

Walsall Council

# **Geo-Environmental Investigation Report**

Former Allen's Centre, Hilton Road, Willenhall

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Date: Reference: Status: February 2016 BM/J-B0984.00 (R01) Final



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# **A** Factual Information

## 1 Introduction

## 1.1 Instruction

- 1.1.1 Opus International Consultants (Opus) were instructed by Walsall Council (The Client) to carry out a Geo-Environmental Investigation of the Former Allen's Centre, Hilton Road, Willenhall.
- **1.1.2** It is understood that the Client proposes to sell the site for residential development however no outline plans are currently available.
- 1.1.3 A Phase 1 Desk Study report for the site, referenced BM/J-B0984.00/R01 and dated January 2016, has been produced by Opus.

## 1.2 Objectives

**1.2.1** The objectives of this Geo-Environmental Investigation were to obtain information relating to the ground conditions beneath the site in order to determine any geotechnical constraints, suitable methods of design and construction for foundations, floor slabs, access roads and car parking for a proposed residential development, and to identify any ground contamination in order to enable formulation of an appropriate remediation strategy for the proposed development if necessary.

## **1.3** Limitations

- **1.3.1** This report has been prepared by Opus with all reasonable skill, care and attention within the terms of the Contract with the Client, Walsall Council, and taking account of the information made available by the Client, as well as the manpower and resources devoted to it by agreement with the Client. Opus disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above Contract.
- **1.3.2** This report has been produced on behalf of the Client and no responsibility is accepted to any Third Party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of Opus. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.
- **1.3.3** Whilst this report may express an opinion on the possible configuration of strata, groundwater, ground gas and contaminants between or beyond exploratory hole positions or on the possible presence of features based on either visual, verbal or published evidence, this is for guidance only, and no liability can be accepted for its accuracy.
- **1.3.4** The comments on groundwater and ground gas conditions are based on observations made at the time of the investigation. It should be noted, however, that groundwater levels and ground gas concentrations may vary from those reported due to seasonal or other effects.

- **1.3.5** The exploratory holes were positioned in order to provide site coverage. The positions were located approximately and no guarantee can be given as to their accuracy on the appended site plans.
- 1.3.6 The site plans appended to this report should not be used for scaling purposes.

## 2 The Site

### 2.1 Location and Access

- 2.1.1 The site is located to the north of Hilton Road, Willenhall, and is shown on the appended **Site Location Plan (Drawing No. J-B0984.00/G001-A)** and centred on National Grid Reference 397380, 302190.
- 2.1.2 Access to the site can be gained from Hilton Road along the south eastern site boundary.

### 2.2 Site Description

- 2.2.1 The following section describes the site at the time of Opus' ground investigation in December 2015.
- 2.2.2 The site can be accessed from Hilton Road to the south-east via a steel gate.
- 2.2.3 The site is approximately 1.35 hectares in area and is surrounded by approximately 2m high steel palisade fencing. It currently comprises flat ground of crushed material within the former footprint of the Allen's Centre. A small two-storey building known as the 'Assessment House', remains in the eastern corner of the site along with front and rear gardens and is separated from the larger site by a continuation of the palisade fencing.
- 2.2.4 Tarmacadam hardstanding remains within the car parking areas to the east and south of the former building. The access road leading from Hilton Road, is located between the former building and the assessment house and runs north from Hilton Road to the rear (north) of the site.
- 2.2.5 Large grassed areas are found to the west and south-west and within the north-eastern corner of the site. Numerous semi-mature and mature trees and bushes are found along the boundaries and also within the site.
- 2.2.6 The site is relatively flat and levels appear to be in keeping with the surrounding area. Numerous underground services have been noted in the vicinity of the former building footprint, although many are thought to have been disconnected. Live 225mm diameter foul water and 525mm diameter surface water drains cross the central section of the site.
- 2.2.7 The site is located within a predominantly residential area and is surrounded by houses and their associated gardens to the north, east and west. Adjacent to the southern boundary of the site is a raised wooded area, known as 'Allen's Rough' which stands approximately 8m above the site. It is understood that the mound is a remnant of a former colliery which once occupied the area.

## 3 Desk Study

## 3.1 Introduction

- 3.1.1 A Phase 1 Desk Study report, referenced BM/J-B0984.00/R01 dated January 2016 has been produced by Opus.
- 3.1.2 The salient points from the Desk Study Report are summarised below:

## 3.2 Site History

- 3.2.1 The earliest maps recorded the site as open fields until it was developed with Allen's Rough Primary School in the early 1980's. The same layout was shown on subsequent plans including the current plan.
- **3.2.2** The earliest map recorded Allen's Rough to the west of the site, and a series of coal shafts in the surrounding area.
- 3.2.3 Allen's Rough colliery was recorded to the south west of the site on the 1919 map and it was shown as disused by the 1938 edition.

## 3.3 Published Geology

3.3.1 The published superficial and bedrock geology of the area is summarised in Table 3.1.

Age	Stratigraphic Name	Location	Description
Devensian Age (QD)	Devensian Till	Beneath the site	Devensian Till is listed as the superficial deposit across the site and comprises <i>"boulder clay;</i> <i>unstratified gravelly clays."</i>
Devensian Age (QD)	Glaciofluvial deposits	Approx 200m North-east	Glaciofluvial deposits are listed approximately 450m north of the site and comprise " <i>stratified sands and gravels.</i> " These could underlie the site at thicknesses of <2.0m.
Duckmantian (CB) to Bolsovian (CC)	Pennine Middle Coal Measures	Beneath the site	The Middle Coal Measures is listed as bedrock geology across the site and comprises "Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams, with a bed of fossiliferous mudstone at the base and fossiliferous mudstone beds in the upper half of the unit."

#### Table 3.1 Geology

- 3.3.2 A Memorandum from Walsall Council in reference to the site, reported that Made Ground may be present on site to depths of 4-5m.
- 3.3.3 The Wyrley Bottom Coal is recorded at outcrop approximately 50m east and south-east of the site, oriented NE-SW and gently dipping to the north-west, it is therefore anticipated this coal seam will be encountered at a shallow depth beneath the site. Old boreholes in the surrounding area recorded coal seams at shallow depth (<15m bgl).

3.3.4 Extensive faulting pervades the area but of significant note is a NE-SW facing fault at surface, approximately 100m south of the site, with a throw of 8.20m towards the south-east against which the Wyrley Bottom Coal appears to terminate. Additionally, a NW-SE facing underground fault is present, encroaching onto the north of the site with a throw of 4.90m towards the south-west.

## 3.4 Hydrogeology

- 3.4.1 The Environment Agency classifies the bedrock geology underlying the site as a Secondary A Aquifer. This is defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
- 3.4.2 The Environment Agency classifies the superficial deposits underlying the site as Unproductive Strata. This is defined as drift deposits with low permeability that have negligible significance for water supply or river base flow.
- 3.4.3 The site is not recorded as being within a Groundwater Source Protection Zone.
- 3.4.4 There are no groundwater abstractions recorded within 500m of the site.

## 3.5 Hydrology

- 3.5.1 The nearest surface water feature is an unnamed pond feature recorded 309m to the north of the site.
- 3.5.2 There are no surface water abstractions recorded within 1km of the site.
- 3.5.3 The Environment Agency indicates that the site is not at risk of flooding from rivers or sea.

## 3.6 Environmental Considerations

3.6.1 The nearest recorded landfill site is recorded 126m to the south west, the last date of input being 1977 and the wastes accepted included industrial wastes and liquid sludge. No other significant environmental issues were recorded on the site or in the surrounding area.

## 3.7 Radon

3.7.1 Reference to the 'Envirocheck' database report and BR211: 2015 indicates that the site is in a lower probability radon area where less than 1% of homes are above the radon action level, and as such no radon protective measures are necessary in the construction of new buildings.

## 3.8 Mineral Workings

- 3.8.1 The Desk Study Report has identified the following key issues:
  - The property is in the likely zone of influence from workings in 4 seams of coal at 30m to 100m depth, and last worked in 1933.
  - The property is not in the likely zone of influence of any present underground coal workings.

- The property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past. The potential presence of coal workings at or close to the surface should be considered prior to any site works or future development activity.
- The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods or where a licence has been granted.
- Reserves of coal exist in the local area which could be worked at some time in the future.
- Within, or within 20 metres of, the boundary of the property there are no known coal mine entries. However, records may be incomplete and consequently, coal mine entries may exist in the local area, mine entries of which the Coal Authority has no knowledge.
- The property is not within the boundary of an opencast site from which coal has been or is planned to be removed by opencast methods.
- 3.8.2 Nine BGS recorded Mineral Sites are shown within 1km of the site. The nearest is located 82m south-west of the site at Allen's Rough Colliery (No.1 and No.2 Pits) where deep coal was mined using underground techniques.

## 3.9 Preliminary Conceptual Model

3.9.1 The preliminary **Source-Pathway-Receptor** relationships identified for the site bearing in mind the proposed redevelopment of the site are summarised as follows:

Source Material/Activity	Potential Contaminant	Pathways	Receptor	Risk
Made Ground on site	Metals; Phenol; PAH; TPH.	Inhalation; Ingestion; Dermal contact.	Future site occupiers; Construction workers; Maintenance workers.	Medium
Made Ground on site	Asbestos containing materials	Inhalation.	Inhalation. Future site occupiers; Construction workers; Maintenance workers.	
Made Ground on site	Methane; Carbon Dioxide; Carbon Monoxide; Hydrogen Sulphide	Migration through permeable strata and accumulation inside buildings	Future site occupiers; Construction workers; Maintenance workers.	Medium
Made Ground and natural coal Measures	Water-soluble Sulphate.	Aggressive attack	Buried concrete	Medium
Made Ground on site and on adjacent sites	Metals; Phenol; PAH; TPH.	Migration of mobile contaminants through permeable strata	Secondary A Aquifer	Low
Made Ground on adjacent sites	Methane; Carbon Dioxide; Carbon Monoxide; Hydrogen Sulphide	Migration through permeable strata and accumulation inside buildings	Future site occupiers; Construction workers; Maintenance workers.	Low

 Table 3.2 Preliminary Source-Pathway-Receptor Relationships

## 4 Investigation Methodology

## 4.1 Objectives

The objectives of this Geo-Environmental Investigation were to obtain information relating to the ground conditions beneath the site in order to determine suitable methods of design and construction for foundations, floor slabs, access roads and car parking for a residential development, and to identify any ground contamination in order to enable formulation of an appropriate remediation strategy if necessary.

#### **4.2 Clearance of Underground Services 4**

4.2.1 Prior to commencing the intrusive investigation, a package of statutory service plans supplied by the client was reviewed in order to ensure that the exploratory holes could be positioned to avoid 'known' services. As an additional precautionary measure, each exploratory hole location was scanned by Opus using a Cable Avoidance Tool (CAT) prior to commencing the site works.

## **4.3** Exploratory Holes

- 4.3.1 Seven window sample boreholes (WS1-WS7) were advanced across the site using a small, tracked, light percussion window sampling rig to depths of 2.00m to 5.00m begl (below existing ground level) and eight trial pits (TP1 TP8) were excavated across the site using a back-acting wheeled excavator to depths of 2.20m to 3.40m begl. In addition, three rotary open holes were advanced across the site using a Klemm Rotary Rig to depths of between 30.0m to 40.0m begl. The window sampling and trial pitting was undertaken on the 17<sup>th</sup> and 18<sup>th</sup> December 2015 with rotary drilling undertaken on the 1<sup>st</sup> and 2<sup>nd</sup> of February 2016.
- 4

**4.3.2** The approximate locations of the exploratory holes are shown on the appended Exploratory Hole Location Plan (Drawing No. J-B0984.00/G002 Rev A).

- **43.3** Combined ground gas and groundwater monitoring wells were installed to depths of between 4.70m and 5.00m begl in window sample boreholes WS1, WS3, WS4 and WS5. The wells were constructed using 42mm HDPE plain pipe in a bentonite seal from existing ground level to 1.00m begl and 42mm HDPE slotted pipe in gravel surround below. The wells were fitted
- 4 with a gas tap assembly at ground level suitable for connection to proprietary gas monitoring equipment and a lockable cover at ground level to provide protection. The other exploratory holes were backfilled with arisings.

## 4.4 Logging and Sampling

- 4.4.1 Engineers' logs of the strata encountered in the exploratory holes were developed in accordance with BS EN ISO 14688 and copies are presented as Appendix 'A'.
- 4.4.2 Standard Penetration Tests (SPT's) were taken at regular 1.0m intervals in the window sample boreholes to provide 'N' values for empirical assessment of strength and density parameters of the strata.

4.4.3 Disturbed soil samples were taken at regular selected intervals in the exploratory holes, placed in appropriate containers and submitted for environmental and geotechnical laboratory testing.

## 4.5 Chemical Testing

- 4.5.1 Selected soil samples were subjected to appropriate chemical testing at the MCERTS and UKAS accredited laboratory of QTS Environmental Limited for a suite of potential contaminants taking account of the Preliminary Conceptual Site Model and site observations.
- 4.5.2 The following soil testing was carried out on selected Made Ground and natural strata samples:

•	Heavy Metals	10 samples
•	Speciated Polycyclic Aromatic Hydrocarbons (PAH)	10 samples
•	Cyanide and Phenol	10 samples
•	Asbestos	10 samples
•	Soil Organic Matter	6 samples

4.5.3 The results of the chemical testing are presented as **Appendix 'B'**.

## 4.6 Geotechnical Testing

- 4.6.1 Selected soil samples were subjected to appropriate geotechnical testing at the MCERTS and UKAS accredited laboratories of QTS Environmental Limited and Geolabs Limited.
- 4.6.2 The following geotechnical testing was carried out on selected Made Ground and natural strata samples:

•	pH	20 samples
•	Water-soluble Sulphate	20 samples
•	BRE SD1-Suite	4 samples
•	Plasticity Index	8 samples
•	Natural Moisture Content	8 samples

4.6.3 The results of the pH and water-soluble sulphate testing are included with the chemical testing results presented as **Appendix 'B'** and the plasticity index and moisture content results are presented as **Appendix 'C'**.

## 4.7 Gas/Groundwater Monitoring

- 4.7.1 Ground gas monitoring has been undertaken in the four monitoring wells on five occasions in order to provide data for a ground gas assessment.
- 4.7.2 Methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide concentrations have been measured using a calibrated Gas Data GFM436 Gas Analyser. Atmospheric pressure and gas flow rates have also been recorded at the same time.
- 4.7.3 The results of the ground gas / groundwater monitoring are presented as **Appendix 'D'**.

## **5** Results of Investigation

## 5.1 Introduction

5.1.1 The ground conditions encountered generally comprise a surface layer topsoil, tarmacadam or demolition material underlain by variable thicknesses of Made Ground between 0.45m begl to in excess of 3.0m begl. The Made Ground overlies variable superficial deposits of both granular and cohesive nature. Cohesive soils typically comprise silty and gravelly, soft to firm locally stiff consistency, low to high strength CLAY and SILT. Granular materials comprise silty locally very clayey loose to dense SAND.

### **5.2 Strata Observations**

#### <u>Topsoil</u>

5.2.1 Topsoil was recorded at the surface in TP1 to TP4, WS1 to WS3 and WS5 and generally comprised grass onto silty, slightly gravelly sand and clay with rootlets. Gravel typically comprises quartzite and occasional brick, ash, plastic mesh and coal. The thicknesses of topsoil range between 0.20m and 0.40m.

#### Made Ground

- 5.2.2 Surface hardstanding was recorded in WS6, WS7 and TP8 and typically comprised tarmacadam and associated sub-base materials to a depth of 0.15 to 0.40m begl. Within the former building footprint, surface cover was clayey gravelly sand of demolition material with gravel of quartzite and brick to a depth of between 0.40 and 0.50m begl.
- 5.2.3 Beneath the surface layer, Made Ground was encountered to depths of between 0.45m to in excess of 3.00m begl. The deeper Made Ground was recorded in the centre of the site. The Made Ground typically comprised both granular and cohesive materials with silty slightly gravelly black, dark grey or red-brown sands and soft silty and sandy gravelly clays. Locally the deeper Made Ground comprised dark grey soft organic clays or included organic matter. Layers of reworked natural clay soils were recorded at the base of the Made Ground

#### **Superficial Deposits**

- **5.2.4** The superficial deposits were typically recorded as a series of orange, red and grey slightly gravelly silty and very silty firm clays and medium dense clayey, locally gravelly or very silty, sands.
- 5.2.5 In the eastern end of the site, silty slightly gravelly firm to stiff clays were recorded at depths in excess of 3.70m.
- 5.2.6 The rotary openholes recorded the superficial deposits to depths of between 8.50m and 9.00m begl.

#### **Coal Measures**

- 5.2.7 Coal Measures strata were recorded to the base of each of the rotary openholes.
- 5.2.8 Very thin coal seams were recorded in RBH1 in the east of the site at 8.50m-8.70m, 17.60m-17.80m and 28.50m-28.70m. Black mudstones were recorded from 8.70m to 17.60m.

- 5.2.9 A very thin coal seam was recorded in RBH2 in the centre of the site at 9.00m-9.30m. Black mudstones were recorded from 9.30m to 19.00m.
- 5.2.10 Coal seams were recorded in RBH3 in the west of the site at 9.00m-9.20m, 10.00m-10.80m and 16.00m-17.00m. Black mudstones were recorded from 10.80m to 16.00m.
- 5.2.11 No broken ground or loss of flush was recorded during the drilling works.
- 5.2.12 Reference should be made to individual exploratory hole records provided in **Appendix 'A'**.

## 5.3 Standard Penetration Tests (SPT's)

5.3.1 SPT's undertaken within the natural strata gave the following corrected 'N' values:

Depth	Exploratory Hole						
	WS1	WS2	WS3	WS4	WS5	WS6	WS7*
1.0m	5	5	8	8	12	4	15
2.0m	5	16	9	6	7	5	15
3.0m	22	12	12	18	10	11	42
4.0m	20	40	12	14	12	14	-
5.0m	27	-	13	20	33	-	-
Kev:							

#### Table 5.1: Corrected SPT 'N' Values

**5 - 12** = SPT within Made Ground

4 - 42 = SPT within Superficial Deposits

= SPT's below 3.0m have been omitted as values are not representative of the strata.

5.3.2 In general terms, the 'N' values provide an appropriate assessment of in situ strength parameters within the Made Ground and superficial soils. Relatively low values within the range 5-7 recorded within WS5 and WS6 at depths of 1-2m are assessed to be a consequence of the interlayered nature of the clays and gravels in this area.

## 5.4 Groundwater Observations

5.4.1 Groundwater was recorded during the siteworks within the Made Ground and natural soils as follows:

Exploratory	Depth of Water Strike	Comment
Hole	mbegl	
TP1	1.50m	Slight ingress in natural clay.
TP2	Not recorded	
TP3	2.40m	Inflow in natural very silty clay.
TP4	Not recorded	
TP5	2.00m	Slight ingress in Made Ground.
TP6	Not recorded	
TP7	Not recorded	
TP8	2.70m	Running sand recorded.
WS1	2.00m	Ingress at base of Made Ground.
WS2	1.70m	In natural very clayey sand.
WS3	2.00m	In natural very silty clay.
WS4	2.00m	In natural sand.
WS5	1.80m	At base of Made Ground.
WS6	3.00m	In natural clay.

5.4.2 Subsequent monitoring of the monitoring wells have recorded standing water levels of between ground level and 1.48m begl, although these water levels are considered to be influenced by standing water within the Made Ground.

## 5.5 Chemical Testing

- 5.5.1 The results of the chemical testing of soil samples have been reviewed in accordance with current legislative framework and criteria to assess the risk to human health.
- 5.5.2 The soil sample chemical testing results have been compared to the Environment Agency Soil Guideline Values (SGV's), DEFRA Category 4 Screening Levels, Opus In-House Tier 1 Screening Values (IHSV's) and Land Quality Management (LQM) & Chartered Institute for Environmental Health (CIEH) 'Suitable 4 Use Levels' (S4UL's) derived using CLEA 1.06 to be protective of human health.
- 5.5.3 The metal and PAH results for the ten tested near-surface soil samples have been subjected to a statistical Tier 1 Human Health Risk Assessment in accordance with the CL:AIRE and CIEH document titled 'Guidance on Comparing Soil Contamination with a Critical Concentration' published in May 2008 using the ESI Contaminated Land Statistical Calculator software.
- 5.5.4 Under the land use planning system, the objective is to determine the 'suitability for use' of the land under consideration and hence demonstrate that there is a 95% probability that the true population mean is below the set critical concentration, such as published SGV's, and Category 4 Screening Levels and, in their absence, Opus Tier 1 IHSV's and LQM/CIEH S4UL's for a 'Residential with Homegrown Produce' site end use.
- 5.5.5 Under the land use planning system, where the aim is to demonstrate 'suitability for use', the Null and Alternative Hypotheses are as follows:
  - Null Hypothesis (H<sub>o</sub>): "Is the true mean concentration greater or equal to that of the critical concentration?" ( $\mu \ge C_c$ )
  - Alternative Hypothesis (H<sub>1</sub>): "Is the true mean concentration less than the critical concentration?" ( $\mu$ <C<sub>c</sub>)
- 5.5.6 Soil Organic Matter (SOM) analysis has also been undertaken to enable the determination of appropriate screening values for organic contaminants. The average SOM% value for the near-surface soils at the site is 2.26%, however, two values significantly exceed the 3% SOM, therefore screening values applicable for 3% SOM are considered appropriate within the generic screening assessment.

#### Metals

- 5.5.7 Ten samples of Made Ground were analysed for a standard metals suite, including three samples of topsoil, five samples of sand from beneath the area s of soft landscaping and two samples of hardcore/demolition materials from the former Allen's Centre and car park. Two recorded concentrations for lead (TP7 242mg/kg in soft landscaping and WS6 406mg/kg beneath the car park) exceed the respective screening value.
- 5.5.8 If all made Ground samples are considered as a single dataset, the analysis shows the Null Hypothesis to be rejected for analysed metals (i.e. the true mean concentration is less than the critical concentration) with the sample from WS6 identified as a statistical outlier and hence is considered to represent a potential hotspot of contamination. If the data is split into

topsoil and sandy Made Ground as two potentially different sources (i.e. topsoil imported as part of the Allen's Centre construction), then the Null Hypothesis is rejected in both cases, although the evidence level is reduced.

5.5.9 In each case, the sample from WS6 is identified as an outlier and hence there will be a requirement for remedial action to be undertaken as part of the proposed development of the site with respect to human health in the area of WS6 if it is within an area of private gardens.

#### Cyanide and Phenol

5.5.10 Ten samples of Made Ground were analysed for total cyanide and total phenol. Total cyanide and total phenols were not detected above their lower laboratory detection limit of 2mg/kg. Hence, no remedial action is considered necessary for cyanide and phenol with respect to human health.

#### PAH's

5.5.11 Ten samples of Made Ground were analysed for speciated PAH's. Individual PAH compounds were detected at varying concentrations within five samples, however all recorded concentrations were below their respective Opus IHSV's. The statistical analysis of the PAH data set for Made Ground has confirmed that the Null Hypothesis has been rejected for analysed PAH compounds (i.e. the true mean concentration is less than the critical concentration). Hence, no remedial action is considered necessary for PAH's with respect to human health.

#### Asbestos

- 5.5.12 A total of ten samples of Made Ground were screened for asbestos fibres. Of the samples screened, one sample (WS6 at 0.6m) was positive for asbestos. Sample WS6 0.6m was taken from the hardcore material from beneath the existing car park and hence is considered to have been imported to site during construction of the Allen's Centre. The sample was subjected to further asbestos classification analysis where the asbestos type was confirmed as Chrysotile.
- 5.5.13 Asbestos was not detected in any of the other screened samples from across the site.

## 5.6 Geotechnical Testing

5.6.1 Geotechnical testing has been carried out on samples of natural soil with the following results:

#### **Made Ground**

- pH values of between 5.6 and 8.6
- Water soluble sulphate values of <10mg/l to 671mg/l
- Acid soluble sulphate values of <0.02% to 0.07%
- Total sulphur values of <0.02% to 0.07%
- Ammonium values between 0.17mg/l and 2.44mg/l
- Water-soluble chloride values between 2.3mg/l and 6.6mg/l
- Water-soluble nitrate values of between <1.5mg/l and 9.7mg/l

#### Superficial Deposits

- pH values of between 5.8 and 7.6
- Water soluble sulphate values of <10mg/l to 64mg/l
- Modified Plasticity Index values of 6.4 to 29
- Natural Moisture Content values of 11.7% to 22.6%

5.6.2 The modified plasticity index values are typically representative of low volume change potential soil in accordance with Chapter 4.2 of the NHBC standards, although the sample from TP6 at 2.40m is recorded as medium volume change potential.

## 5.7 Ground Gas Monitoring Results

- 5.7.1 Gas monitoring results have been compared to guidance presented in CIRIA Report C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings, 2007.
- 5.7.2 CIRIA C665 indicates that ground gas protection measures may be necessary in new buildings on sites where methane concentrations exceed a threshold value of 1% v/v and/or where carbon dioxide concentrations exceed a threshold value of 5% v/v. The gas flow rate is also considered in the required level of protection.
- 5.7.3 Maximum methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) concentrations, as percentage volume in air (%v/v), minimum oxygen (O<sub>2</sub>) concentrations (%v/v), maximum carbon monoxide (CO) and hydrogen sulphide (H<sub>2</sub>S) concentrations, in parts per million (ppm), and gas flow rates in litres per hour (l/hr) have been monitored in the monitoring wells on five occasions to date.
- 5.7.4 The results of the gas monitoring visits are presented in **Appendix 'D'** and the findings summarised below:
  - Carbon dioxide has been recorded at concentrations of between 0.1% and 11.7% v/v.
  - Carbon monoxide has been recorded at a maximum concentration of 1.0 ppm in WS5.
  - Hydrogen sulphide has not been recorded above the detection limit of the instrument.
  - Methane has not been recorded above the detection limit of the instrument.
  - Flow rates of below detection to 2.8l/hr were typically recorded. A maximum flow rate of 17.1l/hr has been recorded although this is considered to be affected by a high and rising water level within the standpipe.
- 5.7.5 The atmospheric pressure recorded at the time of the monitoring visits ranged between 970 and 1000mb with both rising and falling pressure trends.

## **B** Assessment & Recommendations

## 6 Environmental Assessment

## 6.1 Soil

- 6.1.1 Ten Made Ground samples have been analysed for metals, PAH's, asbestos, cyanide and phenol. Two samples of Made Ground contained concentrations of lead that exceeded the screening value (TP7 0.8m begl, WS6 0.6m begl) and asbestos fibres were also identified in WS6 at 0.6m.
- 6.1.2 Consideration of the different materials and their likely provenance, along with the statistical analysis, has identified that remedial action will be required in the area of WS6 dependent upon the proposed layout. It appears that the materials from WS6 which recorded asbestos and elevated lead concentrations are within a hardcore material which was imported to site as part of the development of the site with the Allen's Centre.
- 6.1.3 The hardcore materials are considered to represent a risk to the health of further site users and construction workers. In view of the proposed residential end use, the presence of asbestos fibres within the materials will necessitate the removal of these materials from site, or the encapsulation of the materials in a communal/public open space area.
- 6.1.4 It is recommended that the area of the former car park be subject to further sampling and testing to allow an assessment of the extent of the materials that are impacted by asbestos, and to a lesser extent lead. This could be done prior to lifting of the hardstanding surfacing or following its removal. If the latter is proposed, it is recommended that the works be carried out under a watching brief by a suitably qualified Geo-Environmental Engineer.
- 6.1.5 Concentrations of water soluble sulphate indicate that the risk posed to buried concrete structures and materials on site is negligible. The issue is characterised further in Section 7.6 of this report.

### 6.2 Ground Gas

- 6.2.1 The nearest recorded landfill site is recorded 126m to the south west, the last date of input being 1977 and the wastes accepted included industrial wastes and liquid sludge. In addition, there are a number of old infilled ponds recorded on the site and the site is in an old mining area. The superficial deposits are predominantly cohesive in nature although some layers of sand are also present. Hence the site is considered to be in a medium risk environmental setting in respect of ground gases.
- 6.2.2 A maximum carbon dioxide concentration of 11.7% v/v has been recorded and flow rates typically of between 0 and 2.8l/hr.
- 6.2.3 The maximum carbon dioxide concentration of 11.7% v/v has been selected to calculate an initial Gas Screening Values (GSV) for the site along with a gas flow rate of 2.8l/hr. This is in accordance with CIRIA Report C665 to determine the required level of carbon dioxide protection measures for the proposed future site development.

6.2.4 The GSV is calculated as follows:

#### **GSV = Gas Concentration/100 × Flow Rate**

- 6.2.5 In line with the recommendations provided in CIRIA 665, a preliminary GSV of 0.33 l/hr has been calculated for carbon dioxide. The GSV for carbon dioxide puts the site within 'Characteristic Situation 2' (Low Risk) in accordance with CIRIA 665 and Amber 1 in line with NHBC guidance (based upon the calculated GSV).
- 6.2.6 Trace concentrations of carbon monoxide have been identified at a level of 1.0 ppm, however these levels pose no ongoing risk to any future development of the site.

## 6.3 Revised Conceptual Site Model

6.3.1 The revised Conceptual Site Model based on information obtained from the intrusive investigation, the Tier 1 Human Health Risk Assessment and the Ground Gas Risk Assessment has identified that the majority of the potential pollutant linkages identified at the desk study stage have been broken due to no source being identified. The remaining identified pollutant linkages that require mitigation or remedial works as part of the proposed development are tabulated below.

Source Material/Activity	Potential Contaminant	Pathways	Receptor	Risk
Made Ground	Asbestos containing	Inhalation;	Future site occupiers;	
beneath the former	materials	Ingestion;	Construction workers;	Medium
car parking area	Lead concentrations	Dermal contact.	Maintenance workers.	
Made Ground. Nearby landfill and potential old mineworkings	Carbon Dioxide	Gas migration through permeable strata and accumulation inside buildings	Future site occupiers Construction Workers, Maintenance Workers	Low

Table 6.1 Updated Source Pathway-Receptor Relationships

## 6.4 Health & Safety

- 6.4.1 The Principal Contractor should provide an assessment of the appropriate procedures required to protect site workers from the materials likely to be encountered at the site.
- 6.4.2 The following basic health and safety measures should be adopted as a minimum during the site redevelopment works:
  - Basic Personal Protective Equipment (PPE) including hard hats, gloves, coveralls and steel toe-capped boots to be worn at all times;
  - Eating, drinking and smoking to be forbidden at all times except in designated areas; and
  - Breathing equipment to be available for those working in confined or unventilated spaces.
- 6.4.3 Additional health and safety measures will be required to be adopted when exposing and moving the potentially asbestos contaminated material from beneath the former car parking area. The level of measures will be depended upon the extent of the contaminated materials and the proposed method of working

6.4.4 If ground conditions should differ significantly from those encountered during the intrusive investigation, including the discovery of any visible or odourous contamination, site redevelopment works should be suspended until the suspect material has been inspected and assessed by a competent Geo-Environmental Engineer.

## 6.5 Waste Disposal

6.5.1 Any materials designated for off-site disposal are likely to require classification by the Waste Acceptance Criteria (WAC) in accordance with the Landfill Regulations. No WAC testing has been undertaken as part of this investigation.

## 6.6 Liaison with Regulators

6.6.1 It is recommended that this Geo-Environmental Investigation report be submitted to the EHO for review and comment prior to any irrevocable action taking place.

## 6.7 Water Supply Pipes

6.7.1 It is recommended that this Geo-Environmental Investigation report be submitted to the relevant Water Supply Authority to confirm the necessary level of protection, if any, for future plastic water supply pipes.

## 6.8 Environmental Protection

- 6.8.1 Environmental protection measures should be adopted during the future site redevelopment works and as a minimum should include:
  - Covering or dampening of spoil to prevent the spread of dust;
  - Containment of surface water runoff to prevent the pollution of surface water drains, sewers etc.;
  - Cleaning and washing of boots, vehicle wheels and other equipment at site entry and exit points to prevent the spread of mud.

## 7 Geotechnical Assessment

## 7.1 General

- 7.1.1 It has been assumed that the proposed residential development will be of traditional 2 storey properties with private gardens. No proposed layout is available and hence only general recommendations have been provided. Foundation design options should be reviewed once the proposed layout, site levels, line loads and design details have been finalised.
- 7.1.2 The ground conditions encountered generally comprise a surface layer topsoil, tarmacadam or demolition material underlain by variable thicknesses of Made Ground to between 0.45m begl to in excess of 3.0m begl. The Made Ground overlies variable superficial deposits of both granular and cohesive nature with the cohesive soils typically comprise very silty and gravelly, soft to firm locally stiff consistency, low to high strength clays CLAY. The granular materials typically comprise silty locally very clayey loose to dense SAND.
- 7.1.3 The rotary openholes recorded the superficial deposits to depths of between 8.50m and 9.00m begl.
- 7.1.4 Coal Measures strata were recorded to the base of each of the rotary openholes with the following coal seams recorded:

4	RBH1 (East of the site)	Very thin coal seams at 8.50m-8.70m, 17.60m-17.80m and 28.50m-28.70m. Black mudstones were recorded from 8.70m to 17.60m.
	RBH2 (middle of the site)	Very thin coal seam at 9.00m-9.30m. Black mudstones were recorded from 9.30m to 19.00m.
4	RBH3 (West of the site)	Coal seams at 9.00m-9.20m, 10.00m-10.80m and 16.00m-17.00m. Black mudstones were recorded from 10.80m to 16.00m.

- 7.1.5 No broken ground or loss of flush was recorded during the drilling works.
- 7.1.6 Standard penetration tests within the natural strata showed the variable nature of the composition and consistency/strength of the strata with 'N'-values of between 5 and 16 within the clay strata at 2.00m depth; 10 to 22 within granular deposits at 3.00m depth, a value of 11 in clay at 3.00m; 12 to 20 in clays and 14 and 40 in granular materials at 4.00m; and 13 to 33 in clays at 5.00m.
- 7.1.7 Groundwater was recorded during the siteworks within the Made Ground and natural soils at shallow depth (between 1.70m and 3.00m) although subsequent monitoring of the monitoring wells recorded standing water levels of between ground level and 1.48m begl. It is considered that these standing water levels are influenced by standing water within the Made Ground.

## 7.2 Foundation Design

- 7.2.1 In view of the variable thickness of Made Ground, including the former infilled ponds and high water table, it is considered that traditional strip foundations are unlikely to represent a viable foundation solution for the whole site. It may be possible to utilise strip foundations on individual plots where there is a limited thickness of Made Ground and a competent founding stratum at shallow depth, however this would require further investigation on a plot by plot basis.
- 7.2.2 It is considered that vibro ground improvement could represent a viable option for the proposed development as this would densify the near surface soils and allow foundations to be placed at shallow depth above the standing water table. This could provide a bearing pressure in the region of 100 to 125kN/m<sup>2</sup>.
- 7.2.3 Any ground improvement scheme will need to take account of the proximity to neighbouring residential properties and hence a suitably experience piling contractor should be consulted in order to derive the most appropriate and cost effective solution.
- 7.2.4 Consideration could be given to the use of piled foundations however the presence of shallow coal seams, which may or may not have been worked, may necessitate the piles being taken down through the said seems into the underlying coal measures.
- 7.2.5 Raft foundations may also be a viable option although as with strip foundations above, further investigation would be required to confirm whether this is a viable foundation solution.

### 7.3 Building near Trees

- 7.3.1 Semi-mature and mature trees are present on the adjacent Allen's Rough and hedgerows are present along the site boundaries.
- 7.3.2 Foundation and floor slab designs will need to take account of the specific requirements of NHBC Standards Chapter 4.2 where the plots are influenced by existing, former and proposed trees.
- **7.3.3** It is recommended that the influence of trees should be assessed on a plot by plot basis relative to a detailed tree survey, including both on and off-site vegetation and assuming the presence of clays of low volume change potential.
- 7.3.4 Careful consideration will need to be given in this assessment to the relative distribution of generally non-shrinkable granular layers and to the levels of the tree bases.

## 7.4 Floor Slab Design

7.4.1 In view of the variable nature and thickness of the Made Ground and near surface superficial materials, it is recommended that the ground floor slabs for the proposed development should be suspended.

### 7.5 Pavement Design

7.5.1 Variable Made Ground materials are present beneath the existing topsoil and surfacing which are likely to be exposed at proposed formation levels. These materials are considered likely to provide a Design CBR value of <2%, although in many area of the site the materials are

granular in nature. Where granular soils are exposed, it is considered that higher values could be available following heavy proof rolling.

## 7.6 Construction

- 7.6.1 Anticipated excavation depths should be readily achieved using conventional plant (wheeled back-actor or similar) within the natural strata.
- 7.6.2 Support must be provided for all excavations requiring entry by site workers in accordance with guidance presented in CIRIA Report 97 'Trenching Practice'.
- 7.6.3 High standing groundwater levels were recorded which is likely to necessitate dewatering to be utilised for any excavations in excess of 1m. The trial pit excavations recorded localised inflows but also areas of only minor ingress, hence it is anticipated that sump pumping techniques may be sufficient for excavations which are only open for a short length of time. If deep excavations are proposed, or excavations are to be left open for a significant length of time, a formal dewatering scheme may be required.

## 7.7 Concrete Specification

- 7.7.1 The ground conditions, pH values and water-soluble sulphate concentrations have been assessed for potential aggressive attack on concrete in accordance with BRE Special Digest 1 'Concrete in Aggressive Ground (2005)'.
- 7.7.2 The results indicate that the natural strata falls within Design Sulphate Class DS-2. The results indicate an ACEC (Aggressive Chemical Environment for Concrete) Class within natural strata of AC-3z.
- 7.7.3 The specific concrete mixes for the DS Class to be used at the site will be determined, mindful of the ACEC Class, by the site-specific concrete requirements in terms of the required durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any Additional Protection Measures (APM).

## 7.8 Old Mineworkings

- 7.8.1 Superficial deposits were recorded to depths of between 8.50m and 9.00m depth. Coal Measures strata were recorded beneath the superficial deposits with very thin coals seams recorded within RBH1 and RBH2 but potentially economic seams in RBH3 at 10.00m-10.80m and 16.00m-17.00m. These seam thicknesses and depths correspond to the anticipated depths of the Wyrley Bottom Coal seam based upon the published geological data and the shaft sections for the old Allen's Colliery to the south west.
- 7.8.2 The Coal Authority do not have any records of old mineworkings beneath the site however it did not become a requirement to maintain plans of workings until 1872 by which time much unrecorded mining had taken place. The property is in an area where the Coal Authority believe there is coal at or close to the surface which may have been worked at some time in the past.
- 7.8.3 No broken ground or loss of flush was recorded during the drilling works however given the presence of a coal seam of potentially economic thickness at shallow depth beneath the site,

it is recommended that a programme of proof drilling and grouting be undertaken beneath proposed structures.

7.8.4 No old mine entries are recorded on the site however, the potential for unrecorded mine entries being identified during redevelopment works cannot be discounted.

### 7.9 Soakaways

7.9.1 Soakaway tests in accordance with BRE 365 have not been undertaken as part of this investigation. However, due to the locally extensive Made Ground and the variable but predominantly cohesive nature of the near surface natural soils, it is considered that soakaways will not be a viable drainage solution for the site.

## 8 Recommendations

- 8.1 The following further works are recommended prior to, and during, the redevelopment of the site:
  - (a) Submission of this report to the Local Authority Environmental Health Officer for comment.
  - (b) Assessment of foundation options once a proposed layout, finished levels and line loads are available.
  - (c) Further sampling and testing of the Made Ground materials for asbestos and lead from beneath the former car parking area.
  - (d) Proof drilling and grouting of the shallow coal seams beneath proposed building footprints.



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## **DRAWINGS**



100 mm

2

Orginal Sheet Size A4 [297x210] Plot Date 10 Dec 2015 @ 4:16 PM Path G: Projects 2015 Projects U 80984.00 - Allens Centre, Willenhall Drawings (Current U-80984.00 \_ Goot A Locaton Plandwg Goot



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## APPENDIX A Exploratory Hole Records

Exploratory Hole ID:					DIIS				
TP1	Site: Allens Centre, Willenhall	ens Centre, Willenhall							
						Start Data:	www.opusintern	Iational.co.uk	
Job No: J-B0984.00						Start Date.	'12/2015	End Date: 17/12/201	15
JCB 3CX wheeled e	ation Method: Excavator	Co-ords:				Backtill Date	<sup>»:</sup> /12/2015	Field Recoras:	
		Ground Level (	(mAOD):			Logged: BN	Chkd:	Appr:	
			<u> </u>		Sample	Cample	<u> </u>		Pankfill
	Strata Description	Depth (m)	Level (m)	Legend	Туре	Depth (m)	Tests	Records	Details
MADE GROUND: gravelly sandy dark is subrounded qua	Grass onto very silty, slightly k grey to black topsoil. Gravel artzite.	0.30			3				
MADE GROUND: dark grey sand wit cobbles of quartzit	Silty, slightly gravelly black and h low cobble content. Gravel and e and brick.	-			ES1	0.40			୦.୪ ୦.୪ ୦.୪ ୦.୪ ୦.୪ ୦.୪ ୪୦.୪୦.୪୦.୪୦.୪୦.୬୦ ୪୦.୪୦.୪୦.୪୦.୫୦.୬୦ ୦.୪୦.୪୦.୪୦.୪୦.୬୦.୬
Below 1.30m: Bec	coming damp.	1.40	]		ES2	1.30			
Very silty, slightly ( and pale grey firm clayey SAND. Gra	gravelly sandy orange brown consistency CLAY, varying to a wel is subrounded quartzite.	-			D3	1.65		1.50 —	ଧ୍ୟ ଧ୍ୟ ଧ୍ୟ ଧ୍ୟ ଧ୍ୟ - 
End of	Exploratory Hole at 2.20 m	- 2.20				Sample Ty;	pe Key	Test Type Key	
Remarks: 1. Slight groundwat: 2. Pit wall collapse I 3. Pit dimensions: 0 4. Trial pit terminate	er ingress observed at 1.50m begl. below 1.40m begl. ).50m x 2.50m. ed at 2.20m begl due to unstable pit walls.					D - Disturbe B - Bulk Rej ES - Enviror W - Water U - Undistur J - Jar Sam P - Piston S	si Representative ( presentative ( nmental Sample f rbed Representative ' iple sample Sheet 1	of 1	эter Reading ।e Reading

Exploratory Hole ID:	Client: Walsall Council							DIIS				
TP2	Site: Allens Centre, Willenhall											
· I. KI	-					Start Date:	www.opusintern	Tational.co.uk				
Job No: J-B0984.00		·				Start Date.	/12/2015	End Date: 17/12/201	15			
JCB 3CX wheeled (	ation Method: excavator	Co-oras:				Ваский Бал 17	.e: //12/2015	Field Recoras: BM				
		Ground Level (	(mAOD):			Logged:	Chkd:	Appr:				
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	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details			
MADE GROUND: gravelly sandy dar subrounded quart	: Grass onto very silty, slightly rk brown topsoil. Gravel is tzite.	0.25			ES1	0.20						
MADE GROUND: dark grey sand. G	: Silty, slightly gravelly black and aravel is quartzite and brick.		- -									
			-		ES2	0.80						
MADE GROUND	Gravelly, sandy red orange brown and	- 1.20										
pale grey firm com clayey sand. Grav (Reworked)	sistency clay with pockets of /el is subrounded quartzite.	1.40			D3	1.50						
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			-									
End o	of Exploratory Hole at 3.00 m	- 3.00 -	-		D4	2.80			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
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Remarks: 1. No groundwater 2. Pit wall collapse	observed. below 1.20m begl.					D - Disturbe B - Bulk Re ES - Envire	ed Representative epresentative onmental Sample	(C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrom	eter Reading			
<ol> <li>Pit dimensions: 0</li> <li>Trial pit terminate</li> </ol>	0.50m x 2.20m. ed at 3.00m begl.					W - Water U - Undistu J - Jar Sarr P - Piston	urbed Representative 1 nple Sample	PID - PID Reading V - Hand Shear Van	e Reading			
						Sheet:	Sheet 1	of 1				

TP3       Market and the Centre, Willenhall       Will wanted accurate the Willenhall       With Centre accurate the Willenhall         Jan Me.       Jan Me.       Jan Me.       Start See       Start S	Exploratory Hole ID:	Client: Walsall Council									
All biologic programmed models and the descent of the second of the seco	TP3	Site: Allens Centre, Willenhall									
Addition         Sature         Sature         177/12/2015         177/12/2015           Thirdy Signature Window         Concel         177/12/2015         100         177/12/2015           Sature Signature Window         Concel         100 <td>1 I. KI</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Start Date</td> <td></td> <td></td> <td> Data:</td> <td></td>	1 I. KI						Start Date			Data:	
Diring Supporter Resolution     Dirichle Resolution     Part Resolution       UB 3CX wheeled excervator     Statut Table     17/12/2015     Part Resolution       Resolution     Resolution     Statut Table     17/12/2015     Part Resolution       MADE GROUND: Grass endors very sitty, slightly gradely, sady resolution, inspecific Concells on More Resolution, ins	Job No: J-B0984.00						Start Date.	7/12/2015	E	17/12/	2015
Secure Lane (mADE):         Logant:         Oraci         Material           Material bacepton         Regint:         Level Material         Secure 1 and Secure	Drilling Equipment/ Excave JCB 3CX wheeled e	ation Method: excavator	Co-ords:				Backfill Da	te: 7/12/2015	Fi	eld Records: BN	Л
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South Decryption         Orgin (n)         Larged (n)         Same (n)         Task         Organization (boom (						·	BI	M			
MADE GROUND: Grass on very silly, sight/ny gravely black sand. Gravelly, very silly, red brown firm consistency gravely CLAY with red sand and sill pookets.       0.15       ES1       0.40         Silly, sandy roomp brown adgrap line consistency gravely CLAY with red sand and sill pookets.       0.45       ES3       1.00         Gravely, very silly, red brown firm consistency gravely CLAY with red sand and sill pookets.       1.70       ES3       1.00         Base of PI: Groundwater inflow. End of Exploratory Hole at 2.40 m       2.40       ES1       0.10       ES1         Parate: 1. Groundwater inflow observed at base of pt 2.40 m begi. 3. Pid dnession: 0.50m v.250m.       2.40       ES1       ES1       0.10         Parate: 1. Groundwater inflow observed at base of pt 2.40 m begi. 3. Pid dnession: 0.50m v.250m.       ES1       ES1 <td< td=""><td></td><td>Strata Description</td><td>Depth (m)</td><td>Level (m)</td><td>Legend</td><td>Sample Type</td><td>Sample Depth (m)</td><td>Tests</td><td>i</td><td>Groundwa Records</td><td>ter Backfill Details</td></td<>		Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	i	Groundwa Records	ter Backfill Details
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MADE GROUND: Silly, sightly gravely black sand. Gravel of justice and brick.       0.45       252       0.40         Silly, sandy orange brown and group firm consistency gravely CLAY with red sand and all pockets.       1.70       E53       1.00         Gravely, very silly, red brown firm consistency quarticle gravel. (Carry b).       1.70       E53       1.00         Base of PE: Groundwater inflow End of Exploratory Hole at 2.40 m       1.70       E4       2.00       2.40         Permate:       1.70       1.70       1.70       1.70       1.70       1.70         Base of PE: Groundwater inflow Find of Exploratory Hole at 2.40 m       2.40       1.70       1.70       1.70         Permate:       1.70       1.70       1.70       1.70       1.70       1.70         Base of PE: Groundwater inflow observed at base of ptl 2.40 m       2.40       1.70       1.70       1.70         Permate:       1.70       1.70       1.70       1.70       1.70       1.70       1.70         Base of PE: Groundwater inflow observed at base of ptl 2.40 m       2.40       1.70       1.70       1.70       1.70         Permate:       1.70       1.70       1.70       1.70       1.70       1.70       1.70         Permate:       1.70       1.70 <td< td=""><td>gravelly sandy red subrounded quartz</td><td>brown topsoil. Gravel is zite.</td><td>0.15</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td><u>8</u> 8 8 9 9 9 9 9</td></td<>	gravelly sandy red subrounded quartz	brown topsoil. Gravel is zite.	0.15	-							<u>8</u> 8 8 9 9 9 9 9
Silv. sandy orange brown and grey firm consistency gravely CLAY with red sand and all pockets.       1.70       E53       1.00         Gravely, very silv, red brown firm consistency QuAY with grave of silutione and fire rounded quartatic gravel. (Damp)       1.70       D4       2.00       2.40         Base of Pt: Groundwater inflow First of Exploratory Hole at 2.40 m       2.40       Image: Constraints of Exploratory Hole at 2.40 m       2.40       Image: Constraints of Exploratory Hole at 2.40 m         Penade: 1 - 0 and constraints (Damp)       2.40       Image: Constraints of Exploratory Hole at 2.40 m       Image: Constraints of Exploratory Hole at 2.40 m       Image: Constraints of Exploratory Hole at 2.40 m         Penade: 1 - 0 and constraints (Damp)       2.40 m begi.       Image: Constraints of Exploratory Hole at 2.40 m begi.       Image: Constraints of Exploratory Hole at 2.40 m begi.       Image: Constraints of Exploratory Hole at 2.40 m begi.         2 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	MADE GROUND: Gravel of quartzite	Silty, slightly gravelly black sand.	0.45	-		ES2	0.40				
Gravely, very silly, red brown firm consistency Quarticle gravel. (Damp)     1.70     ES3     1.00       Base of Pit: Groundwater inflow. End of Exploratory Hole at 2.40 m     2.40     D4     2.00       Permits: 1 - Strukt collidation base of pit 2.40m begi. 2 - Pit collidation base of pit 2.40m begi. 3 - Pit collidation base of pit 2.40m begi. 4 - Trial pit ferminated at 2.40m begi due to unstable pit walls.     D4     2.00	Silty, sandy orange	e brown and grey firm consistency	-								
Gravely, very silty, red brown firm consistency CLAY with gravel of siltstone and fine rounded quartizite gravel. (Damp)       1.70       D4       2.00         Base of Pt: Groundwater inflow. End of Exploratory Hole at 2.40 m       2.40       2.40       2.40       2.40         Image: Comparison of the provide at 2.40 m       2.40       2.40       2.40       2.40       2.40         Image: Comparison of the provide at 2.40 m       2.40       2.40       2.40       2.40       2.40         Image: Comparison of the provide at 2.40 m       2.40       1.70       1.70       1.70       1.70         Image: Comparison of the provide at 2.40 m       2.40       1.70       1.70       1.70       1.70         Image: Comparison of the provide at 2.40 m       1.70       1.70       1.70       1.70       1.70         Image: Comparison of the provide at 2.40 m       1.70       1.70       1.70       1.70       1.70         Image: Comparison of the provide at 2.40 m begt.       1.70       1.70       1.70       1.70       1.70         Image: Comparison of the provide at 2.40 m begt.       1.70       1.70       1.70       1.70       1.70       1.70         Image: Comparison of the provide at 2.40 m begt.       1.70       1.70       1.70       1.70       1.70       1.70	graveny out to wa	Theu Sanu and Sin poonots.	. _	-		ES3	1.00				
Gravely, very sity, red brown firm consistency CLAY with gravel of sitstone and fine rounded quarticle gravel. (Damp)       1.70       D4       2.00         Base of Pt: Groundwater inflow. End of Exploratory Hole at 2.40 m       2.40       D4       2.00       2.40         Image: 1. Groundwater inflow observed at base of pt 2.40m begt. 2. Pit vall collapse below 0.15m begt. 3. Pit dimensions 0.50m x 2.50m. 4. Trial pit terminated at 2.40m begt due to unstable pit walls.       Image: 1.70       D4       2.00       Image: 2.00			-	-							
Gravely, very sily, red brown firm consistency CLAV with gravel of sillstone and fine rounded quartizite gravel. (Damp)       1.70       D4       2.00         Base of Pit: Groundwater inflow. End of Exploratory Hole at 2.40 m       2.40       2.40       2.40       2.40         Image: 1. Groundwater inflow observed at base of pit 2.40m begi. 2. Pit valid collapse below 0.15m begi. 3. Pit dimension 5.05m 2.50m. 4. Trial pit terminated at 2.40m begi due to unstable pit walls.       1.70       Image: 1.70       Image: 1.7				-							
Gravelly, very sity, red brown film counsistency CLAW with gravel of sitts counded quartizite gravel. (Bamp)       D4       2.00         Base of Pit: Groundwater inflow.       2.40         End of Exploratory Hole at 2.40 m       2.40         Image: Indicate and the second state of			1 70	-							
guartzite grävel. (Damp)       2.40       D4       2.00       2.40         Base of Pit: Groundwater inflow.       2.40       2.40       2.40       2.40         End of Exploratory Hole at 2.40 m       2.40       2.40       2.40       2.40         Permetris:       1.00       1.00       1.00       1.00       1.00         1.00       2.40       1.00       1.00       1.00       1.00       1.00         Permetris:       1.00       1.00       1.00       1.00       1.00       1.00       1.00         1.00       1.00       0.00       1.00       0.00       1.00       1.00       1.00       1.00       1.00         1.00       1.00       0.00	Gravelly, very silty CLAY with gravel	, red brown firm consistency of siltstone and fine rounded	-	-	××						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Base of Pit: Groundwater inflow.       2.40         End of Exploratory Hole at 2.40 m       2.40         Permate:       1. Groundwater inflow observed at base of pit 2.40m bogl.         2. Pit valid logase below 0.15m bogl.       2.91 Walls         3. Pit dimensions: 0.50m x 2.50m.         4. Trial pit terminated at 2.40m begl due to unstable pit walls.	quartzite gravel. (E	Jamp)		-	× × ×	D4	2.00				&X &X
Base of Pit: Groundwater inflow.       2.40         End of Exploratory Hole at 2.40 m       2.40         Permate:       1. Groundwater inflow observed at base of pit 2.40m begt.         2. Pit valid logase below 1.5m begt.       2.40 methods         3. Pit dimensions: 0.50m x 2.50m.         4. Trial pit terminated at 2.40m begt due to unstable pit walls.			-		××						
End of Exploratory Hole at 2.40 m  End of Exploratory Hole at 2.40 m  Remarks:  Remarks:  Sample Type Key  C: Core SPT  C:	Base of Pit: Groun	ndwater inflow.	2.40	-	<u> </u>					2.40	V fēt 🖓 🗠
Remarka:       1<	End of	Exploratory Hole at 2.40 m									
Remarks:       1<			-	-							
Remarks:       1<			-	-							
Remarks:       1<			-	-							
Remarks:       1.       Sample Type Key       Test Type Key         1.       Groundwater inflow observed at base of pit 2.40m begl.       Sample Type Key       Test Type Key         2.       Pit wall collapse below 0.15m begl.       Somotion to the test of the test of test o			-	-							
Remarks:       1<			-	-							
Remarks:       1. Groundwater inflow observed at base of pit 2.40m begl.         2. Pit wall collapse below 0.15m begl.         3. Pit dimensions: 0.50m x 2.50m.         4. Trial pit terminated at 2.40m begl due to unstable pit walls.             Sheet:             Sheet:			-	-							
Remarks:       1       Sample Type Key       Test Type Key         1. Groundwater inflow observed at base of pit 2.40m begl.       2. Pit wall collapse below 0.15m begl.       Sample Type Key       (C) - Cone SPT         2. Pit wall collapse below 0.15m begl.       3. Pit dimensions: 0.50m x 2.50m.       H. Trial pit terminated at 2.40m begl due to unstable pit walls.       W - Water       W - Water       P) - Pocket Pentrometer Reading         J. Jar Sample       P - Piston Sample       Sheet 1 of 1			-	-							
Remarks:       1<			-	-							
Remarks:       1. Groundwater inflow observed at base of pit 2.40m begl.       Test Type Key       Test Type Key         2. Pit wall collapse below 0.15m begl.       D. Disturbed Representative       (C) - Cone SPT         3. Pit dimensions: 0.50m x 2.50m.       B. Bulk Representative       (S) - Spoot SPT         4. Trial pit terminated at 2.40m begl due to unstable pit walls.       V - Hand Shear Vane Reading         J - Jar Sample       V - Hand Shear Vane Reading         Sheet:       Sheet:			-	-							
Remarks:       1. Groundwater inflow observed at base of pit 2.40m begl.       Sample Type Key       D. Disturbed Representative       Test Type Key         2. Pit wall collapse below 0.15m begl.       B. Bulk Representative       Second Processor       Software       P.D. Pit dimensions: 0.50m x 2.50m.       P.D. Point terminated at 2.40m begl due to unstable pit walls.       P.D. Pit dimensions: 0.50m x 2.50m.       P.D. Point Sample       P.D. Point Sample         P. Piston Sample       P. Piston Sample       Sheet:       Sheet:       Sheet:			-	-							
Remarks:       1       Groundwater inflow observed at base of pit 2.40m begl.       Test Type Key       Test Type Key         2. Pit wall collapse below 0.15m begl.       B- Bulk Representative       (S) - Spon SPT         2. Pit wall collapse below 0.15m begl.       W- Water       Sample Type Key       (S) - Cone SPT         3. Pit dimensions: 0.50m x 2.50m.       U- Undisturbed Representative       P - Docket Pentrometer Reading         V - Undisturbed Representative       V - Hand Shear Vane Reading         V - Hand Shear Vane Reading       Sheet:         Sheet:       Sheet:			-	-							
Remarks:         1. Groundwater inflow observed at base of pit 2.40m begl.         2. Pit wall collapse below 0.15m begl.         3. Pit dimensions: 0.50m x 2.50m.         4. Trial pit terminated at 2.40m begl due to unstable pit walls.         Sheet:         Sheet:			-	-							
Remarks:       1.       Groundwater inflow observed at base of pit 2.40m begl.       Test Type Key       (C) - Cone SPT         2. Pit wall collapse below 0.15m begl.       B - Bulk Representative       (S) - Spon SPT         3. Pit dimensions: 0.50m x 2.50m.       - Disturbed Representative       (S) - Spon SPT         4. Trial pit terminated at 2.40m begl due to unstable pit walls.       - Undisturbed Representative       P - Pocket Pentrometer Reading         J - Jar Sample       P - Piston Sample       V - Hand Shear Vane Reading         Sheet:       Sheet:       Sheet:			-	-							
Remarks:       1. Groundwater inflow observed at base of pit 2.40m begl.       Test Type Key         2. Pit wall collapse below 0.15m begl.       B - Bulk Representative       (C) - Cone SPT         3. Pit dimensions: 0.50m x 2.50m.       ES - Environmental Sample       P - Pocket Pentrometer Reading         4. Trial pit terminated at 2.40m begl due to unstable pit walls.       U - Undisturbed Representative       P - Pocket Pentrometer Reading         J - Jar Sample       P - Piston Sample       V - Hand Shear Vane Reading         Sheet:       Sheet:       Sheet			-	-							
<ul> <li>1. Groundwater inflow observed at base of pit 2.40m begl.</li> <li>2. Pit wall collapse below 0.15m begl.</li> <li>3. Pit dimensions: 0.50m x 2.50m.</li> <li>4. Trial pit terminated at 2.40m begl due to unstable pit walls.</li> <li>B - Bulk Representative ES - Environmental Sample W - Water U - Undisturbed Representative J - Jar Sample P - Piston Sample</li> <li>P - Piston Sample Sheet:</li> </ul>	Bemarks:			1	I	LI_	Sample Ty D - Disturt	L /pe Key ped Representa	Te tive (C	st Type Key	
<ul> <li>3. Pit dimensions: 0.50m x 2.50m.</li> <li>4. Trial pit terminated at 2.40m begl due to unstable pit walls.</li> <li>W - Water</li> <li>U - Undisturbed Representative</li> <li>J - Jar Sample</li> <li>P - Piston Sample</li> <li>Sheet:</li> </ul>	1. Groundwater infl 2. Pit wall collapse	ow observed at base of pit 2.40m begl. below 0.15m begl.					B - Bulk R ES - Envir	epresentative	(S)	) - Spoon SPT - Pocket Pent	rometer Reading
J - Jar Sample P - Piston Sample Sheet:	<ol> <li>Pit dimensions: 0</li> <li>Trial pit terminate</li> </ol>	0.50m x 2.50m. ed at 2.40m bed due to unstable pit walls.					W - Water U - Undist	urbed Represer	ntative V	D - PID Readin	ig Vane Reading
Sheet 1 of 1	T. marpic terminal	a al 2.7011 bogi ado to anotasio premane.					J - Jar Sar	nple	liui vo	- Hund G	Vano Liouzing
Sheet: Sheet 1 of 1							P - Piston	Sample			
							Sheet:	Sh	eet 1 of	 f 1	

Exploratory Hole ID: Client: Walsall Council							OPUS					
TP4	Site: Allens Centre, Willenhall		www.opusinternational.co.uk									
Job No:	-					Start Date:		End Date:				
J-B0984.00	ration Method	Co-ords;				Backfill Da	/12/2015	17/12/201	5			
JCB 3CX wheeled e	excavator					17	/12/2015	BM				
		Ground Level (r	mAOD):			Logged: Bl	VI Chkd:	Appr:				
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details			
MADE GROUND: gravelly sandy dar green plastic mes	: Grass onto very silty, slightly rk grey to black topsoil with a sh. Gravel is subrounded quartzite.	0.20										
MADE GROUND: locally black grave content. Gravel ar	: Silty, slightly clayey orange brown ally sand with low cobble nd cobbles of quartzite and brick.		· · · · · · · · · · · · · · · · · · ·		ES1	0.70			1			
MADE GROUND: sandy soft consist odour. Gravel is si occasional brick c	Silty, gravelly black and dark brown tency clay with a slight organic ubrounded quartzite and obble. (Damp)		- - - - - - - - - - - - - - - - - - -						3명 6명 6명 6명 6명 6명 6명 6명 6명 24 19 18 18 18 18 18 18 18 18 24 18 18 18 18 18 18 18 18 18 18			
MADE GROUND: consistency clay w Gravel is quartzite	: Silty, gravelly dark grey organic soft with a strong organic odour. and occasional brick cobble.	- 2.30 -			D2	2.40			4 6 4 6 4 6 4 6 4 6 4 6 1 6 1 6 1 6 1 6			
End of	f Exploratory Hole at 3.00 m					2.90						
Remarks: 1. No groundwater 2. Pit wall collapse 3. Pit dimensions: ( 4. Trial pit terminate	observed. below 1.10m begl. 0.50m x 2.00m. ed at 3.00m begl.					Sample Ty D - Disturb B - Bulk Re ES - Envirc W - Water U - Undistu J - Jar San P - Piston	pe Key ed Representative spresentative urbed Representative nple Sample Sheet 1	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrome PID - PID Reading V - Hand Shear Van	ter Reading			

Exploratory Hole ID: Client: Walsall Council													
TP5 Site: Allens Centre, Willenhall							UPUS						
	,						www.opusinter	rnational.co.uk					
Job No: J-B0984.00						Start Date	: 7/12/2015	End Date: 17/12/201	15				
JCB 3CX wheeled e	ation Method: excavator	Co-ords:				Backfill Da	ate: 7/12/2015	Field Records: BM					
		Ground Level (	mAOD):			Logged:	Chkd:	Appr:					
			1	1		В	M						
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details				
MADE GROUND: is quartzite and bri	Very gravelly, red brown sand. Gravel ick.		-										
MADE GROUND: consistency grave quartzite. (Rework	Sandy, silty pale grey firm lly clay. Gravel is subrounded ed)	0.40	-		ES1	0.70							
MADE GROUND: black gravelly sand quartzite. (Rework	Very clayey, silty dark brown locally d. Gravel is subrounded ed)	- 0.80	-						1 14 44 44 4 24 24 24 24 24 24 24 24 26 26 24 24 1 20 26 24 1				
		1 70	-		ES2	1.40			X 4X 4X 4X Pc Pc Pc SL BL BL B				
MADE GROUND: mottled black firm is fine quartzite an	Silty, gravelly dark brown locally consistency sandy clay. Gravel d medium coal.	- 1.70	-					2.00 🖂					
Below 2.10m: Slig brown sand pocke	ht groundwater ingress from orange ts.		-		ES3	2.60			2월 6월 6월 6월 6월 6월 5월 5월 5월 5월 5월 81 81 81 81 81 81 81 81				
End of	Exploratory Hole at 3.00 m	- 3.00 -		~~~~~									
Remarks: 1. Slight groundwat 2. Pit walls stable. 3. Pit dimensions: ( 4. Trial pit terminate	ter ingress observed from sand pockets below 0.50m x 2.50m. ed at 3.00m begl.	2.00m begl.				Sample T D - Disturi B - Bulk F ES - Envir W - Water U - Undist J - Jar Sa P - Piston	ype Key bed Representative tepresentative commental Sample urbed Representative mple Sample	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrome PID - PID Reading V - Hand Shear Vand	eter Reading				
						Sheet:	Sheet 1	of 1					

Exploratory Hole ID:	<sup>Client:</sup> Walsall Council		ΟΡυς						
TP6	Site: Allens Centre, Willenhall					$\neg$		/P U J	
tale Min.	-					Start Date	www.opusinten	TEnd Date:	
Job No: J-B0984.00						5tan Date.	//12/2015	17/12/20	15
Drilling Equipment/ Excave JCB 3CX wheeled (	ation Method: excavator	Co-ords:				Backfill Da	.te: 7/12/2015	Field Records: BM	
		Ground Level (I	mAOD):			Logged:	Chkd:	Appr:	
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND: gravelly sand. Gra quartzite.	Clayey, slightly silty red brown avel is fine to coarse brick and		-		ES1	0.20			54
MADE GROUND: and grey firm cons cobble of brick.	Very silty, sandy pale orange brown sistency clay with occasional	0.40			ES2	0.60			1 5 전 5 전 5 전 5 전 6 전 6 1 전 1 전 1 전 1 전 6 전 6 1 전 1 전 1 전 1 전 1 전 1 전 1 전 1 전 1 전 1 전
Silty, red orange a stiff locally soft co decaying organic p	Ind brown mottled grey firm to nsistency CLAY with pockets of plant material.	1.10			D3	2 40			하여 6명 6명 6명 6명 6명 6명 6명 6명 50 5
Very silty, slightly consistency CLAY	sandy red brown firm (.	2.50				2.50			
End of	f Exploratory Hole at 3.30 m	3.30			D4	3.00			14 44 64 12 12 12 12 12 12 12 12 12 12 12 12 12 1
Remarks: 1. No groundwater 2. Pit walls stable. 3. Pit dimensions: ( 4. Trial pit terminate	observed. 0.50m x 2.30m. ed at 3.30m begl.		L			Sample Ty D - Disturb B - Bulk R ES - Envir W - Water U - Undist J - Jar Sar P - Piston Sheet:	rpe Key bed Representative epresentative onmental Sample urbed Representative mple Sample Sheet 1	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrom PID - PID Reading V - Hand Shear Van	eter Reading
Exploratory Hole ID:	<sup>Client:</sup> Walsall Council							DIIS	
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TP7	Site: Allens Centre, Willenhall								
Ish No.	-					Start Date	www.opuanten	TEnd Date:	
Job No: J-B0984.00						17	//12/2015	17/12/20	15
Drilling Equipment/ Excave JCB 3CX wheeled e	ation Method: excavator	Co-ords:				Backfill Dat 17	te: 7/12/2015	Field Records: BM	
		Ground Level (	mAOD):			Logged:	Chkd:	Appr:	
		Depth	Level	Legend	Sample	Sample	Toste	Groundwater	Backfill
MADE GROUND:	Strata Description : Grass onto very silty, slightly	(m)	(m)		Туре	Ueptn (m)		Records	
gravelly sandy dar subrounded quart:	k brown topsoil. Gravel is zite.	0.30	-						
MADE GROUND: brown sand with lo	. Very gravelly, silty dark red and ow cobble content of angular		-						
quartzite.	Casional glass, slate and		-		ES1	0.80			
Silty, sandy grave	Ilv orange brown mottled grey	- 1.10	-						
firm consistency C quartzite.	LAY. Gravel is subrounded		-		ES2	1.40			
		2.00 -	-						
Clayey, sligntly slig of subrounded qua	ly, red brown SAND and GRAVEL artzite.		-						
			-						
		-							
Silty, slightly grave CLAY with bands	ally red brown firm consistency of coal. Gravel is quartzite.	3.20 3.40	-	× × ×	ES3	3.30			
End of	f Exploratory Hole at 3.40 m		-						
		-	-						
			-						
			-						
			-						
			-						
Remarks:	obsorved			LI		Sample Ty D - Disturt B - Bulk F	rpe Key Ded Representative	(C) - Cone SPT	_
<ol> <li>Pit walls stable.</li> <li>Pit dimensions: (</li> </ol>	0.50m x 2.50m.					ES - Enviro W - Water	onmental Sample	P - Pocket Pentrome PID - PID Reading	eter Reading
4. Illai pit terrinnaa	eu al 5.40m begi.					J - Jar Sar P - Piston	nple Sample	V - Hallu Silbai vain	e neaung
						Sheet:			
							Sheet 1	of 1	

Exploratory Hole ID:	<sup>Client:</sup> Walsall Council								
TP8	Site: Allens Centre, Willenhall					$\neg$		PUS	ļ
							www.opusinterr	national.co.uk	
Job No: J-B0984.00						Start Date: 17	′/12/2015	End Date: 17/12/201	15
Drilling Equipment/ Excave JCB 3CX wheeled e	ation Method: excavator	Co-ords:				Backfill Dat	. <sup>te:</sup> 7/12/2015	Field Records: BM	
		Ground Level	(mAOD):			Logged:	Chkd:	Appr:	
			_ <b>_</b>		•	BN	N		
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND:	: Tarmacadam.	0.15	-						
MADE GROUND: crushed sub-base	Silty, pale grey sand and gravel of material.	0.30							
MADE GROUND:	: Tarmacadam.	0.50	$\frac{1}{1}$		ES1	0.50			
MADE GROUND: sand. Gravel and occasional tarmac	Silty, gravelly and cobbly dark brown cobbles of brick, quartzite and								5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4
MADE GROUND: firm to stiff consist quartzite, brick and	Silty, gravelly red brown and brown tency clay. Gravel is d ceramic.	1.20			ES2	1.70			3점 6점 6점 6점 6점 6점 6점 6점 6 2년 1월 1월 1월 1월 1월 1월 1월 1 2년 1월 1월 1월 1월 1월 1월 1월 1월 1 1월 18년 18년 1월 18년 1월 18년 18년
Very silty, sandy re	ed brown firm consistency CLAY.	2.40			ES3	3.00			·····································
End of	Exploratory Hole at 3.30 m					Sample Tr	уре Кеу	Test Type Key	
Remarks: 1. Running sand in 2. Pit walls stable. 3. Pit dimensions: ( 4. Trial pit terminate	gress observed at 2.7m begl. 0.50m x 2.40m. ed at 3.30m begl.					D - Disturb B - Bulk Re ES - Envirc W - Water U - Undistu J - Jar Sar P - Piston	ed Representative presentativ	(C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrome PID - PID Reading V - Hand Shear Van	iter Reading

Exploratory Hole ID:	<sup>Client:</sup> Walsall Council							PUS	
WS1	Site: Allens Centre, Willenhall						www.opusinterr	national.co.uk	
Job No:	-					Start Date:		End Date:	
J-B0984.00						18	3/12/2015	18/12/20	15
Drilling Equipment/ Excave Tracked Window Sa	ation Method: ampling Rig	Co-ords:				Backtill Da	te: 3/12/2015	Field Records: BM	
		Ground Level (r	mAOD):			Logged:	Chkd:	Appr:	
			T	1	I	BI	M		
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND: gravelly dark brow	: Grass onto very silty, slightly n sandy topsoil with rootlets.	-	-						
	ded quartzite.	0.35							
gravelly dark brow	n to black loose sand. Gravel is	-	-	XXX					
קטמונצונס מויט טויטי		-	-						
			-				N=5(C)		0%0
		-	-						
	··· ··· ··· · · · · · · · · · · · · ·	- 1.40 -	-						
MADE GROUND: brown firm to stiff	: Very silty, slightly gravelly grey and consistency sandy clay. Gravel	-	-		ES1	1.60			
is quartzite. (Rewo	orked)		-						
		2.00 -	-				N=5(C)	2.00 \	7
Very silty, brown s SAND. (Wet)	slightly clayey loose		-				\ /		
Silty, slightly grave	elly grey and brown firm to	- 2.30 -	-	××					
stiff consistency, r occasional pocket	high strength CLAY with ts of organic grey clay and	-	-	x_^x	ES2	2.50			
decaying plant ma occasional coal.	aterial. Gravel is quartzite and	-	-	× × ×					
			-	×_^_×			N=22(C)		
Very silty, red brow	wn slightly clayey medium dense	- 3.10 -	-	^ ^ 			··· 、 ,		
SAND with pocket	ts of sandy clay. (Wet)	-	-	$\hat{\mathbf{x}}_{\mathbf{x}} \times \hat{\mathbf{x}}_{\mathbf{x}} \times \hat{\mathbf{x}}_{\mathbf{x}}$					
		-	-	× × × × × × × ×					
		- 3.80 -	-						
Very silty, red brow strength CLAY with	wn stiff consistency, high th thick bands of wet silty sand.		-	$\begin{array}{c} \times \times$			N=20(C)		
Gravel is fine coal	and quartzite.	-	-						
		-	-						
		-	-	$\begin{array}{c} \times \times$					
		-	-	$\begin{array}{c} \times \times$					
		5.00	-	$\begin{array}{c} \times \times \times \times \\ \times \times \times \times \times \\ \times \times \times \times \times \\ \end{array}$			N=27(C)		
End of	f Exploratory Hole at 5.00 m		-						
		-	-						
Pamarka						Sample Ty	/pe Key	Test Type Key	
1. SPT N values co	prected to a N60 value in accordance with BS	EN 22476 Pa	art 3 and	where		B - Bulk R	epresentative (	(S) - Cone SET (S) - Spoon SPT	notor Reading
2. Groundwater en	countered at 2.00m begl.					W - Water	Infriental Sample	PID - PID Reading	Pading
4. Monitoring well in	installed as detailed above.					J - Jar Sar	nple	v - Hallu Shear vai	ie neaulity
						P - Piston	Sample		
						Sheet:			
							Sheet 1	1 10	

Exploratory Hole ID:	Client: Walsall Council							PUS	
WS2	Site: Allens Centre, Willenhall						www.opusinter	national.co.uk	
Job No:						Start Date		End Date:	
J-B0984.00						18	3/12/2015	18/12/201	15
Drilling Equipment/ Excava Tracked Window Sa	ation Method: ampling Rig	Co-ords:	_	_	_	Backfill Da	te: 3/12/2015	Field Records: BM	
		Ground Level (r	mAOD):			Logged:	Chkd:	Appr:	
				<u> </u>	<b></b>				
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND: and black sandy to brick and coal frag	: Grass onto silty, gravelly dark brown opsoil. Gravel is ash, medium gments.	0.30	-		ES1	0.20			
MADE GROUND: firm to stiff consis Gravel is subroun	: Very silty, gravelly grey and black stency sandy CLAY with rootlets. ided quartzite.	0.50							
MADE GROUND: consistency clay. fragments.	: Silty, gravelly grey and brown firm Gravel is quartzite and brick	0.90					N=5(C)		5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Very clayey, grave becoming medium	ally orange brown silty loose n dense SAND with selenite crystals.								
		-					N=16(C)	1.70 🖂	
Silty, red brown fir consistency, medi of coal and siltstor	rm locally firm to stiff ium strength CLAY with fine gravel ne.	- 2.25	-						4 상적 상적 상적 상적 상 (2.4) 장식 (2.4) 장식 (2.4) 장식 (2.4) 장식 (2.4) 정식 (2.4) 장식 (2.4) 정신 (2.4) 장식
Very clayey, grave dense becoming c quartzite.	ally orange brown silty medium dense SAND. Gravel is subrounded	- 3.00 -			D2	2.90	N=12(C)		성 성성 성성 상성 상성 상상 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.
End o	f Exploratory Hole at 4.00 m	- 4.00 -	- - - - - - - - - - -				N=40(C)		144 64 64 6 150 50 50 50 50 50 50 50 50 50 50 50 50
Remarks: 1. SPT N values cc appropriate extra 2. Groundwater en 3. Hole terminated 4. Borehole backfill	prrected to a N60 value in accordance with BS apolated for partial penetration. icountered at 1.70m begl. at 4.00m bgl. led as detailed above.	S EN 22476 P	- - - - - - - - - - - - - - - - - - -	I where		Sample Tı, D - Disturt B - Bulk R ES - Envir W - Water U - Undist J - Jar Saı P - Piston	rpe Key sed Representative tepresentative onmental Sample turbed Representative mple Sample	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrom- PID - PID Reading V - Hand Shear Var	eter Reading
						Sheet:	Sheet 1	of 1	

Exploratory Hole ID:	Client: Walsall Council								
WS3	Site: Allens Centre, Willenhall						www.opusinter	national.co.u	k
Job No:	-					Start Date		End Date:	
J-B0984.00						18	3/12/2015	18/12/	/2015
Drilling Equipment/ Excave Tracked Window S;	ation Method: ampling Rig	Co-ords:				Backtill Da	.te: 3/12/2015	Field Records:	N
		Ground Level (n	mAOD):			Logged:	Chkd:	Appr	
		_	1	<u> </u>					
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwa Records	ter Backfill Details
MADE GROUND: and black sandy to brick and coal frag	: Grass onto silty, gravelly dark brown opsoil. Gravel is ash, medium gments.								
MADE GROUND: rootlets. Gravel is quartzite.	: Very silty, gravelly black sand with fine to coarse brick and	0.60	-		F01	0.75			
MADE GROUND: sand. Gravel is br	: Silty, slightly gravelly brown loose ick, quartzite and clinker.		-		ESI	0.75	N=8(C)		
MADE GROUND: black locally dark Gravel is very fine	: Very clayey, silty slightly gravelly grey sand with organic material. 9 brick.	1.40 1.55 1.65	-		D2	1.70			
Silty, slightly grave quartzite. (Damp)	elly pale grey SAND. Gravel is		-				N=9(C)	2.00	
Very silty, gravelly grey, firm consiste is subrounded qua 2.00m: Pockets o	orange and red brown locally ency, low strength CLAY. Gravel artzite. f wet sand.	2.40	-				IN-0(0)	2.00	
Very silty, slightly consistency mediu subrounded quart	sandy red brown soft to firm um strength CLAY with occasional izite gravel.	2.60	-						
Very silty, slightly pockets of soft to Below 3.00m: Bec	gravelly red brown SAND with firm consistency organic clay. coming wet.		- - - -				N=12(C)		
Very silty, slightly black, firm locally medium strength coal fragments.	gravelly dark red brown and soft to firm consistency, CLAY. Gravel is fine quartzite and	- 3.60 -			D3	3.70	N=12(C)		
End o	f Exploratory Hole at 5.00 m		- - - - - - -	× · · × · · × · · · × · · · · × · · · · × ·			N=13(C)		
Remarks: 1. SPT N values co appropriate extra 2. Groundwater en- 3. Hole terminated 4. Monitoring well i	prrected to a N60 value in accordance with B apolated for partial penetration. countered at 1.70m begl. at 4.00m bgl. installed as detailed above.	S EN 22476 Pa	art 3 and	where		Sample Ty D - Disturt B - Bulk R ES - Envir W - Water U - Undist J - Jar Sa P - Piston Sheet:	pe Key Joe Representative lepresentative onmental Sample urbed Representative mple Sample	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pent PID - PID Readir V - Hand Shear	rometer Reading ng Vane Reading
							Sheet 1	of 1	

Exploratory Hole ID:	Client: Walsall Council								5
WS4	Site: Allens Centre, Willenhall					$\neg$			
						Cit + Data	www.opusinien	national.co.u	ık
Job No: J-B0984.00						Start Date. 18	3/12/2015	End Date: 18/12	2/2015
Drilling Equipment/ Excav Tracked Window S	ation Method: ampling Rig	Co-ords:				Backfill Da	.te: 3/12/2015	Field Records:	M
		Ground Level (r	mAOD):			Logged:	Chkd:	Арр	Jr:
					<b></b>	В	M		
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwa Record	ater Backfill Is Details
MADE GROUND: is brick, quartzite	: Very gravelly, red brown sand. Gravel and concrete.								
MADE GROUND subangular to anç	: Sandy, grey gravel of fine to coarse gular brick, shale and concrete.	0.50	-		ES1	0.45			
MADE GROUND crushed brick. Pe	Sandy, red brown gravel of loose wrched water within this strata.	0.90	-				N=8(C)		
Very silty, gravelly consistency, low s pockets. Gravel is	γ grey brown sandy soft strength CLAY with organic s subrounded quartzite.	1.30	-		500	4 50			
Very silty, sandy c consistency, low s quartzite gravel a	orange brown and grey firm strength CLAY with occasional nd wet sand pockets.		-		E52	1.50			
			-		D3	2.20	N=6(C)		
Very silty, red bro occasional black t	wn medium dense SAND with bands. (Wet)	2.50	- - - - - - - -				N=18(C)		
					D4	3.30	N=14(C)	4.00	
Silty, slightly grave consistency, med quartzite and coal End c	elly red brown firm to stiff lium strength CLAY. Gravel is fine I of Exploratory Hole at 5.00 m		-				N=20(C)		
Remarks: 1. SPT N values cc appropriate extra 2. Groundwater en 3. Hole terminated 4. Monitoring well i	prrected to a N60 value in accordance with E apolated for partial penetration. countered at 2.00m begl. at 5.00m bgl. installed as detailed above.	3S EN 22476 P	art 3 and	J where		Sample Ty D - Disturt: B - Bulk R ES - Enviri W - Water U - Undist J - Jar Sar P - Piston Sheet:	rpe Key Ped Representative epresentative onmental Sample urbed Representative mple Sample	Test Type Key (C) - Cone SPT (S) - Spoon SP1 P - Pocket Pen: PID - PID Readi V - Hand Shear	T trometer Readin ing r Vane Reading
							Sheet 1	of 1	

Exploratory Hole ID:	<sup>Client:</sup> Walsall Council						C	)PUS	
WS5	Site: Allens Centre, Willenhall						www.opusinter	rnational.co.uk	
Job No:	-					Start Date:		End Date:	
J-B0984.00						18	/12/2015	18/12/201	15
Drilling Equipment/ Excav Tracked Window S	ation Method: ampling Rig	Co-ords:				Backfill Dat 18	<sup>ie:</sup> 3/12/2015	Field Records: BM	
		Ground Level (	(mAOD):			Logged:	Chkd:	Appr:	
				<del></del>	<b>.</b>	BN	N		
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND: clayey topsoil with quartzite.	: Grass onto silty, gravelly dark brown rootlets. Gravel is subrounded		-						
MADE GROUND: orange brown me	: Very clayey, silty dark brown to dium dense sand with rootlets.				ES1	0.70	N=12(C)		
MADE GROUND consistency, med fine brick fragmer	: Silty, dark grey and brown firm lium strength CLAY with occasional nts	- 1.30 - 1.70			ES2	1.60			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
MADE GROUND: brown sand with c	: (Wet) silty, clayey black and dark occasional quartzite gravel.	1.95	-			ļ		1.80 —	
Very silty, sandy c consistency, low s quartzite gravel ar	orange brown and grey firm strength CLAY with occasional nd very silty sand pockets.				D3	2.50	N=7(G)		
Sandy, slightly silt consistency, medi quartzite and coal Between 3.00 and	ty, gravelly red brown firm ium strength CLAY. Gravel is fine I. d 3.50m: Wet.	3.00 -			1 201		N=10(C)		
		3.80	-						
Silty, slightiy craye dense SAND.	y orange and red brown medium						N=12(C)		
Very silty sandy.	gravelly red brown firm to stiff	4.80	-			ļ			
consistency, high quartzite and coal End o	strength CLAY. Gravel is fine	5.00					N=33(C)		
Remarks: 1. SPT N values co appropriate extra 2. Groundwater en 3. Hole terminated 4. Monitoring well i	prrected to a N60 value in accordance with B apolated for partial penetration. countered at 1.80m begl. at 5.00m bgl. installed as detailed above.	3S EN 22476 P		J where		Sample Ty D - Disturb B - Bulk Re ES - Envirc W - Water U - Undistı J - Jar Sar P - Piston Sheet:	pe Key ed Representative presentative nmental Sample urbed Representative nple Sample Sheet 1	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrome PID - PID Reading V - Hand Shear Van	e Reading

Exploratory Hole ID:	<sup>Client:</sup> Walsall Council							DIIS	
WS6	Site: Allens Centre, Willenhall								
I-h No:	-					Start Date		TEnd Date:	
Job No: J-B0984.00						18	3/12/2015 	18/12/20	15
Drilling Equipment/ Excave Tracked Window Sa	ation Method: ampling Rig	Co-ords:				Backfill Da	.te: 3/12/2015	Field Records: BM	
		Ground Level (	mAOD):			Logged:	Chkd:	Appr:	
				<b></b>	<b></b>	BI	M		
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND:	. Tarmacadam and subbase.		-						
			-		4				
MADE GROUND:	: Sandy, dark grey gravel of tarmac,	- 0.40	-			~ ~~			
blick and plaster.			-		ESI	0.60			
Very silty slightly	sandu sliahtlu aravallu arav	0.90	-						
and orange brown	I firm consistency, very low	-	-				N=4(C)		
Below 1.10m: Bec	coming sandy.		-		1				
Silty locally sandy	u rad brown firm consistency	1.50	-						
low strength CLA	Y.		-		D2	1.70			
			-						
		-	-				N=5(C)		
			-						
		- 2.50	-		4				
Silty, slightly grave consistency, medi	elly red brown firm ium strength CLAY. Gravel is fine		-		4				
coal and quartzite.			-		4				
Between 3.00 and	d 3.40m: Wet sand pockets.	-	-		1		N=11(C)	3.00 🖄	
			-						
			]		1				
			]		D3	3.60			
Below 3.70m: Bec	coming stiff.		-						
End of	f Exploratory Hole at 4.00 m	- 4.00 -	-	· · · · · · · · · · · · · · · · · · ·			N=14(C)		<u>~</u>
			-						
			1						
			-						
			-						
			-						
			-						
			-						
Remarks:				1	I	Sample Ty D - Disturt	/pe Key ped Representative	Test Type Key (C) - Cone SPT	
1. SPT N values co	prected to a N60 value in accordance with BS	EN 22476 P	'art 3 and	l where		B - Bulk R FS - Envir	epresentative	(S) - Spoon SPT	neter Reading
2. Groundwater end	countered at 3.00m begl.					W - Water		PID - PID Reading	Deading
4. Borehole backfill	led as detailed above.					J - Jar Sar	nple	v - Hariu Sriear va	ie nedulity
						P - Piston	Sample	I	
						Sheet:			
							Sheet 1	of 1	

Exploratory Hole ID:	<sup>Client:</sup> Walsall Council							PUS	
WS7	Site: Allens Centre, Willenhall						www.opusinter	national.co.uk	
Job No:						Start Date	:	End Date:	
J-B0984.00	and the state of t					18	3/12/2015	18/12/201	5
Tracked Window Sa	ampling Rig	Co-oras:				18 18	te: 3/12/2015	BM	
		Ground Level (n	nAOD):			Logged: Bl	M Chkd:	Appr:	
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details
MADE GROUND:	Tarmacadam.	0.15							
MADE GROUND: and gravel of brick	Silty, dark grey, black and brown sand t, hardcore and tarmacadam.	0.15			ES1	0.60			
Slightly gravelly, si firm consistency, r odour and decayin subrounded quartz	Ity brown and orange brown medium strength CLAY with organic ig wood fragments. Gravel is zite.	0.80 -	- - - -				N=15(C)		1 시 시 시 시 시 시 시 는 2 시 년 1 시 1 시 는 3 년 2 년 2 년 2 년 년 1 년 1 년 1 년 1
Silty, slightly grave mottled grey firm o sandy CLAY. Below 1.60m: Bec	Ily to gravelly orange brown consistency, medium strength coming very sandy.		-		D2	1.70			
Below 1.90m: Qua	artzite Cobble.	2.00 -	-			I	N=15(C)		
No recovery - pres within superficial o 3.00m to 4.50m be	umed to be cobble obstruction leposits. Continuous SPT from egl.		-						· · · · · · · · · · · · · · · · · · ·
			-				N=42(C)		
			-				N=33(C)		
							N=37(C)		54 54 54 54 54 5 55 55 55 55 55 55 5 55 55 55 55 5 55 55 55 5 55 55 55 5 55 555
End of	Exploratory Hole at 4.50 m	4.50					N=52(C)		<u>×</u> 0 <u>×</u> 2 <u>×</u> 2
Remarks: 1. SPT N values co appropriate extra 2. No groundwater 3. No recovery belo 4. Hole terminated a 5. Borehole backfille	rrected to a N60 value in accordance with BS I polated for partial penetration. encountered. w 2.0m begl. at 4.45m bgl. ed as detailed above.	EN 22476 Pa	art 3 and	where		Sample Ty D - Disturb B - Bulk R ES - Envirr W - Water U - Undistr J - Jar Sar P - Piston Sheet:	rpe Key ed Representative epresentative onmental Sample urbed Representative mple Sample Sheet 1	Test Type Key (C) - Cone SPT (S) - Spoon SPT P - Pocket Pentrome PID - PID Reading V - Hand Shear Vani	⊭ter Reading e Reading

Exploratory Hole ID:	Client: Walsall Council									
RBH1	Site: Allens Centre, Willenhall									
Job No:	-					Start Date		End Date:		
J-B0984.00						04	4/02/2016	04/02/201	16	
Drilling Equipment/ Excave Klemm Rotary Drilli	L ation Method: ing Rig	Co-ords:				Backfill Da	.te:	Field Records:		
· -		Cround Level (	·				////2010	Appr:		
		Ground Lever (.	ΠΑΟυ			B!	M	ייער <i>י</i> ן.		
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundwater Records	Backfill Details	
MADE GROUND:	: Fill	_				]				
Boulder CLAY		2.00				I				
						I				
						I				
						I				
		8.50		· · · · · · · · · · ·		I				
	·/	8.70				I				
BIACK IVIODO I ONI	E					ľ				
		-				ļ				
						ļ				
		-				ļ				
						I				
COAL		17.60				ļ				
Light grey MUDST	TONE	-				1				
						1				
		-				ļ				
		-				ļ				
		1				ļ				
		-				ľ				
						ļ				
COAL		28.50				ļ				
Light grey MUDST	TONE					ļ				
						ļ				
		- 33.40				I				
Light grey MUDS		34.00				ļ				
Light Grev MUDS		- 36.00 -				I				
Light grey MUDST	TONE	37.00				ļ				
-		] _				I				
End of Remarks:	Exploratory Hole at 40.00 m	<u> </u>	1		<u>L</u> L	Sample Ty D - Distur	/pe Key bed Representative	Test Type Key (C) - Cone SPT		
<ol> <li>No groundwater</li> <li>Borehole cased to</li> </ol>	observed. o 10.0m					B - Bulk R ES - Envir	epresentative ronmental Sample	(S) - Spoon SPT P - Pocket Pentrome	eter Reading	
3. Borehole backfille	ed as detailed above.					W - Water U - Undist	turbed Representative	PID - PID Reading V - Hand Shear Van	e Reading	
						J - Jar Sar P - Piston	nple	1	-	
							Jampie	1		
						Sheet:	Sheet 1	of 1		
							Oneet 1			

Exploratory Hole ID:	Walsall Council								IC I			
RBH2	Site: Allens Centre, Willenhall					www.opusinternational.co.uk						
	4					Start Date	www.opusinter		3.UK			
Job No: J-B0984.00						04	/02/2016	04/	02/201	6		
Drilling Equipment/ Excave Klemm Rotary Drilli	I ation Method: ing Rig	Co-ords:				Backfill Da	te: //02/2016	Field Record	ds:			
		Ground Level (n	1AOD):			Logged:	Chkd:	/	Appr:			
						BI	N					
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groun Rec	dwater ords	Backfill Details		
MADE GROUND:	: Fill	1 00										
Gravelly CLAY												
Weathered COAL Black MUDSTONI		- 9.00 - 9.30										
Grey MUDSTONE	<u>.</u>	19.00 принитрипиратири										
End of	Exploratory Hole at 30.00 m	- 30.00 - 30.00										
Remarks: 1. No groundwater 2. Borehole cased t 3. Borehole backfille	observed. to 10.0m led as detailed above.					Sample Ty D - Disturb B - Bulk R ES - Envirc W - Water U - Undisti J - Jar Sar P - Piston	pe Key led Representative epresentative onmental Sample urbed Representative nple Sample	Test Type Kr (C) - Cone S (S) - Spoon 3 P - Pocket F PID - PID Re	эу PT SPT Pentromet ading near Vane	ter Reading ≽ Reading		
						Sheet.	Sheet 1	of 1				

Exploratory Hole ID:	Walsall Council			OPUS						
RBH3	Site: Allens Centre, Willenhall									
						Ctart Data	www.opusinter		л	
Job No: J-B0984.00						Start Date	1/02/2016	End Date: 04/02	2/2016	
Drilling Equipment/ Excava	ation Method:	Co-ords:				Backfill Da	te:	Field Records	:	
Nellilli nulary Drimi	ng ng					04	/02/2016			
		Ground Level (m	AOD):			Logged: Bl	Chkd: M	App	or:	
		<u> </u>								
	Strata Description	Depth (m)	Level (m)	Legend	Sample Type	Sample Depth (m)	Tests	Groundw Record	vater I Is	Backfill Details
MADE GROUND:	Fill	1.00								
Gravelly CLAY										
COAL		9.00								
Black MUDSTONE	E/	10.00								
COAL										
Black MUDSTONE	E									
		16.00								
COAL		17.00								
Light grey MUDS I	TONE									
End of	Exploratory Hole at 30.00 m	- 30.00 -								
						Sample T	(ne Key	Test Type Key		
Remarks:	choonied					D - Disturt	bed Representative	(C) - Cone SPT	[ )T	
2. Borehole cased to	to 10.0m					ES - Envir	onmental Sample	P - Pocket Pe	ntrometer	Reading
3. Borehole backfille	ed as detailed above.					W - Water	urbed Bepresentative	PID - PID Read	ling ar Vane F	Reading
						J - Jar Sar	nple		u valori	louunig
						P - Piston	Sample			
						Shoot:				
						Sheet.	Sheet 1	of 1		

## **APPENDIX B Chemical Analysis Results**



Ben Murphy Opus International Suite 3 3800 Parkside Birmingham Business Park Birmingham B37 7YG



QTS Environmental Ltd Unit 1 Rose Lane Industrial Estate Rose Lane Lenham Heath Kent ME17 2JN t: 01622 850410 russelLjarvis@gtsenvironmental.com

### QTS Environmental Report No: 15-39034

Site Reference: Allens Centre, Willenhall

Project / Job Ref: J-B0984.00

Order No: BI 21045

Sample Receipt Date: 22/12/2015

Sample Scheduled Date: 22/12/2015

Report Issue Number: 1

**Reporting Date:** 05/01/2016

Authorised by:

Russell Jarvis

Associate Director of Client Services On behalf of QTS Environmental Ltd Authorised by:

KO C Kevin Old Associate Director of Laboratory On behalf of QTS Environmental Ltd





Soil Analysis Certificate						
QTS Environmental Report No: 15-39034	Date Sampled	17/12/15	17/12/15	17/12/15	17/12/15	17/12/15
Opus International	Time Sampled	None Supplied				
Site Reference: Allens Centre, Willenhall	TP / BH No	TP1	TP2	TP3	TP4	TP5
Project / Job Ref: J-B0984.00	Additional Refs	MG	MG	MG	MG	MG
Order No: BI 21045	Depth (m)	0.40	0.20	0.10	0.70	0.70
Reporting Date: 05/01/2016	QTSE Sample No	184146	184147	184148	184149	184150

Determinend	11		A source distant is up					
Determinand	Unit	KL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	
Sample Matrix	Material Type	N/a	NONE					
Asbestos Type	PLM Result	N/a	ISO17025					
pH	pH Units	N/a	MCERTS	7.0	5.9	5.9	7.7	
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	
Total Sulphate as SO <sub>4</sub>	mg/kg	< 200	NONE					
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE					
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS	44	13	< 10	< 10	
W/S Sulphate as SO <sub>4</sub> (2:1)	g/l	< 0.01	MCERTS	0.04	0.01	< 0.01	< 0.01	
Total Sulphur	%	< 0.02	NONE					
Sulphide	mg/kg	< 5	NONE	5	< 5	10	< 5	
Organic Matter	%	< 0.1	MCERTS	5.4			0.7	0.1
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE					
Ammonium as NH <sub>4</sub>	ma/l	< 0.05	NONE					
W/S Chloride (2:1)	ma/ka	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS	9	6	8	6	
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	0.2	0.6	< 0.2	
Chromium (Cr)	mg/kg	< 2	MCERTS	18	23	71	13	
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	
Copper (Cu)	mg/kg	< 4	MCERTS	48	46	82	20	
Lead (Pb)	mg/kg	< 3	MCERTS	50	48	74	19	
W/S Magnesium	mg/l	< 0.1	NONE					
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	
Nickel (Ni)	mg/kg	< 3	MCERTS	13	10	16	11	
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	
Zinc (Zn)	mg/kg	< 3	MCERTS	146	121	231	55	
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than  $30^{\circ}C$ 

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

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

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Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Marcus Jones

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT'' with type(s).





Soil Analysis Certificate						
QTS Environmental Report No: 15-39034	Date Sampled	17/12/15	17/12/15	18/12/15	18/12/15	18/12/15
Opus International	Time Sampled	None Supplied				
Site Reference: Allens Centre, Willenhall	TP / BH No	TP7	TP8	WS2	WS3	WS4
Project / Job Ref: J-B0984.00	Additional Refs	MG	MG	MG	MG	MG
Order No: BI 21045	Depth (m)	0.80	0.50	0.20	0.75	0.45
Reporting Date: 05/01/2016	QTSE Sample No	184151	184152	184153	184154	184155

Determinand	Unit	RI	Accreditation					
Asbestos Screen	N/a	N/a	IS017025	Not Detected				
Sample Matrix	Material Type	N/a	NONE	Hot Detected	Not Detected	Hot Detected	Not Detected	Hot Detected
Asbestos Type	PLM Result	N/a	IS017025					
pH	pH Units	N/a	MCERTS	7.2	8.3	7.8	7.6	8.6
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO <sub>4</sub>	mg/kg	< 200	NONE					
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE					
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS	671	215	20	85	85
W/S Sulphate as SO <sub>4</sub> (2:1)	g/l	< 0.01	MCERTS	0.67	0.22	0.02	0.09	0.08
Total Sulphur	%	< 0.02	NONE					
Sulphide	mg/kg	< 5	NONE	< 5	< 5	6	5	< 5
Organic Matter	%	< 0.1	MCERTS	2.5			4.7	
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE					
Ammonium as NH <sub>4</sub>	mg/l	< 0.05	NONE					
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS	11	11	14	12	5
W/S Boron	mg/kg	< 1	NONE	1.2	< 1	1.2	1.6	< 1
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.4	1.4	0.5	1	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	19	30	16	80	15
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	63	59	103	169	13
Lead (Pb)	mg/kg	< 3	MCERTS	242	170	105	153	39
W/S Magnesium	mg/l	< 0.1	NONE					
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	17	59	24	24	8
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	376	919	332	550	46
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2

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

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

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

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Asbestos Analyst: Marcus Jones

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres -  $\mathsf{PT}''$  with type(s).





Soil Analysis Certificate						
QTS Environmental Report No: 15-39034	Date Sampled	18/12/15	17/12/15	17/12/15	17/12/15	18/12/15
Opus International	Time Sampled	None Supplied				
Site Reference: Allens Centre, Willenhall	TP / BH No	WS6	TP1	TP4	TP5	WS5
Project / Job Ref: J-B0984.00	Additional Refs	MG	MG	MG	MG	MG
Order No: BI 21045	Depth (m)	0.60	1.30	2.90	1.40	1.60
Reporting Date: 05/01/2016	QTSE Sample No	184156	184157	184158	184159	184160

Determinand	Unit	DI	Accreditation					
Ashestos Screen	N/a		TSO17025	Dotoctod				
Sample Matrix	Material Type	N/a	NONE	Loose fibres				
Asbestos Type	PI M Result	N/a	IS017025	Chrysotile				
pH	pH Units	N/a	MCERTS	8.0	7.3	6.9	7.0	5.6
Total Cvanide	ma/ka	< 2	NONE	< 2				
Total Sulphate as SO <sub>4</sub>	ma/ka	< 200	NONE		666	342	< 200	< 200
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE		0.07	0.03	< 0.02	< 0.02
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS	66	21	41	39	60
W/S Sulphate as SO <sub>4</sub> (2:1)	g/l	< 0.01	MCERTS	0.07	0.02	0.04	0.04	0.06
Total Sulphur	%	< 0.02	NONE		0.04	0.07	< 0.02	< 0.02
Sulphide	mg/kg	< 5	NONE	< 5				
Organic Matter	%	< 0.1	MCERTS	0.2				
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE		1.7	24.4	8	6.9
Ammonium as NH <sub>4</sub>	mg/l	< 0.05	NONE		0.17	2.44	0.81	0.69
W/S Chloride (2:1)	mg/kg	< 1	MCERTS		9	5	8	13
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS		4.5	2.3	4	6.6
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS		15	< 3	19	3
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS		7.4	< 1.5	9.7	1.6
Arsenic (As)	mg/kg	< 2	MCERTS	10				
W/S Boron	mg/kg	< 1	NONE	< 1				
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.5				
Chromium (Cr)	mg/kg	< 2	MCERTS	17				
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2				
Copper (Cu)	mg/kg	< 4	MCERTS	35				
Lead (Pb)	mg/kg	< 3	MCERTS	406				
W/S Magnesium	mg/l	< 0.1	NONE		2	2.3	3.3	3.2
Mercury (Hg)	mg/kg	< 1	NONE	< 1				
Nickel (Ni)	mg/kg	< 3	MCERTS	9				
Selenium (Se)	mg/kg	< 3	NONE	< 3				
Zinc (Zn)	mg/kg	< 3	MCERTS	218				
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than  $30^{\circ}C$ 

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

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Asbestos Analyst: Marcus Jones

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres -  $\mathsf{PT}''$  with type(s).





Soil Analysis Certificate						
QTS Environmental Report No: 15-39034	Date Sampled	17/12/15	17/12/15	17/12/15	17/12/15	17/12/15
Opus International	Time Sampled	None Supplied				
Site Reference: Allens Centre, Willenhall	TP / BH No	TP2	TP3	TP4	TP6	TP8
Project / Job Ref: J-B0984.00	Additional Refs	CLAY	CLAY	MG	CLAY	MG
Order No: BI 21045	Depth (m)	1.50	1.00	2.40	3.00	1.70
Reporting Date: 05/01/2016	QTSE Sample No	184161	184162	184163	184164	184165

Determinand	Unit	RI	Accreditation					
Ashestos Screen	N/a	N/a	IS017025					
Sample Matrix	Material Type	N/a	NONE					
Asbestos Type	PLM Result	N/a	IS017025					
Hq	pH Units	N/a	MCERTS	5.8	6.8	6.6	7.5	7.6
Total Cvanide	ma/ka	< 2	NONE					
Total Sulphate as SO <sub>4</sub>	ma/ka	< 200	NONE					
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE					
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS	14	< 10	24	18	45
W/S Sulphate as SO <sub>4</sub> (2:1)	g/l	< 0.01	MCERTS	0.01	< 0.01	0.02	0.02	0.04
Total Sulphur	%	< 0.02	NONE					
Sulphide	mg/kg	< 5	NONE					
Organic Matter	%	< 0.1	MCERTS					
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE					
Ammonium as NH <sub>4</sub>	mg/l	< 0.05	NONE					
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS					
W/S Boron	mg/kg	< 1	NONE					
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS					
W/S Magnesium	mg/l	< 0.1	NONE					
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					
Total Phenols (monohydric)	mg/kg	< 2	NONE					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than  $30^\circ C$ 

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

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Asbestos Analyst: Marcus Jones

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).





Soil Analysis Certificate						
QTS Environmental Report No: 15-39034	Date Sampled	18/12/15	18/12/15	18/12/15	18/12/15	18/12/15
Opus International	Time Sampled	None Supplied				
Site Reference: Allens Centre, Willenhall	TP / BH No	WS3	WS4	WS5	WS6	WS7
Project / Job Ref: J-B0984.00	Additional Refs	CLAY	SAND	CLAY	CLAY	CLAY
Order No: BI 21045	Depth (m)	3.70	3.30	2.50	1.70	1.70
Reporting Date: 05/01/2016	QTSE Sample No	184166	184167	184168	184169	184170

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	IS017025					
Sample Matrix	Material Type	N/a	NONE					
Asbestos Type	PLM Result	N/a	ISO17025					
pH	pH Units	N/a	MCERTS	7.4	7.4	7.3	7.5	7.4
Total Cyanide	mg/kg	< 2	NONE					
Total Sulphate as SO <sub>4</sub>	mg/kg	< 200	NONE					
Total Sulphate as SO <sub>4</sub>	%	< 0.02	NONE					
W/S Sulphate as SO <sub>4</sub> (2:1)	mg/l	< 10	MCERTS	57	20	64	60	54
W/S Sulphate as SO <sub>4</sub> (2:1)	g/l	< 0.01	MCERTS	0.06	0.02	0.06	0.06	0.05
Total Sulphur	%	< 0.02	NONE					
Sulphide	mg/kg	< 5	NONE					
Organic Matter	%	< 0.1	MCERTS					
Ammonium as NH <sub>4</sub>	mg/kg	< 0.5	NONE					
Ammonium as NH <sub>4</sub>	mg/l	< 0.05	NONE					
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/kg	< 3	MCERTS					
Water Soluble Nitrate (2:1) as NO <sub>3</sub>	mg/l	< 1.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS					
W/S Boron	mg/kg	< 1	NONE					
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS					
W/S Magnesium	mg/l	< 0.1	NONE					
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					
Total Phenols (monohydric)	mg/kg	< 2	NONE					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than  $30^\circ C$ 

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

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Asbestos Analyst: Marcus Jones

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).





Soil Analysis Certificate	e - Speciated PAHs							
QTS Environmental Report	rt No: 15-39034		Date Sampled	17/12/15	17/12/15	17/12/15	17/12/15	17/12/15
Opus International			Time Sampled	None Supplied				
Site Reference: Allens Ce	entre, Willenhall		TP / BH No	TP1	TP2	TP3	TP4	TP7
Project / Job Ref: J-B098	34.00		Additional Refs	MG	MG	MG	MG	MG
Order No: BI 21045			Depth (m)	0.40	0.20	0.10	0.70	0.80
Reporting Date: 05/01/2	2016	Q.	<b>TSE Sample No</b>	184146	184147	184148	184149	184151
Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.44
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.14
Fluoranthene	mg/kg	< 0.1	MCERTS	0.18	< 0.1	< 0.1	< 0.1	0.58
Pyrene	mg/kg	< 0.1	MCERTS	0.15	< 0.1	< 0.1	< 0.1	0.50
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.35
Chrysene	mg/kg	< 0.1	MCERTS	0.14	< 0.1	< 0.1	< 0.1	0.31
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.22	< 0.1	< 0.1	< 0.1	0.41
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.14
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	0.24
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	0.18
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.21
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	3.5

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





Soil Analysis Certificate	- Speciated PAHs							
QTS Environmental Report	t No: 15-39034		Date Sampled	17/12/15	18/12/15	18/12/15	18/12/15	18/12/15
Opus International		Time Sampled		None Supplied				
Site Reference: Allens Ce	ntre, Willenhall	TP / BH No		TP8	WS2	WS3	WS4	WS6
Project / Job Ref: J-B098	34.00		Additional Refs	MG	MG	MG	MG	MG
Order No: BI 21045			Depth (m)	0.50	0.20	0.75	0.45	0.60
Reporting Date: 05/01/2	2016	Q	TSE Sample No	184152	184153	184154	184155	184156
Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	1.99	0.21	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	0.37	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	1.54	0.81	0.15	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	1.15	0.74	0.12	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.49	0.52	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	0.42	0.48	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.45	0.84	0.16	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.19	0.24	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.35	0.61	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.25	0.52	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.20	0.45	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	7.6	5.4	< 1.6	< 1.6	< 1.6

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than  $30^{\circ}$ C





Bulk Analysis Certificate									
QTS Environmental Report No: 15-39034	Date Sampled	18/12/15							
Opus International	Time Sampled	None Supplied							
Site Reference: Allens Centre, Willenhall	TP / BH No	WS6							
Project / Job Ref: J-B0984.00	Additional Refs	MG							
Order No: BI 21045	Depth (m)	0.60							
Reporting Date: 05/01/2016	QTSE Sample No	184672							

Determinand	Unit	RL	Accreditation			
Asbestos Type	PLM Result	N/a	ISO17025	Chrysotile		
Sample Matrix	Material Type	N/a	NONE	Cement type		
Sumple Matrix			NONE	material		

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification) that is in accordance with the Health and Safety Executive HSG 248 Appendix 2.

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Graham Revell

RL: Reporting Limit





Soil Analysis Certificate - Sample Descriptions							
QTS Environmental Report No: 15-39034							
Opus International							
Site Reference: Allens Centre, Willenhall							
Project / Job Ref: J-B0984.00							
Order No: BI 21045							
Reporting Date: 05/01/2016							

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
184146	TP1	MG	0.40	16.8	Black sandy loam with vegetation
184147	TP2	MG	0.20	18.5	Brown sandy clay with vegetation
184148	TP3	MG	0.10	24.6	Brown sandy clay with vegetation
184149	TP4	MG	0.70	10.1	Brown sandy clay with stones and stones
184150	TP5	MG	0.70	7.4	Light grey sandy clay
184151	TP7	MG	0.80	15.1	Brown sandy clay with brick and vegetation
184152	TP8	MG	0.50	13.1	Grey sandy clay with brick and concrete
184153	WS2	MG	0.20	18.8	Black sandy clay with vegetation
184154	WS3	MG	0.75	13.2	Brown sandy clay with stones and vegetation
184155	WS4	MG	0.45	11.6	Light brown sandy clay with rubble
184156	WS6	MG	0.60	22.2	Black sandy clay with chalk
184157	TP1	MG	1.30	21.4	Black sandy clay
184158	TP4	MG	2.90	14.5	Brown sandy loam
184159	TP5	MG	1.40	11.8	Light brown sandy clay
184160	WS5	MG	1.60	9.9	Grey sandy clay with stones
184161	TP2	CLAY	1.50	11.9	Light grey sandy clay
184162	TP3	CLAY	1.00	11.7	Light grey sandy clay
184163	TP4	MG	2.40	12.9	Brown sandy clay with stones
184164	TP6	CLAY	3.00	18.1	Light brown sandy clay
184165	TP8	MG	1.70	12.9	Brown sandy clay
184166	WS3	CLAY	3.70	11.1	Brown sandy clay with stones
184167	WS4	SAND	3.30	15.8	Light brown sandy clay
184168	WS5	CLAY	2.50	11.4	Light grey sandy clay with stones
184169	WS6	CLAY	1.70	13.2	Brown sandy clay with stones
184170	WS7	CLAY	1.70	11.1	Light brown sandy clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample <sup>I/S</sup> Unsuitable Sample <sup>U/S</sup>





Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 15-39034
Opus International
Site Reference: Allens Centre, Willenhall
Project / Job Ref: J-B0984.00
Order No: BI 21045
Reporting Date: 05/01/2016

Matrix	Analysed	Determinand	Brief Method Description				
Call	Un	Dawara Wataw Calubla					
Soli		BOFOII - Water Soluble	Determination of water soluble boron in soil by 2:1 not water extract followed by ICP-DES	E012			
Soli	AR	BIEX	Determination of BTEX by headspace GC-MS	E001			
Soli	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002			
SOII	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009			
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016			
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015			
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015			
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015			
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011			
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004			
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022			
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023			
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020			
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004			
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-EID	F004			
	7.0.5	EPH TEXAS (C6-C8, C8-C10, C10-C12,	Determination of actione/hexane extractable hydrocarbons by GC-EID for C8 to C40. C6 to C8 by	2001			
Soil	AR		hadshare GC-MS	E004			
Soil	D	Eluoride - Water Soluble	Determination of Eluoride by extraction with water & analysed by ion chromatography	F009			
5011	D		Determination of fraction of organic carbon by oxidising with potassium dictromate followed by	LUUJ			
Soil	D	FOC (Fraction Organic Carbon)	titration with iron (II) sulphate	E010			
Soil	D	Loss on Ignition @ 450oC	furnace	E019			
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025			
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002			
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004			
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003			
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009			
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010			
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005			
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008			
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011			
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007			
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021			
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009			
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013			
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009			
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014			
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018			
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with agua-regia followed by ICP-OES	E024			
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006			
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017			
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011			
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with	E010			
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Iron (11) suipnate Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004			
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004			
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001			
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001			

D Dried

**AR As Received** 

## **APPENDIX C Geotechnical Analysis Results**



GEOLABS Limited Unit D3 HRS Business Park Granby Avenue Birmingham B33 0SJ

Tel: +44(0) 121 296 4600 Fax: +44(0) 121 296 4599 email: admin@geolabs.co.uk web: www.geolabs.co.uk

> 15 January 2016 Page 1 of 1 Issue No : 01

Opus International Consultants (UK) Ltd 3800 Parkside Birmingham Business Park B37 7YG

For the attention of Ben Murphy

Dear Sirs

 Our ref
 GEO / 23527

 Your Ref
 J-B0984.00

#### Project ALLENS CENTRE, WILLENHALL

Further to your instructions we have pleasure in enclosing the results of the tests you requested in the attached figures.

Item No	Test Quantity	Description
1 2	~ 8	Liquid & Plastic Limits & Water Content Summary Liquid & Plastic Limits

Any opinions or interpretations expressed herein are outside the scope of UKAS accreditation.

All the necessary data required by the documented test procedures has been recorded and will be stored for a period of no less than 6 years. This data will be issued to yourselves at your request. All samples will be disposed of after a period of 28 days from the date of this report. Written confirmation will be required to retain the samples beyond this period and a storage charge may be applied.

We trust that the above meets your requirements and should you require any further information or assistance, please do not hesitate to contact us.

Yours faithfully on behalf of **GEOLABS Limited** 

J A Reynolds Laboratory Manager



"Geolabs" and the Geolabs logo are registered trademarks in the name of Geolabs Limited Registered Office: Bucknalls Lane Garston Watford Hertfordshire WD25 9XX Registered in England and Wales No: 3177641 1115 - PI Summary - 23527.XLSM

# BS1377:Part 2:1990 SUMMARY OF LIQUID AND PLASTIC LIMIT TESTS

- 23													
1115 - PI Summary	Borehole / Trial Pit	Depth m	Sample Ref	Sample Type	Description	% Water Content S EN ISO 17892-1 : 2014	% Liquid Limit	% Plastic Limit	Plasticity Index	% Percentage Passing 425µm	Atterberg Classification	Test Type	Sample Condition
	TP1	1.65		D	Soft brown mottled grey very sandy CLAY with some gravel. Gravel is fine to medium.	16.4	26.0	12.0	14	76	CL	2	3
	TP3	2.00		D	Very soft brown sandy CLAY with much gravel. Gravel is fine to coarse.	14.3	21.0	11.0	10	64	CL	2	3
	TP6	2.40		D	Soft brown slightly sandy silty CLAY.	22.6	53.0	24.0	29	100	СН	2	1
	TP7	1.40		D	Soft brown mottled grey sandy CLAY with some gravel. Gravel is fine to medium.	15.0	28.0	13.0	15	87	CL	2	3
	TP8	3.00		D	Soft brown slightly sandy silty CLAY with some gravel. Gravel is fine to medium.	13.7	23.0	14.0	9	87	CL	2	3
	WS1	2.50		D	Firm dark brown mottled grey sandy silty CLAY with some gravel. Gravel is fine to medium.	15.2	29.0	15.0	14	83	CL	2	3
	WS3	1.70		D	Soft brown mottled grey sandy CLAY with some gravel. Gravel is fine to coarse.	11.7	27.0	12.0	15	73	CL	2	3
	WS4	1.50		D	Soft brown mottled grey sandy silty CLAY with some gravel. Gravel is fine to medium.	18.1	28.0	13.0	15	94	CL	2	3
	Test Type:				Sam	ole conditio	n:						
/2015	1 - 1 point cone 2 - 4 point cone 3 - Non plastic o	penetrometer cla penetrometer cla determination	ause 4.4 ause 4.3		1 - As 2 - Ai 3 - W	s Received r Dried ashed & Ai	r Dried						
1.49 - 30/11	Checked and Approved by: Project Number:		GEO / 23	527					GEOLABS)°				
3L:Version	JA Reynolds - Laboratory Manager			Name:	ALLENS CENTRE, J-B0984	, WILLENHALL							
Ċ	0 15/01/2016 J-DU304.UU								IL				

 Test Report By GEOLABS Limited
 Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33 0SJ

 Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



 Test Report By GEOLABS Limited
 Unit D3 HRS Business Park, Granby Avenue, Birmingham, B

 Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



 Test Report By GEOLABS Limited
 Unit D3 HRS Business Park, Granby Avenue, Birmingham, B

 Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



Test Report By GEOLABS Limited Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33 0SJ Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



 Test Report By GEOLABS Limited
 Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33

 Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



 Test Report By GEOLABS Limited
 Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33

 Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



Test Report By GEOLABS Limited Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33 0SJ Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



Test Report By GEOLABS Limited Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33 0SJ Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park



 Test Report By
 GEOLABS Limited
 Unit D3 HRS Business Park, Granby Avenue, Birmingham, B33 0SJ

 Client : Opus International Consultants (UK) Ltd, 3800 Parkside, Birmingham Business Park
 Description

## **APPENDIX D Gas/Groundwater Monitoring Results**


### CLIENT: Walsall Council

# SITE: Former Allens Centre, Hilton Road, Willenhall DATE: 24/12/2015

JOB NO: J-B0984.00 VISIT NO: 1 of 6

Barometric Pressure (mb) Start 1000 Finish 999 Trend <u>Falling</u>

<u>))</u>	Ambien	t Concentration (% Vol)
	$CH_4$	ND
	CO <sub>2</sub>	ND
	O <sub>2</sub>	20.3

			Peak				S	teady Sta	te		Lowest	Steady	Flow	Groundwater	
Monitoring	C	H <sub>4</sub>	CO <sub>2</sub>	CO	$H_2S$	C	H <sub>4</sub>	CO <sub>2</sub>	CO	$H_2S$	O <sub>2</sub>	O <sub>2</sub>	Rate	Level	Notes
Point	% lel	% v/v	% v/v	ppm	ppm	% lel	% v/v	% v/v	ppm	ppm	% v/v	% v/v	l/hr	m (bgl)	
WS1	ND	ND	0.3	ND	ND	ND	ND	0.3	ND	ND	19.7	19.7	ND	0.46	
WS3	ND	ND	5.2	1	ND	ND	ND	5.2	1	ND	14.8	14.8	ND	1.16	
WS4	ND	ND	0.1	ND	ND	ND	ND	0.1	ND	ND	20.2	20.2	2.8	0.97	
WS5	ND	ND	7.9	ND	ND	ND	ND	7.9	ND	ND	10.5	10.5	ND	1.48	
					-										
					-										
-					-						-				
-															

Monitoring Equipment	GFM 436 Gas Analyser	Weather Conditions	Wet/Cool/Still	
Operator	JAD	Surface Conditions	Wet	

NGW	indicates no ground water encountered		Text shown in Bold & Ital	ic indicates either:		
*	indicates that no measurement was taken		a) Carbon Dioxide equal t	o or above 5%		
ND	indicates no gas detected		by Volume			
NR	indicates not recorded		or			
			b) Methane equal to or above 1% by Volume			
		Checked:	SMD	Approved:	SMD	



### CLIENT: Walsall Council

# SITE: Former Allens Centre, Hilton Road, Willenhall DATE: 07/12/2015

JOB NO: J-B0984.00 VISIT NO: 2 of 6

Barometric Pressure (mb) Start 970 Finish 970 Trend Steady

			Peak				S	teady Sta	te		Lowest	Steady	Flow	Groundwater	
Monitoring	CI	H <sub>4</sub>	CO <sub>2</sub>	CO	$H_2S$	C	H <sub>4</sub>	CO <sub>2</sub>	CO	$H_2S$	O <sub>2</sub>	O <sub>2</sub>	Rate	Level	Notes
Point	% lel	% v/v	% v/v	ppm	ppm	% lel	% v/v	% v/v	ppm	ppm	% v/v	% v/v	l/hr	m (bgl)	
WS1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.1	20.1	ND	0.28	
WS3	ND	ND	0.2	ND	ND	ND	ND	0.2	ND	ND	20.2	20.2	ND	0.60	
WS4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.3	20.3	ND	1.01	
WS5	ND	ND	10.2	ND	ND	ND	ND	10.2	ND	ND	4.9	4.9	0.3	1.21	15.6L/HR MAX FLOW

Ambient Concentration (% Vol)

ND

ND

20.5

 $CH_4$ 

 $\rm CO_2$ 

O<sub>2</sub>

 Monitoring Equipment
 GFM 436 Gas Analyser
 Weather Conditions
 Dry/Cool/Still

 Operator
 JAD
 Surface Conditions
 Wet

NGW	indicates no ground water encountered		Text shown in Bold & Itali	c indicates either:	
*	indicates that no measurement was taken		a) Carbon Dioxide equal t	o or above 5%	
ND	indicates no gas detected		by Volume		
NR	indicates not recorded		or		
			b) Methane equal to or ab	ove 1% by Volume	
		Checked:	SMD	Approved:	SMD



### CLIENT: Walsall Council

## SITE: Former Allens Centre, Hilton Road, Willenhall

DATE: 19/01/2016

JOB NO: J-B0984.00 VISIT NO: 3 of 6

Barometric Pressure (mb) Start 990 Finish 990 Trend Rising

	[			Peak				S	teady Sta	te		Lowest	Steady	Flow	Groundwater	
Point         % iel         % v/v         ppm         ppm         % v/v         % v	Monitoring	С	H <sub>4</sub>	CO <sub>2</sub>	CO	$H_2S$	С	H <sub>4</sub>	CO <sub>2</sub>	CO	$H_2S$	O <sub>2</sub>	O <sub>2</sub>	Rate	Level	Notes
WS1         ND         0.23           WS3         ·	Point	% lel	% v/v	% v/v	ppm	ppm	% lel	% v/v	% v/v	ppm	ppm	% v/v	% v/v	l/hr	m (bgl)	
WS3     ·<	WS1	ND	ND	6.8	ND	ND	ND	ND	6.8	ND	ND	10.3	10.3	ND	0.23	
WS3     ·<																
WS4     ND     ND     ND     ND     ND     ND     ND     0.6     ND     ND     18.9     18.9     ND     1.02       WS4     ND     ND     ND     ND     ND     ND     0.6     ND     ND     18.9     18.9     ND     1.02       WS5     ND     ND     ND     ZO     ND     ND     ND     ND     ND     ND     ND     ND     11.3     11.3     11.3       WS5     ND     ND     ND     ND     ND     ND     ZO     ND     ND     11.3     11.3     11.3       WS5     ND     ND     ND     ND     ND     ND     ND     ZO     ND     ND     11.3     11.3     11.3       WS5     ND       WS5     ND       U     I     I     I     I     I     I     I     I     I     I     I     I       I     I     <	WS3	*	*	*	*	*	*	*	*	*	*	*	*	ND	0.15	Water coming up pipe
WS4         ND         1.02           WS5         ND         11.3         11.3         ND         1.13           WS5         ND         ND         ND         ND         ND         ND         ND         ND         11.3         11.3         ND         1.13           WS5         ND         ND         ND         ND         ND         ND         ND         11.3         11.3         ND         1.13           WS5         ND																
WS5     ND     ND    <	WS4	ND	ND	0.6	ND	ND	ND	ND	0.6	ND	ND	18.9	18.9	ND	1.02	
WS5         ND         ND         ND         ND         ND         ND         ND         ND         ND         11.3         11.3         ND         1.13           Image: Constraint of the system         Image: Constrainted of the system																
Image: Section of the section of t	WS5	ND	ND	7.0	ND	ND	ND	ND	7.0	ND	ND	11.3	11.3	ND	1.13	
Image: Constraint of the second state of the seco																
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Image: Second																
Image: Second																
$ \begin{tabular}{cccccccccccccccccccccccccccccccccccc$																

Ambient Concentration (% Vol)

ND

0.1

20.6

 $CH_4$ 

 $\rm CO_2$ 

O<sub>2</sub>

 Monitoring Equipment
 GFM 436 Gas Analyser
 Weather Conditions
 Slightly Cloudy / Cool / Still

 Operator
 CC
 Surface Conditions
 Frost

NGW	indicates no ground water encountered		Toxt chown in I	old & Italia indicatos aitha	
NGW	indicates no ground water encountered		TEXT SHOWIT III L	bold & hanc mulcales enne	•
*	indicates that no measurement was taken		a) Carbon Dioxi	de equal to or above 5%	
ND	indicates no gas detected		by Volume		
NR	indicates not recorded		or		
			b) Methane equ	al to or above 1% by Volum	e
		Checked:	SMD	Approved:	SM



### CLIENT: Walsall Council

# SITE: Former Allens Centre, Hilton Road, Willenhall

DATE: 29/01/2016

JOB NO: J-B0984.00 VISIT NO: 4 of 6

Barometric Pressure (mb) Start 993 Finish 993 Trend Steady

		Trend		Steady					O <sub>2</sub>		20.5				
			Peak				S	teady Sta	te		Lowest	Steady	Flow	Groundwater	
Monitoring	С	H <sub>4</sub>	CO <sub>2</sub>	CO	H <sub>2</sub> S	С	H <sub>4</sub>	CO <sub>2</sub>	CO	H <sub>2</sub> S	O <sub>2</sub>	O <sub>2</sub>	Rate	Level	Notes
Point	% lel	% v/v	% v/v	ppm	ppm	% lel	% v/v	% v/v	ppm	ppm	% v/v	% v/v	l/hr	m (bgl)	
WS1	ND	ND	4.8	1	ND	ND	ND	0.4	1	ND	15.2	19.8	ND	0.34	
WS3	ND	ND	2.8	1	ND	ND	ND	2.8	1	ND	16.2	16.2	ND	0.20	
WS4	ND	ND	0.6	1	ND	ND	ND	0.6	1	ND	18.4	18.4	ND	1.06	
WS5	ND	ND	0.1	1	ND	ND	ND	0.1	1	ND	20.2	20.2	ND	1.20	
						-									
						-									
	-					-					-				
						-									
						-									

Ambient Concentration (% Vol)

ND

ND

 $CH_4$ 

 $\rm CO_2$ 

 Monitoring Equipment
 GFM 436 Gas Analyser
 Weather Conditions
 Cloudy, Windy, Dry

 Operator
 BM
 Surface Conditions
 Damp

NGW	indicates no ground water encountered		Text shown in B	old & Italic indicates either.	:
*	indicates that no measurement was taken		a) Carbon Dioxid	de equal to or above 5%	
ND	indicates no gas detected		by Volume		
NR	indicates not recorded		or		
			b) Methane equa	al to or above 1% by Volume	9
		Checked:	SMD	Approved:	SMD
		R			



### CLIENT: Walsall Council

# SITE: Former Allens Centre, Hilton Road, Willenhall DATE: 08/02/2016

JOB NO: J-B0984.00 VISIT NO: 5 of 6

Barometric Pressure (mb) Start 961 Finish 961 Trend Steady

	Ambient	Concentration (% Vol)
	CH <sub>4</sub>	ND
	CO <sub>2</sub>	ND
	O <sub>2</sub>	20.3

	Peak					S	teady Sta	te		Lowest	Steady	Flow	Groundwater		
Monitoring	CI	H <sub>4</sub>	CO <sub>2</sub>	CO	H <sub>2</sub> S	C	H <sub>4</sub>	CO <sub>2</sub>	CO	H <sub>2</sub> S	O <sub>2</sub>	O <sub>2</sub>	Rate	Level	Notes
Point	% lel	% v/v	% v/v	ppm	ppm	% lel	% v/v	% v/v	ppm	ppm	% v/v	% v/v	l/hr	m (bgl)	
WS1	ND	ND	5.1	1	ND	ND	ND	5.1	1	ND	13.5	13.5	17.1	0.10	
WS3	*	*	*	*	*	*	*	*	*	*	*	*	*	Above pipe	GW level above pipe
WS4	ND	ND	1.6	ND	ND	ND	ND	1.6	ND	ND	19.3	18.3	7.3	1.04	
WS5	ND	ND	11.7	1	ND	ND	ND	11.7	1	ND	6.2	6.2	ND	1.00	

Operator BM Surface Conditions Wet	Monitoring Equipment	GFM 436 Gas Analyser	Weather Conditions	Showers, windy, damp
Operator BM Surface Conditions Wet				
	Operator	BM	Surface Conditions	Wet

NGW	indicates no ground water encountered		Text shown in Bold & Italic indicates either:							
*	indicates that no measurement was taken	a) Carbon Dioxide equal to or above 5%								
ND	indicates no gas detected	by Volume								
NR	indicates not recorded		or							
			b) Methane equal to or above 1% by Volume							
		Checked:	SMD	Approved:	SMD					

# **APPENDIX E Human Health Assessment Criteria**

Client/client ref Project ref	Walsall Council J-B0984.00	
Site ref	Former Allens Centre, Hilton Road, Willenhall	
Data description	Made Ground	soil & groundwater
Contaminant(s)	Metals & Cyanide	
Test scenario	Planning: is true mean lower than critical concentration ( $\mu$ < Cc)?	
Date		
User details		N
Statistics calculat	or (version 1)	Input data

This spreadsheet has been produced based on the document 'Guidance on Comparing Soil Contamination Data with a Critical Concentration (CIEH/CL:AIRE, 2008)'. Users of this spreadsheet should always refer to this guidance, the User Manual and to relevant guidance on UK legislation and policy, in order to understand how the procedure should be applied in an appropriate context.

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Go to	summ	ary	Data sheet Project of											
Easting Northing		Sample ID	Arsenic (As)	W/S Boron	Cadmium (Cd)	Hexavalent Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Zinc (Zn)	Cyanide	
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mglkg	
		TP1/0.4	9	<1	0.3	<2	48	50	<1	13	<3	146	<2	
		TP2/0.2	6	<1	0.2	<2	46	48	<1	10	<3	121	<2	
		TP3/0.1	8	<1	0.6	<2	82	74	<1	16	<3	231	<2	
		TP4/0.7	6	<1	<0.2	<2	20	19	<1	11	<3	55	<2	
		TP7/0.8	11	1.2	0.4	<2	63	242	<1	17	<3	376	<2	
		TP8/0.5	11	<1	1.4	<2	59	170	<1	59	<3	919	<2	
		WS2/0.2	14	1.2	0.5	<2	103	105	<1	24	<3	332	<2	
		WS3/0.7 5	12	1.6	1	<2	169	153	<1	24	<3	550	<2	
		WS4/0.4 5	5	<1	<0.2	<2	13	39	<1	8	<3	46	<2	
		WS6/0.6	10	<1	0.5	<2	35	406	<1	9	<3	218	<2	

Client/client ref: Walsall Council Project ref: J-80984.00 Site ref: Former Allens Centre, Hilton Road, Willenhall Data description: Made Ground Contaminant(s): Metals & Cyanide Test scenario: Planning Date: 0 January 1900 User details:	Arsenic (As) W/S Boron Cadmium (Cd) (mg/kg) (mg/kg) (mg/kg)		Hexavalent Chromium (Cr) (mg/kg)	Copper (Cu) Lead (Pb) (mg/kg) (mg/kg)		Lead (Pb) Mercury (Hg) (mg/kg) (mg/kg)		Selenium (Se) Zinc (Zn) (mg/kg) (mg/kg)		Cyanide (mglkg)	
Critical concentration, C <sub>c</sub>	37	59	26	21	8340	200	170	130	350	38000	50
Notes	C4SL	Opus IHSV (Residential with homegrown produce)	C4SL	C4SL	Opus IHSV (Residential with homegrown produce)	C4SL	SGV	LQM/CIEH S4UL	SGV	Opus IHSV (Residential with homegrown produce)	Opus IHSV (Residential with homegrown produce)
Sample size, n	10	10	10	10	10	10	10	10	10	10	10
Sample mean, $\overline{X}$	9.2	0.75	0.51	1	63.8	130.6	0.5	19.1	1.5	299.4	1
Standard deviation, s	2.93636207	0.41699987	0.4121758	0	45.7694707	119.411706	0	15.1470569 0		267.548625	0
Number of non-detects	0	0 7		10	0	0	10	0	10	0	10
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit Half detection limit		Half detection limit Half detection limit		Half detection limit Half detection limit	
Outliers?	No	No	No	No	Yes	Yes	No	Yes	No	Yes	No
Distribution	Normal	Non-normal	Normal	Single value	Normal	Normal	Single value	Non-normal Single value		Normal	Single value
Statistical approach	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: One-sample t Auto: Chebychev		Auto: One-sample t	t Auto: Chebychev Auto: Chebyche		Auto: Chebychev	Auto: One-sample t	Auto: Chebychev
Test scenario:	Planning: is true me	an lower than critica	l concentration (µ < )	Cc)? 🗸	Evidence	e level required:	95%	Use Normal distribu	ers 💌		
t statistic, t <sub>0</sub> (or k <sub>0</sub> )	-29.93885521	-441.7331716	-195.5632957	N/A	-571.8143993	-1.837860598	N/A	-23.15278766	N/A	-445.600366	N/A
Upper confidence limit (on true mean concentration, $\mu$ )	10.9021539	1.32479465	0.74893056	1	90.331702	199.820722	0.5	39.9787771	1.5	454.49291	1
Evidence level	100%	100%	100%	100%	100%	95%	100%	100%	100%	100%	100%
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc
Select dataset	ОY	ОY	ОY	ОY	ОY	Э ү	Ôт	ОY	ОY	ОY	ОY
Back to data	Go to	outlier te	st	Go to no	ormality te	st	Show i	ndividual	summary		

Client/client ref Project ref	Walsall Council J-B0984.00	
Site ref	Former Allens Centre, Hilton Road, Willenhall	
Data description	Made Ground	soil & groundwater
Contaminant(s)	PAH & Phenol	
Test scenario	Planning: is true mean lower than critical concentration ( $\mu$ < Cc)?	
Date		
User details		<u> </u>
Statistics calculat	or (version 1)	Input data

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Go to	summ	ary			Da	t a	s h	l e e	t			Project	details						
Easting	Northing	Sample ID	Naphthalene	Acenaphthyl ene	Acenaphthe ne	Fluorene	Phenanthre ne	Anthracene	Fluoranthen e	Pyrene	Benzo(a)ant hracene	Chrysene	Benzo(b)fluor anthene	Benzo(k)fluor anthene	Benzo(a)pyre ne	Indeno(1,2,3- cd)pyrene	Dibenz(a,h)an thracene	Benzo(ghi)per ylene	Phenol
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		TP1/0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.18	0.15	<0.1	0.14	0.22	<0.1	0.13	0.13	<0.1	<0.1	<2
		TP2/0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
		TP3/0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
		TP4/0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
		TP7/0.8	<0.1	<0.1	<0.1	<0.1	0.44	0.14	0.58	0.5	0.35	0.31	0.41	0.14	0.24	0.18	<0.1	0.21	<2
		TP8/0.5	<0.1	<0.1	<0.1	0.16	1.99	0.37	1.54	1.15	0.49	0.42	0.45	0.19	0.35	0.25	<0.1	0.2	<2
		WS2/0.2	<0.1	<0.1	<0.1	<0.1	0.21	<0.1	0.81	0.74	0.52	0.48	0.84	0.24	0.61	0.52	<0.1	0.45	<2
		WS3/0.7 5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.15	0.12	<0.1	<0.1	0.16	<0.1	<0.1	<0.1	<0.1	<0.1	<2
		WS4/0.4 5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
		WS6/0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2

Client/client ref: Walsall Council Project ref: J-B0394.00 Site ref: Former Allens Centre, Hilton Road, Willenhall Data description: Made Ground Contaminant(s): PAH & Phenol Test soenario: Planning Date: 0 Jensor 1900	Naphthalene (mg/kg)	Acenaphthyle ne (mg/kg)	Acenaphthene (mg/kg)	Fluorene (mg/kg)	Phenanthrene (mg/kg)	Anthracene (mg/kg)	Fluoranthene (mg/kg)	Pyrene (mg/kg)	Benzo(a)anthr acene (mg/kg)	Chrysene (mg/kg)	Benzo(b)fluor anthene (mg/kg)	Benzo(k)fluor anthene (mg/kg)	Benzo(a)pyren e (mg/kg)	Indeno(1,2,3- cd)pyrene (mg/kg)	Dibenz(a,h)ant hracene (mg/kg)	Benzo(ghi)per ylene (mg/kg)	Phenol (mg/kg)
Critical concentration	11	420	0.2	2340	220	5860	1630	1150	72	840	0.1	97	5	0.2	0.97	340	320
Notes	Opus IHSV (Residential with homegrown produce 3% SOM)	LQM/CIEH S4UL (Residential with homegrown produce 2.5% SOM)	Opus IHSV (Residential with homegrown produce 3% SOM)	Opus IHSV (Residential with homegrown produce 3% SOM)	LQM/CIEH S4UL (Residential with homegrown produce 2.5% SOM)	Opus IHSV (Residential with homegrown produce 3% SOM)	C4SL adjusted for %SOM (Residential with homegrown produce 3% SOM)	Opus IHSV (Residential with homegrown produce 3% SOM)	Opus IHSV (Residential with homegrown produce 3% SOM)	LQM/CIEH S4UL (Residential with homegrown produce 2.5% SOM)	Opus IHSV (Residential with homegrown produce 3% SOM)						
Sample size, n	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sample mean, $\overline{x}$	0.05	0.05	0.05	0.061	0.299	0.091	0.351	0.291	0.171	0.165	0.233	0.092	0.163	0.138	0.05	0.121	1
Standard deviation, s	7.3142E-18	7.3142E-18	7.3142E-18	0.03478505	0.60748022	0.10202941	0.49435592	0.38336087	0.19946874	0.17167476	0.26242671	0.07161626	0.18809277	0.15156957	7.3142E-18	0.13236733	0
Number of non-detects	10	10	10	9	7	8	5	5	7	6	5	7	6	6	10	7	10
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	Yes	No
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Single value
Statistical approach	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev	Auto: Chebychev
Test scenario:	Planning: is true me	an lower than critic	al concentration (µ <	- Cc)? 🗸 🔻	Evidence	e level required:	95%	Use Normal distribution to test for outliers									
t statistic, t <sub>0</sub> (or k <sub>0</sub> )	-1.8807E+18	-1.81564E+20	-3.95596E+18	-212721.7273	-1143.667789	-181620.7677	-10424.47839	-9483.751171	-111.4342518	-15469.90078	-110.463601	-4279.056149	-81.3212401	-189.0653969	-3.97758E+17	-8119.76593	N/A
Upper confidence limit (on true mean concentration, µ)	0.05	0.05	0.05	0.10894789	1.1363537	0.23163783	1.03242261	0.81942649	0.44594868	0.40163732	0.59473026	0.1907162	0.42226799	0.34692423	0.05	0.30345578	1
Evidence level	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc	μ < Cc
Select dataset	OY	ОY	ΟY	ΟY	ΟY	ΟY	ΟY	ОY	ΟY	ΟY	ОY	ΟY	🔘 Y	ΟY	OY	ΟY	ОY
Back to data	Go to	outlier te	st	Go to no	ormality te	st	Show i	ndividual	summary								