

## 10.6 Assessment of aggressive chemical environment for concrete (ACEC)

10.6.1 Based on the design sulphate class, characteristic value of pH and assessment of groundwater mobility, and with reference to table C1 of SDI: 2005, the ACEC class for each soil type is presented below:

| Summary of concrete classification  |                |                   |                      |                    |                                |          |            |
|-------------------------------------|----------------|-------------------|----------------------|--------------------|--------------------------------|----------|------------|
| Soil type                           | No. of samples | Characteristic pH | Groundwater mobility | Characteristic TPS | Characteristic sulphate (mg/l) | DS class | ACEC class |
| Made Ground                         | 2              | 8.6               | Mobile               | N/A                | 130                            | DS-1     | AC-1       |
| Bognor Sand Member                  | 2              | 8                 | Mobile               | N/A                | 110                            | DS-1     | AC-1       |
| London Clay Formation (undisturbed) | 4              | 8.2               | Static               | N/A                | 210                            | DS-1     | AC-1s      |
| London Clay Formation (disturbed)   |                |                   |                      | 1.47               |                                | DS-4     | AC-3s      |
| Groundwater                         | 2              | -                 | -                    | -                  | 940                            | DS-2     | -          |

**Table 10.6.1**

## 10.7 Concrete - Magnesium attack

### 10.7.1 Hazards

10.10.1.1 Magnesium salts (excepting magnesium hydrogen carbonate) are destructive to concrete. Corrosion of concrete occurs from cation exchange reactions where calcium in the cement paste hydrates and is replaced with magnesium. The cement loses binding power and eventually the concrete disintegrates.

### 10.7.2 Risk assessment

10.7.2.1 In practise 'high' concentrations of magnesium will be found in the UK only in ground having industrial residues. Following BRE Special Digest 1:2005, measurement of the concentration of magnesium is recommended if sulphate concentrations in water extract or groundwater exceed 3000mg/l. Once measured the concentration of magnesium is considered further in BRE Special Digest in establishing the concrete mix to resist chemical attack.

- 10.7.2.2 We are not aware the site has been subject to any manufacturing processes which would have included magnesium containing compounds, and in addition sulphate concentrations did not exceed 3000mg/l, on this basis we have not measured the concentration of magnesium in soils at the site and would consider the risk of soils at the site promoting attack on concrete is considered low.
- 10.7.2.3 BS EN 206-1:2000 '*Concrete - Part 1: Specification, performance, production and conformity*' does, however, provide exposure classes for concrete in contact with water, with varying concentrations of magnesium for the design/specification for concrete mixes. As there is a possibility that concrete for the building may be in contact with groundwater during its life, then we have measured the concentration of magnesium in groundwater samples.
- 10.7.2.4 We have measured the concentration of magnesium in two groundwater samples at the site which produced results of 25 and 13mg/l. As the test results falls below 300mg/l, this indicates that no special consideration is required regarding the exposure of buried concrete to magnesium in groundwater.

## **10.8 Concrete - Ammonium attack**

### **10.8.1 Hazards**

- 10.8.1.1 Ammonium salts, like magnesium salts act as weak acids and attack hardened concrete paste resulting in softening and gradual decrease in strength of the concrete.

### **10.8.2 Risk assessment**

- 10.8.2.1 UK guidance is not available on the concentration of ammonium which may affect concrete. BS EN 206-1: 2000 '*Concrete - Part 1: Specification, performance, production and conformity*' does, however, provide exposure classes for concrete in contact with water with varying concentrations of ammonia for the design/specification for concrete mixes.
- 10.8.2.2 We have measured the concentration of ammonia in two groundwater samples at the site as there is a potential possibility that concrete for the building may be in contact with groundwater during its life. The concentration of ammonia was measured at 0.44 0.12mg/l. As the measured concentration falls below 15mg/l, we consider the risk of buried concrete being affected by ammonia to be low.

## **10.9 Plastic Pipes**

### **10.9.1 Hazards**

- 10.9.1.1 Plastic pipes are predominantly manufactured from PVC and PE but other materials can be used. In general they perform well but it is known that chemical attack and permeation of contaminants through the pipes can result from use in contaminated land. A published review on plastic pipes reports the following:-

- Polyethylene (PE) - good resistance to solvents, acids and alkalis
- Poly vinyl chloride (PVC) - most common form of pipe. Good general resistance to chemical attack but can be attacked by solvents such as ketones, chlorinated hydrocarbons and aromatic polypropylene (PP) - chemically resistant to acids, alkalis and organic solvents but not recommended for use with storing oxidising acids, chlorinated hydrocarbons and aromatics.
- Poly vinylidene fluoride (PVDF) - inert to most solvents, acids and alkalis as well as chlorine, bromide and other halogens
- Polytetrafluoroethylene (PTFE) - one of the most inert thermoplastics available. PTFE has good chemical resistance to solvents, acids and alkalis

A survey carried out by the Water Research Centre (WRc) on reported incidents of permeation (more than 25), only two involved PVC with these incidents relating to spillages of fuel.

## 10.9.2 Assessment

10.9.2.1 A survey carried out by the Water Research Centre (WRc) on reported incidents of permeation (more than 25), only two involved PVC with these incidents relating to spillages of fuel.

The UK Water Industry research (UKWIR) have published a document entitled '*Guidance for the selection of Water supply pipes to be used in Brownfield sites*'. The publication defines brownfield sites as:

*'Land or premises that have been used or developed. They may also be vacant, or derelict. However they are not necessarily contaminated'*

The subject site has previously been developed and on this basis could potentially be considered brownfield in accordance with the UKWIR document. Following the preliminary risk assessment procedures described in the UKWIR document however, (paragraph 2.4.2) there is no evidence to indicate that chemicals have ever been used or stored on site.

10.9.2.2 Whilst we have not carried out a full investigation set out in guidance in the UKWIR document, the subject site does exhibit a degree of hydrocarbon (PAH) contamination. The UKWIR document advises a trigger concentration of 0.125mg/kg for their 'extended VOC (volatile organic carbons) suite' which includes the PAH suite which we have results for. The measured concentration of individual contaminants forming part of the PAH suite exceeds the trigger value of 0.125mg/kg and on this basis it is considered likely that barrier pipes will have to be installed at this site. We recommend Portsmouth Water however is consulted on this to gain their opinion and requirements.

## 11 Classification of waste soils under the Waste Acceptance Criteria

|      |                                                                   |
|------|-------------------------------------------------------------------|
| 11.1 | The Landfill Directive                                            |
| 11.2 | Classification of soil types                                      |
| 11.3 | Waste Acceptance Criteria (WAC)                                   |
| 11.4 | Primary Classification                                            |
| 11.5 | Secondary Classification                                          |
| 11.6 | Naturally deposited soils not affected by artificial contaminants |
| 11.7 | Basic Categorisation                                              |
| 11.8 | Treatment of waste                                                |
| 11.9 | Reuse of soils - Materials Management Plans                       |

### 11.1 The Landfill Directive

11.1.1 The Landfill Directive represents an important change in the way we dispose of waste. It encourages waste minimisation by promoting increased levels of recycling and recovery. The Landfill Directive became law in 1999 and transcribed into the Landfill (England and Wales) Regulations which came into force in 2002. These Regulations were amended in 2005 by introducing criteria to classify soils for disposal to landfill. It is the duty of the waste producer (the client) to classify the soils for this purpose.

### 11.2 Classification of soil types

11.2.1 Our investigations consider two soil types which may be generated as wastes as part of construction operations, potentially contaminated soil and uncontaminated soil. A full hazard assessment and subsequent testing for waste acceptance criteria is undertaken on soils which are not considered to be naturally deposited or are likely to be affected by artificial contamination. For soils that are unlikely to be affected by artificial contamination (such as natural soils), specific testing in relation to the classification process is not necessary.

### 11.3 Waste acceptance criteria (WAC)

11.3.1 The Environment Agency publication, *'Framework for the classification of contaminated soils as hazardous wastes'* (July 2004), provides an appropriate procedure for establishing if the soils are hazardous or non-hazardous and applies to soils that are identified as potentially contaminated. Uncontaminated, natural soils are considered separately (see Section 11.6).

### **11.3.2 Primary classification**

11.3.2.1 The first stage is classifying a potentially 'contaminated' soil for disposal to landfill is to establish its chemical status by first identifying potential sources/types of chemical contamination (desk study) followed by intrusive site investigations to obtain samples for undefined testing of soil samples to measure concentrations of chemical contaminants. Such data provides information to partly complete the basic characteristic checklist.

11.3.2.2 Laboratory test data is then compared with the Environment Agency publication '*hazardous waste – Interpretation of the definition and classification of hazardous waste (second edition, version 2.1)*'. Where the waste is suspected to contain oil, we have referred to the Environment Agency draft consultation paper '*How to Find Out if Waste Oil and Wastes that Contain Oil are Hazardous*' (Draft Version 2.5 – October 2006). With reference to these documents a hazard assessment has been carried out to enable categorisation of the material as hazardous or non-hazardous and to subsequently establish the European Waste Catalogue (EWC) code (ref Section 11.3.4 below).

### **11.3.3 Secondary classification**

11.3.3.1 If the soil is deemed hazardous then measurement of organic contaminants and leachable inorganic contaminants is necessary for comparison with values listed in the Environment Agency publication '*Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures*' (April 2005) Table 5.1. Similarly should the soil be deemed as non-hazardous then such testing may also be undertaken to determine if it is potentially inert. This document also provides guidance on sampling materials and frequency as well as test procedures and quality assurance of testing.

11.3.3.2 The above procedures are described with respect to the subject site in the following sections Section 11.4 (primary) and 11.5 (secondary), leading to basic characterisation of soils for disposal. Subject to the results of the categorisation and anticipated development methodology, consideration should be given by the developer to reduce volumes of disposal or treatment to allow reclassification.

### **11.3.4 European waste catalogue (EWC) coding**

11.3.4.1 The EWC 2002 is a catalogue of all wastes, grouped according to generic industry, process or waste type. It is divided into twenty main chapters, each with a two digit code between 01 and 20. Following the EWC, in our opinion, soils considered as part of this investigation would be categorised within 'Group 17' of the EWC catalogue, which comprises 'Construction and Demolition Wastes (including excavated soils from contaminated sites)'.

- 11.3.4.2 The Catalogue further categorises the waste, such that soils considered as part of this investigation would be classified as either 17 05 04 defined as '*soil and stones (other than those mentioned in 17 05 03)*'; or 17 05 03\* defined as soil or stones containing dangerous substances (where hazardous wastes are described by entries followed by an asterisk).

## **11.4 Primary classification**

### **11.4.1 Soil types**

- 11.4.1.1 Based on soils exposed in exploratory excavations, in combination with anticipated construction works, we assume soils requiring off-site disposal will comprise Made Ground, the Bognor Sand Member and the London Clay Formation arising as a result of foundation and service trench excavations and general site clearance.

### **11.4.2 Classification as hazardous or non-hazardous waste**

- 11.4.2.1 The Environment Agency publication '*Framework for the classification of contaminated soils as hazardous wastes*' (July 2004) provides the following procedure for establishing if the soils are hazardous or non-hazardous. The first stage in classifying a potentially 'contaminated' soil for disposal is to establish its chemical status by first identifying potential sources/types of chemical contamination (desk study) followed by intrusive site investigations to obtain samples for laboratory testing of soil samples to measure concentrations of chemical contaminants.
- 11.4.2.2 An assessment of potential source of contamination is presented in Section 8 of this report. Laboratory testing has been set as deemed appropriate to our source assessment.
- 11.4.2.3 We have carried out an analysis of test data for each chemical contaminant considered in this investigation. A conservative approach has been adopted for the analysis whereby the maximum test value for each contaminant has been adopted as a preliminary screening process to determine if the soils are hazardous or non-hazardous. Should the analysis indicate potentially hazardous properties then a process of zoning by further analysing the site history, geological conditions and analytical data may be undertaken.
- 11.4.2.4 Laboratory test data measures the concentration of anions, which are unlikely to exist in the pure metallic form in the soil, but probably exist as a compound. Following guidance provided in the Environment Agency Technical Guidance WM3 '*Guidance on the classification and assessment of waste*' (2015), we have reviewed a variety of compounds for each of the metallic and semi metallic elements we have tested.

- 11.4.2.5 To determine the hazardous waste properties for each element, we have reviewed chemical compounds listed in Table 3.2 of Annex VI of the European Regulation (1272/2008) for Classification, Labelling and Packaging (CLP) of chemicals which has now superseded the Approved Supply List (Published by the Health and Safety Executive) for the classification of hazardous chemicals in the UK. In order to provide a 'worst case' scenario, initially we adopt the most severe hazardous properties (risk phrases) associated with the various compounds for each element under review. If measured concentrations produce a hazardous outcome then the element or elements are reassessed on a site specific basis. For review of organic contamination, we have directly adopted the threshold concentrations for the appropriate organic compounds listed in Table 3.2.
- 11.4.2.6 The compound or compounds adopted for each element is used to convert the measured metallic concentration to the substance concentration using their respective molecular weights. This derived conversion factor is then used in the threshold concentration spreadsheet (refer paragraph 11.3.2.8 below). Our assessment of each of the chemical substances is maintained on our files and is available for confidential review/audit by the Environment Agency.
- 11.4.2.7 A spreadsheet detailing the hazard assessment following the procedures described in '*framework for the classification of contaminated soils as hazardous wastes*' is presented in Appendix K. The spreadsheet indicates the soils are **non-hazardous**.

## 11.5 Secondary assessment

- 11.5.1 Following '*Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures*' produced by the Environment Agency (Version 1, April 2005) we have scheduled testing of **one** sample to measure the parameters listed in table 5.1 (landfill waste acceptance criteria) included in the above publication. A copy of the test result certificate is presented in Appendix G. The source of the composite sample is detailed below:

| Composition of soil samples for classification testing |             |                                                                                                                                                                                            |
|--------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Strata                                                 | Source      | Soil Type                                                                                                                                                                                  |
| Made Ground                                            | DTS01a 0.4m | Chaotic mixture of sand, gravel and clay with frequent cobbles of brick becoming more fine-grained with depth. Gravels consist of flint, brick timber, concrete, sandstone, glass and ash. |
|                                                        | DTS01a 0.8m |                                                                                                                                                                                            |
|                                                        | DTS01a 1.1m |                                                                                                                                                                                            |
|                                                        | DTS01a 1.7m |                                                                                                                                                                                            |
|                                                        | DTS01b 0.3m |                                                                                                                                                                                            |
|                                                        | DTS01b 1.0m |                                                                                                                                                                                            |
|                                                        | DTS02 0.2m  |                                                                                                                                                                                            |
|                                                        | DTS02 0.5m  |                                                                                                                                                                                            |
|                                                        | DTS03 0.4m  |                                                                                                                                                                                            |
|                                                        | DTS04 0.6m  |                                                                                                                                                                                            |
|                                                        | DTS05 0.6m  |                                                                                                                                                                                            |
|                                                        | DTS05 1.6m  |                                                                                                                                                                                            |
|                                                        | DTS06 0.4m  |                                                                                                                                                                                            |
|                                                        | DTS06 0.9m  |                                                                                                                                                                                            |

**Table 11.5.1**

11.5.2 The sample was deemed representative of Made Ground soils as described in Section 5. The sample was formed by combining individual samples taken from exploratory excavations within the Made Ground. The combined sample was then quartered in the laboratory to produce a representative sample for subsequent testing.

11.5.3 Laboratory test data has been compared with the landfill waste acceptable criteria (table 5.1) to allow the secondary assessment to be completed. A copy of table 5.1 is presented in Appendix L with test result data added for ease of comparison.

11.5.4 Comparison of test data with landfill waste acceptance criteria indicates that Made Ground soils are suitable for disposal as **inert waste**.

## 11.6 Naturally deposited soils not affected by artificial contaminants

11.6.1 With reference to the European Waste Catalogue and table 5.1 of the Environment Agency publication '*a better place – guidance for waste destined for disposal in landfills – version 2 June 2006*', naturally occurring soils not likely to be affected by contamination can be classified as inert waste, with a EWC code of 17 05 04. Should any of the naturally deposited soils be suspected to contain contamination (by virtue of visual or olfactory evidence) upon excavation, then such soils should be stockpiled appropriately and additional testing carried out as considered necessary. Based on evidence obtained during our investigations, we are of the opinion that the Bognor Sand Member and London Clay at the site are not likely to be affected by chemical contamination and thus can be classified as **inert waste**.

## 11.7 Basic categorisation

11.7.1 Based on the preceding assessment, we have produced **three** basic categorisation schedules relating to the Made Ground, Bognor Sand and London Clay Formation deposits, which are presented in Appendix M. This schedule should be provided together with a copy of this report to an appropriately licensed landfill facility to demonstrate the material can be deposited at this facility.

11.7.2 We understand that some landfill sites have licences which have restrictions on concentrations of chemical contaminants and thus we recommend this report is provided to the selected landfill facility to confirm (or otherwise) it can accept the waste. Please be aware that landfill sites are obligated to undertake in house quality assurance tests and thus may require further WAC testing for any soils encountered as part of this investigation. There is no obligation on any landfill operator to accept waste if they choose not to and waste operators may require additional testing of untested waste soils prior to acceptance at landfill in accordance with the landfill regulations.

## **11.8 Treatment of waste**

11.8.1 Treatment of wastes is now a requirement of the landfill directive applied by the Landfill (England and Wales) Regulations 2002. Landfill cannot accept untreated waste (be it hazardous or non-hazardous), thus waste producers have the choice of treating it themselves on site or treating it elsewhere prior to disposal to landfill. The regulations require:

*'10 – (1) The operator of a landfill shall ensure that the landfill is only used for landfilling waste which is subject to prior treatment unless:*

- a) It is inert waste for which treatment is not technically feasible; or*
- b) It is waste other than inert waste and treatment would not reduce its quantity or the hazards which it poses to human health or the environment.'*

11.8.2 Regulation 2 defines treatment as: *'physical, thermal, chemical or biological processes (including sorting) that change the characteristics of waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery.'*

11.8.3 A treatment option must comply with the definition of treatment. This involves a 'three point test' against which treatment is assessed i.e.

1. It must be a physical, thermal, chemical or biological process including sorting
2. It must change the characteristics of the waste: and
3. It must do so in order to:
  - a) Reduce its volume: or
  - b) Reduce its hazardous nature: or
  - c) Facilitate its handling: or
  - d) Enhance its recovery.

### **11.8.4 Treatment of inert wastes**

11.8.4.1 Inert waste does not need to be treated if it is not technically feasible however treatment should reduce the amount of waste which goes to landfill and enhance its recovery (by re-use or recycling). Inert wastes are often suitable for recycling, for example as an aggregate or an engineering fill material. A fact sheet on treatment of inert wastes is available on the following website [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

11.8.4.2 Clearly, excavations in the Bognor Sand and London Clay will generate inert wastes which could be reused on site or off site for bulk filling, subject of course to maintenance of an acceptable water content and provided that it is fit for its intended purpose.

**11.8.5 Treatment of non-hazardous waste**

- 11.8.5.1 Guidance and indeed examples of treatment is provided in the Environment Agency publication '*Treatment of non-hazardous wastes for landfill - your waste – your responsibility*,' again available on the EA website.

**11.8.6 Landfill operators**

- 11.8.6.1 It is a requirement of the landfill operator to check if the waste soils taken to the facility have been treated.

**11.9 Reuse of Soils - Materials Management Plans**

- 11.9.1 Where soils are to be moved and reused onsite, or are to be imported to the site, a Waste Exemption or an Environmental Permit is required.
- 11.9.2 An alternative is the use of a Materials Management Plan (MMP) to determine where soils are and are not considered to be a waste. By following '*The Definition of Waste: Development Industry Code of Practice*' published by CL:AIRE (produced in 2008 and revised in March 2011), soils that are suitable for reuse without the need for remediation (either chemical or geotechnical) and have a certainty of use, are not considered to be waste and therefore do not fall under waste regulations. In addition, following this guidance may present an opportunity to transfer suitable material between sites, without the need for Waste Exemptions or Environmental Permits.
- 11.9.3 MMPs offering numerous benefits, including maximising the use of soils onsite, minimising soils going to landfill and reducing costs and time involved in liaising with waste regulators.
- 11.9.4 We can provide further advice on this and provide fees for producing a Materials Management Plan on further instructions.

## **12 Further investigations**

- 12.1 Although we have endeavoured to provide a comprehensive investigation for the proposed development within budgetary constraints there are areas, which we recommend further investigations be carried out. These are as follows: -
- 12.2 The presence and extent of buried obstructions should be investigated by trial pit methods. Such investigations are required to inform the design of piled foundations.
- 12.3 Plate bearing testing should be undertaken to confirm adequate compaction of subgrade soils prior to casting of a ground bearing floor slab.
- 12.4 Further investigations to determine the extent, nature and source of groundwater contamination.
- 12.5 We would be pleased to carry out any of the supplementary investigations described above and provide proposals with costings on further instructions.



Site location

Title

Site location plan

Scale

Not to scale

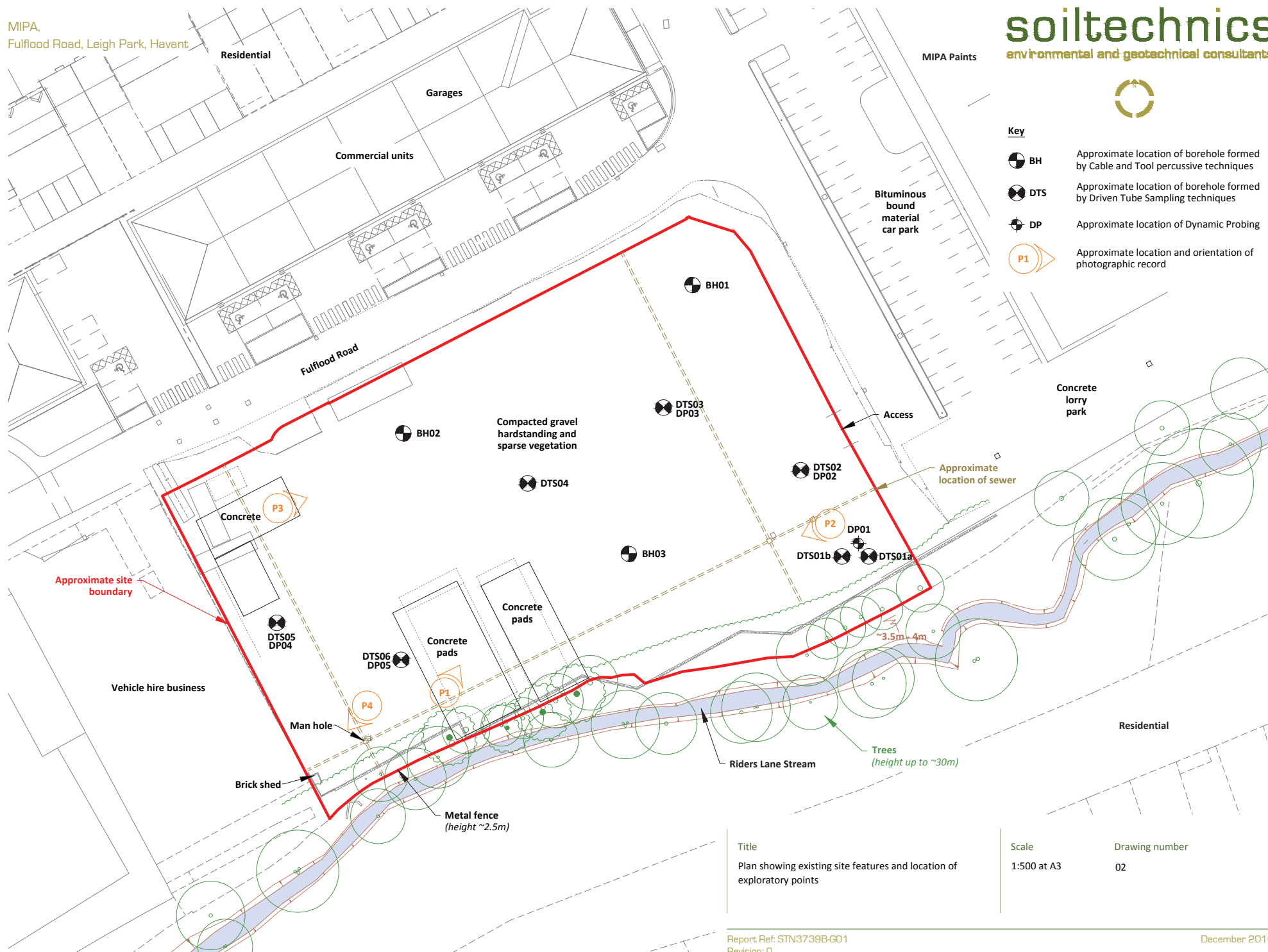
Drawing number

01



## Key

-  BH Approximate location of borehole formed by Cable and Tool percussive techniques
-  DTS Approximate location of borehole formed by Driven Tube Sampling techniques
-  DP Approximate location of Dynamic Probing
-  P1 Approximate location and orientation of photographic record



Title  
Plan showing existing site features and location of  
exploratory points

Scale  
1:500 at A3

Drawing number  
02



**Key**

-  BH Approximate location of borehole formed by Cable and Tool percussive techniques
-  DTS Approximate location of borehole formed by Driven Tube Sampling techniques
-  DP Approximate location of Dynamic Probing

Bituminous bound material car park

Concrete lorry park

Residential

Approximate site boundary

Vehicle hire business

Residential

Garages

Commercial units

Fulford Road

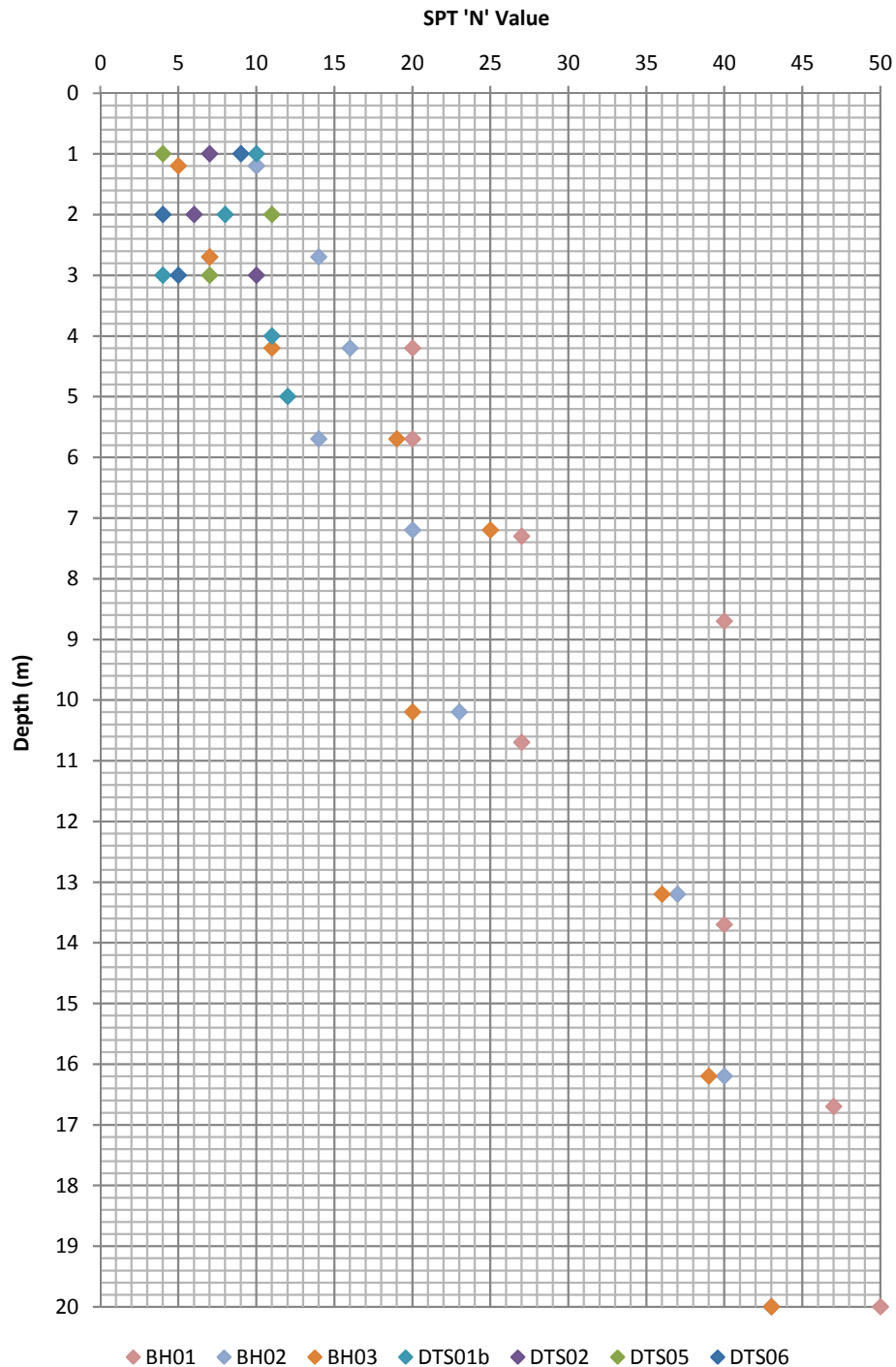
Riders Lane Stream

Trees  
(height up to ~30m)

Title  
Plan showing development layout and location of exploratory points

Scale  
1:500 at A3

Drawing number  
03



Title

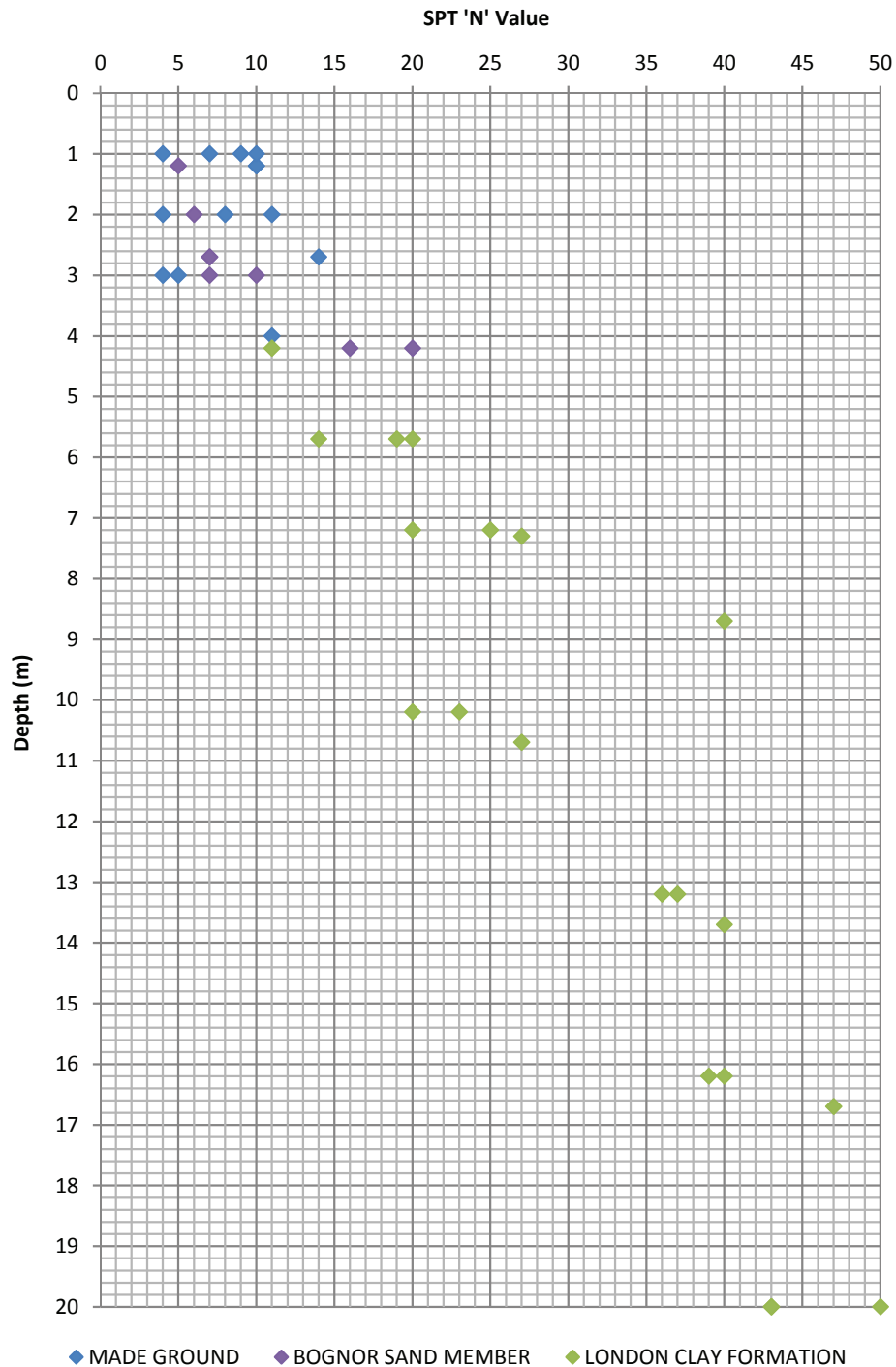
Plot summarising results of standard penetration test results  
by location

Scale

As shown

Drawing number

04a



Title

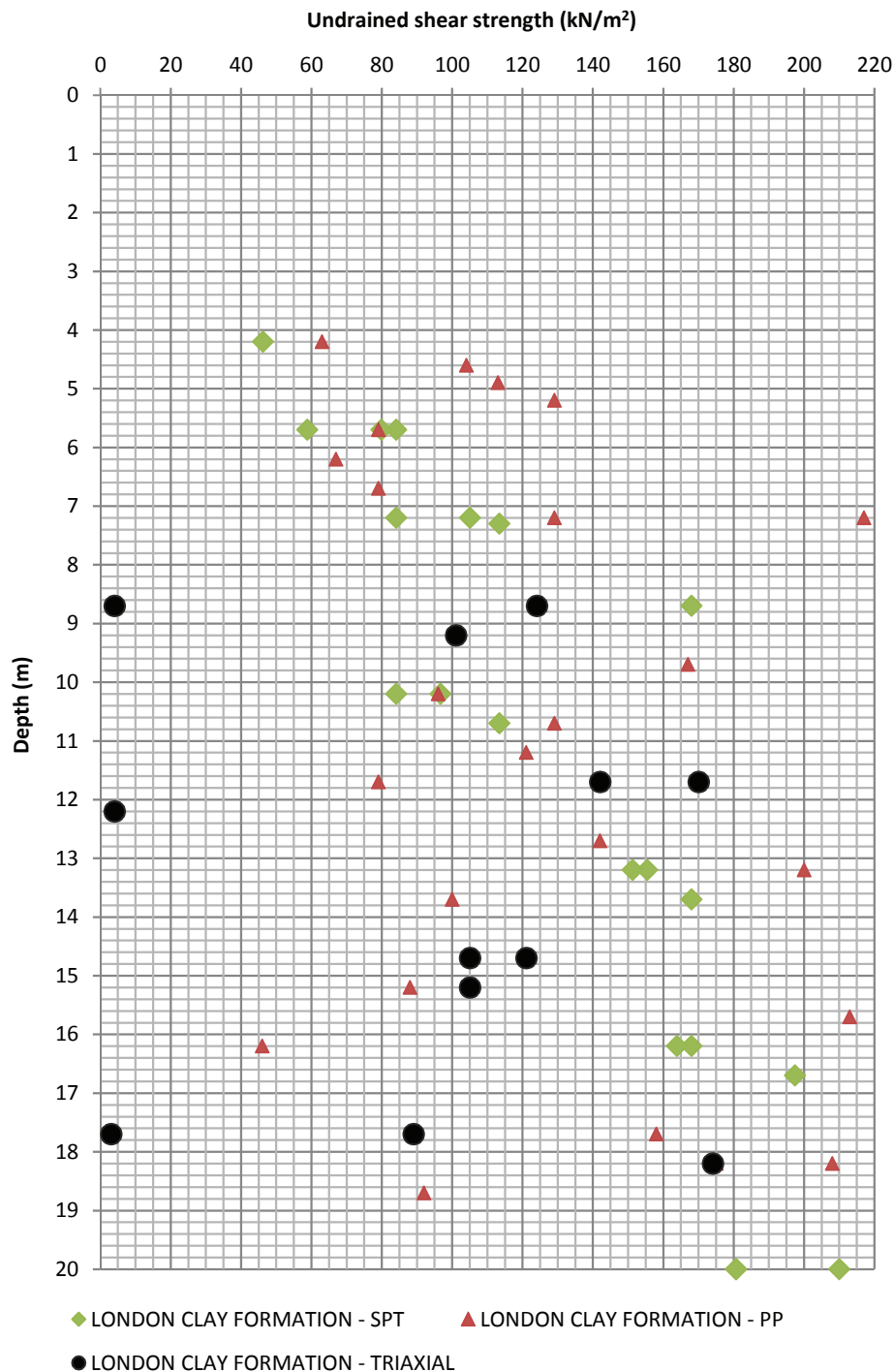
Plot summarising results of standard penetration test results  
by geology

Scale

As shown

Drawing number

04b



#### Title

1) SPT 'N' values calibrated against shear strength data. Using this calibration SPT values are multiplied by a factor of 4.2 (following Stroud & Butler, 1975) to derive an equivalent undrained shear strength

#### Title

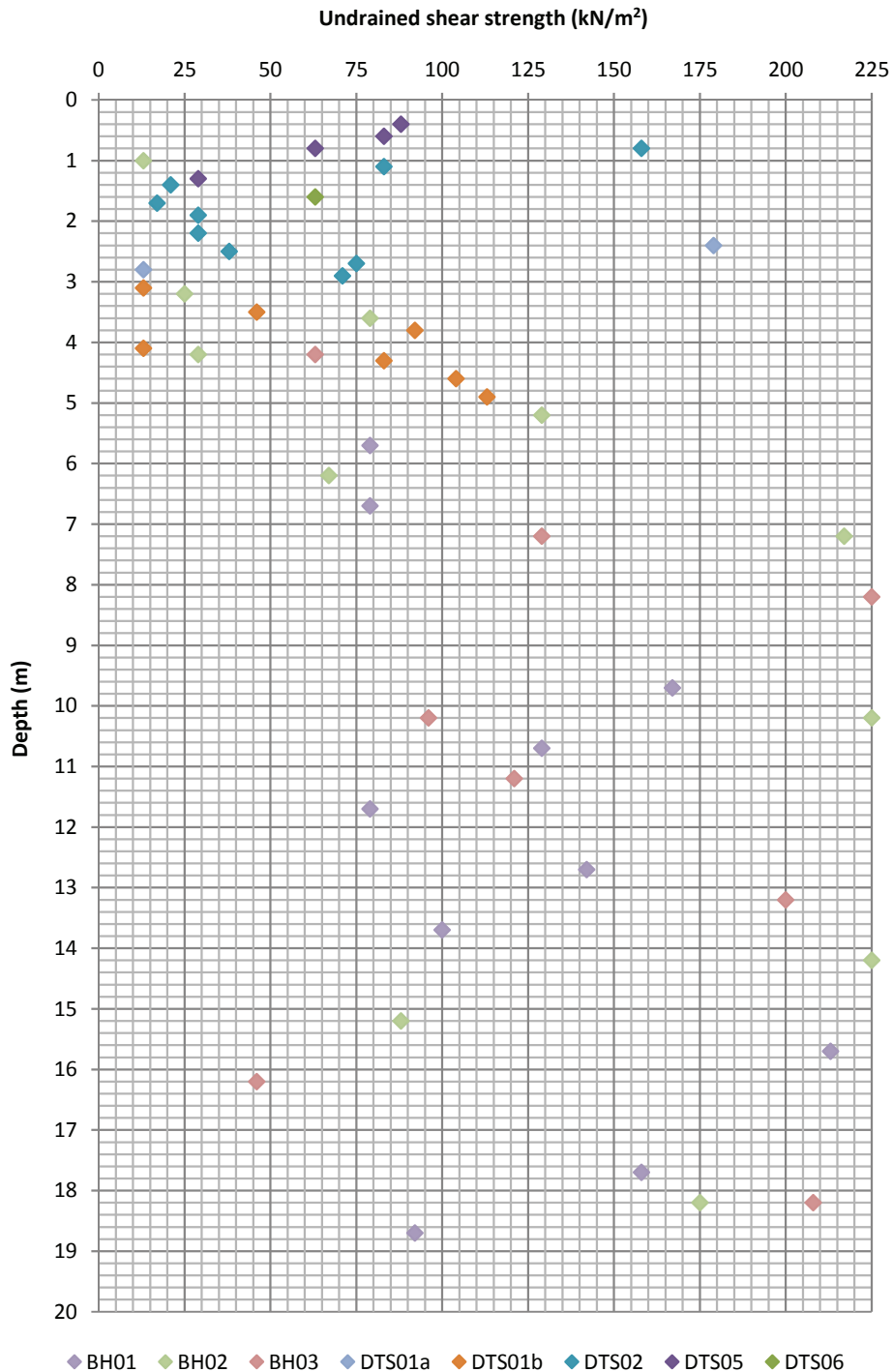
Plot summarising undrained shear strength determinations in London Clay

#### Scale

As shown

#### Drawing number

05



#### Notes

- 1) Equivalent undrained shear strength derived by multiplying Pocket Penetrometer (PP) results by 50

#### Title

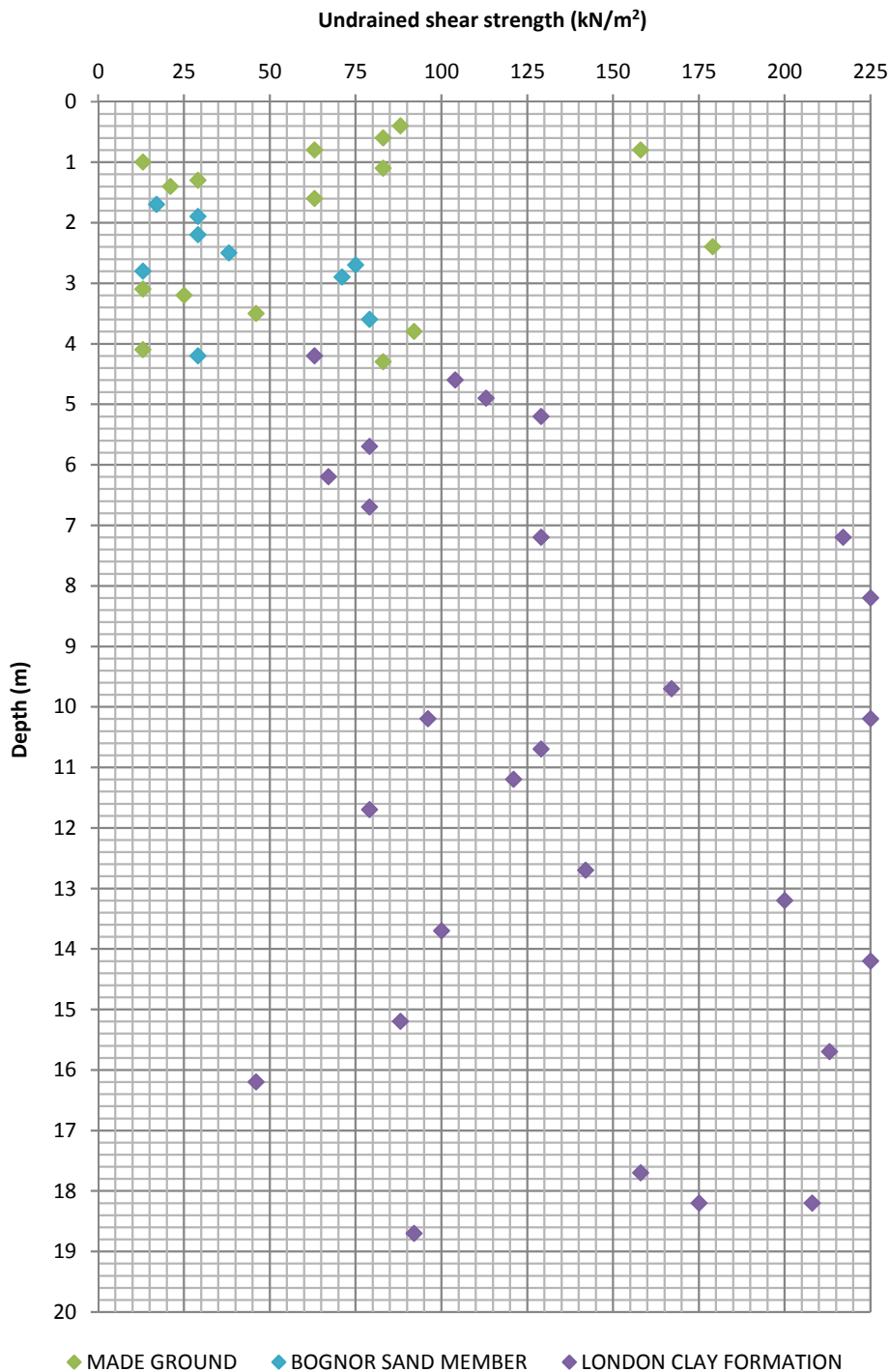
Plot summarising results of pocket penetrometer determinations by location

#### Scale

As shown

#### Drawing number

06a



#### Notes

- 1) Equivalent undrained shear strength derived by multiplying Pocket Penetrometer (PP) results by 50

#### Title

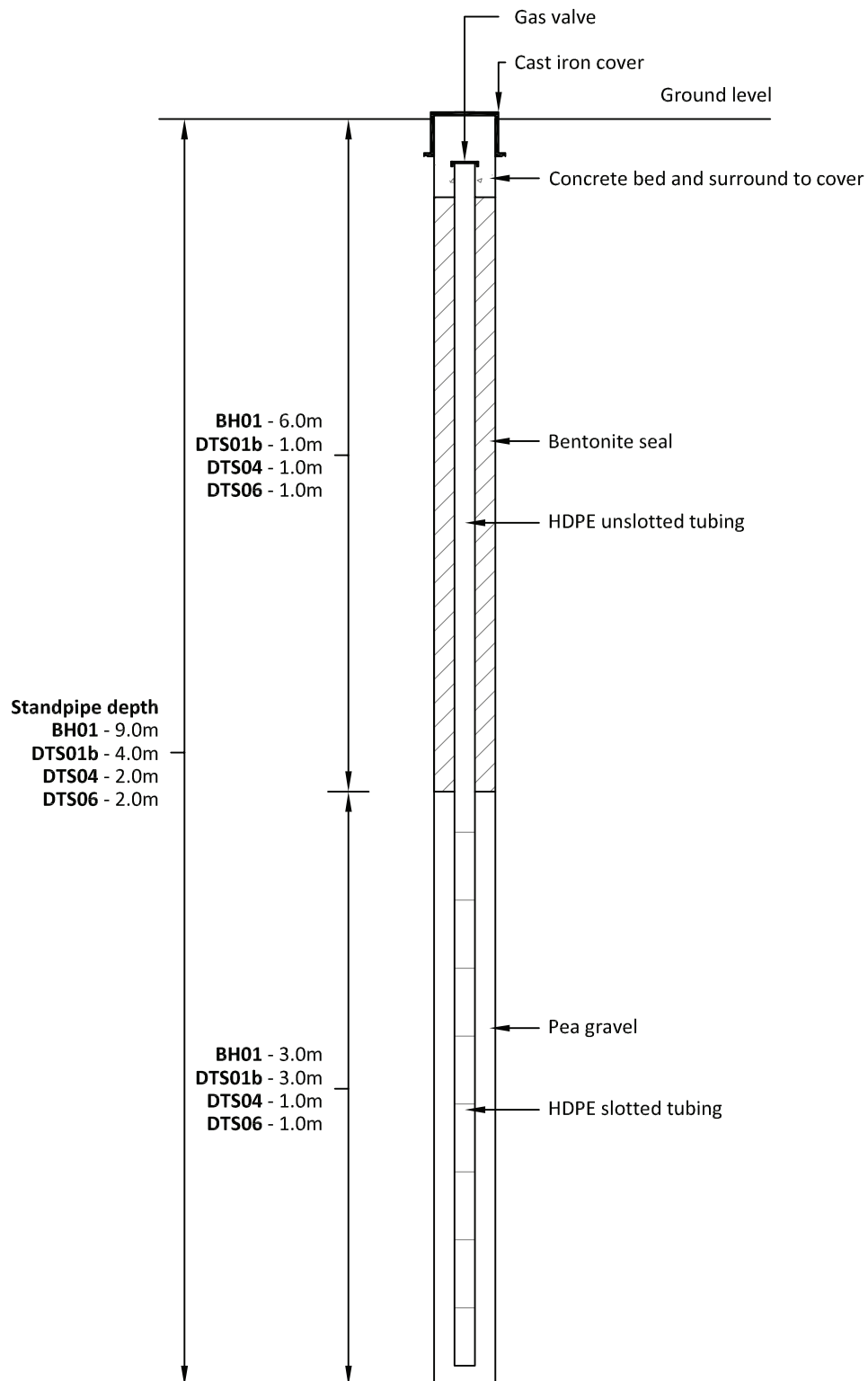
Plot summarising results of pocket penetrometer determinations by geology

#### Scale

As shown

#### Drawing number

06b



Title

Section showing construction of gas monitoring standpipes installed in boreholes BH01, DTS01b, DTS04 and DTS06

Scale

Not to scale

Drawing number

07

## Definition of geotechnical terms used in this report - foundations

***Strip foundations.***

A foundation providing a continuous longitudinal ground bearing.

***Trench fill concrete foundation.***

A trench filled with mass concrete providing continuous longitudinal ground bearing.

***Pad foundation.***

An isolated foundation to spread a concentrated load.

***Raft foundation.***

A foundation continuous in two directions, usually covering an area equal to or greater than the base area of the structure.

***Substructure.***

That part of any structure (including building, road, runway or earthwork) which is below natural or artificial ground level. In a bridge this includes piers and abutments (and wing walls), whether below ground level or not, which support the superstructure.

***Piled foundations and end bearing piles.*** A pile driven or formed in the ground for transmitting the weight of a structure to the soil by the resistance developed at the pile point or base and the friction along its surface. If the pile supports the load mainly by the resistance developed at its point or base, it is referred to as an end-bearing pile; if mainly by friction along its surface, as a friction pile.

***Bored cast in place pile.***

A pile formed with or without a casing by excavating or boring a hole in the ground and subsequently filling it with plain or reinforced concrete.

***Driven pile.***

A pile driven into the ground by the blows of a hammer or a vibrator.

***Precast pile.***

A reinforced or prestressed concrete pile cast before driving.

***Driven cast in place pile.***

A pile installed by driving a permanent or temporary casing, and filling the hole so formed with plain or reinforced concrete.

***Displacement piles.***

Piled formed by displacement of the soil or ground through which they are driven.

***Skin friction.***

The frictional resistance of the surrounding soil on the surface of cofferdam or caisson walls, and pile shafts.

***Downdrag or negative skin friction.*** A downwards frictional force applied to the shaft of a pile caused by the consolidation of compressible strata, e.g. under recently placed fill. Downdrag has the effect of adding load to the pile and reducing the factor of safety.

## Definition of geotechnical terms used in this report – bearing values

***Ultimate bearing capacity.***

The value of the gross loading intensity for a particular foundation at which the resistance of the soil to displacement of the foundation is fully mobilised.

***Presumed bearing value.***

The net loading intensity considered appropriate to the particular type of ground for preliminary design purposes. The particular value is based on calculation from shear strength tests or other field tests incorporating a factor of safety against shear failure.

***Allowable bearing pressure.***

The maximum allowable net loading intensity at the base of the foundation, taking into account the ultimate bearing capacity, the amount and kind of settlement expected and our estimate of ability of the structure to accommodate this settlement.

***Factor of safety.***

The ratio of the ultimate bearing capacity to the intensity of the applied bearing pressure or the ratio of the ultimate load to the applied load.

## Definition of geotechnical terms used in this report – road pavements

The following definitions are based on Transport and Road Research Laboratory (TRRL) Report LR1132.

***Equilibrium CBR values.***

A prediction of the CBR value, which will be attained under the completed pavement.

***Thin pavement.***

A thin pavement (which includes both bound and unbound pavement construction materials 1 in 300mm thick and a thick pavement is 1200mm thick (typical of motorway construction).

## Definition of geo-environmental terms used in this report

### ***Conceptual model***

Textual and/or schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information obtained from the investigatory process.

### ***Contamination***

Presence of a substance which is in, on or under land, and which has the potential to cause harm or to cause pollution of controlled water.

### ***Controlled water***

Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three mile limit of territorial waters.

### ***Harm***

Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of humans, including property.

### ***Pathway***

Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.

### ***Receptor***

Persons, living organisms, ecological systems, controlled waters, atmosphere, structures and utilities that could be adversely affected by the contaminant(s).

### ***Risk***

Probability of the occurrence of, and magnitude of the consequences of, an unwanted adverse effect on a receptor.

### ***Risk Assessment***

Process of establishing, to the extent possible, the existence, nature and significance of risk.

## Definition of environmental risk/hazard terms used in this report.

Based on CIRIA report C552 '*Contaminated land risk assessment – A guide to good practice*'.

### Potential hazard severity definition

| Category      | Definition                                                                                                                                                                     |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Severe</b> | Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters                                                                   |
| <b>Medium</b> | Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures. |
| <b>Mild</b>   | Pollution of non sensitive waters, minor damage to buildings or structures.                                                                                                    |
| <b>Minor</b>  | Requirement for protective equipment during site works to mitigate health effects, damage to non sensitive ecosystems or species.                                              |

### Probability of risk definition

| Category               | Definition                                                                                                                             |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>High likelihood</b> | Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor.      |
| <b>Likely</b>          | Pollutant linkage may be present, and it is probable that the risk will occur over the long term                                       |
| <b>Low likelihood</b>  | Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so. |
| <b>Unlikely</b>        | Pollutant linkage may be present, but the circumstances under which harm would occur are improbable.                                   |

### Level of risk for potential hazard definition

| Probability of risk    | Potential severity |              |              |              |
|------------------------|--------------------|--------------|--------------|--------------|
|                        | Severe             | Medium       | Mild         | Minor        |
| <b>High Likelihood</b> | Very high          | High         | Moderate     | Low/Moderate |
| <b>Likely</b>          | High               | Moderate     | Low/Moderate | Low          |
| <b>Low Likelihood</b>  | Moderate           | Low/Moderate | Low          | Very low     |
| <b>Unlikely</b>        | Low/Moderate       | Low          | Very low     | Very low     |

Refer sheet 2 for definitions of 'very high' to 'low'

## Definition of environmental risk/hazard terms used in this report.

Based on CIRIA report C552 '*Contaminated land risk assessment – A guide to good practice*'.

### Risk classifications and likely action required:

#### **Very high risk**

High probability that severe harm could arise to a designated receptor from an identified hazard OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised is likely to result in substantial liability. Urgent investigation and remediation are likely to be required.

#### **High risk**

Harm is likely to arise to a designated receptor from an identified hazard. This risk, if realised, is likely to result in substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term.

#### **Moderate risk**

It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is likely that the harm would be relatively mild. Investigation is normally required to clarify risks and to determine potential liability. Some remedial works may be required in the long term.

#### **Low risk**

It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that this harm, if realised, would at worst normally be mild.

#### **Very low risk**

It is a low possibility that harm could arise to a designated receptor. On the event of such harm being realised it is not likely to be severe.

## List of documents used in assessment of chemical contamination

| No. | Title                                                                                                                                     | Publication reference / publisher                                     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 1   | Human health toxicological assessment of contaminants in soil                                                                             | EA Science Report – SC050021/SR2                                      |
| 2   | Updated technical background to the CLEA model                                                                                            | EA Science Report – SC050021/SR3                                      |
| 3   | CLEA Software (Version 1.03 beta) Handbook                                                                                                | EA Science Report - SC050021/SR4                                      |
| 4   | Guidance on comparing Soil Contamination Data with a Critical Concentration                                                               | CIEH                                                                  |
| 5   | The LQM/CIEH S4ULs for Human Health Risk Assessment (2015)                                                                                | LQM/CIEH                                                              |
| 6   | Assessment of Risks to Human Health from Land Contamination: An overview of the development of soil guideline values and related research | R&D Publication, Contaminated Land Report CLR 7                       |
| 7   | Contaminants of Soil: Collation of Toxicological Data and Intake Values for Humans                                                        | R&D Publication, Contaminated Land Report CLR 9                       |
| 8   | The Contaminated Land Exposure Assessment Model (CLEA): Technical Basis and Algorithms                                                    | R&D Publication, Contaminated Land Report CLR 10                      |
| 9   | Model Procedures for the Management of Land Contamination                                                                                 | R&D Publication, Contaminated Land Report CLR 11                      |
| 10  | Contaminants in Soil: Collection of Toxicological Data and Intake Values for Human Values                                                 | R&D Publications, Tox. 6                                              |
| 11  | Soil Guideline Values for Contamination (2002)                                                                                            | R&D Publications, SGV 10                                              |
| 12  | Soil Guideline Values (2009)                                                                                                              | EA Science Reports – SC050021                                         |
| 13  | Atkins ATRISK <sup>SOIL</sup> (2011)                                                                                                      | <a href="http://www.atrisksoil.co.uk">http://www.atrisksoil.co.uk</a> |
| 14  | Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (September 2014)                              | CL:AIRE                                                               |

|         |                                                      |
|---------|------------------------------------------------------|
| CIEH    | Chartered institute of Environmental Health          |
| LQM     | Land Quality Management                              |
| EA      | Environment Agency                                   |
| CL:AIRE | Contaminated Land: Applications in Real Environments |

## Testing suite summary

| Table summarising testing suites |                                                                                                                                                                                                                                                                                             |                             |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Suite                            | Parameters                                                                                                                                                                                                                                                                                  | Medium                      |
| Suite 1                          | Arsenic, beryllium, boron, cadmium, chromium (total and VI), copper, lead, mercury, nickel, selenium, vanadium zinc, cyanide (free, total and complex), organic matter content, PAH (16 speciated), pH, phenol (total), TOC                                                                 | Soil                        |
| Suite 2                          | Arsenic, boron (water soluble), beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, vanadium, zinc, cyanide (free, total and complex, PAH (16 speciated), pH, phenol (total), sulfate (water soluble), sulfide, nitrate                                          | Leachate                    |
| Suite 3                          | Arsenic, boron (water soluble), beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, vanadium, zinc, cyanide (free, total and complex, PAH (16 speciated), pH, phenol (total), sulfate (water soluble), sulfide, nitrate                                          | Water                       |
| Suite 4                          | TPH Texas Banding Aliphatic/Aromatic Split, PAH (16 speciated), TOC                                                                                                                                                                                                                         | Soil                        |
| Suite 5                          | TPH Texas Banding Aliphatic/Aromatic Split, PAH (16 speciated)                                                                                                                                                                                                                              | Leachate                    |
| Suite 6                          | TPH Texas Banding Aliphatic/Aromatic Split, PAH (16 speciated)                                                                                                                                                                                                                              | Water                       |
| Suite 7                          | TPH Texas Banding Aliphatic/Aromatic Split, TOC, organic matter                                                                                                                                                                                                                             | Soil                        |
| Suite 8                          | Sulphur (total), sulphate (water and acid soluble), pH                                                                                                                                                                                                                                      | Soil                        |
| Suite 9                          | Sulphate, ammoniacal nitrogen, dissolved magnesium, pH                                                                                                                                                                                                                                      | Water                       |
| Suite 10                         | VOC, SVOC, TOC, organic matter                                                                                                                                                                                                                                                              | Soil                        |
| Suite 11                         | VOC, SVOC                                                                                                                                                                                                                                                                                   | Leachate                    |
| Suite 12                         | VOC, SVOC                                                                                                                                                                                                                                                                                   | Water                       |
| Suite 13                         | Organotins dibutyltin/ tributyl-tin/tetrabutyltin/triphenyl-tin, Tetraethyl-lead/tetramethyl-lead                                                                                                                                                                                           | Soil                        |
| Suite 14                         | Organotin                                                                                                                                                                                                                                                                                   | Leachate                    |
| Suite 15                         | Organotin                                                                                                                                                                                                                                                                                   | Water                       |
| Suite 16                         | TPH Texas Banding Aliphatic/Aromatic Split, BTEX, VOC, SVOC                                                                                                                                                                                                                                 | Soil,<br>water,<br>leachate |
| Suite 17                         | TPH Texas Banding Aliphatic/Aromatic Split, BTEX, SVOC, VOC, arsenic, boron (water soluble), beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, vanadium, zinc, cyanide (free, total and complex, pH, phenol (total), sulfate (water soluble), sulfide, nitrate | Soil,<br>water,<br>leachate |
| Concrete BRE suite               | pH, sulphate (water and acid soluble), magnesium (water soluble), ammonia (water soluble), chloride, nitrate                                                                                                                                                                                | Soil                        |

## Key to legends

### Composite materials, soils and lithology

|                                                                                   |           |                                                                                   |                    |                                                                                     |                 |
|-----------------------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------|-----------------|
|  | Topsoil   |  | Made Ground        |  | Boulders        |
|  | Chalk     |  | Clay               |  | Coal            |
|  | Cobbles   |  | Cobbles & Boulders |  | Concrete        |
|  | Gravel    |  | Limestone          |  | Mudstone        |
|  | Peat      |  | Sand               |  | Sand and Gravel |
|  | Sandstone |  | Silt               |  | Silt / Clay     |
|                                                                                   |           |                                                                                   |                    |  | Siltstone       |

Note: Composite soil types are signified by combined symbols.

## Key to 'test results' and 'sampling' columns

| Test result |                                                                                                                                                                                  | Sampling           |                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------|
| Depth       | Records depth that the test was carried out (i.e.: at 2.10m or between 2.10m and 2.55m)                                                                                          | From (m)<br>To (m) | Records depth of sampling                                |
| Result      | PP – Pocket penetrometer result reported as an equivalent undrained shear strength (kN/m <sup>2</sup> )                                                                          |                    | D Disturbed sample                                       |
|             | SV – Hand held shear vane result reported as an undrained shear strength (kN/m <sup>2</sup> )                                                                                    |                    | B Bulk disturbed sample                                  |
|             | PP result converted to an equivalent undrained shear strength by applying a factor of 50. Where at least 3 results obtained at same depth then an average value may be reported. |                    | ES Environmental sample                                  |
|             | SPT – Standard Penetration Test result (N value) (uncorrected) <sup>1,2,3</sup>                                                                                                  | Type               | W Water sample                                           |
|             | SPT(c) – Standard Penetration Test result (solid cone) (N value) (uncorrected) <sup>1,2,3</sup>                                                                                  |                    | UT Undisturbed thin walled sample 100mm diameter sampler |
|             | UT – Undisturbed sample 100mm diameter sampler with number of blows of driving equipment required to obtain sample                                                               |                    |                                                          |

Note <sup>1</sup>: Seating blows recorded in brackets.

Note <sup>2</sup>: Casing depth records depth of casing when SPT or SPT(c) was carried out.

Note <sup>3</sup>: Water depth records depth of water when SPT or SPT(c) was carried out.

## Water observations

Described at foot of log and shown in the 'water strike' column.

 = water level observed after specified delay in drilling

 = water strike

## Standpipe details

|                                                                                      |                |                                                                                       |          |
|--------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------|----------|
|  | Gravel filter  |  | Arisings |
|  | Bentonite      |                                                                                       |          |
|  | Slotted pipe   |                                                                                       |          |
|  | Unslotted pipe |                                                                                       |          |

| WELL | DESCRIPTION                                                                                           | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS             |                   |                  |                 | SAMPLING     |        |        |
|------|-------------------------------------------------------------------------------------------------------|--------|-----------|--------------|--------------------------|-------------------|------------------|-----------------|--------------|--------|--------|
|      |                                                                                                       |        |           |              | TYPE/ DEPTH (m)          | RESULT            | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m)     | TO (m) | TYPE   |
|      | Brown clayey very gravelly SAND. Gravel consists of concrete, brick, flint and plastic. (MADE GROUND) |        |           |              |                          |                   |                  |                 | 0.00         | 1.20   | B      |
|      |                                                                                                       |        |           |              |                          |                   |                  |                 | 0.50         |        | D      |
|      | Medium dense brown slightly clayey silty fine SAND with rare gravel of flint and brick. (MADE GROUND) |        | 0.80      |              |                          |                   |                  |                 | 1.00         |        | D      |
|      | ...between 1.2m and 1.65m depth, becoming orange brown and grey.                                      |        |           |              | SPT 1.20-1.65            | N=(2) 10          | 1.20             | DRY             | 1.20         |        | D      |
|      |                                                                                                       |        |           |              |                          |                   |                  |                 |              |        |        |
|      | Very soft orange brown very sandy CLAY. (BOGNOR SAND MEMBER)                                          |        | 2.20      |              |                          |                   |                  |                 | 2.20         |        | D      |
|      | ..between 2.7m and 3.15m depth, becoming orange brown, brown and red brown.                           |        |           |              | SPT 2.70-3.15            | N=(3) 7           | 2.70             | 1.5             | 2.70         |        | D      |
|      |                                                                                                       |        |           |              |                          |                   |                  |                 | 3.20         |        | D      |
|      |                                                                                                       |        |           |              |                          |                   |                  |                 |              |        |        |
|      | Very soft dark grey and orange brown very sandy CLAY. (BOGNOR SAND MEMBER)                            |        | 4.20      |              | SPT 4.20-4.65            | N=(6) 20          | 4.20             | 3               | 4.20         |        | D      |
|      |                                                                                                       |        |           |              |                          |                   |                  |                 |              |        |        |
|      | ...at 5.2m depth, some gravel of claystone, flint and pyrite.                                         |        |           |              |                          |                   |                  |                 | 5.20         |        | D      |
|      |                                                                                                       |        |           |              |                          |                   |                  |                 |              |        |        |
|      | Firm high strength dark grey CLAY. (LONDON CLAY FORMATION)                                            |        | 5.70      |              | SPT 5.70-6.15<br>PP 5.70 | N=(7) 20<br>PP=79 | 5.70             | 4               | 5.70<br>5.70 | 6.70   | B<br>D |
|      | CONTINUED ON NEXT SHEET                                                                               |        |           |              |                          |                   |                  |                 |              |        |        |

**Notes:** Chiselling for 1 hour from 8.7m to 8.9m depth.

**Ground level (mAOD)**

**Co-ordinates**

471442, 108321

**Title**

Borehole record

**Method of excavation**

Shell and auger

**Groundwater observations**

Groundwater encountered at 8.6m depth, rising to 4m after 10 minutes, 3.7m after 15 minutes and remaining at 3.7m after 20 minutes.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

-

**Location plan on drawing number**

02

**BH01**

| WELL                    | DESCRIPTION                                                                                        | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS                |                     |                  |                 | SAMPLING |        |      |
|-------------------------|----------------------------------------------------------------------------------------------------|--------|-----------|--------------|-----------------------------|---------------------|------------------|-----------------|----------|--------|------|
|                         |                                                                                                    |        |           |              | TYPE/DEPTH (m)              | RESULT              | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|                         |                                                                                                    |        |           |              | PP 6.70                     | PP=79               |                  |                 | 6.70     |        | D    |
|                         |                                                                                                    |        |           |              | SPT 7.30-7.75               | N=(7) 27            | 5.70             |                 | 7.30     |        | D    |
|                         |                                                                                                    |        |           |              |                             |                     |                  |                 | 7.70     |        | D    |
|                         |                                                                                                    |        | 8.60      |              | SPT (c) 8.70-9.15           | N=(8) 40            | 5.70             | 3.7             | 8.70     |        | D    |
|                         | Medium strong dark grey CLAYSTONE recovered as angular gravel and cobbles. (LONDON CLAY FORMATION) |        |           |              |                             | UT=72               |                  |                 | 9.20     | 9.65   | UT   |
|                         | Stiff becoming very stiff high strength dark grey sandy CLAY. (LONDON CLAY FORMATION)              |        | 9.10      |              | PP 9.70                     | PP=167              |                  |                 | 9.70     |        | D    |
|                         |                                                                                                    |        |           |              | SPT 10.70-11.15<br>PP 10.70 | N=(10) 27<br>PP=129 | 8.70             | 6.5             | 10.70    |        | D    |
|                         |                                                                                                    |        |           |              | PP 11.70                    | PP=79               |                  |                 | 11.70    |        | D    |
| CONTINUED ON NEXT SHEET |                                                                                                    |        |           |              |                             |                     |                  |                 |          |        |      |

**Notes:** Chiselling for 1 hour from 8.7m to 8.9m depth.

**Ground level (mAOD)**

**Co-ordinates**

471442, 108321

**Title**

Borehole record

**Method of excavation**

Shell and auger

**Groundwater observations**

Groundwater encountered at 8.6m depth, rising to 4m after 10 minutes, 3.7m after 15 minutes and remaining at 3.7m after 20 minutes.

**Date of excavation (range if applicable)**

31/10/2016

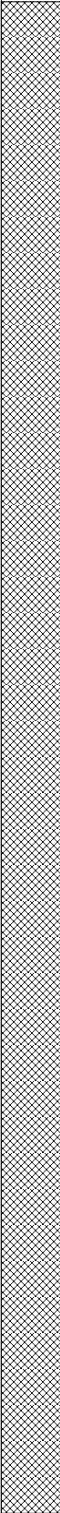
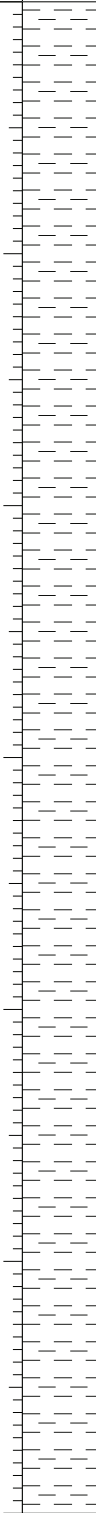
**Appendix**

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**Location plan on drawing number**

02

**BH01**

| WELL                                                                               | DESCRIPTION | LEGEND                                                                             | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS                   |                    |                     |                    | SAMPLING    |        |      |
|------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------|--------------|-----------------|--------------------------------|--------------------|---------------------|--------------------|-------------|--------|------|
|                                                                                    |             |                                                                                    |              |                 | TYPE/<br>DEPTH (m)             | RESULT             | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|  |             |  |              |                 |                                | UT=87              |                     |                    | 12.20       | 12.65  | UT   |
|                                                                                    |             |                                                                                    |              |                 | PP 12.70                       | PP=142             |                     |                    | 12.70       |        | D    |
|                                                                                    |             |                                                                                    |              |                 | SPT<br>13.70-14.15<br>PP 13.70 | N=(9) 40<br>PP=100 | 8.70                | 6.5                | 13.70       |        | D    |
|                                                                                    |             |                                                                                    |              |                 |                                |                    |                     |                    | 14.70       |        | D    |
|                                                                                    |             |                                                                                    |              |                 |                                | UT=100             |                     |                    | 15.20       | 15.75  | UT   |
|                                                                                    |             |                                                                                    |              |                 | PP 15.70                       | PP=213             |                     |                    | 15.70       |        | D    |
|                                                                                    |             |                                                                                    |              |                 | SPT<br>16.70-17.15             | N=(12) 47          | 8.70                | 7                  | 16.70       |        | D    |
|                                                                                    |             |                                                                                    |              |                 | PP 17.70                       | PP=158             |                     |                    | 17.70       |        | D    |
|                                                                                    |             |                                                                                    |              |                 |                                |                    |                     |                    |             |        |      |
|                                                                                    |             |                                                                                    |              |                 |                                |                    |                     |                    |             |        |      |

CONTINUED ON NEXT SHEET

**Notes:** Chiselling for 1 hour from 8.7m to 8.9m depth.

**Ground level (mAOD)**

**Co-ordinates**

471442, 108321

**Title**

Borehole record

**Method of excavation**

Shell and auger

**Groundwater observations**

Groundwater encountered at 8.6m depth, rising to 4m after 10 minutes, 3.7m after 15 minutes and remaining at 3.7m after 20 minutes.

**Date of excavation (range if applicable)**

31/10/2016

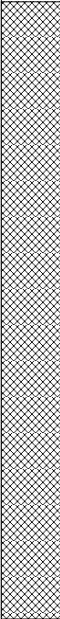
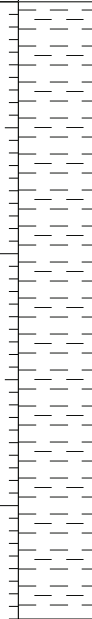
**Appendix**

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**Location plan on drawing number**

02

**BH01**

| WELL                                                                              | DESCRIPTION                   | LEGEND                                                                            | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS       |           |                     |                    | SAMPLING    |        |      |
|-----------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------|--------------|-----------------|--------------------|-----------|---------------------|--------------------|-------------|--------|------|
|                                                                                   |                               |                                                                                   |              |                 | TYPE/<br>DEPTH (m) | RESULT    | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|  |                               |  |              |                 |                    | UT=93     |                     |                    | 18.20       | 18.65  | UT   |
|                                                                                   |                               |                                                                                   |              |                 | PP 18.70           | PP=92     |                     |                    | 18.70       |        | D    |
|                                                                                   |                               |                                                                                   |              |                 |                    |           |                     |                    | 19.70       |        | D    |
|                                                                                   |                               |                                                                                   |              |                 | SPT<br>20.00-20.45 | N=(12) 50 | 8.70                | 7                  | 20.00       |        | D    |
|                                                                                   | BOREHOLE TERMINATED AT 20.45m |                                                                                   | 20.45        |                 |                    |           |                     |                    |             |        |      |

**Notes:** Chiselling for 1 hour from 8.7m to 8.9m depth.

**Ground level (mAOD)**

**Co-ordinates**

471442, 108321

**Title**

Borehole record

**Method of excavation**

Shell and auger

**Groundwater observations**

Groundwater encountered at 8.6m depth, rising to 4m after 10 minutes, 3.7m after 15 minutes and remaining at 3.7m after 20 minutes.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

-

**Location plan on drawing number**

02

**BH01**

| WELL | DESCRIPTION                                                                                                                | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS             |                   |                  |                 | SAMPLING |        |      |
|------|----------------------------------------------------------------------------------------------------------------------------|--------|-----------|--------------|--------------------------|-------------------|------------------|-----------------|----------|--------|------|
|      |                                                                                                                            |        |           |              | TYPE/ DEPTH (m)          | RESULT            | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|      | Brown clayey very gravelly SAND. Gravel consists of concrete, brick, flint and plastic. (MADE GROUND)                      |        |           |              |                          |                   |                  |                 | 0.00     | 1.20   | B    |
|      |                                                                                                                            |        |           |              |                          |                   |                  |                 | 0.50     |        | D    |
|      | Very soft becoming soft brown grey and orange brown sandy gravelly CLAY. Gravel consists of flint and brick. (MADE GROUND) |        | 0.60      |              | PP 1.00                  | PP=13             |                  |                 | 1.00     |        | D    |
|      |                                                                                                                            |        |           |              | SPT 1.20-1.65            | N=(3) 10          |                  | DRY             | 1.20     |        | D    |
|      |                                                                                                                            |        |           |              |                          |                   |                  |                 | 2.20     |        | D    |
|      |                                                                                                                            |        |           |              | SPT 2.70-3.15            | N=(4) 14          | 2.70             | DRY             | 2.70     |        | D    |
|      |                                                                                                                            |        |           |              | PP 3.20                  | PP=25             |                  |                 | 3.20     |        | D    |
|      | Firm orange brown and grey very sandy CLAY. (BOGNOR SAND MEMBER)                                                           |        | 3.60      |              | PP 3.60                  | PP=79             |                  |                 | 3.60     |        | D    |
|      |                                                                                                                            |        |           |              | SPT 4.20-4.65<br>PP 4.20 | N=(3) 16<br>PP=29 | 4.25             | DRY             | 4.20     |        | D    |
|      |                                                                                                                            |        |           |              |                          |                   |                  |                 | 5.20     |        | D    |
|      | Firm to stiff high, medium and very high strength dark grey sandy CLAY. (LONDON CLAY FORMATION)                            |        | 5.20      |              | PP 5.20                  | PP=129            |                  |                 | 5.20     |        | D    |
|      |                                                                                                                            |        |           |              | SPT 5.70-6.15            | N=(1) 14          | 4.25             | DRY             | 5.70     |        | D    |
|      | CONTINUED ON NEXT SHEET                                                                                                    |        |           |              |                          |                   |                  |                 |          |        |      |

**Notes:**

**Ground level (mAOD)**

**Co-ordinates**

471400, 108299

**Title**

Borehole record

**Method of excavation**

Shell and auger

**Groundwater observations**

No groundwater encountered.

**Date of excavation (range if applicable)**

02/11/2016

**Appendix**

C

**Location plan on drawing number**

02

**BH02**

| WELL | DESCRIPTION             | LEGEND | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS                   |                        |                     |                    | SAMPLING    |        |      |
|------|-------------------------|--------|--------------|-----------------|--------------------------------|------------------------|---------------------|--------------------|-------------|--------|------|
|      |                         |        |              |                 | TYPE/<br>DEPTH (m)             | RESULT                 | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      |                         |        |              |                 | PP 6.20                        | PP=67                  |                     |                    | 6.20        |        | D    |
|      |                         |        |              |                 | SPT<br>7.20-7.65<br>PP 7.20    | N=(5) 20<br><br>PP=217 | 4.25                | DRY                | 7.20        |        | D    |
|      |                         |        |              |                 |                                |                        |                     |                    | 8.20        |        | D    |
|      |                         |        |              |                 |                                | UT=77                  |                     |                    | 8.70        | 9.15   | UT   |
|      |                         |        |              |                 |                                |                        |                     |                    | 9.20        |        | D    |
|      |                         |        |              |                 | SPT<br>10.20-10.65<br>PP 10.20 | N=(5) 23<br><br>PP=225 | 4.25                | DRY                | 10.20       |        | D    |
|      |                         |        |              |                 |                                |                        |                     |                    | 11.20       |        | D    |
|      |                         |        |              |                 |                                | UT=89                  |                     |                    | 11.70       | 12.15  | UT   |
|      | CONTINUED ON NEXT SHEET |        |              |                 |                                |                        |                     |                    |             |        |      |

Notes:

|                             |                |                                          |                      |
|-----------------------------|----------------|------------------------------------------|----------------------|
| Ground level (mAOD)         | Co-ordinates   | Title                                    | Method of excavation |
|                             | 471400, 108299 | Borehole record                          | Shell and auger      |
| Groundwater observations    |                | Date of excavation (range if applicable) | Appendix             |
| No groundwater encountered. |                | 02/11/2016                               | C                    |
|                             |                | Location plan on drawing number          |                      |
|                             |                | 02                                       | BH02                 |

**Notes:**

**Report ref:** STN3739B-G01

| WELL | DESCRIPTION                   | LEGEND | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS       |          |                     |                    | SAMPLING    |        |      |
|------|-------------------------------|--------|--------------|-----------------|--------------------|----------|---------------------|--------------------|-------------|--------|------|
|      |                               |        |              |                 | TYPE/<br>DEPTH (m) | RESULT   | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      |                               |        |              |                 | PP 18.20           | PP=175   |                     |                    | 18.20       |        | D    |
|      |                               |        |              |                 |                    |          |                     |                    | 19.20       |        | D    |
|      |                               |        |              |                 | SPT<br>20.00-20.45 | N=(9) 43 | 12.00               | DRY                | 20.00       |        | D    |
|      | BOREHOLE TERMINATED AT 20.45m |        | 20.45        |                 |                    |          |                     |                    |             |        |      |

Notes:

|                                                         |                                |                                                        |                                         |
|---------------------------------------------------------|--------------------------------|--------------------------------------------------------|-----------------------------------------|
| Ground level (mAOD)                                     | Co-ordinates<br>471400, 108299 | Title<br>Borehole record                               | Method of excavation<br>Shell and auger |
| Groundwater observations<br>No groundwater encountered. |                                | Date of excavation (range if applicable)<br>02/11/2016 | Appendix<br>C                           |
|                                                         |                                | Location plan on drawing number<br>02                  | BH02                                    |

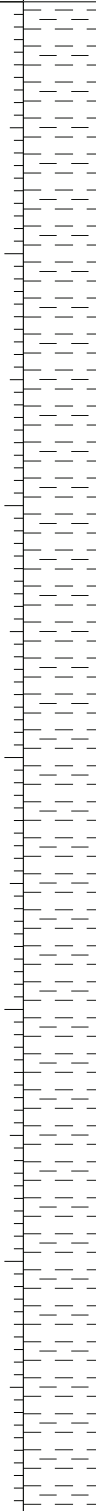
**Notes:**

**Report ref:** STN3739B-G01

| WELL | DESCRIPTION                                             | LEGEND | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS                   |                        |                     |                    | SAMPLING    |        |      |
|------|---------------------------------------------------------|--------|--------------|-----------------|--------------------------------|------------------------|---------------------|--------------------|-------------|--------|------|
|      |                                                         |        |              |                 | TYPE/<br>DEPTH (m)             | RESULT                 | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      | ...at 6.2m depth, gravel and cobbles of weak claystone. |        |              |                 |                                |                        |                     |                    | 6.20        |        | D    |
|      |                                                         |        |              |                 | SPT<br>7.20-7.65<br>PP 7.20    | N=(6) 25<br><br>PP=129 | 4.25                | DRY                | 7.20        |        | D    |
|      |                                                         |        |              |                 | PP 8.20                        | PP=225                 |                     |                    | 8.20        |        | D    |
|      |                                                         |        |              |                 |                                | UT=57                  |                     |                    | 8.70        | 9.15   | UT   |
|      |                                                         |        |              |                 |                                |                        |                     |                    | 9.20        |        | D    |
|      |                                                         |        |              |                 | SPT<br>10.20-10.65<br>PP 10.20 | N=(6) 20<br><br>PP=96  | 6.00                | DRY                | 10.20       |        | D    |
|      |                                                         |        |              |                 | PP 11.20                       | PP=121                 |                     |                    | 11.20       |        | D    |
|      |                                                         |        |              |                 |                                |                        |                     |                    | 11.70       | 12.15  | UT   |
|      | CONTINUED ON NEXT SHEET                                 |        |              |                 |                                |                        |                     |                    |             |        |      |

Notes:

|                             |                |                                          |                      |
|-----------------------------|----------------|------------------------------------------|----------------------|
| Ground level (mAOD)         | Co-ordinates   | Title                                    | Method of excavation |
|                             | 471433, 108282 | Borehole record                          | Shell and auger      |
| Groundwater observations    |                | Date of excavation (range if applicable) | Appendix             |
| No groundwater encountered. |                | 03/11/2016                               | C                    |
|                             |                | Location plan on drawing number          | BH03                 |
|                             |                | 02                                       |                      |

| WELL | DESCRIPTION                                    | LEGEND                                                                             | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS                   |                        |                     |                    | SAMPLING    |        |      |
|------|------------------------------------------------|------------------------------------------------------------------------------------|--------------|-----------------|--------------------------------|------------------------|---------------------|--------------------|-------------|--------|------|
|      |                                                |                                                                                    |              |                 | TYPE/<br>DEPTH (m)             | RESULT                 | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      | <u>...at 12.2m depth, becoming silty.</u>      |  |              |                 |                                |                        |                     |                    | 12.20       |        | D    |
|      |                                                |                                                                                    |              |                 | SPT<br>13.20-13.65<br>PP 13.20 | N=(9) 36<br><br>PP=200 | 6.00                | DRY                | 13.20       |        | D    |
|      |                                                |                                                                                    |              |                 |                                |                        |                     |                    | 14.20       |        | D    |
|      | <u>...at 14.2m depth, gravel of claystone.</u> |                                                                                    |              |                 |                                |                        |                     |                    | 14.70       | 15.15  | UT   |
|      |                                                |                                                                                    |              |                 |                                |                        |                     |                    | 15.20       |        | D    |
|      |                                                |                                                                                    |              |                 | SPT<br>16.20-16.65<br>PP 16.20 | N=(12) 39<br><br>PP=46 | 6.00                | DRY                | 16.20       |        | D    |
|      |                                                |                                                                                    |              |                 |                                |                        |                     |                    | 17.20       |        | D    |
|      | <u>...at 17.2m depth, becoming silty.</u>      |                                                                                    |              |                 |                                |                        |                     |                    | 17.70       | 18.15  | UT   |
|      |                                                |                                                                                    |              |                 |                                |                        |                     |                    |             |        |      |
|      | CONTINUED ON NEXT SHEET                        |                                                                                    |              |                 |                                |                        |                     |                    |             |        |      |

Notes:

|                             |                |                                          |                      |
|-----------------------------|----------------|------------------------------------------|----------------------|
| Ground level (mAOD)         | Co-ordinates   | Title                                    | Method of excavation |
|                             | 471433, 108282 | Borehole record                          | Shell and auger      |
| Groundwater observations    |                | Date of excavation (range if applicable) | Appendix             |
| No groundwater encountered. |                | 03/11/2016                               | C                    |
|                             |                | Location plan on drawing number          | BH03                 |
|                             |                | 02                                       |                      |

| WELL | DESCRIPTION                   | LEGEND | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS       |           |                     |                    | SAMPLING    |        |      |
|------|-------------------------------|--------|--------------|-----------------|--------------------|-----------|---------------------|--------------------|-------------|--------|------|
|      |                               |        |              |                 | TYPE/<br>DEPTH (m) | RESULT    | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      |                               |        |              |                 | PP 18.20           | PP=208    |                     |                    | 18.20       |        | D    |
|      |                               |        |              |                 |                    |           |                     |                    | 19.20       |        | D    |
|      |                               |        |              |                 | SPT<br>20.00-20.45 | N={12} 43 | 6.00                | DRY                | 20.00       |        | D    |
|      | BOREHOLE TERMINATED AT 20.45m |        | 20.45        |                 |                    |           |                     |                    |             |        |      |

Notes:

|                                                         |                                |                                                        |                                         |
|---------------------------------------------------------|--------------------------------|--------------------------------------------------------|-----------------------------------------|
| Ground level (mAOD)                                     | Co-ordinates<br>471433, 108282 | Title<br>Borehole record                               | Method of excavation<br>Shell and auger |
| Groundwater observations<br>No groundwater encountered. |                                | Date of excavation (range if applicable)<br>03/11/2016 | Appendix<br>C                           |
|                                                         |                                | Location plan on drawing number<br>02                  | BH03                                    |

## Key to legends

### Composite materials, soils and lithology

|                                                                                   |           |                                                                                   |                    |                                                                                     |                 |
|-----------------------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------|-----------------|
|  | Topsoil   |  | Made Ground        |  | Boulders        |
|  | Chalk     |  | Clay               |  | Coal            |
|  | Cobbles   |  | Cobbles & Boulders |  | Concrete        |
|  | Gravel    |  | Limestone          |  | Mudstone        |
|  | Peat      |  | Sand               |  | Sand and Gravel |
|  | Sandstone |  | Silt               |  | Silt / Clay     |
|                                                                                   |           |                                                                                   |                    |  | Siltstone       |

Note: Composite soil types are signified by combined symbols.

## Key to 'test results' and 'sampling' columns

| Test result |                                                                                                                                                                                                                                            | Sampling           |                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------|
| Depth       | Records depth that the test was carried out (i.e.: at 2.10m or between 2.10m and 2.55m)                                                                                                                                                    | From (m)<br>To (m) | Records depth of sampling                                                                                            |
| Result      | PID - Photo Ionisation Detector result (ppm equivalent Isobutylene)                                                                                                                                                                        |                    | D Disturbed sample                                                                                                   |
|             | PP – Pocket penetrometer result (kN/m <sup>2</sup> )                                                                                                                                                                                       |                    | B Bulk disturbed sample                                                                                              |
|             | HVP – Hand held shear vane result (kN/m <sup>2</sup> )<br>PP result converted to an equivalent undrained shear strength by applying a factor of 50. Where at least 3 results obtained at same depth then an average value may be reported. |                    | ES Environmental sample comprising plastic and/or glass container                                                    |
|             | SPT – Standard Penetration Test result (uncorrected)<br>SPT(c) – Standard Penetration Test result (solid cone) (uncorrected)                                                                                                               | Type               | W Water sample                                                                                                       |
|             |                                                                                                                                                                                                                                            |                    | U (32) Undisturbed sample 100mm diameter sampler with number of blows of driving equipment required to obtain sample |

## Water observations

Described at foot of log and shown in the 'water strike' column.

|                                                                                     |                                                          |
|-------------------------------------------------------------------------------------|----------------------------------------------------------|
|  | = water level observed after specified delay in drilling |
|  | = water strike                                           |

## Density

Density recorded in brackets inferred from density testing and soil descriptions from across the site (i.e.: [Medium dense]).

## Standpipe details

|                                                                                      |                |                                                                                       |          |
|--------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------|----------|
|  | Gravel filter  |  | Arisings |
|  | Bentonite      |                                                                                       |          |
|  | Slotted pipe   |                                                                                       |          |
|  | Unslotted pipe |                                                                                       |          |

| WELL | DESCRIPTION                                                                                                                                                                                        | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS   |        |                  |                 | SAMPLING |        |      |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------|--------------|----------------|--------|------------------|-----------------|----------|--------|------|
|      |                                                                                                                                                                                                    |        |           |              | TYPE/DEPTH (m) | RESULT | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|      | Vegetation onto dark brown slightly clayey gravelly SAND with frequent rootlets. Gravel consists of flint and brick.<br>(MADE GROUND)                                                              |        | 0.20      |              |                |        |                  |                 | 0.10     |        | D    |
|      |                                                                                                                                                                                                    |        | 0.30      |              |                |        |                  |                 | 0.20     |        | D    |
|      | Yellow brown very silty SAND and GRAVEL. Gravel consists of flint.<br>(MADE GROUND)                                                                                                                |        |           |              |                |        |                  |                 | 0.40     |        | ES   |
|      | Brown and orange brown slightly clayey gravelly very silty fine SAND with occasional gravel-sized pockets of red silt. Gravel consists of flint, brick, timber, ash and concrete.<br>(MADE GROUND) |        | 1.00      |              |                |        |                  |                 | 0.80     |        | D    |
|      | Reddish brown SAND and GRAVEL. Gravel consists of flint and quartzite (pea gravel) and brick.<br>(MADE GROUND)                                                                                     |        | 1.40      |              |                |        |                  |                 | 1.10     |        | D    |
|      | Firm brown slightly sandy gravelly CLAY. Gravel consists of flint and quartzite.<br>(MADE GROUND)                                                                                                  |        | 1.60      |              |                |        |                  |                 |          |        |      |
|      | Compact grey brown slightly sandy slightly gravelly SILT. Gravel consists of flint, brick, timber and calcareous deposits.<br>(MADE GROUND)                                                        |        |           |              |                |        |                  |                 | 1.70     | 1.80   | D    |
|      |                                                                                                                                                                                                    |        | 2.30      |              | PP 2.40        | PP=179 |                  |                 | 2.30     |        | D    |
|      | Firm very high strength orange brown mottled red brown slightly sandy slightly gravelly very silty CLAY. Gravel consists of flint, quartzite, brick and timber.<br>(MADE GROUND)                   |        | 2.70      |              |                |        |                  |                 |          |        |      |
|      | Very soft very low strength grey slightly gravelly very sandy CLAY with occasional rootlets. Gravel consists of flint.<br>(BOGNOR SAND MEMBER)                                                     |        | 3.00      |              | PP 2.80        | PP=13  |                  |                 | 2.80     |        | D    |
|      | BOREHOLE TERMINATED AT 3.00m                                                                                                                                                                       |        |           |              |                |        |                  |                 |          |        |      |

**Notes:** Terminated due to suspected service from 1m to 1.5m depth. Borehole collapsed to 1m depth. For Dynamic Probing, refer to DP01.

**Ground level (mAOD)**

**Co-ordinates**

471468, 108281

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

No groundwater encountered.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

D

**Location plan on drawing number**

02

**DTS01a**

| WELL | DESCRIPTION                                                                                                                                                                          | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS     |          |                  |                 | SAMPLING |        |      |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------|--------------|------------------|----------|------------------|-----------------|----------|--------|------|
|      |                                                                                                                                                                                      |        |           |              | TYPE/DEPTH (m)   | RESULT   | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|      | Vegetation onto dark brown slightly clayey gravelly SAND with frequent rootlets. Gravel consists of bituminous coated material, flint and brick.<br>(MADE GROUND - REWORKED TOPSOIL) |        | 0.10      |              |                  |          |                  |                 |          |        |      |
|      | Grey brown SAND and GRAVEL. Gravel consists of flint, brick and concrete.<br>(MADE GROUND)                                                                                           |        | 0.30      |              |                  |          |                  |                 | 0.30     |        | D    |
|      | Red brown SAND and GRAVEL. Gravel consists of brick and flint.<br>(MADE GROUND)                                                                                                      |        | 0.70      |              |                  |          |                  |                 |          |        |      |
|      | Compact grey brown slightly clayey slightly gravelly sandy SILT. Gravel consists of flint, brick and timber.<br>(MADE GROUND)<br>...from 1.1m depth, becoming grey and orange brown. |        |           |              | SPT<br>1.00-1.45 | N=(7) 10 |                  |                 | 1.00     | 1.30   | D    |
|      |                                                                                                                                                                                      |        |           |              | SPT<br>2.00-2.45 | N=(4) 8  |                  |                 |          |        |      |
|      |                                                                                                                                                                                      |        |           |              | SPT<br>3.00-3.45 | N=(1) 4  |                  |                 |          |        |      |
|      | Very soft very low strength dark grey slightly silty sandy gravelly CLAY. Gravel consists of flint, brick, timber and metal. Slight hydrocarbon odour present.<br>(MADE GROUND)      |        | 3.10      |              | PP 3.10          | PP=13    |                  |                 | 3.10     |        | ES   |
|      | Firm medium to high strength grey mottled orange brown slightly gravelly silty sandy CLAY. Gravel consists of brick and flint. Slight hydrocarbon odour present.<br>(MADE GROUND)    |        | 3.50      |              | PP 3.50          | PP=46    |                  |                 |          |        |      |
|      |                                                                                                                                                                                      |        |           |              | PP 3.80          | PP=92    |                  |                 | 3.80     |        | D    |
|      |                                                                                                                                                                                      |        |           |              | SPT<br>4.00-4.45 | N=(2) 11 |                  |                 | 4.10     |        | ES   |
|      | ...from 4.1m depth, becoming very low strength.                                                                                                                                      |        |           |              | PP 4.10          | PP=13    |                  |                 |          |        |      |
|      | ...from 4.3m depth, becoming high strength.                                                                                                                                          |        |           |              | PP 4.30          | PP=83    |                  |                 |          |        |      |
|      | Firm high strength orange brown and grey slightly silty CLAY.<br>(LONDON CLAY FORMATION)                                                                                             |        | 4.50      |              | PP 4.60          | PP=104   |                  |                 | 4.70     | 4.90   | D    |
|      |                                                                                                                                                                                      |        |           |              | PP 4.90          | PP=113   |                  |                 |          |        |      |
|      | CONTINUED ON NEXT SHEET                                                                                                                                                              |        | 5.00      |              |                  |          |                  |                 |          |        |      |

**Notes:** Hydrocarbon odour between 3.1m and 4.5m depth. Standpipe installed to 5m depth.

**Ground level (mAOD)**

**Co-ordinates**

471464, 108281

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

No groundwater encountered.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

D

**Location plan on drawing number**

02

**DTS01b**

| WELL | DESCRIPTION                  | LEGEND | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS       |          |                     |                    | SAMPLING    |        |      |
|------|------------------------------|--------|--------------|-----------------|--------------------|----------|---------------------|--------------------|-------------|--------|------|
|      |                              |        |              |                 | TYPE/<br>DEPTH (m) | RESULT   | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      |                              |        |              |                 | SPT<br>5.00-5.45   | N=(3) 12 |                     |                    |             |        |      |
|      | BOREHOLE TERMINATED AT 5.45m |        |              |                 |                    |          |                     |                    |             |        |      |

Notes: Hydrocarbon odour between 3.1m and 4.5m depth. Standpipe installed to 5m depth.

|                                                         |                                |                                                        |                        |
|---------------------------------------------------------|--------------------------------|--------------------------------------------------------|------------------------|
| Ground level (mAOD)                                     | Co-ordinates<br>471464, 108281 | Title<br>Driven tube sampler borehole record           | Surface breaking<br>No |
| Groundwater observations<br>No groundwater encountered. |                                | Date of excavation (range if applicable)<br>31/10/2016 | Appendix<br>D          |
|                                                         |                                | Location plan on drawing number<br>02                  | DTS01b                 |

| WELL | DESCRIPTION                                                                                                                                                                              | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS    |          |                  |                 | SAMPLING |        |      |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------|--------------|-----------------|----------|------------------|-----------------|----------|--------|------|
|      |                                                                                                                                                                                          |        |           |              | TYPE/ DEPTH (m) | RESULT   | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|      | Light grey brown SAND and GRAVEL. Gravel consists of brick, concrete, flint and bituminous coated material. (MADE GROUND)                                                                |        |           |              |                 |          |                  |                 | 0.20     |        | ES   |
|      | Firm orange brown and grey slightly gravelly sandy very silty CLAY. Gravel consists of concrete, brick and timber. (MADE GROUND)                                                         |        | 0.40      |              |                 |          |                  |                 | 0.40     |        | D    |
|      | Red and brown very clayey GRAVEL. Gravel consists of brick and flint. (MADE GROUND)                                                                                                      |        | 0.50      |              |                 |          |                  |                 | 0.50     |        | D    |
|      | Stiff very high becoming high strength dark orange brown and grey slightly gravelly silty sandy CLAY. Gravel consists of flint and ferruginous sandstone. (MADE GROUND)                  |        | 0.70      |              | PP 0.80         | PP=158   |                  |                 |          |        |      |
|      | Soft low strength dark brown slightly gravelly silty CLAY with frequent rootlets. Gravel consists of organic matter and flint. Organic odour present. (MADE GROUND)                      |        | 1.30      |              | SPT 1.00-1.45   | N=(2) 7  |                  |                 | 0.90     |        | D    |
|      | Soft low strength dark brown slightly gravelly silty CLAY with frequent rootlets. Gravel consists of organic matter and flint. Organic odour present. (MADE GROUND)                      |        | 1.50      |              | PP 1.10         | PP=83    |                  |                 | 1.10     |        | D    |
|      | Soft low strength dark brown slightly gravelly silty CLAY with frequent rootlets. Gravel consists of organic matter and flint. Organic odour present. (MADE GROUND)                      |        |           |              | PP 1.40         | PP=21    |                  |                 | 1.40     |        | D    |
|      | Soft becoming firm very low to high strength grey brown becoming orange brown and grey slightly sandy silty CLAY with some gravel-sized pockets of grey brown sand. (BOGNOR SAND MEMBER) |        |           |              | PP 1.70         | PP=17    |                  |                 | 1.60     | 1.80   | D    |
|      |                                                                                                                                                                                          |        |           |              | PP 1.90         | PP=29    |                  |                 |          |        |      |
|      |                                                                                                                                                                                          |        |           |              | SPT 2.00-2.45   | N=(2) 6  |                  |                 |          |        |      |
|      |                                                                                                                                                                                          |        |           |              | PP 2.20         | PP=29    |                  |                 |          |        |      |
|      |                                                                                                                                                                                          |        |           |              | PP 2.50         | PP=38    |                  |                 | 2.30     | 2.50   | D    |
|      |                                                                                                                                                                                          |        |           |              | PP 2.70         | PP=75    |                  |                 |          |        |      |
|      |                                                                                                                                                                                          |        |           |              | PP 2.90         | PP=71    |                  |                 | 2.90     |        | D    |
|      |                                                                                                                                                                                          |        |           |              | SPT 3.00-3.45   | N=(3) 10 |                  |                 |          |        |      |
|      | BOREHOLE TERMINATED AT 3.45m                                                                                                                                                             |        | 3.45      |              |                 |          |                  |                 |          |        |      |

**Notes:** Organic odour between 1.3m to 1.5m depth. For Dynamic Probing, refer to DP02.

**Ground level (mAOD)**

**Co-ordinates**

471458, 108294

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

No groundwater encountered.

**Date of excavation (range if applicable)**

31/10/2016

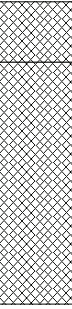
**Appendix**

D

**Location plan on drawing number**

02

**DTS02**

| WELL | DESCRIPTION                                                                                                                                                                     | LEGEND                                                                            | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS       |        |                     |                    | SAMPLING    |        |      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------|-----------------|--------------------|--------|---------------------|--------------------|-------------|--------|------|
|      |                                                                                                                                                                                 |                                                                                   |              |                 | TYPE/<br>DEPTH (m) | RESULT | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m) | TO (m) | TYPE |
|      | Light grey brown SAND and GRAVEL. Gravel consists of brick, concrete, flint and bituminous coated material.<br>(MADE GROUND)                                                    |  | 0.20         |                 |                    |        |                     |                    | 0.20        |        | ES   |
|      | Grey brown, red brown and brown slightly silty very clayey SAND and GRAVEL. Gravel consists of brick, concrete, flint, plastic and bituminous coated material.<br>(MADE GROUND) |                                                                                   |              |                 |                    |        |                     |                    | 0.40        | 0.50   | D    |
|      |                                                                                                                                                                                 |                                                                                   |              |                 |                    |        |                     |                    | 0.60        |        | D    |
|      | ...between 0.6m and 0.7m depth, becoming dark grey.                                                                                                                             |                                                                                   |              |                 |                    |        |                     |                    | 0.80        | 0.90   | D    |
|      | BOREHOLE TERMINATED AT 1.00m                                                                                                                                                    |                                                                                   | 1.00         |                 |                    |        |                     |                    |             |        |      |

**Notes:** Terminated due to concrete obstruction. Borehole collapsed to 0.8m depth.

**Ground level (mAOD)**

**Co-ordinates**  
471438, 108303

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

No groundwater encountered.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

D

**Location plan on drawing number**

02

**DTS03**

| WELL | DESCRIPTION                                                                                                                | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS   |        |                  |                 | SAMPLING |        |      |
|------|----------------------------------------------------------------------------------------------------------------------------|--------|-----------|--------------|----------------|--------|------------------|-----------------|----------|--------|------|
|      |                                                                                                                            |        |           |              | TYPE/DEPTH (m) | RESULT | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|      | Grey GRAVEL. Gravel consists of quartzite.<br>(MADE GROUND)                                                                |        | 0.05      |              |                |        |                  |                 |          |        |      |
|      | Yellowish brown very gravelly SAND. Gravel consists of brick, flint, concrete, mudstone and igneous rock.<br>(MADE GROUND) |        | 0.40      |              |                |        |                  |                 | 0.30     |        | ES   |
|      | Dark grey slightly clayey SAND and GRAVEL. Gravel consists of sandstone, flint and organic matter.<br>(MADE GROUND)        |        | 0.50      |              |                |        |                  |                 | 0.40     |        | ES   |
|      | Brown slightly clayey SAND and GRAVEL. Gravel consists of flint, brick, sandstone and concrete.<br>(MADE GROUND)           |        |           |              |                |        |                  |                 | 0.60     | 0.80   | D    |
|      | Soft becoming stiff brown sandy gravelly CLAY. Gravel consists of flint, brick and sandstone.<br>(MADE GROUND)             |        | 1.10      |              |                |        |                  |                 | 1.15     |        | D    |
|      | Grey and grey brown slightly clayey SAND.<br>(BOGNOR SAND MEMBER)                                                          |        | 1.50      |              |                |        |                  |                 | 1.50     | 1.60   | D    |
|      |                                                                                                                            |        |           |              |                |        |                  |                 | 1.80     |        | ES   |
|      |                                                                                                                            |        |           |              |                |        |                  |                 | 1.90     |        | D    |
|      | BOREHOLE TERMINATED AT 2.00m                                                                                               |        | 2.00      |              |                |        |                  |                 |          |        |      |

**Notes:** For Dynamic Probing, refer to DP03. Standpipe installed to 2m depth. Standpipe 1m above ground level. Slight hydrocarbon odour noted within groundwater.

**Ground level (mAOD)**

**Co-ordinates**  
471418, 108292

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

Groundwater encountered at 1.5m depth 10 minutes after completion, rising to 1.35m depth after 20 minutes.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

D

**Location plan on drawing number**

02

**DTS04**

| WELL | DESCRIPTION                                                                                                                                                                                                                   | LEGEND | DEPTH (m) | WATER STRIKE | TEST RESULTS    |          |                  |                 | SAMPLING |        |      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------|--------------|-----------------|----------|------------------|-----------------|----------|--------|------|
|      |                                                                                                                                                                                                                               |        |           |              | TYPE/ DEPTH (m) | RESULT   | CASING DEPTH (m) | WATER LEVEL (m) | FROM (m) | TO (m) | TYPE |
|      | Dark grey and brown slightly clayey GRAVEL. Gravel consists of granite, flint, quartzite and concrete.<br>(MADE GROUND)                                                                                                       |        | 0.20      |              |                 |          |                  |                 | 0.10     |        | ES   |
|      | Grey brown SAND and GRAVEL. Gravel consists of concrete and flint.<br>(MADE GROUND)                                                                                                                                           |        | 0.30      |              | PP 0.40         | PP=88    |                  |                 | 0.40     |        | D    |
|      |                                                                                                                                                                                                                               |        |           |              | PP 0.60         | PP=83    |                  |                 | 0.60     | 0.80   | D    |
|      | Stiff becoming firm high becoming medium strength grey brown slightly sandy gravelly CLAY with some gravel-sized pockets of dark grey silt. Gravel consists of flint, brick, chalk, ash and glass.<br>(MADE GROUND)           |        | 1.00      |              | PP 0.80         | PP=63    |                  |                 |          |        |      |
|      | from 0.8m depth, becoming orange brown and grey.                                                                                                                                                                              |        |           |              | SPT 1.00-1.45   | N=(4) 4  |                  |                 | 1.10     |        | D    |
|      | Very dark grey SAND and GRAVEL. Gravel consists of bituminous coated material and flint.<br>(MADE GROUND)                                                                                                                     |        | 1.20      |              | PP 1.30         | PP=29    |                  |                 |          |        |      |
|      | Soft low strength orange brown sandy very gravelly CLAY with some gravel-sized pockets of dark grey sand. Gravel consists of brick, flint, bituminous coated material, chalk, ash and ferruginous sandstone.<br>(MADE GROUND) |        |           |              |                 |          |                  |                 | 1.60     | 1.70   | ES   |
|      |                                                                                                                                                                                                                               |        | 2.10      |              | SPT 2.00-2.45   | N=(4) 11 |                  |                 |          |        |      |
|      | Orange brown and light grey clayey SAND. (BOGNOR SAND MEMBER)                                                                                                                                                                 |        |           |              |                 |          |                  |                 | 2.50     | 2.60   | B    |
|      |                                                                                                                                                                                                                               |        |           |              |                 |          |                  |                 |          |        |      |
|      |                                                                                                                                                                                                                               |        |           |              | SPT 3.00-3.45   | N=(2) 7  |                  |                 |          |        |      |
|      | BOREHOLE TERMINATED AT 3.45m                                                                                                                                                                                                  |        | 3.45      |              |                 |          |                  |                 |          |        |      |

**Notes:** 75% recovery between 1m to 2m depth due to compression. Very slight TPH odour noted within groundwater. For Dynamic Probing, refer to DP04.

**Ground level (mAOD)**

**Co-ordinates**

471382, 108271

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

Groundwater encountered at 2.6m depth 30 minutes after completion.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

D

**Location plan on drawing number**

02

**DTS05**

| WELL | DESCRIPTION                                                                                                                                                     | LEGEND | DEPTH<br>(m) | WATER<br>STRIKE | TEST RESULTS       |         |                     |                    | SAMPLING     |        |         |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------|-----------------|--------------------|---------|---------------------|--------------------|--------------|--------|---------|
|      |                                                                                                                                                                 |        |              |                 | TYPE/<br>DEPTH (m) | RESULT  | CASING<br>DEPTH (m) | WATER<br>LEVEL (m) | FROM<br>(m)  | TO (m) | TYPE    |
|      | Dark grey and brown slightly clayey GRAVEL. Gravel consists of granite, flint, quartzite and concrete.<br>(MADE GROUND)                                         |        | 0.20         |                 |                    |         |                     |                    | 0.20         |        | ES      |
|      | Brown clayey gravelly SAND. Gravel consists of brick and flint.<br>(MADE GROUND)                                                                                |        | 0.30         |                 |                    |         |                     |                    | 0.40         | 0.50   | D       |
|      | Red and brown slightly clayey SAND and GRAVEL. Gravel consists of brick and flint.<br>(MADE GROUND)                                                             |        | 0.80         |                 |                    |         |                     |                    | 0.90         |        | D       |
|      | Light grey SAND and GRAVEL. Gravel consists of concrete and flint.<br>(MADE GROUND)                                                                             |        | 1.00         |                 | SPT<br>1.00-1.45   | N=(2) 9 |                     |                    | 1.10         |        | D       |
|      | Soft becoming firm brown gravelly very sandy CLAY. Gravel consists of concrete, flint, brick and bituminous coated material.<br>(MADE GROUND)                   |        | 1.50         |                 | PP 1.60            | PP=63   |                     |                    | 1.55<br>1.60 | 1.70   | ES<br>D |
|      | Soft medium strength dark grey gravelly very sandy CLAY. Gravel consists of flint, brick, bituminous coated material, chalk, clinker and coal.<br>(MADE GROUND) |        |              |                 | SPT<br>2.00-2.45   | N=(0) 4 |                     |                    | 2.50         | 2.60   | ES      |
|      |                                                                                                                                                                 |        |              |                 | SPT<br>3.00-3.45   | N=(1) 5 |                     |                    | 3.20         | 3.30   | ES      |
|      |                                                                                                                                                                 |        |              |                 |                    |         |                     |                    | 3.70         |        | D       |
|      | BOREHOLE TERMINATED AT 3.80m                                                                                                                                    |        | 3.80         |                 |                    |         |                     |                    |              |        |         |

**Notes:** Terminated due to obstruction. Borehole collapsed to 1.85m depth. For Dynamic Probing, refer to DP05. Standpipe installed to 2m depth.

**Ground level (mAOD)**

**Co-ordinates**

471400, 108266

**Title**

Driven tube sampler borehole record

**Surface breaking**

No

**Groundwater observations**

No groundwater encountered.

**Date of excavation (range if applicable)**

31/10/2016

**Appendix**

D

**Location plan on drawing number**

02

**DTS06**

## Summary log for dynamic probing

### Dynamic Probing Test Number: DP01

Easting:

Northing:

Ground level (mAOD):

Date of test: 31/10/2016

Cone type:

Anvil type:

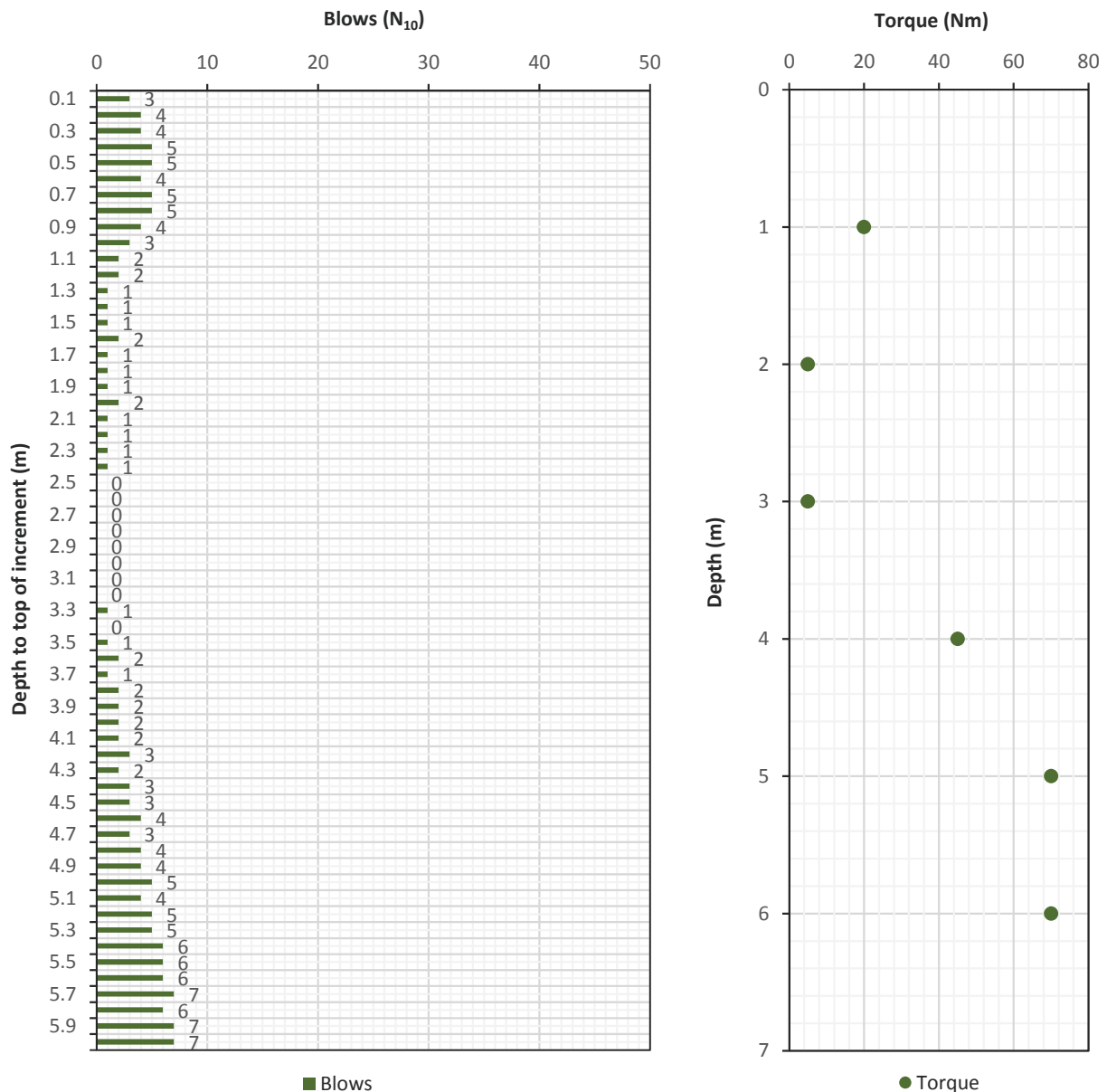
Type of dynamic probing:

Manufacturer:

Model:

Model Number:

Equipment checked and in accordance with EN ISO 22476-2, 5.1:



Title

Summary of dynamic probing log for location DP01

Appendix

E

## Summary log for dynamic probing

### Dynamic Probing Test Number: DP02

Easting:

Northing:

Ground level (mAOD):

Date of test: 31/10/2016

Cone type:

Anvil type:

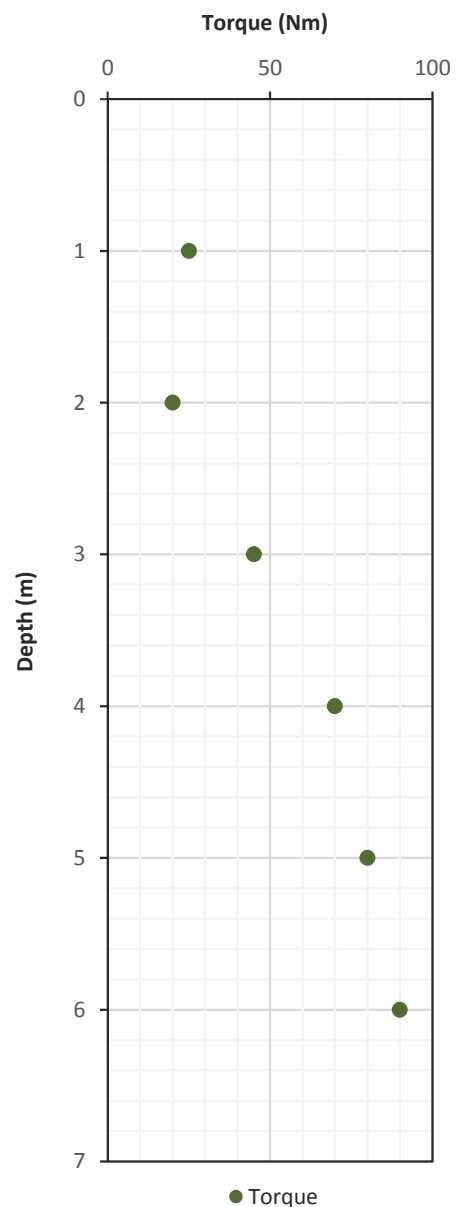
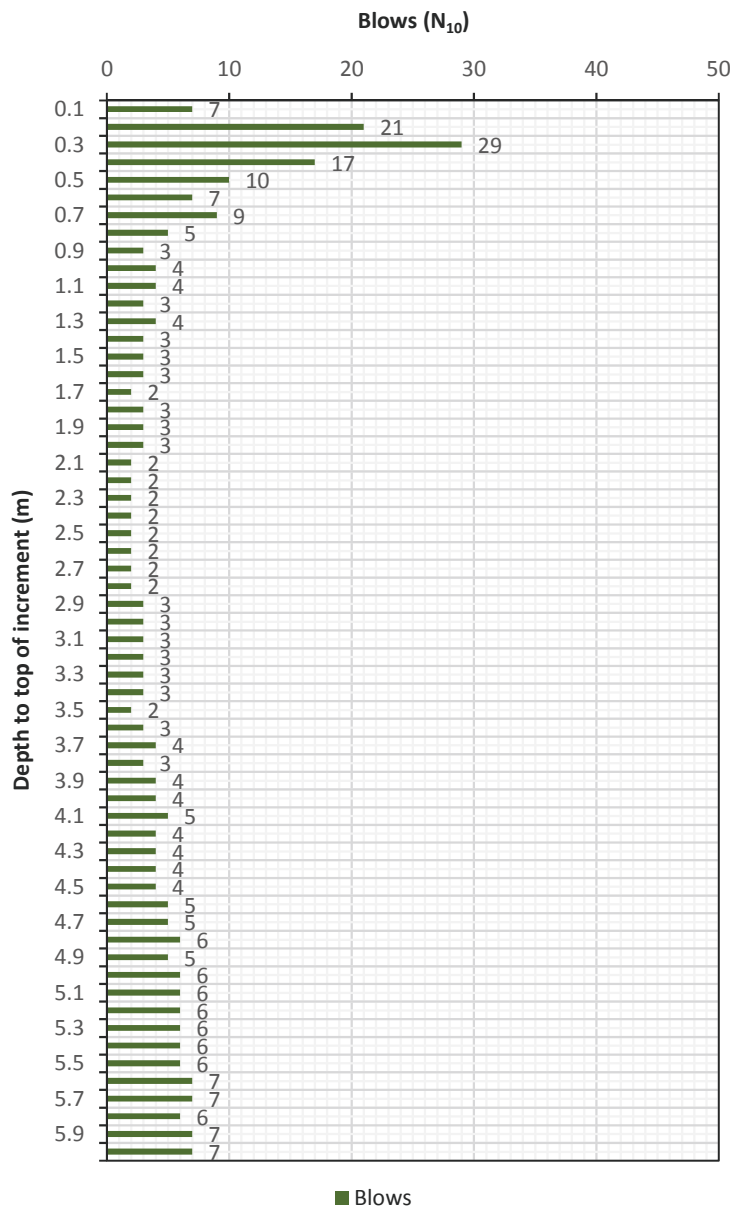
Type of dynamic probing:

Manufacturer:

Model:

Model Number:

Equipment checked and in accordance with EN ISO 22476-2, 5.1:



Title

Summary of dynamic probing log for location DP02

Appendix

E

## Summary log for dynamic probing

### Dynamic Probing Test Number: DP03

Easting:

Northing:

Ground level (mAOD):

Date of test: 31/10/2016

Cone type:

Anvil type:

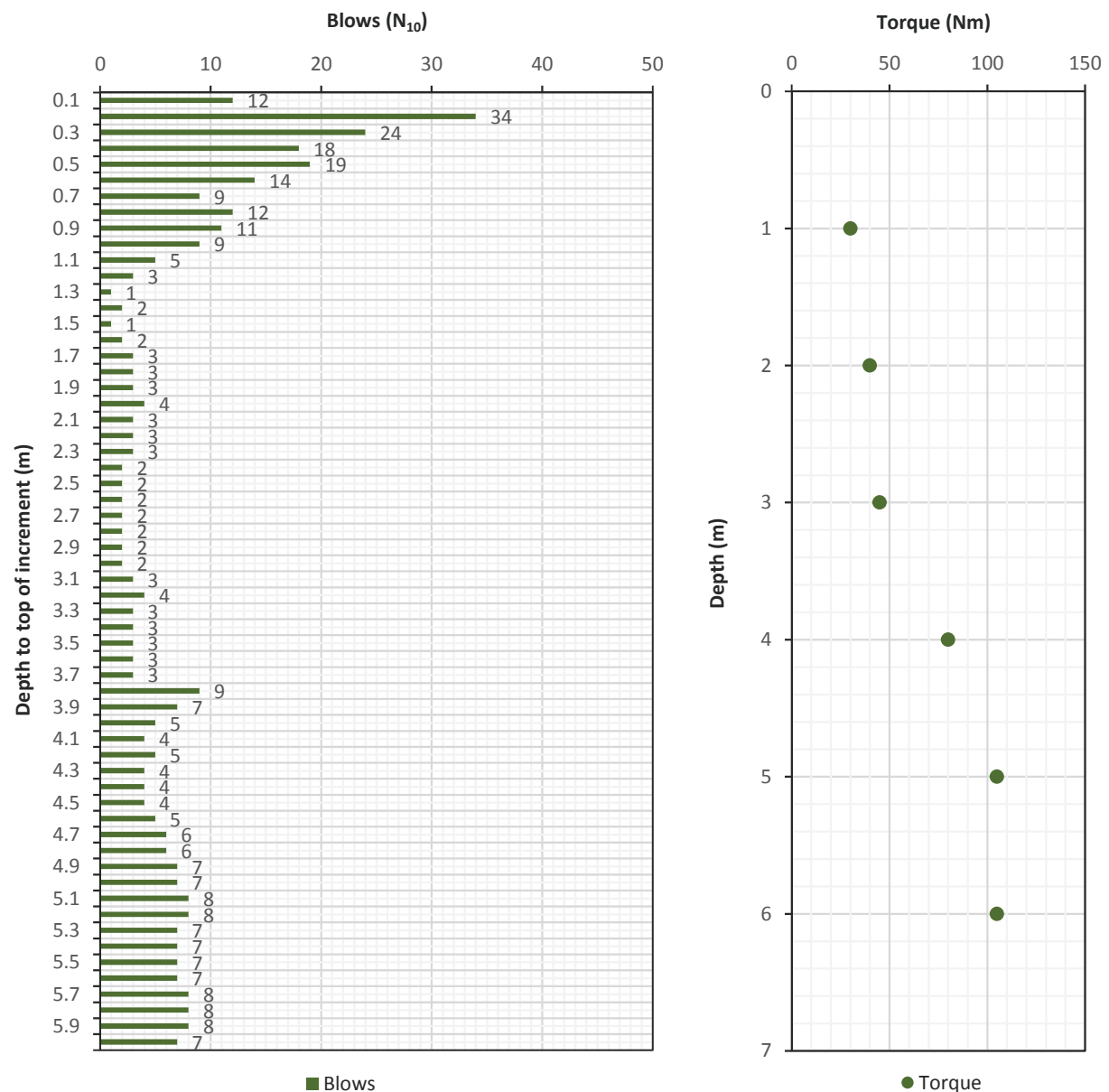
Type of dynamic probing:

Manufacturer:

Model:

Model Number:

Equipment checked and in accordance with EN ISO 22476-2, 5.1:



Title

Summary of dynamic probing log for location DP03

Appendix

E

## Summary log for dynamic probing

### Dynamic Probing Test Number: DP04

Easting:

Northing:

Ground level (mAOD):

Date of test: 31/10/2016

Cone type:

Anvil type:

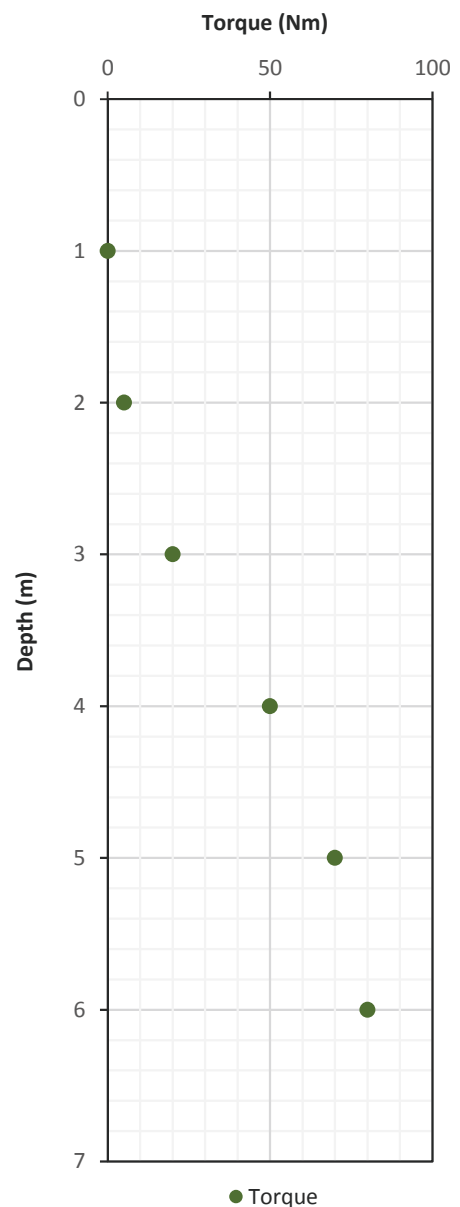
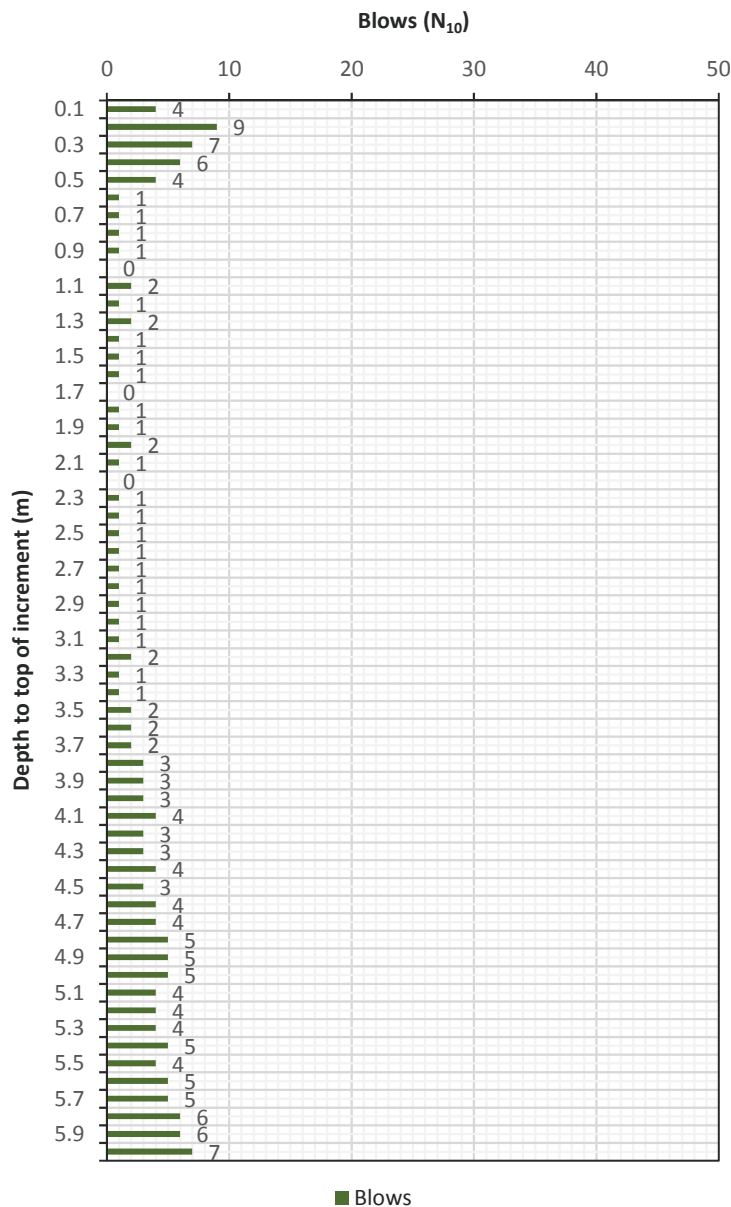
Type of dynamic probing:

Manufacturer:

Model:

Model Number:

Equipment checked and in accordance with EN ISO 22476-2, 5.1:



Title

Summary of dynamic probing log for location DP04

Appendix

E

## Summary log for dynamic probing

### Dynamic Probing Test Number: DP05

Easting:

Northing:

Ground level (mAOD):

Date of test: 01/11/2016

Cone type:

Anvil type:

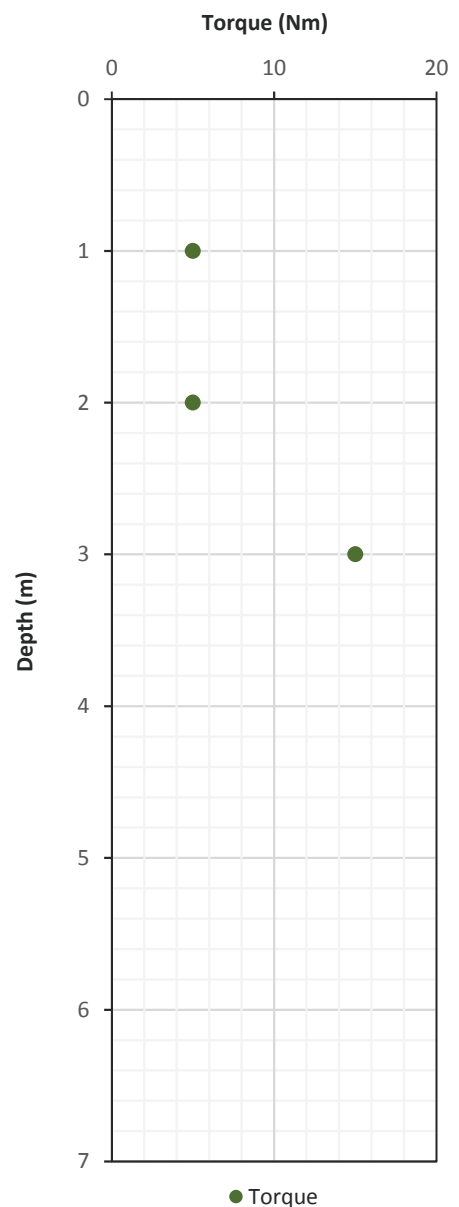
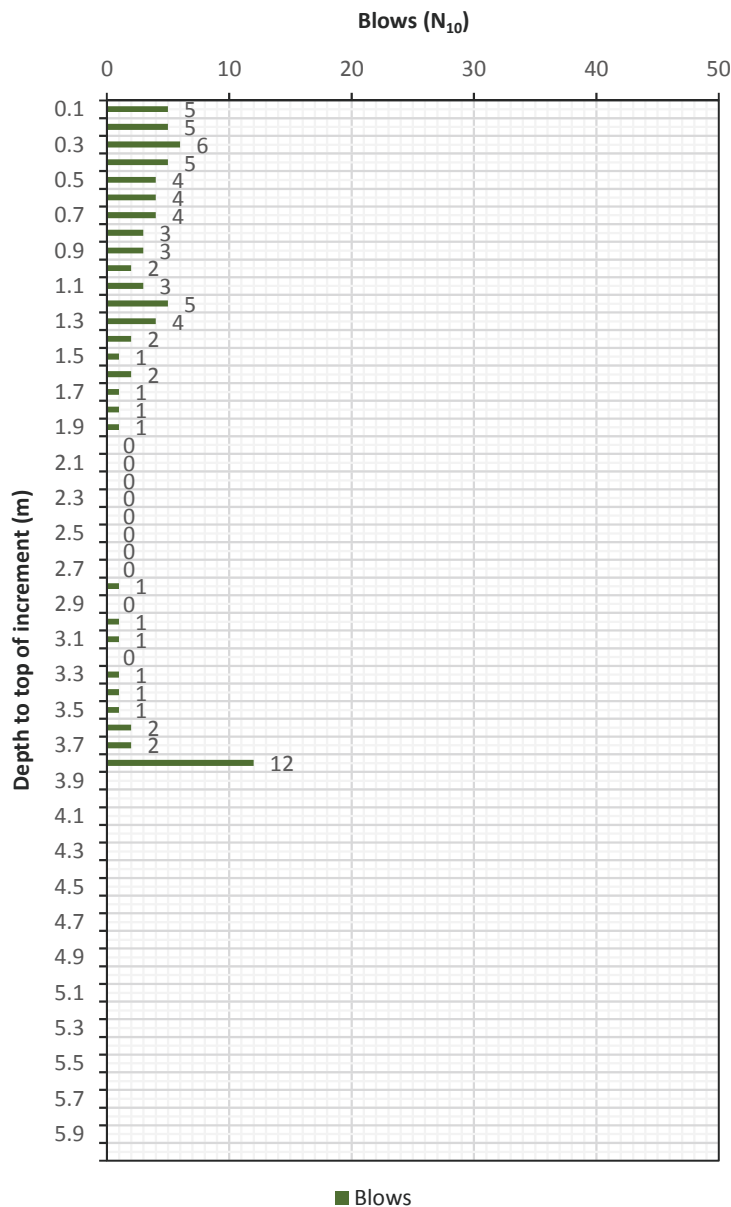
Type of dynamic probing:

Manufacturer:

Model:

Model Number:

Equipment checked and in accordance with EN ISO 22476-2, 5.1:



Title

Summary of dynamic probing log for location DP05

Appendix

E



0001

TEST REPORT

**CONSOLIDATION TEST REPORT**

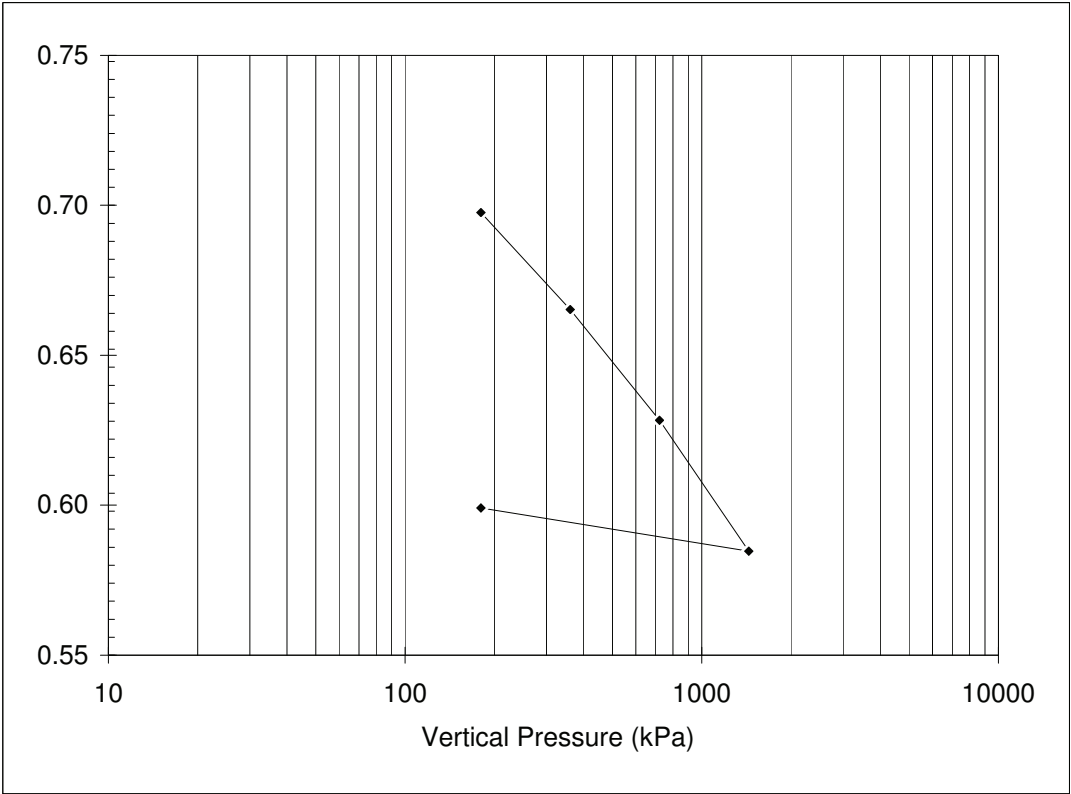
B.S. 1377-5:1990

Client: Soiltechnics Limited  
Address: Cedar Barn, White Lodge, Walgrave, NN6 9PY  
Site: STN3739B - MIPA, Havant  
Location: BH01 @ 9.20-9.65m  
Visual Description: Brown grey CLAY

|                           |                        |                          |                        |
|---------------------------|------------------------|--------------------------|------------------------|
| Initial Moisture Content  | 27.3 %                 | Lab. temperature         | 15-19 °C               |
| Initial Bulk Density      | 1.93 Mg/m <sup>3</sup> | Initial Voids Ratio      | 0.782                  |
| Initial Dry Density       | 1.52 Mg/m <sup>3</sup> | Degree of Saturation     | 94.2 %                 |
| Initial Specimen Diameter | 74.80 mm               | Final Moisture Content   | 24.1 %                 |
| Initial Specimen Height   | 19.10 mm               | Assumed Particle Density | 2.70 Mg/m <sup>3</sup> |

Orientation of specimen: Test specimen taken in same direction as sampling.

Report No. 51028540/16/01  
Lab. Ref. 45302176  
Reported: 29.11.16  
Received: 14.11.16  
Test Date: 17.11.16



|                           |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|
| Increment No.             | 1     | 2     | 3     | 4     | 5     |
| Pressure (kPa)            | 180   | 360   | 720   | 1440  | 180   |
| Settlement (mm)           | 0.900 | 1.247 | 1.643 | 2.111 | 1.956 |
| Voids Ratio               | 0.698 | 0.665 | 0.628 | 0.585 | 0.599 |
| Mv (m <sup>2</sup> /MN)   | 0.26  | 0.11  | 0.06  | 0.04  |       |
| Cv (m <sup>2</sup> /year) | 38.61 | 9.99  | 5.54  | 3.66  |       |
| t90                       | 1.00  | 3.61  | 6.25  | 9.00  |       |

The test was carried out in accordance with BS 1377- 5:1990, Clause 3  
t90 value determined by root time curve-fitting method.

Signed M. Carr

[✓] M. Carr - Section Manager  
[ ] D. Berrill - Laboratory Manager

For and on behalf of Environmental Scientifics Group



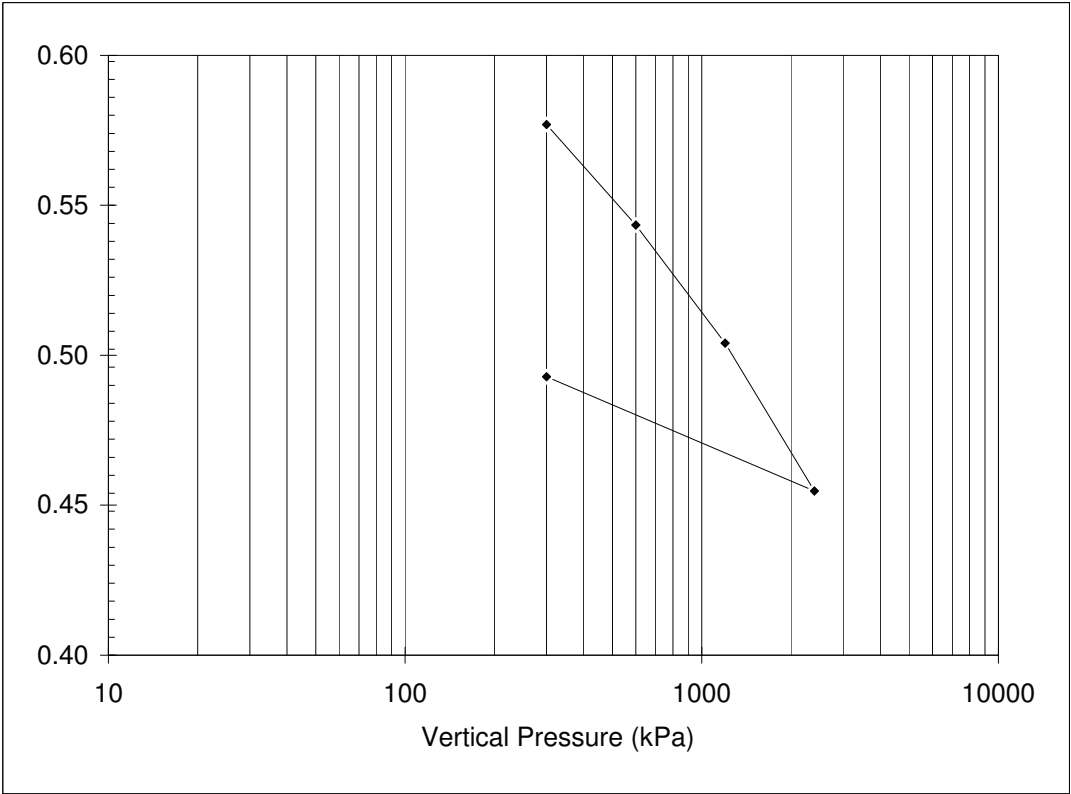
0001

TEST REPORT

**CONSOLIDATION TEST REPORT**

B.S. 1377-5:1990

|                           |                                                    |                          |                        |
|---------------------------|----------------------------------------------------|--------------------------|------------------------|
| Client:                   | Soiltechnics Limited                               | Report No.               | 51028540/16/02         |
| Address:                  | Cedar Barn, White Lodge, Walgrave, NN6 9PY         | Lab. Ref.                | 45302182               |
| Site:                     | STN3739B - MIPA, Havant                            | Reported:                | 29.11.16               |
| Location:                 | BH02 @ 14.70-15.15                                 | Received:                | 14.11.16               |
| Visual Description:       | Grey CLAY                                          | Test Date:               | 17.11.16-24.11.16      |
| Initial Moisture Content  | 24.6 %                                             | Lab. temperature         | 15-19 °C               |
| Initial Bulk Density      | 2.02 Mg/m <sup>3</sup>                             | Initial Voids Ratio      | 0.662                  |
| Initial Dry Density       | 1.62 Mg/m <sup>3</sup>                             | Degree of Saturation     | 100.5 %                |
| Initial Specimen Diameter | 74.70 mm                                           | Final Moisture Content   | 25.4 %                 |
| Initial Specimen Height   | 19.10 mm                                           | Assumed Particle Density | 2.70 Mg/m <sup>3</sup> |
| Orientation of specimen:  | Test specimen taken in same direction as sampling. |                          |                        |



|                           |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|
| Increment No.             | 1     | 2     | 3     | 4     | 5     |
| Pressure (kPa)            | 300   | 600   | 1200  | 2400  | 300   |
| Settlement (mm)           | 0.976 | 1.361 | 1.813 | 2.380 | 1.942 |
| Voids Ratio               | 0.577 | 0.543 | 0.504 | 0.455 | 0.493 |
| Mv (m <sup>2</sup> /MN)   | 0.17  | 0.07  | 0.04  | 0.03  |       |
| Cv (m <sup>2</sup> /year) | 10.65 | 6.20  | 2.78  | 1.58  |       |
| t90                       | 3.61  | 5.76  | 12.25 | 20.25 |       |

The test was carried out in accordance with BS 1377- 5:1990, Clause 3  
t90 value determined by root time curve-fitting method.

Signed M. Carr [✓] M. Carr - Section Manager  
[ ] D. Berrill - Laboratory Manager

For and on behalf of Environmental Scientifics Group



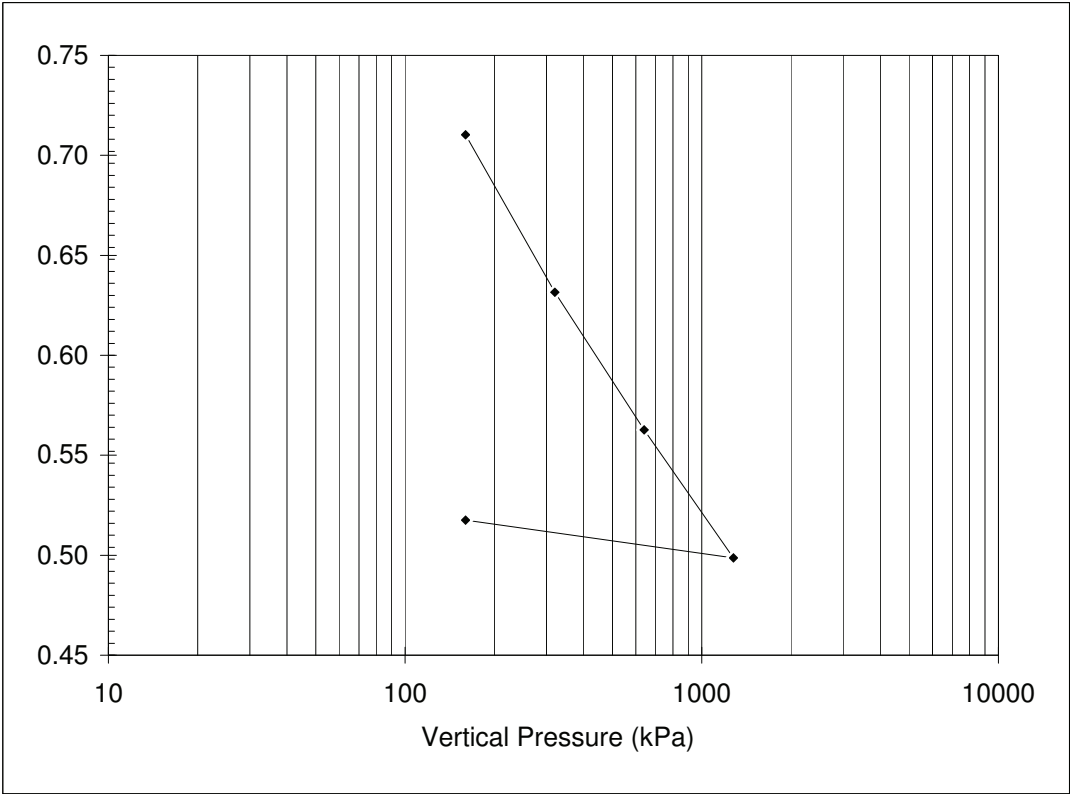
0001

TEST REPORT

**CONSOLIDATION TEST REPORT**

B.S. 1377-5:1990

|                           |                                                    |                          |                        |
|---------------------------|----------------------------------------------------|--------------------------|------------------------|
| Client:                   | Soiltechnics Limited                               | Report No.               | 51028540/16/03         |
| Address:                  | Cedar Barn, White Lodge, Walgrave, NN6 9PY         | Lab. Ref.                | 45302184               |
| Site:                     | STN3739B - MIPA, Havant                            | Reported:                | 29.11.16               |
| Location:                 | BH03 @ 8.70-9.15                                   | Received:                | 14.11.16               |
| Visual Description:       | Grey CLAY                                          | Test Date:               | 17.11.16-24.11.16      |
| Initial Moisture Content  | 33.4 %                                             | Lab. temperature         | 15-19 °C               |
| Initial Bulk Density      | 1.88 Mg/m <sup>3</sup>                             | Initial Voids Ratio      | 0.915                  |
| Initial Dry Density       | 1.41 Mg/m <sup>3</sup>                             | Degree of Saturation     | 98.5 %                 |
| Initial Specimen Diameter | 74.90 mm                                           | Final Moisture Content   | 21.1 %                 |
| Initial Specimen Height   | 18.90 mm                                           | Assumed Particle Density | 2.70 Mg/m <sup>3</sup> |
| Orientation of specimen:  | Test specimen taken in same direction as sampling. |                          |                        |



|                           |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|
| Increment No.             | 1     | 2     | 3     | 4     | 5     |
| Pressure (kPa)            | 160   | 320   | 640   | 1280  | 160   |
| Settlement (mm)           | 2.022 | 2.799 | 3.478 | 4.111 | 3.924 |
| Voids Ratio               | 0.710 | 0.632 | 0.563 | 0.499 | 0.518 |
| Mv (m <sup>2</sup> /MN)   | 0.67  | 0.29  | 0.13  | 0.06  |       |
| Cv (m <sup>2</sup> /year) | 6.17  | 1.98  | 1.56  | 1.25  |       |
| t90                       | 5.76  | 15.21 | 17.64 | 20.25 |       |

The test was carried out in accordance with BS 1377- 5:1990, Clause 3  
t90 value determined by root time curve-fitting method.

Signed M. Carr [✓] M. Carr - Section Manager  
[ ] D. Berrill - Laboratory Manager

For and on behalf of Environmental Scientifics Group



0001

## Determination of Undrained Shear Strength in Triaxial Compression

|          |                                                                           |                       |                |
|----------|---------------------------------------------------------------------------|-----------------------|----------------|
| Client:  | Soiltechnics Limited<br>Cedar Barn,<br>White Lodge<br>Walgrave<br>NN6 9PY | Report No:            | 51028540/16/04 |
| Contact: | Andy Keeler                                                               | Batch Number:         | DAM0064463     |
| Site:    | STN3739B - MIPA, Havant                                                   | Date Sampled:         | 01.11.16       |
|          |                                                                           | Date Received:        | 14.11.16       |
|          |                                                                           | Date Tested:          | 23.11.16       |
|          |                                                                           | Sampled By:           | Client         |
|          |                                                                           | Sampling Certificate: | N              |
|          |                                                                           | Sample Type:          | U100           |

|                     |                                   |           |             |             |
|---------------------|-----------------------------------|-----------|-------------|-------------|
| Sample Details:     | Laboratory Reference:             | 45302176  | 45302177    | 45302178    |
|                     | Client Ref:                       | 1         | 2           | 3           |
|                     | Location:                         | BH01      | BH01        | BH01        |
|                     | Depth (m):                        | 9.20-9.65 | 12.20-12.65 | 15.20-15.75 |
|                     | Initial Height (mm)               | 192       | 207         | 207         |
|                     | Initial Diameter (mm)             | 104       | 104         | 104         |
|                     | Bulk Density (Mg/m <sup>3</sup> ) | 2.07      | 1.95        | 2.06        |
|                     | Moisture Content (%)              | 22        | 32          | 24          |
|                     | Dry Density (Mg/m <sup>3</sup> )  | 1.69      | 1.48        | 1.66        |
| Test Conditions:    | Cell Pressure (kPa)               | 190       | 250         | 310         |
|                     | Rate of Strain (%/min.)           | 1.30      | 1.21        | 1.21        |
| Failure Conditions: | Load at Failure (kN)              | 1.908     | 0.167       | 2.047       |
|                     | Strain at Failure (mm)            | 13.80     | 1.40        | 14.20       |
|                     | Max Deviator Stress (kPa)         | 201       | 7           | 209         |
|                     | Membrane Correction (kPa)         | 0.66      | 0.10        | 0.63        |
|                     | Strain (%)                        | 7.2       | 0.7         | 6.9         |
|                     | Shear Strength (kPa)              | 101       | 4           | 105         |

Failure Diagram:



|                                                              |       |              |       |
|--------------------------------------------------------------|-------|--------------|-------|
| Mode of Failure:                                             | Shear | Barrel/Shear | Shear |
| Depth of test specimen from base within original sample (mm) | 20.18 | 17.66        | 21.02 |
| Membrane Latex Rubber Thickness (mm)                         | 0.40  | 0.40         | 0.40  |

Sample Description:

|          |                       |
|----------|-----------------------|
| 45302176 | Grey Brown sandy CLAY |
| 45302177 | Brown CLAY with silt  |
| 45302178 | Brown CLAY with silt  |

Comments: Sample Preparation: Undisturbed  
Orientation: Maintaining sample direction.

Certified that the test was carried out in accordance with BS 1377-7 :1990, Method 8

Certified that the Moisture Content was determined in accordance with BS 1377-2:1990, Method 3.2

Page 1 of 1  
Date: 28.11.16

**Signed:**

[ ] M. Carr - Section Manager  
[✓] D. Berrill - Laboratory Manager

For and on behalf of Environmental Scientifics Group

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

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0001

## Determination of Undrained Shear Strength in Triaxial Compression

|          |                                                                           |                       |                |
|----------|---------------------------------------------------------------------------|-----------------------|----------------|
| Client:  | Soiltechnics Limited<br>Cedar Barn,<br>White Lodge<br>Walgrave<br>NN6 9PY | Report No:            | 51028540/16/05 |
| Contact: | Andy Keeler                                                               | Batch Number:         | DAM0064463     |
| Site:    | STN3739B - MIPA, Havant                                                   | Date Sampled:         | 01.11.16       |
|          |                                                                           | Date Received:        | 14.11.16       |
|          |                                                                           | Date Tested:          | 23.11.16       |
|          |                                                                           | Sampled By:           | Client         |
|          |                                                                           | Sampling Certificate: | N              |
|          |                                                                           | Sample Type:          | U100           |

|                 |                                   |             |           |             |
|-----------------|-----------------------------------|-------------|-----------|-------------|
| Sample Details: | Laboratory Reference:             | 45302179    | 45302180  | 45302181    |
|                 | Client Ref:                       | 4           | 5         | 6           |
|                 | Location:                         | BH01        | BH02      | BH02        |
|                 | Depth (m):                        | 18.20-18.65 | 8.70-9.15 | 11.70-12.15 |
|                 | Initial Height (mm)               | 207         | 207       | 207         |
|                 | Initial Diameter (mm)             | 104         | 104       | 104         |
|                 | Bulk Density (Mg/m <sup>3</sup> ) | 2.04        | 2.04      | 2.03        |
|                 | Moisture Content (%)              | 21          | 28        | 20          |
|                 | Dry Density (Mg/m <sup>3</sup> )  | 1.68        | 1.60      | 1.69        |

|                  |                         |      |      |      |
|------------------|-------------------------|------|------|------|
| Test Conditions: | Cell Pressure (kPa)     | 370  | 180  | 240  |
|                  | Rate of Strain (%/min.) | 1.21 | 1.21 | 1.21 |

|                     |                           |       |       |       |
|---------------------|---------------------------|-------|-------|-------|
| Failure Conditions: | Load at Failure (kN)      | 3.504 | 2.553 | 2.841 |
|                     | Strain at Failure (mm)    | 22.80 | 29.40 | 23.20 |
|                     | Max Deviator Stress (kPa) | 348   | 249   | 285   |
|                     | Membrane Correction (kPa) | 0.93  | 1.13  | 0.94  |
|                     | Strain (%)                | 11.0  | 14.2  | 11.2  |
|                     | Shear Strength (kPa)      | 174   | 124   | 142   |

Failure Diagram:



|                                                              |              |              |       |
|--------------------------------------------------------------|--------------|--------------|-------|
| Mode of Failure:                                             | Barrel/Shear | Barrel/Shear | Shear |
| Depth of test specimen from base within original sample (mm) | 13.39        | 8.9          | 30.78 |
| Membrane Latex Rubber Thickness (mm)                         | 0.40         | 0.40         | 0.40  |

Sample Description:

|          |                      |
|----------|----------------------|
| 45302179 | Brown CLAY           |
| 45302180 | Brown CLAY           |
| 45302181 | Brown CLAY with silt |

Comments: Sample Preparation: Undisturbed  
Orientation: Maintaining sample direction.

Certified that the test was carried out in accordance with BS 1377-7 :1990, Method 8

Certified that the Moisture Content was determined in accordance with BS 1377-2:1990, Method 3.2

Page 1 of 1  
Date: 28.11.16

**Signed:**

[ ] M. Carr - Section Manager  
[✓] D. Berrill - Laboratory Manager

For and on behalf of Environmental Scientifics Group

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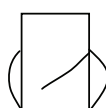
0001

## Determination of Undrained Shear Strength in Triaxial Compression

|          |                                                                           |                       |                |
|----------|---------------------------------------------------------------------------|-----------------------|----------------|
| Client:  | Soiltechnics Limited<br>Cedar Barn,<br>White Lodge<br>Walgrave<br>NN6 9PY | Report No:            | 51028540/16/06 |
| Contact: | Andy Keeler                                                               | Batch Number:         | DAM0064463     |
| Site:    | STN3739B - MIPA, Havant                                                   | Date Sampled:         | 01.11.16       |
|          |                                                                           | Date Received:        | 14.11.16       |
|          |                                                                           | Date Tested:          | 23.11.16       |
|          |                                                                           | Sampled By:           | Client         |
|          |                                                                           | Sampling Certificate: | N              |
|          |                                                                           | Sample Type:          | U100           |

|                     |                                   |             |             |           |
|---------------------|-----------------------------------|-------------|-------------|-----------|
| Sample Details:     | Laboratory Reference:             | 45302182    | 45302183    | 45302184  |
|                     | Client Ref:                       | 7           | 8           | 9         |
|                     | Location:                         | BH02        | BH02        | BH03      |
|                     | Depth (m):                        | 14.70-15.15 | 17.70-18.15 | 8.70-9.15 |
|                     | Initial Height (mm)               | 207         | 207         | 207       |
|                     | Initial Diameter (mm)             | 104         | 104         | 104       |
|                     | Bulk Density (Mg/m <sup>3</sup> ) | 2.02        | 2.01        | 1.84      |
|                     | Moisture Content (%)              | 21          | 25          | 32        |
|                     | Dry Density (Mg/m <sup>3</sup> )  | 1.68        | 1.61        | 1.40      |
| Test Conditions:    | Cell Pressure (kPa)               | 300         | 360         | 180       |
|                     | Rate of Strain (%/min.)           | 1.21        | 1.21        | 1.21      |
| Failure Conditions: | Load at Failure (kN)              | 2.200       | 1.902       | 0.140     |
|                     | Strain at Failure (mm)            | 27.80       | 25.40       | 2.60      |
|                     | Max Deviator Stress (kPa)         | 209         | 178         | 8         |
|                     | Membrane Correction (kPa)         | 1.08        | 1.01        | 0.15      |
|                     | Strain (%)                        | 13.4        | 12.3        | 1.3       |
|                     | Shear Strength (kPa)              | 105         | 89          | 4         |

Failure Diagram:



|                                                              |              |              |        |
|--------------------------------------------------------------|--------------|--------------|--------|
| Mode of Failure:                                             | Barrel/Shear | Barrel/Shear | Barrel |
| Depth of test specimen from base within original sample (mm) | 63.07        | 27.91        | 31.07  |
| Membrane Latex Rubber Thickness (mm)                         | 0.40         | 0.40         | 0.40   |

Sample Description:

|          |                      |
|----------|----------------------|
| 45302182 | Grey sandy CLAY      |
| 45302183 | Brown CLAY with silt |
| 45302184 | Grey CLAY            |

Comments: Sample Preparation: Undisturbed  
Orientation: Maintaining sample direction.

Certified that the test was carried out in accordance with BS 1377-7 :1990, Method 8

Certified that the Moisture Content was determined in accordance with BS 1377-2:1990, Method 3.2

Page 1 of 1  
Date: 28.11.16

**Signed:**

[ ] M. Carr - Section Manager  
[✓] D. Berrill - Laboratory Manager

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