Grovefield Way, Cheltenham

Interpretative Report on Site Investigation

Project No: 731988

Client: Hinton Properties (Midlands) Limited

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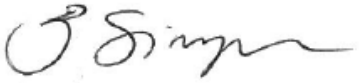
Approved by		B J Simpson MSci (Hons) FGS
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1 INTRODUCTION

This investigation was carried out on the instructions of and on behalf of Hinton Properties (Midlands) Limited. It is proposed to construct a new supermarket, drive-thru coffee shop and a preschool nursery on land located on Grovefield Way, Cheltenham.

The purpose of the work was to investigate ground conditions and provide information for foundation design and to provide information for preliminary contamination assessment purposes. The work included an intrusive investigation, laboratory testing and the preparation of this report, which contains a description of the site and the works carried out, the exploratory hole logs, in-situ and laboratory testing results.

The report gives recommendations relating to geotechnical aspects such as foundation design. It presents an appraisal of geoenvironmental aspects such as soil contamination and gives recommendations on risk reduction. It should not be assumed that these would meet the requirements of the local authority, whose advice should be sought regarding planning permission.

The ground investigation has been carried out using intrusive ground investigation techniques in general accordance with the recommendations of BS5930: 2015 *Code of practice for ground investigations,* which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks. The investigation has been carried out in accordance with BS10175: 2011 *Investigation of Potentially Contaminated Sites: Code of Practice* (including Amendment A1, 2013).

Structural Soils Limited have undertaken other investigations at this site, which are detailed in our reports 722048 *Interpretive Report on Site Investigation at Grovefield Way, Cheltenham* (November 2008) and 729381 *Interpretive Report on Site Investigation at Grovefield Way, Cheltenham* (July 2014) (see References).

All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, and on the results of laboratory and field tests performed during the investigation. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations and water conditions between or below exploratory holes. It should be noted that groundwater levels, gas concentrations and gas flows usually vary due to seasonal, atmospheric and/or other effects and may at times differ to those measured during the investigation.

This report was prepared by Structural Soils Limited for the sole and exclusive use of Hinton Properties (Midlands) Limited in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded. No liability will be accepted after a period of 6 years from the date of the report.

2 SITE DESCRIPTION

2.1 Location and Topography

The site is located on land on Grovefield Way, Cheltenham (see Site Location Map in Appendix A). The British National Grid Reference of the site is SO 907 214.

The site is approximately 230 m by 100 m in size with its long axis orientated east to west (see Exploratory Hole Location Plan in Appendix A). The site is set at an elevation of approximately 39 m above Ordnance Datum (AOD) in the east and 35.5 m AOD in the west of the site.

A walkover survey of the site was undertaken on 27 October 2016 and its findings are detailed in the following paragraphs.

The area of investigation for this report forms part of a larger triangular shaped field that is to be redeveloped, which is approximately 360 m by 210 m in size. The wider field is bounded to the north by the A40 dual carriageway, housing to the east and southeast, with a retail park located 200 m northeast of the site.

At the time of the site visit, construction was under way on the section of field immediately north of the site for a car showroom. As a result, portions of the site were being used for the storage of materials and parking of vehicles and equipment, as well as a site compound for the developers.

Vegetation, including grass, has begun to grow on the site, with areas of bare earth where construction traffic is frequent. In the south eastern corner of the site, there was a large pile of topsoil which had been stripped from the site, which was approximately 70 m across and up to 30 m wide.

The site is currently flat with a gentle slope from the east down towards the west.

It is understood that excavated material from the car showroom construction and other areas of the wider site has been used to raise levels on the site. This raising in ground levels has occurred since Structural Soils Limited attended the site in 2008 and 2014. The levels from the exploratory hole undertaken in this investigation and the approximate site levels at the time of the previous investigations (based on provided topographic survey drawings are compared below:

TABLE 1: SUMMARY OF APPROXIMATE GROUND LEVEL CHANGES

Location	Approximate 2008/2014 Ground Levels (mAOD)	Measured 2016 Ground Levels (mAOD)	Approximate Variation in Ground Level (m)
TP1	33.75	35.56	+ 1.81
TP2	34.12	36.16	+ 2.04
TP3	36.03	36.82	+ 0.79
TP4	37.00	37.76	+ 0.76
TP5	38.00	38.60	+ 0.60
WS1	33.34	35.56	+ 2.22
WS2	34.00	35.87	+ 1.87
WS3	34.09	36.15	+ 2.06

TABLE 1: SUMMARY OF APPROXIMATE GROUND LEVEL CHANGES			
Location	**Approximate 2008/2014 Ground Levels (mAOD)**	**Measured 2016 Ground Levels (mAOD)**	**Approximate Variation in Ground Level (m)**
WS4	36.04	37.15	+ 1.11
WS5	37.00	37.90	+ 0.90
WS6	38.50	39.18	+ 0.68

The information indicates that the western half of the site has been raised by around 1.80 - 2.20 m while the eastern half of the site has been raised by around 0.60 - 1.10 m.

2.2 Geology

Information on the geology of the site was obtained from the following sources published by the British Geological Survey (BGS):

- BGS map (sheet 216, scale 1:50,000, published 1988).
- The BGS digital geology map, which utilises the most up to date names for geological units (www.bgs.ac.uk/data).
- The BGS Lexicon of Named Rock Units, which provides typical descriptions for most geological units (www.bgs.ac.uk/lexicon).

The site is shown to be underlain by the Charmouth Mudstone Formation, which includes dark grey shales and bluish grey mudstones. Ground levels are known to have been raised and hence fill is anticipated to be present across the site.

2.3 Hydrogeology and Hydrology

The Environment Agency (EA) website (http://apps.environment-agency.gov.uk/wiyby/default.aspx) has classified the Charmouth Mudstone Formation as a Secondary 'Undifferentiated' Aquifer.

'Secondary' aquifers include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary 'Undifferentiated' Aquifers are cases where it has not been possible to attribute either Secondary category 'A' or 'B' to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

2.4 Previous Investigations Risk Assessment

The previous investigations' preliminary risk assessment identified potential risks from soil contamination and ground gases. These risks were investigated and subsequently proven to exist around TP12 (soil contamination) and BH7 (ground gases). The current ground investigation was therefore tailored to reassess the site following completion of the filling operations.

3 FIELDWORK

3.1 Scope of Works

The following works were completed on 27 and 28 October 2016 at locations shown on the Exploratory Hole Location Plan in Appendix A:

TABLE 2: SCOPE OF INTRUSIVE WORKS AND IN-SITU TESTING		
Number	**Exploratory Hole or In-Situ Test Type**	**Hole / Test Numbers**
6	Window Sample Holes	WS1 to WS6
5	Machine Dug Trial Pits	TP1 to TP5

The scope of investigation and choice of investigation equipment was decided by Structural Soils Limited in consultation with Hinton Properties (Midlands) Limited. Sampling and in-situ testing details were specified by Structural Soils Limited. The positions were selected by and set out by Structural Soils Limited and adjusted where necessary to take account of buried or overhead services, or other restrictions.

The positions were chosen to target existing or proposed features as follows:

TABLE 3: RATIONALE FOR THE POSITIONING OF EXPLORATORY HOLES	
Exploratory Hole	**Reason for Selection of Position**
WS1	To target previous elevated levels of methane.
WS1-WS3, TP1 & TP2	To target proposed office buildings and nursery.
WS4, TP3 & TP4	To target proposed supermarket.
WS6	To target proposed coffee shop.
TP5	General site coverage.

Access to the original proposed locations for TP3, TP5 and WS6 was prevented due to the site compound for the car showroom construction, and so positions were moved further south than originally planned. Access to the original proposed locations for WS4, WS5 and TP4 was also prevented due to the soil heap in the southwestern corner of the site, and so positions were moved further north than originally planned. Due to the use of one area for parking and active plant movements, the positions for WS2, WS3 and TP2 were moved further west than originally planned.

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1). Detailed descriptions, together with relevant comments, are given in the logs included in Appendix B.

Prior to the commencement of any exploratory hole or intrusive test all positions were checked for buried services by a specialist utility surveyor using a cable avoidance tool (CAT), signal generator ('genny'), and ground penetrating radar (GPR). Inspection pits were hand dug at exploratory locations where noted on the relevant exploratory hole logs.

3.2 Window Sampling

The window sample exploratory holes were drilled using a tracked rig with chain driven drop weight. Windowless steel sample tubes containing a plastic sample liner were used. The holes reduce in diameter with depth, as reported on the logs. The depths of the drilled holes were between 3.00 and 4.00 m.

Small disturbed samples were subsampled from the window samples at regular intervals. 70 mm diameter undisturbed samples were recovered from suitable strata in accordance with BS EN ISO 22475-1 using a thick walled U70 sampler.

Hand vane or hand penetrometer tests were carried out at selected intervals on samples of intact cohesive soils, the results of which are included on the logs contained in Appendix B.

Standard Penetration Tests (SPT) were carried out at selected intervals in the window sample holes using the rig's integral drop weight/hammer (see In-Situ Testing, below).

3.3 Trial Pits

The machine dug trial pits were excavated using a wheeled mechanical excavator and were approximately 2.50 m x 0.40 m in plan and were up to 3.00 m deep. Small and bulk disturbed samples were sampled from the pits at regular intervals.

Hand vane or hand penetrometer tests were carried out at selected intervals on samples of intact cohesive soils, the results of which are included on the logs contained in Appendix B

3.4 Chemical Contamination Sampling

Samples for contamination testing were taken from the exploratory holes where indicated on the exploratory hole logs, recorded as sample types ES for soil.

All samples were placed in appropriate contamination sample containers that were supplied by the laboratory. Containers for volatiles testing of soil samples were filled to capacity. All samples were then kept in cool boxes with ice packs and were transported to the laboratories under Chain of Custody documentation, as promptly as possible to maintain sample integrity.

3.5 In-Situ Testing

Standard Penetration Tests (SPT) were carried out in the window sample holes, in accordance with BS EN ISO 22476-3 using a hammer or hammers which had been calibrated for efficiency. The calibration certificate is included in Appendix C. Seating drives have been recorded in increments of 75 mm in accordance with recommended UK practice.

The SPT N-values are reported on the exploratory hole logs, on which the calibration number of the hammer used is recorded. The full results are presented in tabular format on the Summary of Standard Penetration Tests in Appendix C, on which the normalised N_{60} values are also reported, which are the equivalent N-value for a hammer delivering 60% of the theoretical drop energy. Plots showing both N and N_{60} values versus depth and elevation are also included.

Where 50 test blows failed to achieve 300 mm of penetration, the SPT N-value equivalent to that for 300 mm of penetration has been extrapolated and reported on the exploratory hole logs using the guidance contained in CIRIA Report R143 *The Standard Penetration Test (SPT) - Methods and Use* (1995).

3.6 Backfill, Monitoring Wells and Installations

On completion 40 mm diameter gas and groundwater monitoring wells were installed in the window sample holes, the design having been decided by Structural Soils Limited. The installation details are shown on the exploratory hole logs in Appendix B and are also summarised below:

TABLE 4: SUMMARY OF MONITORING WELL INSTALLATIONS

Location	Well Diameter (mm)	Well Depth (m bgl)	Well Response Zone (m bgl)	Type of Protective Cover	Notes
WS1	40	3.45	0.45-3.45	Flush	-
WS2	40	3.45	0.45-3.45	Flush	-
WS3	40	3.70	0.70-3.70	Flush	-
WS4	40	3.45	0.45-3.45	Flush	-
WS5	40	3.45	0.45-3.45	Flush	Gas tap damaged after installation and unable to be removed, so only gas monitoring was possible.
WS6	40	3.45	0.45-345	Flush	-

The Client or site owner should ensure that the monitoring wells and their protective covers are not damaged or covered until such time as information is no longer required from them. Extra costs would be incurred if it were necessary to reinstate damaged wells.

The trial pits were backfilled with arisings upon completion and compacted in layers with the excavator bucket.

3.7 Post Siteworks Monitoring

Gas concentrations and groundwater levels were recorded in the monitoring wells on 2, 8, 15, 22, 29 November & 6 December 2016. The results together with the temporal (weather) conditions are tabulated in Appendix G.

Ground gas monitoring was carried out over 6 no. monitoring rounds (as considered the minimum for an end-use of a mix of industrial, commercial and a day nursery school, in line with the CIRIA 665). This included periods of falling atmospheric pressures and after rainfall.

An infrared gas meter was used to measure concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2) in percentage by volume, whilst hydrogen sulphide (H_2S) and carbon monoxide (CO) were recorded in parts per million. Initial and steady state concentrations were recorded. An integral flow meter was used to measure borehole flow rates (initial and steady state) in litres per hour (l/hr). In addition the atmospheric pressure before and during monitoring, together with the weather conditions were recorded.

All holes were screened with a Photo-Ionisation Detector (PID) to establish if there are any interferences and cross-sensitivity of other hydrocarbons with the infrared gas meter. The results are recorded as ppm (isobutylene equivalent).

4 LABORATORY TESTING

Samples for potential geotechnical testing were returned to one of the Company's UKAS accredited laboratories, and those for potential contamination testing were sent to a sister company Envirolab Limited, a MCERTS and UKAS accredited chemical testing laboratory. Laboratory tests were scheduled by Structural Soils Limited.

4.1 Geotechnical Laboratory Testing

Geotechnical laboratory testing was generally carried out in accordance with the relevant part of BS1377: 1990, *Methods of Test for Soils for Civil Engineering Purposes*, or, where superseded, by the relevant part of BS EN ISO 17892:2014+ *Geotechnical investigation and testing – Laboratory Testing of Soil*. The number of tests completed and the test methods used are summarised below. Where non-standard procedures have been undertaken, this is recorded on the report sheet. The results are reported in tabular and/or graphical form and included as Appendix D of this report.

TABLE 5: SUMMARY OF GEOTECHNICAL LABORATORY TESTING

Number of tests	Test	Test Method	Notes
Classification Tests			
6	Moisture content.	BS1377: Part 2.	
6	Liquid and plastic (Atterberg) limits.	BS1377: Part 2.	1 no. pre-sieved.
Compressibility, Permeability and Durability Tests			
5	One-dimensional consolidation test.	BS1377: Part 5.	

4.2 Contamination Laboratory Testing

The contamination testing carried out is summarised in the following table. The results are included as Appendix E of this report, and include details of the test method.

TABLE 6: SUMMARY OF CONTAMINATION LABORATORY TESTING*

Numbers of tests	Description	Notes
SOIL		
6	SSL HHA Human Screening suite	Comprises arsenic, cadmium, chromium (total), lead, mercury, selenium, copper, nickel, zinc, speciated polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH banded 1 with ID), soluble organic matter, soluble sulphate and pH.

5 GROUND CONDITIONS

5.1 General

The exploratory holes were logged by an engineer and the ground conditions encountered are detailed on the logs contained in Appendix B. The exploratory holes encountered the following general descending sequence of strata:

TABLE 7: SUMMARY OF GROUND CONDITIONS

Strata	Exploratory holes encountered in	Depth to top of stratum m bgl	Thickness (m)
Made Ground - Fill	WS1-WS6 & TP1-TP5	0.00	0.48-2.80
Made Ground - Possible Fill	WS2 WS6 TP1 TP4 TP5	0.48-2.00	0.30-1.02
Charmouth Mudstone Formation	WS1-WS6 & TP1-TP5	0.55-2.80	>0.15->2.15

Identification of the different strata was complicated by the similarity and homogeneity of the soil types. This would be expected where strata excavated from one area of the site has been placed elsewhere on site as fill, especially where the topsoil defining layer has been stripped prior to filling. The ground conditions have therefore been based on the strata descriptions, in-situ test results, review of the approximate changes in site level and review of the previous ground investigation logs. It is noted that the depth of material interpreted as fill or possible fill is often greater than the changes in topographic levels alone. This is anticipated to be due to the presence of historic made ground, the stripping of topsoil at the site prior to filling and potentially other earthworks activities prior to the commencement of filling.

The interpreted ground conditions are summarised below.

5.2 Made Ground - Fill

The strata interpreted as made ground fill comprised firm, stiff and very stiff mottled slightly sandy slightly gravelly clay. The thickness of the made ground fill varied across the site presumably as a result of the difference between the original topography and the current level development area. Anthropogenic (man-made) components of the made ground fill included brick fragments, rare concrete and rare plastic. Given their similarity, it is likely that some made ground that existed prior to the filling operations, has also been interpreted being part of this stratum. No relict topsoil layer was present to define at the base of the made ground fill, the topsoil presumably having been stripped prior to the commencement of filling operations. However the localised presence of rootlets at depth was also used as a potential indicator of the base of the made ground fill.

5.3 Made Ground - Possible Fill

Strata interpreted as made ground possible fill was locally recorded beneath the made ground fill and comprised firm, stiff and very stiff mottled slightly sandy slightly gravelly clay. The absence of any anthropogenic materials in this stratum was used to distinguish it from the overlying made ground fill. Given their similarity, it is likely that some of the Superficial Deposits and less stiff Charmouth Mudstone Formation that existed prior to the filling operations (as recorded in the previous ground investigations), have also been interpreted being part of this stratum.

5.4 Charmouth Mudstone Formation

The made ground fill and possible fill was underlain by stiff to very stiff dark grey silty and sandy locally fissured clay of the Charmouth Mudstone Formation containing localised shell fragments and gypsum crystals. This was comparable to the findings of the previous investigations.

5.5 Groundwater

Groundwater was not encountered in any of the exploratory holes over the depths investigated (up to 4.15 m depth and down to 32.00 mAOD) and over the investigation timescales. This was comparable to the findings of the previous investigations. Subsequent monitoring of the installed standpipes also showed them to be generally dry over the initial monitoring rounds and then with water levels near surface (<1.00 m depth) after a noted period of surface water flooding/ponding. The recorded water depths are therefore not considered to be significant, with levels most likely being flooding of the installations (which subsequently does not drain due to the poor infiltration characteristics of the encountered strata) rather than actual groundwater levels.

5.6 Indications of Contamination

There were no olfactory or visual indications of contamination in any of the exploratory holes.

6 GEOTECHNICAL SITE ASSESSMENT

6.1 Proposed Development

It is proposed to construct a new supermarket, drive-thru coffee shop and a preschool nursery. The layout of the proposed development is shown on the Proposed Phase 2 Master Plan contained in Appendix A.

6.2 Previous Earthworks Filling

The increase in ground levels between the previous investigations and this investigation prove that earthworks filling operations have taken place. Structural Soils Limited have not been involved in the specification, monitoring or validation of the placed fill but have been advised by the Client that:

The material was put down February 2015. It was engineered in 300mm layers, compacted with a sheep's foot roller and sealed with a D6 bulldozer.

It is therefore uncertain if the material was placed to an end specification or method specification and if the planned use of the fill was *General Fill* or *Fill to Structures* etc. Based on the strata descriptions and the laboratory test results undertaken on the currently placed made ground fill material, the Department for Transport, *Manual of Contract Documents for Highway Works* (MCHW), Volume One: *Specification for Highway Works*, Section 600 *Earthworks,* November 2009 would classify the fill as *Class 2A Wet Cohesive Material* or *Class 2 C Stony Cohesive Material* which are both acceptable as *General Fill*. The material does not meet the requirements of *Class 7A Selected Cohesive Material Fill to Structures* due to its high plasticity index and liquid limit values.

The following recommendations therefore assume that the placed material is acceptable as *General Fill* only. This assessment is similar to the conclusions of the previous investigations.

6.3 Site Preparation and Excavation

The soils encountered at the site are considered suitable for excavation by standard mechanical plant such as a wheeled backhoe excavator.

Unsupported excavations up to 4.15 m depth within the cohesive made ground fill, possible fill and natural strata are likely to remain stable in the short term. Groundwater is not anticipated although it should be noted that groundwater levels may change due to seasonal or other variations. Surface water run-off from rainfall may also enter excavations. Advice on suitable dewatering techniques is given in CIRIA Report C515 *Groundwater Control – design and practice*.

All excavations should be planned and due consideration should be given to providing temporary support or suitable battering. Excavations should be regularly inspected by a competent person to ensure continued safety. Further advice on the safety of excavations is given in *Health and Safety in Construction*. Excavations or below ground

voids should be checked for the presence of harmful gases and vapours prior to personnel entry.

The siteworks were undertaken at a time when the ground surface at site was generally firm and dry. However, given the nature of the near surface soils on the site and the subsequent evidence of surface water flooding/ponding, some softening would be expected were construction undertaken during wetter parts of the year, and this should be taken into account when designing haul roads or temporary laydown areas.

6.4 Shrinkage and Swelling

Atterberg Limits tests performed on samples taken from the made ground fill, possible fill and natural strata showed them to have medium volume change potentials with changes in moisture content, according to the criteria of NHBC Standards, Chapter 4.2 *Building Near Trees*, after correction where necessary for their >0.425mm fraction. However the previous investigations, which involved the testing of a greater number of samples, showed the strata on site to have medium to high volume change potentials with changes in moisture content. It is therefore recommended that a high volume change potential is used in design.

It is noted from the consolidation tests undertaken on samples of made ground fill that the samples underwent swelling at low pressures. This is likely due to the presence of natural material excavated from a greater depth now being present within the fill at a lesser depth. The risk of heave should be considered if the fill material is allowed to become saturated. However assuming the filling operations were undertaken in a controlled manner and that the surface of the placed fill was suitably sealed on completion of filling operations (as expected from the evidence of surface flooding/ponding), then the risk should be minimal and should be further reduced by the majority of the proposed development being either hardstand or buildings (thus preventing any meteoric water ingress).

6.5 Foundations

Given the presence of competent natural soils at a relatively shallow depth (<3.00 m) it is considered that spread (strip or pad) foundations will be suitable for the proposed development.

Foundations should be taken through any made ground fill and possible fill on to the natural strata of the Charmouth Mudstone Formation recorded at depths of 0.55-2.80m. Placement of foundations on the made ground fill and possible fill is not recommended as the specification to which this was placed is not known plus the DOT *Manual of Contract Documents for Highway Works* would deem the fill to be unsuitable as *Fill to Structures*.

It is recommended that minimum foundation depths be determined in accordance with the NHBC Standards with respect to the potential influence of trees and major shrubs. The NHBC Standards apply to residential developments, but may reasonably be applied to other forms of development. NHBC Standards would require a minimum foundation depth of 1.00 m for soils with a high volume change potential, in the absence of trees. However based on the thickness of made ground fill and possible fill (which as

discussed above would not be suitable as a bearing strata), actual foundation depths will likely exceed any NHBC requirements.

Given the similarity of the made ground fill and possible fill to the natural Charmouth Mudstone Formation strata, as well as the possibility that that some of the Superficial Deposits and less stiff Charmouth Mudstone Formation that existed prior to the filling operations (as recorded in the previous ground investigations), have also been interpreted as being part of the possible fill, it is recommended that design follow our previous guidance namely that, assuming a conservative undrained shear strength of 75 kPa, the safe bearing capacity for a 1.00 m wide strip foundation at minimum 1.00 m depth or for a 2.00 m by 2.00 m pad at the same minimum depth would be of the order of 160kPa, which should be adequate for the type of development proposed. However, settlement of a 1.00 m wide strip foundation at 1.00 m depth loaded to a line load of 160kN/m^2 run, would be of the order of 25-30 mm, using a coefficient of volume compressibility (m_v) of 0.20 m^2/MN (based on an assessment of the consolidation test results) and a geological factor (μ_g) of 0.70. Therefore the allowable bearing pressure should be reduced to 140kN/m^2 to keep settlements below the generally accepted value of 25 mm.

6.6 Floor Slabs

As discussed in Section 6.2 and in our previous report, the use of ground bearing floor slabs placed on to the existing made ground fill is not recommended due to its unsuitability as *Fill to Structures* as determined by the DOT *Manual of Contract Documents for Highway Works*. The use of suspended floor slabs is therefore recommended and where a risk of heave is anticipated, then these should incorporate a suitable void or void former beneath the slab. For larger buildings where suspending slabs across the entire building footprint may not be feasible, the use of dedicated floor slab foundations (e.g. strip, pad or mini piles) may be required.

Although not strictly applicable to the proposed developments, floor slabs should be designed in accordance with NHBC Standards.

6.7 Protection of Buried Concrete

This assessment of the potential for chemical attack on buried concrete is based on current guidance contained in BRE Special Digest 1 ('SD1', 2005) *Concrete in Aggressive Ground Part 1: Assessing the aggressive chemical environment.* Third Edition.

The site is classed as *natural,* as buried concrete will be in contact with either undisturbed ground that is in its natural state or clean fill derived from such ground, and has not been subject to previous industrial development. Table C1 in BRE SD1 is therefore used to assess the site.

Groundwater is assumed to be *static* over the depths investigated. 'Static groundwater' applies to locations where the ground is either permanently dry, or contains water but has low permeability (i.e. little water movement is possible, permeability generally less than 10^{-7} m/s).

Within the made ground fill soil pH values ranging from 7.86 to 8.39 were recorded. From these results a 'Characteristic Value' of 7.91 is derived. The water-soluble sulphate (SO_4) results range from <10 mg/l to 380 mg/l. From these results a 'Characteristic Value' of 260 mg/l is derived.

The Characteristic Value for pH is defined as the lowest ('worst case') pH value for a data set of less than five pH values, as the mean of the lowest two pH values for a data set of five to nine pH values, and as the mean of the lowest 20% for ten or more results. To determine Characteristic Values for sulphate and any other compounds the highest results are used.

Based on the results the Design Sulphate Class for the made ground fill is DS-1.

It is concluded that for this site the Aggressive Chemical Environment for Concrete (ACEC) class is AC-1s where there is no risk of concrete being in contact with groundwater. This is comparable to the findings of the previous investigations undertaken prior to placement of the made ground fill. However the previous investigations, which also encountered and tested groundwater, determined an ACEC class of AC-4 where concrete could be contact with groundwater. The designer should utilise these classifications in order to produce the concrete specification.

7 GEOENVIRONMENTAL SITE ASSESSMENT

7.1 Proposed Development

The proposed development is detailed in Section 6.1 of this report.

7.2 Previous Investigation Findings

The previous investigations undertaken prior to placement of the made ground fill encountered a general absence of soil contamination with the exception of one location (TP12 at 0.15 m depth) where elevated lead levels were recorded, although this was interpreted as likely being due to the presence of lead glazed pottery fragments. It was recommended that the made ground from this area be removed if it were to be soft landscaping. Elevated gas levels were recorded that fell in to Characteristic Situation 2 and this was primarily due to the methane results from one standpipe location (BH7). Gas protection measures were recommended. No significant risks to water supply pipes or groundwater were identified and hence no further assessment has been undertaken during this investigation.

7.3 Contamination – Soil

7.3.1 Risk to Human Health

7.3.1.1 General

To determine whether contaminants are present at levels that may be deemed to pose a significant hazard to human health, measured contamination levels in soil at the site are compared against derived guideline values ('Tier 2' soil screening), either directly or following statistical analysis. Where contaminants are present above the screening values it is probable that site-specific information will be required to further examine the potential risk of harm arising from such contamination.

The background to the assessment is contained in Appendix F and the findings are summarised in the following pages.

The proposed used of the site is a supermarket, drive-thru coffee shop and a preschool nursery and thus the primary school guidelines have been used to assess the results.

7.3.1.2 Results

There were no olfactory or visual indications of contamination in any of the holes.

Contaminants assessed against the GAC's are: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, Polycyclic Aromatic Hydrocarbons (PAH) & Total Petroleum Hydrocarbons (TPH).

All of the individual results for the contaminants tested were below the GAC/CLEA SGV's for a primary school end-use.

7.3.1.3 Conclusions

The investigation has shown contaminant levels in the made ground fill soil to be below the assessment criteria, which indicates that no risks to human health have been identified. The elevated lead result from the previous investigations (TP12 at 0.15 m depth) is considered to no longer be an issue as the made ground is likely to now be buried at a depth where it is no longer a risk or that the material was removed during the assumed site strip prior to the filling operations (no relict topsoil being encountered in any of the current investigation positions). It is unknown if any stripped made ground from around TP12 was segregated from or has been included in the current topsoil stockpile on site.

7.3.2 Ground Gases

7.3.2.1 General

In order to assess the significance of ground gases at the site, measured concentrations (by volume in air) and flow rates have been used to generate Gas Screening Values (GSVs). These have then been compared to the Revised Wilson and Card Classification presented within CIRIA Report 665. BS8485 has also been referenced.

It is recommended that the gas risk should be assessed by the consideration of pathways to human receptors as follows:

- Gas entering the building through the substructure and building up to hazardous levels

7.3.2.2 Results

The following ground gas parameters from the current investigation have been recorded over 6 no. gas monitoring rounds including 1 no. period of low (<1000 mb) pressure:

- A maximum ‘initial’ methane concentration of 0.0-0.1 %;
- A maximum ‘steady state’ carbon dioxide concentration of 0.1-1.6 %;
- A maximum ‘initial’ flow rate of 0.0-0.1 l/hr; and
- A maximum ‘steady state’ flow rate of 0.0-0.2 l/hr.

Other than the elevated methane results from BH7 the findings of this investigation were comparable to those of the previous investigations.

The worst case Gas Screening Values (GSV) for both methane and carbon dioxide have been calculated. In accordance with NHBC guidance for methane the GVS is calculated using the peak concentration and flow and for carbon dioxide the residual concentrations and flow rates are used.

Water levels were initially below the solid pipe sections of the wells and thus gas results should be representative of gas conditions in the ground.

7.3.2.3 Conclusion

Current GSV’s for methane and carbon dioxide have been calculated to be 0.0001 l/hr and 0.003 l/hr respectively.

Therefore based on the current results alone, the site falls into 'Characteristic Situation' 1 (very low hazard) in Table 8.5 of CIRIA 665. The type of buildings proposed are public / commercial and for this Table 8.6 of CIRIA 665 indicates that no special protection measures are required.

The previous elevated methane result recorded in BH7 during the previous investigations occurred on only one occasion (round number 2 of a total of 8 rounds) with all other rounds recording methane levels of zero or <0.1 %. In addition BH7 is located in a position of car parking away from any buildings while the standpipes installed in this investigation were purposely located in the vicinity of the buildings. These facts, coupled with the findings of this current investigation suggest that the previous BH7 result is insignificant/potentially erroneous and need not be considered in the gas risk assessment.

7.3.3 Contamination Conclusion

No contamination has currently been recorded at the site resulting in no complete pollutant linkages being identified. It is therefore considered that the site is fit for the proposed end use without further assessment or remediation.

Where topsoil is to be placed in soft landscaping areas, it should be further tested to assess its suitability if it has been either imported from off site, or is known to contain or to have been mixed with potentially contaminated material.

7.4 Off-site Disposal of Surplus Soil

7.4.1 General

All excavated material and excess spoil must be classified for waste disposal purposes prior to disposal at landfill. Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all wastes must be classified as:

- 'inert', or
- 'non-hazardous', or
- 'hazardous'.

The Environment Agency's *Guidance on the Assessment and Classification of Waste*, Environment Agency, WM3, First Edition May 2015 document outlines the methodology for classifying wastes. Currently all wastes may require pre-treatment prior to disposal at landfill.

7.4.2 Initial Waste Characterisation

Envirolab have produced an assessment tool, 'Haswaste', that characterises contaminated waste soil by following the guidance within WM3. The 'total solid testing' results from this investigation have been run through this assessment tool to aid potential future off-site disposal of materials. This assessment produces an 'initial' characterisation of the waste which determines if it is hazardous or not. If it is 'not' hazardous, then it may be either inert (insoluble and inorganic) or non-hazardous. However, due to complications with the terminology of 'inert waste' it is best not to refer to it as such until after Waste Acceptance Criteria testing.

The assessment is included in Appendix E. Any samples that are classed as hazardous will have light cells with bold text, in the respective sample columns (assuming results are in black & white, otherwise yellow cells on a colour copy). The results are summarised as follows:

The initial waste characterisation indicates that none of the samples from the made ground fill material are classed as hazardous.

It is important to note that whilst we believe our in-house assessment tool to be an accurate interpretation of the requirements of WM3, thereby producing initial classifications in accordance with it, landfill operators often have their own assessment tools and can often come to a different conclusion. As a result, some landfill operators could even refuse to take apparently suitable waste.

8 SUMMARY

8.1 The current ground investigation was undertaken to reassess the site following completion of the filling operations; Structural Soils Limited having previously investigated the site.

8.2 6 no. window sample holes and 5 no. trial pits were undertaken on 27 and 28 October 2016 and encountered 0.55-2.80 m of firm to very stiff made ground fill and possible fill sandy gravelly clay (understood to comprise material derived from other excavations on site) over stiff to very stiff sandy silty clay of the Charmouth Mudstone Formation. No groundwater was encountered. Interpretation of the different layers encountered was difficult due to the similarity of the strata.

8.3 The fill material does not meet the requirements of *Class 7A Selected Cohesive Material Fill to Structures* due to its high plasticity index and liquid limit values. The following recommendations therefore assume that the placed material is acceptable as *General Fill* only.

8.4 Based on the findings of the current and previous investigations a high volume change potential should be assumed for the fill and natural material on site. The risk of heave should be considered if the fill material is allowed to become saturated.

8.5 NHBC Standards would require a minimum foundation depth of 1.00 m for soils with a high volume change potential, in the absence of trees. However based on the thickness of made ground fill and possible fill, actual foundation depths will likely exceed any NHBC requirements.

8.6 Given the similarity of the made ground fill and possible fill to the natural Charmouth Mudstone Formation strata, as well as the possibility that that some of the Superficial Deposits and less stiff Charmouth Mudstone Formation that existed prior to the filling operations (as recorded in the previous ground investigations), have also been interpreted as being part of the possible fill, it is recommended that design follow our previous guidance namely that, for foundations up to 1m wide, an allowable bearing pressure of 140kN/m^2 should be assumed to keep settlements below the generally accepted value of 25 mm.

8.7 The use of ground bearing floor slabs placed on to the existing made ground fill is not recommended due to its unsuitability as *Fill to Structures* as determined by the DOT *Manual of Contract Documents for Highway Works*. The use of suspended floor slabs is therefore recommended and where a risk of heave is anticipated, then these should incorporate a suitable void or void former beneath the slab.

8.8 The Aggressive Chemical Environment for Concrete (ACEC) class is AC-1s where there is no risk of concrete being in contact with groundwater. However the previous investigations, which also encountered and tested groundwater, determined an ACEC class of AC-4 where concrete could be contact with groundwater.

8.9 No contamination has currently been recorded at the site resulting in no complete pollutant linkages being identified. It is therefore considered that the site is fit for the proposed end use without further assessment or remediation. The previous locally identified risks from soil contamination and ground gases are no longer considered significant.

8.10 The initial waste characterisation indicates that none of the samples from the made ground fill material are classed as hazardous.

9 REFERENCES

9.1 BS 5930:2015 *Code of practice for ground investigations*

9.2 Structural Soils Report 722048 *Interpretive Report on Site Investigation at Grovefield Way, Cheltenham* (November 2008)

9.3 Structural Soils Report 729381 *Interpretive Report on Site Investigation at Grovefield Way, Cheltenham* (July 2014)

9.4 British Geological Survey sheet sheet 216, scale 1:50,000, published 1988

9.5 British Geological Survey online digital geological map, www.bgs.ac.uk/data

9.6 British Geological Survey Lexicon of Named Rock Units, www.bgs.ac.uk/lexicon

9.7 Environment Agency website, www.environment–agency.gov.uk

9.8 BS EN ISO 14688-1:2002 *Geotechnical investigation and testing – Identification and classification of soil: Part 1: Identification and description*, incl. Amendment A1 2013

9.9 BS EN ISO 14688-2:2004 *Geotechnical investigation and testing – Identification and classification of soil: Part 2: Principles for a classification*, incl. Amendment A1 2013

9.10 BS EN ISO 22476-3:2005 (updated February 2007) *Geotechnical Investigation and Testing – Field Testing Part 3: Standard Penetration Test*, incl. Amendment A1 (2011)

9.11 BS 1377:1990 *Methods of Test for Soils for Civil Engineering Purposes*

9.12 BRE Special Digest 1 (SD1)(2005) *Concrete in Aggressive Ground Part 1: Assessing the aggressive chemical environment*. Third Edition

9.13 *Health and Safety in Construction*, HSG150, HSE, 1996

9.14 CIRIA Report C515 (2000) *Groundwater Control – design and practice*

9.15 *NHBC Standards* (2016)

9.16 Department for Transport, *Manual of Contract Documents for Highway Works* (MCHW), Volume One: *Specification for Highway Works*, Section 600 *Earthworks,* Nov 2009

9.17 Environment Agency Policy. Part IIA – *Detailed Quantitative Assessment of Chronic Risks to Human Health from Contaminated Soils*. Policy Number 199_04, dated 9 March 2004

9.18 Environment Agency Science Report SR2: *Human health toxicological assessment of contaminants in soil* (Final SC050021/SR2).

9.19 Environment Agency Science Report SR3: *Updated technical background to the CLEA model* (Final SC050021/SR3).

9.20 Land Quality Management/Chartered Institute of Environmental Health, 2nd edition 2009. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, Nottingham.

9.21 R & D Publication CLR 11 (September 2004). *Model Procedures for the Management of Contaminated Land. Contaminated Land*. Environment Agency

9.22 CIRIA Report C665 *Assessing risks posed by hazardous ground gases to buildings*, London, 2007

9.23 BS 8485:2015 *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*

9.24 Boyle, RA and Witherington, PJ (2007, Edition 04) *Guidance On Evaluation Of Development Proposals On Sites Where Methane and Carbon Dioxide Are Present*, NHBC

9.25 *Guidance on the Assessment and Classification of Waste, Environment Agency*, WM3, First Edition May 2015

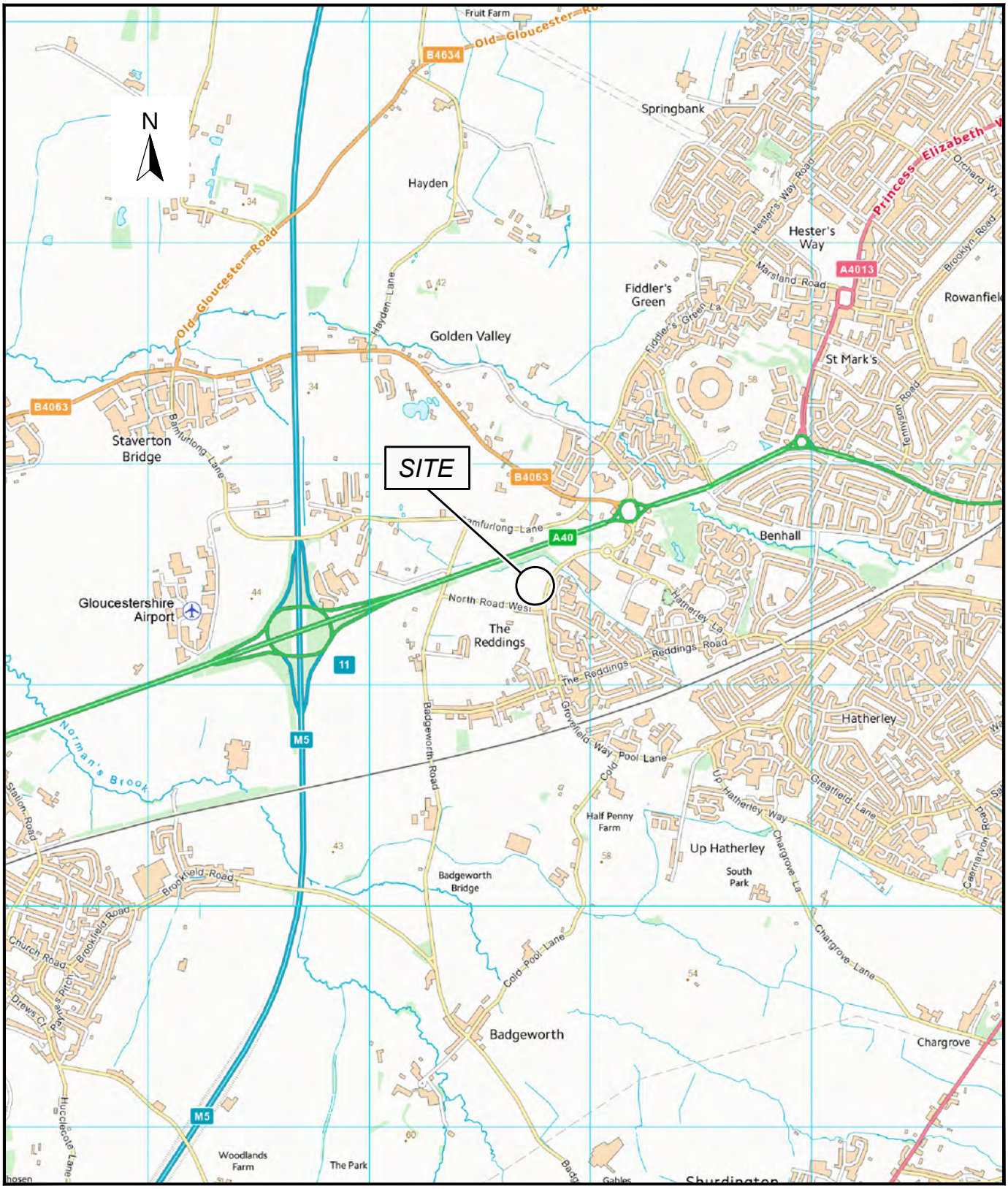
9.26 *Landfill (England & Wales) Regulations* 2002

APPENDIX A -
PLANS AND DRAWINGS

(i) Site Location Plan

(ii) Exploratory Hole Location Plan

(iii) Proposed Development Layout Plan



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB
Tel: 0117 947 1000
ask@soils.co.uk
www.soils.co.uk

CLIENT: Hinton Properties (Midlands) Limited

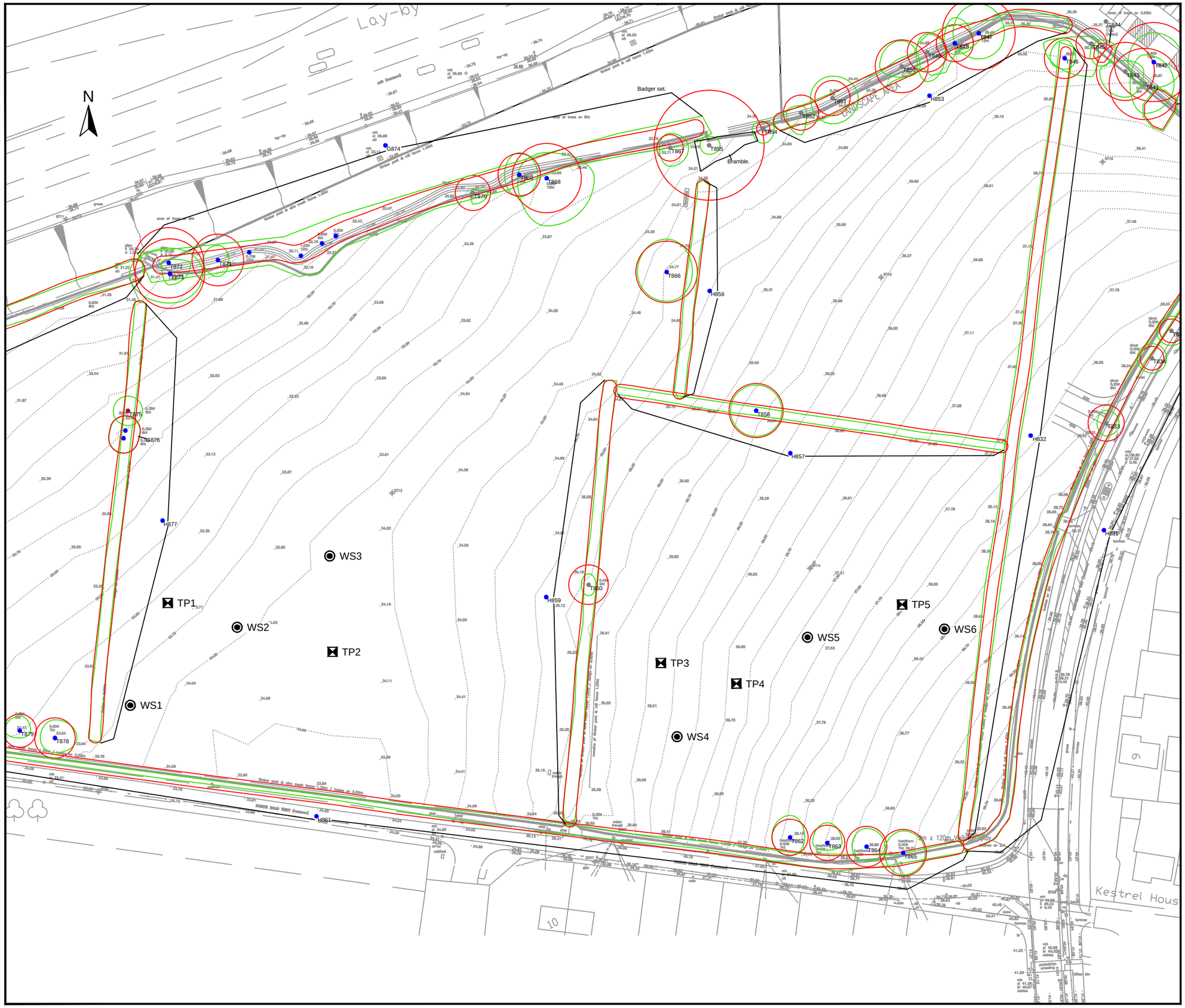
PROJECT: Grovefield Way, Cheltenham

TITLE: SITE LOCATION MAP

REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	31.10.2016	-	JH	RL	-

DIMENSION	SCALE	DRAWING STATUS
m	1:25,000	-

JOB NO	GRID REF	SCALE BAR	ORIGIN SIZE	FIGURE
731988	SO 907 214	0 250 500 750 1,000m	A4	1



LEGEND

- Trial Pit Location
- Window Sample Location

REV	DATE	DESCRIPTION	BY	CHD	APR
00	31.10.2016	-	JH	RL	-

DIMENSION	SCALE	ORIGIN SIZE
m	1:1000	A3

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CLIENT

Hinton Properties (Midlands) Limited

PROJECT

Grovefield Way, Cheltenham

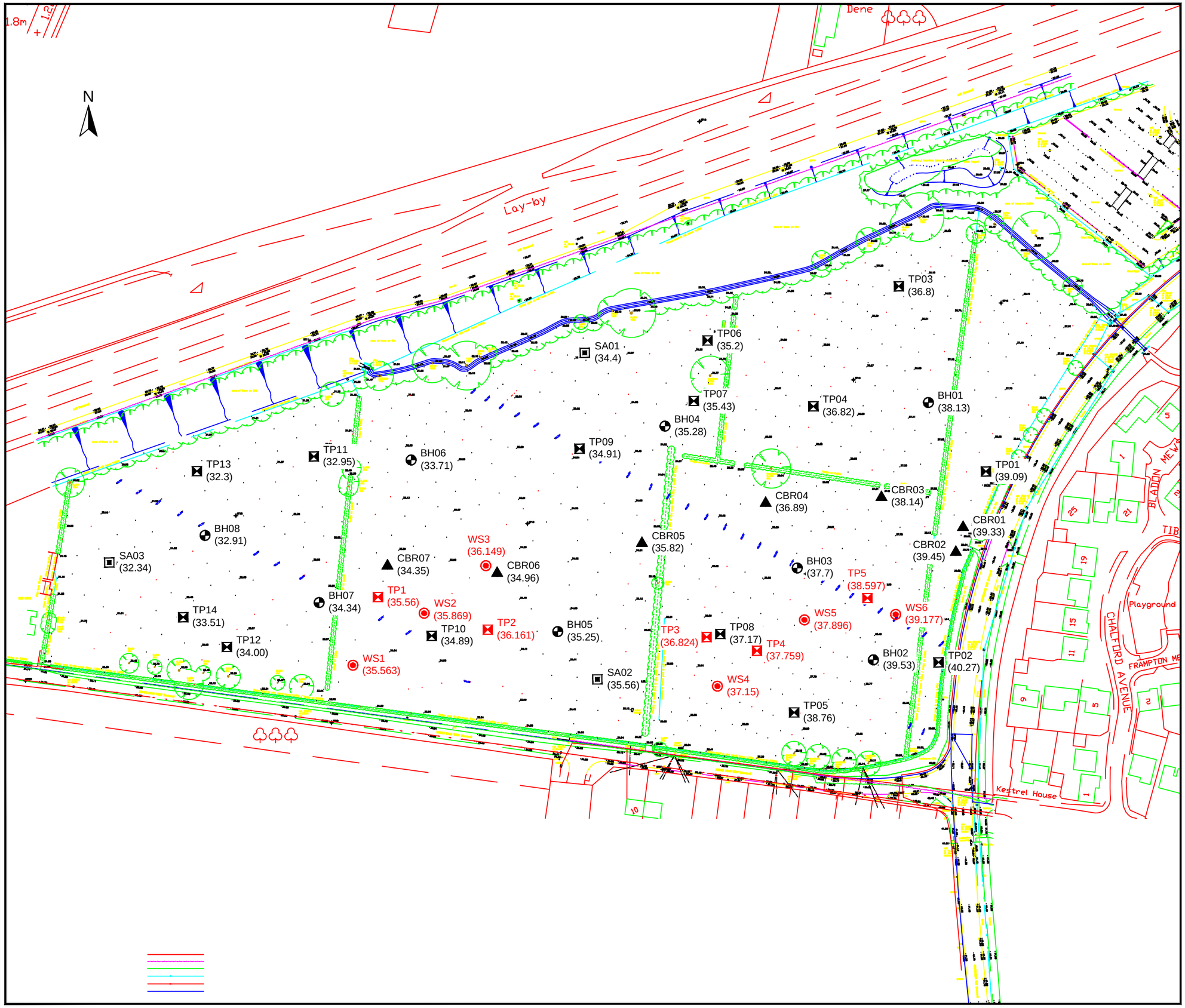
TITLE

EXPLORATORY HOLE LOCATION PLAN

JOB NO	FIGURE
731988	2
DRAWING STATUS	REV
-	00

SCALE BAR

0 10 20 30 40 50m



LEGEND

- Trial Pit Location (Hole Elevation)
- Additional Trial Pit Location (Hole Elevation)
- Additional Window Sample Location (Hole Elevation)

REV	DATE	DESCRIPTION	BY	CHD	APR
00	02.11.2016	-	JH	RL	-

DIMENSION	SCALE	ORIGIN SIZE
m	1:1500	A3

STRUCTURAL SOILS

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CLIENT

Hinton Properties (Midlands) Limited

PROJECT

Grovefield Way, Cheltenham

TITLE

EXPLORATORY HOLE LOCATION PLAN

JOB NO	FIGURE
731988	3
DRAWING STATUS	REV
-	00

SCALE BAR

0 20 40 60 80m

All drawings and specification to be read in conjunction with Structural Engineer and other consultants drawings; all discrepancies should be reported to the architect.

Figured dimensions only are to be taken from this drawing

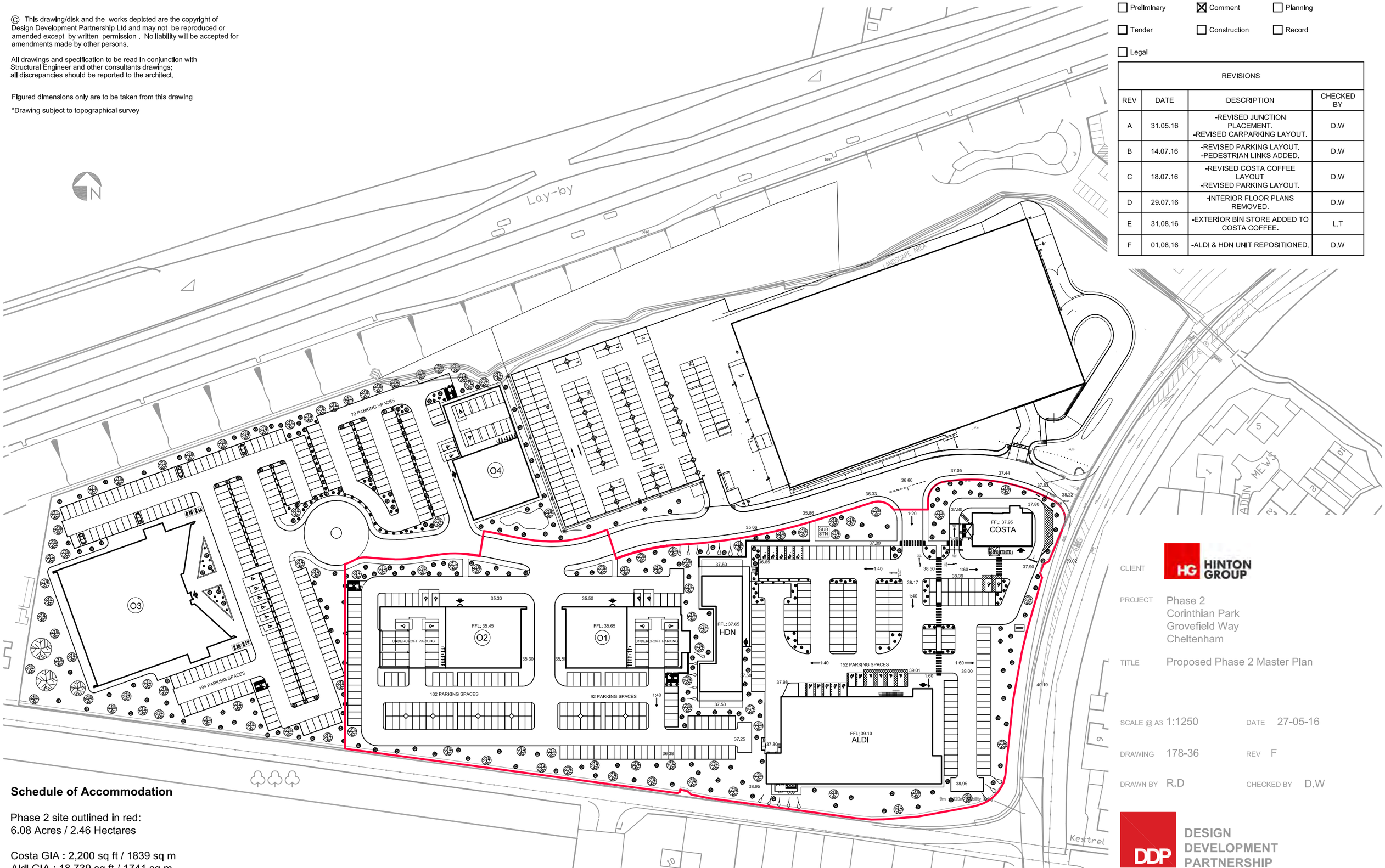
*Drawing subject to topographical survey

☐ Preliminary ☒ Comment ☐ Planning

☐ Tender ☐ Construction ☐ Record

☐ Legal

REVISIONS			
REV	DATE	DESCRIPTION	CHECKED BY
A	31.05.16	-REVISED JUNCTION PLACEMENT. -REVISED CARPARKING LAYOUT.	D.W
B	14.07.16	-REVISED PARKING LAYOUT. -PEDESTRIAN LINKS ADDED.	D.W
C	18.07.16	-REVISED COSTA COFFEE LAYOUT -REVISED PARKING LAYOUT.	D.W
D	29.07.16	-INTERIOR FLOOR PLANS REMOVED.	D.W
E	31.08.16	-EXTERIOR BIN STORE ADDED TO COSTA COFFEE.	L.T
F	01.08.16	-ALDI & HDN UNIT REPOSITIONED.	D.W



Schedule of Accommodation

Phase 2 site outlined in red:
6.08 Acres / 2.46 Hectares

Costa GIA : 2,200 sq ft / 1839 sq m
Aldi GIA : 18,739 sq ft / 1741 sq m
HDN GIA : 5,408 sq ft / 502 sq m
Office 1 GIA : 24,538 sq ft / 2,279 sq m
Office 2 GIA : 29,663 sq ft / 2755 sq m
Office 3 GIA : 66,480 sq ft / 6176 sq m
Office 4 GIA : 20,000 sq ft / 1858 sq m

Total Parking : 346 spaces

CLIENT HINTON GROUP

PROJECT Phase 2
Corinthian Park
Grovefield Way
Cheltenham

TITLE Proposed Phase 2 Master Plan

SCALE @ A3 1:1250 DATE 27-05-16

DRAWING 178-36 REV F

DRAWN BY R.D CHECKED BY D.W

DDP DESIGN DEVELOPMENT PARTNERSHIP

ARCHITECTURE + PLANNING + PRINCIPAL DESIGNER

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APPENDIX B - EXPLORATORY HOLE RECORDS

(i) Key to Exploratory Hole Logs

(ii) Trial Pit Logs

(iii) Window Sample Logs

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

SAMPLING

Sample type codes

D	=	Small disturbed sample.
DSPT	=	Small disturbed sample originating from SPT test.
ES	=	Soil sample for environmental testing.
U	=	Undisturbed driven tube sample - Number of blows indicated. % recovery reported.

IN-SITU TESTING

$SPT_{(c)}$	=	Standard Penetration Test using a solid 60 degree cone.
SPT	=	Standard Penetration Test using split spoon sampler. ($SPT_{(NR)}$ indicates 'No Sample Recovery').
	=	* denotes extrapolated N value. NP denotes 'No Penetration'.
HP	=	Hand Penetrometer Test. Value given as shear strength c_u, in kPa.

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.
2. Material types divided by a broken line (- - -) indicates an unclear boundary.
3. The data on any sheet within the report showing the AGS icon is available in the AGS format.

GINT_LIBRARY_V8_06.GLB|GrfcText G - LEGEND - 1 OF 2 | 731988_GROVEFIELD_WAY_CHELTENHAM.GPJ - v8_06 | 23/12/16 - 08:41 | BJS1.
Structural Soils Ltd, Head Office - Bristol: The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB. Tel: 0117-947-1000, Fax: 0117-947-1004, Web: www.soils.co.uk, Email:admin@soils.co.uk.

STRUCTURAL SOILS

Contract Reference: **731988**

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

MATERIAL GRAPHIC LEGENDS


CLAY


MADE GROUND


Sandy CLAY


Sandy silty CLAY


Silty CLAY


MADE GROUND

INSTRUMENTATION SYMBOLS


Backfill


Bentonite seal


Gravel filter


Flush cover


Plain pipe


Slotted pipe

GINT_LIBRARY_V8_06.GLB|GrfcText G - LEGEND - 2 OF 2 | 731988_GROVEFIELD_WAY_CHELTENHAM.GPJ - v8_06 | 23/12/16 - 08:41 | BJS1.
Structural Soils Ltd, Head Office - Bristol: The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB. Tel: 0117-947-1000, Fax: 0117-947-1004, Web: www.soils.co.uk, Email:admin@soils.co.uk.

STRUCTURAL SOILS

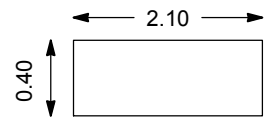
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**TP1**

Contract Ref:	Start: **28.10.16**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	End: **28.10.16**	**35.56**	**E:390552.7 N:221422.7**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.00-0.30	1	D				MADE GROUND - FILL: Patchy grass over firm to stiff dark yellowish brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular fine to coarse brick and limestone.			
						. . . at 0.10m two cobbles of subrounded oolitic limestone.			
0.80-1.10	2	D							
						. . . at 0.90m band of dark grey clay.		(2.00)	
1.00	101	ES							
1.60-1.90	3	D							
							33.56	2.00	
						MADE GROUND - POSSIBLE FILL: Firm dark yellowish brown mottled dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular fine to coarse brick and limestone.		(0.30)	
							33.26	2.30	
2.30-2.45	4	D				Very stiff dark grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)			
							33.11	2.45	
						Trail pit terminated at 2.45m depth.			

Plan (Not to Scale)



General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered.
3. Pit walls stable.
4. Backfilled with arising.
5. Possible fill material up to 2.30m depth, determined from change in topographic levels.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**RLynes**	JS

STRUCTURAL SOILS

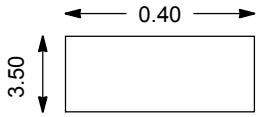
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**TP2**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	**28.10.16** End: **28.10.16**	**36.16**	**E:390597.7 N:221409.3**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.10	101	ES				MADE GROUND - FILL: Firm to stiff dark grey mottled yellowish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick, oolitic, limestone and mudstone.			
0.20-0.40	1	D				. . . at 0.00m bivalve fossil.			
0.40		HP	c_u=88/75/88			. . . at 0.10m plastic cord/ribbon wrapped material in western end of trial pit and pocket of pink igneous gravel/ballast in eastern end.		(1.40)	
0.90		HP	c_u=75/88/75				34.76	1.40	
1.40-1.50	2	D				MADE GROUND - FILL: Firm to stiff dark greyish brown slightly gravelly sandy CLAY with occasional rootlets and pockets of organic material. Sand is fine to medium. Gravel is subangular limestone and brick.	34.66	1.50	
1.45	102	ES							
1.45		HP	c_u=100/75/50						
1.70-1.90	3	D				MADE GROUND - FILL: Stiff to very stiff dark yellowish brown mottled dark grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine limestone.		(1.30)	
2.50-2.80	5	D					33.36	2.80	
2.80-3.00	6	D				Very stiff fissured dark bluish grey silty CLAY with occasional shells and gypsum crystals. (CHARMOUTH MUDSTONE FORMATION)	33.16	3.00	
2.90		HP	c_u=150/150/150			Trail pit terminated at 3.00m depth.			

Plan (Not to Scale)



General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered.
3. Pit walls stable.
4. Backfilled with arising.
5. Possible fill material up to 2.80m depth, determined from change in topographic levels and previous site invetigation logs.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**RLynes**	JS

STRUCTURAL SOILS

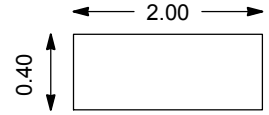
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**TP3**

Contract Ref:	Start: **28.10.16**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	End: **28.10.16**	**36.82**	**E:390687.3 N:221406.3**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.10-0.30	1	D				MADE GROUND - FILL: Stiff to very stiff dark yellowish brown slightly sandy silty CLAY with occasional rootls. Sand is fine.		(0.55)	
0.50	101	ES					36.27	0.55	
0.80-1.00	2	D				Very stiff fissured light bluish grey mottled orangish brown silty CLAY with rare shell fragments and occasional decomposed roots. (CHARMOUTH MUDSTONE FORMATION)		(1.15)	
1.50-1.70	3	D				. . . between 1.60m to 1.70m fragments of dark bluish grey mudstone.	35.12	1.70	
						Trail pit terminated at 1.70m depth.			

Plan (Not to Scale)



General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered.
3. Pit walls stable.
4. Backfilled with arising.
5. Possible fill material up to 1.70m depth, determined from change in topographic levels and previous site invetigation logs.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**RLynes**	JS

STRUCTURAL SOILS

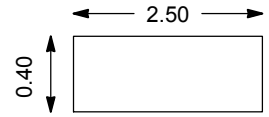
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**TP4**

Contract Ref:	Start: **28.10.16**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	End: **28.10.16**	**37.76**	**E:390707.9 N:221400.7**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.10-0.20	1	D				MADE GROUND - FILL: Patchy grass over firm to stiff dark brown sandy slightly gravelly CLAY with frequent roots. Sand is fine to coarse. Gravel is angular to coarse brick.		(0.66)	
0.20-0.40	101	ES					37.10	0.66	
0.40-0.60	2	D				MADE GROUND - FILL: Very stiff light bluish grey mottled orangish brown silty CLAY.	36.96	0.80	
						MADE GROUND - POSSIBLE FILL: Very stiff dark yellowish brown slightly sandy CLAY. Sand is fine.		(0.40)	
1.20-1.50	3	D					36.56	1.20	
						Very stiff dark yellowish brown slightly sandy CLAY. Sand is fine. (CHARMOUTH MUDSTONE FORMATION)		(0.70)	
							35.86	1.90	
						Trail pit terminated at 1.90m depth.			

Plan (Not to Scale)



General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered.
3. Pit walls stable.
4. Backfilled with arising.
5. Possible fill material up to 1.20m depth, determined from change in topographic levels and previous site invetigation logs.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**RLynes**	JS

STRUCTURAL SOILS

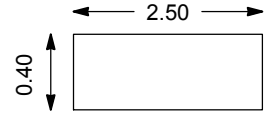
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**TP5**

Contract Ref:	Start: **28.10.16**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	End: **28.10.16**	**38.60**	**E:390753.2 N:221422.3**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND: Dark brownish grey clayey sandy GRAVEL. Sand is fine to coarse. Gravel is angular fine to medium igneous ballast.	38.55	0.05	
0.20-0.40	1	D				MADE GROUND - FILL: Very stiff dark yellowish brown slightly sandy CLAY. Sand is fine to coarse.		(0.43)	
							38.12	0.48	
						MADE GROUND - POSSIBLE FILL: Very stiff light bluish grey mottled orangish brown fissured silty CLAY.			
0.80-1.00	2	D				. . . at 0.50m land drain.		(1.02)	
							37.10	1.50	
1.50-1.70	3	D				Very stiff light bluish grey mottled orangish brown fissured silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		(0.50)	
							36.60	2.00	
2.00-2.30	4	D				Very stiff dark bluish grey CLAY with occasional shell fragments. (CHARMOUTH MUDSTONE FORMATION)		(0.30)	
						. . . at 2.00m breaks along bedding planes and unable to use hand vane due to splitting down bedding planes.	36.30	2.30	
						Trail pit terminated at 2.30m depth.			

Plan (Not to Scale)



General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered.
3. Pit walls stable.
4. Backfilled with arising.
5. Possible fill material up to 1.50m depth, determined from change in topographic levels and previous site invetigation logs.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**RLynes**	JS

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**WS1**

Contract Ref:	Start: **27.10.16**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	End: **27.10.16**	**35.56**	**E:390542.4 N:221394.7**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
0.00 - 1.00 (101mm dia) 100% rec	0.00-0.40	1	D				MADE GROUND - FILL: Stiff dark grey mottled yellowish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to medium brick, mortar and limestone.			
	0.50	101	ES						(1.45)	
	1.00-1.45	2	U					34.11	1.45	
1.00 - 2.00 (86mm dia) 100% rec	1.50-2.00	3	D				MADE GROUND - FILL: Very stiff dark grey mottled orangish brown slightly sandy CLAY with occasional fine rootlets. Sand is fine.			
	1.60		HP	c_u=188/200/175					(0.60)	
	2.00-2.45	1	SPT(c)	N=17				33.51	2.05	
	2.00-3.00	4	D				MADE GROUND - FILL: Very stiff dark grey slightly gravelly CLAY. Gravel is angular fine shell fragments.	33.36	2.20	
2.00 - 3.00 (77mm dia) 100% rec	2.50		HP	c_u=225/>225/>225			. . . possible mixing zone from 2.05m. Very stiff dark grey CLAY. With occasional angular fine shell fragments. (CHARMOUTH MUDSTONE FORMATION)		(1.25)	
	3.00-3.45	2	SPT(c)	N=37				32.11	3.45	
							Window sample terminated at 3.45m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
27/10/16	12:00	3.00	-	77	Dry

General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered. Pit walls stable.
3. Installed with 0.45m plain and 3.00m slotted pipe.
4. Possible fill material up to 2.20m depth, determined from change in topographic levels.
5. SPT hammer DT15187-2015 (E_r = 64.21%) used.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Phil Guinness**	**RLynes**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**WS2**

Contract Ref:	Start: **27.10.16**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	End: **27.10.16**	**35.87**	**E:390571.6 N:221416.0**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
	0.25-0.50	1	D				MADE GROUND - FILL: Firm dark greenish grey mottled yellowish black slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick, flint and charcoal.			
	0.30	101	ES							
	0.50-0.95	2	U						(1.70)	
	1.00-1.50	102	ES							
0.50 - 2.00 (101mm dia) 100% rec	1.30		HP	c_u=50/50/75			. . . at 1.20m band of dark black sandy clay.			
	1.50-1.70	2	D					34.17	1.70	
	1.70-2.00	3	D				MADE GROUND - POSSIBLE FILL: Firm to stiff dark grey mottled orangish brown slightly gravelly CLAY. Gravel is subrounded fine limestone.			
	1.80		HP	c_u=100/100/100						
	2.00-2.45	1	SPT(c)	N=15					(0.70)	
	2.00-2.48	4	D							
	2.30		HP	c_u=125/125/75			. . . at 2.30m possible zone of mixing orange material gives high hand penetrometer than softer grey material.	33.47	2.40	
2.00 - 3.00 (86mm dia) 100% rec	2.50-3.00	5	D				Very stiff dark grey slightly sandy silty CLAY with frequent bands of coarse sand sized shell fragments and fine rootlets. (CHARMOUTH MUDSTONE FORMATION)			
	2.60		HP	c_u=200/>225/>225					(1.05)	
	3.00-3.45	2	SPT(c)	N=27				32.42	3.45	
							Window sample terminated at 3.45m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
27/10/16	11:00	3.00	-	77	Dry

General Remarks

1. Cleared with CAT and Genny.
2. No groundwater encountered. Pit walls stable.
3. Installed with 0.45m plain and 3.00m slotted pipe.
4. Possible fill material up to 2.40m depth, determined from change in topographic levels.
5. SPT hammer DT15187-2015 (E_r = 64.21%) used.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window sampling	**Unknown**	**Phil**	**RLynes**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**WS3**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	**27.10.16** End: **27.10.16**	**36.15**	**E:390596.9 N:221435.5**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
	0.25-0.50	1	D				MADE GROUND - FILL: Firm dark greenish brown mottled dark grey and orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular fine brick.		(1.00)	
	0.50	101	ES					35.15	1.00	
1.00 - 2.00 (101mm dia) 65% rec	1.00-1.45	2	U				MADE GROUND - FILL: Firm to stiff dark greenish brown mottled dark grey and orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular fine brick.		(1.00)	
	1.50-2.00	3	D							
	1.60		HP	c_u=88/75/88			. . . at 1.76m pieces of fine gravel of brick and coal.	34.15	2.00	
	2.00-2.45	1	SPT	N=13			MADE GROUND - FILL: Firm to stiff light brownish grey mottled orangish brown slightly gravelly CLAY. Gravel is angular fine brick.		(0.53)	
	2.00	1	DSPT							
2.00 - 3.00 (86mm dia) 100% rec	2.00-2.53	4	D					33.62	2.53	
	2.53-2.90	5	D				Stiff to very stiff fissured dark grey mottled orangish brown silty CLAY with occasional fine rootlets. (CHARMOUTH MUDSTONE FORMATION)		(0.37)	
	2.53		HP	c_u=150/138/150				33.25	2.90	
	3.00-3.45	2	SPT	N=27			Very stiff dark grey silty CLAY. With occasional fine gypsum crystals. (CHARMOUTH MUDSTONE FORMATION) . . . at 2.90m possible zone of mixing between made ground and natural ground. . . . at 3.30m material to stiff to use hand vane.			
	3.00	2	DSPT							
3.00 - 3.70 (77mm dia) 100% rec	3.00-3.70	6	D						(1.25)	
	3.30		HP	c_u=200/213/200						
	3.70-4.15	3	SPT	N=41			. . . at 3.60m shell fragments.			
	3.70	3	DSPT					32.00	4.15	
							Window sample terminated at 4.15m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
27/10/16	10:00	3.70	-	77	Dry

General Remarks

1. Cleared with CAT and Genny.
2. No groundwater encountered. Pit walls stable.
3. Installed with 0.70m plain and 3.00m slotted pipe.
4. Possible fill material up to 2.53m depth, determined from change in topographic levels and previous site investiagtion logs.
5. SPT hammer DT15187-2015 (E_r = 64.21%) used.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Phil Guinness**	**RLynes**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**WS4**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	**27.10.16** End: **27.10.16**	**37.15**	**E:390691.7 N:221386.2**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
0.00 - 1.00 (101mm dia) 100% rec	0.00-0.45	1	D				MADE GROUND - FILL: Very stiff fissured dark greyish brown mottled dark reddish brown slightly sandy CLAY with frequent rootlets and decomposing wood. Sand is fine.		(0.45)	
	0.30		HP	c_u=>225/225/>225				36.70	0.45	
							. . . at 0.40m splits along fissure revealing dark red clay staining.			
	0.60		HP	c_u=75/63/88			MADE GROUND - FILL: Firm to stiff light grey mottled orangish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine limestone.			
	0.70	101	ES							
	1.00-1.45	2	U						(1.55)	
1.00 - 2.00 (87mm dia) 100% rec	1.50-2.00	3	D					35.15	2.00	
	2.00-2.45	1	SPT	N=28			Very stiff dark grey silty CLAY. With occasional fine gypsum crytals and shell fragments. (CHARMOUTH MUDSTONE FORMATION)			
	2.00	1	DSPT							
	2.10	102	ES							
2.00 - 3.00 (77mm dia) 100% rec	2.50-3.00	4	D						(1.45)	
	3.00-3.45	2	SPT	N=38				33.70	3.45	
	3.00	2	DSPT							
							Window sample terminated at 3.45m due to refusal.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
27/10/16	13:00	3.00	-	77	Dry

General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered. Pit walls stable.
3. Installed with 0.45m plain and 3.00m slotted pipe.
4. Possible fill material up to 2.00m depth, determined from change in topographic levels.
5. SPT hammer DT15187-2015 (E_r = 64.21%) used.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Phil Guinness**	**RLynes**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**WS5**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	**27.10.16** End: **27.10.16**	**37.90**	**E:390727.4 N:221413.3**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
0.00 - 1.00 (70mm dia) 100% rec	0.00-0.15	101	ES				MADE GROUND: Grass over firm to stiff dark yellowish brown slightly sandy slightly gravelly silty CLAY with rare rootlets. Sand is fine to medium. Gravel is angular fine brick and coal.		(0.34)	
							. . . at 0.13m piece of coal 30mm in diameter.	37.56	0.34	
	0.50-1.00	1	D				MADE GROUND - FILL: Stiff dark brownish grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine limestone.		(0.96)	
	1.00-1.50	2	D							
	1.00-1.45	2	U					36.60	1.30	
1.00 - 2.00 (52mm dia) 80% rec							Very stiff dark bluish grey mottled orangish brown silty fissured CLAY with occasional bands of gypsum crystals. (CHARMOUTH MUDSTONE FORMATION)		(0.65)	
	2.00-2.45	1	SPT(c)	N=23				35.95	1.95	
	2.00-2.50	3	D				Very stiff dark bluish grey CLAY with occasional bands of gypsum crystals. (CHARMOUTH MUDSTONE FORMATION)			
							. . . at 1.95m band of gypsum crystals.			
							. . . at 2.30m band of gypsum crystals.			
2.00 - 3.00 (45mm dia) 100% rec	2.50-3.00	4	D				. . . at 2.41m decomposed rootlets with gypsum.		(1.50)	
							. . . at 2.73m band of gypsum crystals.			
							. . . at 2.77m band of gypsum crystals.			
							. . . at 2.88m band of fine orangish brown sand.			
	3.00-3.45	2	SPT(c)	N=40			. . . at 2.96m band of gypsum crystals.	34.45	3.45	
							Window sample terminated at 3.45m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
27/10/16	13:30	3.00	-	50	Dry

General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered. Pit walls stable.
3. Installed with 0.45m plain and 3.00m slotted pipe.
4. Possible fill material up to 1.30m depth, determined from change in topographic levels and previous site investiagtion logs.
5. SPT hammer DT15187-2015 (E_r = 64.21%) used.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Phil Guinness**	**RLynes**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Grovefield Way, Cheltenham	**Hinton Properties (Midlands) Limited**	**WS6**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
731988	**27.10.16** End: **27.10.16**	**39.18**	**E:390764.7 N:221415.6**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
0.00 - 1.00 (70mm dia) 70% rec	0.00-0.50	1	D				MADE GROUND - FILL: Grass over stiff dark yellowish brown slightly sandy slightly gravelly CLAY with rare rootlets. Sand is fine to medium. Gravel is angular to fine brick and coal.		(0.56)	
								38.62	0.56	
	0.56-1.00	2	D				MADE GROUND - FILL: Very stiff fissured dark grey mottled orangish brown slightly gravelly silty CLAY. Gravel is subangular to subrounded fine limestone.		(0.54)	
								38.08	1.10	
1.00 - 2.00 (50mm dia) 60% rec	1.00-1.45	2	U				MADE GROUND - POSSIBLE FILL: Very stiff fissured dark grey mottled orangish brown slightly gravelly silty CLAY. Gravel is subangular to subrounded fine limestone.		(0.80)	
	1.00-1.90	3	D							
								37.28	1.90	
	2.00-2.45	1	SPT(c)	N=20			Very stiff dark bluish grey CLAY with frequent bands of gypsum crystals. (CHARMOUTH MUDSTONE FORMATION)			
	2.00-2.50	4	D				. . . at 2.00m bed of yellowish brown gravelly sand containing shells and shell fragments.			
2.00 - 3.00 (45mm dia) 100% rec	2.50-3.00	5	D				. . . from 2.00m to 3.00m bed of gypsum crystals every 50mm.		(1.55)	
	3.00-3.45	2	SPT(c)	N=38						
								35.73	3.45	
							Window sample terminated at 3.45m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
27/10/16	14:30	3.00	-	50	Dry

General Remarks

1. Cleared with CAT, Genny and GPR.
2. No groundwater encountered. Pit walls stable.
3. Installed with 0.45m plain and 3.00m slotted pipe.
4. Possible fill material up to 1.90m depth, determined from change in topographic levels and previous site investiagtion logs.
5. SPT hammer DT15187-2015 (E_r = 64.21%) used.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Phil Guinness**	**RLynes**	

APPENDIX C -
IN-SITU TESTING

(i) Standard Penetration Test (SPT) Summary Sheet

(ii) SPT Hammer Calibration Records

(iii) SPT N Value versus Depth & Elevation Plots

(iv) SPT $N_{(60)}$ Value versus Depth & Elevation Plots

STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
WS1	2.00	86		DRY	3,3	150	2,4,5,6		N=17	DT15187-2015	25/10/2015	64.21	18	SPT(c)
	3.00	77		DRY	4,7	150	7,10,11,9		N=37	DT15187-2015	25/10/2015	64.21	40	SPT(c)
WS2	2.00	101		DRY	3,4	150	4,3,4,4		N=15	DT15187-2015	25/10/2015	64.21	16	SPT(c)
	3.00	77		DRY	5,5	150	6,6,7,8		N=27	DT15187-2015	25/10/2015	64.21	29	SPT(c)
WS3	2.00	101		DRY	2,2	150	3,4,3,3		N=13	DT15187-2015	25/10/2015	64.21	14	
	3.00	86		DRY	5,6	150	7,7,6,7		N=27	DT15187-2015	25/10/2015	64.21	29	
	3.70	77		DRY	6,8	150	9,10,10,12		N=41	DT15187-2015	25/10/2015	64.21	44	
WS4	2.00	86		DRY	3,4	150	6,7,8,7		N=28	DT15187-2015	25/10/2015	64.21	30	
	3.00	77		DRY	5,6	150	7,11,10,10		N=38	DT15187-2015	25/10/2015	64.21	41	
WS5	2.00	87		DRY	4,3	150	4,6,6,7		N=23	DT15187-2015	25/10/2015	64.21	25	SPT(c)
	3.00	77		DRY	6,7	150	9,10,11,10		N=40	DT15187-2015	25/10/2015	64.21	43	SPT(c)
WS6	2.00	87		DRY	5,4	150	4,5,5,6		N=20	DT15187-2015	25/10/2015	64.21	21	SPT(c)
WS6	3.00	77		DRY	5,7	150	8,9,11,10		N=38	DT15187-2015	25/10/2015	64.21	41	SPT(c)

Notes:
1. Tests carried out in general accordance with BS EN ISO 22476-3:2005, including amendment A1 (2011).
2. Reported blows are for 75mm penetration unless indicated "+".
3. Where full test drive was not achieved, actual penetration (R) and extrapolated N value (N*) reported.
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
5. Entries in the water depth column reflects the measured water depth at time of test.

N_{60} = (Measured hammer energy ratio / 60) x N value

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By		Date	Contract Ref:
HPerry	**HPERRY**	**22.12.16**	**731988**
Contract: **Grovefield Way, Cheltenham**			Page: **1** of **2**

STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					

Notes:

1. Tests carried out in general accordance with BS EN ISO 22476-3:2005, including amendment A1 (2011).
2. Reported blows are for 75mm penetration unless indicated "+".
3. Where full test drive was not achieved, actual penetration (R) and extrapolated N value (N*) reported.
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
5. Entries in the water depth column reflects the measured water depth at time of test.

N_{60} = (Measured hammer energy ratio / 60) x N value

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By		Date	Contract Ref:
HPerry	**HPERRY**	**22.12.16**	**731988**
Contract: **Grovefield Way, Cheltenham**			Page: **2** of **2**

SPT Calibration Report

www.equipegroup.com

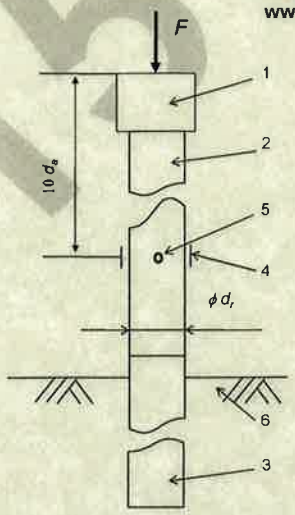
Hammer Energy Measurement Report

Type of Hammer	DANDO TERRIER
Client	STRUCTURAL SOILS
Test No	EQU1369
Test Depth (m)	6.67
Date of Test	26 October 2015
Valid until	25 October 2016
Hammer ID	DT15187

Mass of the hammer	m = 63.5kg
Falling height	h = 0.76m
E_{theor} =	$m \times g \times h$ = 473J

Characteristics of the instrumented rod

Diameter	d_r = 0.052 m
Length of the instrumented rod	0.558 m
Area	A = 11.61 cm^2
Modulus	E_a = 206843 MPa

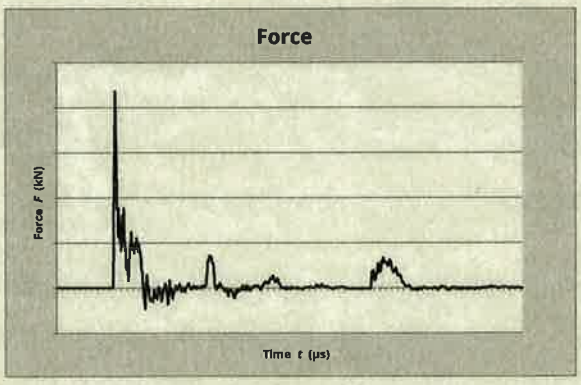


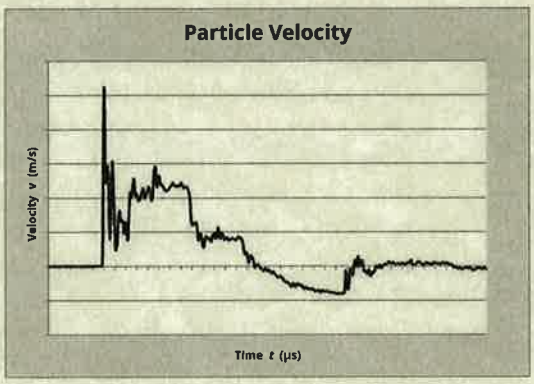
Key

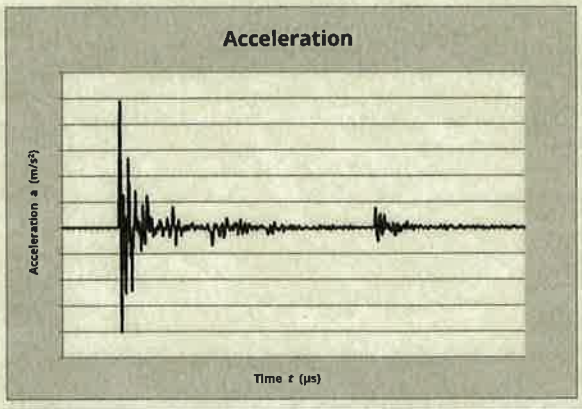
1 Anvil
2 Part of instrumented rod
3 Drive Rod
4 Strain Gauge
5 Accelerometer
6 Ground

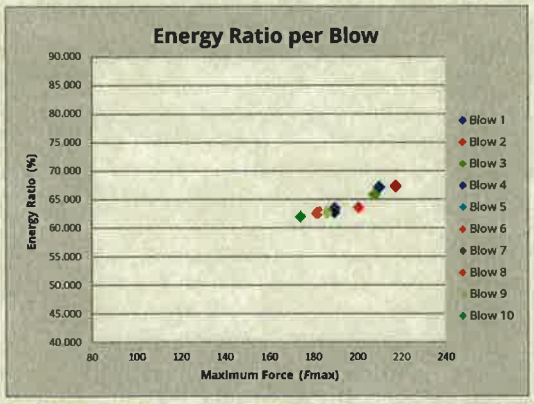
F Force
d_r Diameter of rod

Fig. B.1 and B.2 BS EN ISO 22476-3 : 2005 + A1 : 2011









Observations:
1.

E_{meas} =	**0.304** kN-m
E_{theor} =	**0.473** kN-m

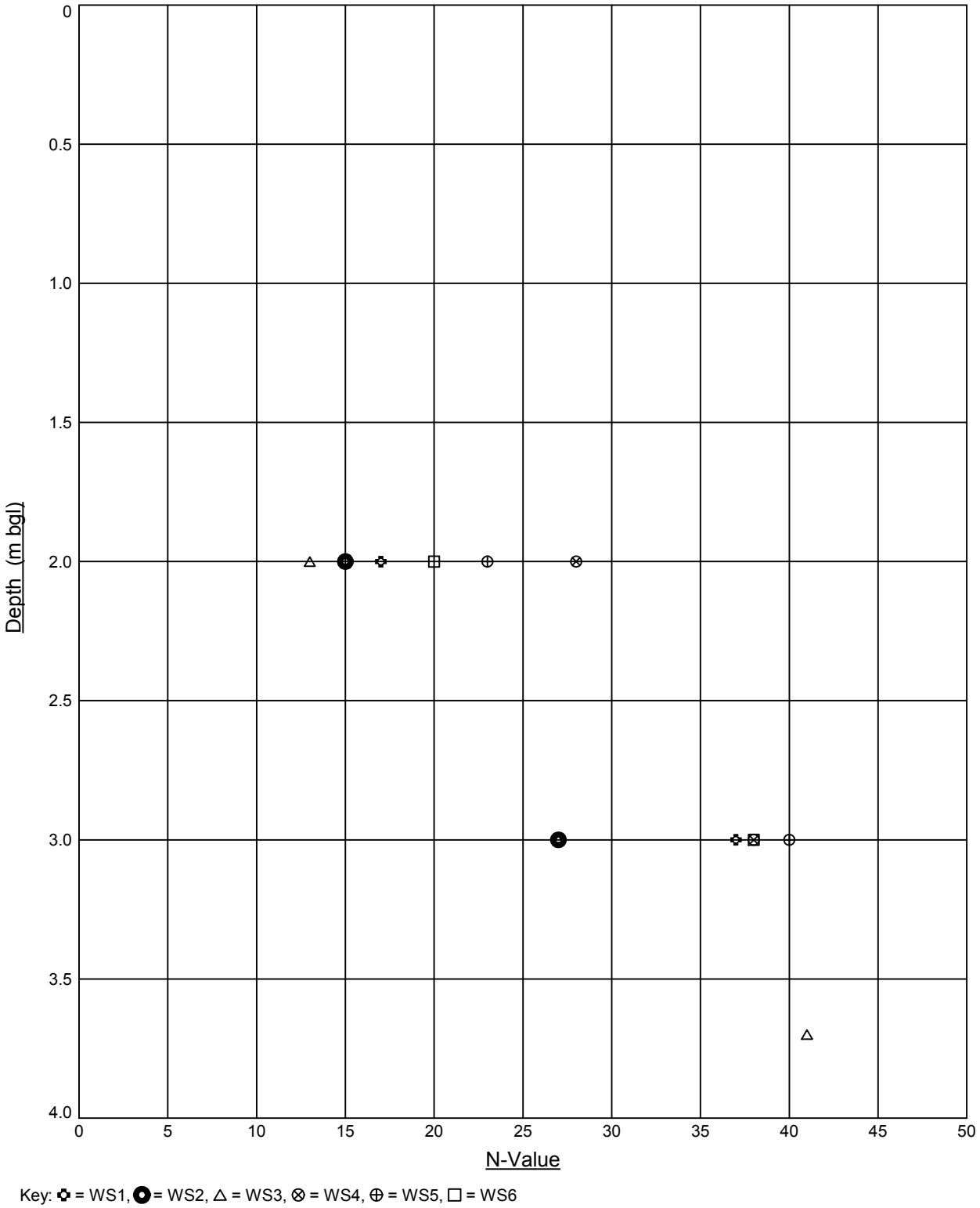
Energy Ratio (E_r) = $\frac{E_{meas}}{E_{theor}}$ = **64.21%**

Equipe SPT Analyzer Operators: KS

Prepared by: **Checked by:** **Date** 27/10/2015

 Equipe Group, The Paddocks, Home Farm Offices, The Upton Estate, Banbury, Oxfordshire, OX15 6HU
Tel: +44 (0)1295 670990 Fax: +44 (0)1295 678232 Email: info@equipegroup.com

STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH

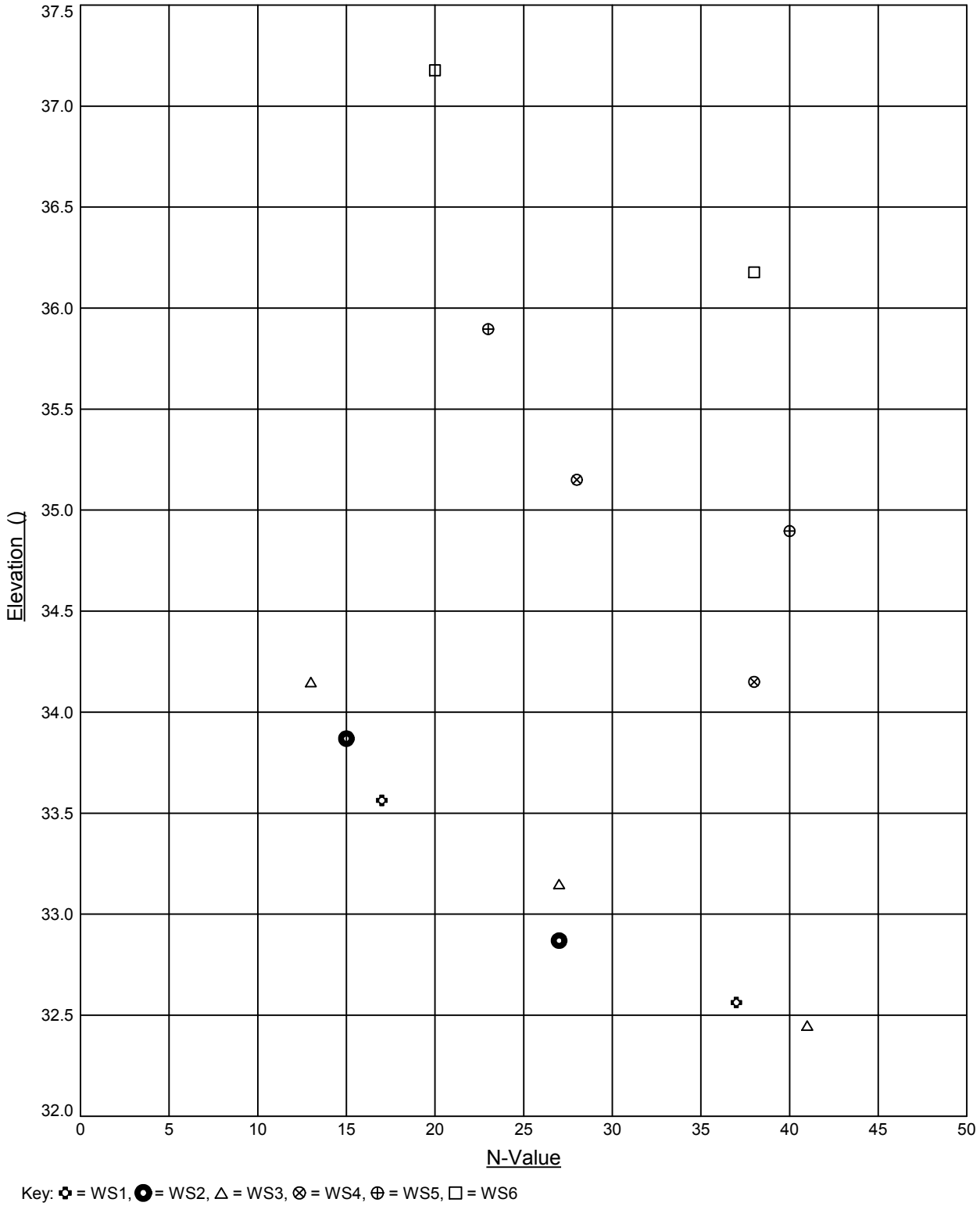


Key: ✪ = WS1, ● = WS2, △ = WS3, ⊗ = WS4, ⊕ = WS5, □ = WS6

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Contract	Date	Compiled By
Grovefield Way, Cheltenham	**22.12.16**	HP
Client: **Hinton Properties (Midlands) Limted**	Contract Ref: **731988**	

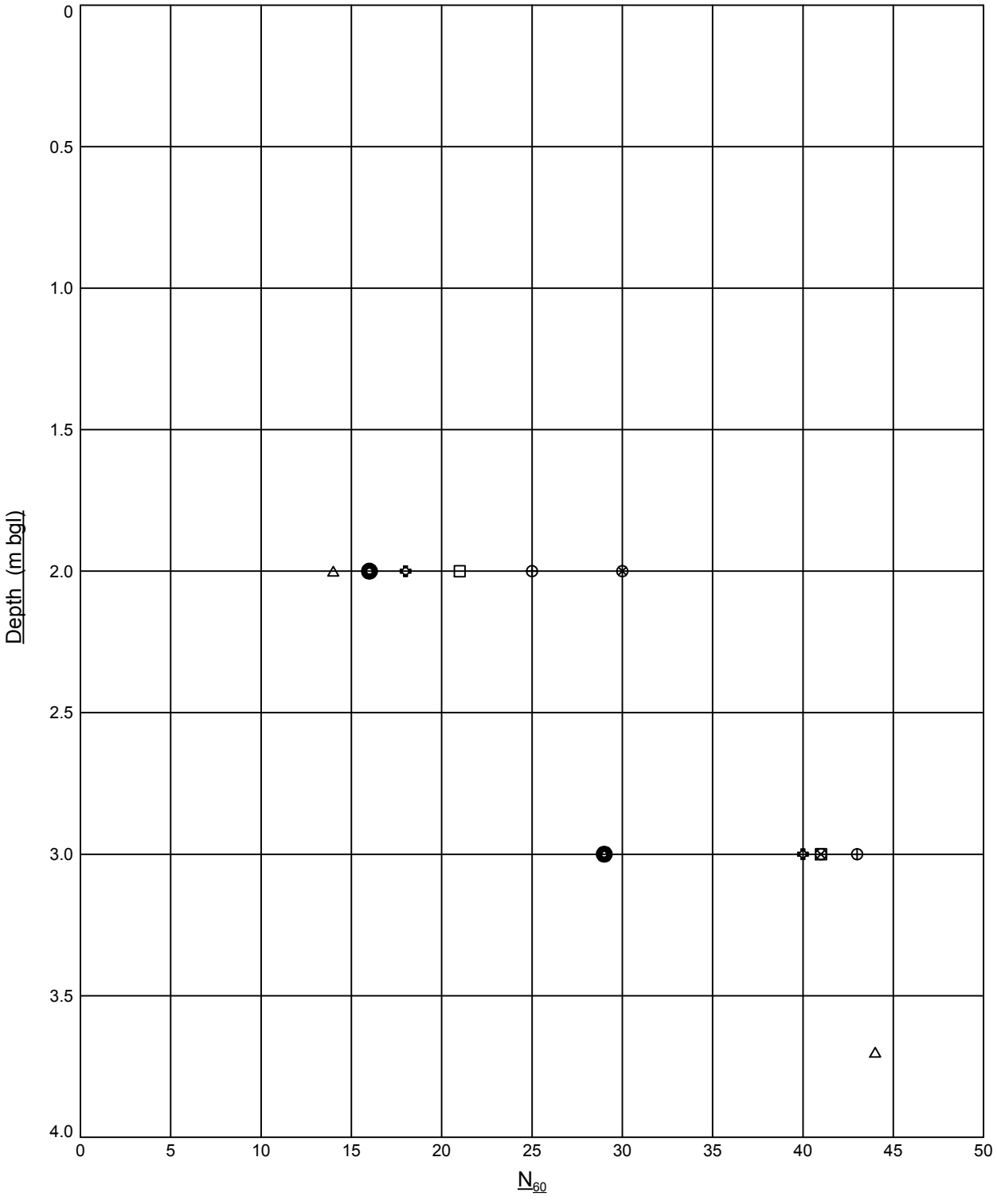
STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION



Key: ✿ = WS1, ● = WS2, △ = WS3, ⊗ = WS4, ⊕ = WS5, □ = WS6

STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **Grovefield Way, Cheltenham**	Date **22.12.16**	Compiled By HP
	Client **Hinton Properties (Midlands) Limted**	Contract Ref: **731988**	AGS

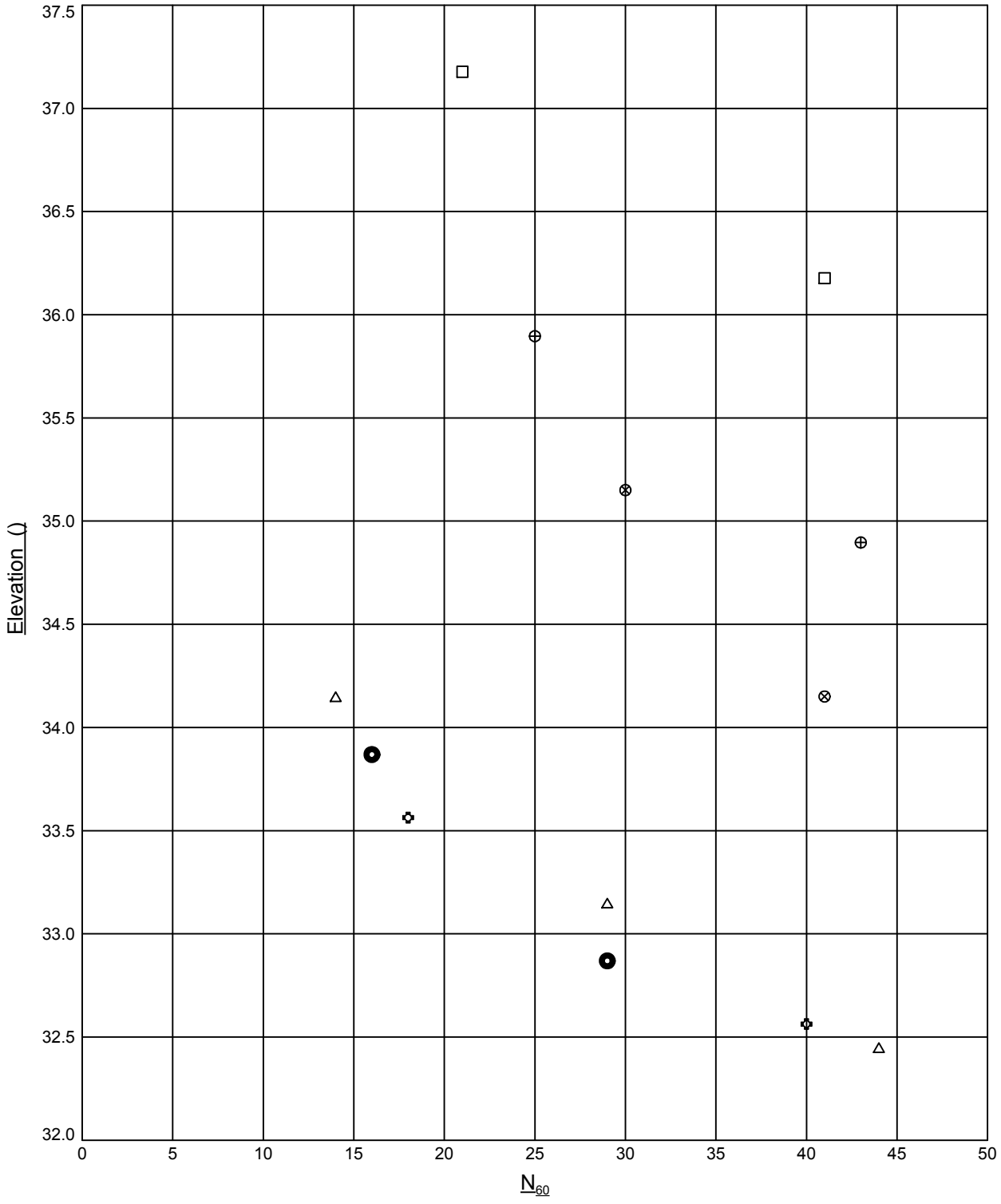
STANDARD PENETRATION TEST (SPT N_{60}) vs DEPTH



Key: ✣ = WS1, ● = WS2, △ = WS3, ⊗ = WS4, ⊕ = WS5, □ = WS6

STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **Grovefield Way, Cheltenham**	Date **22.12.16**	Compiled By HP
	Client **Hinton Properties (Midlands) Limted**	Contract Ref: **731988**	AGS

STANDARD PENETRATION TEST (SPT N_{60}) vs ELEVATION



Key: ✿ = WS1, ● = WS2, △ = WS3, ⊗ = WS4, ⊕ = WS5, □ = WS6

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Contract	Date	Compiled By
Grovefield Way, Cheltenham	**22.12.16**	HP
Client: **Hinton Properties (Midlands) Limted**	Contract Ref: **731988**	

APPENDIX D - GEOTECHNICAL LABORATORY TESTING

(i) Laboratory Test Verification Sheet

(ii) Laboratory Test Results

TESTING VERIFICATION CERTIFICATE

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **06/12/2016 12:40:36**.

Testing reported after this date is not covered by this Verification Certificate.

Dimitris Xirouchakis

Approved Signatory
Dimitris Xirouchakis (Associate Laboratory Director)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

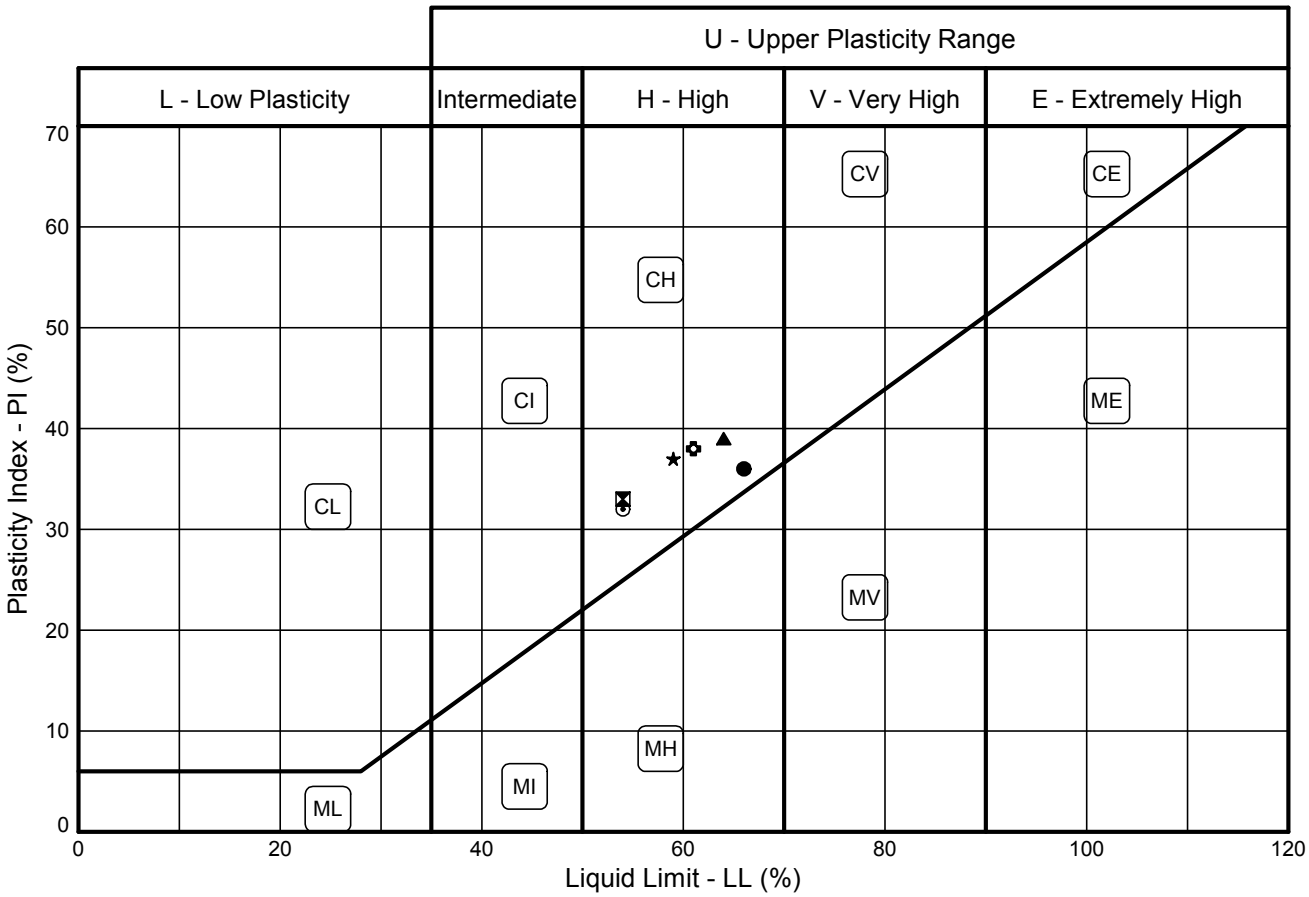
Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU

STRUCTURAL SOILS LTD	Contract: **Grovefield Way, Cheltenham**	Job No: **731988**

PLASTICITY CHART - PI Vs LL

In accordance with clause 42.3 of BS5930:1999
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %	Lab location	
	Exploratory Position ID	Sample	Depth (m)									
●	TP2	2D	1.40	3.2/4.4/5.3/5.4	4.2.4	37	66	30	36	90	B	
⊠	TP2	5D	2.50	3.2/4.4/5.3/5.4	4.2.3	24	54	21	33	100	B	
▲	TP4	3D	1.20	3.2/4.4/5.3/5.4	4.2.3	29	64	25	39	100	B	
★	TP5	1D	0.20	3.2/4.4/5.3/5.4	4.2.3	23	59	22	37	96	B	
⊙	WS1	4D	2.00	3.2/4.4/5.3/5.4	4.2.3	21	54	22	32	100	B	
✿	WS2	3D	1.70	3.2/4.4/5.3/5.4	4.2.3	27	61	23	38	100	B	

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By		Date
A.D. Frost	**ALAN FROST**	**06/12/16**

Contract	Contract Ref:
Grovefield Way, Cheltenham	**731988**

AGS

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
TP2	2	D	1.40	37	66	30	36	90	Grey mottled brown slightly sandy slightly gravelly silty CLAY
TP2	5	D	2.50	24	54	21	33	100	Grey mottled brown CLAY
TP4	3	D	1.20	29	64	25	39	100	Brown mottled grey slightly sandy CLAY
TP5	1	D	0.20	23	59	22	37	96	Yellowish brown slightly sandy slightly gravelly CLAY
WS1	4	D	2.00	21	54	22	32	100	Grey mottled orangish brown slightly sandy CLAY
WS2	3	D	1.70	27	61	23	38	100	Grey mottled orangish brown CLAY

STRUCTURAL SOILS LTD

Contract:

Grovefield Way, Cheltenham

Contract Ref:

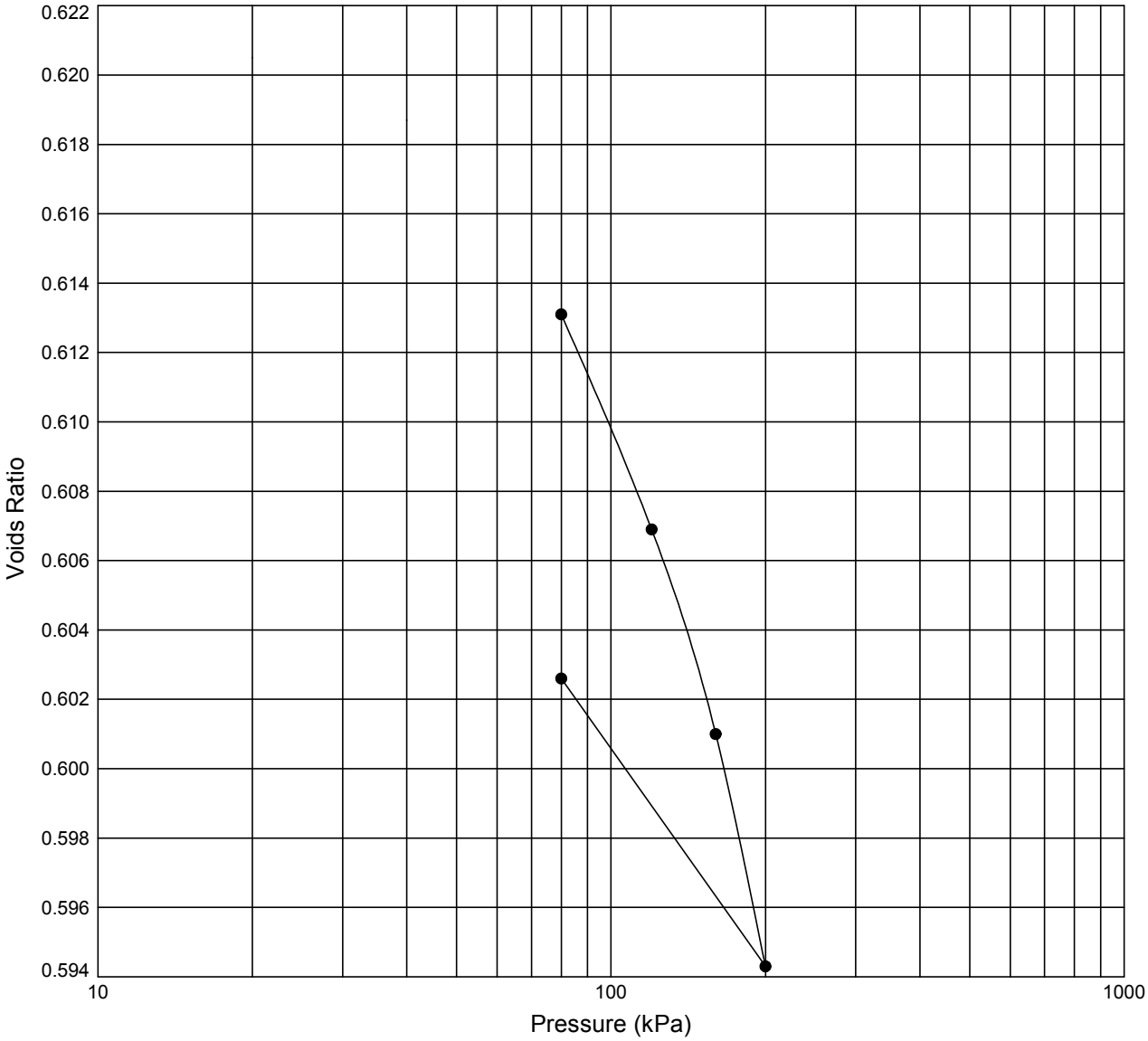
731988

AGS

ONE DIMENSIONAL CONSOLIDATION TEST

In accordance with BS1377:Part 5:1990

Window Sample: **WS1** Sample Ref: **2** Sample Type: **U** Depth (m): **1.15**



Initial Specimen Condition			Final Specimen Condition		
Moisture Content (%)	:	**25**	Moisture Content (%)	:	**25**
Bulk Density (Mg/m^3)	:	**2.02**	Bulk Density (Mg/m^3)	:	**2.07**
Dry Density (Mg/m^3)	:	**1.62**	Dry Density (Mg/m^3)	:	**1.66**
Void Ratio	:	**0.6368**	Void Ratio	:	**0.6026**

Specimen Details			
Description	Height (mm)	:	**19.74**
	Diameter (mm)	:	**49.94**
Grey mottled orangish brown slightly sandy CLAY with occasional shell fragments	Particle Density (Mg/m^3) (assumed)	:	**2.65**
	Swelling Pressure (kPa)	:	**NA**

Test Results			
Pressure Range (kPa)	Mv (m^2/MN)	Cv (m^2/yr)	Voids Ratio
0 - 20	**Sample**	**Swelling**	**0.6205**
20 - 40	**Sample**	**Swelling**	**0.6187**
40 - 80	**0.087**	**10**	**0.6131**
80 - 120	**0.095**	**8.0**	**0.6069**
120 - 160	**0.093**	**2.7**	**0.6010**
160 - 200	**0.10**	**1.2**	**0.5943**
200 - 80	**NA**	**NA**	**0.6026**

Notes: Method of time-setting used: **T90.**

STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

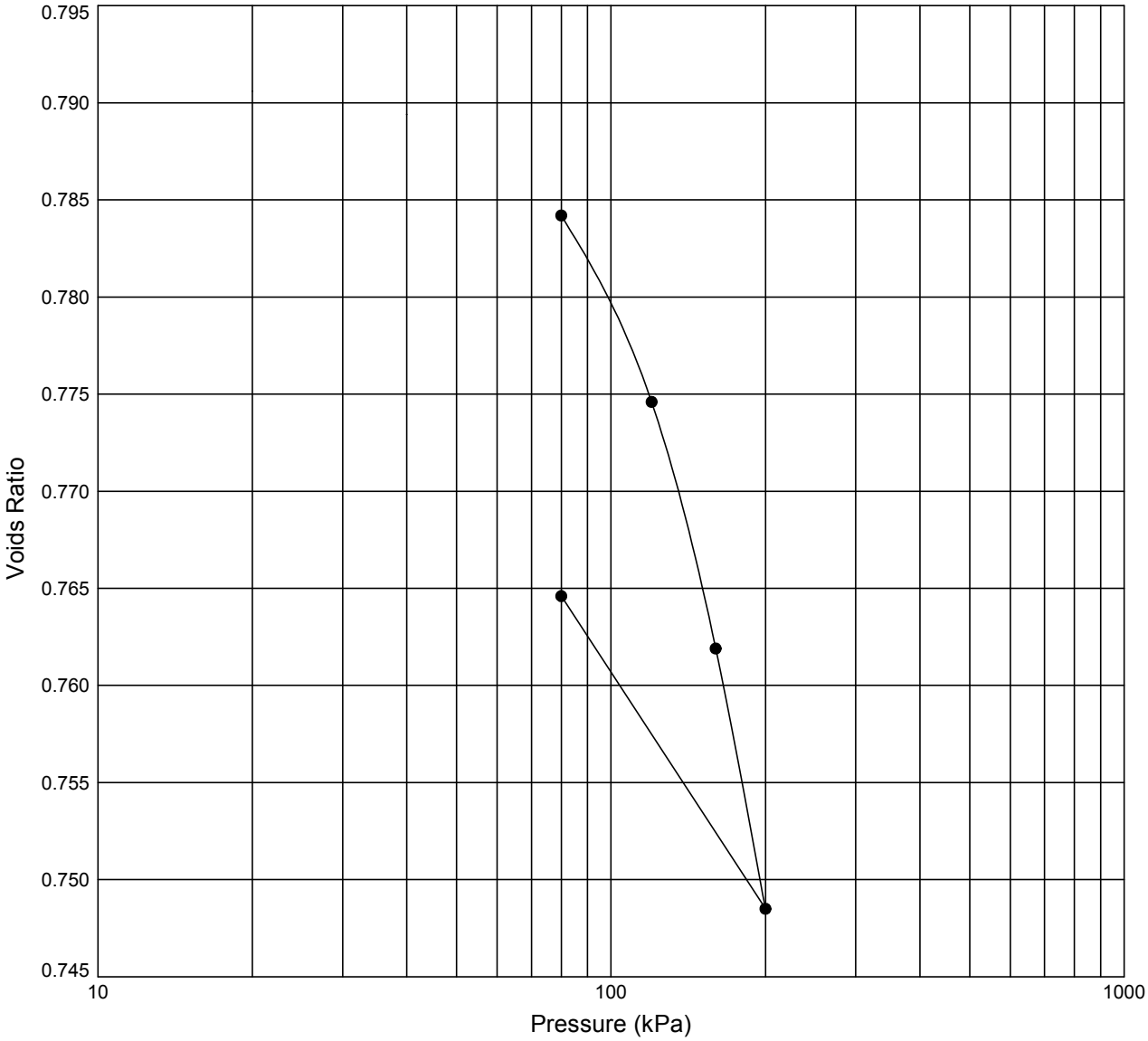
Compiled By		Date
A.D. Frost	**ALAN FROST**	**06/12/16**

Contract	Contract Ref:
Grovefield Way, Cheltenham	**731988**

ONE DIMENSIONAL CONSOLIDATION TEST

In accordance with BS1377:Part 5:1990

Window Sample: **WS3** Sample Ref: **2** Sample Type: **U** Depth (m): **1.22**



Initial Specimen Condition			Final Specimen Condition		
Moisture Content (%)	:	**29**	Moisture Content (%)	:	**29**
Bulk Density (Mg/m^3)	:	**1.91**	Bulk Density (Mg/m^3)	:	**1.94**
Dry Density (Mg/m^3)	:	**1.48**	Dry Density (Mg/m^3)	:	**1.50**
Void Ratio	:	**0.7930**	Void Ratio	:	**0.7646**

Specimen Details			
Description	Height (mm)	:	**19.96**
	Diameter (mm)	:	**49.86**
Dark grey mottled orangish brown slightly sandy slightly gravelly CLAY	Particle Density (Mg/m^3) (assumed)	:	**2.65**
	Swelling Pressure (kPa)	:	**NA**

Test Results			
Pressure Range (kPa)	Mv (m^2/MN)	Cv (m^2/yr)	Voids Ratio
0 - 20	**Sample**	**Swelling**	**0.7906**
20 - 40	**Sample**	**Swelling**	**0.7894**
40 - 80	**0.073**	**14**	**0.7842**
80 - 120	**0.13**	**3.2**	**0.7746**
120 - 160	**0.18**	**2.1**	**0.7619**
160 - 200	**0.19**	**1.2**	**0.7485**
200 - 80	**NA**	**NA**	**0.7646**

Notes: Method of time-setting used: **T90.**

STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By		Date
A.D. Frost	**ALAN FROST**	**06/12/16**

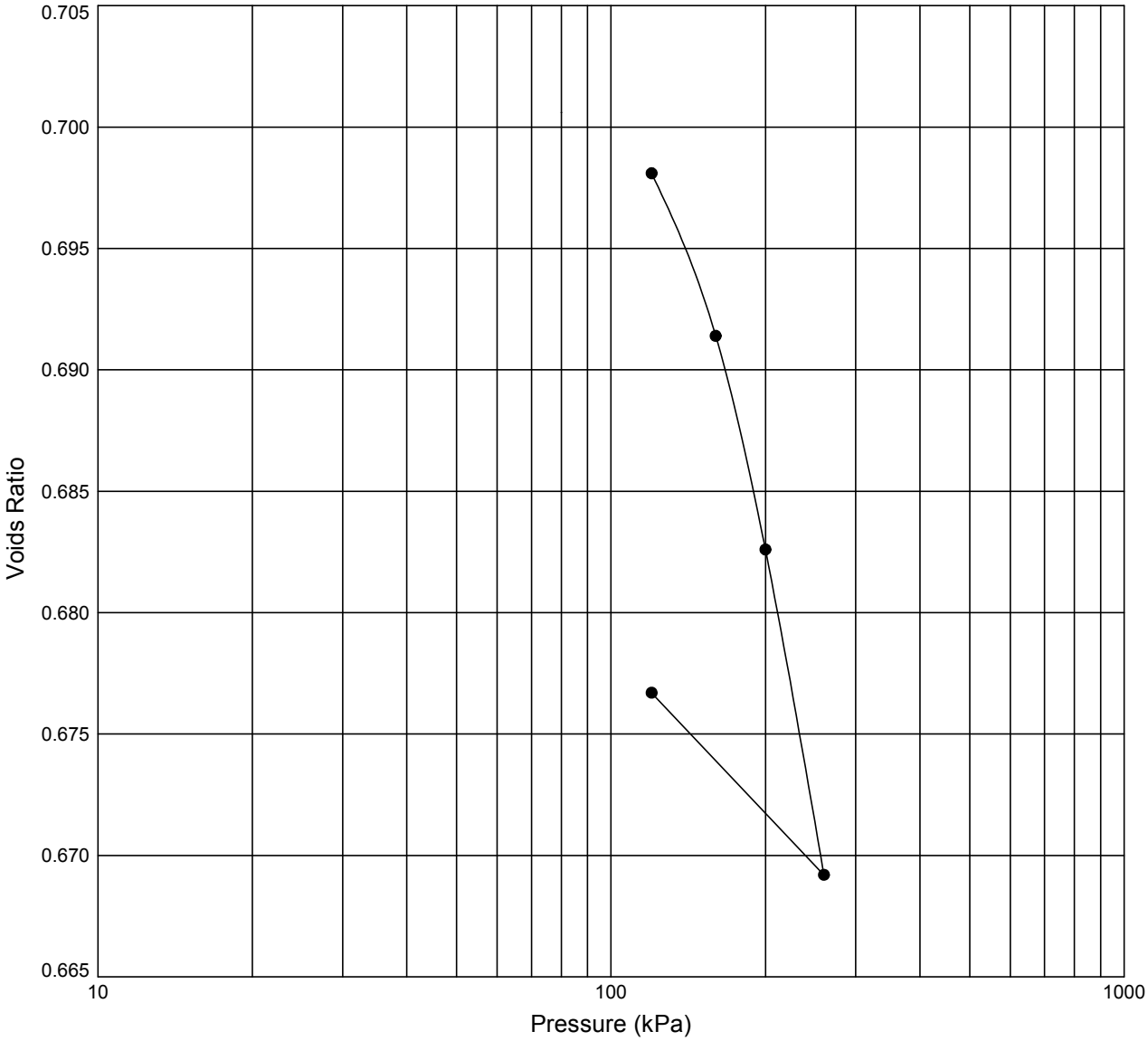
Contract	Contract Ref:
Grovefield Way, Cheltenham	**731988**

AGS

ONE DIMENSIONAL CONSOLIDATION TEST

In accordance with BS1377:Part 5:1990

Window Sample: **WS4** Sample Ref: **2** Sample Type: **U** Depth (m): **1.21**



Initial Specimen Condition			Final Specimen Condition		
Moisture Content (%)	:	**29**	Moisture Content (%)	:	**29**
Bulk Density (Mg/m^3)	:	**1.97**	Bulk Density (Mg/m^3)	:	**2.04**
Dry Density (Mg/m^3)	:	**1.53**	Dry Density (Mg/m^3)	:	**1.58**
Void Ratio	:	**0.7333**	Void Ratio	:	**0.6767**

Specimen Details			
Description	Height (mm)	:	**19.92**
	Diameter (mm)	:	**49.90**
Grey mottled orangish brown CLAY	Particle Density (Mg/m^3) (assumed)	:	**2.65**
	Swelling Pressure (kPa)	:	**NA**

Test Results			
Pressure Range (kPa)	Mv (m^2/MN)	Cv (m^2/yr)	Voids Ratio
0 - 80	**Sample**	**Swelling**	**0.7006**
80 - 120	**0.036**	**9.2**	**0.6981**
120 - 160	**0.099**	**4.1**	**0.6914**
160 - 200	**0.13**	**2.2**	**0.6826**
200 - 260	**0.13**	**1.4**	**0.6692**
260 - 120	**NA**	**NA**	**0.6767**

Notes: Method of time-setting used: **T90.**

STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By		Date
A.D. Frost	**ALAN FROST**	**06/12/16**

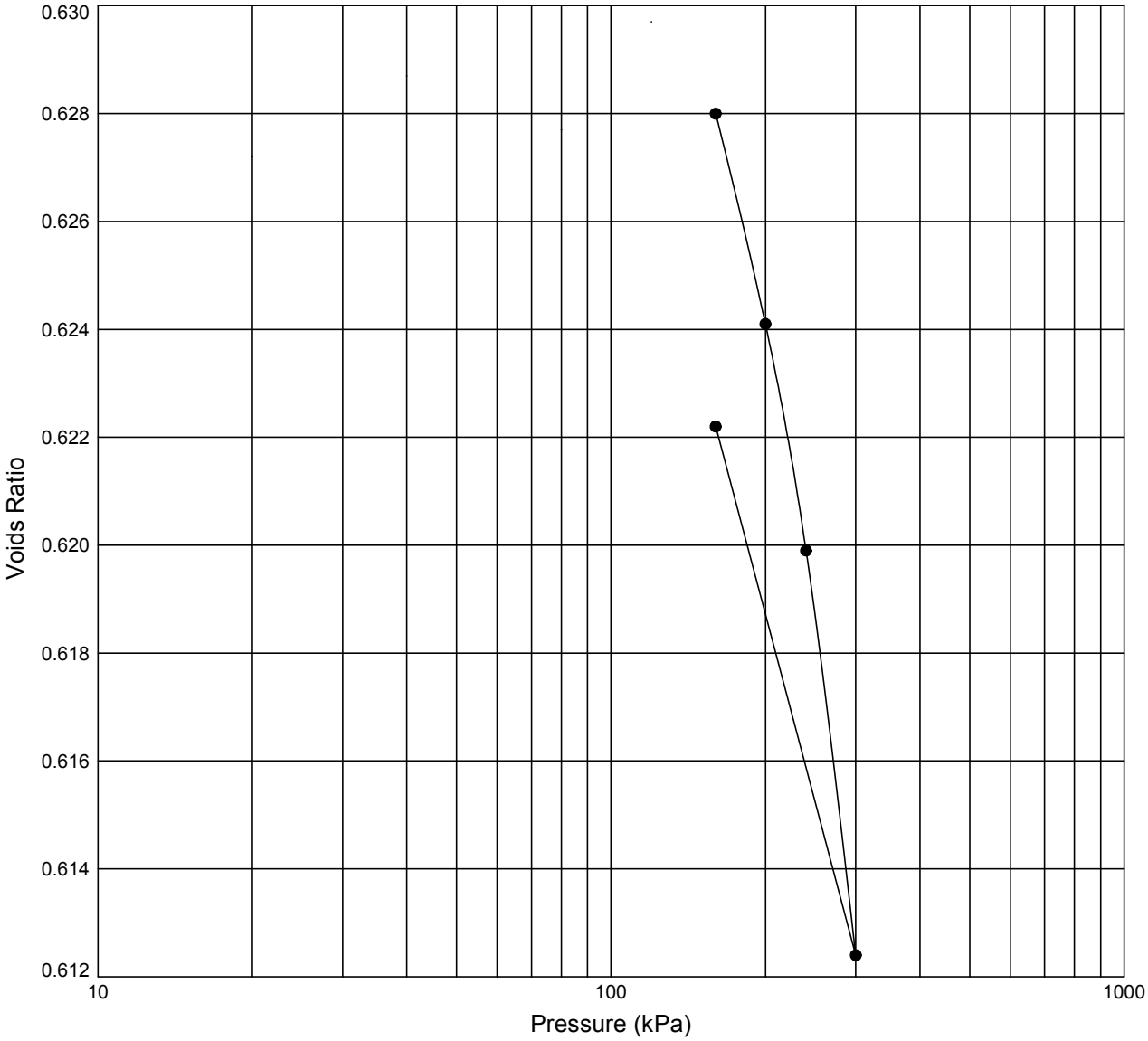
Contract	Contract Ref:
Grovefield Way, Cheltenham	**731988**

AGS

ONE DIMENSIONAL CONSOLIDATION TEST

In accordance with BS1377:Part 5:1990

Window Sample: **WS5** Sample Ref: **2** Sample Type: **U** Depth (m): **1.22**



Initial Specimen Condition			Final Specimen Condition		
Moisture Content (%)	:	**25**	Moisture Content (%)	:	**26**
Bulk Density (Mg/m^3)	:	**2.04**	Bulk Density (Mg/m^3)	:	**2.06**
Dry Density (Mg/m^3)	:	**1.63**	Dry Density (Mg/m^3)	:	**1.64**
Void Ratio	:	**0.6294**	Void Ratio	:	**0.6222**

Specimen Details			
Description	Height (mm)	:	**19.70**
	Diameter (mm)	:	**49.77**
Grey mottled orangish brown CLAY	Particle Density (Mg/m^3) (assumed)	:	**2.65**
	Swelling Pressure (kPa)	:	**NA**

Test Results			
Pressure Range (kPa)	Mv (m^2/MN)	Cv (m^2/yr)	Voids Ratio
0 - 20	**Sample**	**Swelling**	**0.6272**
20 - 40	**Sample**	**Swelling**	**0.6287**
40 - 80	**Sample**	**Swelling**	**0.6277**
80 - 120	**Sample**	**Swelling**	**0.6297**
120 - 160	**0.027**	**18**	**0.6280**
160 - 200	**0.060**	**3.5**	**0.6241**
200 - 240	**0.065**	**2.6**	**0.6199**
240 - 300	**0.077**	**1.6**	**0.6124**
300 - 160	**NA**	**NA**	**0.6222**

Notes: Method of time-setting used: **T90.**

STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By		Date
A.D. Frost	**ALAN FROST**	**06/12/16**

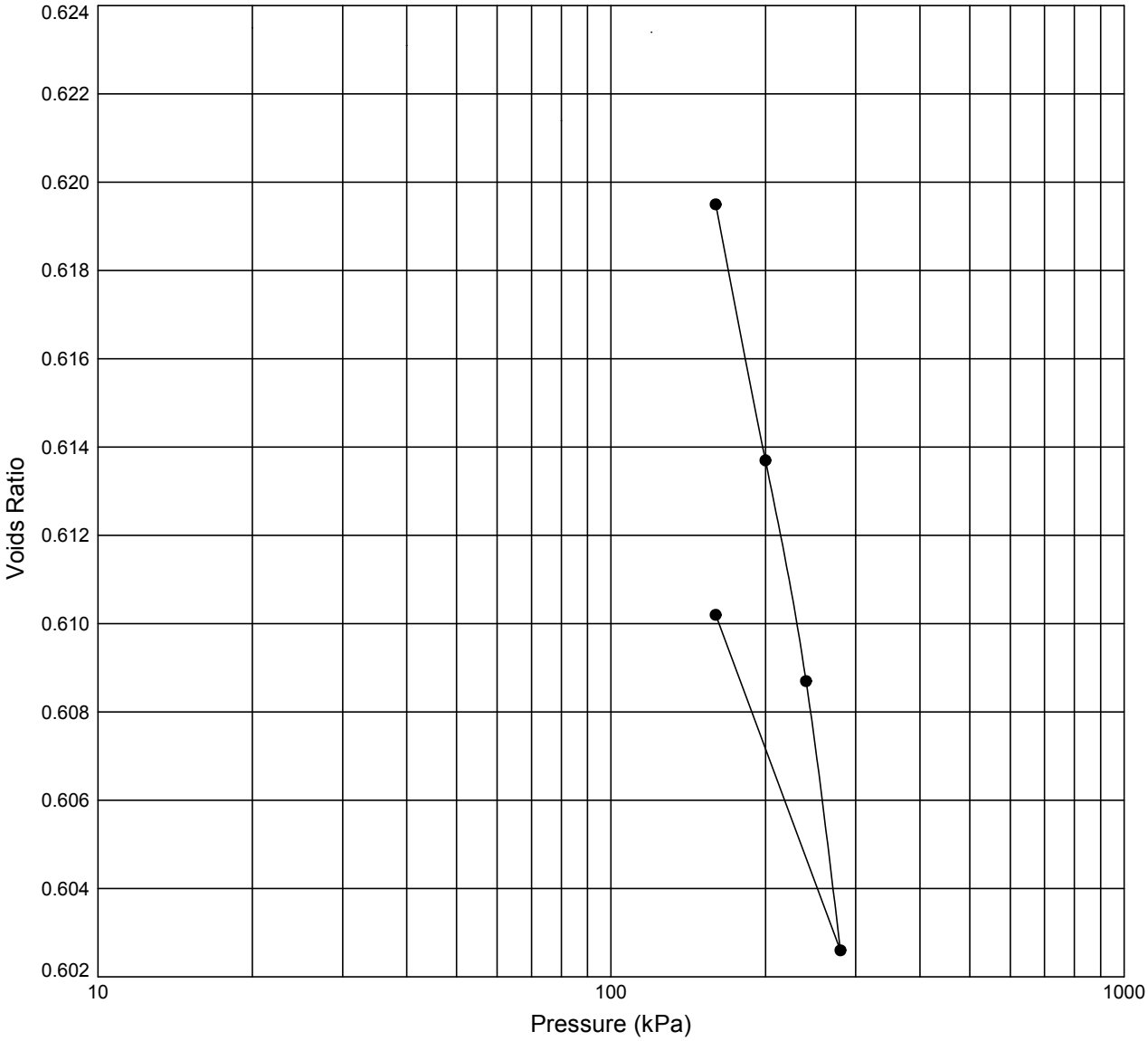
Contract	Contract Ref:
Grovefield Way, Cheltenham	**731988**

AGS

ONE DIMENSIONAL CONSOLIDATION TEST

In accordance with BS1377:Part 5:1990

Window Sample: **WS6** Sample Ref: **2** Sample Type: **U** Depth (m): **1.27**



Initial Specimen Condition			Final Specimen Condition		
Moisture Content (%)	:	**25**	Moisture Content (%)	:	**26**
Bulk Density (Mg/m^3)	:	**2.03**	Bulk Density (Mg/m^3)	:	**2.07**
Dry Density (Mg/m^3)	:	**1.63**	Dry Density (Mg/m^3)	:	**1.64**
Void Ratio	:	**0.6290**	Void Ratio	:	**0.6102**

Specimen Details			
Description	Height (mm)	:	**19.19**
	Diameter (mm)	:	**49.85**
Grey mottled orangish brown CLAY	Particle Density (Mg/m^3) (assumed)	:	**2.65**
	Swelling Pressure (kPa)	:	**NA**

Test Results			
Pressure Range (kPa)	Mv (m^2/MN)	Cv (m^2/yr)	Voids Ratio
0 - 20	**Sample**	**Swelling**	**0.6235**
20 - 40	**Sample**	**Swelling**	**0.6231**
40 - 80	**Sample**	**Swelling**	**0.6214**
80 - 120	**Sample**	**Swelling**	**0.6234**
120 - 160	**0.060**	**15**	**0.6195**
160 - 200	**0.089**	**3.7**	**0.6137**
200 - 240	**0.078**	**1.6**	**0.6087**
240 - 280	**0.095**	**1.2**	**0.6026**
280 - 160	**NA**	**NA**	**0.6102**

Notes: Method of time-setting used: **T90.**

STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By	Date
A.D. Frost — **ALAN FROST**	**06/12/16**

Contract	Contract Ref:
Grovefield Way, Cheltenham	**731988**

APPENDIX E - GEOENVIRONMENTAL TESTING

(i) Laboratory Test Results

(ii) Initial Waste Characterisation (Haswaste)

(iii) Laboratory UKAS Accreditation Certificate

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 16/06963
Issue Number: 1 **Date:** 15 November, 2016

Client:
Structural Soils Limited (Bristol)
The Old School
Stillhouse Lane
Bedminster
Bristol
UK
BS3 4EB

Project Manager: Bryan Simpson/enviro@soils.co.uk/Rhian Lynes
Project Name: Grovefield Way, Cheltenham
Project Ref: 731988
Order No: N/A
Date Samples Received: 31/10/16
Date Instructions Received: 02/11/16
Date Analysis Completed: 14/11/16

Prepared by:

Danielle Brierley
Administrative Assistant

Approved by:

Georgia King
Client Service Manager

Envirolab Job Number: 16/06963

Client Project Name: Grovefield Way, Cheltenham

Client Project Ref: 731988

Lab Sample ID	16/06963/4	16/06963/5	16/06963/6	16/06963/8	16/06963/10	16/06963/12			Units	Method ref
Client Sample No	101	101	101	102	101	101				
Client Sample ID	TP3	TP4	WS1	WS2	WS4	WS5				
Depth to Top	0.50	0.40	0.50	1.00	0.70	0.15				
Depth To Bottom										
Date Sampled	28-Oct-16	28-Oct-16	27-Oct-16	27-Oct-16	27-Oct-16	01-Nov-16				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	3A	3A	3A	3A	3A	6A				
% Stones >10mm$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	3.9			% w/w	A-T-044
pH$_D^{M\#}$	8.29	7.95	8.01	7.86	8.10	8.39			pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.06	<0.01	0.14	0.38	0.11	0.10			g/l	A-T-026s
Organic matter$_D^{M\#}$	0.9	1.1	0.5	4.2	1.7	2.5			% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	3	7	5	7	3	9			mg/kg	A-T-024s
Cadmium$_D^{M\#}$	1.4	2.0	1.1	1.8	1.5	2.3			mg/kg	A-T-024s
Copper$_D^{M\#}$	25	20	20	25	21	37			mg/kg	A-T-024s
Chromium$_D^{M\#}$	34	37	20	46	52	32			mg/kg	A-T-024s
Lead$_D^{M\#}$	11	18	9	55	11	47			mg/kg	A-T-024s
Mercury$_D$	0.20	<0.17	<0.17	0.45	0.43	0.21			mg/kg	A-T-024s
Nickel$_D^{M\#}$	34	45	25	35	35	33			mg/kg	A-T-024s
Selenium$_D$	1	1	<1	<1	<1	<1			mg/kg	A-T-024s
Zinc$_D^{M\#}$	56	53	33	74	56	111			mg/kg	A-T-024s

Envirolab Job Number: 16/06963

Client Project Name: Grovefield Way, Cheltenham

Client Project Ref: 731988

Lab Sample ID	16/06963/4	16/06963/5	16/06963/6	16/06963/8	16/06963/10	16/06963/12			Units	Method ref
Client Sample No	101	101	101	102	101	101				
Client Sample ID	TP3	TP4	WS1	WS2	WS4	WS5				
Depth to Top	0.50	0.40	0.50	1.00	0.70	0.15				
Depth To Bottom										
Date Sampled	28-Oct-16	28-Oct-16	27-Oct-16	27-Oct-16	27-Oct-16	01-Nov-16				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	3A	3A	3A	3A	3A	6A				
PAH 16										
Acenaphthene$_A^{M\#}$	<0.01	<0.01	<0.01	0.07	<0.01	<0.01			mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	<0.02	<0.02	0.16	<0.02	<0.02			mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	0.10	<0.04	<0.04			mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	<0.04	<0.04	0.09	<0.04	<0.04			mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	<0.05	<0.05	0.12	<0.05	<0.05			mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07			mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	<0.06	<0.06	0.14	<0.06	<0.06			mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	<0.08	<0.08	0.43	<0.08	<0.08			mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	0.09	<0.01	<0.01			mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	<0.03	<0.03	0.07	<0.03	<0.03			mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	<0.03	<0.03	0.69	<0.03	<0.03			mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	<0.07	<0.07	0.29	<0.07	<0.07			mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	<0.08	<0.08	<0.08	2.27	<0.08	<0.08			mg/kg	A-T-019s
TPH Banded 1 with ID										
>C6-C8$_A^{\#}$	<10	<10	<10	<10	<10	<10			mg/kg	A-T-007s
>C8-C10$_A^{\#}$	<10	<10	<10	<10	<10	<10			mg/kg	A-T-007s
>C10-C12$_A^{\#}$	<10	<10	<10	<10	<10	<10			mg/kg	A-T-007s
>C12-C16$_A^{\#}$	<10	<10	<10	<10	<10	<10			mg/kg	A-T-007s
>C16-C21$_A^{\#}$	<10	<10	<10	<10	<10	<10			mg/kg	A-T-007s
>C21-C40$_A$	<10	<10	<10	33	<10	47			mg/kg	A-T-007s
TPH Total (sum of bands) (>C6-C40)$_A$	<10	<10	<10	33	<10	47			mg/kg	A-T-007s
TPH ID (for FID characterisations)$_A$	N/A	N/A	N/A	Unknown profile	N/A	Unknown profile				A-T-007s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

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Haswaste, developed by Dr. Iain Haslock.

Site Code and Name 731988
Grovefield Way, Cheltenham

TP/WS/BH		TP3	TP4	WS1	WS2	WS4	WS5			
Depth (m)		0.50	0.40	0.50	1.00	0.70	0.15			
Envirolab reference		16/06963/4	16/06963/5	16/06963/6	16/06963/8	16/06963/10	16/06963/12			
% Moisture	%									
pH (soil)		8.29	7.95	8.01	7.86	8.10	8.39			
pH (leachate)										
Arsenic	mg/kg	3	7	5	7	3	9			
Cadmium	mg/kg	1.4	2.0	1.1	1.8	1.5	2.3			
Copper	updated v5.4e mg/kg	25	20	20	25	21	37			
CrVI or Chromium	mg/kg	34	37	20	46	52	32			
Lead	mg/kg	11	18	9	55	11	47			
Mercury	mg/kg	0.20	0.17	0.17	0.45	0.43	0.21			
Nickel	mg/kg	34	45	25	35	35	33			
Selenium	mg/kg	1	1	1	1	1	1			
Zinc	mg/kg	56	53	33	74	56	111			
Barium	mg/kg									
Beryllium	mg/kg									
Vanadium	mg/kg									
Cobalt	mg/kg									
Manganese	mg/kg									
Molybdenum	mg/kg									
Antimony	mg/kg									
Aluminium	mg/kg									
Bismuth	mg/kg									
CrIII	mg/kg									
Iron	mg/kg									
Strontium	mg/kg									
Tellurium	mg/kg									
Thallium	mg/kg									
Titanium	mg/kg									
Tungsten	mg/kg									
Ammoniacal N	mg/kg									
ws Boron	mg/kg									
PAH (Input Total PAH **OR** individual PAH results)										
Acenaphthene	mg/kg	0.01	0.01	0.01	0.07	0.01	0.01			
Acenaphthylene	mg/kg	0.01	0.01	0.01	0.01	0.01	0.01			
Anthracene	mg/kg	0.02	0.02	0.02	0.16	0.02	0.02			
Benzo(a)anthracene	mg/kg	0.04	0.04	0.04	0.10	0.04	0.04			
Benzo(a)pyrene	mg/kg	0.04	0.04	0.04	0.09	0.04	0.04			
Benzo(b)fluoranthene	mg/kg	0.05	0.05	0.05	0.12	0.05	0.05			
Benzo(ghi)perylene	mg/kg	0.05	0.05	0.05	0.05	0.05	0.05			
Benzo(k)fluoranthene	mg/kg	0.07	0.07	0.07	0.07	0.07	0.07			
Chrysene	mg/kg	0.06	0.06	0.06	0.14	0.06	0.06			
Dibenzo(ah)anthracene	mg/kg	0.04	0.04	0.04	0.04	0.04	0.04			
Fluoranthene	mg/kg	0.08	0.08	0.08	0.43	0.08	0.08			
Fluorene	mg/kg	0.01	0.01	0.01	0.09	0.01	0.01			
Indeno(123cd)pyrene	mg/kg	0.03	0.03	0.03	0.07	0.03	0.03			
Naphthalene	mg/kg	0.03	0.03	0.03	0.03	0.03	0.03			
Phenanthrene	mg/kg	0.03	0.03	0.03	0.69	0.03	0.03			
Pyrene	mg/kg	0.07	0.07	0.07	0.29	0.07	0.07			
Coronene	mg/kg									
Total PAHs (16 or 17)	mg/kg									
TPH										
Petrol	mg/kg									
Diesel	mg/kg									
Lube Oil	mg/kg									
Crude Oil	New v5.4e									
White Spirit / Kerosene	mg/kg									
Creosote	mg/kg									
Unknown TPH with ID	mg/kg	10.0	10.0	10.0	33.0	10.0	47.0			
Unknown TPHCWG	mg/kg									
Total Sulphide	mg/kg									
Complex Cyanide	mg/kg									
Free (or Total) Cyanide	mg/kg									
Thiocyanate	mg/kg									
Elemental/Free Sulphur	mg/kg									
Phenols Input Total Phenols HPLC **OR** individual Phenol results.										
Phenol	mg/kg									
Cresols	mg/kg									
Xylenols	mg/kg									
Resourcinol	mg/kg									
Phenols Total by HPLC	mg/kg									
BTEX Input Total BTEX **OR** individual BTEX results.										
Benzene	mg/kg									
Toluene	mg/kg									
Ethylbenzene	mg/kg									
Xylenes	mg/kg									
Total BTEX	mg/kg									
PCBs (POPs)										
PCBs Total (eg EC7/WHO12)	mg/kg									
PBBs (POPs)										
Hexabromobiphenyl (Total or PBB153; 2,2',4,4',5,5'- if only available)	mg/kg									

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name 731988
Grovefield Way, Cheltenham

TP/WS/BH	TP3	TP4	WS1	WS2	WS4	WS5			
Depth (m)	0.50	0.40	0.50	1.00	0.70	0.15			
Envirolab reference	16/06963/4	16/06963/5	16/06963/6	16/06963/8	16/06963/10	16/06963/12			

POPs Dioxins and Furans Input Total Dioxins and Furans **OR** individual Dioxin and Furan results.

2,3,7,8-TeCDD	mg/kg								
1,2,3,7,8-PeCDD	mg/kg								
1,2,3,4,7,8-HxCDD	mg/kg								
1,2,3,6,7,8-HxCDD	mg/kg								
1,2,3,7,8,9-HxCDD	mg/kg								
1,2,3,4,6,7,8-HpCDD	mg/kg								
OCDD	mg/kg								
2,3,7,8-TeCDF	mg/kg								
1,2,3,7,8-PeCDF	mg/kg								
2,3,4,7,8-PeCDF	mg/kg								
1,2,3,4,7,8-HxCDF	mg/kg								
1,2,3,6,7,8-HxCDF	mg/kg								
2,3,4,6,7,8-HxCDF	mg/kg								
1,2,3,7,8,9-HxCDF	mg/kg								
1,2,3,4,6,7,8-HpCDF	mg/kg								
1,2,3,4,7,8,9-HpCDF	mg/kg								
OCDF	mg/kg								
Total Dioxins and Furans	mg/kg								

Some Pesticides (POPs unless otherwise stated)

Aldrin	mg/kg								
α Hexachlorocyclohexane (alpha-HCH) *(leave empty if total HCH results used)*	mg/kg								
β Hexachlorocyclohexane (beta-HCH) *(leave empty if total HCH results used)*	mg/kg								
α Cis-Chlordane (alpha) ***OR*** *Total Chlordane*	mg/kg								
δ Hexachlorocyclohexane (delta-HCH) *(leave empty if total HCH results used)*	mg/kg								
Dieldrin	mg/kg								
Endrin	mg/kg								
χ Hexachlorocyclohexane (gamma-HCH) (lindane) ***OR*** *Total HCH*	mg/kg								
Heptachlor	mg/kg								
Hexachlorobenzene	mg/kg								
o,p'-DDT *(leave empty if total DDT results used)*	mg/kg								
p,p'-DDT ***OR*** *Total DDT*	mg/kg								
χ Trans-Chlordane (gamma) *(leave empty if total Chlordane results used)*	mg/kg								
Chlordecone (kepone)	mg/kg								
Pentachlorobenzene	mg/kg								
Mirex	mg/kg								
Toxaphene (camphechlor)	mg/kg								

Tin

Tin *(leave empty if Organotin and Tin excl Organotin results used)*	mg/kg								

Organotin

Dibutyltin; DiBT	mg/kg								
Tributyltin; TriBT	mg/kg								
Triphenyltin; TriPT	mg/kg								
Tetrabutyltin; TeBT	mg/kg								

Tin excluding Organotin

Tin excl Organotin	mg/kg								

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Haswaste, developed by Dr. Iain Haslock.

Site Code and Name 731988 Grovefield Way, Cheltenham

TP/WS/BH	TP3	TP4	WS1	WS2	WS4	WS5			
Depth (m)	0.50	0.40	0.50	1.00	0.70	0.15			
Envirolab reference	16/06963/4	16/06963/5	16/06963/6	16/06963/8	16/06963/10	16/06963/12			
Asbestos in Soil	Thresholds								
Asbestos detected in Soil (enter Y or N)	Y								
		Asbestos in Soil above is "Y", the soil is Hazardous Waste HP5 and HP7							
Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only)	see "Carc HP7 % Asbestos in Soil (Fibres)" below	%							
Carcinogenic HP7 % Asbestos in Soil (fibres or micro pieces)	≥0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
		If Asbestos in Soil above is "Y", but Asbestos % above is "<0.1%", the soil is Non Hazardous Waste. You can only use Asbestos % results where loose fibres or micro pieces are only present. You cannot use Asbestos % results when visual identifiable pieces are present.							
Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N)	Y								

If visual identifiable pieces of asbestos are present, you cannot use Asbestos % results and the whole soil sample is Hazardous Waste HP5 and HP7 Construction material containing Asbestos 17 06 05. Therefore, if Asbestos in Soil above is "Y", the Asbestos % above is "<0.1%", but the Asbestos Identifiable Pieces visible with the naked eye is "Y", the soil is Hazardous Waste.

Identifiable Pieces are Cement, Fragments, Board, Rope etc. ie anything ACM that is not Loose Fibres.

All visual asbestos pieces need to be removed leaving only fibres (or micro pieces) with an Asbestos % Composition in Soil result of <0.1% for the soil to become non-hazardous waste.

Hazardous Property	Thresholds	Cut Off Value								
Corrosive HP8	≥5%	<1%	0.00692	0.00803	0.00450	0.00976	0.01038	0.00733	0.00000	0.00000	0.00000
Irritant HP4	≥10%	<1%	0.00322	0.00318	0.00292	0.00375	0.00277	0.00537	0.00000	0.00000	0.00000
Irritant HP4	≥20%	<1%	0.00971	0.01136	0.00732	0.01002	0.00946	0.01086	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥1%		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥20%		0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥1%		0.00687	0.00909	0.00505	0.00883	0.00998	0.00667	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥10%		0.00700	0.00663	0.00413	0.00925	0.00700	0.01388	0.00000	0.00000	0.00000
Aspiration Toxicity HP5	≥10%		0.00100	0.00100	0.00100	0.00330	0.00100	0.00470	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00042	0.00094	0.00068	0.00097	0.00044	0.00121	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥5%	<0.1%	0.00667	0.00725	0.00398	0.00897	0.01013	0.00629	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥25%	<1%	0.01795	0.01999	0.01246	0.02494	0.01771	0.02967	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00002	0.00002	0.00002	0.00005	0.00004	0.00002	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥2.5%	<0.1%	0.00653	0.00710	0.00384	0.00883	0.00998	0.00614	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥15%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥55%	<1%	0.00014	0.00020	0.00011	0.00018	0.00015	0.00023	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.5%	<0.1%	0.00669	0.00732	0.00397	0.00906	0.01018	0.00640	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥3.5%	<0.1%	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥22.5%	<1%	0.01779	0.01978	0.01234	0.02465	0.01754	0.02942	0.00000	0.00000	0.00000
Carcinogenic HP7	≥0.1%		0.00687	0.00909	0.00505	0.00883	0.00998	0.00667	0.00000	0.00000	0.00000
Carcinogenic HP7	≥0.1%		0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
Carcinogenic HP7	≥1%		0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic HP7 Unknown TPH with ID	≥1,000mg/kg		10.00	10.00	10.00	33.00	10.00	47.00	0.00	0.00	0.00
Carcinogenic HP7 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		0.40000	0.40000	0.40000	0.27273	0.40000	0.08511	#DIV/0!	#DIV/0!	#DIV/0!
pH Corrosive HP8 pH (soil or leachate)	H8 ≥11.5		8.29	7.95	8.01	7.86	8.10	8.39	0.00	0.00	0.00
pH Corrosive HP8 pH (soil or leachate)	H8 ≤2		8.29	7.95	8.01	7.86	8.10	8.39	0.00	0.00	0.00
Toxic for Reproduction HP10	≥0.3%		0.00700	0.00909	0.00505	0.00925	0.00707	0.01388	0.00000	0.00000	0.00000
Toxic for Reproduction HP10	≥3%		0.00653	0.00710	0.00384	0.00883	0.00998	0.00614	0.00000	0.00000	0.00000
Mutagenic HP11	≥0.1%		0.00653	0.00710	0.00384	0.00883	0.00998	0.00614	0.00000	0.00000	0.00000
Mutagenic HP11 Unknown TPH with ID	≥1,000mg/kg		10.00	10.00	10.00	33.00	10.00	47.00	0.00	0.00	0.00
Mutagenic HP11 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		0.40000	0.40000	0.40000	0.27273	0.40000	0.08511	#DIV/0!	#DIV/0!	#DIV/0!
Mutagenic HP11	≥1%		0.00687	0.00909	0.00505	0.00707	0.00707	0.00667	0.00000	0.00000	0.00000
Produces Toxic Gases HP12 Sulphide	≥1,400mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Cyanide	≥1,200mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Thiocyanate	≥2,600mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP13 Sensitising	≥10%		0.00687	0.00909	0.00505	0.00883	0.00998	0.00667	0.00000	0.00000	0.00000
Ecotoxic HP14	≥1.0	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.10070	0.11327	0.06904	0.14106	0.11366	0.15069	0.00000	0.00000	0.00000
Ecotoxic HP14	≥25%	<0.1%	0.02508	0.02822	0.01716	0.03500	0.02832	0.03721	0.00000	0.00000	0.00000
Ecotoxic HP14	≥25%	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.02608	0.02922	0.01816	0.03824	0.02931	0.04190	0.00000	0.00000	0.00000

Table 3.1 of the CLP, CL Inventory, ATPs, IARC, Concawe, MSDSs, REACH + Pesticide Properties databases. Worst case REACH + MSDS's used for "*" STOT + Acute Toxicity.

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name 731988 Grovefield Way, Cheltenham

TP/WS/BH	TP3	TP4	WS1	WS2	WS4	WS5			
Depth (m)	0.50	0.40	0.50	1.00	0.70	0.15			
Envirolab reference	16/06963/4	16/06963/5	16/06963/6	16/06963/8	16/06963/10	16/06963/12			
Ecotoxic HP14 individual substance specific thresholds (Benzo(a)anthracene, Dibenz(ah)anthracene (or Total PAH if only used), Sn, TriPT)	≥0.0025%	0.000004	0.000004	0.000004	0.000010	0.000004	0.000004	0.000000	0.000000	0.000000
Ecotoxic HP14 individual substance specific thresholds (Co, γ-HCH, DiBT, TriBT)	≥0.025%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Persistent Organic Pollutant (PCB, PBB or POP Pesticides)	>0.005%	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
Persistent Organic Pollutant (Total Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
Persistent Organic Pollutant (Individual Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

If other contaminants need adding to Haswaste, please contact Envirolab.

United Kingdom Accreditation Service

ACCREDITATION CERTIFICATE

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UNITED KINGDOM ACCREDITATION SERVICE

TESTING LABORATORY
No. 1247

Envirolab

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The schedule to this certificate is an essential accreditation document and from time to time may be revised and reissued by the United Kingdom Accreditation Service. The most recent issue of the schedule of accreditation, which bears the same accreditation number as this certificate, is available from the UKAS website www.ukas.com.

This accreditation is subject to continuing conformity
with United Kingdom Accreditation Service requirements. The absence of a schedule on the UKAS website indicates that the accreditation is no longer in force.

Accreditation Manager, United Kingdom Accreditation Service

Initial Accreditation date
2 December 1992

This certificate issued on
12 November 2012

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APPENDIX F - BACKGROUND TO GEOENVIRONMENTAL ASSESSMENT

(i) RSK Group Generic Assessment Criteria (GAC)

Generic assessment criteria for human health: primary school

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances for the published land uses. The current RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7], where a C4SL has not been published.

GAC for a primary school land use have not been published previously, and RSK has used available reference documents, experience and professional judgement to provide suitable exposure assumptions to characterise this land use. RSK has used the toxicology published within the SP1010 final project report[3] and associated appendices[6], where available, or the toxicology published by LQM/CIEH in 2015[7] or by the USEPA[22].

This GAC appendix therefore presents RSK GAC that may be used in the GQRA stage for a school and will be overly conservative for use at secondary schools.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.06 and supporting EA guidance[5,8,9]. As the SAC are calculated using generic assumptions with respect to a particular scenario, they will be referred to as generic assessment criteria (GAC).

Conceptual model

This scenario considers the risk to a female child from the age of 3 to 11 years, which is the typical age range within a UK primary school with a preschool attached. The number of primary schools in each local authority with a preschool varies, so this element has been included for the assessment criteria to be suitably protective of the variety of situations to which these GAC may be used. The consumption of home-grown produce has not been included in this scenario, as the

amount of produce grown by a school is typically very small and often in raised planters. The consumption of any produce is usually overseen by a teacher or parent and therefore likely to have been thoroughly washed. The pathways considered for the production of SAC in the primary school are

- direct soil and dust ingestion
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

The CLEA model only considers the risk of volatile compounds from the soils and not groundwater. Groundwater assessment criteria (GrAC) have not been produced by RSK for this land use scenario, so site-specific assessment criteria should be derived if required.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9].

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible, as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, vapour exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical correction factor of 10 into the CLEA chemical database for all petroleum hydrocarbons (including BTEX, trimethylbenzenes and total petroleum hydrocarbons (TPH) fraction) and the polycyclic aromatic hydrocarbons (PAH), naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[22]. Toxicological and specific chemical parameters for aromatic hydrocarbon C_8–C_9 (styrene), 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C_8–C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C_8–C_9 have been taken from styrene.

Physical parameters

The building type has been based on best practice guidance for the construction of new primary schools as set out in 'Building Bulletin 99: Briefing Framework for Primary School Projects'[12], published by the Department for Education and Skills. The site area has been calculated for a single-storey building with 240 pupils, which equates to a total net site area of 12,100m^2 and a building footprint of 1535m^2. A total area of 7840m^2 has been classed as soft landscaping and accounts for badly worn sports pitches and areas of natural habitat. The figure is considered highly conservative, as most of this area is likely to be covered by grass, which is classed as not available for dust generation in the CLEA model. The building parameters are given in Table 1.

The parameters for a sandy loam soil type were used in line with SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced SAC for an SOM of 1%, 2.5% and 6%.

The SAC were produced using the input parameters in Tables 1 to 5. The final selected GAC are presented by pathway in Table 6 and the combined GAC in Table 7.

Figure 1: Conceptual model for primary school scenario

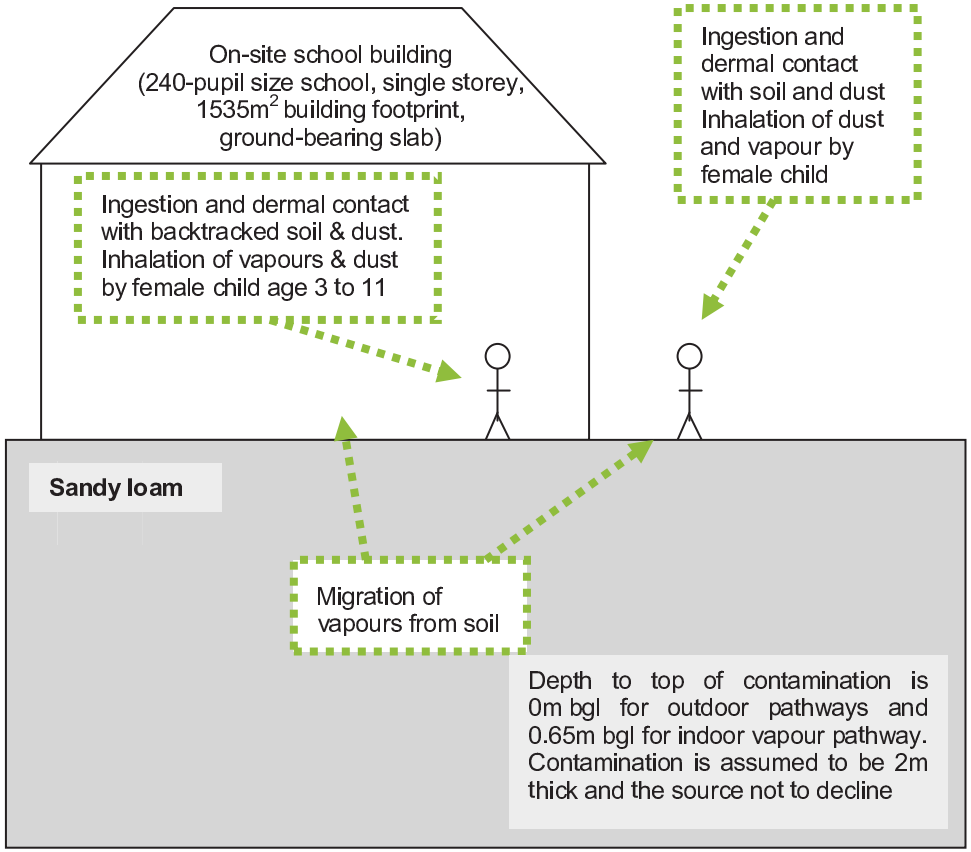

Table 1: Exposure assessment parameters for primary school scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Primary school – RSK-derived land use	Chosen land use. It has been assumed that the amount of produce grown and consumed by the pupils is negligible. The assumed primary school characteristics are presented in Table 2.
Receptor	Female child age 3 to 11	Typical age range of primary schools with preschool. A school with a preschool was chosen in order to be conservative.
Building	Primary school	Building type varies significantly depending on age of school and location. Therefore, typical building type scenario was created for a 240-pupil size school, using guidance set out in 'Building Bulletin 99: Briefing Framework for Primary School Projects'[13]. It has been assumed that the building is single storey with a ground-bearing floor slab.
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, report SC050021/SR3)[5]
Start AC (age class)	4	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 3 to 11
End AC (age class)	11	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[12]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Primary school characteristics

Parameter	Unit	Value	Justification
Number of pupils	No	240	One-form entry nursery, infant and junior school. Eight classes of thirty pupils. Considered reasonable assumption
Number of storeys	No	1	Assumed primary school is one storey
Building area			
Likely gross building area	m^2	1420	Calculated using the formula in BB99[12], in Appendix 4
Additional area for nursery	m^2	115	Page 60 BB99[12], basic assumption for additional nursery space
Total	m^2	1535	
Site area			
Pitches (assumed to be soft cover)	m^2	4800	Calculated using the formula in BB99[12], in Appendix 4
Soft play (informal and social)	m^2	1400	Calculated using the formula in BB99[12], in Appendix 4
Games courts (hard surfaced)	m^2	1080	Calculated using the formula in BB99[12], in Appendix 4
Hard play (informal and social)	m^2	760	Calculated using the formula in BB99[12], in Appendix 4
Habitat (soft landscaped areas)	m^2	440	Calculated using the formula in BB99[12], in Appendix 4
Float (any of the above assumed to be soft)	m^2	1200	Calculated using the formula in BB99[12], in Appendix 4
Total net[A] site area	m^2	9680	Calculated using the formula in BB99[12], in Appendix 4
Likely minimum gross[B] site area from (110% of net)	m^2	10,840	Page 53 of BB99[12]
Likely maximum site area to (125% of net)	m^2	12,100	Page 53 of BB99[12]
Area of soft cover	m^2	7840	Calculated using the formula in BB99[12], in Appendix 4
Fraction of hard cover to soft cover lower limit	fraction	0.27	Calculated from gross area at 110% of net. This includes grass, landscaped areas, pitches and vegetable plots.
Fraction hard cover to soft cover upper limit	fraction	0.35	Calculated from gross area at 125% of net. This includes grass, landscaped areas, pitches and vegetable plots.
Building footprint	m^2	1535	Calculated using the formula in Appendix 4 of Building Bulletin 99[12],

Note: BB99[12] stipulates best practice for new builds.

[A] Net site area is the total of five categories of space (sports pitches, games courts (hard surfaces), soft play (informal and social), hard play, habitat areas), as defined in BB99[12]

[B] Gross (or total) site area is the net site area and the buildings and access area (footprint of buildings, refuse/deliveries area, entrance paths/roads, car parking and drop-off, bicycle storage), as defined in BB99[12]

Table 3: Primary school – land use data for CLEA model

Parameter	Unit	Age class							
		4	5	6	7	8	9	10	11
EF (soil and dust ingestion)	day yr^{-1}	190	195	195	195	195	195	195	195
EF (consumption of home-grown produce)	day yr^{-1}	0	0	0	0	0	0	0	0
EF (skin contact, indoor)	day yr^{-1}	190	195	195	195	195	195	195	195
EF (skin contact, outdoor)	day yr^{-1}	190	195	195	195	195	195	195	195
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	190	195	195	195	195	195	195	195
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	190	195	195	195	195	195	195	195
Justification	Based on 38 weeks for preschool children who are entitled to 15 hours of free nursery education for 38 weeks of the year[14], and typical number of school days for primary school (Department of Education)								
Occupancy period (indoor)	hr day^{-1}	2.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Occupancy period (outdoor)	hr day^{-1}	0.5	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Justification	Age class 4: preschool is based on statutory 15 hours a week for 38 weeks. A 30-min. outdoor break has been included. Age class 5–11 primary school is based on typical school day (6hr 25min) with 1hr 30min break[15] outdoors; 2hr of exercise per week (voluntary target set by Department for Education[15]), 1hr of which is indoor to account for inclement weather and forms part of the school day; and 1hr of extracurricular (additional to the school day) outdoor activity a week outside of school hours. The occupancy period does not include for daily use of breakfast or after-school clubs, as this is not a statutory requirement and not all schools provide such care.								
Soil to skin adherence factor (indoor)	mg cm^{-2} day^{-1}	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Soil to skin adherence factor (outdoor)	mg cm^{-2} day^{-1}	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Justification	Indoor: Table 8.1, SR3[5] and Table 4.1 (lifetime), SR4[9]; Outdoor: Table 3.5, SP1010[3]								
Soil and dust ingestion rate	g day^{-1}	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Justification	Table 6.2, SR3[5] and Table 4.1 (lifetime), SR4[9]								
Note: For **cadmium**, the exposure assessment for the primary school land use is based on estimates representative of lifetime exposure to AC18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer time period. See the Environment Agency Science Report SC050021/TOX 3[1] and Science Report SC050021/Cadmium SGV[1].									

Table 4: Primary school – receptor data for CLEA model

Parameter	Unit	Age class							
		4	5	6	7	8	9	10	11
Body weight	kg	15.1	16.9	19.7	22.1	25.3	27.5	31.4	35.7
Body height	m	0.9	1.0	1.1	1.2	1.2	1.3	1.3	1.4
Justification	Table 4.6, SR3[3]. See Table 4.8 SR3[3] for AC12 to 18								
Inhalation rate	m^3 day^{-1}	22.08	24.33	24.33	25.96	25.96	25.96	25.96	25.96
Justification	USEPA Exposure Factor Handbook[16] Table 6.2, short-term mean exposure values (males and female combined). Mean inhalation rates calculated for the occupancy period and factored up to assume an hourly rate for a 24hr period. Age class 5–11: ~1.5hr high-intensity activity (i.e. football, running), ~5 hours light intensity (i.e. time in classroom, eating). Age class 4: 0.5hr high intensity, 2.5hr light intensity.								
Max exposed skin fraction (indoor)	m^2 m^{-2}	0.35	0.35	0.33	0.22	0.22	0.30	0.30	0.30
Max exposed skin fraction (outdoor)	m^2 m^{-2}	0.28	0.28	0.26	0.15	0.15	0.15	0.15	0.14
Justification	Data in Table 4.8, SR3[5]. See Table 4.8 of SR(3)[5] for AC12 to 18.								

Parameter	Unit	Age class						
		12	13	14	15	16	17	18
Inhalation rate (AC12 to 18)	m^3 day^{-1}	30.47	30.47	30.47	30.47	30.47	30.06	28.81
Justification	For use when modeling lifetime exposure (cadmium) to AC18. USEPA Exposure Factor Handbook[16] Table 6.2, short-term mean exposure values (males and female combined). Mean inhalation rates calculated for the occupancy period and factored up to assume an hourly rate for a 24hr period. Age class 5–11: ~1.5hr high-intensity activity (i.e. football, running), ~5 hours light intensity (i.e. time in classroom, eating). Age class 4: 0.5hr high intensity, 2.5hr light intensity.							

Table 5: Primary school – default soil and building inputs for CLEA model

Parameter	Unit	Value	Justification
Soil properties for sandy loam			
Porosity, total	cm^3 cm^{-3}	0.53	Default soil type is sandy loam, Section 4.3.1, SR3[5] Parameters for sandy loam from Table 4.4, SR3[5]
Porosity, air filled	cm^3 cm^{-3}	0.20	
Porosity, water filled	cm^3 cm^{-3}	0.33	
Residual soil water content	cm^3 cm^{-3}	0.12	
Saturated hydraulic conductivity	cm s^{-1}	3.56E-03	

Parameter	Unit	Value	Justification
van Genuchten shape parameter (m)	-	3.20E-01	
Bulk density	g cm^{-3}	1.21	
Threshold value of wind speed at 10m	m s^{-1}	7.20	Default value taken from Section 9.2.2, SR3[5]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[5]
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3[5]
Air dispersion model			
Mean annual wind speed (10m)	m s^{-1}	5.00	Default value taken from Section 9.2.2, SR3[5]
Air dispersion factor at height of 0.8m	g m^{-2} s^{-1} per kg m^{-3}	68	Values for a 2ha site, appropriate to land use in Newcastle (most representative city for UK) (from Table 9.1, SR3)[5]
Air dispersion factor at height of 1.6m	g m^{-2} s^{-1} per kg m^{-3}	120	
Fraction of site with hard or vegetative cover	m^2 m^{-2}	0.675	Upper limit calculated from BB99[12]. It has been assumed that 50% of the soft cover is vegetative cover such as grass. The remaining 50% of soft cover is assumed to be disturbed in some way, either by gardening or sports/ playtime activities.
Building properties for primary school with ground-bearing floor slab			
Building footprint	m^2	1535	Calculated from Building Bulletin 99[12]. See Table 2.
Living space air exchange rate	hr^{-1}	2	The Building Regulations 2000, Approved Document F[17] states that ventilation should be designed in accordance with 'Building Bulletin 101: Ventilation for School Buildings'[18]. The School Premises Regulations 1999[19] apply to existing buildings and state that all occupied areas in a school building shall have controllable ventilation at a minimum rate of three litres of fresh air per second for each of the maximum number of persons the area will accommodate. BB101[18] states that in a special school, the minimum air exchange rate should be 2.5 air changes per hour. CIBSE Guide B2:2001[20], states that for schoolrooms, there should be a minimum of 4–6 air changes per hour. A conservative rate of 2 has been used.
Living space height (above ground)	m	2.4	Minimum height requirement for a school hall used for physical education is 3.5m (BB99[12]). It is assumed that the school is single storey. A minimum classroom height of 2.4m has been assumed in order to be conservative.
Living space height (below ground)	m	0.0	Assumed no basement

Parameter	Unit	Value	Justification
Pressure difference (soil to enclosed space)	Pa	5.2	From Table 4.21, SR3[5]. Based on the negative pressure of an office of similar dimensions and construction, most conservative value assumed.
Foundation thickness	m	0.15	Assumed reasonable
Floor crack area	cm^2	4940	From Table 4.21, SR3[5]. Based on an office of similar construction, scaled up to the size of the generic school building (office post 1970 x 2.5).
Dust loading factor	$\mu g\ m^{-3}$	100	Default value for a commercial property taken from Section 9.3, SR3[5] in absence of school specific data found during brief literature review.
Vapour model			
Default soil gas ingress rate	$cm^3\ s^{-1}$	150	Generic flow rate for commercial property, Section 10.3, SR3[5], based on a worst-case building type and therefore considered suitable for a primary school building. The value also lies at the top end of soil ingress rate observed by Hers et al[21].
Depth to top of source (beneath building)	cm	65	Section 3.2.6, SR3[5] states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3[5] assumes impact from 0m to 1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4[9]
Time average period for surface emissions	years	8	Time period of a 3–11 year old, Box 3.5, SR3[5]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[5]

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PRIMARY SCHOOL

Table 6

Human Health Generic Assessment Criteria by Pathway for Primary School

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	1.23E+02	1.06E+03	NR	NR	1.23E+02	1.06E+03	NR	NR	1.23E+02	1.06E+03	NR	NR
Cadmium	(a)	5.10E+02	6.40E+02	3.00E+02	NR	5.10E+02	6.40E+02	3.00E+02	NR	5.10E+02	6.40E+02	3.00E+02	NR
Chromium (III) - trivalent	(c)	6.23E+04	2.56E+03	2.46E+03	NR	6.23E+04	2.56E+03	2.46E+03	NR	6.23E+04	2.56E+03	2.46E+03	NR
Chromium (VI) - hexavalent	(a,d)	1.84E+02	4.15E+01	NR	NR	1.84E+02	4.15E+01	NR	NR	1.84E+02	4.15E+01	NR	NR
Copper		3.37E+04	3.13E+04	1.90E+04	NR	3.37E+04	3.13E+04	1.90E+04	NR	3.37E+04	3.13E+04	1.90E+04	NR
Lead	(a)	9.79E+02	NR	NR	NR	9.79E+02	NR	NR	NR	9.79E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	5.68E+00	NR	4.31E+00	NR	1.03E+01	NR	1.07E+01	NR	1.53E+01	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		2.04E+02	7.32E+03	1.98E+02	NR	2.04E+02	7.32E+03	1.98E+02	NR	2.04E+02	7.32E+03	1.98E+02	NR
Methyl Mercury (Hg^{4+})		6.24E+01	3.23E+02	5.23E+01	7.33E+01	6.24E+01	4.69E+02	5.51E+01	1.42E+02	6.24E+01	7.05E+02	5.74E+01	3.04E+02
Nickel	(d)	5.85E+02	3.66E+02	2.93E+02	NR	5.85E+02	3.66E+02	2.93E+02	NR	5.85E+02	3.66E+02	2.93E+02	NR
Selenium	(b)	1.87E+03	NR	NR	NR	1.87E+03	NR	NR	NR	1.87E+03	NR	NR	NR
Zinc	(b)	1.26E+05	7.32E+07	NR	NR	1.26E+05	7.32E+07	NR	NR	1.26E+05	7.32E+07	NR	NR
Cyanide (free)		1.25E+02	2.78E+04	1.25E+02	NR	1.25E+02	2.78E+04	1.25E+02	NR	1.25E+02	2.78E+04	1.25E+02	NR
Volatile Organic Compounds													
Benzene	(a)	2.22E+02	3.09E+01	2.72E+01	1.22E+03	2.22E+02	5.61E+01	4.48E+01	2.26E+03	2.22E+02	1.12E+02	7.45E+01	4.71E+03
Toluene		8.67E+04	2.85E+04	2.15E+04	8.69E+02	8.67E+04	6.00E+04	3.55E+04	1.92E+03	8.67E+04	1.28E+05	5.16E+04	4.36E+03
Ethylbenzene		3.89E+04	2.45E+03	2.30E+03	5.18E+02	3.89E+04	5.40E+03	4.74E+03	1.22E+03	3.89E+04	1.16E+04	8.93E+03	2.84E+03
Xylene - m		7.01E+04	2.48E+03	2.40E+03	6.25E+02	7.01E+04	5.46E+03	5.07E+03	1.47E+03	7.01E+04	1.16E+04	9.96E+03	3.46E+03
Xylene - o		7.01E+04	2.65E+03	2.56E+03	4.78E+02	7.01E+04	5.79E+03	5.35E+03	1.12E+03	7.01E+04	1.22E+04	1.04E+04	2.62E+03
Xylene - p		7.01E+04	2.39E+03	2.31E+03	5.76E+02	7.01E+04	5.25E+03	4.88E+03	1.35E+03	7.01E+04	1.12E+04	9.62E+03	3.17E+03
Total xylene		7.01E+04	2.39E+03	2.31E+03	6.25E+02	7.01E+04	5.25E+03	4.88E+03	1.47E+03	7.01E+04	1.12E+04	9.62E+03	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		1.17E+05	3.17E+04	2.50E+04	2.04E+04	1.17E+05	4.96E+04	3.48E+04	1.47E+03	1.17E+05	8.83E+04	5.03E+04	6.27E+04
Trichloroethene		1.95E+02	5.96E-01	5.95E-01	1.54E+03	1.95E+02	1.25E+00	1.24E+00	3.22E+03	1.95E+02	2.75E+00	2.71E+00	7.14E+03
Tetrachloroethene		2.23E+03	5.90E+00	5.89E+00	4.24E+02	2.23E+03	1.32E+01	1.31E+01	9.51E+02	2.23E+03	3.00E+01	2.98E+01	2.19E+03
1,1,1-Trichloroethane		2.34E+05	3.15E+02	3.15E+02	1.43E+03	2.34E+05	6.43E+02	6.42E+02	2.92E+03	2.34E+05	1.41E+03	1.40E+03	6.39E+03
1,1,1,2 Tetrachloroethane		2.24E+03	4.98E+01	4.88E+01	2.60E+03	2.24E+03	1.14E+02	1.09E+02	6.02E+03	2.24E+03	2.62E+02	2.35E+02	1.40E+04
1,1,2,2-Tetrachloroethane		2.24E+03	1.28E+02	1.21E+02	2.67E+03	2.24E+03	2.59E+02	2.32E+02	5.46E+03	2.24E+03	5.56E+02	4.45E+02	1.20E+04
Carbon Tetrachloride		1.56E+03	8.84E-01	8.83E-01	1.52E+03	1.56E+03	1.93E+00	1.93E+00	3.32E+03	1.56E+03	4.36E+00	4.36E+00	7.54E+03
1,2-Dichloroethane		4.68E+01	3.34E-01	3.32E-01	3.41E+03	4.68E+01	4.81E-01	4.76E-01	4.91E+03	4.68E+01	8.21E-01	8.07E-01	8.43E+03
Vinyl Chloride		5.46E+00	3.20E-02	3.18E-02	1.36E+03	5.46E+00	4.13E-02	4.10E-02	1.76E+03	5.46E+00	6.31E-02	6.24E-02	2.96E+03
1,2,4-Trimethylbenzene		NR	1.05E+02	NR	4.74E+02	NR	1.73E+02	NR	1.16E+03	NR	2.41E+02	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		2.29E+04	3.40E+05	2.14E+04	5.70E+01	2.29E+04	5.56E+05	2.20E+04	1.41E+02	2.29E+04	5.56E+05	2.20E+04	3.36E+02
Acenaphthylene		2.29E+04	3.28E+05	2.14E+04	8.61E+01	2.29E+04	5.35E+05	2.20E+04	2.12E+02	2.29E+04	5.35E+05	2.20E+04	5.06E+02
Anthracene		1.15E+05	2.83E+06	1.10E+05	1.17E+00	1.15E+05	4.87E+06	1.12E+05	2.91E+00	1.15E+05	4.87E+06	1.12E+05	6.96E+00
Benzo(a)anthracene		5.92E+01	6.80E+01	3.16E+01	1.71E+00	5.92E+01	8.91E+01	3.56E+01	4.28E+00	5.92E+01	8.91E+01	3.56E+01	1.03E+01
Benzo(b)fluoranthene		1.49E+01	1.99E+01	8.52E+00	1.22E+00	1.49E+01	2.52E+01	9.36E+00	3.04E+00	1.49E+01	2.52E+01	9.36E+00	7.29E+00
Benzo(g,h,i)perylene		1.31E+03	2.43E+03	8.52E+02	1.54E-02	1.31E+03	2.84E+03	8.98E+02	3.85E-02	1.31E+03	2.84E+03	8.98E+02	9.23E-02
Benzo(k)fluoranthene		3.93E+02	5.77E+02	2.34E+02	6.87E-01	3.93E+02	7.16E+02	2.54E+02	1.72E+00	3.93E+02	7.16E+02	2.54E+02	4.12E+00
Chrysene		1.18E+02	1.27E+02	6.13E+01	4.40E-01	1.18E+02	1.68E+02	6.94E+01	1.10E+00	1.18E+02	1.68E+02	6.94E+01	2.64E+00
Dibenzo(a,h)anthracene		1.18E+00	1.86E+00	7.23E-01	3.93E-03	1.18E+00	2.27E+00	7.78E-01	9.84E-03	1.18E+00	2.27E+00	7.78E-01	2.36E-02
Fluoranthene		4.77E+03	2.97E+05	4.69E+03	1.89E+01	4.77E+03	4.36E+05	4.71E+03	4.73E+01	4.77E+03	4.36E+05	4.71E+03	1.13E+02
Fluorene		1.53E+04	1.52E+05	1.39E+04	3.09E+01	1.53E+04	2.96E+05	1.45E+04	7.65E+01	1.53E+04	2.96E+05	1.45E+04	1.83E+02
Indeno(1,2,3-cd)pyrene		1.69E+02	2.16E+02	9.48E+01	6.13E-02	1.69E+02	2.75E+02	1.05E+02	1.53E-01	1.69E+02	2.75E+02	1.05E+02	3.68E-01
Phenanthrene		4.75E+03	1.27E+05	4.58E+03	3.60E+01	4.75E+03	2.15E+05	4.65E+03	8.96E+01	4.75E+03	2.15E+05	4.65E+03	2.14E+02
Pyrene		1.14E+04	6.85E+05	1.13E+04	2.20E+00	1.14E+04	1.01E+06	1.13E+04	5.49E+00	1.14E+04	1.01E+06	1.13E+04	1.32E+01
Benzo(a)pyrene	(a)	1.59E+01	3.65E+01	NR	9.11E-01	1.59E+01	4.57E+01	NR	2.28E+00	1.59E+01	4.57E+01	NR	5.46E+02
Naphthalene		7.54E+03	4.90E+02	4.60E+02	7.64E+01	7.54E+03	9.51E+02	8.45E+02	1.83E+02	7.54E+03	9.51E+02	8.45E+02	4.32E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PRIMARY SCHOOL

Table 6

Human Health Generic Assessment Criteria by Pathway for Primary School

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Phenol		2.06E+05	6.86E+03	6.64E+03	2.42E+04	2.06E+05	7.87E+03	7.58E+03	3.81E+04	2.06E+05	7.87E+03	7.58E+03	7.03E+04

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PRIMARY SCHOOL

Table 6

Human Health Generic Assessment Criteria by Pathway for Primary School

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC_5-EC_6		9.75E+05	1.64E+03	1.64E+03	3.04E+02	9.75E+05	2.98E+03	2.98E+03	5.58E+02	9.75E+05	6.08E+03	6.07E+03	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		9.75E+05	3.95E+03	3.94E+03	1.44E+02	9.75E+05	8.68E+03	8.66E+03	3.22E+02	9.75E+05	1.94E+04	1.93E+04	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		1.95E+04	9.89E+02	9.77E+02	7.77E+01	1.95E+04	2.33E+03	2.26E+03	1.90E+02	1.95E+04	5.28E+03	4.87E+03	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		1.95E+04	4.55E+03	4.26E+03	4.75E+01	1.95E+04	1.05E+04	8.75E+03	1.18E+02	1.95E+04	2.28E+04	1.40E+04	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		1.95E+04	3.06E+04	1.55E+04	2.37E+01	1.95E+04	6.49E+04	1.78E+04	5.91E+01	1.95E+04	1.27E+05	1.87E+04	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	3.22E+05	NR	NR	8.48E+00	3.49E+05	NR	NR	2.12E+01	3.64E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	3.22E+05	NR	NR	8.48E+00	3.49E+05	NR	NR	2.12E+01	3.64E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		4.67E+03	1.47E+04	3.54E+03	6.26E+02	4.67E+03	3.13E+04	4.06E+03	1.44E+03	4.67E+03	6.50E+04	4.36E+03	3.35E+03
Aromatic hydrocarbons >EC_9-EC_{10}		7.80E+03	1.56E+03	1.48E+03	6.13E+02	7.80E+03	3.50E+03	3.02E+03	1.50E+03	7.80E+03	7.38E+03	5.05E+03	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		7.80E+03	6.99E+03	4.91E+03	3.64E+02	7.80E+03	1.46E+04	6.50E+03	8.99E+02	7.80E+03	2.83E+04	7.19E+03	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		7.80E+03	4.43E+04	7.43E+03	1.69E+02	7.80E+03	8.07E+04	7.60E+03	4.19E+02	7.80E+03	1.37E+05	7.69E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	5.66E+03	NR	NR	5.37E+01	5.72E+03	NR	NR	1.34E+02	5.76E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	5.80E+03	NR	NR	4.83E+00	5.81E+03	NR	NR	1.21E+01	5.82E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	5.80E+03	NR	NR	4.83E+00	5.81E+03	NR	NR	1.21E+01	5.82E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but will not effect the SAC significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PRIMARY SCHOOL

Table 7
Human Health Generic Assessment Criteria for Primary School

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	123	123	123
Cadmium	300	300	300
Chromium (III) - trivalent	2,560	2,560	2,560
Chromium (VI) - hexavalent	41	41	41
Copper	19,000	19,000	19,000
Lead	980	980	980
Elemental Mercury (Hg^0)	5.7 (4.3)	10.3	15.3
Inorganic Mercury (Hg^{2+})	200	200	200
Methyl Mercury (Hg^{4+})	52	55	57
Nickel	370	370	370
Selenium	1,870	1,870	1,870
Zinc	126,400	126,400	126,400
Cyanide (free)	125	125	125
Volatile Organic Compounds			
Benzene	27	45	74
Toluene	21,000 (869)	35,000 (1,920)	52,000 (4,360)
Ethylbenzene	2,000 (518)	5,000 (1,220)	9,000 (2,840)
Xylene - m	2,400 (625)	5,100 (1,470)	10,000 (3,460)
Xylene - o	2,600 (478)	5,300 (1,120)	10,400 (2,620)
Xylene - p	2,300 (576)	4,900 (1,350)	9,600 (3,170)
Total xylene	2,300 (625)	4,900 (1,470)	9,600 (3,460)
Methyl tertiary-Butyl ether (MTBE)	25,000 (20,400)	35,000 (1,470)	50,000
Trichloroethene	0.59	1.24	2.71
Tetrachloroethene	6	13	30
1,1,1-Trichloroethane	310	640	1,400
1,1,1,2 Tetrachloroethane	50	110	230
1,1,2,2-Tetrachloroethane	120	230	450
Carbon Tetrachloride	0.88	1.93	4.36
1,2-Dichloroethane	0.33	0.48	0.81
Vinyl Chloride	0.032	0.041	0.062
1,2,4-Trimethylbenzene	105	173	241
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	21,400 (57)	22,000	22,000
Acenaphthylene	21,400 (86)	22,000	22,000
Anthracene	110,000	112,000	112,000
Benzo(a)anthracene	32	36	36
Benzo(b)fluoranthene	9	9	9
Benzo(g,h,i)perylene	850	900	900
Benzo(k)fluoranthene	230	250	250
Chrysene	61	69	69
Dibenzo(a,h)anthracene	0.72	0.78	0.78
Fluoranthene	4,700	4,700	4,700
Fluorene	14,000	15,000	15,000
Indeno(1,2,3-cd)pyrene	90	100	100
Phenanthrene	4,600	4,600	4,600
Pyrene	11,000	11,000	11,000
Benzo(a)pyrene	15.9	15.9	15.9
Naphthalene	460 (76)	840 (183)	840 (432)
Phenol	440*	690*	1,300*
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	1,600 (304)	3,000 (558)	6,100 (1,151)
Aliphatic hydrocarbons >EC_6-EC_8	4,000 (144)	9,000 (322)	19,000 (736)
Aliphatic hydrocarbons >EC_8-EC_{10}	1,000 (78)	2,300 (190)	4,900 (451)
Aliphatic hydrocarbons >EC_{10}-EC_{12}	4,300 (48)	8,800 (118)	14,000 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	16,000 (24)	18,000 (59)	19,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	322,000	349,000	364,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	322,000	349,000	364,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	3,500 (626)	4,100 (1,440)	4,400 (3,350)
Aromatic hydrocarbons >EC_9-EC_{10}	1,500 (613)	3,000 (1,500)	5,100 (3,580)
Aromatic hydrocarbons >EC_{10}-EC_{12}	4,900 (364)	6,500 (899)	7,200 (2,150)
Aromatic hydrocarbons >EC_{12}-EC_{16}	7,400	7,600	7,700
Aromatic hydrocarbons >EC_{16}-EC_{21}	5,700	5,700	5,800
Aromatic hydrocarbons >EC_{21}-EC_{35}	5,800	5,800	5,800
Aromatic hydrocarbons >EC_{35}-EC_{44}	5,800	5,800	5,800

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

* The GAC for Phenol is based on a threshold which is protective of direct contact (SC050021/Phenol SGV report)

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS) The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

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Risk Assessment Methodology

Risk is a combination of the 'likelihood' of an even occurring and the magnitude of its 'consequences'. Therefore, in order to assess risk, both the likelihood and the consequences of an event must be taken into account. RSK Group Plc has adopted guidance provided in CIRIA C552 for use in the production of risk assessments.

The likelihood of an event can be classified on a four point system using the following terms and definitions based on CIRIA C552:

Highly likely: The event appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution;

Likely: It is probable that an event will occur, or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term;

Low likelihood: Circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term;

Unlikely: Circumstances are such that it is improbably the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

Severe: Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);

Medium: Chronic damage to human health ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);

Mild: Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment; and

Minor: Harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the likelihood of an event occurring and its severity have been classified, a risk category can be assigned the table below.

		RISK CLASSIFICATION SYSTEM (CIRIA 552)			
		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Highly likely**	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

UKWIR Guidelines

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A range of pipe materials are available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes, and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to potable water supply by permeating plastic water supply pipes. To fulfil their statutory obligations, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that a remedial strategy is proposed that will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or in specific zones.

In 2010, UK Water Industry Research (UKWIR) published Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was also to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipes failing prematurely due to the presence of contamination.

Report 10/WM/03/21 concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for PE and PVC pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GACs for this linkage and are reproduced in the table on the following page.

Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.5m and 1.5m below finished ground level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used provided that they are considered representative of the strata within those depths. Report 10/WM/03/21 also specifies that sampling should characterise the ground conditions to a minimum of 0.5m below the proposed depth of the pipe and to 15m either side of it.

It should be noted that the assessment provided in this report is a guide only and the method of assessment and recommendations should be checked with the relevant water supply company.

Where a water main and/or service pipe is to be laid close to fuel or chemical storage tanks (e.g. petrol filling stations) then the local water company may require the pipe materials laid within a designated distance of the facility to take account of future contamination risk.

Generic assessment criteria (GAC) for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	**PE**	**PVC**
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC	0.5#	0.125#
1a	• BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C_5–C_{10})	2##	1.4##
2e	• Phenols	2	0.4
2f	• Cresols and chlorinated phenols	2	0.04
3	Mineral oil C_{11}–C_{20}	10	Suitable
4	Mineral oil C_{21}–C_{40}	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Further parameters identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable

Notes: where indicated as 'suitable', the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIR.
#: Total VOC result minus BTEX and MTBE results
##: Total SVOC result minus total phenols/cresols/chlorinated phenols results

APPENDIX G - MONITORING RECORDS

(i) Gas/Groundwater Monitoring Results

IN-SITU GAS MONITORING RESULTS

[Pressures]	Previous	During	Start	End	Equipment Used & Remarks
Round 1	Constant	Fluctuating	1021	1021	Ground: Damp + Wind: None + Air Temp: 7DegC
Round 2	-	Constant	1006	1006	Ground: Damp + Wind: None + Air Temp: 1DegC
Round 3	Fluctuating	Constant	1021	1021	Ground: Wet + Wind: None + Air Temp: 14DegC
Round 4	Falling	Falling	993	991	Weather: Cloudy + Ground: Wet + Wind: Light + Air Temp: 16DegC
Round 5	Constant	Constant	1029	1029	Ground: Frost + Wind: None + Air Temp: -1DegC
Round 6	Constant	Constant	1020	1020	Ground: Wet + Wind: None

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS1	1	40	1	3.45	---	0.45 to 3.45	02/11/2016 09:24:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS1	1	40	1		---	0.45 to 3.45	30 secs	-	-	$0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS1	1	40	1 (2)	3.45	---	0.45 to 3.45	02/11/2016 09:25:00	-	-	-	-	0.1	0.0	20.9	0.0	2.0	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	1.1	0.0	20.8	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	1.1	0.0	20.5	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.2	0.0	20.3	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	1.1	0.0	20.4	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.9	0.0	20.4	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.6	0.0	20.6	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.5	0.0	20.6	0.0	-	0.0	0.0
WS1	1	40	1 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.4	0.0	20.6	0.0	-	0.0	0.0
WS1	1	40	1 (3)	3.45	3.27	0.45 to 3.45	02/11/2016 09:31:00	-	-	-	DRY	-	-	-	-	-	-	-
WS1	1	40	2	3.45	---	0.45 to 3.45	08/11/2016 10:21:00	1006	1006	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS1	1	40	2		---	0.45 to 3.45	30 secs	-	-	$0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS1	1	40	2 (2)	3.45	---	0.45 to 3.45	08/11/2016 10:22:00	-	-	-	-	0.1	0.0	20.9	0.0	0.7	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	1.0	0.0	20.8	0.0	-	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	1.0	0.0	20.5	0.0	-	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.0	0.0	20.4	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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Compiled By	Date	Checked By	Date	Contract Ref:
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Contract: **Grovefield Way, Cheltenham**

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS1	1	40	2 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.9	0.0	20.4	0.0	-	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.7	0.0	20.5	0.0	-	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.6	0.0	20.6	0.0	-	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.5	0.0	20.7	0.0	-	0.0	0.0
WS1	1	40	2 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.4	0.0	20.7	0.0	-	0.0	0.0
WS1	1	40	2 (3)	3.45	3.27	0.45 to 3.45	08/11/2016 10:28:00	-	-	-	DRY	-	-	-	-	-	-	-
WS1	1	40	3	3.45	---	0.45 to 3.45	15/11/2016 09:55:00	-	1021	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS1	1	40	3 (2)	3.45	3.28	0.45 to 3.45	15/11/2016 09:56:00	-	-	-	DRY	-	-	-	-	-	-	-
	Remarks: Area flooded - PID could not be taken. No LNAPL/DNAPL detected.																	
WS1	1	40	4	3.45	3.26	0.45 to 3.45	22/11/2016	-	-	-	DRY	-	-	-	-	-	-	-
	Remarks: Headworks flooded unable to monitor.																	
WS1	1	40	5	3.45	---	0.45 to 3.45	29/11/2016 10:03:00	1029	1029	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS1	1	40	5		---	0.45 to 3.45	30 secs	-	-	$0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS1	1	40	5 (2)	3.45	---	0.45 to 3.45	29/11/2016 10:04:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS1	1	40	5 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS1	1	40	5 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	0.0	0.0
WS1	1	40	5 (3)	3.45	3.28	0.45 to 3.45	29/11/2016 10:10:00	-	-	-	0.22	-	-	-	-	-	-	-
WS1	1	40	6	3.45	---	0.45 to 3.45	06/12/2016 09:57:00	1020	1020	$0.1_{(I)}$	-	-	-	-	-	-	-	-
WS1	1	40	6		---	0.45 to 3.45	30 secs	-	-	$0.2_{(SS)}$	-	-	-	-	-	-	-	-
WS1	1	40	6 (2)	3.45	---	0.45 to 3.45	06/12/2016 09:58:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	1.0	0.1	20.6	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.5	0.0	20.5	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	21.1	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	21.1	0.0	-	0.0	0.0
WS1	1	40	6 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	21.1	0.0	-	0.0	0.0
WS1	1	40	6 (3)	3.45	3.28	0.45 to 3.45	06/12/2016 10:04:00	-	-	-	0.23	-	-	-	-	-	-	-

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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Contract: **Grovefield Way, Cheltenham**

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS2	1	40	1	3.45	---	0.45 to 3.45	02/11/2016 09:39:00	1020	1020	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS2	1	40	1		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS2	1	40	1 (2)	3.45	---	0.45 to 3.45	02/11/2016 09:40:00	-	-	-	-	0.1	0.0	20.9	0.0	0.2	0.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.9	0.0	20.8	0.0	-	5.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.9	0.0	20.5	0.0	-	3.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.3	0.0	20.3	0.0	-	1.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	1.6	0.1	20.1	-	-	0.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	1.5	0.1	20.1	-	-	0.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	1.1	0.0	20.3	0.0	-	0.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.8	0.0	20.5	0.0	-	0.0	0.0
WS2	1	40	1 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.7	0.0	20.5	0.0	-	0.0	0.0
WS2	1	40	1 (3)	3.45	3.02	0.45 to 3.45	02/11/2016 09:46:00	-	-	-	DRY	-	-	-	-	-	-	-
WS2	1	40	2	3.45	---	0.45 to 3.45	08/11/2016 10:33:00	1006	1006	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS2	1	40	2		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS2	1	40	2 (2)	3.45	---	0.45 to 3.45	08/11/2016 10:34:00	-	-	-	-	0.1	0.0	20.7	0.0	0.1	0.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	1.0	0.0	20.7	0.0	-	1.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	1.0	0.0	20.4	0.0	-	1.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.2	0.0	20.3	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS2	1	40	2 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	1.3	0.1	20.2	-	-	0.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	1.3	0.0	20.2	0.0	-	0.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	1.0	0.0	20.4	0.0	-	0.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.8	0.0	20.5	0.0	-	0.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.6	0.0	20.5	0.0	-	0.0	0.0
WS2	1	40	2 (2)		---	0.45 to 3.45	360 secs	-	-	-	-	0.6	0.0	20.6	0.0	-	0.0	0.0
WS2	1	40	2 (3)	3.45	3.03	0.45 to 3.45	08/11/2016 10:41:00	-	-	-	2.92	-	-	-	-	-	-	-
WS2	1	40	3	3.45	---	0.45 to 3.45	15/11/2016 10:10:00	-	1021	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	3 (2)	3.45	3.02	0.45 to 3.45	15/11/2016 10:11:00	-	-	-	DRY	-	-	-	-	-	-	-
	Remarks: Area flooded. No PID taken.																	
WS2	1	40	4	3.45	2.98	0.45 to 3.45	22/11/2016	-	-	-	DRY	-	-	-	-	-	-	-
	Remarks: Headworks flooded unable to monitor.																	
WS2	1	40	5	3.45	---	0.45 to 3.45	29/11/2016 10:15:00	1029	1029	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS2	1	40	5		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS2	1	40	5 (2)	3.45	---	0.45 to 3.45	29/11/2016 10:16:00	-	-	-	-	0.1	0.0	20.9	0.0	0.7	0.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	3.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	1.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	1.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS2	1	40	5 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	5 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	1.0	0.0
WS2	1	40	5 (3)	3.45	3.03	0.45 to 3.45	29/11/2016 10:22:00	-	-	-	0.19	-	-	-	-	-	-	-
WS2	1	40	6	3.45	---	0.45 to 3.45	06/12/2016 10:10:00	1020	1020	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS2	1	40	6		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS2	1	40	6 (2)	3.45	---	0.45 to 3.45	06/12/2016 10:11:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS2	1	40	6 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS2	1	40	6 (3)	3.45	3.02	0.45 to 3.45	06/12/2016 10:17:00	-	-	-	0.21	-	-	-	-	-	-	-

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IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
	Remarks: Slight sheen of water on surface noted.																	
WS3	1	40	1	3.70	---	0.70 to 3.70	02/11/2016 09:50:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS3	1	40	1		---	0.70 to 3.70	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS3	1	40	1 (2)	3.70	---	0.70 to 3.70	02/11/2016 09:51:00	-	-	-	-	0.1	0.0	20.8	0.0	0.1	0.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	15 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	5.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	30 secs	-	-	-	-	0.7	0.0	20.5	0.0	-	2.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	60 secs	-	-	-	-	1.0	0.1	20.2	-	-	0.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	90 secs	-	-	-	-	1.3	0.1	20.0	-	-	0.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	120 secs	-	-	-	-	1.2	0.1	20.1	-	-	0.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	180 secs	-	-	-	-	0.9	0.0	20.3	0.0	-	0.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	240 secs	-	-	-	-	0.8	0.0	20.4	0.0	-	0.0	0.0
WS3	1	40	1 (2)		---	0.70 to 3.70	300 secs	-	-	-	-	0.7	0.0	20.5	0.0	-	0.0	0.0
WS3	1	40	1 (3)	3.70	3.56	0.70 to 3.70	02/11/2016 09:57:00	-	-	-	DRY	-	-	-	-	-	-	-
WS3	1	40	2	3.70	---	0.70 to 3.70	08/11/2016 10:45:00	1006	1006	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS3	1	40	2		---	0.70 to 3.70	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS3	1	40	2 (2)	3.70	---	0.70 to 3.70	08/11/2016 10:46:00	-	-	-	-	0.2	0.0	20.8	0.0	0.0	0.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	15 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	1.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	30 secs	-	-	-	-	0.7	0.0	20.5	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS3	1	40	2 (2)		---	0.70 to 3.70	60 secs	-	-	-	-	0.9	0.0	20.4	0.0	-	0.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	90 secs	-	-	-	-	1.1	0.1	20.2	-	-	0.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	120 secs	-	-	-	-	1.1	0.1	20.1	-	-	0.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	180 secs	-	-	-	-	1.0	0.1	20.2	-	-	0.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	240 secs	-	-	-	-	0.9	0.0	20.2	0.0	-	0.0	0.0
WS3	1	40	2 (2)		---	0.70 to 3.70	300 secs	-	-	-	-	0.8	0.0	20.3	0.0	-	0.0	0.0
WS3	1	40	2 (3)	3.70	3.56	0.70 to 3.70	08/11/2016 10:52:00	-	-	-	DRY	-	-	-	-	-	-	-
WS3	1	40	3	3.70	---	0.70 to 3.70	15/11/2016 10:29:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS3	1	40	3		---	0.70 to 3.70	30 secs	-	-	$0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS3	1	40	3 (2)	3.70	---	0.70 to 3.70	15/11/2016 10:30:00	-	-	-	-	0.1	0.0	20.8	0.0	0.2	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	15 secs	-	-	-	-	0.2	0.0	20.8	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	30 secs	-	-	-	-	0.3	0.0	20.7	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	60 secs	-	-	-	-	0.4	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	90 secs	-	-	-	-	0.4	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	120 secs	-	-	-	-	0.4	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	180 secs	-	-	-	-	0.4	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	240 secs	-	-	-	-	0.3	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	3 (2)		---	0.70 to 3.70	300 secs	-	-	-	-	0.3	0.0	20.6	0.0	-	0.0	1.0

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IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS3	1	40	3 (3)	3.70	3.56	0.70 to 3.70	15/11/2016 10:36:00	-	-	-	1.75	-	-	-	-	-	-	-
WS3	1	40	4	3.70	---	0.70 to 3.70	22/11/2016 09:08:00	993	993	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS3	1	40	4		---	0.70 to 3.70	60 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS3	1	40	4 (2)	3.70	---	0.70 to 3.70	22/11/2016 09:09:30	-	-	-	-	0.0	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	15 secs	-	-	-	-	0.1	0.0	20.9	-	-	1.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	30 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	60 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	90 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	120 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	180 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	240 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (2)		---	0.70 to 3.70	300 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS3	1	40	4 (3)	3.70	3.53	0.70 to 3.70	22/11/2016 09:15:30	-	-	-	0.38	-	-	-	-	-	-	-
WS3	1	40	5	3.70	---	0.70 to 3.70	29/11/2016 10:28:00	1029	1029	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS3	1	40	5		---	0.70 to 3.70	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS3	1	40	5 (2)	3.70	---	0.70 to 3.70	29/11/2016 10:29:00	-	-	-	-	0.1	0.0	20.7	0.0	0.1	0.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	15 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	1.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	30 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS3	1	40	5 (2)		---	0.70 to 3.70	60 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	90 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	1.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	120 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	180 secs	-	-	-	-	0.1	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	240 secs	-	-	-	-	0.1	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	5 (2)		---	0.70 to 3.70	300 secs	-	-	-	-	0.1	0.0	20.6	0.0	-	0.0	0.0
WS3	1	40	5 (3)	3.70	3.57	0.70 to 3.70	29/11/2016 10:35:00	-	-	-	0.54	-	-	-	-	-	-	-
WS3	1	40	6	3.70	---	0.70 to 3.70	06/12/2016 10:22:00	1020	1020	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS3	1	40	6		---	0.70 to 3.70	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS3	1	40	6 (2)	3.70	---	0.70 to 3.70	06/12/2016 10:23:00	-	-	-	-	0.1	0.0	20.9	0.0	0.1	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	15 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	30 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	60 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	90 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	120 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	180 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	240 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS3	1	40	6 (2)		---	0.70 to 3.70	300 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS3	1	40	6 (3)	3.70	3.57	0.70 to 3.70	06/12/2016 10:29:00	-	-	-	0.61	-	-	-	-	-	-	-
WS4	1	40	1	3.45	---	0.45 to 3.45	02/11/2016 10:03:00	-	-	$0.2_{(SS)}$	-	-	-	-	-	-	-	-
WS4	1	40	1		---	0.45 to 3.45	180 secs	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS4	1	40	1 (2)	3.45	---	0.45 to 3.45	02/11/2016 10:07:00	-	-	-	-	0.1	0.0	20.9	0.0	2.8	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.9	0.0	220.7	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.9	0.0	20.2	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.0	0.0	20.0	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	1.0	0.0	19.9	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	1.0	0.0	20.0	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.7	0.0	20.3	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.5	0.0	20.4	0.0	-	0.0	0.0
WS4	1	40	1 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.4	0.0	20.5	0.0	-	0.0	0.0
WS4	1	40	1 (3)	3.45	3.12	0.45 to 3.45	02/11/2016 10:13:00	-	-	-	DRY	-	-	-	-	-	-	-
WS4	1	40	2	3.45	---	0.45 to 3.45	08/11/2016 10:58:00	1006	1006	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS4	1	40	2		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS4	1	40	2 (2)	3.45	---	0.45 to 3.45	08/11/2016 10:59:00	-	-	-	-	0.1	0.0	20.9	0.0	0.8	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.9	0.0	20.9	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS4	1	40	2 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.9	0.0	20.6	0.0	-	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.0	0.0	20.5	0.0	-	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	1.0	0.0	20.5	0.0	-	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.9	0.0	20.5	0.0	-	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.7	0.0	20.7	0.0	-	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.5	0.0	20.8	0.0	-	0.0	0.0
WS4	1	40	2 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.4	0.0	20.9	0.0	-	0.0	0.0
WS4	1	40	2 (3)	3.45	3.12	0.45 to 3.45	08/11/2016 11:05:00	-	-	-	2.83	-	-	-	-	-	-	-
WS4	1	40	3	3.45	---	0.45 to 3.45	15/11/2016 10:42:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS4	1	40	3		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS4	1	40	3 (2)	3.45	---	0.45 to 3.45	15/11/2016 10:43:00	-	-	-	-	0.1	0.0	20.7	0.0	0.4	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	1.1	0.0	20.4	0.0	-	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	1.1	0.0	19.9	0.0	-	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	1.2	0.0	19.8	0.0	-	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	1.2	0.0	19.8	0.0	-	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	1.1	0.0	19.9	0.0	-	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.7	0.0	20.2	0.0	-	0.0	0.0
WS4	1	40	3 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.5	0.0	20.3	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS4	1	40	3 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.4	0.0	20.4	0.0	-	0.0	0.0
WS4	1	40	3 (3)	3.45	3.12	0.45 to 3.45	15/11/2016 10:49:00	-	-	-	2.60	-	-	-	-	-	-	-
WS4	1	40	4	3.45	---	0.45 to 3.45	22/11/2016 09:22:00	991	991	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS4	1	40	4		---	0.45 to 3.45	60 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS4	1	40	4 (2)	3.45	---	0.45 to 3.45	22/11/2016 09:24:00	-	-	-	-	0.0	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.2	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS4	1	40	4 (3)	3.45	3.10	0.45 to 3.45	22/11/2016 09:30:00	-	-	-	0.14	-	-	-	-	-	-	-
WS4	1	40	5	3.45	---	0.45 to 3.45	29/11/2016 10:42:00	1029	1029	$0.1_{(I)}$	-	-	-	-	-	-	-	-
WS4	1	40	5		---	0.45 to 3.45	30 secs	-	-	$0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS4	1	40	5 (2)	3.45	---	0.45 to 3.45	29/11/2016 10:43:00	-	-	-	-	0.1	0.0	20.8	0.0	0.2	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.2	0.0	20.8	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS4	1	40	5 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.2	0.0	20.7	0.0	-	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	20.8	0.0	-	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0
WS4	1	40	5 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	20.7	0.0	-	0.0	0.0
WS4	1	40	5 (3)	3.45	3.13	0.45 to 3.45	29/11/2016 10:49:00	-	-	-	0.43	-	-	-	-	-	-	-
WS4	1	40	6	3.45	---	0.45 to 3.45	06/12/2016 10:35:00	1020	1020	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS4	1	40	6		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS4	1	40	6 (2)	3.45	---	0.45 to 3.45	06/12/2016 10:36:00	-	-	-	-	0.1	0.0	20.9	0.0	0.2	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS4	1	40	6 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS4	1	40	6 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS4	1	40	6 (3)	3.45	3.13	0.45 to 3.45	06/12/2016 10:42:00	-	-	-	0.52	-	-	-	-	-	-	-
WS5	1	40	1	3.45	---	0.45 to 3.45	02/11/2016 10:20:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS5	1	40	1		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS5	1	40	1 (2)	3.45	---	0.45 to 3.45	02/11/2016 10:21:00	-	-	-	-	0.1	0.0	20.7	0.0	0.1	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.5	0.0	20.6	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.5	0.0	20.4	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.5	0.0	20.4	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.5	0.0	20.3	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.5	0.0	20.4	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.4	0.0	20.4	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.3	0.0	20.5	0.0	-	0.0	0.0
WS5	1	40	1 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.3	0.0	20.5	0.0	-	0.0	0.0
WS5	1	40	1 (3)	3.45	---	0.45 to 3.45	02/11/2016 10:26:30	-	-	-	-	-	-	-	-	-	-	-
WS5	1	40	2	3.45	---	0.45 to 3.45	08/11/2016 11:11:00	1006	1006	$0.1_{(I)}$	-	-	-	-	-	-	-	-
WS5	1	40	2		---	0.45 to 3.45	30 secs	-	-	$0.2_{(SS)}$	-	-	-	-	-	-	-	-
WS5	1	40	2 (2)	3.45	---	0.45 to 3.45	08/11/2016 11:12:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS5	1	40	2 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.6	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.5	0.0	20.7	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.4	0.0	20.8	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	0.0	0.0
WS5	1	40	2 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.3	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	2 (3)	3.45	---	0.45 to 3.45	08/11/2016 11:18:00	-	-	-	-	-	-	-	-	-	-	-
WS5	1	40	3	3.45	---	0.45 to 3.45	15/11/2016 10:56:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS5	1	40	3		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS5	1	40	3 (2)	3.45	---	0.45 to 3.45	15/11/2016 10:57:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.4	0.0	20.7	0.0	-	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.4	0.0	20.5	0.0	-	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.4	0.0	20.5	0.0	-	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.3	0.0	20.6	0.0	-	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.3	0.0	20.7	0.0	-	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.2	0.0	20.8	0.0	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS5	1	40	3 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.2	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	3 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.2	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	3 (3)	3.45	---	0.45 to 3.45	15/11/2016 11:03:00	-	-	-	-	-	-	-	-	-	-	-
WS5	1	40	4	3.45	---	0.45 to 3.45	22/11/2016 09:38:00	991	991	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS5	1	40	4		---	0.45 to 3.45	120 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS5	1	40	4 (2)	3.45	---	0.45 to 3.45	22/11/2016 09:40:30	-	-	-	-	0.0	0.0	20.9	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.2	0.0	20.8	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.2	0.0	20.8	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.2	0.0	20.8	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS5	1	40	4 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	20.9	-	-	0.0	0.0
WS5	1	40	4 (3)	3.45	---	0.45 to 3.45	22/11/2016 09:46:30	-	-	-	-	-	-	-	-	-	-	-
	Remarks: Unable to dip due to concrete around top.																	
WS5	1	40	5	3.45	---	0.45 to 3.45	29/11/2016 10:57:00	1029	1029	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS5	1	40	5		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS5	1	40	5 (2)	3.45	---	0.45 to 3.45	29/11/2016 10:58:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	21.1	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	21.1	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	21.2	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	21.2	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	21.3	0.0	-	0.0	0.0
WS5	1	40	5 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	21.3	0.0	-	0.0	0.0
WS5	1	40	5 (3)	3.45	---	0.45 to 3.45	29/11/2016 11:04:00	-	-	-	-	-	-	-	-	-	-	-
	Remarks: Unable to dip due to concrete around top.																	
WS5	1	40	6	3.45	---	0.45 to 3.45	06/12/2016 10:47:00	1020	1020	$0.1_{(I)}$	-	-	-	-	-	-	-	-
WS5	1	40	6		---	0.45 to 3.45	30 secs	-	-	$0.2_{(SS)}$	-	-	-	-	-	-	-	-
WS5	1	40	6 (2)	3.45	---	0.45 to 3.45	06/12/2016 10:48:00	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0

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IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS5	1	40	6 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.1	0.0	21.0	0.0	-	0.0	0.0
WS5	1	40	6 (2)		---	0.45 to 3.45	360 secs	-	-	-	-	-	-	-	-	-	-	-
	Remarks: Unable to dip due to concrete around top.																	
WS6	1	40	1	3.45	---	0.45 to 3.45	02/11/2016 10:33:00	1021	1021	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS6	1	40	1		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS6	1	40	1 (2)	3.45	---	0.45 to 3.45	02/11/2016 10:34:00	-	-	-	-	0.1	0.0	20.7	0.0	0.4	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.6	0.0	20.5	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.7	0.0	20.5	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.6	0.0	20.5	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.5	0.0	20.6	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.4	0.0	20.7	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	0.0	0.0
WS6	1	40	1 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	0.0	0.0
WS6	1	40	1 (3)	3.45	3.38	0.45 to 3.45	02/11/2016 10:39:30	-	-	-	DRY	-	-	-	-	-	-	-

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STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By	Date	Checked By	Date	Contract Ref:
J. Simpson	23/12/16	J. Simpson	23/12/16	731988

Contract: **Grovefield Way, Cheltenham**

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS6	1	40	2	3.45	---	0.45 to 3.45	08/11/2016 11:21:00	1006	1006	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS6	1	40	2		---	0.45 to 3.45	30 secs	-	-	$0.0_{(SS)}$	-	-	-	-	-	-	-	-
WS6	1	40	2 (2)	3.45	---	0.45 to 3.45	08/11/2016 11:22:00	-	-	-	-	0.1	0.0	20.9	0.0	0.1	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.5	0.0	20.9	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	60 secs	-	-	-	-	0.7	0.0	20.6	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	90 secs	-	-	-	-	0.6	0.0	20.7	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	120 secs	-	-	-	-	0.5	0.0	20.7	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	180 secs	-	-	-	-	0.4	0.0	20.8	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	240 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	0.0	0.0
WS6	1	40	2 (2)		---	0.45 to 3.45	300 secs	-	-	-	-	0.3	0.0	20.9	0.0	-	0.0	0.0
WS6	1	40	2 (3)	3.45	3.38	0.45 to 3.45	08/11/2016 11:28:00	-	-	-	3.16	-	-	-	-	-	-	-
WS6	1	40	3	3.45	---	0.45 to 3.45	15/11/2016 11:05:00	-	1021	-	-	0.1	0.0	20.9	0.0	-	0.0	0.0
WS6	1	40	3 (2)	3.45	3.39	0.45 to 3.45	15/11/2016 11:06:00	-	-	-	DRY	-	-	-	-	-	-	-
	Remarks: Area flooded. No PID taken.																	
WS6	1	40	4	3.45	3.33	0.45 to 3.45	22/11/2016	-	-	-	DRY	-	-	-	-	-	-	-
	Remarks: Headworks flooded unable to monitor.																	
WS6	1	40	5	3.45	---	0.45 to 3.45	29/11/2016 11:12:00	1029	1029	$0.0_{(I)}$	-	-	-	-	-	-	-	-

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IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Exploratory Position ID	Pipe ref	Pipe diameter (mm)	Monitoring Round	Reported Installation Depth (m)	Measured Installation Depth (mbgl)	Response Zone	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
WS6	1	40	5		---	0.45 to 3.45	30 secs	-	-	$0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS6	1	40	5 (2)	3.45	---	0.45 to 3.45	29/11/2016 11:13:00	-	-	-	-	0.1	0.0	20.9	0.0	0.4	0.0	0.0
WS6	1	40	5 (2)		---	0.45 to 3.45	7 secs	-	-	-	-	0.3	0.0	17.4	0.0	-	33.0	0.0
WS6	1	40	5 (3)	3.45	3.40	0.45 to 3.45	29/11/2016 11:13:30	-	-	-	0.40	-	-	-	-	-	-	-
WS6	1	40	6	3.45	---	0.45 to 3.45	06/12/2016 10:59:00	1020	1020	$0.0_{(I)}$	-	-	-	-	-	-	-	-
WS6	1	40	6		---	0.45 to 3.45	30 secs	-	-	$-0.1_{(SS)}$	-	-	-	-	-	-	-	-
WS6	1	40	6 (2)	3.45	---	0.45 to 3.45	06/12/2016 11:00:00	-	-	-	-	0.1	0.0	20.9	0.0	0.2	0.0	0.0
WS6	1	40	6 (2)		---	0.45 to 3.45	15 secs	-	-	-	-	0.4	0.0	19.9	0.0	-	0.0	0.0
WS6	1	40	6 (2)		---	0.45 to 3.45	30 secs	-	-	-	-	0.2	0.0	19.1	0.0	-	0.0	0.0
WS6	1	40	6 (3)	3.45	3.40	0.45 to 3.45	06/12/2016 11:01:30	-	-	-	0.27	-	-	-	-	-	-	-
	Remarks: Test abandoned at 45 seconds due to analyser sucking up water.																	

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Contract: **Grovefield Way, Cheltenham**