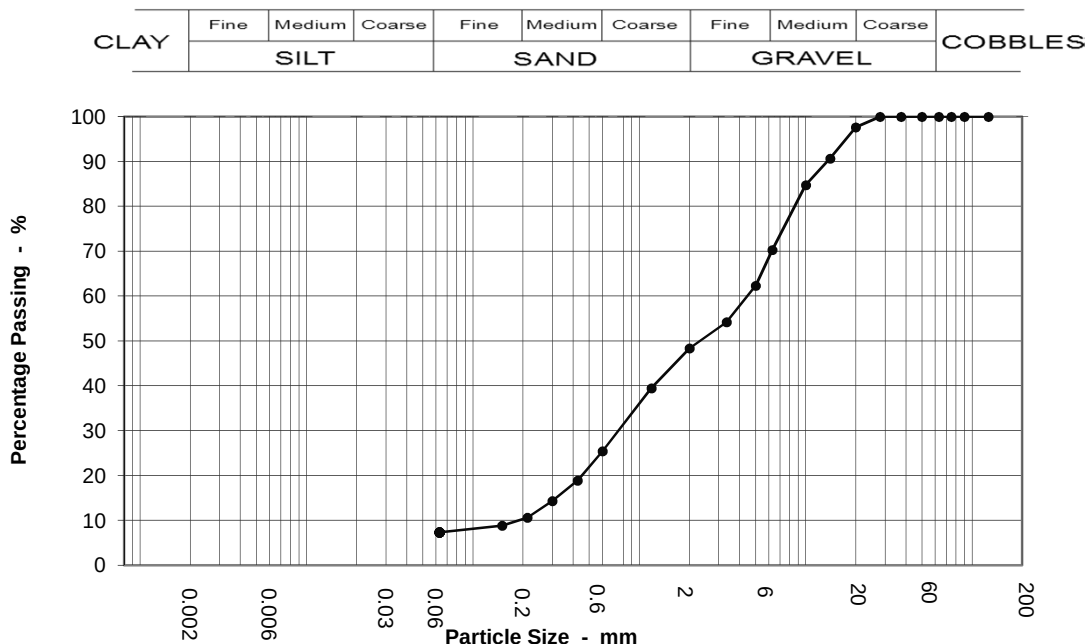
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Appendix B

Geotechnical Laboratory Analysis

Project Name: Hayling island						Samples Received: 10/05/2012		K4 SOILS 	
						Project Started: 11/05/2012			
Client: Soils Ltd						Testing Started: 16/05/2012			
Project No: J12952				Our job/report no: 12688		Date Reported: 18/05/2012			
Borehole No:	Sample No:	Depth (m)	Description	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425 mm (%)	Remarks
TP2	D	1.50	Orange brown slightly gravelly sandy CLAY (gravel is fm and angular to sub-angular)	20	32	18	14	90	
TP5	D	1.10	Brown slightly silty slightly gravelly CLAY (gravel is fm and angular)	24	38	20	18	92	
TP7	D	0.80	Brown slightly gravelly CLAY (gravel is fm and angular)	25	49	20	29	97	
TP9	D	1.10	Yellowish brown and pale grey slightly gravelly sandy CLAY (gravel is fm and angular)	23	27	22	5	95	
TP15	D	0.60	Grey sandy gravelly CLAY (gravel is fm and angular to rounded)	20	39	16	23	43	
TP15	D	1.00	Pale greenish grey slightly gravelly sandy CLAY (gravel is fm and angular to rounded)	21	32	21	11	85	
 Summary of Test Results BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method. BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index. BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.									Checked and Approved Initials: K.P Date: 18/05/2012
Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr) All samples connected with this report ,incl any on 'hold' will be stored and disposed off according to Company policy.Acoppy of this policy is available on request.									

K4 SOILS 	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Our Report No:	12688
		Project No:	J12952
Location	Hayling island	Borehole / Trial Pit No:	TP12
		Depth	1.20 m
Visual Soil Description	Greyish brown slightly clayey sandy GRAVEL (gravel is fmc and sub-angular to sub-rounded)	Sample Type/No	D -



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	91		
10	85		
6.3	70		
5	62		
3.35	54		
2	48		
1.18	39		
0.6	25		
0.425	19		
0.3	14		
0.212	11		
0.15	9		
0.063	7		

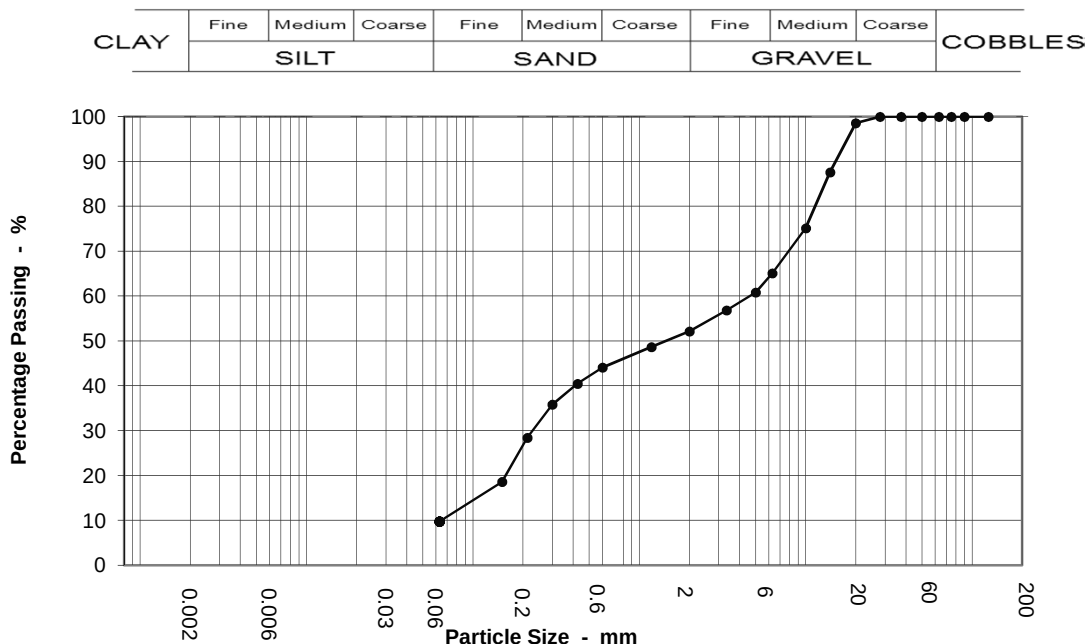
Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause
Sedimentation	N/A
Suitable Amount Of Sample Received	Yes

Sample Proportions	
Cobbles	0.0
Gravel	51.7
Sand	41.0
Silt & Clay	7.3

Grading Analysis	
D100	125.0
D60	4.5
D10	0.2
Uniformity Coefficient	24

K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU. E-mail: k4soils@aol.com	Approved Signatories:		Checked and Approved	
	K.Phaure(Tech.Mgr)	J.Phaure(Lab.Mgr)	Initials: kp	
	Test results relate only to the sample numbers shown above		Date: 18/05/2012	
All samples connected with this report, incl any on 'hold' will be disposed off according to company policy. A copy of this policy is available on request. Sheet 3/3 MSF-11/R9				
				2519

K4 SOILS 	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Our Report No:	12688
		Project No:	J12952
Location	Hayling island	Borehole / Trial Pit No:	TP16
		Depth	1.50 m
Visual Soil Description	Orange brown slightly clayey sandy GRAVEL (gravel is fmc and sub-angular to sub-rounded)	Sample Type/No	D -



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	99		
14	88		
10	75		
6.3	65		
5	61		
3.35	57		
2	52		
1.18	49		
0.6	44		
0.425	40		
0.3	36		
0.212	28		
0.15	19		
0.063	10		

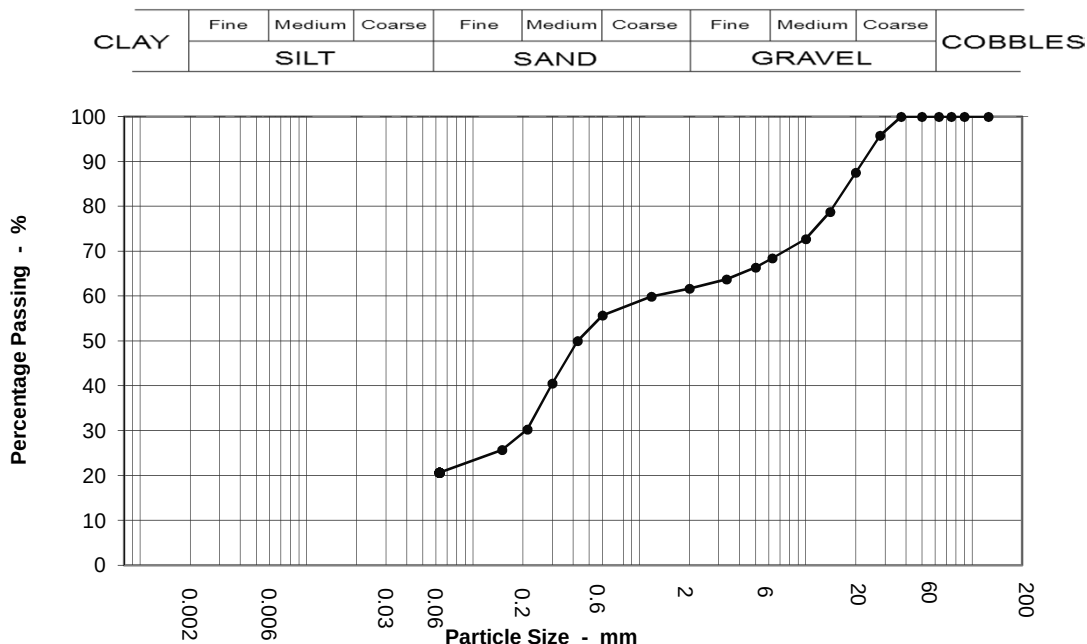
Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause
Sedimentation	N/A
Suitable Amount Of Sample Received	Yes

Sample Proportions	
Cobbles	0.0
Gravel	47.9
Sand	42.4
Silt & Clay	9.7

Grading Analysis	
D100	125.0
D60	4.7
D10	0.1
Uniformity Coefficient	71

K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU. E-mail: k4soils@aol.com	Approved Signatories: K.Phaure(Tech.Mgr) J.Phaure(Lab.Mgr)	Checked and Approved Initials: kp	
	Test results relate only to the sample numbers shown above	Date: 18/05/2012	
All samples connected with this report, incl any on 'hold' will be disposed off according to company policy. A copy of this policy is available on request. Sheet 3/3 MSF-11/R9			2519

K4 SOILS 	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Our Report No:	12688
		Project No:	J12952
Location	Hayling island	Borehole / Trial Pit No:	TP18
		Depth	1.10 m
Visual Soil Description	Pale brown clayey gravelly SAND (gravel is fmc and sub angular to sub-rounded)	Sample Type/No	D -



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	96		
20	88		
14	79		
10	73		
6.3	68		
5	66		
3.35	64		
2	62		
1.18	60		
0.6	56		
0.425	50		
0.3	40		
0.212	30		
0.15	26		
0.063	21		

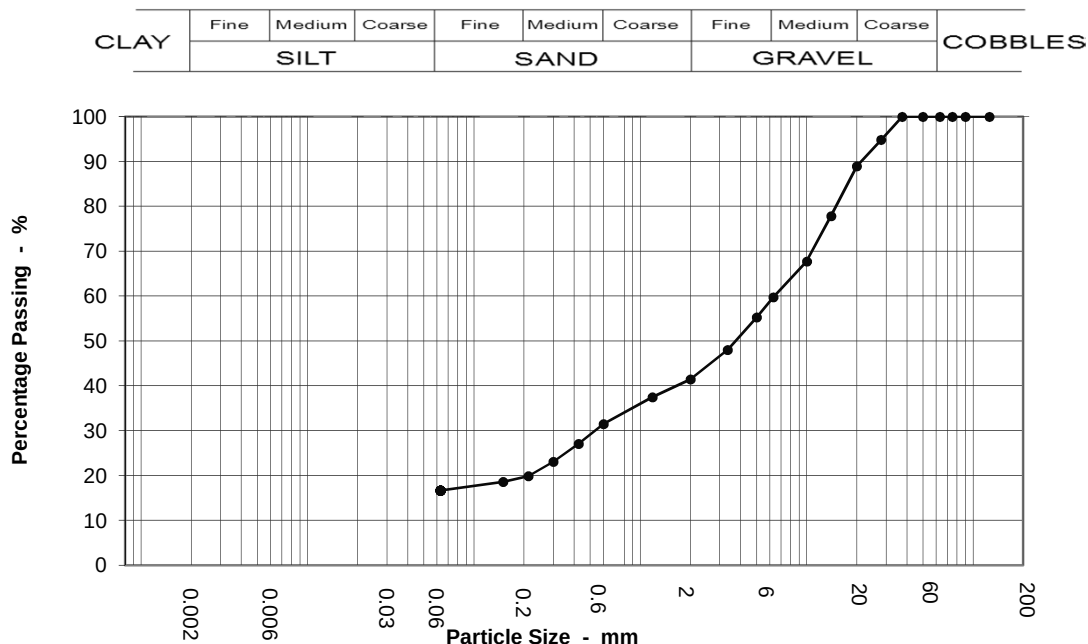
Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause
Sedimentation	N/A
Suitable Amount Of Sample Received	Yes

Sample Proportions	
Cobbles	0.0
Gravel	38.3
Sand	41.0
Silt & Clay	20.6

Grading Analysis	
D100	125.0
D60	1.2
D10	
Uniformity Coefficient	N/A

K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU. E-mail: k4soils@aol.com	Approved Signatories: K.Phaure(Tech.Mgr)J.Phaure(Lab.Mgr)	Checked and Approved Initials: kp	
	Test results relate only to the sample numbers shown above	Date: 18/05/2012	
All samples connected with this report, incl any on 'hold' will be disposed off according to company policy. A copy of this policy is available on request. Sheet 3/3 MSF-11/R9			2519

K4 SOILS 	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Our Report No:	12688
		Project No:	J12952
Location	Hayling island	Borehole / Trial Pit No:	TP24
		Depth	0.80 m
Visual Soil Description	Brown slightly clayey sandy GRAVEL with traces of fm chalk fragments (gravel is fmc and sub-rounded to angular)	Sample Type/No	D -



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	95		
20	89		
14	78		
10	68		
6.3	60		
5	55		
3.35	48		
2	41		
1.18	37		
0.6	31		
0.425	27		
0.3	23		
0.212	20		
0.15	19		
0.063	17		

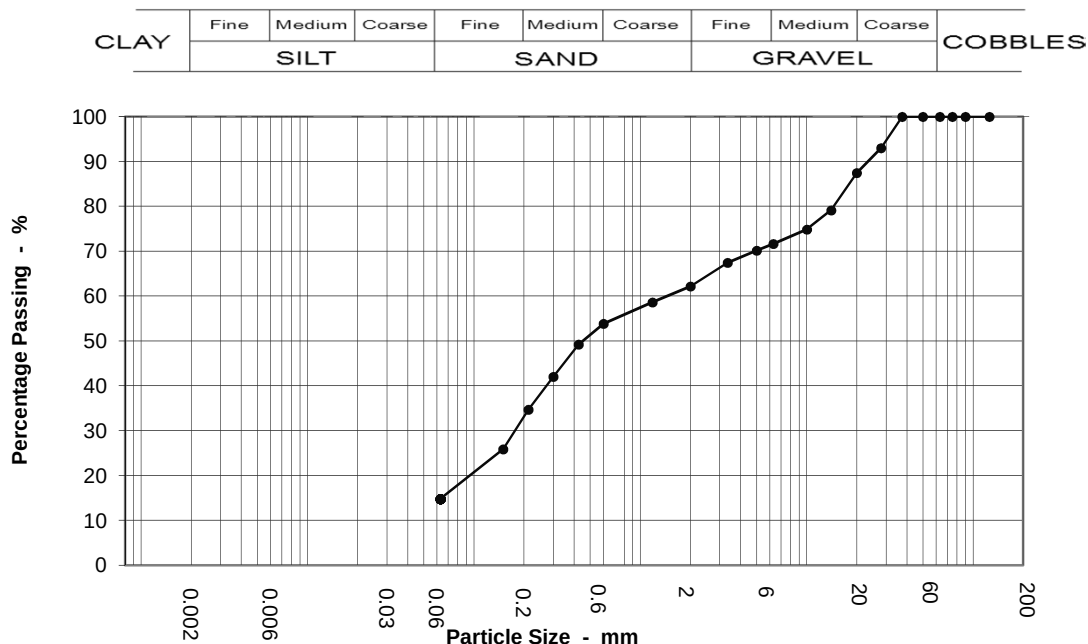
Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause
Sedimentation	N/A
Suitable Amount Of Sample Received	Yes

Sample Proportions	
Cobbles	0.0
Gravel	58.6
Sand	24.8
Silt & Clay	16.6

Grading Analysis	
D100	125.0
D60	6.4
D10	
Uniformity Coefficient	N/A

K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU. E-mail: k4soils@aol.com	Approved Signatories:		Checked and Approved	
	K.Phaure(Tech.Mgr)	J.Phaure(Lab.Mgr)	Initials: kp	
	Test results relate only to the sample numbers shown above		Date: 18/05/2012	
All samples connected with this report, incl any on 'hold' will be disposed off according to company policy. A copy of this policy is available on request. Sheet 3/3 MSF-11/R9				
				2519

K4 SOILS 	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Our Report No:	12688
		Project No:	J12952
Location	Hayling island	Borehole / Trial Pit No:	TP25
		Depth	1.40 m
Visual Soil Description	Grey, brown and orange brown slightly clayey gravelly SAND (gravel is fmc and sub-rounded to angular)	Sample Type/No	D -



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	93		
20	87		
14	79		
10	75		
6.3	72		
5	70		
3.35	67		
2	62		
1.18	59		
0.6	54		
0.425	49		
0.3	42		
0.212	35		
0.15	26		
0.063	15		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause
Sedimentation	N/A
Suitable Amount Of Sample Received	Yes

Sample Proportions	
Cobbles	0.0
Gravel	37.8
Sand	47.4
Silt & Clay	14.8

Grading Analysis	
D100	125.0
D60	1.5
D10	
Uniformity Coefficient	N/A

K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU. E-mail: k4soils@aol.com	Approved Signatories:		Checked and Approved	
	K.Phaure(Tech.Mgr)	J.Phaure(Lab.Mgr)	Initials: kp	
	Test results relate only to the sample numbers shown above		Date: 18/05/2012	
All samples connected with this report, incl any on 'hold' will be disposed off according to company policy. A copy of this policy is available on request. Sheet 3/3 MSF-11/R9				
				2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 17/05/2012

Project no: J12952

Our job /report no: 12688

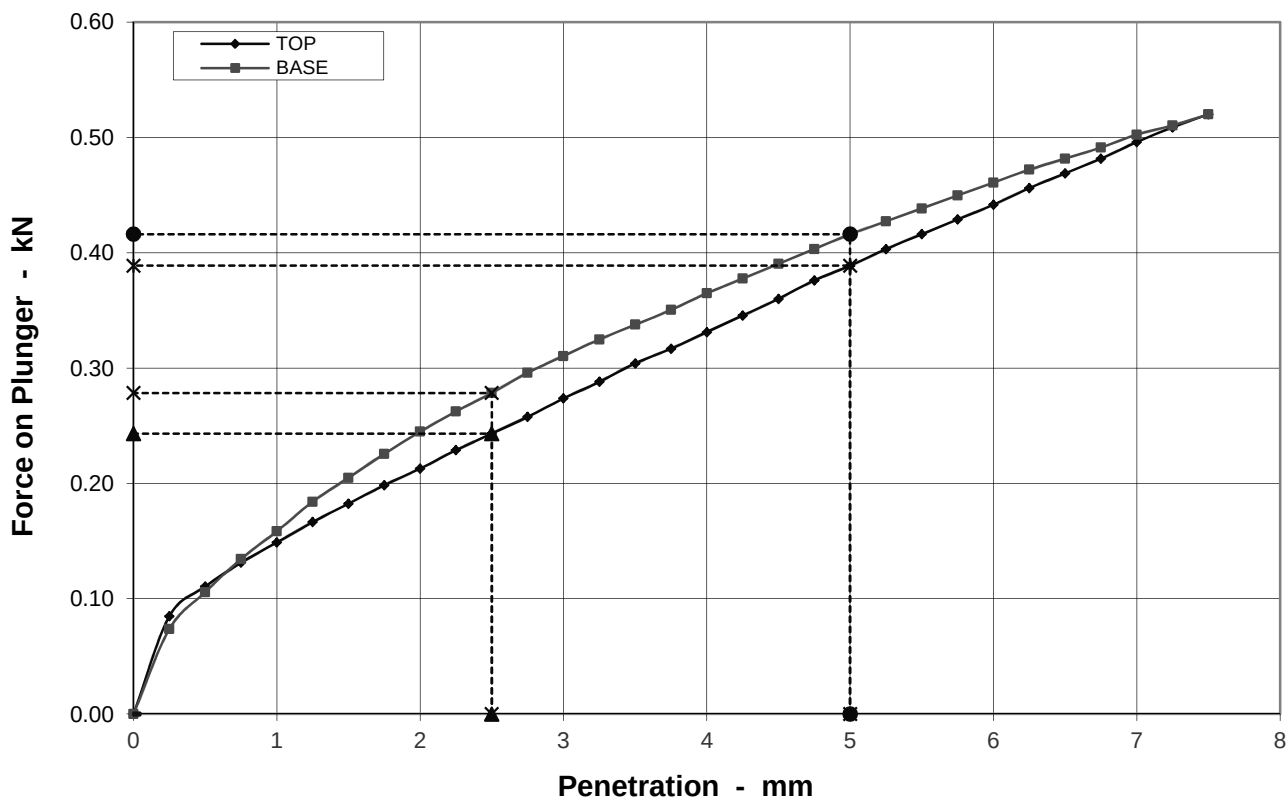
Date reported: 18/05/2012

BH / TP no: TP2

Sample no: B

Depth (m): 0.50

Soil Description: Light brown and orange brown slightly gravelly slightly sandy silty CLAY and occasional fine rootlets (gravel is fmc and sub-angular to sub-rounded)



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	24
Moisture Content - TOP	%	25
Moisture Content - BASE	%	24
Bulk Density	Mg/m ³	2.02
Dry Density	Mg/m ³	1.63

Test Conditions		
Sample Retained on 20 mm sieve	%	0.3
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	1.8	2.1
5	1.9	2.1
Accepted CBR	1.9	2.1

K4 SOILS LABORATORY

Unit 8, Olds Close, Watford, Herts, WD18 9RU.

Tel:01923711288 Fax:01923711311.

E-mail: k4soils@aol.com

Approved Signatories:

K.Phaure(Tech.Mgr)

J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 17/05/2012

Project no: J12952

Our job /report no: 12688

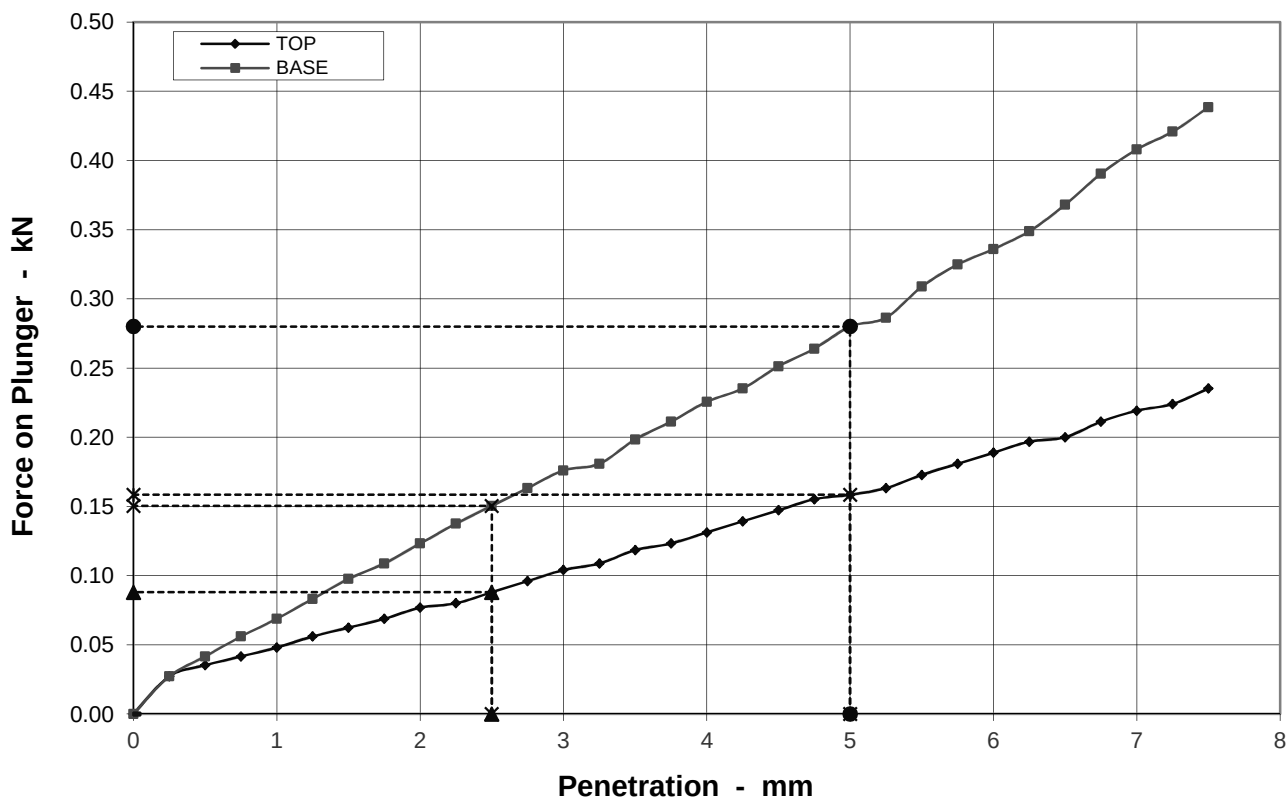
Date reported: 18/05/2012

BH / TP no: TP3

Sample no: B

Depth (m): 0.70

Soil Description: Grey brown clayey GRAVEL (gravel is fmc and rounded to angular)



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	15
Moisture Content - TOP	%	15
Moisture Content - BASE	%	15
Bulk Density	Mg/m ³	2.19
Dry Density	Mg/m ³	1.91

Test Conditions		
Sample Retained on 20 mm sieve	%	6.0
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	0.67	1.1
5	0.79	1.4
Accepted CBR	0.79	1.4

K4 SOILS LABORATORY

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Approved Signatories:

K.Phaure(Tech.Mgr)

J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 15/05/2012

Project no: J12952

Our job /report no: 12688

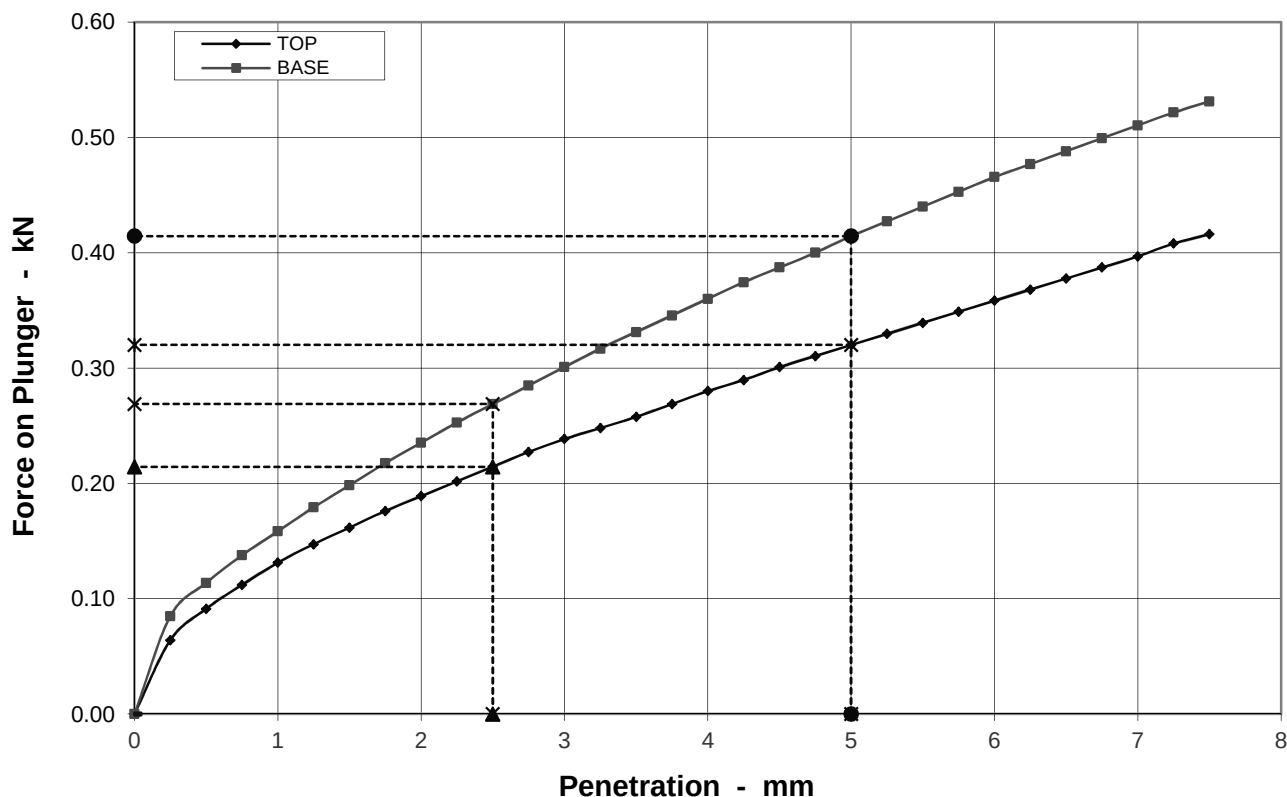
Date reported: 18/05/2012

BH / TP no: TP4

Sample no: B

Depth (m): 0.60

Soil Description: Brown slightly gravelly silty sandy CLAY (gravel is fm and angular to sub-angular)



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	24
Moisture Content - TOP	%	24
Moisture Content - BASE	%	24
Bulk Density	Mg/m ³	1.99
Dry Density	Mg/m ³	1.61

Test Conditions		
Sample Retained on 20 mm sieve	%	0.0
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	1.6	2.0
5	1.6	2.1
Accepted CBR	1.6	2.1

K4 SOILS LABORATORY

Unit 8, Olds Close, Watford, Herts, WD18 9RU.

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E-mail: k4soils@aol.com

Approved Signatories:

J.Phaure(Lab.Mgr)

K.Phaure(Tech.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 17/05/2012

Project no: J12952

Our job /report no: 12688

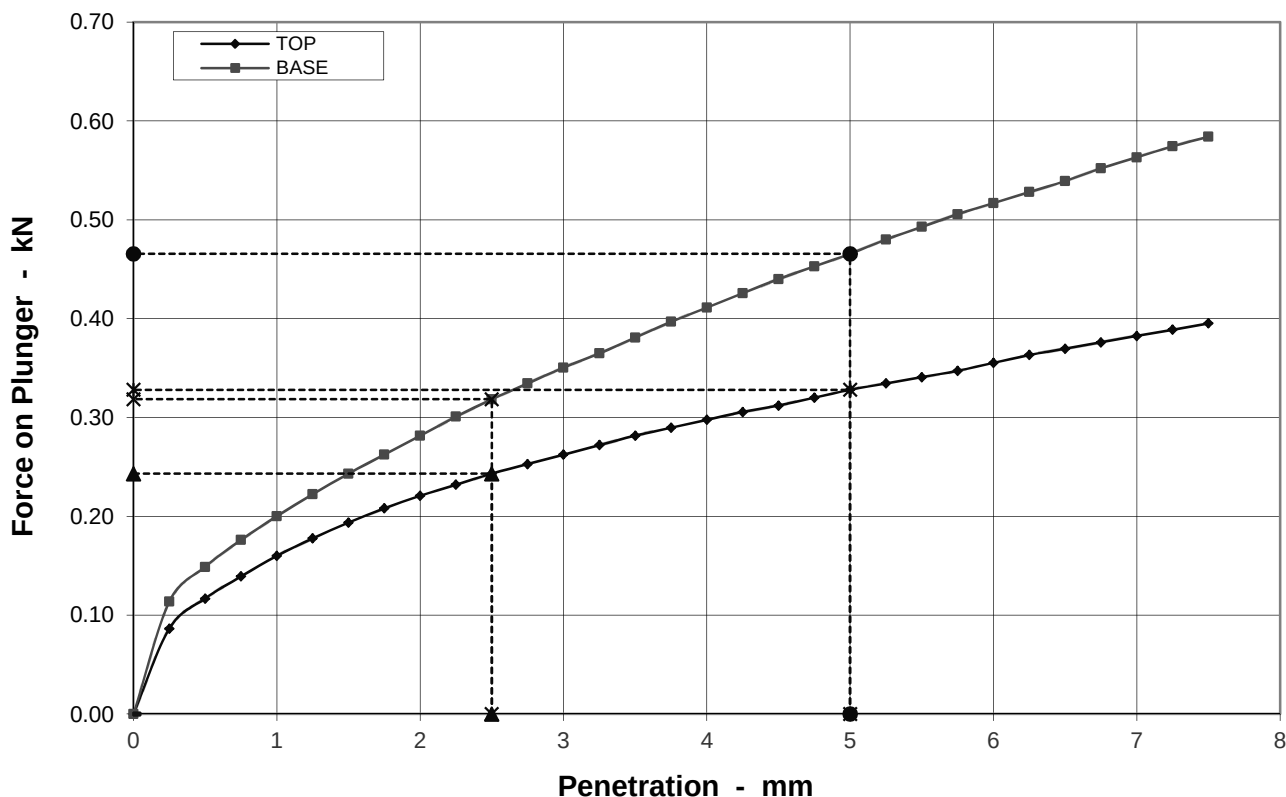
Date reported: 18/05/2012

BH / TP no: TP8

Sample no: B

Depth (m): 0.70

Soil Description: Light brown slightly silty CLAY



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	23
Moisture Content - TOP	%	23
Moisture Content - BASE	%	23
Bulk Density	Mg/m ³	2.00
Dry Density	Mg/m ³	1.63

Test Conditions		
Sample Retained on 20 mm sieve	%	0.0
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	1.8	2.4
5	1.6	2.3
Accepted CBR	1.8	2.4

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Approved Signatories:

K.Phaure(Tech.Mgr)

J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 17/05/2012

Project no: J12952

Our job /report no: 12688

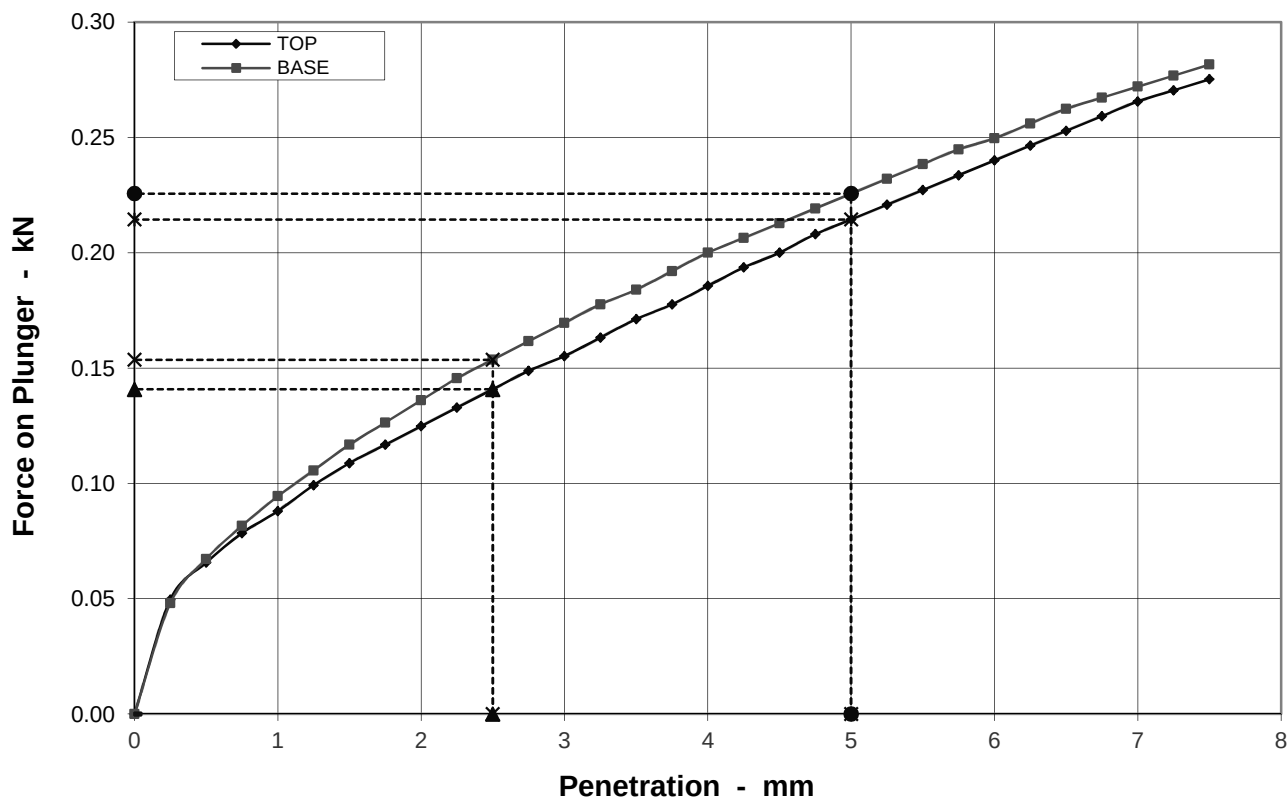
Date reported: 18/05/2012

BH / TP no: TP13

Sample no: B

Depth (m): 0.70

Soil Description: Light brown slightly gravelly silty CLAY (gravel is fmc and sub-rounded to rounded)



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	25
Moisture Content - TOP	%	25
Moisture Content - BASE	%	25
Bulk Density	Mg/m ³	1.96
Dry Density	Mg/m ³	1.57

Test Conditions		
Sample Retained on 20 mm sieve	%	2.0
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	1.1	1.2
5	1.1	1.1
Accepted CBR	1.1	1.2

K4 SOILS LABORATORY

Unit 8, Olds Close, Watford, Herts, WD18 9RU.

Tel:01923711288 Fax:01923711311.

E-mail: k4soils@aol.com

Approved Signatories:

J.Phaure(Lab.Mgr)

K.Phaure(Tech.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 17/05/2012

Project no: J12952

Our job /report no: 12688

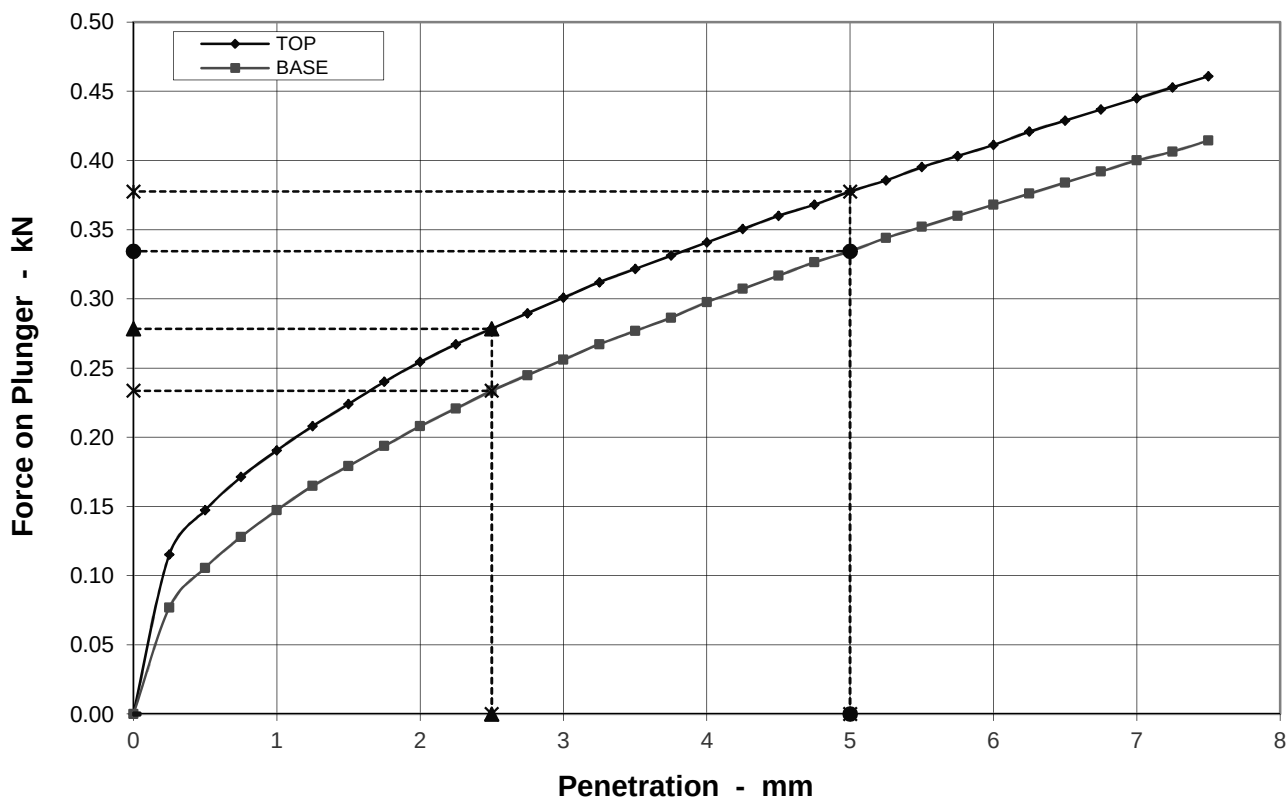
Date reported: 18/05/2012

BH / TP no: TP18

Sample no: B

Depth (m): 0.60

Soil Description: Light brown slightly gravelly silty CLAY with numerous rootlets (gravel is fm and sub-angular to rounded)



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	25
Moisture Content - TOP	%	25
Moisture Content - BASE	%	24
Bulk Density	Mg/m³	1.96
Dry Density	Mg/m³	1.57

Test Conditions		
Sample Retained on 20 mm sieve	%	0.0
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	2.1	1.8
5	1.9	1.7
Accepted CBR	2.1	1.8

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Approved Signatories:

K.Phaure(Tech.Mgr)

J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name: Hayling island

Samples Received: 10/05/2012

Project Started: 11/05/2012

Client: Soils Ltd

Testing started: 15/05/2012

Project no: J12952

Our job /report no: 12688

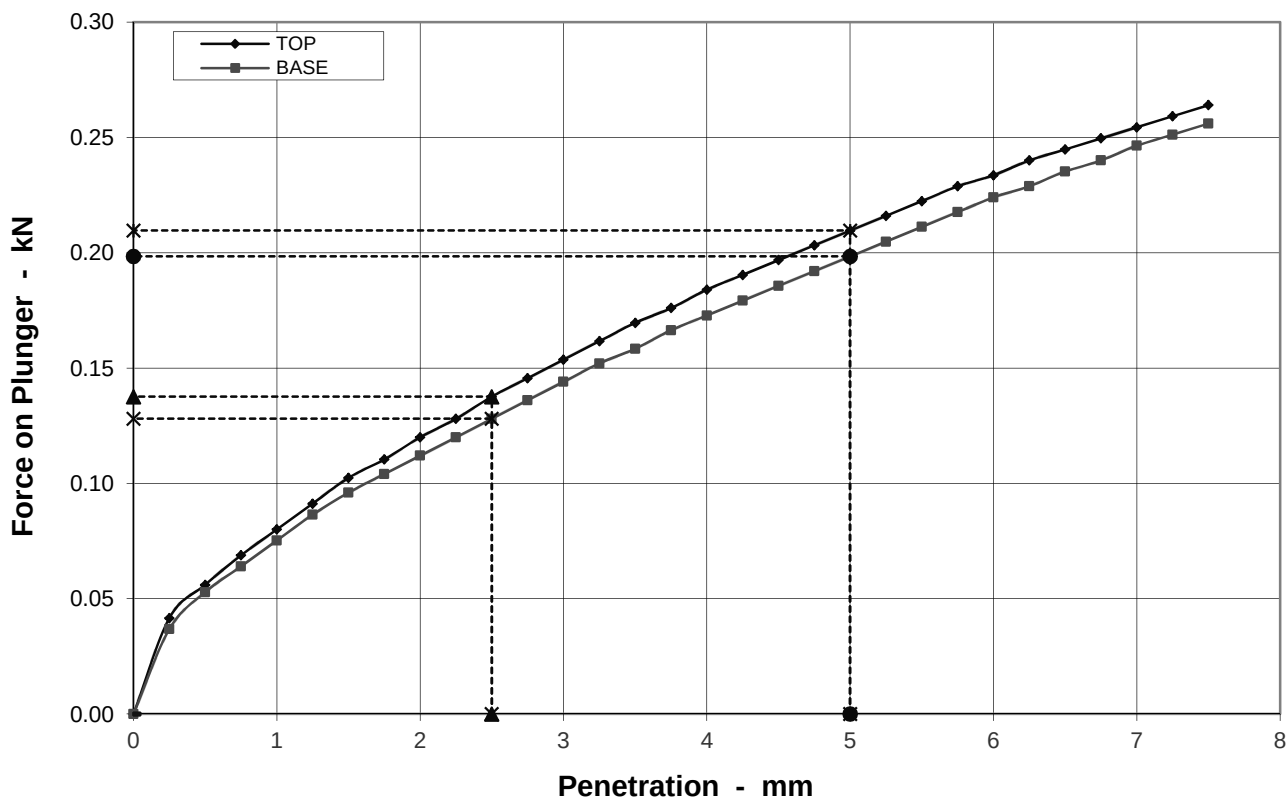
Date reported: 18/05/2012

BH / TP no: TP27

Sample no: B

Depth (m): 0.50

Soil Description: Brown slightly sandy slightly gravelly CLAY (gravel is fmc and angular to sub-rounded)



Preparation	Method of Compaction	
	Rammer compaction with specified effort	
	Hammer type	2.5kg Rammer
	Soaking Period	days
	Amount of Swell	mm

Sample Conditions		
Natural Moisture Content	%	22
Moisture Content - TOP	%	23
Moisture Content - BASE	%	22
Bulk Density	Mg/m ³	2.03
Dry Density	Mg/m ³	1.66

Test Conditions		
Sample Retained on 20 mm sieve	%	1.8
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	10
Seating Load - BASE	N	10
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	1.0	1.0
5	1.0	1.0
Accepted CBR	1.0	1.0

K4 SOILS LABORATORY

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E-mail: k4soils@aol.com

Approved Signatories:

K.Phaure(Tech.Mgr)

J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved

Initials: kp

Date: 18/05/2012



2519



Craig Morrison
Soils Ltd
Brunel House
Unit 14, Chalcroft Distribution Park
Burnetts Lane
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Hampshire SO30 2PA



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russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 9607

Site Reference: Hayling Island

Project / Job Ref: 12952

Order No: None Supplied

Sample Receipt Date: 10/05/2012

Sample Scheduled Date: 10/05/2012

Report Issue Number: 1

Reporting Date: 16/05/2012

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd



QTS Environmental Ltd
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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 851105



Soil Analysis Certificate						
QTS Environmental Report No: 9607	Date Sampled	27/04/12	27/04/12	27/04/12		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Hayling Island	TP / BH No	TP6	TP13	TP16		
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.60	1.00	1.00		
Reporting Date: 16/05/2012	QTSE Sample No	44877	44878	44879		

Determinand	Unit	MDL	Accreditation				
Stone Content	%	<0.1	NONE	<0.1	<0.1	<0.1	

General Inorganics	Unit	MDL	Accreditation				
pH	pH Units	+ / - 0.1	MCERTS	7.8	6.9	7.0	
Total Sulphate as SO ₄	mg/kg	<200	NONE	399	<200	241	
W/S Sulphate as SO ₄ (2:1)	g/l	<0.01	NONE	<0.01	<0.01	<0.01	
W/S Chloride (2:1)	mg/kg	<10	NONE	21	38	17	
Total Sulphur	mg/kg	<200	NONE	<200	<200	<200	
Ammonium as NH ₄	mg/kg	<0.5	NONE	<0.5	<0.5	<0.5	
Water Soluble Nitrate (2:1) as N	mg/kg	<4	NONE	<4	<4	<4	

Metals	Unit	MDL	Accreditation				
W/S Magnesium	mg/kg	<10	NONE	40	<10	24	

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Stone content is classified as material greater than 10mm in diameter



QTS Environmental Report No: 9607	
Soils Ltd	
Site Reference: Hayling Island	
Project / Job Ref: 12952	
Order No: None Supplied	
Reporting Date: 16/05/2012	

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Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 9607

Soils Ltd

Site Reference: Hayling Island

Project / Job Ref: 12952

Order No: None Supplied

Reporting Date: 16/05/2012

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry	E016
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	AR	Asbestos Screening	Visual screening of samples for fibrous material	E024
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water followed by titration using silver nitrate	E021
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by turbidimeter	E020
Soil	D	Fluoride - Water Soluble	Test Kit	E023
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E011
Soil	D	Loss on Ignition @ 450°C	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	D	Phosphorus	Determination of phosphorus by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	AR	Sulphide	Determination of sulphide by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia, potassium iodide/iodate followed by ICP-OES	E002
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E011
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E009
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E009
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E010
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E009
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	VPH (C6 - C10)	Determination of hydrocarbons C6-C10 by headspace GC-MS	E001
Soil	AR	EPH TEXAS	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	TPH CWG	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	TPH LQM	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	EPH (with florilil cleanup)	Determination of acetone/hexane extractable hydrocarbons with florilil cleanup step by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001

Key

D Dried
AR As Received

.

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Appendix C

Chemical Laboratory Analysis



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russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 9606

Site Reference: Hayling Island

Project / Job Ref: 12952

Order No: None Supplied

Sample Receipt Date: 10/05/2012

Sample Scheduled Date: 10/05/2012

Report Issue Number: 1

Reporting Date: 17/05/2012

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd



QTS Environmental Ltd
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Rose Lane
Lenham Heath
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Soil Analysis Certificate

QTS Environmental Report No: 9606	Date Sampled	27/04/12	27/04/12	27/04/12	27/04/12	27/04/12
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hayling Island	TP / BH No	TP5	TP6	TP7	TP9	TP12
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.30	0.20	0.20	0.30	0.20
Reporting Date: 17/05/2012	QTSE Sample No	44867	44868	44869	44870	44871

Determinand	Unit	MDL	Accreditation					
Stone Content	%	<0.1	NONE	<0.1	<0.1	<0.1	<0.1	<0.1
Fibrous Material Screen	Positive / Negative	N/a	NONE	Negative	Negative	Negative	Negative	Negative

General Inorganics	Unit	MDL	Accreditation					
pH	pH Units	+ / - 0.1	MCERTS	7.0	6.4	5.9	5.6	5.4
Total Cyanide	mg/kg	<2	NONE	<2	<2	<2	<2	<2
W/S Sulphate as SO ₄ (2:1)	g/l	<0.01	NONE	0.01	<0.01	<0.01	<0.01	<0.01
Sulphide	mg/kg	<5	NONE	<5	<5	<5	<5	<5
Organic Matter	%	<0.1	NONE	4.9	2.4	2.4	2.7	2.6
Total Organic Carbon (TOC)	%	<0.1	NONE	2.8	1.4	1.4	1.6	1.5
Total Phenols (monohydric)	mg/kg	<2	NONE	<2	<2	<2	<2	<2

Metals	Unit	MDL	Accreditation					
Arsenic (As)	mg/kg	<2	MCERTS	4	4	6	5	6
Beryllium (Be)	mg/kg	<0.5	NONE	<0.5	<0.5	<0.5	<0.5	<0.5
W/S Boron	mg/kg	<1	NONE	<1	<1	<1	<1	<1
Cadmium (Cd)	mg/kg	<0.5	MCERTS	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (hexavalent)	mg/kg	<2	NONE	<2	<2	<2	<2	<2
Chromium (Cr)	mg/kg	<2	MCERTS	22	23	23	21	20
Copper (Cu)	mg/kg	<4	MCERTS	16	12	12	11	12
Lead (Pb)	mg/kg	<3	MCERTS	44	36	44	41	36
Mercury (Hg)	mg/kg	<1	NONE	<1	<1	<1	<1	<1
Nickel (Ni)	mg/kg	<3	MCERTS	12	12	12	11	11
Selenium (Se)	mg/kg	<3	NONE	<3	<3	<3	<3	<3
Vanadium (V)	mg/kg	<2	NONE	32	33	36	30	30
Zinc (Zn)	mg/kg	<3	MCERTS	49	50	47	46	44

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Stone content is classified as material greater than 10mm in diameter



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Soil Analysis Certificate

QTS Environmental Report No: 9606	Date Sampled	27/04/12	27/04/12	24/04/12		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Hayling Island	TP / BH No	TP19	TP24	TP27		
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.30	0.20	0.20		
Reporting Date: 17/05/2012	QTSE Sample No	44874	44875	44876		

Determinand	Unit	MDL	Accreditation			
Stone Content	%	<0.1	NONE	<0.1	<0.1	<0.1
Fibrous Material Screen	Positive / Negative	N/a	NONE	Negative	Negative	Negative

General Inorganics	Unit	MDL	Accreditation			
pH	pH Units	+ / - 0.1	MCERTS	5.2	5.2	5.8
Total Cyanide	mg/kg	<2	NONE	<2	<2	<2
W/S Sulphate as SO ₄ (2:1)	g/l	<0.01	NONE	<0.01	<0.01	<0.01
Sulphide	mg/kg	<5	NONE	<5	<5	<5
Organic Matter	%	<0.1	NONE	2.6	2.2	3
Total Organic Carbon (TOC)	%	<0.1	NONE	1.5	1.3	1.7
Total Phenols (monohydric)	mg/kg	<2	NONE	<2	<2	<2

Metals	Unit	MDL	Accreditation			
Arsenic (As)	mg/kg	<2	MCERTS	6	6	5
Beryllium (Be)	mg/kg	<0.5	NONE	<0.5	<0.5	<0.5
W/S Boron	mg/kg	<1	NONE	<1	<1	<1
Cadmium (Cd)	mg/kg	<0.5	MCERTS	<0.5	<0.5	<0.5
Chromium (hexavalent)	mg/kg	<2	NONE	<2	<2	<2
Chromium (Cr)	mg/kg	<2	MCERTS	17	21	15
Copper (Cu)	mg/kg	<4	MCERTS	13	15	14
Lead (Pb)	mg/kg	<3	MCERTS	50	37	52
Mercury (Hg)	mg/kg	<1	NONE	<1	<1	<1
Nickel (Ni)	mg/kg	<3	MCERTS	8	11	8
Selenium (Se)	mg/kg	<3	NONE	<3	<3	<3
Vanadium (V)	mg/kg	<2	NONE	26	31	22
Zinc (Zn)	mg/kg	<3	MCERTS	40	48	38

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Stone content is classified as material greater than 10mm in diameter



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Soil Analysis Certificate - Speciated PAHs

QTS Environmental Report No: 9606	Date Sampled	27/04/12	27/04/12	27/04/12	27/04/12	27/04/12
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hayling Island	TP / BH No	TP5	TP6	TP7	TP9	TP12
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.30	0.20	0.20	0.30	0.20
Reporting Date: 17/05/2012	QTSE Sample No	44867	44868	44869	44870	44871

Determinand	Unit	MDL	Accreditation					
Naphthalene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1	<0.1	<0.1
Total EPA-16 PAHs	mg/kg	<1.6	MCERTS	<1.6	<1.6	<1.6	<1.6	<1.6

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs

QTS Environmental Report No: 9606	Date Sampled	27/04/12	27/04/12	24/04/12		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Hayling Island	TP / BH No	TP19	TP24	TP27		
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.30	0.20	0.20		
Reporting Date: 17/05/2012	QTSE Sample No	44874	44875	44876		

Determinand	Unit	MDL	Accreditation					
Naphthalene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Acenaphthylene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Acenaphthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Fluorene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Phenanthrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Anthracene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Fluoranthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Pyrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Benzo(a)anthracene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Chrysene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Benzo(b)fluoranthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Benzo(k)fluoranthene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Benzo(a)pyrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Dibenz(a,h)anthracene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		
Benzo(ghi)perylene	mg/kg	<0.1	MCERTS	<0.1	<0.1	<0.1		

Total EPA-16 PAHs	mg/kg	<1.6	MCERTS	<1.6	<1.6	<1.6		
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Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C



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Soil Analysis Certificate - Organochlorine Pesticides

QTS Environmental Report No: 9606	Date Sampled	27/04/12	27/04/12	27/04/12		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Hayling Island	TP / BH No	TP4	TP15	TP18		
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.30	0.20	0.20		
Reporting Date: 17/05/2012	QTSE Sample No	44866	44872	44873		

Determinand	Unit	MDL	Accreditation					
Aldrin*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
alpha-HCH*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
beta-HCH*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
cis-chlordane*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
delta-HCH*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		
Dieldrin*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Endosulfan A*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Endosulfan B*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Endrin*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
gamma-HCH (Lindane)*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Heptachlor*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Heptachlor epoxide*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Hexachlorobenzene (HCB)*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Isodrin*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
Methoxychlor*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		
o,p' - DDD*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		
o,p' - DDE*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		
o,p' - DDT*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		
p,p' - DDD*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
p,p' - DDE*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
p,p' - DDT*	mg/kg	<0.02	ISO17025	<0.02	<0.02	<0.02		
trans-chlordane*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		
Trifluralin*	mg/kg	<0.02	NONE	<0.02	<0.02	<0.02		

*Subcontracted analysis



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Soil Analysis Certificate - Phenyl Urea Herbicides

QTS Environmental Report No: 9606	Date Sampled	27/04/12	27/04/12	27/04/12		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Hayling Island	TP / BH No	TP4	TP15	TP18		
Project / Job Ref: 12952	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.30	0.20	0.20		
Reporting Date: 17/05/2012	QTSE Sample No	44866	44872	44873		

Determinand	Unit	MDL	Accreditation					
Chloroxuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Chlortoluron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Diflubenzuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Dimefuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Diuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Isoproturon*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Linuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Methabenzthiazuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Metoxuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Monolinuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Monuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		
Pencycuron*	mg/kg	<0.1	NONE	<0.1	<0.1	<0.1		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C

*Subcontracted analysis



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 9606	
Soils Ltd	
Site Reference: Hayling Island	
Project / Job Ref: 12952	
Order No: None Supplied	
Reporting Date: 17/05/2012	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	AR	Fibrous Material Screen	Visual screening of samples for fibrous material	E024
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water followed by titration using silver nitrate	E021
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by turbidimeter	E020
Soil	D	Fluoride - Water Soluble	Test Kit	E023
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E011
Soil	D	Loss on Ignition @ 450°C	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	D	Phosphorus	Determination of phosphorus by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Sulphate (as SO ₄) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	D	Sulphate (as SO ₄) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	AR	Sulphide	Determination of sulphide by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia, potassium iodide/iodate followed by ICP-OES	E002
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E011
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E009
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E009
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E010
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E009
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	VPH (C6 - C10)	Determination of hydrocarbons C6-C10 by headspace GC-MS	E001
Soil	AR	EPH TEXAS	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	TPH CWG	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	TPH LQM	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	EPH (with florasil cleanup)	Determination of acetone/hexane extractable hydrocarbons with florasil cleanup step by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001

Key

D Dried
AR As Received

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Appendix D
Soil Guideline Values and General Assessment Criteria

Appendix D

Soil Guideline Values and General Assessment Criteria

D1 Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'.

D1.1 Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:

- 1) EA Science Report SC050021/SR2: *Human health toxicological assessment of contaminants in soil.*
- 2) EA Science Report SC050021/SR3: *Updated technical background to the CLEA model.*
- 3) EA CLEA Bulletin (2009).
- 4) CLEA software version 1.04 (2009)
- 5) Toxicological reports and SGV technical notes.

The CLEA guidance and tools:

- *do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures.*
- *do not cover risks to the environment, such as groundwater, ecosystems or buildings.*
- *do not provide a definitive test for telling when human health risks are significant.*
- *are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.*

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

D1.2 Land-use Scenarios

The CLEA model uses a range of standard land-use scenarios to develop conceptual exposure models as follows, overleaf:

1) Residential

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil and indoor dust ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours.
- Building type is a two-storey small terraced house.

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur.

2) Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
- There is no building.

3) Commercial/Industrial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

- Critical receptor is a working female adult (aged 16 to 65 years old).
- Exposure duration is a working lifetime of 49 years.
- Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
- Building type is a three-storey office (pre 1970).

D1.3 Soil Guideline Values

The EA are publishing a series of SGV reports for a selection of common contaminants relevant to the assessment of land contamination.

SGV's are generic assessment criteria based on CLEA standard land-uses and can be used to simplify the assessment of human health risks from long-term exposure to chemical contamination in soil. They do not cover short-term exposure (i.e. construction and maintenance workers), acute exposure or other risks such as fire, suffocation or explosion, as might arise from an accumulation of gases such as methane and carbon dioxide, or either odour or aesthetic issues.

SGV's represent 'trigger values', indicators that soil concentrations above the SGV level may pose a possibility of *significant harm* to human health. The converse, where soil concentrations are less than the SGV, is that the long-term human health risks are considered to be tolerable or minimal.

D1.4 Generic Assessment Criteria

If an SGV is not available for a substance identified in the soil then the range of Generic Assessment Criteria published from a collaborative research by Land Quality Management Limited (LQM) and the Chartered Institute of Environmental Health will be used. For derivation of these Generic Assessment Criteria reference must be made to:

Nathanial, P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A., Ogden, R., Scott, D. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition)*. **Land Quality Press**. 2009.

In the case of Lead, no SGV or GAC has been published to date. This is likely to be due to the toxicity review that is currently being undertaken by the Environment Agency. In the absence of updated toxicity information the SGV derived using CLEA 1.01 methodology and related toxicity will be used.

D1.5 Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of an SGV/GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a DQRA may be undertaken to develop site specific values for relevant soil contaminants.

- | | |
|---|--|
| ⇒ | Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation. |
| ⇒ | Developing more accurate parameters using site data. |

D1.6 Ongoing development of CLEA based guidance

The EA is involved in a programme of publishing SGV's and related toxicity data (the TOX reports). As at July 2009 ten SGV's and matching TOX reports had been published.

Soil Assessment Criteria (SAC's) may be derived using toxicity data from the updated TOX reports, where these are published, or from the original TOX reports. SGV reports also take account of recent updates for plant uptake and other factors.

- ⇒ GAC's developed by CLEA guidance and given in this report will need to be assessed against updated TOX reports and SGV's when these are published.
- ⇒ SGV reports may give values that differ from the GAC's used in this report.
- ⇒ These variations may materially alter the remediation requirement for the site, requiring either an increase or decrease in the extent, type and cost of remediation.

D1.7 Phytotoxicity

CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

- ICRCL 70/90: *Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing.*

D1.8 Statistical Tests

DEFRA R&D Publication CLR 7 (DOE 1994) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95th percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

The DEFRA discussion paper Assessing risks from land contamination – a proportionate approach ('the way forward') (CLAN06/2006) aimed to increase understanding of the role that statistics can play in quantifying the uncertainty attached to the estimates of the mean concentration of contaminants in soil. In direct response CLAIRE/CIEH published a joint report, *Guidance in comparing soil contamination data with a critical concentration* (CLAIRE/CIEH 2008). A software implementation of the statistical techniques given in the report was published by ESI International (2008).

Treatment of Hot-Spots

- ⇒ A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.
- ⇒ Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

D2 Soil Guideline Values and General Acceptance Criteria

Soil Guideline Values and General Acceptance Criteria used in the preparation of this report is tabulated in the following pages:

DEFRA CLEA 1.04 Soil Guideline Values (as at July 2009)

Soil Guideline Values CLEA 1.04 (Sandy Loam, pH 7, SOM 6%)			
Contaminant	Residential (mg/kg DW)	Allotments (mg/kg DW)	Commercial (mg/kg DW)
Inorganic			
Arsenic	32	43	640
Cadmium	10	1.8	230
Mercury			
- Elemental	1.0	26	26
- Inorganic	170	80	3600
- Methyl	11	8	410
Nickel	130	230	1800
Selenium	350	120	13000
Organic May not be protective if SOM <6%			
Phenol	420	280	3200 (38,000*)
Benzene	0.33	0.07	95
Toluene	610	120	4400
Ethylbenzene	350	90	2800
Xylenes			
- o-xylene	250	160	2600
-m-xylene	240	180	3500
-p-xylene	230	160	3200
Dioxins			
Sum of PCDDs, PCDFs and dioxin-like PCB's.	8	8	240

* Based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health affects following long term exposure provided for illustration only)

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Soil Guideline Values CLEA 1.01				
Contaminant	Residential With Plant Uptake (mg/kg)	Residential Without Plant Uptake (mg/kg)	Commercial & Industrial (mg/kg)	Allotments (mg/kg)
Lead	450	450	750	450

LQM CIEH General Assessment Criteria (2nd edition)

LQM CIEH General Assessment Criteria			
Contaminant	Residential (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
<i>Metals:</i>			
Beryllium	51	55	420
Boron	291	45	192000
Chromium (III)	3000	34600	30400
Chromium (VI)	4.3	2.1	35
Copper	2330	524	71700
Vanadium	75	18	3160
Zinc	3750	618	665000

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LQM CIEH General Assessment Criteria (cont.)

General Assessment Criteria For Polycyclic Aromatic Hydrocarbons (PAH's)				
Determinants		Residential (mg/kg)	Allotments (mg/kg)	Commercial (mg/kg)
Acenaphthene	1.0% SOM	210	34	85,000 (57) ^{sol}
	2.5% SOM	480	85	98,000 (141) ^{sol}
	6.0% SOM	100	200	100,000
Acenaphthylene	1.0% SOM	170	28	84,000 (86) ^{sol}
	2.5% SOM	400	69	97,000 (212) ^{sol}
	6.0% SOM	850	160	100,000
Anthracene	1.0% SOM	2,300	380	530,000
	2.5% SOM	4,900	950	540,000
	6.0% SOM	9,200	2200	540,000
Benzo(a)anthracene	1.0% SOM	3.1	2.5	90
	2.5% SOM	4.7	5.5	95
	6.0% SOM	5.9	10	97
Benzo(a)pyrene	1.0% SOM	0.83	0.6	14
	2.5% SOM	0.94	1.2	14
	6.0% SOM	1.0	2.1	14
Benzo(b)flouranthene	1.0% SOM	5.6	3.5	100
	2.5% SOM	6.5	7.4	100
	6.0% SOM	7.0	13	100
Benzo(ghi)perylene	1.0% SOM	44	70	650
	2.5% SOM	46	120	660
	6.0% SOM	47	160	660
Benzo(k)flouranthene	1.0% SOM	8.5	6.8	140
	2.5% SOM	9.6	14	140
	6.0% SOM	10	23	140
Chrysene	1.0% SOM	6.0	2.6	140
	2.5% SOM	8.0	5.8	140
	6.0% SOM	9.3	12	140
Dibenzo(ah)anthracene	1.0% SOM	0.76	0.76	13
	2.5% SOM	0.86	1.5	13
	6.0% SOM	0.90	2.3	13
Flouranthene	1.0% SOM	260	52	23,000
	2.5% SOM	460	130	23,000
	6.0% SOM	670	290	23,000
Flourene	1.0% SOM	160	27	64,000 (31) ^{sol}
	2.5% SOM	380	67	69,000
	6.0% SOM	780	160	71,000
Indeno(123-cd)pyrene	1.0% SOM	3.2	1.8	60
	2.5% SOM	3.9	3.8	61
	6.0% SOM	4.2	7.1	62
Napthalene	1.0% SOM	1.5	4.1	200 (76) ^{sol}
	2.5% SOM	3.7	9.9	480 (183) ^{sol}
	6.0% SOM	8.7	23	1100 (432) ^{sol}
Phenanthrene	1.0% SOM	92	16	22,000
	2.5% SOM	200	38	22,000
	6.0% SOM	380	90	23,000
Pyrene	1.0% SOM	560	110	54,000
	2.5% SOM	1,000	270	54,000
	6.0% SOM	1,600	620	54,000

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^{vap} – GAC presented exceeds the vapour saturation limit, which is presented in brackets.

^{sol} – GAC presented exceeds the soil saturation limit, which is presented in brackets.

LQM CIEH General Assessment Criteria (cont.)

General Assessment Criteria For TPH				
Aliphatic		Residential (mg/kg)	Allotments (mg/kg)	Commercial (mg/kg)
EC 5-6	1.0% SOM	30	740	3,400 (304) ^{sol}
	2.5% SOM	55	1,700	6,200 (558) ^{sol}
	6.0% SOM	110	3,900	13,000 (1150) ^{sol}
EC >6-8	1.0% SOM	73	2,300	8,300 (144) ^{sol}
	2.5% SOM	160	5,600	18,000 (322) ^{sol}
	6.0% SOM	370	13,000	42,000 (736) ^{sol}
EC >8-10	1.0% SOM	19	320	2,100 (78) ^{sol}
	2.5% SOM	46	770	5,100 (118) ^{vap}
	6.0% SOM	110	1,700	12,000 (451) ^{vap}
EC >10-12	1.0% SOM	93 (48) ^{vap}	2,200	10,000 (48) ^{sol}
	2.5% SOM	230 (118) ^{vap}	4,400	24,000 (118) ^{vap}
	6.0% SOM	540 (283) ^{vap}	7,300	49,000 (283) ^{vap}
EC >12-16	1.0% SOM	740 (24) ^{sol}	11,000	61,000 (24) ^{sol}
	2.5% SOM	1,700 (59) ^{sol}	13,000	83,000 (59) ^{sol}
	6.0% SOM	3,000 (142) ^{sol}	13,000	91,000 (142) ^{sol}
EC >16-35	1.0% SOM	45,000 (8.48) ^{sol}	260,000	1,600,000
	2.5% SOM	64,000 (21) ^{sol}	270,000	1,800,000
	6.0% SOM	76,000	270,000	1,800,000
EC >35-44	1.0% SOM	45,000 (8.48) ^{sol}	260,000	1,600,000
	2.5% SOM	64,000 (21) ^{sol}	270,000	1,800,000
	6.0% SOM	76,000	270,000	1,800,000

Cont'd Overleaf

LQM CIEH General Assessment Criteria (cont.)

General Assessment Criteria For TPH Cont.				
Aromatic		Residential (mg/kg)	Allotments (mg/kg)	Commercial (mg/kg)
EC 5-7	1.0% SOM	65	13	28,000 (1220) ^{sol}
	2.5% SOM	130	27	49,000 (2260) ^{sol}
	6.0% SOM	280	57	90,000 (4710) ^{sol}
EC >7-8	1.0% SOM	120	22	59,000 (869) ^{vap}
	2.5% SOM	270	51	110,000 (1920) ^{sol}
	6.0% SOM	611	120	190,000 (4360) ^{vap}
EC >8-10	1.0% SOM	27	8.6	3,700 (613) ^{vap}
	2.5% SOM	65	21	8,600 (1500) ^{vap}
	6.0% SOM	151	51	18,000 (3580) ^{vap}
EC >10-12	1.0% SOM	69	13	17,000 (364) ^{sol}
	2.5% SOM	160	31	29,000 (899) ^{sol}
	6.0% SOM	346	74	34,500 (2150) ^{sol}
EC >12-16	1.0% SOM	140	23	36,000 (169) ^{sol}
	2.5% SOM	480	57	37,000
	6.0% SOM	770	130	37,800
EC >16-21	1.0% SOM	250	46	28,000
	2.5% SOM	480	110	28,000
	6.0% SOM	770	260	28,000
EC >21-35	1.0% SOM	890	370	28,000
	2.5% SOM	1,100	820	28,000
	6.0% SOM	1,230	1,600	28,000
EC >35-44	1.0% SOM	890	370	28,000
	2.5% SOM	1,100	820	28,000
	6.0% SOM	1,230	1,600	28,000

General Assessment Criteria For TPH Cont.				
Determinant		Residential (mg/kg)	Allotments (mg/kg)	Commercial (mg/kg)
Aromatic & Aliphatic EC >44 - 70	1.0% SOM	1200	1200	28,000
	2.5% SOM	1300	2100	28,000
	5.0% SOM	1300	3000	28,000

Note: SOM = Soil Organic Matter Content (%)
LQM CIEH GAC not set for Allotment land-use

Phytotoxicity Recommendations

ICRCL 70/90 Restoration of metalliferous mining areas

Phytotoxicity (Harmful to Plants) Threshold Trigger Values	
Copper	250mg/kg
Zinc	1000mg/kg
Notes: Many cultivars and specifically grasses have a high tolerance and there will be no ill-effect at the threshold trigger values given for neutral or near neutral pH. Site observation of plant vitality may give additional guidance.	

Cont'd Overleaf

LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	Residential (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
<i>Chloroalkanes & alkenes</i>			
1,2 Dichloroethane			
1.0% SOM	0.0054	0.0046	0.71
2.5% SOM	0.0080	0.0083	1.00
6.0% SOM	0.014	0.016	1.80
1,1,2,2 Tetrachloroethane			
1.0% SOM	1.4	0.41	290
2.5% SOM	2.9	0.89	580
6.0% SOM	6.3	2.0	1200
1,1,1,2 Tetrachloroethane			
1.0% SOM	0.90	0.79	120
2.5% SOM	2.1	1.9	260
6.0% SOM	4.8	4.4	590
Tetrachloroethene			
1.0% SOM	0.94	1.6	130
2.5% SOM	2.1	3.7	290
6.0% SOM	4.8	8.7	660
1,1,1 Trichloroethane			
1.0% SOM	6.2	48	700
2.5% SOM	13	110	1400
6.0% SOM	28	240	3100
Tetrachloromethene			
1.0% SOM	0.018	0.16	3.0
2.5% SOM	0.039	0.37	6.6
6.0% SOM	0.089	0.85	15
Trichloroethene			
1.0% SOM	0.11	0.43	12
2.5% SOM	0.22	0.95	25
6.0% SOM	0.49	2.2	55
Trichloromethane			
1.0% SOM	0.75	0.36	110
2.5% SOM	1.3	0.70	190
6.0% SOM	2.7	1.5	370
Vinyl Chloride			
1.0% SOM	0.00047	0.00055	0.063
2.5% SOM	0.00064	0.0010	0.081
6.0% SOM	0.00099	0.0018	0.12

Cont'd Overleaf

LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	Residential (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
Explosives			
2,4,6 Trinitrotoluene			
1.0% SOM	1.6	0.24	1000
2.5% SOM	3.7	0.58	1000
6.0% SOM	8.0	1.4	1100
RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)			
1.0% SOM	3.5	0.52	6400
2.5% SOM	7.4	1.1	6400
6.0% SOM	16	2.5	6400
HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)			
1.0% SOM	5.7	0.86	110,000
2.5% SOM	13	1.9	110,000
6.0% SOM	26	3.9	110,000
Atrazine			
1.0% SOM	0.24	0.037	870
2.5% SOM	0.56	0.085	880
6.0% SOM	1.3	0.20	880
Pesticides			
Aldrin			
1.0% SOM	1.7	1.3	54
2.5% SOM	2.0	2.6	54
6.0% SOM	2.1	4.0	54
Dieldrin			
1.0% SOM	0.69	0.13	90
2.5% SOM	1.4	0.32	91
6.0% SOM	2.2	0.73	92
Dichlorvos			
1.0% SOM	0.29	0.044	942
2.5% SOM	0.6	0.091	972
6.0% SOM	1.3	0.2	983
Alpha - Endosulfan			
1.0% SOM	2.9	0.47	2310 (0.003) ^{vap}
2.5% SOM	7.0	1.2	2990 (0.007) ^{vap}
6.0% SOM	16	2.7	3390

Cont'd Overleaf

LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	Residential (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
<i>Pesticides</i>			
Beta - Endosulfan			
1.0% SOM	2.8	0.44	2580 (0.00007) ^{vap}
2.5% SOM	6.6	1.1	3160 (0.0002) ^{vap}
6.0% SOM	15	2.6	3480
Alpha - Hexachlorocyclohexanes			
1.0% SOM	19	3.0	14000
2.5% SOM	46	7.4	14600
6.0% SOM	100	18	14900
Beta - Hexachlorocyclohexanes			
1.0% SOM	1.7	0.26	1120
2.5% SOM	3.9	0.64	1130
6.0% SOM	8.5	1.5	1130
Gamma - Hexachlorocyclohexanes			
1.0% SOM	0.58	0.089	532
2.5% SOM	1.4	0.22	546
6.0% SOM	3.0	0.52	552
<i>Chlorobenzenes</i>			
Chlorobenzene			
1.0% SOM	0.33	5.9	59
2.5% SOM	0.73	14	32
6.0% SOM	59	130	310
1,2-Dichlorobenzene			
1.0% SOM	16	94	2100 (571) ^{sol}
2.5% SOM	39	230	5100 (1370) ^{sol}
6.0% SOM	91	540	12000 (3240) ^{sol}
1,3-Dichlorobenzene			
1.0% SOM	0.29	0.25	32
2.5% SOM	0.70	0.61	77
6.0% SOM	1.7	1.5	180
1,4-Dichlorobenzene			
1.0% SOM	30	15	4500 (224) ^{vap}
2.5% SOM	72	37	10000 (540) ^{vap}
6.0% SOM	167	88	22000 (1280) ^{vap}
1,2,3-Trichlorobenzene			
1.0% SOM	1.0	4.7	110
2.5% SOM	2.6	12	270
6.0% SOM	6.1	28	620

Cont'd Overleaf

LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	Residential (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
<i>Chlorobenzenes</i>			
1,2,4,-Trichlorobenzene			
1.0% SOM	1.8	31	230
2.5% SOM	4.5	75	560
6.0% SOM	11	180	1300
1,3,5,-Trichlorobenzene			
1.0% SOM	0.23	4.7	24
2.5% SOM	0.57	12	57.8
6.0% SOM	1.3	28	140
1,2,3,4,-Tetrachlorobenzene			
1.0% SOM	12	4.4	1800 (122) ^{vap}
2.5% SOM	4.5	75	3200 (304) ^{vap}
6.0% SOM	11	180	4500 (728) ^{vap}
1,2,3,5,- Tetrachlobenzene			
1.0% SOM	0.49	0.38	52 (39.4) ^{vap}
2.5% SOM	1.2	0.94	120 (98.1) ^{vap}
6.0% SOM	2.8	2.2	250 (235) ^{vap}
1,2,4, 5,-Tetrachlobenzene			
1.0% SOM	0.30	0.064	44 (19.7) ^{sol}
2.5% SOM	0.68	0.16	73 (49.1) ^{sol}
6.0% SOM	1.4	0.37	97
Pentachlorobenzene			
1.0% SOM	5.2	1.2	650 (43.0) ^{sol}
2.5% SOM	10	3.1	770 (107) ^{sol}
6.0% SOM	17	7.1	830
Hexachlorobenzene			
1.0% SOM	0.59 (0.20) ^{vap}	0.18	48 (0.20) ^{vap}
2.5% SOM	1.0 (0.50) ^{vap}	0.42	53
6.0% SOM	1.4	0.92	55

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

Contaminant	Residential (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
<i>Phenols & Chlorophenols</i>			
Chlorophenols (4 Congeners)			
1.0% SOM	0.87	0.13	3500
2.5% SOM	2.0	0.30	4000
6.0% SOM	4.4	0.70	4200
Pentachlorophenols			
1.0% SOM	0.55	0.084	1200
2.5% SOM	1.3	0.21	0.49
6.0% SOM	1200	1300	1400
<i>Others</i>			
Carbon Disulphide			
1.0% SOM	0.10	4.8	12
2.5% SOM	0.20	10	23
6.0% SOM	0.44	23	50
Hexachloro-1,3-Butadiene			
1.0% SOM	0.21	0.25	32
2.5% SOM	0.51	0.61	69
6.0% SOM	1.2	1.4	120

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Appendix E
Information Provided by the Client



Legend

- 2 Bed Flat (drive thro)
- 2 Bed House
- 3 Bed House
- 4 Bed House
- Carport
- Existing tree
- New tree
- Existing hedgerow
- New hedgerow

Schedule

2 bed flat	5
2 bed house	44
3 bed house	67
4 bed detached	15
Total	131

100020449

Mengham Junior School
Mengham Junior School

HAWTHORN GROVE

5.8m

4.3m

No. 23

Mengham Court

ST MARGARET'S ROAD

El Sub Sta

The Barn House