

1A & 1C Eynsham Drive, Abbey Wood

Ground Investigation report - Addendum

Date: September 2018

Consultant: Ground & Water Ltd







GROUND INVESTIGATION REPORT

for the site at

**PDSA VETS AND ARC CAR WASH, EYNHAM DRIVE, ABBEY WOOD, LONDON
SE2 9RD**

on behalf of

ABBAY WOOD PROPERTY LIMITED C/O SHEAR DESIGN LIMITED

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	James Dalziel BSc (Hons) MSc FGS Geotechnical & Geo-Environmental Engineer	Francis Williams MGeol (Hons) FGS CEnv AGS CGeol Director
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1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by Abbey Wood Property Limited c/o Shear Design Limited on the 19th June 2017 to conduct a Ground Investigation on a potential redevelopment site at PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD. The scope of the investigation was detailed within the Ground and Water Limited fee proposal ref: GWQ3136, dated 20th November 2016.

1.2 Aims of the Investigation

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

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

Included within the fee proposal was an allowance to undertake chemical laboratory testing on soil samples recovered from the site to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any potential contamination identified, as detailed in the Conceptual Site Model (CSM) within the Ground and Water Limited Desk Study Report (ref. GWPR2179/DS/September 2017). This Ground Investigation Report must be read in conjunction with the Desk Study Report.

The techniques adopted for the investigation were chosen considering the requirements of the client, anticipated ground conditions, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

1.3 Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

This version supersedes the previous report (GWPR2179/GIR/September 2017) to take into account the revised proposed development.

2.0 SITE SETTING

2.1 Site Location

The site comprised a ~2,250m² triangular shaped plot of land to the south-west of the roundabout junction of Harrow Manor Way, Eynsham Drive and Yarnton Way. The site was located in north-east Abbey Wood, south-east of Thamesmead and east of Woolwich, in east/south-east London.

A site location plan can be seen in Figure 1 with the site development area shown in Figure 2. The approximate O.S. National Grid Reference at the centre of the site was TQ 47263 79568.

2.2 Site Description

A Site Walkover was undertaken on the 27th June 2017. A description of the site, as noted during the Site Walkover, is tabulated below. An aerial view of the site, showing an approximate site boundary, is given within Figure 3.

Site Description Sheet	
Use of site	The site comprised mixed light industrial and commercial use with a Car Wash, PDSA Pet Hospital building and associated parking areas with soft grassed landscaping.
Site topography	The western boundary of the site was slightly sloped to the south and a small embankment was noted along the northern boundary, to the north of the PDSA Pet Hospital building. The remainder of the site was generally flat and level.
Area topography	The area surrounding site was generally flat and level.
Structures on-site	1No. single-storey, rectangular ~5m x 15m metal car wash building, with associated vacuum machines and covered parking area, in eastern half of site. 1No. single-storey brick-built PDSA Pet Hospital, with associated tarmac car park, in the western half of site.
Structures off-site	Caravan park with single-storey, brick, wood and plastic-built static caravans to the south. ~5 – 11 storey brick and concrete-built residential tower blocks to the east and south-east. 2-storey brick-built residential housing to the north and north-west. Part metal and concrete-built 1 – 2 storey Lidl supermarket noted to the west. A row of corrugated metal industrial units, including an MOT garage, were noted to the south-west.
Use of surrounding ground	The area to the north, east and south of site was mostly residential use, with a mixture of commercial and industrial use noted to the west and south-west.
Boundary features	A ~2m high metal security fence was noted along the western boundary. A ~1m high metal fence was noted along the northern boundary. A ~2m high wood panel fence was present across the southern boundary. A ~2m high chain-link fence was present across the east and north-east. A ~2m high metal security fence divided the eastern and western portions of site, running north to south.
Site covering	The site was mostly covered by tarmac access roads and parking areas, with soft landscaping areas along the eastern boundary and in the south-eastern corner of site.
Contamination sources on-site	Fly-tipped furniture including fridges, sofas and mattresses noted along the southern boundary. Potential leaks/spills of chemicals from car wash in eastern half of site.
Contamination sources off-site	TPH and PAH contamination from the MOT garage noted to the south-west of site-
Vegetation on-site	2No. semi-mature ~5 – 6m high trees were present along the soft landscaping in the northern portion of site. A mature ~6m high tree was noted in the north-eastern corner. ~1 – 2m high hedges and bushes were noted adjacent to the security fence dividing the site, and a mature ~8m high tree was present in the south-western corner.
Vegetation off-site	Mature >10m high trees were present in the residential estate to the north, north-west and north-east of site, and mature ~6 – 8m high trees were noted around the caravan park to the south.
Services	Drains were present across the northern portion of site, and a fire hydrant was noted beyond the northern boundary.
Comments	None.

Photographs of the site are provided within Appendix B.

2.3 Proposed Development

At the time of reporting, September 2018, it was understood the proposed development would comprise the construction of a series of multi-storey block of flats, with a small basement area in the south-eastern portion of site. The ground floor was understood to comprise a commercial unit in the north-west corner of site, with the PDSA Vet Hospital relocated to the north-eastern corner and residential flats in the southern boundary of site. Ground floor residential flats are proposed for the southern part of the building. The remaining storeys are understood to comprise 272No. residential flats, with a raised podium garden on the first floor and roof gardens on each block. The raised podium garden on the first floor will be used as a communal area for the residential flats, with smaller communal areas at the ground floor for the commercial units. No areas of soft landscaping are proposed but a number of permeable grasscrete parking spaces will be located along the perimeter of the site.

A plan view of the proposed basement floor, ground floor and first floors can be seen in Figures 4 – 6, with a section view of the flats and basement seen in Figure 7.

2.4 Geology

The BGS Geological Map (Solid and Drift) for the Dartford area (Sheet No. 271) revealed that the site was underlain by a superficial capping of Alluvium and Taplow Gravel Formation deposits overlying the bedrock deposits of the Thanet Sand Formation and then the Undifferentiated Seaford Chalk Formation and Newhaven Chalk Formation. No areas of Worked or Made Ground were noted within a 250m radius of the site.

Alluvium

Alluvium in the Thames valley consists largely of silty clays and clayey silts with locally developed beds of fine to coarse grained sand mainly less than 1m thick but locally up to 4m. There are also sporadic beds with scattered pebbles and granules. Interbedded peat occurs in the east of the Thames valley. The total thickness of peat beds exceeds 2m in large areas between the confluence of the rivers Thames and Lea and Tilbury.

Taplow Gravel Formation

The Taplow Gravel Formation is part of a complex series of River Terrace Deposits formed by the River Thames and its tributaries. These terraces represent ancient floodplain deposits that became isolated as the river cut downwards to lower levels. The Taplow Gravel Formation is largely encountered along the Thames valley and in the lower parts of the Brent, Wandle, Lea, Cray and Darent valleys and is found at an elevation generally above the current river.

The composition of the River Terrace Gravels varies greatly, depending on the source material available in the river's catchment. Deposits generally consist of sands and gravels of roughly bedded flint or chert commonly in a matrix of silts and clays.

Thanet Sand Formation

The Thanet Sand Formation comprises mainly of fine-grained pale yellow to grey sand becoming silty with depth. The basal level comprises a layer of glauconitic clayey fine grained sand with green glauconitic coated flints.

Undifferentiated Seaford Chalk Formation and Newhaven Chalk Formation

The Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formation is a soft

white friable microporous limestone composed of coccolith biomicrites with a varying proportion of larger shell fragments. Flint characterises the Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk, occurring as nodular courses, tabular beds and linings to fractures.

At various levels clay sized material occurs as marl seams and partings. Close to the surface the upper few metres are invariably discoloured brown, due to leaching from the overlying strata. The interface with any overlying stratum is invariably extremely irregular as a result of localised weathering and dissolution. Weathering by frost action may extend to a depth of several metres.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits; can be found in the chalk deposits. These features sometimes manifest themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

2.5 Hydrogeology and Hydrology

A study of the aquifer maps on the Environment Agency website and the Groundsure Enviroinsight datasheets, presented in Appendix D of this report, revealed the site to be located on a **Secondary (Undifferentiated) Aquifer** comprising the superficial deposits of the Alluvium, and a **Secondary (A) Aquifer** comprising the superficial Taplow Gravel Formation and bedrock deposits of the Thanet Sand Formation. The Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formation, underlying the Thane Sand Formation, were classed as a **Principal Aquifer**.

Superficial drift deposits are described as permeable unconsolidated (loose) deposits e.g. sands and gravels. The bedrock is described as solid permeable formations e.g. sandstone, chalk and limestone.

A Principal Aquifer is a layer of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary Aquifers include a wide range of drift deposits with an equally wide range of water permeability and storage capacities. Secondary (A) Aquifers consist of deposits with 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.

Undifferentiated Secondary Aquifers are assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both a minor aquifer and non-aquifer in different locations due to the variable characteristics of the rock type.

Examination of the Environment Agency records showed that the site did **not** fall within a Groundwater Source Protection Zone as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water feature to site was South Mere Lake, located ~260m to the north-east. The River Thames was located ~1.62km to the north-west.

Examination of the Environment Agency records showed that the site was located in a **Flood Zone 3**. The site **was** in an area that benefits from flood defences.

An **Environment Agency Flood Zone 3** shows the extent of a river flood with a 1 in 100 (1%0 or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (~2 – 3m bgl). It was considered that the groundwater was flowing in an overall northern direction in alignment with local topography and towards the River Thames.

2.6 Radon

BRE 211 (2015) Map 5 of London, Sussex and west Kent revealed the site **was not** located within an area where mandatory protection measures against the ingress of Radon were required. The site **was not** located within an area where a risk assessment was required.

3.0 FIELDWORK

3.1 Scope of Works

Fieldwork was undertaken between the 28th – 30th June 2017 and the 3rd – 4th July 2017 and comprised the drilling of two Cable Percussion Boreholes (BH1 – BH2) to a depth of 25.00m bgl, and two Competitor Windowless Sampler Boreholes (WS1 – WS2) to between 1.10m – 3.00m bgl. Standard Penetration Tests (SPTs) were carried out in BH1 and BH2 at 1.50m – 3.00m intervals. Two 50mm internal diameter combined bio-gas and groundwater monitoring wells were installed to 10.00m bgl within BH1 and 5.00m bgl in BH2.

The construction of the well installed can be seen tabulated below.

Combined Bio-gas and Groundwater Monitoring Well Construction				
Trial Hole	Depth of Installation (m bgl)	Thickness of slotted piping with gravel filter pack (m)	Depth of plain piping with bentonite seal (m bgl)	Piping external diameter (mm)
BH1	10.00m	9.00m	1.00m	63
BH2	5.00m	4.00m	1.00m	63

The approximate location of the trial holes can be seen within Figure 8.

Prior to commencing the ground investigation, a walkover survey was carried out to identify the presence of underground services and drainage. Where underground services/drainage were suspected and/or positively identified, the exploratory position was relocated away from these areas.

Upon completion of the drilling works, the trial holes were backfilled and made good, in relation to the surrounding area.

3.2 Sampling Procedures

Small disturbed samples were recovered from the trial holes at the depths shown on the trial hole records. Soil samples were generally retrieved from each change of strata and/or at specific areas of concern. Samples were also taken at approximately 0.5m intervals during broad homogenous soil horizons.

A selection of samples were despatched for geotechnical testing purposes. A selection of soil samples were also sent off for analysis for a broad range of contaminants in accordance with the Conceptual Site Model (CSM) developed within the Ground and Water Desk Study Report (ref. GWPR2179/DS/September 2017) and DEFRA/CLEA methodologies.

4.0 ENCOUNTERED GROUND CONDITIONS

4.1 Soil Conditions

The trial holes were logged by Darina Jurovskaja of Ground and Water Limited, and Dan Pearce on behalf of Ground and Water Limited, generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

The ground conditions encountered within the trial holes constructed on the site did generally conform to that anticipated from examination of the geology map. A capping of Made Ground was noted to overlie superficial soils of the Alluvium and Taplow Gravel Formation, and bedrock deposits of the Thanet Sand Formation.

The ground conditions encountered during the investigation are described in this section. The trial hole logs can be seen in Appendix B and the trial hole location plan can be viewed in Figure 8.

Made Ground
Alluvium (BH1 – BH2)
Taplow Gravel Formation (BH1 – BH2)
Thanet Sand Formation (BH1 – BH2)

Made Ground

Made Ground was encountered from ground level in all trial holes, to a depth of between 2.00 – 3.00m bgl in BH1 – BH2, and for the full depth of WS1 – WS2, a depth of between 1.10 – 3.00m bgl. The soils generally comprised a light to dark brown and orange/grey-brown gravelly clayey sand, locally a silty sandy gravelly clay. The sand was fine to medium grained and the gravel was rare to occasional, fine to medium, sub-angular to sub-rounded flint, brick, concrete, metal and glass fragments.

Alluvium

Soils described as Alluvium were encountered underlying the Made Ground to a depth of 9.50m bgl in BH1 – BH2. To a depth of between 3.80 – 4.00m bgl, in both boreholes, and from 9.50 – 13.70m bgl in BH2, the soils comprised a grey-brown silty sandy clay. The soil became darker in colour at 3.50m bgl in BH1 and 10.50m bgl in BH2.

For the remaining depth of the Alluvium deposits noted in BH1, and to a depth of 9.50m bgl in BH2, the soils comprised a dark brown to black clayey peat with decomposed roots. The soils became more clayey with depth, and large decayed root fragments were noted at 8.50m bgl in BH2.

Taplow Gravel Formation

Superficial deposits of the Taplow Gravel Formation were noted underlying the Alluvium to a depth of 14.50m bgl in BH1 and 21.50m bgl in BH2. The deposits generally comprised a light to dark brown/black, locally clayey, sandy gravel. The sand was fine to coarse grained and the gravel was abundant, sub-angular to sub-rounded, fine to coarse flint. The colour becomes lighter and the gravel becomes coarser with depth.

Thanet Sand Formation

Soils of the Thanet Sand Formation were noted underlying the Taplow Gravel Formation for the remaining depth of BH1 and BH2, a depth of 25.00m bgl. The soils comprised a dark grey (locally gravelly) silty clayey sand. The sand was very fine to fine grained and the gravel was rare, sub-angular to sub-rounded flint. The deposits became slightly clayey from 15.50m bgl in BH1.

For details of the composition of the Made Ground, Alluvium, Taplow Gravel Formation of Thanet Sand Formation, reference must be made to the trial hole logs within Appendix B.

4.2 Roots Encountered

Roots were noted to 0.50m bgl in BH1 and 3.50m bgl in BH2. No roots noted in WS1 or WS2.

It must be noted that the chance of determining actual depth of root penetration through a narrow diameter borehole is low. Roots may be found to greater depths at other locations on the site, particularly close to trees and/or trees that have been removed both within the site and its close environs.

4.3 Groundwater Conditions

Groundwater strikes were noted at 3.00m bgl, rising to 2.50m bgl after 20mins, and 9.50m bgl, rising to 3.20m bgl after 20mins in BH1. Groundwater strikes were noted at 3.00m, 8.00m and 13.70m bgl in BH2, rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins. Groundwater depths are given in the table below:

Groundwater Strikes noted during intrusive investigation		
Trial Hole	Groundwater Strike Depth (m bgl)	Groundwater depth after 20 minutes (m bgl)
BH1	3.00m	2.50m
BH1	9.50m	3.20m
BH2	3.00m	2.10m
BH2	8.00m	5.50m
BH2	13.70m	2.80m
WS1	None	-
WS2	None	-

Return visits undertaken by a Ground and Water Limited Engineer to monitor groundwater levels in the wells installed to 10.00m bgl in BH1 and 5.00m bgl in BH2 shall be issued as an addendum to this report.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. Exact groundwater levels may only be determined through long term measurements from monitoring wells installed on-site.

The site investigation was conducted in June – July 2017, when groundwater levels should be falling towards their annual minimum (lowest elevation). The long-term groundwater elevation might increase at some time in the future due to seasonal fluctuation in weather conditions. Isolated pockets of groundwater may be perched within any Made Ground found at other locations around the site.

4.4 Obstructions

No artificial or natural sub-surface obstructions were noted during construction of the trial holes.

5.0 IN-SITU AND LABORATORY GEOTECHNICAL TESTING

5.1 In-Situ Geotechnical Testing

5.1.1 Standard Penetration Tests (SPTs)

Standard Penetration Tests (SPTs) were carried out in BH1 and BH2 at 1.50m – 3.00m intervals. The results of the SPT's have not been amended to take into account hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. The test results are presented on the borehole logs within Appendix B.

Cable Percussion Boreholes provide samples of the ground for assessment but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50 mm and an inside diameter of 35 mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5 kg falling through a distance of 760 mm. The sample tube is driven 150 mm into the ground and then the number of blows needed for the tube to penetrate each 150 mm up to a depth of 450 mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

The granular soils of the Made Ground, Taplow Gravel Formation and Thanet Sand Formation were classified based on the table below.

Correlation between normalised SPT blow counts (N_{160}) and granular classification.	
Classification	Equivalent SPT Blow Counts (N_1)
Extremely Dense	>58
Very Dense	42 – 58
Dense	25 – 42
Medium	8 – 25
Loose	3 – 8
Very Loose	0 – 3

The cohesive soils of the Alluvium were classified based on the table below.

Undrained Shear Strength from Field Inspection/ SPT Results Cohesive Soils (EN ISO 14688-2:2004 & Stroud (1974))		
Classification	Undrained Shear Strength (kPa)	Field Indications
Extremely High	>300	-
Very High	150 – 300	Brittle or very tough
High	75 – 150	Cannot be moulded in the fingers
Medium	40 – 75	Can be moulded in the fingers by strong pressure
Low	20 – 40	Easily moulded in the fingers
Very Low	10 – 20	Exudes between fingers when squeezed in the fist
Extremely Low	<10	-

An interpretation of the in-situ geotechnical testing results is given in the table overpage.

Interpretation of In-situ Geotechnical Testing Results					
Strata	SPT "N" Blow Counts	Equivalent Undrained Shear Strength (kPa) Cohesive Soils	Soil Type		Trial Hole/s
			Cohesive	Granular	
Made Ground (Granular soils)	7 2 – 12	-	-	Loose V. Loose – Medium	BH1 (GL – 2.00m bgl) BH2 (GL – 3.00m bgl)
Alluvium (Cohesive soils)	2 – 13 1 – 4	10 – 65 <10 – 20	V. Low – Medium Ext. Low – Low	-	BH1 (2.00 – 9.50m bgl) BH2 (3.00 – 13.70m bgl)
Taplow Gravel Formation (Granular soils)	14 – 27 15 – 26	-	-	Medium – Dense	BH1 (9.50 – 14.50m bgl) BH2 (13.70 – 21.50m bgl)
Thanet Sand Formation (Granular soils)	45 – >58 46 – 57	-	-	V. Dense – Ext. Dense V. Dense	BH1 (14.50 – 25.00m bgl) BH2 (21.50 – 25.00m bgl)

It must be noted that field measurements of undrained shear strength are dependent on a number of variables including disturbance of sample, method of investigation and also the size of specimen or test zone etc.

5.2 Laboratory Geotechnical Testing

A programme of geotechnical laboratory testing, scheduled by Ground and Water Limited and carried out by K4 Soils Laboratory and QTS Environmental Ltd, was undertaken on samples recovered from the Made Ground, Alluvium and Taplow Gravel Formation. The results of the tests are presented in Appendix C.

The test procedures used were generally in accordance with the methods described in BS1377:1990. Details of the specific tests used in each case are given below.

Standard Methodology for Laboratory Geotechnical Testing		
Test	Standard	Number of Tests
Atterberg Limit Tests	BS1377:1990:Part 2:Clauses 3.2, 4.3 & 5	3
Particle Size Distribution	BS1377:1990:Part 2:Clause 9	3
Soil Organic Matter (Titrimetry)	BS1377:1990:Part 3:Clause 4	2
Water Soluble Sulphate & pH	BS1377:1990:Part 3:Clause 5	2
BRE Special Digest 1 (incl. pH, Total Sulphate, W/S Sulphate, Total Chlorine, W/S Chlorine, Total Sulphur, Ammonium as NH ₄ , W/S Nitrate, W/S Magnesium)	BRE Special Digest 1 "Concrete in Aggressive Ground (BRE, 2005).	2

5.2.1 Atterberg Limit Tests

A précis of Atterberg Limit Tests undertaken on three samples of the cohesive Alluvium can be seen tabulated below.

Atterberg Limit Tests Results Summary							
Stratum/Depth	Moisture Content (%)	Passing 425 µm sieve (%)	Modified PI (%)	Soil Class	Consistency Index (I _c)	Volume Change Potential	
						NHBC	BRE
Alluvium	49 – 101	99 – 100	28 – 79	CH – CE	V. Soft – Soft	Medium – High	Medium – V. High

NB: NP – Non-plastic
 BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
 Soil Classification based on British Soil Classification System.
 Consistency Index (Ic) based on BS EN ISO 14688-2:2004.

5.2.2 Comparison of Soil's Moisture Content with Index Properties

5.2.2.1 Liquidity Index Analyses

The results of the Atterberg Limit test undertaken on three samples of the cohesive Alluvium were analysed to determine the Liquidity Index of the samples. This gives an indication as to whether the samples recovered showed a moisture deficit and their degree of consolidation. The results are tabulated below.

The test results are presented within Appendix C.

Liquidity Index Calculations Summary					
Stratum/Trial Hole/Depth	Moisture Content (%)	Plastic Limit (%)	Modified Plasticity Index (%)	Liquidity Index	Result
Alluvium BH1/3.50m bgl (Dark blue-grey mottled brown silty CLAY with rare fine gravel).	62	31	42.57	0.73	Overconsolidated
Alluvium BH2/3.50m bgl (Dark grey mottled brown sandy silty CLAY with traces of fine rootlets).	49	23	28.00	0.93	Overconsolidated
Alluvium BH2/11.00m bgl (Dark grey mottled brown silty CLAY).	101	54	79.00	0.59	Overconsolidated

Liquidity Index testing revealed no evidence for moisture deficit within the three overconsolidated samples of the Alluvium tested.

5.2.2.2 Liquid Limit

A comparison of the soil moisture content and the liquid limit can be seen tabulated below.

Moisture Content vs. Liquid Limit				
Strata/Trial Hole/Depth/Soil Description	Moisture Content (MC) (%)	Liquid Limit (LL) (%)	40% Liquid Limit (LL)	Result
Alluvium BH1/3.50m bgl (Dark blue-grey mottled brown silty CLAY with rare fine gravel).	62	74	29.6	MC > 0.4 x LL (No Significant Moisture Deficit)
Alluvium BH2/3.50m bgl (Dark grey mottled brown sandy silty CLAY with traces of fine rootlets).	49	51	20.4	MC > 0.4 x LL (No Significant Moisture Deficit)
Alluvium BH2/11.00m bgl (Dark grey mottled brown silty CLAY).	101	133	53.2	MC > 0.4 x LL (No Significant Moisture Deficit)

The results in the table above indicate that the three samples of Alluvium tested showed no evidence of a significant moisture deficit.

5.2.3 Particle Size Distribution (PSD) Tests

The results of PSD testing undertaken on two granular samples of the Taplow Gravel Formation and one granular sample of the Made Ground encountered are tabulated below.

PSD Test Results Summary			
Trial Hole/Depth/Soil Description	Volume Change Potential Range		Passing 63µm sieve Range (%)
	BRE	NHBC	
Taplow Gravel Formation BH1/10.00m bgl (Dark grey sandy GRAVEL (gravel is F – C and sub-rounded to sub-angular)).	No	No	0.2
Made Ground BH2/2.50m bgl (Grey-brown gravelly very clayey SAND with traces of rootlets and wood fragments (gravel is F – C and sub-angular to rounded)).	Yes	No	21.3
Taplow Gravel Formation BH2/14.00m bgl (Brown very sandy GRAVEL (gravel is F – C and sub-angular to rounded)).	No	No	0.7

NB Volume Change Potential refers to BRE Digest 240 (based on Grading test results).
Shrinkability refers to NHBC Standards Chapter 4.2 (based on Grading test results).

Volume Change Potential – BRE 240 states that a soil has a volume change potential when the clay fraction exceeds 15%. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve.

NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.

5.2.4 Soil Organic Matter Test

The results of Soil Organic Matter testing by Titrimetry undertaken on two samples of Alluvium are tabulated below.

Soil Organic Matter Test Results Summary		
Trial Hole/Depth/Soil Description	Soil Organic Matter (%)	Classification in accordance with BS EN 14688-2:2004
Alluvium BH1/4.50m bgl (Silty Loam).	3.5	Low Organic Content
Alluvium BH1/9.50m bgl (Silty Loam).	6.6	Medium Organic Content

5.2.5 Sulphate and pH Tests

A sulphate and pH test was undertaken on two samples from the Alluvium (BH1/4.50m and BH2/11.00m bgl). The sulphate concentration was between 660 – 1000mg/l with a pH range of 7.25 – 7.70.

5.2.6 BRE Special Digest 1

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground' (BRE, 2005) two samples from the Alluvium (BH1/4.00m bgl, BH2/8.50m bgl) were scheduled for laboratory analysis to determine parameters for concrete specification.

The results are given within Appendix C and a summary is tabulated overpage.

Summary of Results of BRE Special Digest Testing			
Determinand	Unit	Minimum	Maximum
pH	-	7.5	7.5
Ammonium as NH ₄	mg/kg	70.1	634.0
Sulphur	mg/kg	4,100	16,900
Chloride (water soluble)	mg/kg	770	1,960
Magnesium (water soluble)	g/l	0.014	0.071
Nitrate (water soluble)	mg/kg	13	21
Sulphate (water soluble)	g/l	0.55	2.45
Sulphate (total)	mg/kg	1,667	5,565

6.0 ENGINEERING CONSIDERATIONS

6.1 Soil Characteristics and Geotechnical Parameters

Based on the results of the intrusive investigation and geotechnical laboratory testing the following interpretations have been made with respect to engineering considerations.

- Made Ground was encountered from ground level in all trial holes, to a depth of between 2.00 – 3.00m bgl in BH1 – BH2, and for the full depth of WS1 – WS2, a depth of between 1.10 – 3.00m bgl.

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

Made Ground may be found to deeper depth at other locations on the site, especially close to former structures/foundations and service runs.

- Soils described as Alluvium were encountered underlying the Made Ground to a depth of 9.50m – 13.70m bgl in BH1 – BH2. To a depth of between 3.80 – 4.00m bgl in both boreholes, and from 9.50 – 13.70m bgl in BH2, the soils comprised a grey-brown silty sandy clay of extremely low to medium undrained shear strength (<10 – 65kPa). The soil became darker in colour at 3.50m bgl in BH1 and 10.50m bgl in BH2.

For the remaining depth of the Alluvium deposits noted in BH1, and to a depth of 9.50m bgl in BH2, the soils comprised a dark brown to black clayey peat with decomposed roots. The soils became more clayey with depth, and large decayed root fragments were noted at 8.50m bgl in BH2.

The cohesive soils of the Alluvium were determined to have **medium to high volume change potential** in accordance with NHBC Standards Chapter 4.2 and **medium to very high volume change potential** in accordance with BRE240. Consistency Index testing revealed the soils to be very soft to soft and overconsolidated.

Liquidity index testing for the cohesive soils of the Alluvium revealed no potential moisture deficits in the overconsolidated soils tested.

Given the low undrained shear strength noted, the presence of roots and organic material within the soils, and the potential for high load-induced settlements, foundations should bypass these soils in favour of the underlying Taplow Gravel Formation. Therefore these deposits were no longer considered as a founding stratum in this report.

- Superficial deposits of the Taplow Gravel Formation were noted underlying the Alluvium to a depth of 14.50m bgl in BH1 and 21.50m bgl in BH2, and generally comprised a medium-dense to dense light to dark brown/black locally clayey sandy gravel. The sand was fine to coarse grained and the gravel was abundant, sub-angular to sub-rounded, fine to coarse flint. The colour becomes lighter and the gravel becomes coarser with depth.

The granular soils of the Taplow Gravel Formation were determined to have **no volume change potential** in accordance with NHBC Standards Chapter 4.2 and BRE240.

Given their depth, the granular soils of the Taplow Gravel Formation were likely to be a suitable stratum for **moderately to highly** loaded piled foundations. The settlements induced on loading are likely to be low.

- Soils of the Thanet Sand Formation were noted underlying the Taplow Gravel Formation for the remaining depth of BH1 and BH2, a depth of 25.00m bgl. The soils comprised a very dense to extremely dense dark grey (locally gravelly) silty clayey sand. The sand was very fine to fine grained and the gravel was rare, sub-angular to sub-rounded flint. The deposits became slightly clayey from 15.50m bgl in BH1.

The granular soils of the Thanet Sand Formation was considered likely to have **no volume change potential** in accordance with NHBC Standards Chapter 4.2 and BRE240. Further geotechnical testing may be necessary in order to confirm this.

The granular soils of the Thanet Sand Formation were likely to be a suitable stratum for **moderately to highly** loaded piled foundations. The settlements induced on loading are likely to be low.

The final design of foundations will need to take into account the volume change potential of the soil, the depth of root penetration and/or desiccation and the likely serviceability and settlement requirements of the proposed structure. These parameters for design are discussed in the next section of this report.

- Groundwater strikes were noted at 3.00m bgl, rising to 2.50m bgl after 20mins, and 9.50m bgl, rising to 3.20m bgl after 20mins in BH1. Groundwater strikes were noted at 3.00m, 8.00m and 13.70m bgl in BH2, rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins. No groundwater was noted in WS1 or WS2.
- Roots were noted to 0.50m bgl in BH1 and 3.50m bgl in BH2. No roots noted in WS1 or WS2.

6.2 Spread Foundations

At the time of reporting, September 2018, it was understood the proposed development would comprise the construction of a series of multi-storey block of flats, with a small basement area in the south-eastern portion of site. The ground floor was understood to comprise a commercial unit in the north-west corner of site, with the PDSA Vet Hospital relocated to the north-eastern corner and residential flats in the southern boundary of site. Ground floor residential flats are proposed for the southern part of the building. The remaining storeys are understood to comprise 272No. residential flats, with a raised podium garden on the first floor and roof gardens on each block. The raised podium garden on the first floor will be used as a communal area for the residential flats, with smaller communal areas at the ground floor for the commercial units. No areas of soft landscaping are proposed but a number of permeable grasscrete parking spaces will be located along the perimeter of the site.

A plan view of the proposed basement floor, ground floor and first floors can be seen in Figures 4 – 6, with a section view of the flats and basement seen in Figure 7.

The proposed development fell within Geotechnical Design Category 2 in accordance with Eurocode 7.

The proposed foundation loads were not known to Ground and Water Limited at the time of reporting but are likely to range from 75 – 150kN/m².

The cohesive soils of the Alluvium were determined to have **medium to high volume change potential** in accordance with NHBC Standards Chapter 4.2 and **medium to very high volume change potential** in accordance with BRE240. The granular soils of the Taplow Gravel Formation were determined to have **no volume change potential** in accordance with NHBC Standards Chapter 4.2 and BRE240.

The granular soils of the Thanet Sand Formation was considered likely to have **no volume change potential** in accordance with NHBC Standards Chapter 4.2 and BRE240, however further geotechnical testing may be necessary in order to confirm this.

Roots were noted to a depth of between 0.50 – 3.50m bgl in BH1 – BH2. Made Ground was noted to a proved depth of between 1.10 – 3.00m bgl, and Alluvium was noted to a depth of between 9.50 – 13.70m bgl.

Given the depth and thickness of Made Ground and Alluvium noted, as well as the depth of roots present, the site is considered unsuitable for spread foundations due to the depth of excavations required and potential for high load-induced settlements. Therefore, a piled foundation solution is recommended.

6.3 Piled Foundations

Given that foundations shall need to extend beyond 2.50m bgl in order to bypass the Made Ground, root penetration and settlement-prone Alluvium, this means the footings will need to be engineer designed. Given the increased costs of digging to such a depth, amount of waste produced, amount of concrete required and the likely need for dewatering due to groundwater being noted at shallow depth, forming strip footings at depth was considered impractical. Therefore, a piled foundation scheme was considered to be most appropriate.

Piles should be taken through the Made Ground and Alluvium into the Taplow Gravel Formation such that sufficient bearing capacities were achieved.

The construction of a piled foundation is a specialist job, and the advice of a reputable contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the foundation design, as the actual pile working load will depend on the particular type of pile and method of installation adopted.

Indicative limit loads and settlements for a bored pile have been given within the tables below and have been based on the SPT profile for BH2.

An allowance for negative skin friction to occur within the top 13.70m of the soil has been included within the calculations where it could pass through any Made Ground, root penetrated soils and soils showing a possible moisture deficit (Alluvium). An adhesion factor of 0.45m has been applied.

The bearing values may be limited by the maximum permissible stress allowable on a concrete pile. To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Bored Pile – Limit Loads and Settlement Parameters (Based on BH2/ Classic (FOS of 3.0))						
Depth (m bgl)	Diameter (m)	Limit States (kN)			Settlement (Poulos Davis (1968))	
		Tip	Lateral	Total	Load (kN)	Total (Elastic + Rigid) (cm)
18	0.30	249.06	167.64	384.89	380	0.2625
	0.45	560.38	251.46	740.27	740	0.4335
	0.60	996.23	335.27	1204.27	1200	0.5273
20	0.30	421.79	248.77	635.22	630	0.3960
	0.45	949.04	373.16	1242.67	1240	0.6277
	0.60	1687.18	497.54	2043.34	2040	0.7745
22	0.30	809.96	340.88	1111.96	1110	0.6039
	0.45	1822.41	511.32	2246.26	2240	0.9529
	0.60	3239.83	681.77	3766.09	3760	1.1996

The bearing values given in the table above are applicable to single piles. Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of approximately 0.8 and a calculation made to check the factor of safety against block failure.

The piles will need to be designed in accordance with the volume change potential of the soils encountered, depth of desiccation, root penetration, etc. Temporary casing may be required where the upper portion of the pile passes through the Made Ground, particularly where perched water is encountered, to prevent necking of the concrete.

Groundwater strikes were noted at 3.00m bgl, rising to 2.50m bgl after 20mins, and 9.50m bgl, rising to 3.20m bgl after 20mins in BH1, and at 3.00m, 8.00m and 13.70m bgl in BH2, rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins. Based on the groundwater readings taken during this investigation to-date, it was considered **likely** that groundwater will be encountered during installation of the piles. This will need to be taken into account in the final design.

6.4 Basement Excavations and Stability

Shallow excavations in the Made Ground and Alluvium are likely to be marginally stable at best. Long, deep excavations, through these strata and the Taplow Gravel Formation/Thanet Sand Formation are likely to become unstable.

The excavation of the basement must not affect the integrity of the adjacent structures beyond the boundaries. The excavation must be supported by suitably designed retaining walls. It is considered unlikely that battering the sides of the excavation, casting the retaining walls and then backfilling to the rear of the walls would be suitable given the close proximity of the party walls.

The retaining walls for the basement will need to be constructed based on cohesive soils with an appropriate angle of shear resistance (ϕ') for the ground conditions encountered.

Based on the ground conditions encountered the following parameters could be used in the design of retaining walls. These have been designed based the results of geotechnical classification tests and reference to literature.

Retaining Wall/Basement Design Parameters					
Strata	Unit Volume Weight (kN/m ³)	Cohesion Intercept (c') (kPa)	Angle of Shearing Resistance (Ø)	Ka	Kp
Made Ground	~15	0	12	0.66	1.52
Alluvium (Cohesive Soils)	~16	0	18	0.53	1.89
Alluvium (Peaty Soils)	~15	0	10	0.70	1.42
Taplow Gravel Formation (Granular Soils)	~20	0	34	0.28	3.54
Thanet Sand Formation (Granular Soils)	~22	0	42	0.20	5.04

Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported before excavations are entered by personnel.

Groundwater strikes were noted at 3.00m bgl, rising to 2.50m bgl after 20mins, and 9.50m bgl, rising to 3.20m bgl after 20mins in BH1, and at 3.00m, 8.00m and 13.70m bgl in BH2, rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins. Based on the groundwater readings taken during this investigation to-date, it was considered **likely** that groundwater will be encountered during basement construction.

The advice of a reputable dewatering contractor, familiar with the type of ground and groundwater conditions encountered on this site, should be sought prior to finalising the design of the excavation for the basement.

Consideration should be given formation of a secant or contiguous piled wall and construction of a coffer dam, to allow for dewatering to be undertaken.

6.5 Hydrogeological Effects

The proposed development was located within a **Secondary (Undifferentiated) Aquifer** comprising the superficial deposits of the Alluvium, and a **Secondary (A) Aquifer** comprising the superficial Taplow Gravel Formation and bedrock deposits of the Thanet Sand Formation. The Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formation, underlying the Thane Sand Formation, were classed as a **Principal Aquifer**.

The ground conditions encountered within the borehole constructed on the site did generally conform to that anticipated from examination of the geology map, with a capping of Made Ground noted to overlie cohesive Alluvium, granular soils of the Taplow Gravel Formation and granular soils of the Thanet Sand Formation.

Based on a visual appraisal of the soils encountered the permeability of the cohesive Alluvium was considered to be relatively low. The granular Taplow Gravel Formation and Thanet Sand Formation were considered to have high permeability.

Groundwater strikes were noted at 3.00m bgl, rising to 2.50m bgl after 20mins, and 9.50m bgl, rising to 3.20m bgl after 20mins in BH1. Groundwater strikes were noted at 3.00m, 8.00m and 13.70m bgl in BH2, rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins.

Based on the groundwater readings taken during this investigation it is considered **likely** that groundwater will be encountered during basement construction.

Higher groundwater levels during winter months or during inclement weather may affect basement construction.

Consideration should be given formation of a secant or contiguous piled wall and construction of a coffer dam, to allow for dewatering to be undertaken.

Once constructed, the Made Ground and Alluvium are unlikely to act as a porous medium for water to migrate through; therefore additional drainage around the basement should be considered.

6.6 Surface Water Disposal

Infiltration tests were beyond the scope of the investigation.

Soakaways constructed in the Made Ground and Alluvium are considered unlikely to perform to a satisfactory standard for the disposal of storm water. Given the depth of the granular soils encountered, consideration could be given to deep borehole soakaways constructed within the soils of the Taplow Gravel Formation or Thanet Sand Formation. Borehole soakaway tests may be required to confirm this.

Consultation with the Environment Agency must be sought regarding any use that may have an impact on groundwater resources.

6.7 Sub-Surface Concrete

Sulphate concentrations measured in 2:1 water/soil extracts taken from the Made Ground and Alluvium from both the geotechnical and chemical laboratory testing, fell into Class DS-5 of the BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'*. Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-5. For the classification given, the "mobile" and "natural" case was adopted given the lithology encountered, the presence of groundwater and the residential use of the site.

The sulphate concentrations ranged from 24 – 2450mg/l with a pH range of 7.25 – 7.70. The total sulphate concentration was between 0.17 – 0.56%. Total potential sulphate levels (3 x Total Sulphur) were between 1.23 – 5.07%.

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

7.0 PHASE 2 CONTAMINATION RISK ASSESSMENT

7.1 Results of the Phase 1 Risk Assessment (Conceptual Site Model)

The tabulated Conceptual Site Model developed by the Ground and Water Desk Study (ref. GWPR2179/DS/September 2018) is reproduced in this section and can be seen below and overleaf.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	Potential Absorption Pathways	Potential Receptors
<p>Contaminants introduced on-site by historic demolition and construction activities on the site:</p> <ul style="list-style-type: none"> • Heavy metals and semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging) <p>Contaminants from car wash drainage:</p> <ul style="list-style-type: none"> • Anionic Detergents. 	<p>Direct ingestion of soil and soil derived household dust;</p> <p>Dermal contact of soil and soil derived household dust;</p> <p>Ingestion of soil with elevated concentration of determinants;</p> <p>Dermal contact with impacted soils;</p> <p>Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants;</p> <p>Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants.</p>	<p>Via surface water</p> <p>Construction workers (particularly during foundation construction and removal of waste)</p> <p>Service and Maintenance Operatives</p> <p>Site Occupiers</p>
<p>Ground gas produced by putrescible Alluvium underlying site:</p> <ul style="list-style-type: none"> • Carbon Dioxide • Methane <p>In accordance with BS8485, the basement and walls would need to conform to BS 8102:2009 with Grade 2 and 3 waterproofing in order to obtain a gas protection score of 2 and 2.50 respectively. Further risk assessment would be required.</p> <p>However, areas remote from the basement require a risk assessment.</p>	<p>Migration through anthropogenic & natural pathways;</p> <p>Inhalation;</p> <p>Explosive risk.</p>	<p>Construction workers (particularly during foundation construction and removal of waste).</p> <p>Service and Maintenance Operatives.</p> <p>Site Occupiers.</p>

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	Potential Absorption Pathways	Potential Receptors
<p>Contaminants present within groundwater underlying the site.</p> <ul style="list-style-type: none"> • Poly-cyclic Aromatic Hydrocarbons – Benzo(a)pyrene, Fluorene, Dibenzo(A,H)anthracene etc. • Petroleum Hydrocarbons. • Volatile Organic Compounds • Semi-volatile Organic Compounds <p>Ground gas produced by putrescible Alluvium underlying site.</p> <ul style="list-style-type: none"> • Carbon Dioxide • Methane <p>In accordance with BS8485, the basement and walls would need to conform to BS 8102:2009 with Grade 2 and 3 waterproofing in order to obtain a gas protection score of 2 and 2.50 respectively. Further risk assessment would be required.</p> <p>However, areas remote from the basement require a risk assessment.</p>	<p>Migration through anthropogenic & natural pathways;</p> <p>Inhalation;</p>	<p>Via surface water;</p> <p>Construction workers (particularly during foundation construction and removal of waste);</p> <p>Service and Maintenance Operatives;</p> <p>Site Occupiers;</p>

Made Ground and peaty Alluvium were encountered during the investigation, as anticipated, consequently there was no need to modify the tabulated Conceptual Site Model developed by the Ground and Water Desk Study (ref. GWPR2179/DS/August 2017).

No visual or olfactory evidence for hydrocarbon type contamination was noted within the trial holes constructed.

7.2 Sampling Locations

The methodology for sampling locations can be seen tabulated below. A trial hole location plan is given within Figure 8. A random sampling strategy was adopted.

Methodology for Sampling Locations		
Trial Holes	Depth (m bgl)	Sampling Strategy
BH1	25.00m	Random sampling locations
BH2	25.00m	
WS1	1.10m	
WS2	3.00m	

The area investigated as part of the proposed residential development totals ~0.23ha (2,250m²) and with four sampling locations, given an unknown hotspot shape, the sampling density means that a hotspot with an area of approximately 843.75m² and a radius of approximately 16.39m would be encountered (CLR 4).

Sampling depths were chosen to reflect the receptor of concern, human health and typically comprised a surface or near surface sample and at approximately 0.5m depth increments thereafter, extending into the underlying natural soils. The human health receptors relevant to the sampling

depths were as follows:

Near surface samples	Direct ingestion, dermal contact and dust inhalation. Protection of end-users and maintenance workers e.g. Landscape Gardeners. Protection of shallow rooted plants Perched Water/Surface Water Run-off
>0.5m below ground level	Protection of deep rooted plants Perched Water/Surface Water Run-off

The depth of soil sampling can be seen within the trial hole logs presented in Appendix B.

7.3 Chemical Laboratory Testing – Human Health Risk Assessment

A programme of chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by QTS Environmental Limited, was undertaken on three samples of Made Ground (WS1/0.20m, WS1/0.50m and WS2/0.50m bgl).

The samples tested and the reason for testing can be seen tabulated overpage.

Methodology for Sampling Locations and Chemical Laboratory Testing		
Trial Hole	Depth (m bgl)	Sampling Strategy
WS1	0.20m	Representative samples of Made Ground from across the site.
WS1	0.50m	
WS2	0.50m	

The analysis suite is presented below and comprised:

- Semi Metals and Heavy Metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium (WS1/0.20m, WS1/0.50m and WS2/0.50m bgl);
- Asbestos (WS1/0.20m, WS1/0.50m and WS2/0.50m bgl);
- Polycyclic Aromatic Hydrocarbons (PAHs) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene (WS1/0.20m, WS1/0.50m and WS2/0.50m bgl);
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split (WS1/0.20m and WS2/0.50m bgl);
- BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) and MTBE – used as marker compounds for Volatile Organic Compounds (VOCs) (WS1/0.20m and WS2/0.50m bgl).

The chemical laboratory results are presented in Appendix D.

7.3.1 Soil Assessment Criteria

The derivation of Soil Assessment Criteria used within this report can be seen within Appendix E.

7.3.2 Determination of Representative Contamination Concentration

At the time of reporting, September 2018, it was understood the proposed development would comprise the construction of a series of multi-storey block of flats, with a small

basement area in the south-eastern portion of site. The ground floor was understood to comprise a commercial unit in the north-west corner of site, with the PDSA Vet Hospital relocated to the north-eastern corner and residential flats in the southern boundary of site. Ground floor residential flats are proposed for the southern part of the building. The remaining storeys are understood to comprise 272No. residential flats, with a raised podium garden on the first floor and roof gardens on each block. The raised podium garden on the first floor will be used as a communal area for the residential flats, with smaller communal areas at the ground floor for the commercial units. No areas of soft landscaping are proposed but a number of permeable grasscrete parking spaces will be located along the perimeter of the site.

A plan view of the proposed basement floor, ground floor and first floors can be seen in Figures 4 – 6, with a section view of the flats and basement seen in Figure 7.

Therefore, the results of the chemical laboratory testing were compared to the LQM/CIEH Suitable 4 Use Levels (S4UL) for a ***‘Residential without Home-grown Produce’*** land-use scenario, as this was considered the most appropriate land-use scenarios. The C4SL LLTC for Lead was compared to a ***‘Residential without Home-grown Produce’*** land-use scenario.

Where no LQM/CIEH S4UL/C4SL LLTC was available for a particular determinant then preliminary reference was made to the laboratory detection limit of the determinant. If a positive concentration was noted then further risk assessment was undertaken.

For Cyanide, where no SGC/GAC or C4SL LLTC was available a Site Specific Assessment Criteria of 10mg/kg was adopted. This is based on ICRL 59/83, TCL, ATRISK (SOIL) Screening Value and Dutch Intervention Value (ranging from 20 – 34mg/kg). Therefore, a SSAC of ~10mg/kg is considered conservative.

Where a contaminant of concern’s LQM/CIEH S4UL/C4SL LLTC varies according to the Soil’s Organic Matter (SOM), the SOM recorded for the soil sample was used to derive the appropriate SGV/GAC. The SOM of the samples analysed was between 0.7 – 2.00%. The results showing comparison of the representative contaminant concentrations are presented in the table overleaf.

Soil Guideline Values and General Acceptance Criteria Results	
Substance	Sample Location Where available LQM/CIEH S4UL and CSL4 LLTC were exceeded for relevant land-use scenario
	"Residential without Home-grown Produce" Land-Use Scenario
Arsenic	None
Boron	None
Cadmium	None
Chromium (III)	None
Hexavalent Chromium (VI)	None
Copper	None
Lead	None
Mercury (Elemental)	None
Nickel	None
Selenium	None
Vanadium	None
Zinc	None
Cyanide (Total)	None
Total Phenol	None
Naphthalene	None
Acenaphthylene	None
Acenaphthene	None
Fluorene	None
Phenanthrene	None
Anthracene	None
Fluoranthene	None
Pyrene	None
Benzo(a)anthracene	None
Chrysene	None
Benzo(b)fluoranthene	None
Benzo(k)fluoranthene	None
Benzo(a)pyrene	None
Indeno(1,2,3-cd)pyrene	None
Dibenz(a,h)anthracene	None
Benzo(ghi)perylene	None
TPH C5 – C6 (aliphatic)	None
TPH C6 – C8 (aliphatic)	None
TPH C8 - C10 (aliphatic)	None
TPH C10 - C12 (aliphatic)	None
TPH C12 - C16 (aliphatic)	None
TPH C16 - C21 (aliphatic)	None
TPH C21 - C34 (aliphatic)	None
TPH C5 – C7 (aromatic)	None
TPH C7 – C8 (aromatic)	None
TPH C8 - C10 (aromatic)	None
TPH C10 - C12 (aromatic)	None
TPH C12 - C16 (aromatic)	None
TPH C16 - C21 (aromatic)	None
TPH C21 - C35 (aromatic)	None
Benzene	None
Toluene	None
Ethylbenzene	None
Xylene (o, m & p)	None
MTBE	None
Asbestos Screen	None

Chemical laboratory testing of the Made Ground revealed no elevated levels of determinants above the guideline levels for a '**Residential without homegrown produce**' land-use scenario.

In addition, the intrusive investigation did not reveal any visual or olfactory evidence to suggest any hydrocarbon-type contamination in the trial holes excavated on the site.

The chemical laboratory results have verified that no elevated concentrations of aliphatic/aromatic hydrocarbons (C5-C35) or BTEX compounds are present in the soils underlying the site.

7.4 Groundwater Risk Assessment

The Desk Study revealed the site to be located on a **Secondary (Undifferentiated) Aquifer** comprising the superficial deposits of the Alluvium, and a **Secondary (A) Aquifer** comprising the superficial Taplow Gravel Formation and bedrock deposits of the Thanet Sand Formation. The Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formation, underlying the Thane Sand Formation, were classed as a **Principal Aquifer**.

Examination of the Environment Agency records showed that the site did **not** fall within a Groundwater Source Protection Zone as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water feature to site was South Mere Lake, located ~260m to the north-east. The River Thames was located ~1.62km to the north-west.

Examination of the Environment Agency records showed that the site was located in a **Flood Zone 3**. The site **was** in an area that benefits from flood defences.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (~2 – 3m bgl). It was considered that the groundwater was flowing in an overall northern direction in alignment with local topography and towards the River Thames.

Given the hydrogeological setting of the site, the groundwater (**Secondary A Aquifer, Secondary Undifferentiated Aquifer**) directly underlying the site was considered to be a sensitive receptor.

The Principal Aquifer associated with the Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formation is also considered likely to be a sensitive receptor, however given the density of the Thanet Sand Formation it is unlikely that piles will need to extend into the chalk. Therefore, the Principal Aquifer is not at risk.

However, given the generally low levels of determinants noted during the investigation and their likely limited mobility, the Made Ground encountered on site was not considered likely to pose a risk to groundwater. The use of CFA piling will minimise risks to groundwater.

A programme of chemical laboratory testing, scheduled by Ground and Water Limited and carried out by QTS Environmental Limited, was undertaken on groundwater samples recovered from the monitoring standpipes installed within BH1 and BH2.

Samples were recovered from BH1 and BH2 on the 4th July 2017. The samples were taken to determine if the groundwater underlying the site was impacted from historic uses onsite or within the sites environs.

The testing schedule and suite was based on the Conceptual Site Model given within 7.1 of this report.

During the sampling visit the well was purged (three times the volume of water in the well) prior to sampling.

The analysis suite is presented below and comprised:

- Semi-metals and heavy metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc (BH1, BH2);
- Polycyclic Aromatic Hydrocarbons (PAH's) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene (BH1, BH2);
- Fuel, Motor & Heating Oils –Speciated TPH including full aliphatic/aromatic split (BH1, BH2);
- Benzene, Toluene, Ethylbenzene, Xylene (BH1, BH2);

The results of the groundwater analysis can be seen tabulated overpage.

Tabulated Results For Groundwater Testing				
Determinant	Units	EQS Source	EQS Level	Samples where EQS Level was exceeded
Arsenic	µg/l	DWS	10	BH1 (11µg/l), BH2 (12µg/l)
Boron	µg/l	DWS	1000	None
Cadmium	µg/l	DWS	5	None
Chromium	µg/l	DWS	50	None
Copper	µg/l	DWS	2000	None
Lead	µg/l	DWS	10	None
Mercury	µg/l	DWS	1	None
Nickel	µg/l	DWS	20	None
Selenium	µg/l	DWS	10	None
Vanadium	µg/l	EQS Freshwater	20 – 60	None
Zinc	µg/l	DWS	5000	None
Phenol	µg/l	DWS	0.5	None
Naphthalene	µg/l	EQS Freshwater	10	None
Anthracene	µg/l	EQS Freshwater	0.1	None
Fluoranthene	µg/l	EQS Freshwater	0.1	None
Benzo(a)pyrene	µg/l	DWS	0.01	None
Benzo(b)fluoranthene + Benzo(k)fluoranthene	µg/l	EQS Freshwater	0.03	None
Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene	µg/l	EQS Freshwater	0.002	None
⁽¹⁾ Total Polycyclic Aromatic Hydrocarbons (PAH)	µg/l	DWS	0.1	None
Total Petroleum Hydrocarbons (TPH)	µg/l	PWSR	10	None
Benzene	µg/l	DWS	1	None
Toluene	µg/l	WHO	300	None
Ethylbenzene	µg/l	EQS Freshwater	50	None
Xylene	µg/l	EQS Freshwater	30	None
Notes	DWS = UK Drinking Water Standards EQS = Environmental Quality Standard for Protection of Aquatic Life (Freshwater or Saltwater) PWSR = Private Water Supplies Regulations (1991) WHO = World Health Organisation (1) Sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene and indeno(1,2,3-cd)pyrene			

* Although the DWS for TPH has been withdrawn it is our understanding from the Environment Agency that in the absence of other guidance the Drinking Water Standard for Petroleum Hydrocarbons should be used in these cases.

The results of the groundwater testing can be seen in Appendix D.

An elevated level of dissolved Arsenic was noted in both BH1 (11 µg/l) and BH2 (12µg/l), above the UK Drinking Water Standard of 10µg/l. Given the built-up nature of the site, the marginal exceedance of Arsenic noted is to be expected and is thought not to present any significant risk to groundwater.

No other significantly elevated levels of determinants were noted within the samples of the groundwater taken during groundwater monitoring, and therefore no remediation of groundwater is required.

7.5 Groundwater Vapour Risk Assessment

The results of groundwater testing were also compared against the guideline values provided in the 'SOCIETY OF BROWNFIELD RISK ASSESSMENT, Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater', Version 1.0, February 2017. The results are tabulated overpage. The results of the analysis can be seen in Appendix D.

Soil Guideline Values and General Acceptance Criteria Results		
Substance	Sample Location Where available GAC _{gw} were exceeded.	Water Quality Standards
	"Residential" Land-Use Scenario	GAC _{gw} (µg/l)
Elemental Mercury	None	1.1
Naphthalene	None	220
Acenaphthylene	None	220,000
Acenaphthene	None	170,000
Fluorene	None	210,000
TPH C5 – C6 (aliphatic)	None	1,900
TPH C6 – C8 (aliphatic)	None	1,500
TPH C8 - C10 (aliphatic)	None	57
TPH C10 - C12 (aliphatic)	None	37
TPH C5 – C7 (aromatic)	None	210,000
TPH C7 – C8 (aromatic)	None	220,000
TPH C8 – C10 (aromatic)	None	1,900
TPH C10 – C12 (aromatic)	None	6,800
TPH C12 – C16 (aromatic)	None	39,000
Benzene	None	210
Toluene	None	230,000
Ethylbenzene	None	10,000
P-xylene	None	9,900
m-xylene	None	9,500
o-xylene	None	12,000
MTBE	None	83,000

No elevated levels of VOC's were noted in the groundwater which were considered likely to pose a volatile vapour risk.

7.6 Ground-gas Risk Assessment

The Conceptual Site Model had determined that there is a risk that levels of methane and carbon dioxide may be being produced from the superficial Alluvium underlying the site.

In accordance with BS8485, the basement and walls would need to conform to BS 8102:2009 with Grade 2 and 3 waterproofing in order to obtain a gas protection score of 2 and 2.50 respectively.

Further risk assessment would be required.

Further risk assessment is therefore recommended in areas remote from the basement. Appropriate monitoring of ground gases will therefore be required with reference to current technical guidance.

7.6 Re-Evaluated Phase 2 Conceptual Site Model

Following completion of the Phase 2 Site Investigation, the CSM within Section 7.1 of this report was re-evaluated and can be seen below and overpage.

The plausible pollutant linkages remaining after risk assessment are shown and where risk assessment has indicated no unacceptable risk to sensitive receptors, the pollutant linkages have been crossed out.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	Potential Absorption Pathways	Potential Receptors
<p>Contaminants introduced on-site by historic demolition and construction activities on the site:</p> <ul style="list-style-type: none"> • Heavy metals and semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging) <p>Contaminants from car wash drainage:</p> <ul style="list-style-type: none"> • Anionic Detergents. <p>No elevated determinands noted during chemical testing.</p>	<p>Direct ingestion of soil and soil derived household dust;</p> <p>Dermal contact of soil and soil derived household dust;</p> <p>Ingestion of soil with elevated concentration of determinants;</p> <p>Dermal contact with impacted soils;</p> <p>Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants;</p> <p>Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants.</p>	<p>Via surface water</p> <p>Construction workers (particularly during foundation construction and removal of waste)</p> <p>Service and Maintenance Operatives</p> <p>Site Occupiers</p>
<p>Ground gas produced by putrescible Alluvium underlying site:</p> <ul style="list-style-type: none"> • Carbon Dioxide • Methane <p>In accordance with BS8485, the basement and walls would need to conform to BS 8102:2009 with Grade 2 and 3 waterproofing in order to obtain a gas protection score of 2 and 2.50 respectively. Further risk assessment would be required.</p> <p>However, areas remote from the basement require a risk assessment.</p>	<p>Migration through anthropogenic & natural pathways;</p> <p>Inhalation;</p> <p>Explosive risk.</p>	<p>Construction workers (particularly during foundation construction and removal of waste).</p> <p>Service and Maintenance Operatives.</p> <p>Site Occupiers.</p>

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	Potential Absorption Pathways	Potential Receptors
<p>Contaminants present within groundwater underlying the site:</p> <ul style="list-style-type: none"> • Poly-cyclic Aromatic Hydrocarbons – Benzo(a)pyrene, Fluorene, Dibenzo(A,H)anthracene etc. • Petroleum Hydrocarbons. • Volatile Organic Compounds • Semi-volatile Organic Compounds <p>Marginal exceedance of Arsenic thought to present no risk. No other elevated determinands noted during chemical testing of groundwater.</p> <p>Ground gas produced by putrescible Alluvium underlying site.</p> <ul style="list-style-type: none"> • Carbon Dioxide • Methane <p>In accordance with BS8485, the basement and walls would need to conform to BS 8102:2009 with Grade 2 and 3 waterproofing in order to obtain a gas protection score of 2 and 2.50 respectively. Further risk assessment would be required.</p> <p>However, areas remote from the basement require a risk assessment.</p>	<p>Migration through anthropogenic & natural pathways;</p> <p>Inhalation;</p>	<p>Via surface water;</p> <p>Construction workers (particularly during foundation construction and removal of waste);</p> <p>Service and Maintenance Operatives;</p> <p>Site Occupiers;</p>

The Conceptual Site Model had determined that there is a risk that levels of methane and carbon dioxide may be being produced from the superficial Alluvium underlying the site. Geotechnical testing revealed the Alluvium tested had a low to medium organic content.

In accordance with BS8485, the basement and walls would need to conform to BS 8102:2009 with Grade 2 and 3 waterproofing in order to obtain a gas protection score of 2 and 2.50 respectively. Further risk assessment would be required.

Further risk assessment is therefore recommended in areas remote from the basement. Appropriate monitoring of ground gases will therefore be required with reference to current technical guidance.

7.7 Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation. For example, there may have been underground storage tanks (UST's) not identified during the Ground Investigation for which there is no historical or contemporary evidence.

Such occurrences may be discovered during the demolition and construction phases for the redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified

person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

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

7.8 Waste Disposal

The excavation of foundations is likely to produce waste which will require classification and then recycling or removal from site.

Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all waste must be classified as;

- Inert;
- Non-hazardous, or;
- Hazardous.

The Environment Agency's Hazardous Waste Technical Guidance (WM2) document outlines the methodology for classifying wastes.

Once classified the waste can be removed to the appropriately licensed facilities, with some waste requiring pre-treatments prior to disposal.

Based on a risk phrase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive and undertaken by Ground and Water Limited, the samples of Made Ground encountered on-site were classed as **NON-HAZARDOUS**. The results of the assessment are given within Appendix F.

INERT waste classification should be undertaken to determine if the proposed waste confirms to INERT or NON-HAZARDOUS Waste Acceptable Criteria (WAC).

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM3, therefore producing an initial classification in accordance with the guidance, landfill operators have their own assessment tools and can often come to different conclusions. As a result, some landfill operators could refuse to take apparently suitable waste. It is recommended that the receiving landfill views the results of this assessment and the chemical laboratory results to determine their own classification.

7.9 Imported Material

Any soil which is to be imported onto the site must undergo chemical analysis to prove that it is suitable for the purpose for which it is intended.

A Validation of Imported Materials Method Statement may be required given the amount of materials potentially required to form the first-floor communal gardens.

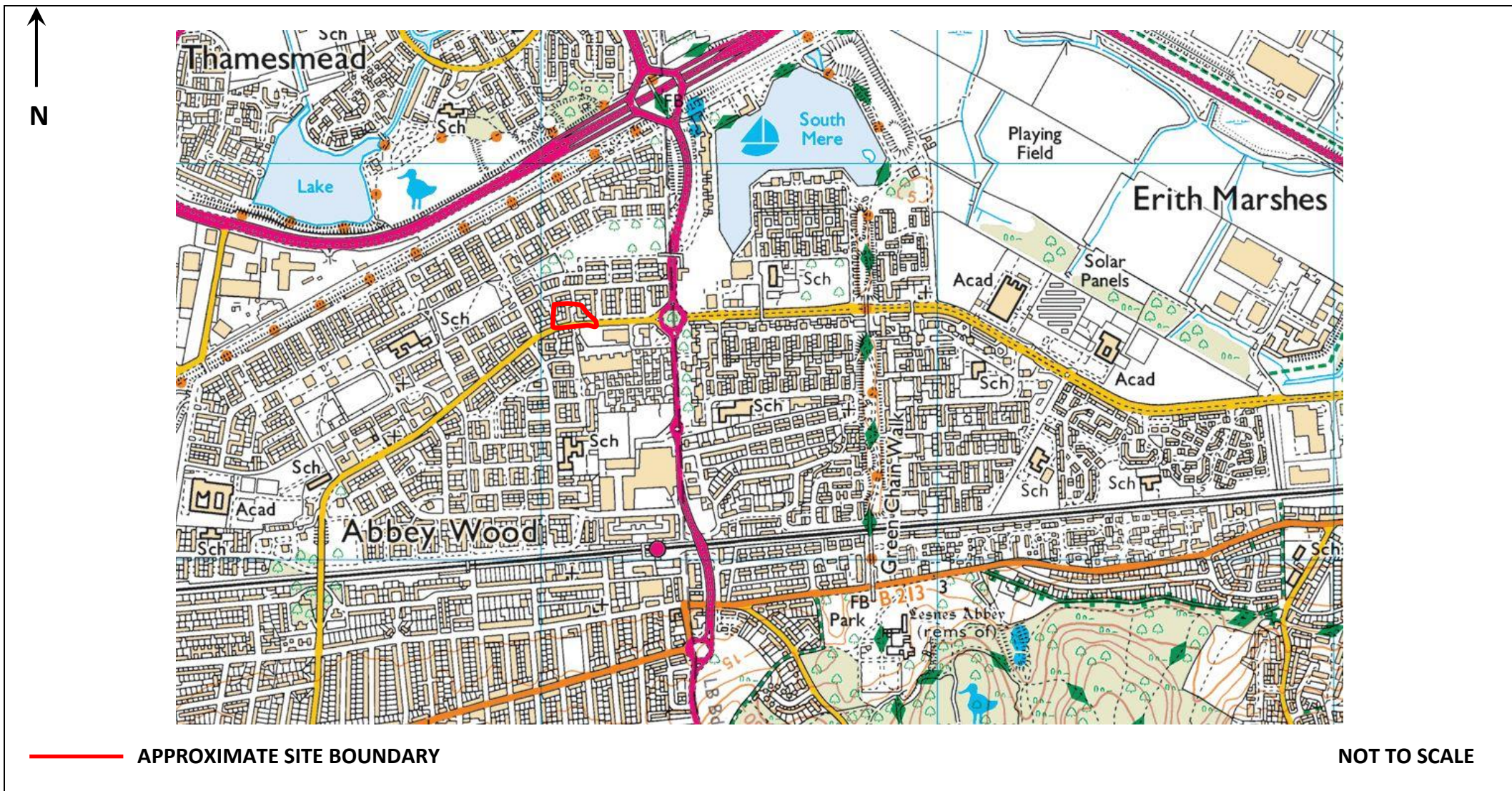
The Topsoil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, either prior to placing (ideally) or after placing, to ensure that the human receptor cannot come into contact with compounds that could be detrimental to human health. The compounds that are to be tested for are those given in the LQM S4UL's, which can be viewed in Appendix E of this report.

7.10 Duty of Care

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

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

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.



Project:

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Client:

Abbey Wood Property Limited c/o Shear Design Limited

Date:

September 2018

Site Location Plan

Ref:

GWPR2179

Figure 1

ground&water



APPROXIMATE SITE BOUNDARY

NOT TO SCALE

Project:

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Client:

Abbey Wood Property Limited c/o Shear Design Limited

Date:

September 2018

Site Development Area

Ref:

GWPR2179

Figure 2

ground&water



— APPROXIMATE SITE BOUNDARY

NOT TO SCALE

Project:

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Client:

Abbey Wood Property Limited c/o Shear Design Limited

Date:

September 2018

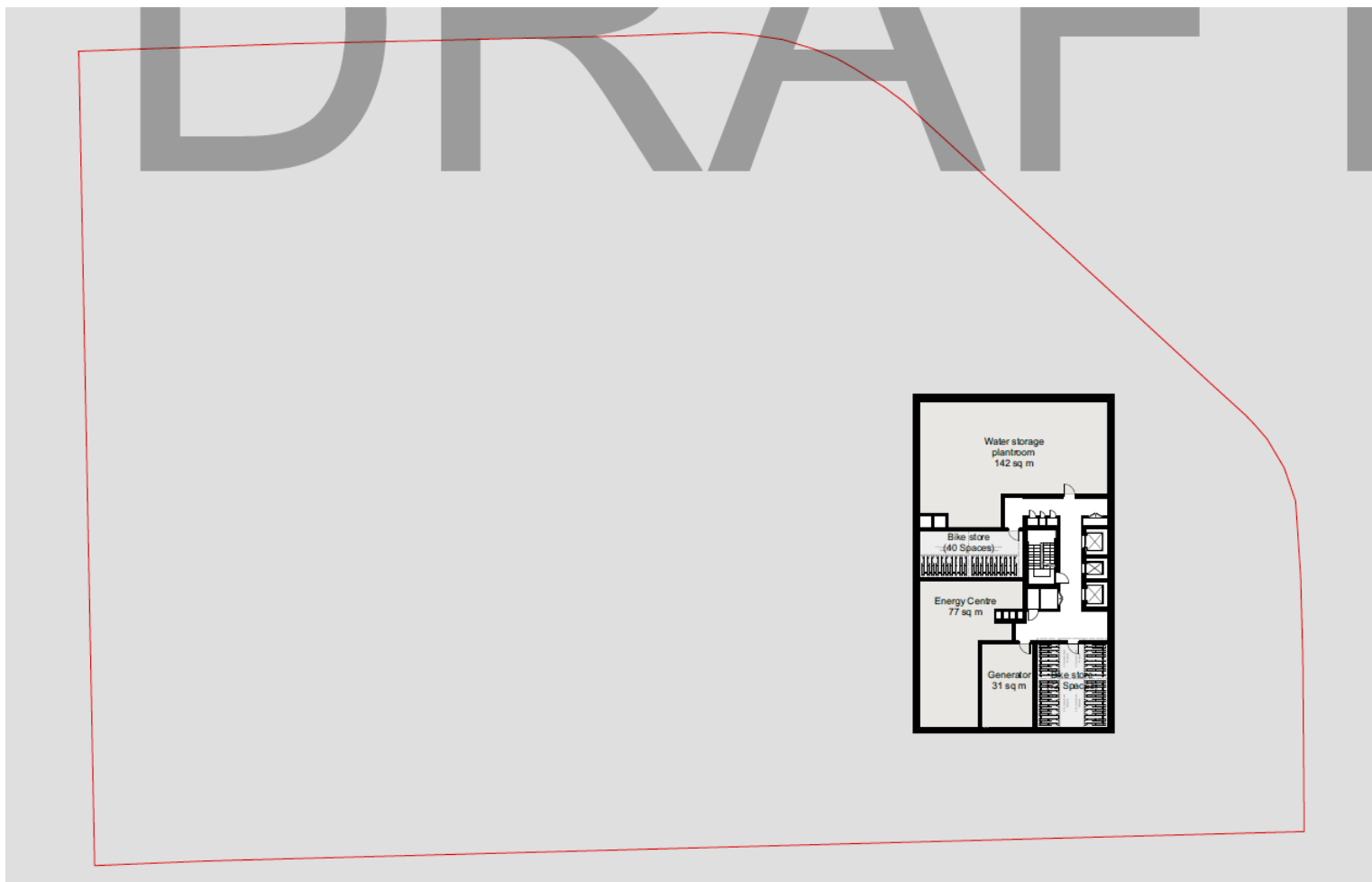
Aerial View of Site

Ref:

GWPR2179

Figure 3

ground&water



NOT TO SCALE

Project:

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Client:

Abbey Wood Property Limited c/o Shear Design Limited

Date:

September 2018

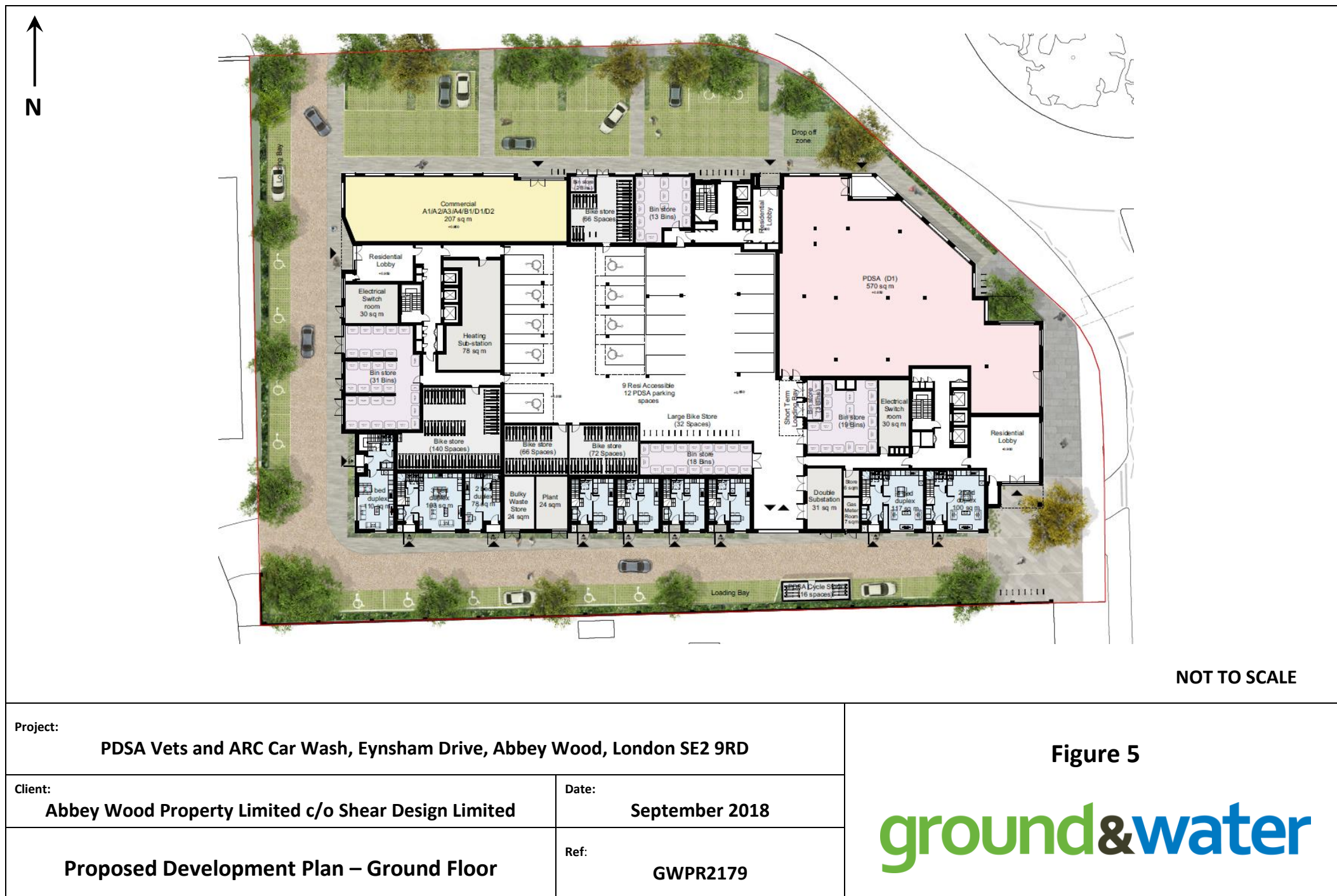
Proposed Development Plan – Basement

Ref:

GWPR2179

Figure 4

ground&water





Project:

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Client:

Abbey Wood Property Limited c/o Shear Design Limited

Date:

September 2018

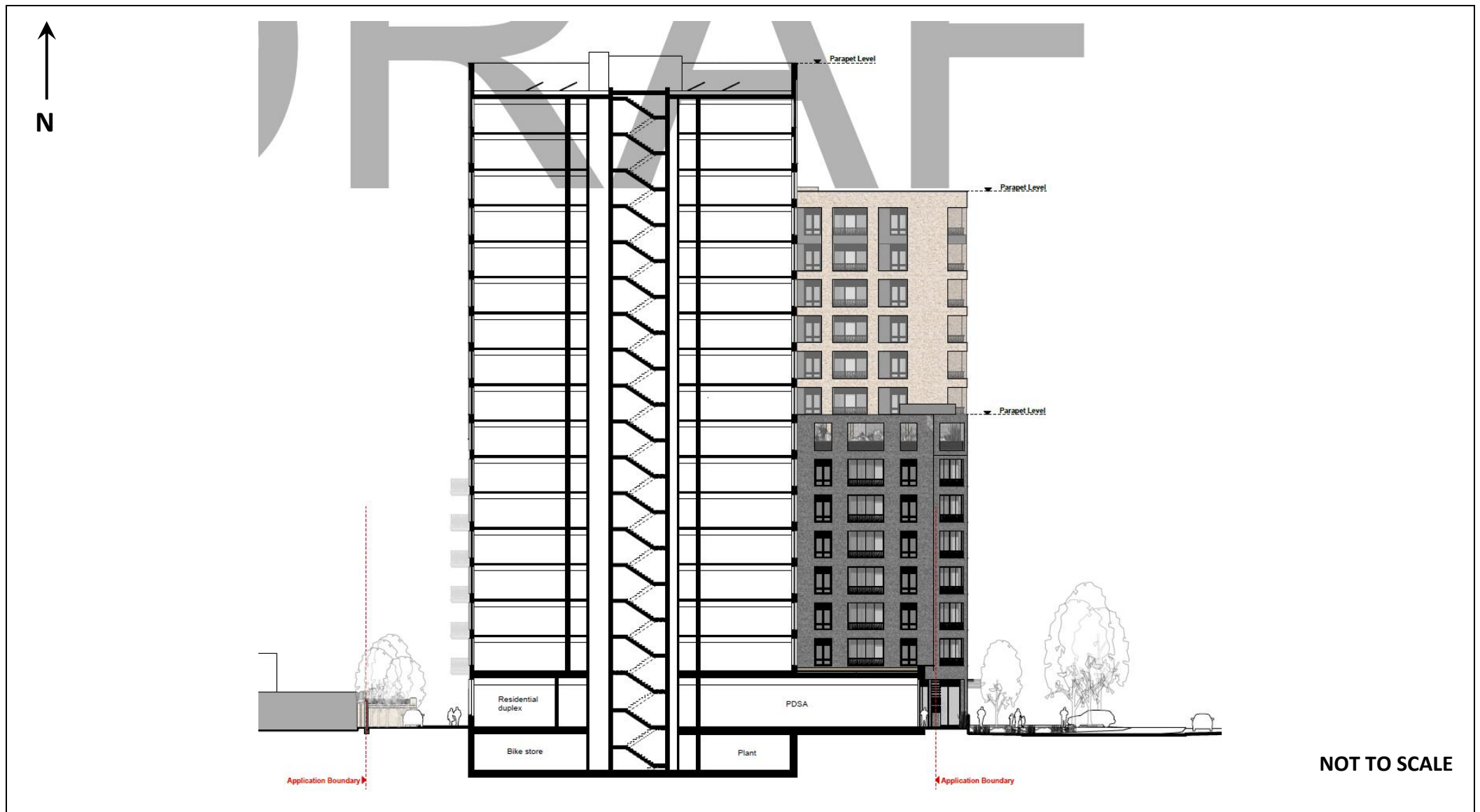
Proposed Development Plan – First Floor

Ref:

GWPR2179

Figure 6

ground&water



Project:

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Client:

Abbey Wood Property Limited c/o Shear Design Limited

Date:

September 2017

Proposed Development – Sectional View

Ref:

GWPR2179

Figure 7

ground&water

APPENDIX A

Conditions and Limitations

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report (“you” or “the Recipient”) are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

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

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD.

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

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

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

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

APPENDIX B
Fieldwork Logs

Project Name
PDSA Vets & ARC Car Wash

Project No.
GWPR2179

Co-ords: -

Hole Type
Cable

Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD

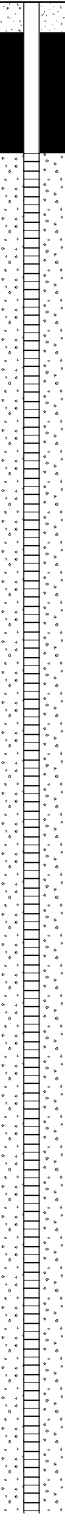



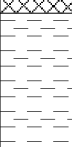




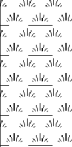


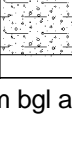
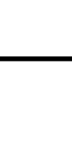

Level: -

Scale
1:50

Client: Abbey Wood Property Limited

Dates: 28/06/2017-29/06/2017

Logged By
DJ

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D		1.00			MADE GROUND: Light brown gravelly clayey sand. Sand is fine to medium grained. Gravel is rare to occasional, sub-rounded to sub-angular, fine to medium flint and glass fragments.	
		1.00	D					MADE GROUND: Dark brown/black gravelly clayey sand. Sand is fine to medium grained. Gravel is occasional, sub-angular to sub-rounded, fine to medium flint and brick.	1
		1.50	SPT	N=7	2.00			ALLUVIUM: Grey-brown CLAY. Colour becomes darker at 3.50m bgl.	2
		1.50	D	(2,2/					
		1.50-2.00	B	1,1,2,3)					
		2.00	D					ALLUVIUM: Grey-brown CLAY. Colour becomes darker at 3.50m bgl.	3
		2.50	D						
		2.50-2.95	U					ALLUVIUM: Grey-brown CLAY. Colour becomes darker at 3.50m bgl.	4
		3.00	D						
		3.50	SPT	N=2	4.00			ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	5
		3.50	D	(0,0/					
		4.00	D	1,0,1,0)				ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	6
		4.50	D						
		4.50-4.95	U					ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	7
		5.00	D						
		5.50	D					ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	8
		6.00	SPT	N=2					
		6.00	D	(0,0/				ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	9
		6.50	D	1,0,0,1)					
		7.00	D					ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	10
		7.50	D						
		7.50-7.95	U					ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	11
		8.00	D						
		8.50	D					ALLUVIUM: Dark brown to black clayey PEAT with decomposed roots. Becomes more clayey from 6.00 - 7.00m bgl.	12
		9.00	SPT	N=13					
		9.00	D	(0,0/				TAPLOW GRAVEL FORMATION: Dark brown/black clayey sandy GRAVEL. Sand is fine to coarse grained. Gravel is abundant, sub-angular	13
		9.00-9.50	B	1,0,5,7)					
		9.50	D		9.50				

Continued next sheet

Remarks: Groundwater strikes at 3.00m rising to 2.50m bgl after 20mins and 9.50m bgl rising to 3.20m bgl after 20mins.
Roots noted to 0.50m bgl.



Project Name

PDSA Vets & ARC Car Wash

Project No.

GWPR2179

Co-ords: -

Hole Type

Cable

Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD

Level: -

Scale

1:50

Client: Abbey Wood Property Limited

Dates: 28/06/2017-29/06/2017

Logged By

DJ

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00	D					to sub-rounded, fine to coarse flint. Colour becomes lighter and gravel coarsens from 11.00m bgl.	
		10.50	SPT	N=14					
		10.50	D	(1,2/					
		10.50-11.00	B	3,3,4,4)					
		11.00	D						11
		11.50	D						
		12.00	SPT	N=15					12
		12.00	D	(2,4/					
		12.00-12.50	B	4,4,3,4)					
		12.50	D						
		13.00	D					THANET SAND FORMATION: Dark grey gravelly silty SAND. Sand is very fine to fine grained. Gravel is rare, sub-angular to sub-rounded flint. Becomes slightly clayey from 15.50m bgl.	13
		13.50	SPT	N=27					
		13.50	D	(3,5/					
		13.50-14.00	B	5,7,7,8)					
		14.00	D						14
		14.50	D		14.50				
		15.00	SPT	N=56					15
		15.00	D	(6,10/					
				12,12,15,17)					
		15.50	D						
		16.00	D						16
		16.50	SPT	53					
		16.50	D	(4,10/					
				15,18,20)					
		17.00	D						17
		17.50	D						
		18.00	SPT	N=90					18
		18.00	D	(7,12/					
				16,22,12,40)					
		18.50	D						
		19.00	D						19
		19.50	SPT	54					
		19.50	D	(8,15/					
				20,34)					
			Type	Results				Continued next sheet	

Remarks: Groundwater strikes at 3.00m rising to 2.50m bgl after 20mins and 9.50m bgl rising to 3.20m bgl after 20mins.
Roots noted to 0.50m bgl.



Project Name

PDSA Vets & ARC Car Wash

Project No.

GWPR2179

Co-ords: -

Hole Type

Cable

Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD

Level: -

Scale

1:50

Client: Abbey Wood Property Limited

Dates: 28/06/2017-29/06/2017

Logged By

DJ

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		20.00	D	56 (6,10/ 15,18,23)	25.00			THANET SAND FORMATION: Dark grey gravelly silty SAND. Sand is very fine to fine grained. Gravel is rare, sub-angular to sub-rounded flint. Becomes slightly clayey from 15.50m bgl.	21
		20.50	D						
		21.00	SPT						
		21.00	D						
		21.50	D	N=100 (7,10/ 14,22,14,50)					22
		22.00	D						
		22.50	SPT						
		22.50	D						
		23.00	D	45 (8,15/ 18,27)					23
		23.50	D						
		24.00	SPT						
		24.00	D						
24.50	D	24							
25.00	D								
End of Borehole at 25.00 m								25	
									26
									27
									28
									29

Remarks: Groundwater strikes at 3.00m rising to 2.50m bgl after 20mins and 9.50m bgl rising to 3.20m bgl after 20mins.
Roots noted to 0.50m bgl.



Project Name
PDSA Vets & ARC Car Wash

Project No.
GWPR2179

Co-ords: -

Hole Type
Cable

Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD

Level: -

Scale
1:50

Client: Abbey Wood Property Limited

Dates: 30/06/2017-01/07/2017

Logged By
DJ

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D					MADE GROUND: Light brown gravelly clayey sand. Sand is fine to medium grained. Gravel is occasional, sub-angular to sub-rounded, fine to medium flint, brick and metal fragments.	
		1.00	D						
		1.20	SPT	N=12 (2,3/					
		1.20-1.70	B	2,3,4,3)					
		2.00	SPT	N=2 (1,0/	2.00			MADE GROUND: Light grey/orange gravelly clayey sand. Sand is fine to medium grained. Gravel is rare, fine to medium, sub-rounded flint and brick fragments.	
		2.00	D	0,1,0,1)					
		2.50	D						
		3.00	D		3.00			ALLUVIUM: Grey - brown CLAY.	
		3.00-3.45	U						
		3.50	D						
		4.00	SPT	N=1 (0,0/	3.80			ALLUVIUM: Black clayey PEAT with decomposed roots. Becomes more clayey at 7.50m bgl. Large decayed root fragments noted at 8.50m bgl.	
		4.00	D	0,0,1,0)					
		4.50	D						
		5.00	D						
		5.00-5.45	U						
		5.50	D						
		6.00	D						
		6.50	SPT	N=2 (0,0/					
		6.50	D	0,1,0,1)					
		7.00	D						
		7.50	D						
		8.00	D						
		8.00-8.45	U						
		8.50	D						
		9.00	D						
		9.50	SPT	N=4 (1,1/	9.50			ALLUVIUM: Grey-brown silty sandy CLAY. Sand is fine grained. Colour becomes darker from 10.50m bgl shell fragments noted	
		9.50	D	1,1,1,1)					

Continued next sheet

Remarks: Groundwater strikes at 3.00m, 8.00m and 13.70m bgl. (Rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins). Roots noted to 3.50m bgl.



Project Name

PDSA Vets & ARC Car Wash

Project No.

GWPR2179

Co-ords: -

Hole Type

Cable

Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD

Level: -

Scale



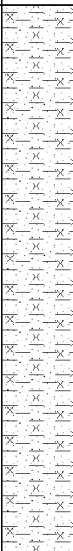
1:50

Client: Abbey Wood Property Limited

Dates: 30/06/2017-01/07/2017

Logged By




DJ


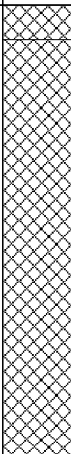
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00	D		13.70		throughout.	11	
		10.50	D						
		11.00	D						
		11.00-11.45	U						
		11.50	D						
		12.00	D						
		12.50	SPT	N=2					
		12.50	D	(0,0/ 1,0,0,1)					
		13.00	D						
		13.50	D						
		14.00	SPT	N=15					
		14.00	D	(1,2/ 2,3,4,6)					
		14.00-14.50	B						
		14.50	D						
		15.00	D						
		15.50	SPT	N=18					
		15.50	D	(2,2/ 3,5,5,5)					
		15.50-16.00	B						
		16.00	D						
	16.50	D							
17.00	SPT	N=20							
17.00	D	(2,3/ 4,4,5,7)							
17.00-17.50	B								
17.50	D								
18.00	D								
18.50	SPT	N=24							
18.50	D	(2,2/ 4,5,7,8)							
18.50-19.00	B								
19.00	D								
19.50	D								
		Type	Results				Continued next sheet		

Remarks: Groundwater strikes at 3.00m, 8.00m and 13.70m bgl. (Rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins).
Roots noted to 3.50m bgl.




Ground and Water Ltd							Borehole No BH2 Sheet 3 of 3				
Project Name PDSA Vets & ARC Car Wash			Project No. GWPR2179		Co-ords: -		Hole Type Cable				
Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD					Level: -		Scale 1:50				
Client: Abbey Wood Property Limited					Dates: 30/06/2017-01/07/2017		Logged By DJ				
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		20.00	SPT	N=26	21.50			TAPLOW GRAVEL FORMATION: Light brown sandy GRAVEL. Sand is fine to coarse grained. Gravel is abundant, sub-angular to sub-rounded, fine to medium flint. Gravel becomes coarser from 18.00m bgl.	21		
		20.00	D	(2,3/							
		20.00-20.50	B	4,5,7,10)							
		20.50	D								
		21.00	D								
		21.50	SPT	N=46							
		21.50	D	(3,7/							
		22.00	D	8,10,12,16)							
		22.50	D								
		23.00	SPT	N=50							
		23.00	D	(8,10/							
		23.50	D	12,14,14,10)							
		24.00	D								
		24.50	SPT	57							
		24.50	D	(10,14/							
25.00	D	20,37)	25.00			End of Borehole at 25.00 m	25				
											26
											27
											28
											29
Remarks: Groundwater strikes at 3.00m, 8.00m and 13.70m bgl. (Rising to 2.10m, 5.50m and 2.80m bgl respectively after 20mins). Roots noted to 3.50m bgl.											

Ground and Water Ltd							Borehole No WS1 Sheet 1 of 1		
Project Name PDSA Vets & ARC Car Wash			Project No. GWPR2179		Co-ords: -		Hole Type WS		
Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD					Level: -		Scale 1:50		
Client: Abbey Wood Property Limited					Dates: 04/07/2017		Logged By DP		
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D		1.10			MADE GROUND: Brown gravelly clay. Gravel is occasional, fine to medium, sub-angular to sub-rounded flint, brick and concrete fragments.	1
		0.50	D						
		1.10	D						
								End of Borehole at 1.10 m	2
									3
									4
									5
									6
									7
									8
									9
Remarks: No groundwater encountered. No roots noted.									

Ground and Water Ltd								Borehole No WS2 Sheet 1 of 1	
Project Name PDSA Vets & ARC Car Wash				Project No. GWPR2179		Co-ords: -		Hole Type WS	
Location: 1a Eynsham Drive, Abbey Wood, London SE2 9RD						Level: -		Scale 1:50	
Client: Abbey Wood Property Limited						Dates: 04/07/2017		Logged By DP	
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D		0.23			MADE GROUND: Pale brown silty sandy gravelly clay. Sand is fine to medium, gravel is occasional, fine to medium, flint, brick and concrete fragments. MADE GROUND: Brown gravelly clay. Gravel is occasional, fine to medium, sub-angular to sub-rounded flint, brick and concrete fragments.	1
		1.00	D						2
		1.50	D						3
		2.00	D						4
		2.50	D						5
		3.00	D		3.00	6			
End of Borehole at 3.00 m									7
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									100

Remarks: No groundwater encountered.
No roots noted.



APPENDIX C
Geotechnical Laboratory Test Results

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
23084	PDSA Vets, Abbey Wood	Samples received	12/07/2017
		Schedule received	10/07/2017
Project No.	Client	Project started	12/07/2017
GWPR2179	Ground & Water Ltd	Testing Started	24/07/2017

[illegible]

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

**Checked and
Approved**

Initials J.P

Date: 27/07/2017

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5-R1(b)



Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618
Facsimile: (01424) 729911
info@elab-uk.co.uk

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 17-13242

Issue: 1

Date of Issue: 27/07/2017

Contact: James Phaure

Customer Details: K4 Soils Laboratory Ltd
Unit 8
Watford
Hertfordshire WD18 9RU

Quotation No: Q16-00568

Order No: Not Supplied

Customer Reference: 23084

Date Received: 24/07/2017

Date Approved: 27/07/2017

Details: PDSA Vets, Abbey Wood

Approved by:

John Wilson, Operations Manager

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



Sample Summary

Report No.: 17-13242

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
107109	BH1 4.50	Not Provided	24/07/2017	Silty loam	a
107110	BH2 9.50	Not Provided	24/07/2017	Silty loam	a



2683

Results Summary

Report No.: 17-13242

ELAB Reference	107109	107110
Customer Reference		
Sample ID		
Sample Type	SOIL	SOIL
Sample Location	BH1	BH2
Sample Depth (m)	4.50	9.50
Sampling Date	Not Provided	Not Provided

Determinand	Codes	Units	LOD		
Miscellaneous					
Soil Organic Matter	U	%	0.1	3.5	6.6



Method Summary

Report No.: 17-13242

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Soil organic matter	U	Air dried sample	27/07/2017	BS1377:P3	Titrimetry

Report Information

Report No.: 17-13242

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C)

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage



Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results
Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9

Job No.	Project Name	Programme	
23084	PDSA Vets, Abbey Wood	Samples received	12/07/2017
		Schedule received	10/07/2017
Project No.	Client	Project started	12/07/2017
GWPR2179	Ground & Water Ltd	Testing Started	24/07/2017

[illegible]

Test Report by K4 SOILS LABORATORY

Unit 8 Olds Close Olds Approach

Watford Herts WD18 9RU

Tel: 01923 711 288

Email: James@k4soils.com

Checked and
Approved

Initials J.P

Date: 27/07/2017

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

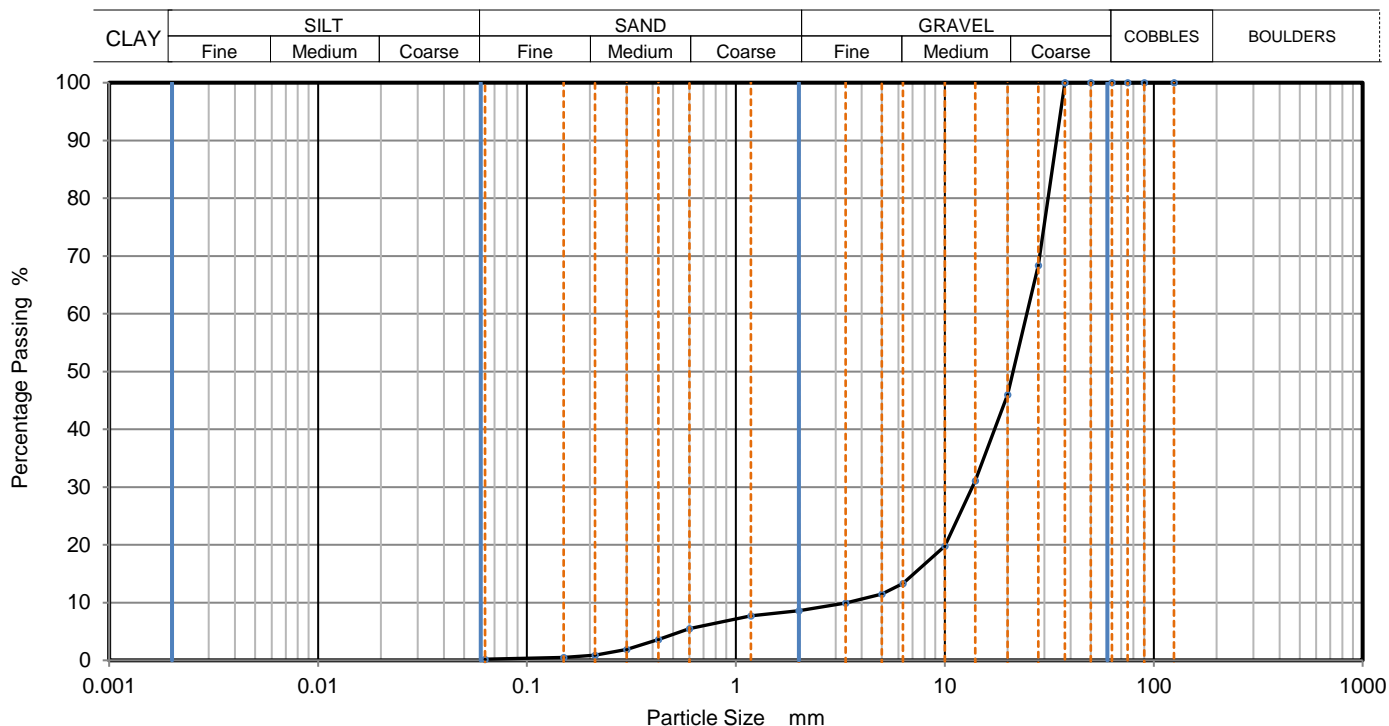
MSF-5-R29



PARTICLE SIZE DISTRIBUTION

Job Ref	23084
Borehole/Pit No.	BH1
Sample No.	-
Depth Top	10.00 m
Depth Base	- m
Sample Type	D
Samples received	12/07/2017
Schedules received	10/07/2017
Project started	12/07/2017
Date tested	25/07/2017

Site Name	PDSA Vets, Abbey Wood		
Project No.	GWPR2179	Client	Ground & Water Ltd
Soil Description	Dark grey sandy GRAVEL (gravel is fmc and sub-rounded to sub-angular)		
Test Method	BS1377:Part 2: 1990, clause 9.0		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	68		
20	46		
14	31		
10	20		
6.3	13		
5	12		
3.35	10		
2	9		
1.18	8		
0.6	6		
0.425	4		
0.3	2		
0.212	1		
0.15	1		
0.063	0		

Dry Mass of sample, g 1425

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	91.4
Sand	8.5
Fines <0.063mm	0.2

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	7.2
Curvature Coefficient	2.2

Remarks
Preparation and testing in accordance with BS1377 unless noted below



K4 Soils Laboratory
Unit 8, Olds Close, Watford, Herts, WD18 9RU
Email: james@k4soils.com
Tel: 01923 711288

Checked and Approved

Initials: J.P
Date: 27/07/2017



PARTICLE SIZE DISTRIBUTION

Job Ref 23084

Borehole/Pit No. BH2

Site Name PDSA Vets, Abbey Wood

Sample No. -

Project No. GWPR2179 Client Ground & Water Ltd

Depth Top 2.50 m

Soil Description

Brownish grey gravelly very clayey SAND with traces of rootlets and wood fragments (gravel is fmc and sub-angular to rounded)

Depth Base - m

Sample Type D

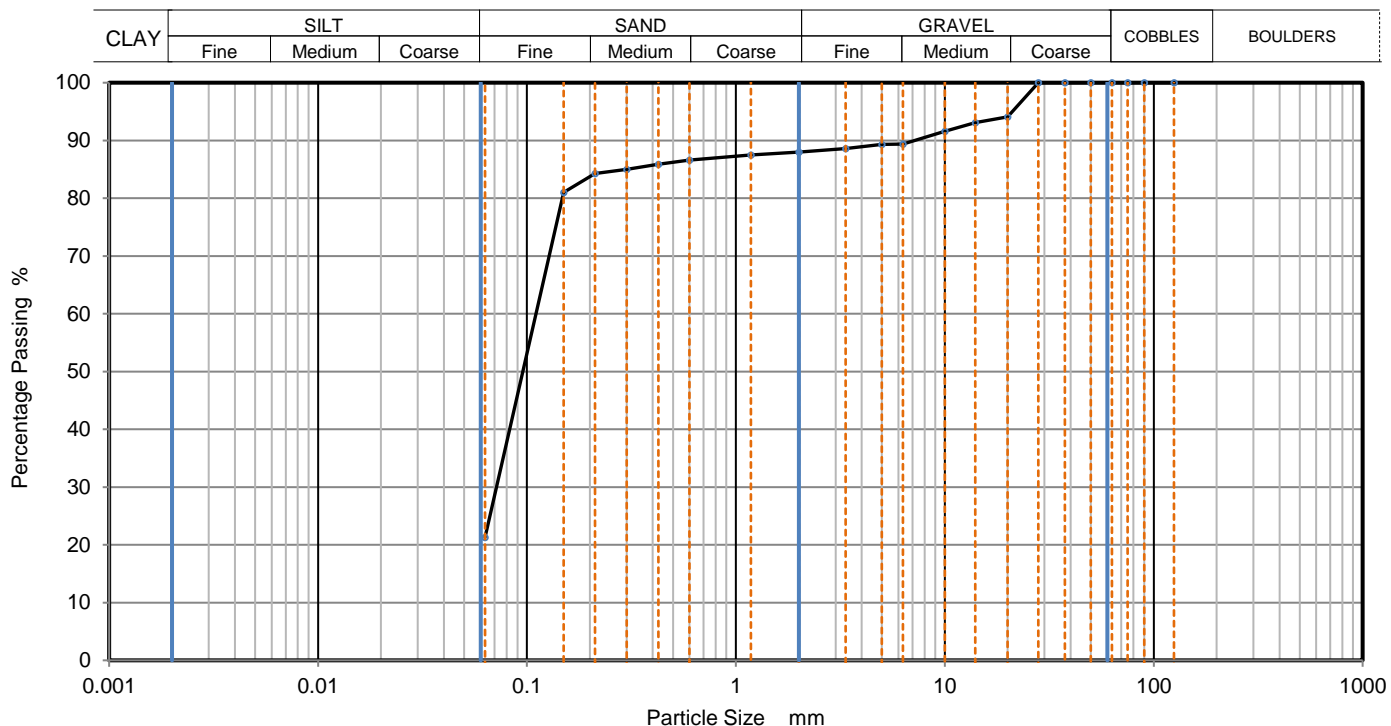
Samples received 12/07/2017

Schedules received 10/07/2017

Test Method BS1377:Part 2: 1990, clause 9.0

Project started 12/07/2017

Date tested 25/07/2017



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	94		
14	93		
10	92		
6.3	89		
5	89		
3.35	89		
2	88		
1.18	88		
0.6	87		
0.425	86		
0.3	85		
0.212	84		
0.15	81		
0.063	21		

Dry Mass of sample, g

498

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	12.0
Sand	66.7
Fines <0.063mm	21.3

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below



2519

K4 Soils Laboratory

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

Email: james@k4soils.com

Tel: 01923 711288

Checked and Approved

Initials: J.P

Date: 27/07/2017

MSF-5-R3

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)



PARTICLE SIZE DISTRIBUTION

Job Ref 23084

Borehole/Pit No. BH2

Site Name PDSA Vets, Abbey Wood

Sample No. -

Project No. GWPR2179 Client Ground & Water Ltd

Depth Top 14.00 m

Soil Description

Brown very sandy GRAVEL (gravel is fmc and sub-angular to rounded)

Depth Base - m

Sample Type D

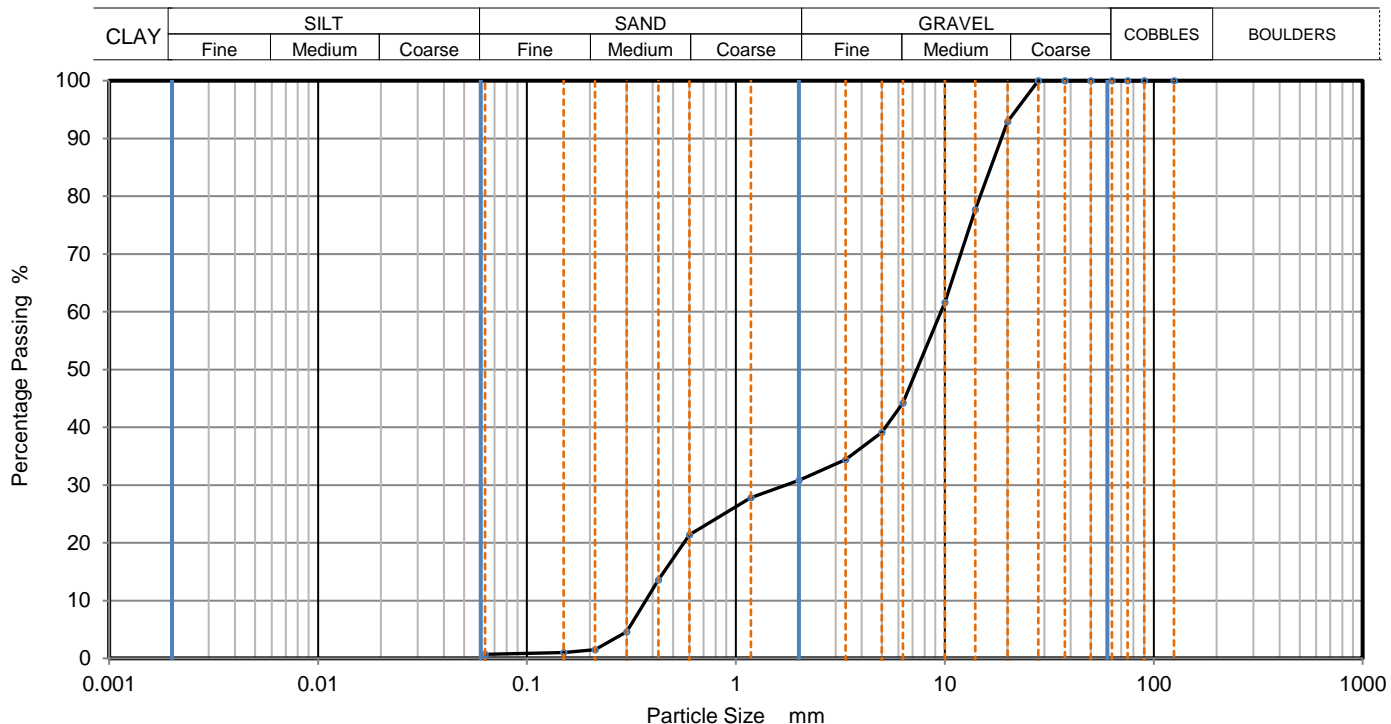
Samples received 12/07/2017

Schedules received 10/07/2017

Test Method BS1377:Part 2: 1990, clause 9.0

Project started 12/07/2017

Date tested 25/07/2017



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	93		
14	78		
10	62		
6.3	44		
5	39		
3.35	34		
2	31		
1.18	28		
0.6	21		
0.425	14		
0.3	5		
0.212	2		
0.15	1		
0.063	1		

Dry Mass of sample, g 1220

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	69.2
Sand	30.1
Fines <0.063mm	0.7

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	26
Curvature Coefficient	0.85

Remarks

Preparation and testing in accordance with BS1377 unless noted below

7



2519

K4 Soils Laboratory

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

Email: james@k4soils.com

Tel: 01923 711288

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Checked and Approved

Initials: J.P

Date: 27/07/2017

MSF-5-R3

APPENDIX D
Chemical Laboratory Test Results



Darina Jurovskaja
Ground & Water Ltd
2 The Long Barn
Norton Farm
Selborne Road
Alton
Hampshire
GU34 3NB

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

QTS Environmental Report No: 17-61394

Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD

Project / Job Ref: GWPR2179

Order No: None Supplied

Sample Receipt Date: 11/07/2017

Sample Scheduled Date: 11/07/2017

Report Issue Number: 1

Reporting Date: 17/07/2017

Authorised by:

Kevin Old
Associate Director of Laboratory

Authorised by:

Russell Jarvis
Associate Director of Client Services

QTSE is the trading name of DETS Ltd, company registration number 03705645



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
QTS Environmental Report No: 17-61394	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	BH1	BH2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	4.00	8.50			
Reporting Date: 17/07/2017	QTSE Sample No	278990	278991			

Determinand	Unit	RL	Accreditation	(n)	(n)			
pH	pH Units	N/a	MCERTS	7.5	7.5			
Total Sulphate as SO ₄	mg/kg	< 200	NONE	5565	1667			
Total Sulphate as SO ₄	%	< 0.02	NONE	0.56	0.17			
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	2450	551			
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	2.45	0.55			
Total Sulphur	%	< 0.02	NONE	1.69	0.41			
Ammonium as NH ₄	mg/kg	< 0.5	NONE	70.1	634			
Ammonium as NH ₄	mg/l	< 0.05	NONE	7.01	63.40			
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	770	1960			
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	385	981			
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	< 3	MCERTS	21	13			
Water Soluble Nitrate (2:1) as NO ₃	mg/l	< 1.5	MCERTS	10.5	6.6			
W/S Magnesium	mg/l	< 0.1	NONE	71	14			

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
 Subcontracted analysis ^(S)
 (n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Water Analysis Certificate						
QTS Environmental Report No: 17-61394	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	BH1	BH2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	None Supplied	None Supplied			
Reporting Date: 17/07/2017	QTSE Sample No	278988	278989			

Determinand	Unit	RL	Accreditation	(hs)	(hs)			
pH	pH Units	N/a	ISO17025	7.5	7.4			
Total Cyanide	ug/l	< 5	NONE	< 5	< 5			
Sulphate as SO ₄	mg/l	< 1	ISO17025	181	192			
Arsenic (dissolved)	ug/l	< 5	ISO17025	11	12			
Boron (dissolved)	ug/l	< 5	ISO17025	606	621			
Cadmium (dissolved)	ug/l	< 0.4	ISO17025	< 0.4	< 0.4			
Chromium (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Chromium (hexavalent)	ug/l	< 20	NONE	< 20	< 20			
Copper (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Lead (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Mercury (dissolved)	ug/l	< 0.05	ISO17025	< 0.05	< 0.05			
Nickel (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Selenium (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Vanadium (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Zinc (dissolved)	ug/l	< 2	ISO17025	< 2	< 2			
Total Phenols (monohydric)	ug/l	< 10	NONE	< 10	< 10			

Subcontracted analysis ^(S)
Insufficient sample ^{I/S}
Unsuitable Sample ^{U/S}
(hs) Please note deviating sample due to head space in container



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Water Analysis Certificate - Speciated PAH						
QTS Environmental Report No: 17-61394	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	BH1	BH2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	None Supplied	None Supplied			
Reporting Date: 17/07/2017	QTSE Sample No	278988	278989			

Determinand	Unit	RL	Accreditation	(hs)	(hs)			
Naphthalene	ug/l	< 0.01	NONE	0.15	0.24			
Acenaphthylene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Acenaphthene	ug/l	< 0.01	NONE	0.04	0.05			
Fluorene	ug/l	< 0.01	NONE	0.02	0.03			
Phenanthrene	ug/l	< 0.01	NONE	0.03	0.04			
Anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Pyrene	ug/l	< 0.01	NONE	0.01	< 0.01			
Benzo(a)anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Chrysene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(b)fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(k)fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(a)pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Dibenz(a,h)anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(ghi)perylene	ug/l	< 0.008	NONE	< 0.008	< 0.008			
Total EPA-16 PAHs	ug/l	< 0.01	NONE	0.25	0.36			



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Water Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 17-61394	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	BH1	BH2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	None Supplied	None Supplied			
Reporting Date: 17/07/2017	QTSE Sample No	278988	278989			

Determinand	Unit	RL	Accreditation	(hs)	(hs)			
Aliphatic >C5 - C6	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C6 - C8	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C8 - C10	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C10 - C12	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C12 - C16	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C16 - C21	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C21 - C34	ug/l	< 10	NONE	< 10	< 10			
Aliphatic (C5 - C34)	ug/l	< 70	NONE	< 70	< 70			
Aromatic >C5 - C7	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C7 - C8	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C8 - C10	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C10 - C12	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C12 - C16	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C16 - C21	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C21 - C35	ug/l	< 10	NONE	< 10	< 10			
Aromatic (C5 - C35)	ug/l	< 70	NONE	< 70	< 70			
Total >C5 - C35	ug/l	< 140	NONE	< 140	< 140			

(hs) Please note deviating sample due to head space in container



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Water Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 17-61394	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	BH1	BH2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	None Supplied	None Supplied			
Reporting Date: 17/07/2017	QTSE Sample No	278988	278989			

Determinand	Unit	RL	Accreditation	(hs)	(hs)			
Benzene	ug/l	< 1	ISO17025	< 1	< 1			
Toluene	ug/l	< 5	ISO17025	< 5	< 5			
Ethylbenzene	ug/l	< 5	ISO17025	< 5	< 5			
p & m-xylene	ug/l	< 10	ISO17025	< 10	< 10			
o-xylene	ug/l	< 5	ISO17025	< 5	< 5			
MTBE	ug/l	< 10	ISO17025	< 10	< 10			

(hs) Please note deviating sample due to head space in container



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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 17-61394	
Ground & Water Ltd	
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	
Project / Job Ref: GWPR2179	
Order No: None Supplied	
Reporting Date: 17/07/2017	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
278990	BH1	None Supplied	4.00	27.5	Green silt
278991	BH2	None Supplied	8.50	28.4	Brown silt

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

Insufficient Sample ^{1/5}

Unsuitable Sample ^{U/5}



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 17-61394	
Ground & Water Ltd	
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	
Project / Job Ref: GWPR2179	
Order No: None Supplied	
Reporting Date: 17/07/2017	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	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-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle 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 aqua-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 iron (II) sulphate	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)	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



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 17-61394	
Ground & Water Ltd	
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	
Project / Job Ref: GWPR2179	
Order No: None Supplied	
Reporting Date: 17/07/2017	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	UF	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR detection	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GI-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	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)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	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 liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered
UF Unfiltered



Darina Jurovskaja
Ground & Water Ltd
2 The Long Barn
Norton Farm
Selborne Road
Alton
Hampshire
GU34 3NB

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

QTS Environmental Report No: 17-61492

Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD

Project / Job Ref: GWPR2179

Order No: None Supplied

Sample Receipt Date: 13/07/2017

Sample Scheduled Date: 13/07/2017

Report Issue Number: 1

Reporting Date: 19/07/2017

Authorised by:

Kevin Old
Associate Director of Laboratory

Authorised by:

Russell Jarvis
Associate Director of Client Services

QTSE is the trading name of DETS Ltd, company registration number 03705645



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
QTS Environmental Report No: 17-61492	Date Sampled	04/07/17	04/07/17	04/07/17		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	TP1	TP1	TP2		
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.20	0.50	0.50		
Reporting Date: 19/07/2017	QTSE Sample No	279285	279286	279287		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	7.7	7.7	7.7		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	29	41	24		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.03	0.04	0.02		
Organic Matter	%	< 0.1	MCERTS	2	1.4	0.7		
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	1.2	0.8	0.4		
Arsenic (As)	mg/kg	< 2	MCERTS	11	12	5		
W/S Boron	mg/kg	< 1	NONE	< 1	2	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	16	23	10		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	34	11	16		
Lead (Pb)	mg/kg	< 3	MCERTS	154	24	46		
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	12	19	8		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3		
Vanadium (V)	mg/kg	< 2	NONE	28	44	19		
Zinc (Zn)	mg/kg	< 3	MCERTS	114	62	56		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 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)

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: Javeed Malik

RL: Reporting Limit

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

Subcontracted analysis ^(S)



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 17-61492	Date Sampled	04/07/17	04/07/17	04/07/17		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	TP1	TP1	TP2		
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.20	0.50	0.50		
Reporting Date: 19/07/2017	QTSE Sample No	279285	279286	279287		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	0.62	< 0.1	0.14		
Anthracene	mg/kg	< 0.1	MCERTS	0.14	< 0.1	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	1.36	< 0.1	0.54		
Pyrene	mg/kg	< 0.1	MCERTS	1.17	< 0.1	0.45		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.55	< 0.1	0.20		
Chrysene	mg/kg	< 0.1	MCERTS	0.60	< 0.1	0.18		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.61	< 0.1	0.19		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.36	< 0.1	0.11		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.45	< 0.1	0.15		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.25	< 0.1	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.20	< 0.1	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	6.3	< 1.6	1.9		

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



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 17-61492	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	TP1	TP2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	0.20	0.50			
Reporting Date: 19/07/2017	QTSE Sample No	279285	279287			

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10			
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21			
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3			
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10			
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21			
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42			

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



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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 17-61492	Date Sampled	04/07/17	04/07/17			
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	TP / BH No	TP1	TP2			
Project / Job Ref: GWPR2179	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	0.20	0.50			
Reporting Date: 19/07/2017	QTSE Sample No	279285	279287			

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2			
Toluene	ug/kg	< 5	MCERTS	< 5	< 5			
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2			
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2			
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2			
MTBE	ug/kg	< 5	MCERTS	< 5	< 5			

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



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Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 17-61492	
Ground & Water Ltd	
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	
Project / Job Ref: GWPR2179	
Order No: None Supplied	
Reporting Date: 19/07/2017	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
279285	TP1	None Supplied	0.20	7.1	Brown sandy clay with stones
279286	TP1	None Supplied	0.50	14.1	Brown sandy clay with stones
279287	TP2	None Supplied	0.50	5.6	Brown sandy clay with stones

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

Insufficient Sample ^{1/5}

Unsuitable Sample ^{U/5}



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 17-61492	
Ground & Water Ltd	
Site Reference: 1A Eynsham Drive, Abbey Wood, London, SE2 9RD	
Project / Job Ref: GWPR2179	
Order No: None Supplied	
Reporting Date: 19/07/2017	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	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-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle 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 aqua-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 iron (II) sulphate	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)	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 E
Soil Assessment Criteria

Appendix E

Soil Guideline Values and General Assessment Criteria

E1 Assessment Criteria

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

E1.1 Contaminated Land Exposure Assessment Model (CLEA)

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

The CLEA Guidance comprises the following documents:

- 1) EA Science Report SC050021/SR2: *Human health toxicological assessment of contaminants in soil.*
- 2) EA Science Report SC050021/SR3: *Updated technical background to the CLEA model.*
- 3) EA CLEA Bulletin (2009).
- 4) CLEA software version 1.06 (2009)
- 5) Toxicological reports and SGV technical notes.

The CLEA guidance and tools:

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

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

E1.2 Land-use Scenarios

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

1 Residential (with home grown produce) (RwHP)

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

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

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur. (Residential without homegrown produce (RwoHP)).

2) **Allotments**

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

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

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

3) **Commercial/Industrial**

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

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

E1.4 **LQM/CIEH SUITABLE 4 USE LEVELS (S4UL)**

For derivation of these S4UL reference must be made to:

Nathanial, P., McCaffrey, C., Gillet, A., Ogden, R., Nathanial, J., *The LQM/CIEH S4UL's for Human Health Risk Assessment*. Land Quality Press. 2015

The LQM/CIEH S4UL for a given land use is the concentration of the contaminant in soil at which the predicted daily exposure, as calculated by the CLEA software, equals the Health Criteria Value.

The final output for each contaminant represents a synthesis of new toxicological (and fate and transport) reviews published since the preparation of the 2nd edition LQM/CIEH GAC's (Nathanial et al., 2009).

In the derivation of LQM/CIEH S4UL's the principles of 'minimal' or 'tolerable' risk enshrined in SR2, which has not been withdrawn, has been maintained.

S4UL's have been derived for the basic CLEA land-uses, as described above, and for two new land uses:

- Public Open Spaces near Residential Housing (POSresi)
- Public Park (POSpark).

Public Open Spaces near Residential Housing (POSresi)

Includes the predominantly grassed areas adjacent to high density housing, the central green area on many 1930's – 1970's housing estates, and smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soils with planting. It is assumed that the close proximity to the place of residence will allow tracking back of soil to occur.

Public Park (POSpark)

An area of open space, usually owned and maintained by the local authority, provided for recreational uses including family visits and picnics, children's play area, informal sporting activities (not a dedicated sports pitch), and dog walking. It is assumed that tracking back of soils into places of residence will be negligible.

The following LQM/CIEH S4ULs (Copyright Land Quality Management Limited) have been reproduced with permission, to the publication number S4UL3072

E1.5 Category 4 Screening Levels (C4SLs)

In the case of Lead, no SGV or GAC has been published to date. This is likely to be due to the toxicity review that is currently being undertaken by the Environment Agency. In the absence of updated toxicity information the SGV derived using CLEA 1.06 methodology and related toxicity will be used.

The overall objective of the C4SLs research project was to assist the provision of technical guidance in support of Defra's revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A) (Defra, 2012a). Specifically, the project aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised SG presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high. More specific guidance on what type of land should be considered as Category 4 (Human Health) is provided in Paragraphs 4.21 and 4.22 of the revised SG, as follows:

“4.21 The local authority should consider that the following types of land should be placed into Category 4: Human Health:

(a) Land where no relevant contaminant linkage has been established.

(b) Land where there are only normal levels of contaminants in soil, as explained in Section 3 of this Guidance.

(c) Land that has been excluded from the need for further inspection and assessment because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of this Guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of this Guidance.

(d) Land where estimated levels of exposure to contaminants in soil are likely to form only a small proportion of what a receptor might be exposed to anyway through other sources of environmental exposure (e.g. in relation to average estimated national levels of exposure to substances commonly found in the environment, to which receptors are likely to be exposed in the normal course of their lives).

4.22 The local authority may consider that land other than the types described in paragraph 4.21 should be placed into Category 4: Human Health if following a detailed quantitative risk assessment it is satisfied that the level of risk posed is sufficiently low.”

The C4SLs are intended as “relevant technical tools” (in relation to Paragraph 4.21(c)) to help local authorities and others when deciding to stop further assessment of a site, on the grounds that it falls within Category 4 (Human Health).

The Impact Assessment (IA), which accompanied the revised SG (Defra, 2012b) provides further information on the nature and potential role of the C4SLs. Paragraph 47(h) of the IA states that:

“The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land.”

A key distinction between the Soil Guideline Values (SGVs) and the C4SLs is the level of risk that they describe. As described by the Environment Agency (2009a): *“SGVs are guidelines on the level of long-term human exposure to individual chemicals in soil that, unless stated otherwise, are tolerable or pose a minimal risk to human health.”*

The implication of Paragraph 47(h) of the IA is that minimal risk is well within Category 4 and that the C4SLs should describe a higher level of risk which, whilst not minimal, can still be considered low enough to allow a judgement to be made that land containing substances at, or below, the C4SLs would typically fall within Category 4. This reflects Paragraph 4.20 of the revised SG, which states:

“4.20 The local authority should not assume that land poses a significant possibility of significant harm if it considers that there is no risk or that the level of risk posed is low. For the purposes of this Guidance, such land is referred to as a “Category 4: Human Health” case. The authority may decide that the land is a Category 4: Human Health case as soon as it considers it has evidence to this effect, and this may happen at any stage during risk assessment including the early stages.”

C4SLs, therefore, should not be viewed as “SPOSH levels” and they should not be used as a legal trigger for the determination of land under Part 2A.

The generic screening values referred to before usually take the form of risk-based Soil Guideline Values (SGVs) or other Generic Assessment Criteria (GACs) that are most typically derived using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) model, as described in the Environment Agency's SR2, SR3 and SR7 reports (EA, 2009b & c; EA, 2008). It is anticipated that C4SLs will be used in a similar manner; as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the SGVs.

The suggested approach to the development of C4SLs consists of the retention and use of the CLEA framework, modified according to considerations of the underlying science within the context of Defra's policy objectives relating to the revised SG. Within this context, it is suggested that the development of C4SLs may be achieved in one of three ways, namely:

- By modifying the toxicological parameters used within CLEA (while maintaining current exposure parameters);
- By modifying the exposure parameters embedded within CLEA (while maintaining current toxicological “minimal risk” interpretations); and
- By modifying both toxicological and exposure parameters.

There is also a suggested check on “other considerations” (e.g., background levels, epidemiological data, sources of uncertainty) within the approach, applicable to all three options.

It is suggested that a new term is defined for the toxicological guidance values associated with the derivation of C4SLs – a Low Level of Toxicological Concern (LLTC). A LLTC should represent an intake of low concern that remains suitably protective of health, and definitely does not approach an intake level that could be defined as SPOSH.

E1.6 CL:AIRE Generic Assessment Criteria (GAC)

For derivation of the CL:AIRE Generic Assessment Criteria (GAC) reference should be made to the following report:

CL:AIRE, *The Soil Generic Assessment Criteria for Human Health Risk Assessment. Contaminated Land: Applications in the Real Environment*. 2009.

Within this report CL:AIRE provided Generic Assessment Criteria (GAC's) in accordance with the CLEA software and the principles outlined above for a further 35 contaminants sometime encountered on land affected by contamination.

E1.7 Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of an S4UL/GAC/C4SL is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses then a DQRA may be undertaken to develop site specific values for relevant soil contaminants.

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

E1.8 Phytotoxicity

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

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

E1.8 Statistical Tests

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

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

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

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

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

Treatment of Hot-Spots

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

E2 Ground and Water Limited Soil Assessment Criteria

The Soil Assessment Criteria used in the preparation of this report are tabulated in the following pages:

C4SL Low Level of Toxicological Concern

C4SL Low Level of Toxicological Concern						
Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Lead	<210	<330	<84	<6000	<760	<1400

Phytotoxicity Recommendations

ICRCL 70/90 *Restoration of metalliferous mining areas*

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

Cont'd Overleaf:

Cont'd from previous page:
LQM CIEH Suitable 4 Use Levels (S4UL's)

LQM/CIEH Suitable 4 Use Levels – Metals and Semi-metals						
Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
<i>Metals:</i>						
Arsenic	37	40	43	640	79	170
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11000	45	240000	21000	46000
Cadmium	11	85	1.9	190	120	532
Chromium (III)	910	910	18000	8600	1500	33000
Chromium (VI)	6	6	1.8	33	7.7	20
Copper	2400	7100	520	68000	12000	44000
Elemental Mercury	1.2	1.2	21	58	16	30
Inorganic Mercury	40	56	19	1100	120	240
Methylmercury	11	15	6	320	40	68
Nickel	180	180	230	980	230	3400
Selenium	250	430	88	12000	1100	1800
Vanadium	410	1200	91	9000	2000	5000
Zinc	3700	40000	620	730000	81000	170000

LQM/CIEH Suitable 4 Use Levels – BTEX Compounds							
Contaminant	Soil Organic Matter	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Benzene	1.0% SOM	0.087	0.38	0.017	27	72	90
	2.5% SOM	0.170	0.70	0.034	47	72	100
	6.0% SOM	0.370	1.40	0.075	90	73	110
Toluene	1.0% SOM	130	880	22	56000	56000	87000
	2.5% SOM	290	1900	51	110000	56000	95000
	6.0% SOM	660	3900	120	180000	56000	100000
Ethylbenzene	1.0% SOM	47	83	16	5700	24000	17000
	2.5% SOM	110	190	39	13000	24000	22000
	6.0% SOM	260	440	91	27000	25000	27000
o-Xylene	1.0% SOM	60	88	28	6600	41000	17000
	2.5% SOM	140	210	67	15000	42000	24000
	6.0% SOM	330	480	160	33000	43000	33000
m-Xylene	1.0% SOM	59	82	31	6200	41000	17000
	2.5% SOM	140	190	74	14000	42000	24000
	6.0% SOM	320	450	170	31000	43000	33000
p-Xylene	1.0% SOM	56	79	29	5900	41000	17000
	2.5% SOM	130	180	69	14000	42000	23000
	6.0% SOM	310	430	160	30000	43000	31000
The most health protective value in each scenario for Xylene is highlighted in bold.							

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LQM/CIEH Suitable 4 Use Levels For TPH							
Aliphatic		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
EC 5-6	1.0% SOM	42	42	730	3,200 (304) ^{sol}	570,000 (304) ^{sol}	95,000 (304) ^{sol}
	2.5% SOM	78	78	1,700	5,900 (558) ^{sol}	590,000	130,000 (558) ^{sol}
	6.0% SOM	160	160	3,900	12,000 (1150) ^{sol}	600,000 ^l	180,000 (1150) ^{sol}
EC >6-8	1.0% SOM	100	100	2,300	7,800 (144) ^{sol}	600,000	150,000 (144) ^{sol}
	2.5% SOM	230	230	5,600	17,000 (322) ^{sol}	610,000	220,000 (322) ^{sol}
	6.0% SOM	530	530	13,000	40,000 (736) ^{sol}	620,000	320,000 (736) ^{sol}
EC >8-10	1.0% SOM	27	27	320	2,000 (78) ^{sol}	13,000	14,000 (78) ^{sol}
	2.5% SOM	65	65	770	4,800 (118) ^{vap}	13,000	18,000 (118) ^{vap}
	6.0% SOM	150	150	1,700	11,000 (451) ^{vap}	13,000	21,000 (451) ^{vap}
EC >10-12	1.0% SOM	130 (48) ^{vap}	130 (48) ^{vap}	2,200	9,700 (48) ^{sol}	13,000	21,000 (48) ^{sol}
	2.5% SOM	330 (118) ^{vap}	330 (118) ^{vap}	4,400	23,000 (118) ^{vap}	13,000	23,000 (118) ^{vap}
	6.0% SOM	760 (283) ^{vap}	770 (283) ^{vap}	7,300	47,000 (283) ^{vap}	13,000	24,000 (283) ^{vap}
EC >12-16	1.0% SOM	1,100 (24) ^{sol}	1,100 (24) ^{sol}	11,000	59,000 (24) ^{sol}	13,000	25,000 (24) ^{sol}
	2.5% SOM	2,400 (59) ^{sol}	2,400 (59) ^{sol}	13,000	82,000 (59) ^{sol}	13,000	25,000 (59) ^{sol}
	6.0% SOM	4,300 (142) ^{sol}	4,400 (142) ^{sol}	13,000	90,000 (142) ^{sol}	13,000	26,000 (142) ^{sol}
EC >16-35	1.0% SOM	65,000 (8.48) ^{sol}	65,000 (8.48) ^{sol}	260,000	1,600,000	250,000	450,000
	2.5% SOM	92,000 (21) ^{sol}	92,000 (21) ^{sol}	270,000	1,700,000	250,000	480,000
	6.0% SOM	110,000	110,000	270,000	1,800,000	250,000	490,000
EC >35-44	1.0% SOM	65,000 (8.48) ^{sol}	65,000 (8.48) ^{sol}	260,000	1,600,000	250,000	450,000
	2.5% SOM	92,000 (21) ^{sol}	92,000 (21) ^{sol}	270,000	1,700,000	250,000	480,000
	6.0% SOM	110,000	110,000	270,000	1,800,000	250,000	490,000

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LQM/CIEH Suitable 4 Use Levels For TPH							
Aromatic		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
EC 5-7 (Benzene)	1.0% SOM	70	370	13	26,000 (1220) ^{sol}	56,000	76,000 (1220) ^{sol}
	2.5% SOM	140	690	27	46,000 (2260) ^{sol}	56,000	84,000 (2260) ^{sol}
	6.0% SOM	300	1,400	57	86,000 (4710) ^{sol}	56,000	92,000 (4710) ^{sol}
EC >7-8 (Toluene)	1.0% SOM	130	860	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{sol}
	2.5% SOM	290	1,800	51	110,000 (1920) ^{sol}	56,000	95,000 (1920) ^{sol}
	6.0% SOM	660	3,900	120	180,000 (4360) ^{vap}	56,000	100,000 (4360) ^{vap}
EC >8-10	1.0% SOM	34	47	8.6	3,500 (613) ^{vap}	5,000	7,200 (613) ^{vap}
	2.5% SOM	83	110	21	8,100 (1500) ^{vap}	5,000	8,500 (1500) ^{vap}
	6.0% SOM	190	270	51	17,000 (3850) ^{vap}	5,000	9,300 (3580) ^{vap}
EC >10-12	1.0% SOM	74	250	13	16,000 (364) ^{sol}	5,000	9,200 (364) ^{sol}
	2.5% SOM	180	590	31	28,000 (899) ^{sol}	5,000	9,700 (889) ^{sol}
	6.0% SOM	380	1,200	74	34,000 (2150) ^{sol}	5,000	10,000
EC >12-16	1.0% SOM	140	1,800	23	36,000 (169) ^{sol}	5,100	10,000
	2.5% SOM	330	2,300 (419) ^{sol}	57	37,000	5,100	10,000
	6.0% SOM	660	2,500	130	38,000	5,000	10,000
EC >16-21	1.0% SOM	260	1,900	46	28,000	3,800	7,600
	2.5% SOM	540	1,900	110	28,000	3,800	7,700
	6.0% SOM	930	1,900	260	28,000	3,800	7,800
EC >21-35	1.0% SOM	1,100	1,900	370	28,000	3,800	7,800
	2.5% SOM	1,500	1,900	820	28,000	3,800	7,800
	6.0% SOM	1,700	1,900	1,600	28,000	3,800	7,900
EC >35-44	1.0% SOM	1,100	1,900	370	28,000	3,800	7,800
	2.5% SOM	1,500	1,900	820	28,000	3,800	7,800
	6.0% SOM	1,700	1,900	1,600	28,000	3,800	7,900
EC >44-70	1.0% SOM	1,600	1,900	1,200	28,000	3,800	7,800
	2.5% SOM	1,800	1,900	2,100	28,000	3,800	7,800
	6.0% SOM	1,900	1,900	3,000	28,000	3,800	7,900

SOM = Soil Organic Matter Content (%)

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LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAH's)

Determinants		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Acenaphthene	1.0% SOM	210	3,000 (57.0) ^{sol}	34	84,000(57.0) ^{sol}	15,000	29,000
	2.5% SOM	510	4,700(141) ^{sol}	85	97,000(141) ^{sol}	15,000	30,000
	6.0% SOM	1100	6,000(336) ^{sol}	200	100,000	15,000	30,000
Acenaphthylene	1.0% SOM	170	2,900(86.1) ^{sol}	28	83,000(86.1) ^{sol}	15,000	29,000
	2.5% SOM	420	4,600(212) ^{sol}	69	97,000(212) ^{sol}	15,000	30,000
	6.0% SOM	920	6,000(506) ^{sol}	160	100,000	15,000	30,000
Anthracene	1.0% SOM	2,400	31,000(1.17) ^{vap}	380	520,000	74,000	150,000
	2.5% SOM	5,400	35,000	950	540,000	74,000	150,000
	6.0% SOM	11,000	37,000	2,200	540,000	74,000	150,000
Benzo(a)anthracene	1.0% SOM	7.20	11	2.90	170	29	49
	2.5% SOM	11	14	6.50	170	29	56
	6.0% SOM	13	15	13	180	29	62
Benzo(a)pyrene	1.0% SOM	2.20	3.20	0.97	35	5.70	11
	2.5% SOM	2.70	3.20	2.00	35	5.70	12
	6.0% SOM	3.00	3.20	3.50	36	5.70	13
Benzo(b)flouranthene	1.0% SOM	2.60	3.90	0.99	44	7.10	13
	2.5% SOM	3.30	4.00	2.10	44	7.20	15
	6.0% SOM	3.70	4.00	3.90	45	7.20	16
Benzo(ghi)perylene	1.0% SOM	320	360	290	3,900	640	1,400
	2.5% SOM	340	360	470	4,000	640	1,500
	6.0% SOM	350	360	640	4,000	640	1,600
Benzo(k)flouranthene	1.0% SOM	77	110	37	1,200	190	370
	2.5% SOM	93	110	75	1,200	190	410
	6.0% SOM	100	110	130	1,200	190	440
Chrysene	1.0% SOM	15	30	4.10	350	57	93
	2.5% SOM	22	31	9.40	350	57	110
	6.0% SOM	27	32	19	350	57	120
Dibenzo(ah)anthracene	1.0% SOM	0.24	0.31	0.14	3.50	0.57	1.10
	2.5% SOM	0.28	0.32	0.27	3.60	0.57	1.30
	6.0% SOM	0.30	0.32	0.43	3.60	0.58	1.40

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LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAH's)							
Determinants		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Flouranthene	1.0% SOM	280	1,500	52	2,3000	3,100	6,300
	2.5% SOM	560	1,600	130	2,3000	3,100	6,300
	6.0% SOM	890	1,600	290	2,3000	3,100	6,300
Flourene	1.0% SOM	170	2,800 (30.9) ^{sol}	27	63,000(30.9) ^{sol}	9,900	20,000
	2.5% SOM	400	3,800(76.5) ^{sol}	67	68,000	9,900	20,000
	6.0% SOM	860	4,500(183) ^{sol}	160	71,000	9,900	20,000
Indeno(123-cd)pyrene	1.0% SOM	27	45	9.50	500	82	150
	2.5% SOM	36	46	21	510	82	170
	6.0% SOM	41	46	39	510	82	180
Napthalene	1.0% SOM	2.30	2.6	4.10	190 ^f (76.4) ^{sol}	4,900 ^f	1,200 ^f (76.4) ^{sol}
	2.5% SOM	5.60	5.6	10	460 ^f (183) ^{sol}	4,900 ^f	1,900 ^f (183) ^{sol}
	6.0% SOM	13	13	24	1,100 ^f (432) ^{sol}	4,900 ^f	3,000
Phenanthrene	1.0% SOM	95	1,300(183) ^{sol}	18	22,000	3,100	6,200
	2.5% SOM	220	1,500	38	22,000	3,100	6,200
	6.0% SOM	440	1,500	90	23,000	3,100	6,300
Pyrene	1.0% SOM	620	3,700	110	54,000	7,400	15,000
	2.5% SOM	1200	3,800	270	54,000	7,400	15,000
	6.0% SOM	2000	3,800	620	54,000	7,400	15,000
Coal Tar (Benzo(a)pyrene used as marker compound)	1.0% SOM	0.79	1.2	0.32	15	2.20	4.40
	2.5% SOM	0.98	1.2	0.67	15	2.20	4.70
	6.0% SOM	1.10	1.2	1.20	15	2.20	4.80

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

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

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LQM/CIEH Suitable 4 Use Levels (cont.)

LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds						
Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
<i>Chloroalkanes & alkenes</i>						
1,2 Dichloroethane						
1.0% SOM	0.0071	0.0092	0.0046	0.67	29	21
2.5% SOM	0.011	0.013	0.0083	0.97	29	24
6.0% SOM	0.019	0.023	0.016	1.70	29	28
1,1,2,2 Tetrachloroethane						
1.0% SOM	1.60	3.90	0.41	270	1,400	1,800
2.5% SOM	3.40	8.00	0.89	550	1,400	2,100
6.0% SOM	7.50	17	2.00	1,100	1,400	2,300
1,1,1,2 Tetrachloroethane						
1.0% SOM	1.20	1.50	0.79	110	1,400	1,500
2.5% SOM	2.80	3.50	1.90	250	1,400	1,800
6.0% SOM	6.40	8.20	4.40	560	1,400	2,100
Tetrachloroethene						
1.0% SOM	0.18	0.18	0.65	19	1,400	810 ^{sol} (424)
2.5% SOM	0.39	0.40	1.50	42	1,400	1,100 ^{sol} (951)
6.0% SOM	0.90	0.92	3.60	95	1,400	1,500
1,1,1 Trichloroethane						
1.0% SOM	8.80	9.00	48	660	140,000	57,000 ^{vap} (1425)
2.5% SOM	18	18	110	1,300	140,000	76,000 ^{vap} (2915)
6.0% SOM	39	40	240	3,000	140,000	100,000 ^{vap} (6392)
Tetrachloromethene						
1.0% SOM	0.026	0.026	0.45	2.90	890	190
2.5% SOM	0.056	0.056	1.00	6.30	920	270
6.0% SOM	0.130	0.130	2.40	14	950	400
Trichloroethene						
1.0% SOM	0.016	0.017	0.041	1.20	120	70
2.5% SOM	0.034	0.036	0.091	2.60	120	91
6.0% SOM	0.075	0.080	0.210	5.70	120	120
Trichloromethane						
1.0% SOM	0.91	1.20	0.42	99	2,500	2,600
2.5% SOM	1.70	2.10	0.83	170	2,500	2,800
6.0% SOM	3.40	4.20	1.70	350	2,500	3,100
Vinyl Chloride						
1.0% SOM	0.00064	0.00077	0.00055	0.059	3.50	4.80
2.5% SOM	0.00087	0.00100	0.00100	0.077	3.50	5.00
6.0% SOM	0.00014	0.00150	0.00180	0.120	3.50	5.40

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LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds						
Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Explosives						
2,4,6 Trinitrotoluene						
1.0% SOM	1.60	65	0.24	1,000	130	260
2.5% SOM	3.70	66	0.58	1,000	130	270
6.0% SOM	8.10	66	1.40	1,000	130	270
RDX (Hexogen/Cyclonite/1,3,5- trinitro-1,3,5- triazacyclohexane)						
1.0% SOM	120	13,000	17	210,000	26,000	49,000(18.7) ^{sol}
2.5% SOM	250	13,000	38	210,000	26,000	51,000
6.0% SOM	540	13,000	85	210,000	27,000	53,000
HMX (Octogen/1,3,5,7- tetrenitro-1,3,5,7- tetrazacyclo-octane)						
1.0% SOM	5.70	67,00	0.86	110,000	13,000	23,000(0.35) ^{vap}
2.5% SOM	13	67,00	1.90	110,000	13,000	23,000(0.39) ^{vap}
6.0% SOM	26	67,00	3.90	110,000	13,000	24,000(0.48) ^{vap}
Atrazine						
1.0% SOM	3.30	610	0.50	9,300	1,200	2,300
2.5% SOM	7.60	620	1.20	9,400	1,200	2,400
6.0% SOM	17.40	620	2.70	9,400	1,200	2,400
Pesticides						
Aldrin						
1.0% SOM	5.70	7.30	3.20	170	18	30
2.5% SOM	6.60	7.40	6.10	170	18	31
6.0% SOM	7.10	7.50	9.60	170	18	31
Dieldrin						
1.0% SOM	0.97	7.00	0.17	170	18	30
2.5% SOM	2.00	7.30	0.41	170	18	30
6.0% SOM	3.50	7.40	0.96	170	18	31
Dichlorvos						
1.0% SOM	0.032	6.40	0.0049	140	16	26
2.5% SOM	0.066	6.50	0.0100	140	16	26
6.0% SOM	0.140	6.60	0.0220	140	16	27
Alpha - Endosulfan						
1.0% SOM	7.40	160(0.003) ^{vap}	1.20	5,600(0.003) ^{vap}	1,200	2,400
2.5% SOM	18	280(0.007) ^{vap}	2.90	7,400(0.007) ^{vap}	1,200	2,400
6.0% SOM	41	410(0.016) ^{vap}	6.80	8,400(0.016) ^{vap}	1,200	2,400

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

Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Pesticides						
Beta - Endosulfan						
1.0% SOM	7.00	190(0.00007) ^{vap}	1.10	6,300(0.00007) ^{vap}	1,200	2,400
2.5% SOM	17	320(0.0002) ^{vap}	2.70	7,800(0.0002) ^{vap}	1,200	2,400
6.0% SOM	39	440(0.0004) ^{vap}	6.40	8700	1,200	2,500
Alpha - Hexachlorocyclohexanes						
1.0% SOM	0.23	6.90	0.035	170	24	47
2.5% SOM	0.55	9.20	0.087	180	24	48
6.0% SOM	1.20	11	0.210	180	24	48
Beta - Hexachlorocyclohexanes						
1.0% SOM	0.085	3.70	0.013	65	8.10	15
2.5% SOM	0.200	3.80	0.032	65	8.10	15
6.0% SOM	0.460	3.80	0.077	65	8.10	16
Gamma - Hexachlorocyclohexanes						
1.0% SOM	0.06	2.90	0.0092	67	8.2	14
2.5% SOM	0.14	3.30	0.0230	69	8.2	15
6.0% SOM	0.33	3.50	0.0540	70	8.2	15
Chlorobenzenes						
Chlorobenzene						
1.0% SOM	0.46	0.46	5.90	56	11,000	1,300(675) ^{sol}
2.5% SOM	1.00	1.00	14	130	13,000	2,000(1520) ^{sol}
6.0% SOM	2.40	2.40	32	290	14,000	2,900
1,2-Dichlorobenzene						
1.0% SOM	23	24	94	2,000 (571) ^{sol}	90,000	24,000(571) ^{sol}
2.5% SOM	55	57	230	4,800 (1370) ^{sol}	95,000	36,000(1370) ^{sol}
6.0% SOM	130	130	540	11,000 (3240) ^{sol}	98,000	51,000(3240) ^{sol}
1,3-Dichlorobenzene						
1.0% SOM	0.40	0.44	0.25	30	300	390
2.5% SOM	1.00	1.10	0.60	73	300	440
6.0% SOM	2.30	2.50	1.50	170	300	470
1,4-Dichlorobenzene						
1.0% SOM	61	61	15	4,400 (224) ^{vap}	17,000 ^g	36,000 (224) ^{vap}
2.5% SOM	150	150	37	10,000 (540) ^{vap}	17,000 ^g	36,000 (540) ^{vap}
6.0% SOM	350	350	88 ^g	25,000 (1280) ^{vap}	17,000 ^g	36,000 (1280) ^{vap}
1,2,3-Trichlorobenzene						
1.0% SOM	1.50	1.50	4.70	102	1,800	770(134) ^{vap}
2.5% SOM	3.60	3.70	12	250	1,800	1,100(330) ^{vap}
6.0% SOM	8.60	8.80	28	590	1,800	1,600(789) ^{vap}

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

Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Chlorobenzenes						
1,2,3,- Trichlorobenzene						
1.0% SOM	1.50	1.50	4.70	102	1,800	770(134) ^{vap}
2.5% SOM	3.60	3.70	12	250	1,800	1,100(330) ^{vap}
6.0% SOM	8.60	8.80	28	590	1,800	1,600(789) ^{vap}
1,2,4,- Trichlorobenzene						
1.0% SOM	2.60	2.60	55	220	15,000	1,700(318) ^{vap}
2.5% SOM	6.40	6.40	140	530	17,000	2,600(786) ^{vap}
6.0% SOM	15	15	320	1,300	19,000	4,000(1880) ^{vap}
1,3,5,- Trichlorobenzene						
1.0% SOM	0.33	0.33	4.70	23	1,700	380(36.7) ^{vap}
2.5% SOM	0.81	0.81	12	55	1,700	590(90.8) ^{vap}
6.0% SOM	1.90	1.90	140	130	1,800	860(217) ^{vap}
1,2,3,4,- Tetrachlorobenzene						
1.0% SOM	15	24	4.40	1,700(122) ^{vap}	830	1,500(122) ^{vap}
2.5% SOM	36	56	11	3,080(304) ^{vap}	830	1,600
6.0% SOM	78	120	26	4,400(728) ^{vap}	830	1,600
1,2,3,5,- Tetrachlorobenzene						
1.0% SOM	0.66	0.75	0.38	49(39.4) ^{vap}	78	110(39) ^{vap}
2.5% SOM	1.60	1.90	0.90	120(98.1) ^{vap}	79	120
6.0% SOM	3.70	4.30	2.20	240(235) ^{vap}	79	130
1,2,4, 5,- Tetrachlorobenzene						
1.0% SOM	0.33	0.73	0.06	42(19.7) ^{sol}	13	25
2.5% SOM	0.77	1.70	0.16	72(49.1) ^{sol}	13	26
6.0% SOM	1.60	3.50	0.37	96	13	26
Pentachlorobenzene						
1.0% SOM	5.80	19	1.20	640(43.0) ^{sol}	100	190
2.5% SOM	12	30	3.10	770(107) ^{sol}	100	190
6.0% SOM	22	38	7.00	830	100	190
Hexachlorobenzene						
1.0% SOM	1.80(0.20) ^{vap}	4.10 (0.20) ^{vap}	0.47	110(0.20) ^{vap}	16	30
2.5% SOM	3.30(0.50) ^{vap}	5.70 (0.50) ^{vap}	1.10	120	16	30
6.0% SOM	4.90	6.70 (1.2) ^{vap}	2.50	120	16	30

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

Contaminant	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Phenols & Chlorophenols						
Phenols						
1.0% SOM	280	750	66	760 ^{dir} (31,000)	760 ^{dir} (11,000)	760 ^{dir} (8,600)
2.5% SOM	550	1,300	140	1,500 ^{dir} (35,000)	1,500 ^{dir} (11,000)	1,500 ^{dir} (9,700)
6.0% SOM	1100	2,300	280	3,200 ^{dir} (37,000)	3,200 ^{dir} (11,000)	3,200 ^{dir} (11,000)
Chlorophenols (4 Congeners)						
1.0% SOM	0.87	94	0.13	3,500	620	1,100
2.5% SOM	2.00	150	0.30	4,000	620	1,100
6.0% SOM	4.50	210	0.70	4,300	620	1,100
Pentachlorophenols						
1.0% SOM	0.22	27(16.4) ^{vap}	0.03	400	60	110
2.5% SOM	0.52	29	0.08	400	60	120
6.0% SOM	1.20	31	0.19	400	60	120
Others						
Carbon Disulphide						
1.0% SOM	0.14	0.14	4.80	11	11,000	1,300
2.5% SOM	0.29	0.29	10	22	11,000	1,900
6.0% SOM	0.62	0.62	23	47	12,000	2,700
Hexachloro-1,3-Butadiene						
1.0% SOM	0.29	0.32	0.25	31	25	48
2.5% SOM	0.70	0.78	0.61	68	25	50
6.0% SOM	1.60	1.80	1.40	120	25	51

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CL:AIRE Soil Generic Assessment Criteria				
Contaminant	Residential (mg/kg)	Residential without plant uptake (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
<i>Metals:</i>				
Antimony	ND	550	ND	7500
Barium	ND	1300	ND	22000
Molybdenum	ND	670	ND	17000

ND – Not Derived.

NA – Not Applicable

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	Residential (mg/kg)	Residential without plant uptake (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
1,1,2 Trichloroethane				
1.0% SOM	0.60	0.88	0.28	94
2.5% SOM	1.20	1.8	0.61	190
6.0% SOM	2.70	3.9	1.40	400
1,1-Dichloroethane				
1.0% SOM	2.40	2.50	9.20	280
2.5% SOM	3.90	4.10	17	450
6.0% SOM	7.40	7.70	35	850
1,1-Dichloroethene				
1.0% SOM	0.23	0.23	2.80	26
2.5% SOM	0.40	0.41	5.60	46
6.0% SOM	0.82	0.82	12	92
1,2,4-Trimethylbenzene				
1.0% SOM	0.35	0.41	0.38	42
2.5% SOM	0.85	0.99	0.93	99
6.0% SOM	2.00	2.30	2.20	220
1,2-Dichloropropane				
1.0% SOM	0.024	0.024	0.62	3.3
2.5% SOM	0.042	0.042	1.20	5.9
6.0% SOM	0.084	0.085	2.60	12
2,4-Dimethylphenol				
1.0% SOM	19	210	3.10	16000*
2.5% SOM	43	410	7.20	24000*
6.0% SOM	97	730	17	30000*
2,4-Dinitrotoluene				
1.0% SOM	1.50	170*	0.22	3700*
2.5% SOM	3.20	170	0.49	3700*
6.0% SOM	7.20	170	1.10	3800*
2,6-Dinitrotoluene				
1.0% SOM	0.78	78	0.12	1900*
2.5% SOM	1.70	84	0.27	1900*
6.0% SOM	3.90	87	0.61	1900*
2-Chloronaphthalene				
1.0% SOM	3.70	3.80	40	390*
2.5% SOM	9.20	9.30	98	960*
6.0% SOM	22	22	230	2200*

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	Residential (mg/kg)	Residential without plant uptake (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
Biphenyl				
1.0% SOM	66*	220*	14	18000*
2.5% SOM	160	500*	35	33000*
6.0% SOM	360	980*	83	48000*
Bis (2-ethylhexyl) phthalate				
1.0% SOM	280*	2700*	47*	85000*
2.5% SOM	610*	2800*	120*	86000*
6.0% SOM	1100*	2800*	280*	86000*
Bromobenzene				
1.0% SOM	0.87	0.91	3.2	97
2.5% SOM	2.0	2.1	7.6	220
6.0% SOM	4.7	4.9	18	520
Bromodichloromethane				
1.0% SOM	0.016	0.019	0.016	2.1
2.5% SOM	0.030	0.034	0.032	3.7
6.0% SOM	0.061	0.070	0.068	7.6
Bromoform				
1.0% SOM	2.8	5.2	0.95	760
2.5% SOM	5.9	11	2.1	1500
6.0% SOM	13	23	4.6	3100
Butyl benzyl phthalate				
1.0% SOM	1400*	42000*	220*	940000*
2.5% SOM	3300*	44000*	550*	940000*
6.0% SOM	7200*	44000*	1300*	950000*
Chloroethane				
1.0% SOM	8.3	8.4	110	960
2.5% SOM	11	11	200	1300
6.0% SOM	18	18	380	2100
Chloromethane				
1.0% SOM	0.0083	0.0085	0.066	1.0
2.5% SOM	0.0098	0.0099	0.13	1.2
6.0% SOM	0.013	0.013	0.23	1.6
Cis 1,2 Dichloroethene				
1.0% SOM	0.11	0.12	0.26	14
2.5% SOM	0.19	0.20	0.50	24
6.0% SOM	0.37	0.39	1.0	47

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	Residential (mg/kg)	Residential without plant uptake (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
Dichloromethane				
1.0% SOM	0.58	2.10	0.10	270
2.5% SOM	0.98	2.80	0.19	360
6.0% SOM	1.70	4.50	0.34	560
Diethyl Phthalate				
1.0% SOM	120*	1800*	19*	150000*
2.5% SOM	260*	3500*	41*	220000*
6.0% SOM	570*	6300*	94*	290000*
Di-n-butyl phthalate				
1.0% SOM	13*	450*	2.00	15000*
2.5% SOM	31*	450*	5.00	15000*
6.0% SOM	67*	450*	12	15000*
Di-n-octyl phthalate				
1.0% SOM	2300*	3400*	940*	89000*
2.5% SOM	2800*	3400*	2100*	89000*
6.0% SOM	3100*	3400*	3900*	89000*
Hexachloroethane				
1.0% SOM	0.20	0.22	0.27	22*
2.5% SOM	0.48	0.54	0.67	53*
6.0% SOM	1.10	1.30	1.60	120*
Isopropylbenzene				
1.0% SOM	11	12	32	1400*
2.5% SOM	27	28	79	3300*
6.0% SOM	64	67	190	7700*
Methyl tert-butyl ether				
1.0% SOM	49	73	23	7900
2.5% SOM	84	120	44	13000
6.0% SOM	160	220	90	24000
Propylbenzene				
1.0% SOM	34	40	34	4100*
2.5% SOM	82	97	83	9700*
6.0% SOM	190	230	200	21000*
Styrene				
1.0% SOM	8.10	35	1.60	3300*
2.5% SOM	19	78	3.70	6500*
6.0% SOM	43	170	8.70	11000*

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CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds				
Contaminant	Residential (mg/kg)	Residential without plant uptake (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
Total Cresols (2-, 3-, and 4-methylphenol)				
1.0% SOM	80	3700	12	160000
2.5% SOM	180	5400	27	180000*
6.0% SOM	400	6900	63	180000*
Trans 1,2 Dichloroethene				
1.0% SOM	0.19	0.19	0.93	22
2.5% SOM	0.34	0.35	1.90	40
6.0% SOM	0.70	0.71	0.24	81
Tributyl tin oxide				
1.0% SOM	0.25	1.40	0.042	130*
2.5% SOM	0.59	3.10	0.100	180*
6.0% SOM	1.30	5.70	0.240	200*

Notes: *Soil concentration above soil saturation limit

APPENDIX F
Waste Hazard Assessment

Waste Classification Report



USVP5-TLYKG-M6M6M

Job name

GWPR2179

Description/Comments

Project

PDSA Vets and ARC Car Wash, Eynsham Drive, Abbey Wood, London SE2 9RD

Site

Waste Stream Template

Ground and Water V2 PA

Classified by

Name:
James Dalziel
Date:
29/08/2017 16:45:50 UTC
Telephone:
0333 600 1221

Company:
Ground and Water
2 The Long Barn
Norton Farm, Selborne Road
Alton
GU34 3NB

Report

Created by: James Dalziel
Created date: 29/08/2017 16:45 UTC

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazard properties	Page
1	WS1	0.20	Non Hazardous		2
2	WS1[1]	0.50	Non Hazardous		5
3	WS2	0.50	Non Hazardous		7

Appendices	Page
Appendix A: Classifier defined and non CLP determinands	10
Appendix B: Rationale for selection of metal species	12
Appendix C: Version	12

Classification of sample: WS1

✔ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
WS1	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.20 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
7.1%	
(no correction)	

Hazard properties

None identified

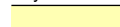




Determinands

Moisture content: 7.1% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
1	pH				7.7 pH		7.7	pH	7.7 pH		
2	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<2 mg/kg	1.884	<3.768	mg/kg	<0.000377 %		<LOD
	006-007-00-5										
3	arsenic { arsenic trioxide }				11 mg/kg	1.32	14.524	mg/kg	0.00145 %		
	033-003-00-0	215-481-4	1327-53-3								
4	boron { boron tribromide/trichloride/trifluoride (combined) }				<1 mg/kg	13.43	<13.43	mg/kg	<0.00134 %		<LOD
			10294-33-4, 10294-34-5, 7637-07-2								
5	cadmium { cadmium sulfide }			1	0.3 mg/kg	1.285	0.386	mg/kg	0.00003 %		
	048-010-00-4	215-147-8	1306-23-6								
6	Chromium (III) Sulphate				16 mg/kg		16	mg/kg	0.0016 %		
			10101-53-8								
7	chromium { chromium(VI) oxide }				<2 mg/kg	1.923	<3.846	mg/kg	<0.000385 %		<LOD
	024-001-00-0	215-607-8	1333-82-0								
8	copper { dicopper oxide; copper (I) oxide }				34 mg/kg	1.126	38.28	mg/kg	0.00383 %		
	029-002-00-X	215-270-7	1317-39-1								
9	lead { lead chromate }			1	154 mg/kg	1.56	240.212	mg/kg	0.0154 %		
	082-004-00-2	231-846-0	7758-97-6								
10	mercury { mercury dichloride }				<1 mg/kg	1.353	<1.353	mg/kg	<0.000135 %		<LOD
	080-010-00-X	231-299-8	7487-94-7								
11	nickel { nickel dihydroxide }				12 mg/kg	1.579	18.954	mg/kg	0.0019 %		
	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]								
12	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				<3 mg/kg	2.554	<7.661	mg/kg	<0.000766 %		<LOD
	034-002-00-8										

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
13	vanadium { divanadium pentaoxide; vanadium pentoxide }				28 mg/kg	1.785	49.985 mg/kg	0.005 %		
	023-001-00-8	215-239-8	1314-62-1							
14	zinc { zinc chromate }				114 mg/kg	2.774	316.253 mg/kg	0.0316 %		
	024-007-00-3									
15	phenol				<2 mg/kg		<2 mg/kg	<0.0002 %		<LOD
	604-001-00-2	203-632-7	108-95-2							
16	naphthalene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3							
17	acenaphthylene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
		205-917-1	208-96-8							
18	acenaphthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
		201-469-6	83-32-9							
19	fluorene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
		201-695-5	86-73-7							
20	phenanthrene				0.62 mg/kg		0.62 mg/kg	0.000062 %		
		201-581-5	85-01-8							
21	anthracene				0.14 mg/kg		0.14 mg/kg	0.000014 %		
		204-371-1	120-12-7							
22	fluoranthene				1.36 mg/kg		1.36 mg/kg	0.000136 %		
		205-912-4	206-44-0							
23	pyrene				1.17 mg/kg		1.17 mg/kg	0.000117 %		
		204-927-3	129-00-0							
24	benzo[a]anthracene				0.55 mg/kg		0.55 mg/kg	0.000055 %		
	601-033-00-9	200-280-6	56-55-3							
25	chrysene				0.6 mg/kg		0.6 mg/kg	0.00006 %		
	601-048-00-0	205-923-4	218-01-9							
26	benzo[b]fluoranthene				0.61 mg/kg		0.61 mg/kg	0.000061 %		
	601-034-00-4	205-911-9	205-99-2							
27	benzo[k]fluoranthene				0.36 mg/kg		0.36 mg/kg	0.000036 %		
	601-036-00-5	205-916-6	207-08-9							
28	benzo[a]pyrene; benzo[def]chrysene				0.45 mg/kg		0.45 mg/kg	0.000045 %		
	601-032-00-3	200-028-5	50-32-8							
29	indeno[123-cd]pyrene				0.25 mg/kg		0.25 mg/kg	0.000025 %		
		205-893-2	193-39-5							
30	dibenz[a,h]anthracene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
	601-041-00-2	200-181-8	53-70-3							
31	benzo[ghi]perylene				0.2 mg/kg		0.2 mg/kg	0.00002 %		
		205-883-8	191-24-2							
32	benzene				<2 mg/kg		<2 mg/kg	<0.0002 %		<LOD
	601-020-00-8	200-753-7	71-43-2							
33	toluene				<5 mg/kg		<5 mg/kg	<0.0005 %		<LOD
	601-021-00-3	203-625-9	108-88-3							
34	ethylbenzene				<2 mg/kg		<2 mg/kg	<0.0002 %		<LOD
	601-023-00-4	202-849-4	100-41-4							
35	xylene				<2 mg/kg		<2 mg/kg	<0.0002 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]							
36	o-xylene; [1] p-xylene; [2] m-xylene; [3] xylene [4]				<2 mg/kg		<2 mg/kg	<0.0002 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]							
37	diesel petroleum group				<35 mg/kg		<35 mg/kg	<0.0035 %		<LOD
			68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9							
38	TPH (C6 to C40) petroleum group				<42 mg/kg		<42 mg/kg	<0.0042 %		<LOD
			TPH							
Total:								0.0737 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Determinand defined by classifier (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS1[1]

✔ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
WS1[1]	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.50 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
14.1%	
(no correction)	

Hazard properties

None identified

Determinands

Moisture content: 14.1% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
1	pH		PH		7.7 pH		7.7 pH	7.7 pH		
2	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<2 mg/kg	1.884	<3.768 mg/kg	<0.000377 %		<LOD
	006-007-00-5									
3	arsenic { arsenic trioxide }				12 mg/kg	1.32	15.844 mg/kg	0.00158 %		
	033-003-00-0	215-481-4	1327-53-3							
4	boron { boron tribromide/trichloride/trifluoride (combined) }				2 mg/kg	13.43	26.86 mg/kg	0.00269 %		
			10294-33-4, 10294-34-5, 7637-07-2							
5	cadmium { cadmium sulfide }			1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
	048-010-00-4	215-147-8	1306-23-6							
6	Chromium (III) Sulphate				23 mg/kg		23 mg/kg	0.0023 %		
			10101-53-8							
7	chromium { chromium(VI) oxide }				<2 mg/kg	1.923	<3.846 mg/kg	<0.000385 %		<LOD
	024-001-00-0	215-607-8	1333-82-0							
8	copper { dicopper oxide; copper (I) oxide }				11 mg/kg	1.126	12.385 mg/kg	0.00124 %		
	029-002-00-X	215-270-7	1317-39-1							
9	lead { lead chromate }			1	24 mg/kg	1.56	37.436 mg/kg	0.0024 %		
	082-004-00-2	231-846-0	7758-97-6							
10	mercury { mercury dichloride }				<1 mg/kg	1.353	<1.353 mg/kg	<0.000135 %		<LOD
	080-010-00-X	231-299-8	7487-94-7							
11	nickel { nickel dihydroxide }				19 mg/kg	1.579	30.01 mg/kg	0.003 %		
	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]							
12	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				<3 mg/kg	2.554	<7.661 mg/kg	<0.000766 %		<LOD
	034-002-00-8									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
13	vanadium { divanadium pentaoxide; vanadium pentoxide }				44 mg/kg	1.785	78.548 mg/kg		0.00785 %		
	023-001-00-8	215-239-8	1314-62-1								
14	zinc { zinc chromate }				62 mg/kg	2.774	171.997 mg/kg		0.0172 %		
	024-007-00-3										
15	phenol				<2 mg/kg		<2 mg/kg		<0.0002 %		<LOD
	604-001-00-2	203-632-7	108-95-2								
16	naphthalene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3								
17	acenaphthylene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		205-917-1	208-96-8								
18	acenaphthene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		201-469-6	83-32-9								
19	fluorene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		201-695-5	86-73-7								
20	phenanthrene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		201-581-5	85-01-8								
21	anthracene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		204-371-1	120-12-7								
22	fluoranthene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		205-912-4	206-44-0								
23	pyrene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		204-927-3	129-00-0								
24	benzo[a]anthracene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-033-00-9	200-280-6	56-55-3								
25	chrysene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-048-00-0	205-923-4	218-01-9								
26	benzo[b]fluoranthene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-034-00-4	205-911-9	205-99-2								
27	benzo[k]fluoranthene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-036-00-5	205-916-6	207-08-9								
28	benzo[a]pyrene; benzo[def]chrysene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-032-00-3	200-028-5	50-32-8								
29	indeno[123-cd]pyrene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		205-893-2	193-39-5								
30	dibenz[a,h]anthracene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
	601-041-00-2	200-181-8	53-70-3								
31	benzo[ghi]perylene				<0.1 mg/kg		<0.1 mg/kg		<0.00001 %		<LOD
		205-883-8	191-24-2								
Total:									0.0403 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Determinand defined by classifier (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS2

✔ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
WS2	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.50 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
5.6%	
(no correction)	

Hazard properties

None identified






Determinands

Moisture content: 5.6% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
1	pH		PH		7.7 pH		7.7 pH	7.7 pH		
2	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<2 mg/kg	1.884	<3.768 mg/kg	<0.000377 %		<LOD
	006-007-00-5									
3	arsenic { arsenic trioxide }				5 mg/kg	1.32	6.602 mg/kg	0.00066 %		
	033-003-00-0	215-481-4	1327-53-3							
4	boron { boron tribromide/trichloride/trifluoride (combined) }				<1 mg/kg	13.43	<13.43 mg/kg	<0.00134 %		<LOD
			10294-33-4, 10294-34-5, 7637-07-2							
5	cadmium { cadmium sulfide }			1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
	048-010-00-4	215-147-8	1306-23-6							
6	Chromium (III) Sulphate				10 mg/kg		10 mg/kg	0.001 %		
			10101-53-8							
7	chromium { chromium(VI) oxide }				<2 mg/kg	1.923	<3.846 mg/kg	<0.000385 %		<LOD
	024-001-00-0	215-607-8	1333-82-0							
8	copper { dicopper oxide; copper (I) oxide }				16 mg/kg	1.126	18.014 mg/kg	0.0018 %		
	029-002-00-X	215-270-7	1317-39-1							
9	lead { lead chromate }			1	46 mg/kg	1.56	71.751 mg/kg	0.0046 %		
	082-004-00-2	231-846-0	7758-97-6							
10	mercury { mercury dichloride }				<1 mg/kg	1.353	<1.353 mg/kg	<0.000135 %		<LOD
	080-010-00-X	231-299-8	7487-94-7							
11	nickel { nickel dihydroxide }				8 mg/kg	1.579	12.636 mg/kg	0.00126 %		
	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]							
12	selenium { selenium compounds with the exception of cadmium selenide and those specified elsewhere in this Annex }				<3 mg/kg	2.554	<7.661 mg/kg	<0.000766 %		<LOD
	034-002-00-8									

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
13	vanadium { divanadium pentaoxide; vanadium pentoxide }				19	mg/kg	1.785	33.919	mg/kg	0.00339 %		
	023-001-00-8	215-239-8	1314-62-1									
14	zinc { zinc chromate }				56	mg/kg	2.774	155.352	mg/kg	0.0155 %		
	024-007-00-3											
15	phenol				<2	mg/kg		<2	mg/kg	<0.0002 %		<LOD
	604-001-00-2	203-632-7	108-95-2									
16	naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3									
17	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-917-1	208-96-8									
18	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-469-6	83-32-9									
19	fluorene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-695-5	86-73-7									
20	phenanthrene				0.14	mg/kg		0.14	mg/kg	0.000014 %		
		201-581-5	85-01-8									
21	anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		204-371-1	120-12-7									
22	fluoranthene				0.54	mg/kg		0.54	mg/kg	0.000054 %		
		205-912-4	206-44-0									
23	pyrene				0.45	mg/kg		0.45	mg/kg	0.000045 %		
		204-927-3	129-00-0									
24	benzo[a]anthracene				0.2	mg/kg		0.2	mg/kg	0.00002 %		
	601-033-00-9	200-280-6	56-55-3									
25	chrysene				0.18	mg/kg		0.18	mg/kg	0.000018 %		
	601-048-00-0	205-923-4	218-01-9									
26	benzo[b]fluoranthene				0.19	mg/kg		0.19	mg/kg	0.000019 %		
	601-034-00-4	205-911-9	205-99-2									
27	benzo[k]fluoranthene				0.11	mg/kg		0.11	mg/kg	0.000011 %		
	601-036-00-5	205-916-6	207-08-9									
28	benzo[a]pyrene; benzo[def]chrysene				0.15	mg/kg		0.15	mg/kg	0.000015 %		
	601-032-00-3	200-028-5	50-32-8									
29	indeno[123-cd]pyrene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-893-2	193-39-5									
30	dibenz[a,h]anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-041-00-2	200-181-8	53-70-3									
31	benzo[ghi]perylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-883-8	191-24-2									
32	benzene				<2	mg/kg		<2	mg/kg	<0.0002 %		<LOD
	601-020-00-8	200-753-7	71-43-2									
33	toluene				<5	mg/kg		<5	mg/kg	<0.0005 %		<LOD
	601-021-00-3	203-625-9	108-88-3									
34	ethylbenzene				<2	mg/kg		<2	mg/kg	<0.0002 %		<LOD
	601-023-00-4	202-849-4	100-41-4									
35	xylene				<2	mg/kg		<2	mg/kg	<0.0002 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
36	o-xylene; [1] p-xylene; [2] m-xylene; [3] xylene [4]				<2	mg/kg		<2	mg/kg	<0.0002 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
37	diesel petroleum group				<35	mg/kg		<35	mg/kg	<0.0035 %		<LOD
			68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9									
38	TPH (C6 to C40) petroleum group				<42	mg/kg		<42	mg/kg	<0.0042 %		<LOD
			TPH									
Total:										0.0408 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Determinand defined by classifier (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Appendix A: Classifier defined and non CLP determinands

■ pH (CAS Number: PH)

Description/Comments: Appendix C4
Data source: WM3 1st Edition 2015
Data source date: 25/05/2015
Risk Phrases: None.
Hazard Statements: None.

■ salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex

CLP index number: 006-007-00-5
Data source: Commission Regulation (EC) No 790/2009 - 1st Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP1)
Additional Risk Phrases: None.
Additional Hazard Statement(s): EUH032 >= 0.2 %
Reason for additional Hazards Statement(s)/Risk Phrase(s):
14/12/2015 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

■ boron tribromide/trichloride/trifluoride (combined) (CAS Number: 10294-33-4, 10294-34-5, 7637-07-2)

Conversion factor: 13.43
Description/Comments: Combines the hazard statements and the average of the conversion factors for boron tribromide, boron trichloride and boron trifluoride
Data source: N/A
Data source date: 06/08/2015
Risk Phrases: R14 , T+ R26/28 , C R34 , C R35
Hazard Statements: EUH014 , Acute Tox. 2 H330 , Acute Tox. 2 H300 , Skin Corr. 1A H314 , Skin Corr. 1B H314

■ Chromium (III) Sulphate (CAS Number: 10101-53-8)

Description/Comments:
Data source: 10101-53-8
Data source date: 24/06/2015
Risk Phrases: None.
Hazard Statements: None.

■ dicopper oxide; copper (I) oxide (EC Number: 215-270-7, CAS Number: 1317-39-1)

CLP index number: 029-002-00-X
Data source: Regulation (EU) 2016/1179 of 19 July 2016 (ATP9)
Additional Risk Phrases: N R50/53 , N R50/53 >= 0.25 %
Additional Hazard Statement(s): None.
Reason for additional Hazards Statement(s)/Risk Phrase(s):
10/10/2016 - N R50/53 risk phrase sourced from: WM3 v1 still uses ecotoxic risk phrases
10/10/2016 - N R50/53 >= 0.25 % risk phrase sourced from: WM3 v1 still uses ecotoxic risk phrases

■ acenaphthylene (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 17/07/2015
Risk Phrases: R22 , R26 , R27 , R36 , R37 , R38
Hazard Statements: Acute Tox. 4 H302 , Acute Tox. 1 H330 , Acute Tox. 1 H310 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315

■ acenaphthene (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 17/07/2015
Risk Phrases: R36 , R37 , R38 , N R50/53 , N R51/53
Hazard Statements: Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410 , Aquatic Chronic 2 H411

■ fluorene (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06/08/2015
Risk Phrases: N R50/53
Hazard Statements: Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

▪ **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 06/08/2015

Risk Phrases: R22 , R36 , R37 , R38 , R40 , R43 , N R50/53

Hazard Statements: Acute Tox. 4 H302 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Carc. 2 H351 , Skin Sens. 1 H317 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410 , Skin Irrit. 2 H315

▪ **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17/07/2015

Risk Phrases: R36 , R37 , R38 , R43 , N R50/53

Hazard Statements: Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Skin Sens. 1 H317 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

▪ **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 21/08/2015

Risk Phrases: Xn R22 , N R50/53

Hazard Statements: Acute Tox. 4 H302 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

▪ **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 21/08/2015

Risk Phrases: Xi R36/37/38 , N R50/53

Hazard Statements: Skin Irrit. 2 H315 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

▪ **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 06/08/2015

Risk Phrases: R40

Hazard Statements: Carc. 2 H351

▪ **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 23/07/2015

Risk Phrases: N R50/53

Hazard Statements: Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

▪ **ethylbenzene** (EC Number: 202-849-4, CAS Number: 100-41-4)

CLP index number: 601-023-00-4

Data source: Commission Regulation (EU) No 605/2014 – 6th Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP6)

Additional Risk Phrases: None.

Additional Hazard Statement(s): Carc. 2 H351

Reason for additional Hazards Statement(s)/Risk Phrase(s):

03/06/2015 - Carc. 2 H351 hazard statement sourced from: IARC Group 2B (77) 2000

▪ **diesel petroleum group** (CAS Number: 68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013

Data source: WM3 1st Edition 2015

Data source date: 25/05/2015

Risk Phrases: R40 , R51/53 , R65 , R66

Hazard Statements: Flam. Liq. 3 H226 , Skin Irrit. 2 H315 , Acute Tox. 4 H332 , Carc. 2 H351 , Asp. Tox. 1 H304 , STOT RE 2 H373 , Aquatic Chronic 2 H411

• **TPH (C6 to C40) petroleum group** (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013

Data source: WM3 1st Edition 2015

Data source date: 25/05/2015

Risk Phrases: R10 , R45 , R46 , R51/53 , R63 , R65

Hazard Statements: Flam. Liq. 3 H226 , Asp. Tox. 1 H304 , STOT RE 2 H373 , Muta. 1B H340 , Carc. 1B H350 , Repr. 2 H361d , Aquatic Chronic 2 H411

Appendix B: Rationale for selection of metal species

cyanides {salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex}

Worst case species

arsenic {arsenic trioxide}

Worst case species based on risk phrases

boron {boron tribromide/trichloride/trifluoride (combined)}

Worst case species based on risk phrases

cadmium {cadmium sulfide}

Worst case species based on risk phrases

chromium {chromium(VI) oxide}

Worst case species based on risk phrases

copper {dicopper oxide; copper (I) oxide}

Most likely common species

lead {lead chromate}

Worst case species based on risk phrases

mercury {mercury dichloride}

Worst case species based on risk phrases

nickel {nickel dihydroxide}

Worst case species based on risk phrases

selenium {selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex}

Worst case species based on risk phrases

vanadium {divanadium pentaoxide; vanadium pentoxide}

most common form

zinc {zinc chromate}

Worst case species based on risk phrases

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition, May 2015

HazWasteOnline Classification Engine Version: 2017.237.3385.6834 (25 Aug 2017)

HazWasteOnline Database: 2017.237.3385.6834 (26 Aug 2017)

This classification utilises the following guidance and legislation:

WM3 - Waste Classification - May 2015

CLP Regulation - Regulation 1272/2008/EC of 16 December 2008

1st ATP - Regulation 790/2009/EC of 10 August 2009

2nd ATP - Regulation 286/2011/EC of 10 March 2011

3rd ATP - Regulation 618/2012/EU of 10 July 2012

4th ATP - Regulation 487/2013/EU of 8 May 2013

Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013

5th ATP - Regulation 944/2013/EU of 2 October 2013

6th ATP - Regulation 605/2014/EU of 5 June 2014

WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014

Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014

7th ATP - Regulation 2015/1221/EU of 24 July 2015

8th ATP - Regulation (EU) 2016/918 of 19 May 2016

9th ATP - Regulation (EU) 2016/1179 of 19 July 2016

10th ATP - Regulation (EU) 2017/776 of 4 May 2017

POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004

1st ATP to POPs Regulation - Regulation 756/2010/EU of 24 August 2010

2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010