



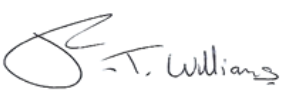
CONTAMINATION ASSESSMENT REPORT

for the site at

**LAND TO THE REAR OF 1 – 25 UPPER REDLANDS ROAD, UNIVERSITY OF
READING, WHITEKNIGHTS CAMPUS, READING RG6 6UD**

on behalf of

UNIVERSITY OF READING C/O RIDGE AND PARTNERS LLP

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1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by the University of Reading c/o Ridge and Partners LLP on the 29th January 2018 to conduct an Updated Phase 3 Contamination Assessment Report at their redevelopment site on the land to the rear of 1 – 25 Upper Redlands Road, University of Reading, Whiteknights Campus, Reading RG6 6UD.

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.

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 Phase 1 Desk Study provided by Enzygo Geo-Environmental Report (CRM.415.001.GE. R.001.A). This Ground Investigation Report must be read in conjunction with this report.

This report consolidates the Phase 2 information provided by Enzygo Geo-Environmental with additional Phase 3 and Phase 4 works undertaken by Ground and Water Limited.

Phase 4 of site works was undertaken following Knowles and Sons going into administration. The purpose of Phase 4 site works was to determine if any remedial works had been undertaken or whether any materials onsite had been reworked. At the time of the Phase 4 site investigation conducted by Ground and Water Limited in March 2018, the site was a derelict construction site.

The techniques adopted for the investigation were chosen considering the anticipated ground conditions and development proposals on-site, 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.

Total reliance has been placed the Phase 1 and Phase 2 Enzygo Geo-Environmental Report (ref. CRM.415.001.GE R.001.A).

This version of the report supersedes any previously issued. This version of the report includes further Phase 4 site works undertaken by Ground and Water Limited.

2.0 SITE SETTING

2.1 Site Location

The total site comprised a ~0.3887ha (3887m²) irregular shaped plot of land, orientated in a north-east to south-west direction, ~45m south-east of Upper Redlands Road, within the University of Reading Whiteknights Campus.

The approximate O.S. National Grid reference for the site is SU 73388 72365. A general site location is given within Figure 1. A plan showing the site boundary and Phase B can be seen in Figure 2.

2.2 Site Description

At the time of the site walkover, conducted in May 2016 by an Enzygo representative, the eastern area of the site was occupied by small commercial units surrounding an area of concrete hardstanding. The hardstanding was noted to be un-even and in a poor state of repair.

The commercial units comprise single storey sheds of block and timber construction. An area of waste storage was noted within the north-east corner of the site, which was occupied by wheelie bins.

Access to the commercial units is via a track leading off Upper Redlands Road approximately 50m north.

An access track is present to the north of the commercial units giving access to the western area of the site. The western area of the site comprises open land which appears to have been part of rear gardens to the north of the site. The western area of the site was occupied by open land with tree stumps noted.

Within the south west area of the site is an existing car park with associated soft landscaping vegetated with grass and trees. Vehicular access to this area of the site is provided from a service road present to the south of the site.

No evidence of contamination sources were noted onsite or adjacent to the site and no evidence of spillages were noted.

An aerial view of the site, showing an approximate site boundary, is given within Figure 3.

At the time of the Phase 3 site investigation conducted by Ground and Water Limited, in July 2017, the site was an active construction site.

Phase 4 of site works was undertaken following Knowles and Sons going into administration. The purpose of Phase 4 site works was to determine if any remedial works had been undertaken or whether any materials onsite had been reworked. At the time of the Phase 4 site investigation conducted by Ground and Water Limited in March 2018, the site was a derelict construction site.

2.3 Proposed Development

At the time of reporting, April 2018, it was understood the proposed development will comprise the demolition of the existing properties and the construction of 10No. residential properties with associated infrastructure. A car parking area will be constructed within the south-western section of the site. Private rear gardens will be constructed with paved areas and small grassed areas in north. A public open space would be constructed to the south of the properties.

A plan of the proposed development can be seen in Figure 4.

2.4 Geology

The British Geological Survey Solid and Drift Geology Map for the Reading area (Sheet No. 268) revealed that the site was located on bedrock deposits of the London Clay Formation. No areas of Made Ground were noted within a 250m radius of the site.

London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of Gypsum (Selenite) are often found within the weathered part of the London Clay Formation, and precautions against sulphate attack to concrete are sometimes required. The lowest part of the formation is a sandy bed with black rounded gravel and occasional layers of sandstone and is known as the Basement Bed.

A number of BGS borehole records were noted within a 250m radius of the site, mainly to the south-west in association with the University of Reading. The boreholes generally showed a shallow capping of Topsoil (0.15 – 0.45m thickness), underlain by gravelly clays to 1.20 – 1.50m bgl, before encountering the London Clay Formation to a depth of at least 6.00m bgl.

2.5 Hydrogeology and Hydrology

A study of the aquifer maps on the Environment Agency website revealed the site was located on **Unproductive Strata** associated with the bedrock deposits of the London Clay Formation. No classification was given for superficial deposits, due to the likely absence of such soils.

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

Unproductive strata are rock layers with low permeability that have negligible significance for water supply or river base flow. These were formerly classified as non-aquifers.

Examination of the Environment Agency records showed that the site was located within an **Outer Groundwater Source Protection Zone** (SPZ2) as classified in the Policy and Practice for the Protection of Groundwater.

An SPZ2 is defined by a 400-day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs and instead this zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction.

Two ponds were noted ~85m east and ~155m south-east of the site. A lake, referred to as Whiteknights Lake, was noted ~210m south-east of the site. No significant flowing watercourses were noted within a 250m radius of the site.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at depth (>5.00m below existing ground level (bgl)). It was considered that the groundwater was flowing in alignment with local topography in an overall northerly direction towards The River Thames.

Examination of the Environment Agency records showed that the site **was not** at risk from flooding from rivers or seas.

2.6 Radon

BRE 211 (2015) Map 4 of Hampshire, Berkshire and south Oxfordshire revealed the site **was not** located within an area where mandatory protection measures against the ingress of Radon were likely to be required. The site **was not** located within an area where a risk assessment was required.

2.7 Results of Phase 1 and Phase 2 Risk Assessment

A Review of the Enzygo Phase 1 Risk Assessment (CRM.415.001.GE. R.001.A, May 2016) revealed the following information:

Enzygo Phase 1 Risk Assessment (CRM.415.001.GE. R.001.A), May 2016;

The report highlighted that the site was unoccupied and noted as woodland and fields until 1899, when a building was noted in the eastern portion of the site. By 1911 gardens were noted in the north-west section as well as buildings in the eastern portion of the site. By 1971 the site was labelled as a builders' yard.

The site was shown to be located on London Clay Formation (Unproductive Strata). No superficial deposits were noted on-site. No Made Ground was identified in close proximity to the site.

Enzygo Phase 2 Risk Assessment (CRM.415.001.GE. R.001.A), May 2016;

The site works were undertaken on 19th April 2016 and comprised five window sampler boreholes (WS1 to WS5) to depths of 4.45 – 5.45m bgl and three hand pits (HP1 to HP3) to depths of 0.40 – 0.60m bgl. Standard Penetration Testing (SPTs) were undertaken within WS1 – WS5 and 1.00m intervals. A soakaway test was undertaken in WS1. Combined ground-gas and groundwater monitoring standpipes were constructed within WS1 and WS5 to 5.00m bgl.

A tabulated summary of the ground conditions can be viewed below:

Tabulated Ground Conditions		
Strata	Summary Description	Thickness
Made Ground	Concrete over orange brown sandy gravel comprising flint, brick and concrete.	0.20 – 0.30
	Firm brown slightly gravelly clay with fragments of flint, ash, metal and brick.	0.10 – 0.55
Drift Deposits	Soft to firm, becoming stiff with depth orange brown sandy gravelly clay. Gravel comprises well rounded flint.	1.10 – 3.10
London Clay Formation	Stiff orange brown and blue grey silty clay.	>4.05

Groundwater seepages were noted during the site investigation at 2.00m bgl within WS1 and WS4. Three return visits (26th April 2016, 3rd May 2016 and 6th May 2016) revealed groundwater levels of between 0.67 – 0.82 bgl within WS1 and between 1.06 – 1.20m bgl within WS5.

Three ground-gas monitoring rounds undertaken on the 26th April, 3rd May and 6th May 2016 revealed negligible methane and up to 2.2% Carbon Dioxide.

The soakaway test undertaken within WS1 recorded insufficient soakage for a soil infiltration rate to be calculated.

A programme of chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by QTS Environmental Limited, was undertaken on six samples of Made Ground (WS01/0.30m, WS02/0.30m, WS03/0.30m, WS05/0.20m, HP01/0.30m, HP02/0.30m bgl) can be viewed overleaf.

Methodology for Chemical Laboratory Testing		
Bore Holes	Depth (m bgl)	Sampling Strategy
WS01	0.30	Representative samples of Made Ground.
WS02	0.30	
WS03	0.30	
WS05	0.20	
HP01	0.30	
HP02	0.30	

Contamination analysis revealed elevated levels of PAH's (Benzo(a)Pyrene and Benzo(b)Fluoranthene) in WS5 at 0.20m bgl as well as elevated levels of Lead within HP1 at 0.30m, WS1 at 0.30m and WS5 at 0.20m bgl, when compared to the Human Health Assessment Reference Values adopted in the report.

Asbestos fibres were detected in samples of Made Ground from HP1 and WS05, identified as Amosite Board and loose Chrysotile fibres respectively.

Based on the results of the Phase 1 and Phase 2 investigation, the following CSM was adopted for the Phase 3 works.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Sources	Potential Absorption Pathways	Potential Receptors
Contaminants present within Made Ground onsite and from the sites current use as a builders' storage yard. • Asbestos; • Lead; • Poly-cyclic Aromatic Hydrocarbons – Benzo(a)pyrene, Benzo(b)Fluoranthene.	Direct ingestion of soil and soil derived household dust	Construction workers (particularly during foundation construction).
	Dermal contact of soil and soil derived household dust	
	Dermal contact with impacted soils	
	Ingestion of soil with elevated concentration of determinants	Service and Maintenance Operatives.
	Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants;	Site Occupiers.

3.0 FIELDWORK

3.1 Scope of Works

Phase 3 of site works were carried out on 17th July 2017 and comprised the excavation/drilling of 9No. Hand Dug and Window Sampler Boreholes (TPA – TPI) to a depth of between 1.00 – 2.00m bgl.

Phase 4 of site works were carried out on 13th March 2018 and comprised the excavation of 8No. Hand Dug trial pits (TPA1-TPA8) to depths of 1.00 – 1.10m bgl.

The approximate locations of the trial holes can be seen within Figure 5.

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, exploratory positions were relocated away from these areas.

As a further precautionary measure, the positions were hand scanned with a Cable Avoidance Tool (CAT scanner) to minimise the risk to services.

Upon completion of the site works, the trial holes were backfilled and made good/reinstated 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 the surface and at the base of the trial hole.

A number of samples were sent to undergo chemical laboratory testing, scheduled by Ground and Water Limited and carried out by QTS Environmental Limited.

4.0 ENCOUNTERED GROUND CONDITIONS

4.1 Soil Conditions (Phase 3 and Phase 4)

The exploratory holes were logged by James Harvey, Harry Brock and Robin Gledhall of Ground and Water Limited 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 what was anticipated from examination of the Phase 1 and 2 Report, with a capping of Made Ground/Topsoil underlain by superficial Head Deposits.

The ground conditions encountered during the investigation are described in this section. All trial hole and borehole logs can be seen in Appendix B and the trial hole location plan can be viewed in Figure 5.

For the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised as follows:

Made Ground (TPA – TPH & TPA1- TPA6)/Topsoil (TP1 & TPA7-TPA8) Head Deposits (TPA – TPH, TP1 & TPA5-TPA8)

Made Ground/Topsoil

In Phase 3 of site works, Made Ground was encountered from ground level to depths of between 0.70 – 1.20m bgl in TPA – TPH. The Made Ground comprised a brown/dark brown/orange brown sandy gravelly clay to gravelly sand. The sand was fine to coarse grained and the gravel was rare to abundant, fine to medium, sub-angular to sub-rounded flint and brick. Glass fragments were noted in TPA and TPD. Concrete fragments were noted in TPA. Carbonaceous material (possibly tarmac) was noted in TPD, TPF, TPG and TPH.

Topsoil was encountered from ground level to the base of TPI, at 1.00m bgl. The soils comprised dark brown gravelly sand where sand was fine to coarse grained and gravel was abundant to occasional, fine to medium, sub-angular to sub-rounded flints.

In Phase 4 of site works, Made Ground was encountered from ground level to depths of between 1.00 - >1.00m bgl in TPA1 – TPA6. The Made Ground comprised a light brown/orange-brown, grey and dark brown mottled sandy gravelly silty clay to gravelly sandy silty clay. The sand was fine to coarse grained. The gravel was rare to abundant, fine to coarse, sub-angular to sub-rounded flint, brick, concrete, plastic, carbonaceous material and metal fragments. Rare rotting organic material was noted in TPA6. Within TPA2, abundant carbonaceous material was noted from 0.80 – 1.00m bgl.

The Made Ground noted in the Phase 4 works was of similar extent and consistency as noted in the Phase 3 works.

Topsoil was encountered from ground level to depths of between 0.40 – 0.50m bgl in TPA7 – TPA8. The Topsoil comprised a dark brown/brown gravelly sandy silty clay. The sand was fine to coarse grained. The gravel was rare to occasional, fine to medium, sub-angular to sub-rounded flint.

Head Deposits

In Phase 3 of site works, Head Deposits were encountered within TPA – TPH from depths of between 0.70m – 1.20m, to the base of each trial pit (1.00 – 2.00m bgl). These soils comprised light

brown/brown/grey mottled gravelly clay. The gravel was rare to occasional, fine to coarse, sub-angular to sub-rounded flint.

In Phase 4 of site works, Head Deposits were encountered underlying the Made Ground/Topsoil to depths of between 0.40 - >1.20m bgl in TPA1 & TPA5-TPA8. The Head Deposits comprised an orange-brown/brown/grey-brown gravelly silty clay. The gravel was rare to occasional, fine, sub-angular to sub-rounded flint.

The Head Deposits noted in the Phase 4 works was of similar extent and consistency as noted in the Phase 3 works.

For details of the composition of the soils encountered at particular points, reference must be made to the individual trial hole logs within Appendix B.

4.2 Roots Encountered

A tabulated summary of the maximum depths of root penetrated soils during Phase 3 and 4 of site investigation can be seen below.

Summary of Roots Encountered (TPA – TPI & TPA1 – TPA8)	
Trial Pit	Roots Encountered (m bgl)
TPA, TPH	None encountered
TPG	0.50
TPC, TPD, TPF	0.80
TPB, TPE, TPI, TPA1, TPA4	1.00
TPA2, TPA6	1.10
TPA7	0.70
TPA8	0.40

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

No groundwater was noted during construction of the Phase 3 trial holes.

A groundwater strike was noted at 0.40m bgl in TPA1 and 1.00m bgl in TPA6 during construction of Phase 4 trial holes. Given the shallow depth, this was considered to be perched water.

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. Phase 3 site investigation was undertaken in July 2017, when groundwater levels are likely to be at their annual minimum (i.e. highest level). Phase 4 site investigation was undertaken in March 2018, where groundwater levels are likely to be at their annual maximum.

Isolated pockets of groundwater may be perched within any Made Ground found at other locations around the site.

4.4 Obstructions

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

5.0 PHASE 2 CONTAMINATION RISK ASSESSMENT

5.1 Results of the Phase II and III Risk Assessment (Conceptual Site Model)

The Conceptual Site Model (CSM) on which this Contamination Assessment has been based can be seen below.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Sources	Potential Absorption Pathways	Potential Receptors
Contaminants present within Made Ground onsite and from the sites current use as a builders' storage yard.	Direct ingestion of soil and soil derived household dust	Construction workers (particularly during foundation construction).
- Asbestos; - Lead; - Poly-cyclic Aromatic Hydrocarbons – Benzo(a)pyrene, Benzo(b)Fluoranthene.	Dermal contact of soil and soil derived household dust	
	Dermal contact with impacted soils	
	Ingestion of soil with elevated concentration of determinants	
	Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants;	Service and Maintenance Operatives.
		Site Occupiers.

As expected, Made Ground was encountered from ground level in all trial holes to a depth of 0.30 - >1.00m bgl. Therefore, there was no requirement to revise the conceptual site model highlighted above.

The results of the Phase 2, Phase 3 and Phase 4 contamination testing will be combined to form a comprehensive human health risk assessment for the site.

5.2 Sampling Locations

The methodology for sampling locations can be seen tabulated below. A trial hole location plan is given within Figure 5 and the proposed development plan is shown within Figure 4.

Methodology for Sampling Locations (Phase 3)			
Phase	Trial Holes	Sampling Strategy	Anticipated Proposed End-use
Phase 2	WS01	Random sampling strategy	Within private garden area to the rear of Plot 8
	WS02	Random sampling strategy	Within private garden area to the rear of Plot 6
	WS03	Random sampling strategy	Under the footprint of Plot 9
	WS04	Random sampling strategy	Under the footprint of Plot 4
	WS05	Random sampling strategy	Under the footprint of Plots 1 and 2
	HP01	Random sampling strategy	Within private garden area to the rear of Plots 1 and 2
	HP02	Random sampling strategy	Within private garden area to the rear of Plots 3 and 4
	HP03	Random sampling strategy	Within Car Park area
Phase 3	TPA	Targeted sampling strategy	Within private garden area to the rear of Plot 10
	TPB	Targeted sampling strategy	Within private garden area to the rear of Plot 9
	TPC	Targeted sampling strategy	Within private garden area to the rear of Plot 8
	TPD	Targeted sampling strategy	Within private garden area to the rear of Plot 7
	TPE	Targeted sampling strategy	Within private garden area to the rear of Plot 5
	TPF	Targeted sampling strategy	Within private garden area to the rear of Plot 4
	TPG	Targeted sampling strategy	Within private garden area to the rear of Plot 3
	TPH	Targeted sampling strategy	Within private garden area to the rear of Plot 1
	TPI	Targeted sampling strategy	Within private garden area to the rear of Plot 2
Phase 4	TPA1	Targeted sampling strategy	Within private garden area to the rear of Plot 10
	TPA2	Targeted sampling strategy	Within private garden area to the rear of Plot 9
	TPA3	Targeted sampling strategy	Within private garden area to the rear of Plot 7
	TPA4	Targeted sampling strategy	Within private garden area to the rear of Plot 5
	TPA5	Targeted sampling strategy	Within private garden area to the rear of Plot 4
	TPA6	Targeted sampling strategy	Within private garden area to the rear of Plot 1
	TPA7	Targeted sampling strategy	Within proposed open public soft landscaped area
	TPA8	Targeted sampling strategy	Within proposed open public soft landscaped area

The area investigated totals ~0.3887ha (3887m²) and with a total of 25 sampling locations, given an unknown hotspot shape, the sampling density means that a hotspot with an area of approximately ~233.22m² and a radius of approximately ~8.61m would be encountered (CLR 4). **This sampling density is deemed suitable.**

Soil sampling depths were chosen to reflect the receptors of concern, human health, and typically comprised a surface or near surface sample.

The receptors relevant to the sampling depths can be seen below.

Near surface samples	Direct ingestion, dermal contact and dust inhalation. Protection of end-users and maintenance workers e.g. Residents, Landscape Gardeners. Protection of shallow rooted plants.
>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.

5.3 Chemical Laboratory Testing – Human Health Risk Assessment

A programme of chemical laboratory testing, scheduled by Enzygo and carried out by QTS Environmental Limited, was undertaken on five samples of Made Ground from the Phase 2 works. A programme of chemical laboratory testing, scheduled by Ground and Water Limited and carried out by QTS Environmental Limited, was undertaken on eight samples of Made Ground from the Phase 3 works. The samples tested and the reasons for testing can be seen tabulated below. A programme of chemical laboratory testing, scheduled by Ground and Water Limited and carried out by QTS

Environmental Limited, was undertaken on eight samples of Made Ground from the Phase 4 works. The samples tested and the reasons for testing can be seen tabulated below.

Methodology for Chemical Laboratory Testing			
Phase	Boreholes	Depth (m bgl)	Sampling Strategy
Phase 2	WS01	0.30	Representative sample of Made Ground
	WS02	0.30	
	WS05	0.20	
	HP01	0.30	
	HP02	0.30	
Phase 3	TPA	0.20	Representative sample of Made Ground.
	TPB	0.20	
	TPC	0.20	
	TPD	0.20	
	TPE	0.20	
	TPF	0.20	
	TPG	0.20	
	TPH	0.20	
Phase 4	TPA1	0.20	Representative sample of Made Ground.
	TPA2	0.20	
	TPA3	0.20	
	TPA4	0.50	
	TPA5	0.20	
	TPA6	0.20	
	TPA6	0.50	
	TPA7	0.20	
	TPA8	0.20	

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 (WS01/0.30m, WS02/0.30m, WS05/0.20m, HP01/0.30m, HP02/0.30m, TPA7 0.20m and TPA8 0.20m bgl);
- Asbestos (WS01/0.30m, WS02/0.30m, WS05/0.20m, HP01/0.30m, HP02/0.30m, TPA/0.20m, TPB/0.20m, TPC/0.20m, TPD/0.20m, TPE/0.20m, TPF/0.20m, TPG/0.20m, TPH/0.20m bgl, TPA1/0.20m, TPA3/0.20m, TPA6/0.50m, TPA7/0.20m and TPA8/0.20m bgl);
- Lead (TPA/0.20m, TPB/0.20m, TPC/0.20m, TPD/0.20m, TPE/0.20m, TPF/0.20m, TPG/0.20m, TPH/0.20m bgl, TPA1/0.20m, TPA2/0.20m, TPA6/0.50m, TPA7/0.20m and TPA8/0.20m 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 (WS01/0.30m, WS02/0.30m, WS05/0.20m, HP01/0.30m, HP02/0.30m, TPA/0.20m, TPB/0.20m, TPC/0.20m, TPD/0.20m, TPE/0.20m, TPF/0.20m, TPG/0.20m, TPH/0.20m, TPA1/0.20m, TPA3/0.20m, TPA6/0.50m, TPA7/0.20m and TPA8/0.20m bgl);
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split (WS01/0.30m, WS02/0.30m, WS05/0.20m, HP01/0.30m, HP02/0.30m and TPA8/0.20m bgl);
- BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) and MTBE – used as marker compounds for Volatile Organic Compounds (VOCs) (WS01/0.30m, WS02/0.30m, WS05/0.20m, HP01/0.30m, HP02/0.30m and TPA8/0.20m bgl).

The chemical laboratory results are presented in Appendix C.

5.3.1 Soil Assessment Criteria

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

5.3.2 Determination of Representative Contamination Concentration

At the time of reporting, April 2018, it was understood the proposed development will comprise the demolition of the existing properties and the construction of 10No. residential properties with associated infrastructure. A car parking area will be constructed within the south-western section of the site. Terraced back gardens would be constructed within each back garden, with small grassed areas in northern sections of the back gardens. A public open space would be constructed to the south of the properties.

Terraced gardens are expected to be constructed, therefore, the results of the chemical laboratory testing were compared to the LQM/CIEH Suitable 4 Use Levels (S4UL) for a **'Residential with Homegrown Produce (RwHP)'** and **'Residential without Homegrown Produce (RwoHP)'** land-use scenarios, as this was considered the most appropriate land-use scenarios. The C4SL LLTC for Lead was compared to a **'Residential with Homegrown Produce (RwHP)'** and **'Residential without Homegrown Produce (RwoHP)'** land-use scenarios. This was considered suitable given the small size of the soft landscaping present. However, for secondary assessment, soils were compared to the **'Public Open Spaces near Residential Housing (POSResi)'** land-use scenario due to the public open space with trees noted to the south of the properties.

There 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 ICRCL 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 most conservative value was used.

The results of the Phase 2, Phase 3 and Phase 4 contamination testing can be viewed overpage.

Soil Guideline Values and General Acceptance Criteria Results (Ground and Water Limited)			
Substance	Sample Location Where available LQM/CIEH S4UL and CSL4 LLTC were exceeded for relevant land-use scenario		
	"Residential with Homegrown Produce (RwHP)" Land-Use Scenario	"Residential without Homegrown Produce (RwoHP)" Land-Use Scenario	"Public Open Spaces near Residential Housing (POSResi)" Land-Use Scenario
Arsenic	None	None	None
Boron	None	None	None
Beryllium	None	None	None
Cadmium	None	None	None
Chromium (III)	None	None	None
Hexavalent Chromium (VI)	None	None	None
Copper	None	None	None
Lead	HP01 at 0.30m bgl (3400mg/kg) WS01 at 0.30m bgl (330mg/kg) WS05 at 0.20m bgl (530mg/kg) TPF at 0.20m bgl (1590mg/kg) TPA6 at 0.50m bgl (295mg/kg) TPA2 at 0.20m bgl (264mg/kg)	HP01 at 0.30m bgl (3400mg/kg) WS01 at 0.30m bgl (330mg/kg) WS05 at 0.20m bgl (530mg/kg) TPF at 0.20m bgl (1590mg/kg)	HP01 at 0.30m bgl (3400mg/kg) TPF at 0.20m bgl (1590mg/kg)
Mercury (Elemental)	None	None	None
Nickel	None	None	None
Selenium	None	None	None
Vanadium	None	None	None
Zinc	None	None	None
Cyanide (Total)	None	None	None
Total Phenol	None	None	None
Napthalene	None	None	None
Acenaphthylene	None	None	None
Acenaphthene	None	None	None
Fluorene	None	None	None
Phenanthrene	None	None	None
Anthracene	None	None	None
Fluoranthene	None	None	None
Pyrene	None	None	None
Benzo(a)anthracene	None	None	None
Chrysene	None	None	None
Benzo(b)fluoranthene	WS05 at 0.20m bgl (3.40mg/kg)	None	None
Benzo(k)fluoranthene	None	None	None
Benzo(a)pyrene	WS05 at 0.20m bgl (2.60mg/kg)	None	None
Indeno(1,2,3-cd)pyrene	None	None	None
Dibenz(a,h)anthracene	None	None	None
Benzo(ghi)perylene	None	None	None
TPH C5 – C6 (aliphatic)	None	None	None
TPH C6 – C8 (aliphatic)	None	None	None
TPH C8 - C10 (aliphatic)	None	None	None
TPH C10 - C12 (aliphatic)	None	None	None
TPH C12 - C16 (aliphatic)	None	None	None
TPH C16 - C21 (aliphatic)	None	None	None
TPH C21 - C34 (aliphatic)	None	None	None
TPH C5 – C7 (aromatic)	None	None	None
TPH C7 – C8 (aromatic)	None	None	None
TPH C8 - C10 (aromatic)	None	None	None
TPH C10 - C12 (aromatic)	None	None	None
TPH C12 - C16 (aromatic)	None	None	None
TPH C16 - C21 (aromatic)	None	None	None
TPH C21 - C35 (aromatic)	None	None	None
Benzene	None	None	None
Toluene	None	None	None
Ethylbenzene	None	None	None
Xylene (o, m & p)	None	None	None
MTBE	None	None	None
Asbestos	HP01 at 0.30m bgl (Amosite board) WS05 at 0.20m bgl (loose Chrysotile fibres) TPA at 0.20m bgl (0.002% fibre bundles of Chrysotile)	HP01 at 0.30m bgl (Amosite board) WS05 at 0.20m bgl (loose Chrysotile fibres) TPA at 0.20m bgl (0.002% fibre bundles of Chrysotile)	HP01 at 0.30m bgl (Amosite board) WS05 at 0.20m bgl (loose Chrysotile fibres) TPA at 0.20m bgl (0.002% fibre bundles of Chrysotile)

Chemical laboratory testing of the Made Ground revealed elevated levels of Lead (210 – 3400mg/kg) within HP01 at 0.30m, WS01 at 0.30m, WS05 at 0.20m, TPF at 0.20m, TPA2 at 0.20m and TPA6 at 0.50m bgl for the “Residential with Homegrown Produce (RwHP)”.

The levels of Lead at HP01 at 0.30m, WS01 at 0.30m, WS05 at 0.20m and TPF at 0.20m bgl exceeded the threshold for the “Residential without Homegrown Produce (RwoHP)” land use scenario.

The levels of Lead at HP01 at 0.30m and TPF at 0.20m bgl also exceeded the threshold for the “Public Open Space near Residential Housing (POSResi)” land use scenario.

Chemical laboratory testing of the Made Ground also revealed elevated levels of Benzo(b)fluoranthene (3.40mg/kg) and Benzo(a)pyrene (2.60mg/kg) within WS05 at 0.20m bgl for the “Residential with Homegrown Produce (RwHP)” land use scenario. The levels of PAH’s noted did not exceed the RwoHP or POSResi S4UL’s.

Chemical laboratory testing of the Made Ground revealed 0.002% fibre bundles of Chrysotile within TPA at 0.20m bgl, as well as Amosite board asbestos within HP01 and loose Chrysotile fibres within WS05.

Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a “**Residential with Homegrown Produce (RwHP)**”, “**Residential with Homegrown Produce**” (RwoHP) and “**Public Open Space near Residential Housing**” land-use scenarios.

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.

Overall, Phase 4 contamination results fell in line with that of Phase 3 results, as well as Phase 2 results obtained by Enzygo Limited.

Quantitative Asbestos Risk Assessment

A quantitative Risk Assessment was carried out in accordance with CIRIA7733 to assess the mesothelioma or Lung Cancer lifetime risk to either staff or students as a result of exposure to Chrysotile present on the site.

Risk Assessment CIRIA7733:

1. Chrysotile (fibre bundles in soil (0.002%)) Risk Assessment (TPA/0.20m bgl):

The risk assessment has been based on an intermediate to sandy soil (as per soil sample descriptions from QTS and the trial hole logs within Appendix B) in accordance with Addison et al 1988.

The asbestos type was Chrysotile (fibre bundles) with a concentration of in the soil of 0.002% at one location (TPA/0.20m bgl).

In accordance with CIRIA7733 in order to determine a cumulative exposure in fibre/ml.years the following equation is required:

$((K_{\text{asbestostype}} \times K_{\text{soil}})/K_{\text{overall}}) \times \text{Soil Concentration} = \text{fibre/ml per mg/m}^3$.

$\text{Fibre/ml per mg/m}^3 \times \text{Dust Concentration} = \text{f/ml}$.

$(\text{f/ml} \times \text{Dry Days Exposure (hrs)}) = \text{f/ml.hr}$

Conversion to years by dividing by 1950hr (Occupational hours in year) = f/ml.year.

Apply age correction factor at which point exposure occurs.

The following has been used within the calculation:

Soil Type: Sandy Clay.

Soil Concentration: 0.002%.

Asbestos Type: Chrysotile.

Asbestos Form: Fibre Bundles.

Dust Concentration: 0.1mg/m³ – Based on ART model and Soil Dust Concentrations & Gardening.

Dry Day Exposure: 150hrs/year.

No. of Years: 5yrs segments up until 55.

Age exposure correction for mesothelioma: Taking risk as persisting for 80yrs.

Based on above:

$\text{fibre/ml per mg/m}^3 = (2.9 \times 1.3)/1.6 = 1.38125$.

$1.38125 \times 0.002 = 0.0027625$

$0.0027625 \times 0.1 = 0.00027625 \text{ f/ml}$.

$(0.00027625 \times 750 \text{ (150hours} \times 5\text{year)})/1950 \text{ (occupational hours in year)} = 0.2071875 \text{ f/ml.year}$.

A worst-case exposure scenario for staff, groundworkers or students (0 – 70yrs) within the communal gardens being exposed for a period of 70 years, equates to a cumulative exposure of **0.001785f/ml/year**.

Based on Table 14.1 this equates to an insignificant risk of mesothelioma or Lung Cancer lifetime risk. Therefore, no remediation procedures are considered necessary where loose chrysotile fibres were detected.

The previous detection of loose Chrysotile fibres within WS05/0.20m bgl are likely to be in line with the above risk assessment and pose no unacceptable risk to end-users.

An unacceptable risk is considered to be present where the Amosite board was noted.

5.4 CLAIRE Risk Assessment

CLAIRE statistical analysis of the results of contamination testing was carried out targeting the contaminants identified as posing an unacceptable risk to end-users (Lead, Benzo(b)Flouranthene and Benzo(a)Pyrene).

CLAIRE statistical analysis looks at the distribution of contaminants across the site to determine if overall levels exceed the critical criteria and whether there are outliers within the sample population which can be treated as hotspots.

The Made Ground encountered from the investigation undertaken by Enzygo Geo-Environmental and Ground and Water Limited was considered to be of the same population, therefore statistical analysis on all results obtained was deemed appropriate.

A summary of analysis undertaken can be seen overleaf. Results can be seen in Appendix E.

Soil Guideline Values and General Acceptance Criteria Results					
Substance	Outliers Present	Upper Confidence Limit of Sample Population (mg/kg)	Does the Upper Confidence Limit of the Sample Population Exceed the C4SL LLTC		
			"Residential with Homegrown Produce (RwHP)" Land-Use Scenario	"Residential without Homegrown Produce (RwoHP)" Land-Use Scenario	"Public Open Spaces near Residential Housing (POSResi)" Land-Use Scenario
Lead	YES	1272.00	Yes (210mg/kg)	Yes (330mg/kg)	Yes (760mg/kg)
Lead	NO	255.56	Yes (210mg/kg)	No (330mg/kg)	No (760mg/kg)
Benzo(b)Fluoranthene	YES	1.27	No (2.60mg/kg)	No (2.60mg/kg)	No (2.60mg/kg)
Benzo(a)Pyrene	YES	0.97	No (2.20mg/kg)	No (2.20mg/kg)	No (2.20mg/kg)

CLAIRE statistical analysis of the distribution of elevated levels of Lead within the Made Ground analysed revealed the contaminants to have a non-normal distribution and three outliers relating to HP01/0.30m, WS05/0.20m and TPF/0.20m bgl and with the mean and Upper Confidence Limit of the sample population above the C4SL LLTC (Residential with Homegrown Produce (RwHP), Residential without Homegrown Produce (RwoHP), and Public Open Spaces near Residential Housing (POSResi)). With outliers removed, the upper confidence limit of the sample population was still found to exceed the C4SL LLTC in the "Residential with Homegrown Produce (RwHP) Land-Use Scenario. With outliers removed, the upper confidence limit was below the C4SL LLTC limit in the "Residential without Homegrown produce (RwoHP)" and "Public Open Spaces near Residential Housing (POSResi)" Land-Use Scenario.

Therefore, with and without hotspots, the elevated levels of Lead were considered a site-wide issue in a "Residential with Homegrown Produce (RwHP) Land-Use Scenario.

The isolated elevated levels of Lead within HP01/0.30m, WS05/0.20m and TPF/0.20m were considered to pose a potential risk to end-users in the Public Open Spaces near Residential Housing (POSResi) Scenario.

CLAIRE statistical analysis of the distribution of elevated levels of Benzo(b)Fluoranthene and Benzo(a)Pyrene within the Made Ground analysed revealed the contaminants to have a non-normal distribution with two outliers relating to WS05/0.20m and HP01/0.30 bgl; however, with the mean and Upper Confidence Limit of the sample population below the C4SL LLTC (Residential with Homegrown Produce (RwHP), Residential without Homegrown Produce (RwoHP), and Public Open Spaces near Residential Housing (POSResi)). Therefore, the elevated levels of Benzo(b)Fluoranthene and Benzo(a)Pyrene, including hotspots, were not considered to pose a significant risk to end-users.

5.5 Re-Evaluated Phase 1 Conceptual Site Model

Following completion of the Phase 2 Site Investigation, the revised CSM developed within Section 2.7 of this report was re-evaluated and can be seen below and overleaf.

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 Sources	Potential Absorption Pathways	Potential Receptors
Contaminants present within Made Ground onsite and from the sites current use as a builders' storage yard. - Asbestos; - Lead; ~~Poly-cyclic Aromatic Hydrocarbons—Benzo(a)pyrene, Benzo(b)Fluoranthene.~~ 3x lead hotspots were identified (HP01/0.30m, WS05/0.20m and TPF/0.20m bgl). Elevated levels of lead deemed sight wide issue "Residential with Homegrown Produce (RwHP) Land-Use Scenario." Unacceptable risk considered to be present where amosite board was noted (HP01/0.30m bgl)	Direct ingestion of soil and soil derived household dust Dermal contact of soil and soil derived household dust Dermal contact with impacted soils Ingestion of soil with elevated concentration of determinants Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants;	Construction workers (particularly during foundation construction). Service and Maintenance Operatives. Site Occupiers.

Phase 2, 3 and 4 of site works found three outliers relating to elevated levels of lead (HP01/0.30m, WS05/0.20m and TPF/0.20m bgl). With removal of the Lead hotspots, site wide levels of lead were still sufficiently high to potentially pose a risk to end-users.

Phase 2 and 3 of site works found asbestos in three locations (HP01/0.30m, (Amosite board), WS05/0.20m (loose Chrysotile fibres) and TPA/0.20m bgl (Chrysotile fibres)). As the Asbestos Risk Assessment of the loose Chrysotile fibres of TPA/0.20m bgl suggested an insignificant risk of to end users, the other Chrysotile fibres encountered at WS05/0.20m bgl will likely be similar. The loose fibres WS05 and TPA were therefore not considered likely to pose a risk to end-users. However, the potential for Amosite board material to be noted in HP01 required further attention. Further testing in Phase 4 of site works (TPA1/0.20m, TPA4/0.50m and TPA6/0.20m bgl) found no detectable levels of asbestos.

Below is a summary of the location of contaminants relative to the proposed land use.

Location of Contaminants relative to Anticipated Proposed End-use		
Trial Holes	Contaminant	Anticipated Proposed End-use
WS05	Lead	Under the footprint of Plots 1 and 2
HP01	Lead	Within private garden area to the rear of Plots 1 and 2
	Asbestos (Amosite board)	
TPF	Lead	Within private garden area to the rear of Plot 4
Site wide	Lead (with and without hotspot)	Private garden areas across the site.

Given then location of WS05, under an area of hardstanding, this would remove the potential pollutant linkages with respect to the lead identified, and therefore no further remediation is considered necessary. It is considered likely that HP01 is an extension of the hotspot in WS05 and will therefore is likely be remediated.

Therefore, remediation is considered necessary to remove potential unacceptable risk to end-users from the lead and asbestos hotspots associated with HP01 and TPF as well as the site wide-issue of elevated lead.

6.0 DEVELOPMENT OF A REMEDIATION STRATEGY

6.1 Option Appraisal

This section of the report will discuss the options available following completion of the Site Investigation and Risk Assessment with respect to the soil and groundwater contamination.

The Risk Assessment to date has revealed the following contaminants of concern:

Amosite asbestos boards were identified within HP01 at 0.30m bgl.

Hotspots of Lead were noted centred around HP01 at 0.30m bgl and TPF at 0.20m. Without the hotspots the levels of Lead were also considered a site-wide issue.

We have assessed that the contamination noted does not pose a risk to groundwater and therefore remediation is solely necessary with respect to human health.

Risk Assessment has indicated that the determinants noted pose no unacceptable risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding. However, given the risks posed to end-users, remediation is necessary for areas of soft landscaping.

Complete removal of Made Ground from the site has not been considered given the cost implications and that a simple capping system could be adopted. This would prevent needless lorry movements and prevent waste unnecessarily being sent to landfills with only a finite capacity.

All works associated with construction/remediation will need to take into account the presence of asbestos fibres within the Made Ground at the concentrations noted within the report. The Method Statements must ensure that not only site operative/workers are protected from any potential release of asbestos fibres but also that local residents/pupils are not affected.

All future maintenance workers/service operatives, working within areas of hardstanding (including beneath the footprint of building), will need to take into account the presence of Made Ground potentially containing fibrous asbestos within their work Method Statements.

In relation to end-users the presence of permanent hardstanding will sever any plausible pollutant linkages present. In areas of soft landscaping then a risk may exist and remediation will be required.

6.2 Remediation strategy:

Hotspots of Lead and Amosite asbestos.

1. A suitable remediation strategy would be a reduced dig of Made Ground to a nominal depth of 0.50m bgl in a circular area, ~8.61m in diameter centred on the locations of HP01 and TPF.
2. Followed by validation sampling and testing. Should validation sampling identify further contamination then remedial excavation should continue until validation sampling reveals all contaminants to have been removed.
3. The void created by the reduced dig should then be backfilled with certified clean Topsoil/Subsoil. It should be noted that NHBC/Local Authority may require a suitably thick capping of Topsoil for a growing medium.

Following hotspot removal the UCL of the Lead across the Made Ground exceeds the critical concentration of 210 mg/kg. As the UCL (255.56 mg/kg) was not six times over the Upper Confidence Limit of 210 mg/kg then BRE Cover System could be adopted.

The BRE *“Cover Systems for Land Regeneration, Thickness Design of Cover Systems for Contaminated Land, BRE, March 2004”*, allows for the design of cover systems to impacted soils where the concentration of determinants within the ground does not exceed any of the respective SGVs or GACs by more than six.

The BRE Cover Systems spreadsheet was based on a mixing zone of 600mm. The lower the concentration of the elevated determinants in the imported Topsoil, the lesser the amount of clean cover will be required.

An **example cover thickness** has been calculated of ~200mm of clean certified Topsoil using an approximate assumed concentration of lead (100mg/kg) likely to be present in any imported Topsoil, which can be viewed in Appendix G. **The actual cover thickness would need to be calculated once a source of imported Topsoil was known with available chemical results certificates.**

Excavation of the soft landscaped garden areas must be independently inspected to validate that the calculated depth has been achieved **before any Topsoil is imported onto the site.**

A remediation strategy plan is shown in Figure 6.

6.3 Remediation Method Statement

The following remediation is required for the asbestos and Lead hotspots identified at HP01/0.30m bgl and TPF/0.20m and site wide lead following hotspot removal.

Hotspot Removal:

- It is recommended that Made Ground is removed to a depth to a nominal depth of 0.50m bgl in a circular area, ~8.61m in diameter, centred on the locations of HP01 and TPF.
- It is recommended that all remedial works are supervised by a Ground and Water Limited Engineer. This will allow for supervision and segregation of the waste produced whilst remedial works are ongoing. This may reduce overall disposal costs.
- Following the reduced dig the voids created must be visually inspected by an independent and suitably qualified person to verify the removal of the hotspots. Validation samples from the sides and, where applicable, the base of the excavations should be taken and analysed for the presence of asbestos and/or elevated levels of contaminants. Excavations may cease at shallower depth where natural soils are encountered.
- The voids created should be measured and photographed.
- Should validation sampling identify further contamination then remedial excavation should continue until validation sampling reveals all contaminants to have been removed. Repeat points above till sampling proves contaminants have been removed.
- Excavations should cease at 1.00m below the proposed finish ground level and a 150mm coarse grained anti-capillarity barrier should be installed at the base of the void. If applicable.

- The voids should be backfilled with certified clean Subsoil/Topsoil

All Private Gardens:

- The source of Topsoil should be determined and verified as suitable for us.
- Sampling of the imported Topsoil should be analysed for Lead to determine if the levels confirm to the BRE Cover System assumptions.
- If the lead concentrations were found to differ from the assumptions adopted, then the BRE Cover Systems spreadsheet would need to be revised.
- Following confirmation of the cover required the formation level of the proposed garden should be surveyed.
- Should sufficient cover be possible then the cover may be placed. Should insufficient cover be present then a reduce dig of the formation level should be undertaken to facilitate the appropriate cover.
- Any cover soils would need to be verified as suitable for use, from a human health/contamination perspective, prior to importation.

Waste Removal:

- Materials to be removed off-site must be classified by carrying out Waste Acceptance Produce (WAP) testing. A registered contractor must undertake the removal of waste. Full liaison must be made with the Environment Agency prior to the removal of any material and must be conducted to meet their full approval.
- Stockpiled contaminated Made Ground, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.

6.4 Validation Strategy

Any remedial works undertaken on the site will need to be inspected and independently validated by a Ground and Water Limited Engineer. All remedial excavations will need to be inspected, documented and photographed.

6.5 Waste Disposal

Foundation and remedial excavations on-site are 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.

Hazardous waste requires pre-treatment prior to removal. The site may need to be registered as a Hazardous waste producer should such waste be removed from the site.

Asbestos was detected in three of the samples of the Made Ground analysed (HP01/0.30m, WS05/0.20m and TPA/0.20m bgl). No asbestos was found in the remaining samples analysed.

Asbestos is the name given to a group of naturally occurring minerals which consist of flexible fibres. The most common types of asbestos are Chrysotile (white), Amosite (brown) and Crocidolite (blue). The properties of asbestos, in particular its strength, high thermal and electrical insulation, chemical resistance and fire resistance made it a very useful building material. However, breathing in asbestos fibres can cause diseases of the respiratory system. Whilst its use has now been banned, there are still many buildings which have asbestos containing materials which were installed before the ban came into effect.

Asbestos is both carcinogenic and toxic. The threshold limit for carcinogenic materials (0.1%) is lower than the threshold for toxic materials (3%). In practice, this means that any material containing more than 0.1% asbestos is classed as hazardous waste.

The Chrysotile fibres identified within TPA had a quantification of 0.002%, which is below the hazardous waste threshold limit and therefore the quantity of asbestos within the soil of TPA is deemed to be **NON-HAZARDOUS**. The quantification of chrysotile fibres within WS05 were assumed to have been similar.

However, there is potential for the Amosite board identified in HP01 to be **HAZARDOUS**. Further testing of the potential waste within HP01 and the Amosite board is required to confirm waste classification.

Based on a risk phase analysis of the remaining chemical laboratory test results, in accordance with EC Hazardous Waste Directive, undertaken by Ground and Water Limited, the Made Ground encountered onsite is **NON-HAZARDOUS**, apart from HP01/0.30m bgl, which was classified as **HAZARDOUS**, due to elevated levels of Lead. The results of the assessment are given within Appendix F.

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

Hazardous waste requires pre-treatment prior to removal. The site may need to be registered as a Hazardous waste producer should such waste be removed from the site. It is recommended that the waste from HP01, following removal, is stockpiled onsite and re-tested in the bulk, for lead and asbestos. Supervision of the remediation should be considered in order to "pick out" any fragments of asbestos containing materials identified during the excavation works.

Following this initial waste hazard assessment, a Full WAC Solid Suite Test with single batch leachate should be undertaken to determine which landfill category the waste conformed to.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM2, 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.

6.6 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.

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 CIEH Generic Assessment Criteria, which can be viewed in Appendix D of this report.

6.7 Duty of Care

All works associated with construction/remediation will need to take into account the presence of elevated lead and asbestos fibres within the Made Ground at the concentrations noted within the report. The Method Statements must ensure that not only site operative/workers are protected from any potential release of asbestos fibres but also that local residents/pupils are not affected.

All future maintenance workers/service operatives, working within areas of hardstanding (including beneath the footprint of building), will need to take into account the presence of Made potentially containing elevated PAHs and fibrous asbestos within their work Method Statements.

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 would be generated as a result of construction activities.

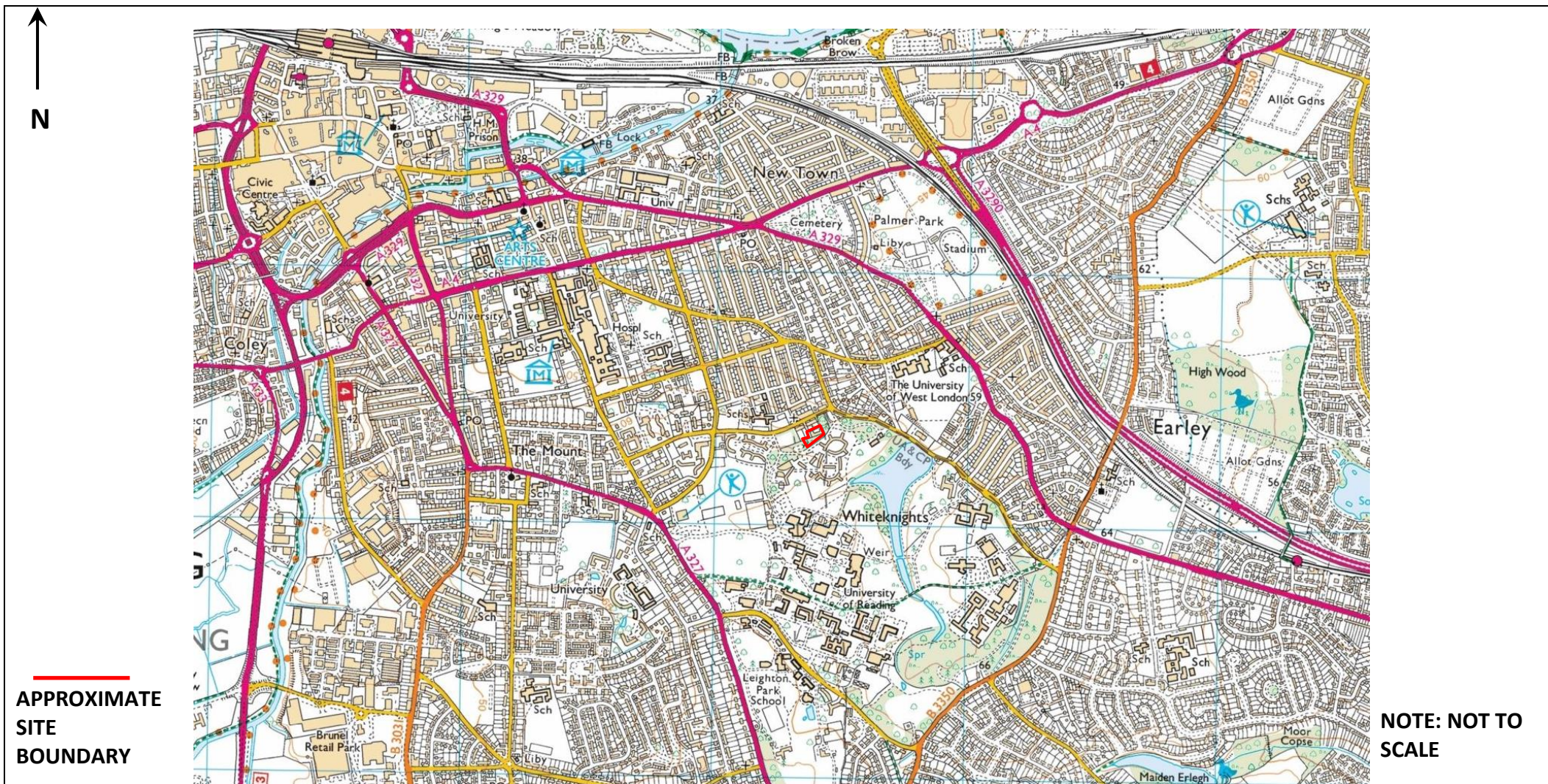
The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

6.8 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 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.



Project:

Land to the rear of 1 – 25 Upper Redlands Road, University of Reading, Whiteknights Campus,
Reading RG6 6UD

Client:

University of Reading c/o Ridge and Partners LLP

Date:

April 2018

Site Location Plan

Ref:

GWPR2462

Figure 1

ground&water



**APPROXIMATE
SITE BOUNDARY**



NOTE: NOT TO SCALE

Project:

**Land to the rear of 1 – 25 Upper Redlands Road, University of Reading, Whiteknights Campus,
Reading RG6 6UD**

Client:

University of Reading c/o Ridge and Partners LLP

Date:

April 2018

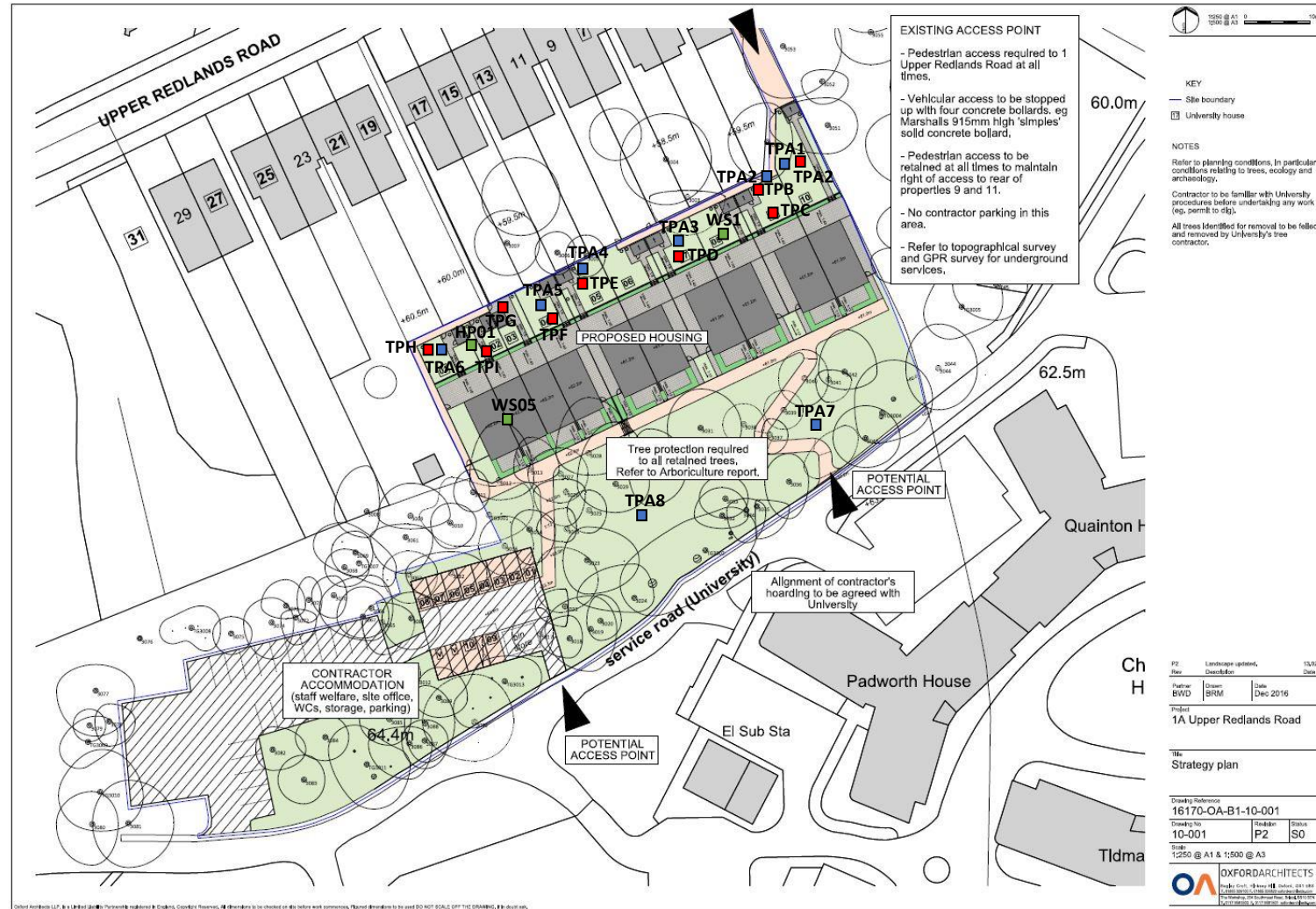
Aerial View of Site

Ref:

GWPR2462

Figure 3

ground&water



Project:

Land to the rear of 1 – 25 Upper Redlands Road, University of Reading, Whiteknights Campus, Reading RG6 6UD

Client:

University of Reading c/o Ridge and Partners LLP

Date:

April 2018

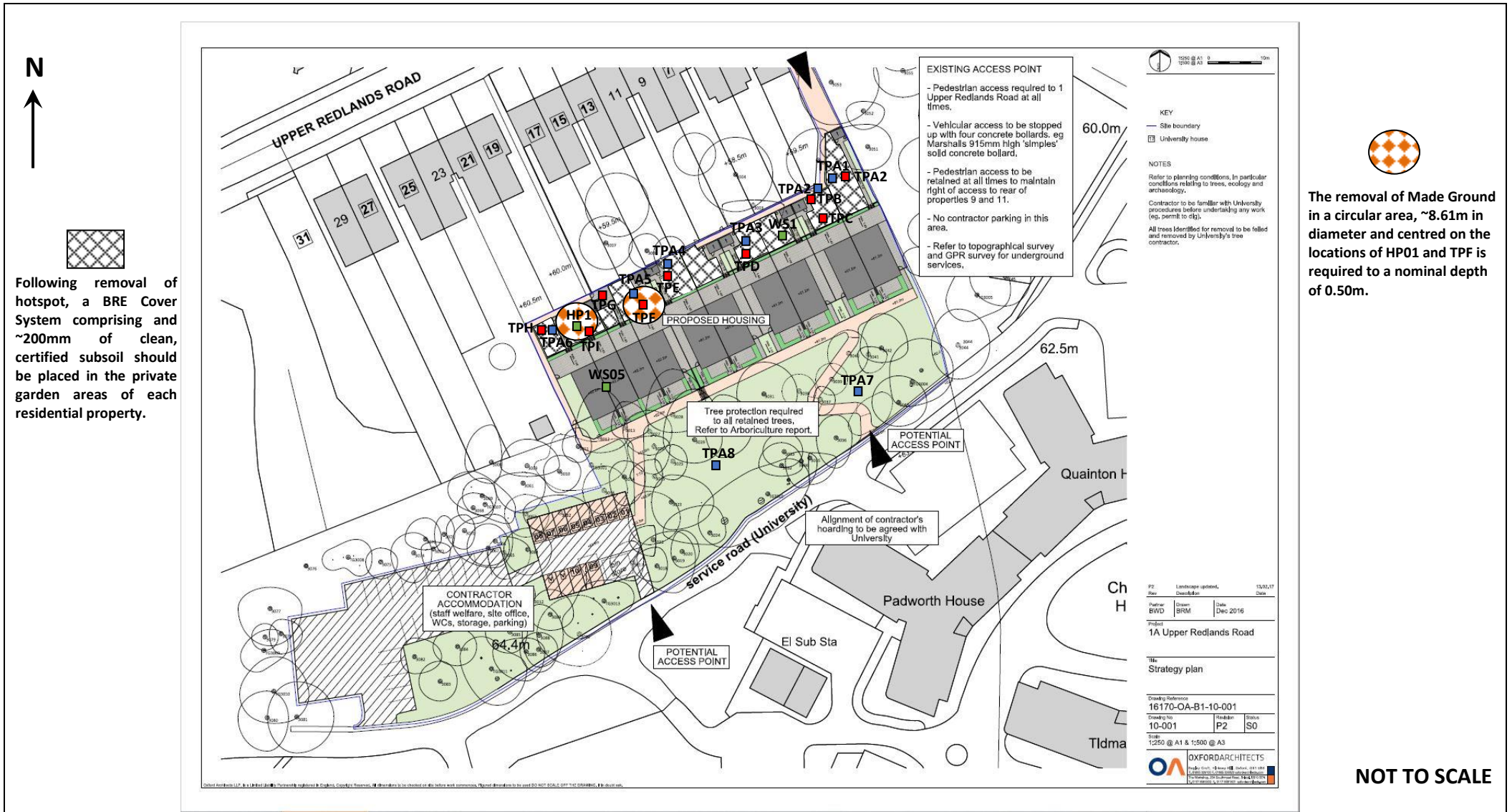
Ref:

GWPR2462

Trial Hole Location Plan

Figure 1

ground&water



Project: Land to the rear of 1 – 25 Upper Redlands Road, University of Reading, Whiteknights Campus, Reading RG6 6UD		Figure 1	
Client: University of Reading c/o Ridge and Partners LLP	Date: April 2018		
Trial Hole Location Plan	Ref: GWPR2462		

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 Land to the Rear of 1 – 25 Upper Redlands Road, University of Reading.

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.

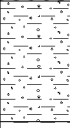
The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees,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

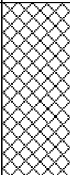
Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets, remain with Ground and Water Limited. Licence is for the sole use of the client and may not be assigned, transferred or given to a third party.

Only our client may rely on this report and should this report or any information contained in it be provided to any third party we accept no responsibility to the third party for the contents of this report save to the extent expressly outlined by us in writing in a reliance letter addressed from us to the third party.

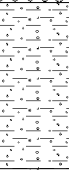
Recipients are not permitted to publish this report outside of their organisation without our express written consent.

APPENDIX B
Fieldwork Logs

Ground and Water Ltd								Borehole No TPA Sheet 1 of 1						
Project Name University of Reading				Project No. GWPR2207		Co-ords: -		Hole Type WS						
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR						Level: -		Scale 1:50						
Client: Knowles & Son						Dates: 17/07/2017		Logged By JH						
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description						
		Depth (m)	Type	Results										
		0.50	D		1.20			MADE GROUND: Brown gravelly clay. Gravel is occasional, fine to medium, sub-angular to sub-rounded flint, brick, glass and concrete.	1					
		0.90	D											
		1.00	D											
		1.50	D											
					2.00			HEAD DEPOSITS: Brown grey mottled gravelly CLAY. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint.	2					
		End of Borehole at 2.00 m												
														3
														4
														5
														6
														7
														8
														9
		Remarks: No groundwater encountered. No roots noted.												
														

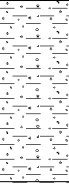
Ground and Water Ltd										Borehole No TPA Sheet 1 of 1			
Project Name University of Reading					Project No. GWPR2207		Co-ords: -			Hole Type WS			
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR							Level: -			Scale 1:50			
Client: Knowles & Son							Dates: 17/07/2017			Logged By JH			
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.50	D		1.20			MADE GROUND: Brown gravelly clay. Gravel is occasional, fine to medium, sub-angular to sub-rounded flint, brick, glass and concrete.					
		0.90	D										
		1.00	D					2.00		HEAD DEPOSITS: Brown grey mottled gravelly CLAY. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint.			
		1.50	D										
End of Borehole at 2.00 m													

Ground and Water Ltd							Borehole No TPB Sheet 1 of 1		
Project Name University of Reading			Project No. GWPR2207		Co-ords: -		Hole Type WS		
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR					Level: -		Scale 1:50		
Client: Knowles & Son					Dates: 17/07/2017		Logged By JH		
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D		1.20			MADE GROUND: Dark brown gravelly clay. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint and brick.	1
		0.80	D						
		1.00	D						
		1.50	D		2.00			HEAD DEPOSITS: Brown grey mottled gravelly CLAY. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint.	2
		2.00	D						
							End of Borehole at 2.00 m		
									3
									4
									5
									6
									7
									8
									9
Remarks: No groundwater encountered. Roots to 1.00m bgl.									

Ground and Water Ltd							Borehole No TPC Sheet 1 of 1		
Project Name University of Reading			Project No. GWPR2207		Co-ords: -		Hole Type WS		
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR					Level: -		Scale 1:50		
Client: Knowles & Son					Dates: 17/07/2017		Logged By JH		
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D		0.90			MADE GROUND: Dark brown sandy clay. Sand is fine to coarse grained.	1
		0.80	D						
		1.00	D						
		1.50	D		2.00			HEAD DEPOSITS: Brown grey gravelly CLAY. Gravel is occasional, fine to coarse, sub-angular to sub-runded flints.	2
		2.00	D						
							End of Borehole at 2.00 m		
									3
									4
									5
									6
									7
									8
									9
Remarks: No groundwater encountered. Roots noted to 0.80m bgl.									

[illegible]

Ground and Water Ltd							Borehole No TPF Sheet 1 of 1		
Project Name University of Reading			Project No. GWPR2207		Co-ords: -		Hole Type WS		
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR					Level: -		Scale 1:50		
Client: Knowles & Son					Dates: 17/07/2017		Logged By JH		
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D		0.70			MADE GROUND: Dark brown gravelly sand. Sandy is fine to coarse grained. Gravel is abundant to occasional, fine to medium, sub-angular to sub-rounded flint, brick and tarmac.	1
		0.80	D						
		1.00	D						
								End of Borehole at 1.00 m	2
									3
									4
									5
									6
									7
									8
									9
Remarks: No groundwater encountered. Roots noted to 0.80m bgl.									

Ground and Water Ltd							Borehole No TPG Sheet 1 of 1				
Project Name University of Reading			Project No. GWPR2207		Co-ords: -		Hole Type WS				
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR					Level: -		Scale 1:50				
Client: Knowles & Son					Dates: 17/07/2017		Logged By JH				
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		0.50	D		0.80			MADE GROUND: Dark brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant to occasional, fine to medium, sub-angular to sub-rounded, flints, tarmac and brick.	1		
		0.80	D								
		1.00	D								
					2.00			HEAD DEPOSITS: Light brown grey mottled gravelly CLAY. Gravel is occasional to rare, fine to medium, sub-angular to sub-rounded flint.	2		
		End of Borehole at 2.00 m									
											3
											4
											5
											6
											7
											8
											9
		Remarks: No groundwater encountered. Roots noted to 0.50m bgl.									

Ground and Water Ltd										Borehole No TPI Sheet 1 of 1	
Project Name University of Reading					Project No. GWPR2207		Co-ords: -			Hole Type WS	
Location: Whiteknights Campus, Shinfield Road, Reading RG6 6UR							Level: -			Scale 1:50	
Client: Knowles & Son							Dates: 17/07/2017			Logged By JH	
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		1.00	D		1.00			TOPSOIL: Dark brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant to occasional, fine to medium, sub-angular to sub-rounded flints. ----- End of Borehole at 1.00 m			

Ground and Water Ltd							Trialpit No TPA1 Sheet 1 of 1	
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018	
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: -		Scale 1:25	
Client: Ridge & Partners LLc/o Uni Reading					Depth 1.10m		Logged By HB	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.20	D					MADE GROUND: Light brown sandy gravelly (25%) silty clay. Sand is fine to coarse grained. Gravel is occasional, fine to coarse, sub-angular to sub-rounded flint (50%) brick (30%) and concrete (20%). Rare carbonaceous material noted. Gravel becomes less abundant with depth.		
0.40	D							
0.60	D							
0.80	D							
1.00	D		1.00					
			1.10			HEAD DEPOSITS: Grey-brown gravelly silty CLAY. Gravel is rare, fine to medium, sub-angular to sub-rounded flint.		
						Trialpit Complete at 1.10 m		
1 2 3 4								
Remarks: Roots noted to 1.00m bgl.								
Groundwater: Groundwater strike at 0.40m bgl.								

Ground and Water Ltd							Trialpit No TPA5 Sheet 1 of 1	
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018	
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: -		Scale 1:25	
Client: Ridge & Partners LLc/o Uni Reading					Depth 1.20m		Logged By RG	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.20	D		1.10 1.20			MADE GROUND: Light brown sandy gravelly (25%) silty clay. Sand is fine to coarse grained. Gravel is occasional, fine to coarse, sub-angular to sub-rounded flint (40%), brick (40%) and concrete (20%). Rare carbonaceous material noted. Gravel becomes less abundant with depth.		
0.50	D							
0.70	D							
1.00	D							
						HEAD DEPOSITS: Grey-brown gravelly silty CLAY. Gravel is rare, fine to medium, sub-angular to sub-rounded flint.		
						Trialpit Complete at 1.20 m		
1 2 3 4								
Remarks: No roots noted.								
Groundwater: No groundwater encountered.								

Ground and Water Ltd							Trialpit No TPA8 Sheet 1 of 1	
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018	
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: -		Scale 1:25	
Client: Ridge & Partners LLc/o Uni Reading					Depth 0.60m		Logged By HB	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.20	D					TOPSOIL: Brown sandy gravelly silty clay. Sand is fine to coarse grained. Gravel is rare, fine to medium, sub-angular to sub-rounded flint.		
0.40	D		0.40			HEAD DEPOSITS: Brown gravelly silty CLAY. Gravel is rare, fine to coarse, sub-angular to sub-rounded flint.		
0.60	D		0.60			Trialpit Complete at 0.60 m		
							1	
							2	
							3	
							4	
Remarks: Roots noted to 0.40m bgl.								
Groundwater: No groundwater encountered.								

Ground and Water Ltd							Trialpit No TPA2 Sheet 1 of 1		
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018		
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: -		Scale 1:25		
Client: Ridge & Partners LLc/o Uni Reading					Depth 1.10m		Logged By RG		
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description			
Depth (m)	Type	Results							
0.20	D		1.10			MADE GROUND: Orange brown, grey and dark brown mottled sandy gravelly (15%) silty clay. Sand is fine to coarse grained. Gravel is rare to occasional, fine to coarse, sub-angular to sub-rounded flint (60%), brick (30%) and concrete (10%). Gravel becomes less abundant with depth. Rare carbonaceous material noted, becoming abundant between 0.80 - 1.00m bgl.	1		
0.50	D								
0.80	D								
1.00	D								
						Trialpit Complete at 1.10 m		2	
								3	
								4	
Remarks: Roots noted to 1.10m bgl.									
Groundwater: No groundwater encountered.									

Ground and Water Ltd							Trialpit No TPA3 Sheet 1 of 1		
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018		
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: -		Scale 1:25		
Client: Ridge & Partners LLc/o Uni Reading					Depth 1.10m		Logged By RG		
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description			
Depth (m)	Type	Results							
0.20	D		1.10			MADE GROUND: Orange brown, grey and dark brown mottled sandy gravelly (20%) silty clay. Sand is fine to coarse grained. Gravel is rare to occasional, fine to coarse, sub-angular to sub-rounded flint (70%), brick (20%) and concrete (10%). Rare carbonaceous material noted. Gravel becomes less abundant with depth.	1		
0.50	D								
0.80	D								
1.00	D								
						Trialpit Complete at 1.10 m		2	
								3	
								4	
Remarks: Roots noted to 1.00m bgl.									
Groundwater: No groundwater encountered.									

Ground and Water Ltd							Trialpit No TPA6 Sheet 1 of 1	
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018	
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: - Depth 1.10m		Scale 1:25	
Client: Ridge & Partners LLc/o Uni Reading							Logged By RG	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.20	D					MADE GROUND: Orange brown, grey and dark brown mottled gravelly (20%) sandy silty clay. Sand is fine to coarse grained. Gravel is rare to occasional, fine to coarse, sub-angular to sub-rounded flint (60%), brick (30%), concrete (9%) and metal fragments (<1%). Rare rotting organic material. Gravel becomes less abundant with depth.		
0.50	D							
0.80	D							
1.00	D		1.00					
			1.10			HEAD DEPOSITS: Orange brown gravelly silty CLAY. Gravel is rare, fine, sub-angular to sub-rounded flint.		1
							Trialpit Complete at 1.10 m	
							2	
							3	
							4	
Remarks: Roots noted at 1.10m bgl.								
Groundwater: Groundwater strike at 1.00m bgl.								



Ground and Water Ltd							Trialpit No TPA7 Sheet 1 of 1	
Project Name University of Reading			Project No. GWPR2462		Co-ords: - Level: -		Date 13/03/2018	
Location: Whiteknights Campus, Reading RG6 6UD					Dimensions: -		Scale 1:25	
Client: Ridge & Partners LLc/o Uni Reading					Depth 0.70m		Logged By RG	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.20	D		0.50			TOPSOIL: Dark brown sandy gravelly silty clay. Sand is fine to coarse grained. Gravel is occasional, fine to medium, sub-angular to sub-rounded flint.		
0.40	D						HEAD DEPOSITS: Brown gravelly silty CLAY. Gravel is rare, fine, sub-angular to sub-rounded flint.	
						Trialpit Complete at 0.70 m		
							1	
							2	
							3	
							4	
Remarks: Roots noted to 0.70m bgl.								
Groundwater: No groundwater encountered.								

APPENDIX C
Chemical Laboratory Test Results



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

DETS 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: 18-72669

Site Reference: University of Reading, Whiteknight Campus

Project / Job Ref: GWPR2462

Order No: None Supplied

Sample Receipt Date: 23/03/2018

Sample Scheduled Date: 23/03/2018

Report Issue Number: 1

Reporting Date: 29/03/2018

Authorised by:

A handwritten signature in black ink, appearing to read 'Kevin Old'.

Kevin Old
Associate Director of Laboratory

Authorised by:

A handwritten signature in black ink, appearing to read 'Dave Ashworth'.

Dave Ashworth
Deputy Quality Manager

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



DETS 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: 18-72669	Date Sampled	13/03/18	13/03/18	13/03/18	13/03/18	13/03/18
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA7	TPA8	TPA6	TPA1	TPA2
Project / Job Ref: GWPR2462	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.20	0.20	0.50	0.20	0.20
Reporting Date: 29/03/2018	QTSE Sample No	323953	323954	323955	323957	323958

Determinand	Unit	RL	Accreditation				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected		Not Detected
pH	pH Units	N/a	MCERTS	7.9	6.3		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	28	13		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.03	0.01		
Organic Matter	%	< 0.1	MCERTS	2.7	3.1		
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	1.6	1.8		
Arsenic (As)	mg/kg	< 2	MCERTS	14	9		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	21	14		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	12	12		
Lead (Pb)	mg/kg	< 3	MCERTS	32	30	295	264
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	16	9		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3		
Vanadium (V)	mg/kg	< 2	NONE	33	30		
Zinc (Zn)	mg/kg	< 3	MCERTS	60	40		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2		

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



DETS 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: 18-72669	Date Sampled	13/03/18	13/03/18	13/03/18		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA5	TPA4	TPA6		
Project / Job Ref: GWPR2462	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.20	0.50	0.20		
Reporting Date: 29/03/2018	QTSE Sample No	323959	323960	323961		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025		Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS					
Total Cyanide	mg/kg	< 2	NONE					
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS					
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS					
Organic Matter	%	< 0.1	MCERTS					
Total Organic Carbon (TOC)	%	< 0.1	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS					
W/S Boron	mg/kg	< 1	NONE					
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS	207				
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Vanadium (V)	mg/kg	< 2	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					
Total Phenols (monohydric)	mg/kg	< 2	NONE					

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



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



Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18	13/03/18	13/03/18	13/03/18	13/03/18
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA7	TPA8	TPA6	TPA3	TPA1
Project / Job Ref: GWPR2462	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.20	0.20	0.50	0.20	0.20
Reporting Date: 29/03/2018	QTSE Sample No	323953	323954	323955	323956	323957

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.12	< 0.1	< 0.1	0.12	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.13	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

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



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Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA8				
Project / Job Ref: GWPR2462	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 29/03/2018	QTSE Sample No	323954				

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

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



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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA8				
Project / Job Ref: GWPR2462	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 29/03/2018	QTSE Sample No	323954				

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

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



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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 18-72669	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknight Campus	
Project / Job Ref: GWPR2462	
Order No: None Supplied	
Reporting Date: 29/03/2018	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
323953	TPA7	None Supplied	0.20	9.5	Brown sandy clay with stones and vegetation
323954	TPA8	None Supplied	0.20	16.6	Brown sandy clay
323955	TPA6	None Supplied	0.50	18.2	Brown sandy clay with stones
323956	TPA3	None Supplied	0.20	14.3	Brown sandy clay
323957	TPA1	None Supplied	0.20	19.7	Brown sandy clay with stones
323958	TPA2	None Supplied	0.20	14.5	Brown sandy clay with brick
323959	TPA5	None Supplied	0.20	28.6	Brown sandy clay

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

Insufficient Sample ^{1/S}

Unsuitable Sample ^{U/S}



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 18-72669	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknights Campus	
Project / Job Ref: GWPR2462	
Order No: None Supplied	
Reporting Date: 29/03/2018	

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



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QTS Environmental Report No: 17-62212

Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR

Project / Job Ref: GWPR2207

Order No: None Supplied

Sample Receipt Date: 27/07/2017

Sample Scheduled Date: 27/07/2017

Report Issue Number: 1

Reporting Date: 02/08/2017

Authorised by:

Kevin Old
Associate Director of Laboratory

Authorised by:

Russell Jarvis
Associate Director of Client Services

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Soil Analysis Certificate						
QTS Environmental Report No: 17-62212	Date Sampled	17/07/17	17/07/17	17/07/17	17/07/17	17/07/17
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	TP / BH No	TPA	TPB	TPC	TPD	TPE
Project / Job Ref: GWPR2207	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.20	0.20	0.20	0.20	0.20
Reporting Date: 02/08/2017	QTSE Sample No	282166	282167	282168	282169	282170

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Detected	Not Detected	Not Detected	Not Detected	Not Detected
Sample Matrix ^(S)	Material Type	N/a	NONE	Fibre bundles present				
Asbestos Type ^(S)	PLM Result	N/a	ISO17025	Chrysotile				
Lead (Pb)	mg/kg	< 3	MCERTS	42	151	129	31	77

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						
QTS Environmental Report No: 17-62212	Date Sampled	17/07/17	17/07/17	17/07/17		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	TP / BH No	TPF	TPG	TPH		
Project / Job Ref: GWPR2207	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.20	0.20	0.20		
Reporting Date: 02/08/2017	QTSE Sample No	282171	282172	282173		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
Sample Matrix ^(S)	Material Type	N/a	NONE					
Asbestos Type ^(S)	PLM Result	N/a	ISO17025					
Lead (Pb)	mg/kg	< 3	MCERTS	1590	205	82		

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: 17-62212	Date Sampled	17/07/17	17/07/17	17/07/17	17/07/17	17/07/17
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	TP / BH No	TPA	TPB	TPC	TPD	TPE
Project / Job Ref: GWPR2207	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.20	0.20	0.20	0.20	0.20
Reporting Date: 02/08/2017	QTSE Sample No	282166	282167	282168	282169	282170

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	0.28	0.41	0.14	0.13
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.54	0.79	0.22	0.32
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.50	0.71	0.19	0.29
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.21	0.37	< 0.1	0.14
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	0.20	0.32	< 0.1	0.16
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.22	0.38	< 0.1	0.16
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.15	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.18	0.30	< 0.1	0.14
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.12	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.16	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	2.1	3.7	< 1.6	< 1.6

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



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 17-62212	Date Sampled	17/07/17	17/07/17	17/07/17		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	TP / BH No	TPF	TPG	TPH		
Project / Job Ref: GWPR2207	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.20	0.20	0.20		
Reporting Date: 02/08/2017	QTSE Sample No	282171	282172	282173		

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	0.25	0.46	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.14	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	0.65	1.14	0.22		
Pyrene	mg/kg	< 0.1	MCERTS	0.60	1.07	0.21		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.32	0.59	0.14		
Chrysene	mg/kg	< 0.1	MCERTS	0.36	0.54	0.12		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.45	0.71	0.15		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.20	0.29	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.33	0.55	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.17	0.30	< 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	0.17	0.27	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	3.5	6.1	< 1.6		

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



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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 17-62212	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	
Project / Job Ref: GWPR2207	
Order No: None Supplied	
Reporting Date: 02/08/2017	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
282166	TPA	None Supplied	0.20	15.2	Brown sandy clay
282167	TPB	None Supplied	0.20	14.6	Brown clayey sand with stones
282168	TPC	None Supplied	0.20	11.1	Brown sandy clay with stones and brick
282169	TPD	None Supplied	0.20	16.6	Brown clay
282170	TPE	None Supplied	0.20	14.9	Brown sandy clay
282171	TPF	None Supplied	0.20	15.5	Brown sandy clay with stones and brick
282172	TPG	None Supplied	0.20	11.2	Brown sandy clay with stones
282173	TPH	None Supplied	0.20	14.6	Brown clayey sand with stones

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

Insufficient Sample ^{1/S}

Unsuitable Sample ^{U/S}



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Tel : 01622 850410



Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 17-62212	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	
Project / Job Ref: GWPR2207	
Order No: None Supplied	
Reporting Date: 02/08/2017	

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



Francis Williams
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russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 17-62515

Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR

Project / Job Ref: GWPR2207

Order No: None Supplied

Sample Receipt Date: 27/07/2017

Sample Scheduled Date: 03/08/2017

Report Issue Number: 1

Reporting Date: 08/08/2017

Authorised by:

A handwritten signature in black ink, appearing to read 'Kevin Old'.

Kevin Old
Associate Director of Laboratory

Authorised by:

A handwritten signature in black ink, appearing to read 'Russell Jarvis'.

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
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Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
QTS Environmental Report No: 17-62515	Date Sampled	17/07/17				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	TP / BH No	TPA				
Project / Job Ref: GWPR2207	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 08/08/2017	QTSE Sample No	283418				

Determinand	Unit	RL	Accreditation				
Asbestos Quantification ^(S)	%	< 0.001	ISO17025	0.002			

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)



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 17-62515	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknights Campus, Reading, RG6 6UR	
Project / Job Ref: GWPR2207	
Order No: None Supplied	
Reporting Date: 08/08/2017	

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D Dried
AR As Received



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QTS Environmental Report No: 18-72669

Site Reference: University of Reading, Whiteknight Campus

Project / Job Ref: GWPR2462

Order No: None Supplied

Sample Receipt Date: 23/03/2018

Sample Scheduled Date: 23/03/2018

Report Issue Number: 1

Reporting Date: 29/03/2018

Authorised by:

Kevin Old
Associate Director of Laboratory

Authorised by:

Dave Ashworth
Deputy Quality Manager

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



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Soil Analysis Certificate						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18	13/03/18	13/03/18	13/03/18	13/03/18
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA7	TPA8	TPA6	TPA1	TPA2
Project / Job Ref: GWPR2462	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.20	0.20	0.50	0.20	0.20
Reporting Date: 29/03/2018	QTSE Sample No	323953	323954	323955	323957	323958

Determinand	Unit	RL	Accreditation				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected		Not Detected
pH	pH Units	N/a	MCERTS	7.9	6.3		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	28	13		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.03	0.01		
Organic Matter	%	< 0.1	MCERTS	2.7	3.1		
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	1.6	1.8		
Arsenic (As)	mg/kg	< 2	MCERTS	14	9		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	21	14		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	12	12		
Lead (Pb)	mg/kg	< 3	MCERTS	32	30	295	264
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	16	9		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3		
Vanadium (V)	mg/kg	< 2	NONE	33	30		
Zinc (Zn)	mg/kg	< 3	MCERTS	60	40		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2		

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



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Soil Analysis Certificate						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18	13/03/18	13/03/18		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA5	TPA4	TPA6		
Project / Job Ref: GWPR2462	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.20	0.50	0.20		
Reporting Date: 29/03/2018	QTSE Sample No	323959	323960	323961		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025		Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS					
Total Cyanide	mg/kg	< 2	NONE					
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS					
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS					
Organic Matter	%	< 0.1	MCERTS					
Total Organic Carbon (TOC)	%	< 0.1	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS					
W/S Boron	mg/kg	< 1	NONE					
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS	207				
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Vanadium (V)	mg/kg	< 2	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					
Total Phenols (monohydric)	mg/kg	< 2	NONE					

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



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18	13/03/18	13/03/18	13/03/18	13/03/18
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA7	TPA8	TPA6	TPA3	TPA1
Project / Job Ref: GWPR2462	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.20	0.20	0.50	0.20	0.20
Reporting Date: 29/03/2018	QTSE Sample No	323953	323954	323955	323956	323957

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.12	< 0.1	< 0.1	0.12	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.13	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

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



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Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA8				
Project / Job Ref: GWPR2462	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 29/03/2018	QTSE Sample No	323954				

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

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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 18-72669	Date Sampled	13/03/18				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: University of Reading, Whiteknight Campus	TP / BH No	TPA8				
Project / Job Ref: GWPR2462	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 29/03/2018	QTSE Sample No	323954				

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

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



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



Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 18-72669	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknight Campus	
Project / Job Ref: GWPR2462	
Order No: None Supplied	
Reporting Date: 29/03/2018	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
323953	TPA7	None Supplied	0.20	9.5	Brown sandy clay with stones and vegetation
323954	TPA8	None Supplied	0.20	16.6	Brown sandy clay
323955	TPA6	None Supplied	0.50	18.2	Brown sandy clay with stones
323956	TPA3	None Supplied	0.20	14.3	Brown sandy clay
323957	TPA1	None Supplied	0.20	19.7	Brown sandy clay with stones
323958	TPA2	None Supplied	0.20	14.5	Brown sandy clay with brick
323959	TPA5	None Supplied	0.20	28.6	Brown sandy clay

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

Insufficient Sample ^{1/S}

Unsuitable Sample ^{U/S}



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 18-72669	
Ground & Water Ltd	
Site Reference: University of Reading, Whiteknights Campus	
Project / Job Ref: GWPR2462	
Order No: None Supplied	
Reporting Date: 29/03/2018	

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 D
Soil Assessment Criteria

Appendix D

Soil Guideline Values and General Assessment Criteria

D1 Assessment Criteria

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

D1.1 Contaminated Land Exposure Assessment Model (CLEA)

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

The CLEA Guidance comprises the following documents:

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

D1.2 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).

D1.4 **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.

D1.5 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.

D1.6 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.

D1.7 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 undertaking to develop site specific values for relevant soil contaminants.

⇒ Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.

⇒ Developing more accurate parameters using site data.

D1.8 Phytotoxicity

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

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

D1.9 Statistical Tests

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

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

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

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

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

Treatment of Hot-Spots

⇒ A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.

⇒ Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

D2 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:

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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)fluoranthene	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)fluoranthene	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 [†] (76.4) ^{sol}	4,900 [†]	1,200 [†] (76.4) ^{sol}
	2.5% SOM	5.60	5.6	10	460 [†] (183) ^{sol}	4,900 [†]	1,900 [†] (183) ^{sol}
	6.0% SOM	13	13	24	1,100 [†] (432) ^{sol}	4,900 [†]	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)
Chloroalkanes & alkenes						
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-Chloronapthalene				
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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