

Phase 2 Site Investigation Report

Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR

On behalf of Richard Brookes

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EXECUTIVE SUMMARY

PROPOSED DEVELOPMENT	At the time of reporting, July 2021, the proposed development was understood to comprise the erection of a two storey detached residential property with a detached garage, associated car parking and garden areas. It was understood that the main building was to have piled foundations and the detached garage was to be founded on a raft.
GEOLOGY	The British Geological Survey Solid and Drift Geology Map for the Fontwell area (Chichester Sheet no. 317) revealed that the site was underlain by Head Deposits and Raised Beach Deposits over the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk formation, Culver Chalk Formation and Portsdown Chalk Formation. No areas of Made Ground or Reworked Ground were noted within a 250m radius.
HYDROGEOLOGY	A study of the aquifer maps on the DEFRA website revealed the site was underlain by a Secondary (A) Aquifer comprising the superficial Head Deposits and Raised Beach Deposits, underlain by a Principal Aquifer comprising bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation. Examination of the Environment Agency records showed that the majority of the site was located within an Outer Zone (Zone II) Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater. An Outer Zone (Zone II) Groundwater source Protection Zone 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. No surface water features were present within a 250m radius of the site. From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth within the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation. Some amounts of groundwater however may be present at shallower depths within Made ground, parts of the Head Deposits or silty/sandy pockets of the Raised Beach Deposits. It was considered that groundwater was flowing in a southerly direction in line with local topography. Examination of the Environment Agency records showed that the site was located within a Flood Zone 1, i.e. an area with a very low probability of flooding.
VOLUME CHANGE POTENTIAL	The soils of the Head Deposits were tested to have a low volume change potential in accordance with BRE240 and no volume change potential in accordance with NHBC Standards Chapter 4.2.

	The soils of the Raised Beach Deposits were tested to have a low to medium volume change potential in accordance with BRE240 and NHBC Standards Chapter 4.2.
FOUNDATION DESIGN	Minimum foundation depth for the raft foundation for garage are likely to be 0.75m bgl, subject to reference to NHBC tables. See section 6.2 for bearing capacities and anticipated settlements. Piles must extend to a minimum of 12.00m bgl to bypass the soft horizons, and into the competent Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation and should be designed in accordance with guidance given in CIRIA C574 Part 8.
SUB-SURFACE CONCRETE	According to BRE Special Digest 1, 2005, 'Concrete in Aggressive Ground' a Sulphate Design Class of DS-1 could be used for sub-surface concrete in contact with the soils beneath the site. Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of AC-1.
CONTAMINATION	Chemical laboratory testing of the Made Ground revealed no elevated levels of determinands above the guideline levels for a 'Residential without Homegrown Produce' land-use scenario.

1. INTRODUCTION

1.1. General

Ground and Water Limited were instructed by Richard Brooks on the 16th April 2021 to conduct a Ground Investigation on the site at Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR. The scope of the investigation was detailed within the fee proposal GWQ6355, dated the 29th March 2021.

1.2. Aims of the Investigation

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

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

A contamination assessment was to be undertaken following 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.

This Ground Investigation Report must be read in conjunction with the Phase 1 Desk Study Report referenced GWPR4206/DS/July 2021.

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.

2. SITE SETTING

2.1. Site Location

The site comprised a 0.15ha rectangular-shaped plot of land to the south of a “Sundown”, orientated in an east to west direction on the eastern side of Littleheath Road. The site was located to the west of the village of Fontwell in West Sussex. The national grid reference/Easting Northing for the centre of the site was approximately TQ 94545 07675. A site location plan is given within Figure 1. A plan showing the site area is given within Figure 2.

2.2. Site Description

A Site Walkover was undertaken on the 13th April 2021. A description of the site, as noted during the Site Walkover, is tabulated below. An aerial view of the site, showing an approximate site boundary, is given within Figure 3.

Site Description Sheet	
Use of site	At the time of the Site Walkover, 23 rd March 2020, the site was an open plot of land located to the south of “Sundown” to the north.
Site topography	The western portion of the site was flat. The eastern portion of the site comprised a depression that was ~2m lower with a steep break of slope separating the two portions. An ~2m high cut face formed the eastern boundary.
Area topography	The general area flat and level with a very gentle slope towards the south. A depression ~2m deep extended to the north and south of the eastern portion of the site at the same level as the ground surface of the site.
Structures onsite	None noted.
Structures off-site	Detached residential buildings were noted to the north, east and south. An area of woodland was noted to the west of the site across Littleheath Road.
Use of surrounding ground	Residential to the north, east and south and an area of woodland to the west
Boundary features	Northern Boundary: Western portion comprised ~2m high wooden fence; the eastern portion was a ~1m high wire and post fence.. Eastern Boundary: An ~1.80m high wooden fence on top of an ~2m high cut face at the edge of the depression. Southern Boundary: The western portion was a row of cropped trees; the eastern portion was open. Western Boundary: ~2m high wooden fence
Site covering	The site was an area of soft landscaping.
Contamination sources onsite	None noted.
Contamination sources off-site	Above ground unbunded heating oil tanks associated with the residential properties to the north and south.
Vegetation onsite	A number of ~20 – 25m mature trees were located to the east of the proposed structure within the base of the depression. A cropped line of trees was located along the southern boundary of the site.
Vegetation off-site	~Numerous trees of varying heights and maturity were noted in the gardens of the properties to the north, east and south of the site. An area of mixed woodland was noted on the western side of Littleheath Road to the west of the site.
Services	None noted

2.3. Proposed Development

At the time of reporting, July 2021, the proposed development was understood to comprise the erection of a two storey detached residential property with a detached garage, associated car parking and garden areas. No lower ground floor level or basement was anticipated. It was understood that the main building was to have piled foundations and the detached garage was to be founded on a raft. The proposed development plan can be seen within Figure 4.

2.4. Geology

The British Geological Survey Solid and Drift Geology Map for the Fontwell area (Chichester Sheet No. 317) revealed that the site was underlain by superficial Head Deposits over Raised Beach Deposits and bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation. No other superficial deposits, outcrops of bedrock deposits or areas of Made/Worked Ground were noted within a 250m radius of the site.

Superficial deposits (Drift) are the youngest geological deposits formed during the most recent period of geological time. They rest on older deposits or rocks referred to as bedrock (Solid), which are the main mass forming the Earth. Bedrock is present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

2.5. Relevant Geological Formations

Head Deposits

Periglacial activity in a succession of cold periods and more recent downwash was responsible for the formation of Head Deposits and Head Gravel Deposits. Head is widespread in the district but had been mapped mainly in valleys where locally more than 2m may occur. The lithology of Head Deposits is determined largely by the parent materials upslope.

Raised Beach Deposits

The deposits are variable and predominantly comprise gravel (shingle), Sand, Silt and Clay, commonly containing organic debris. The deposits are now at the level of the present shoreline as a results of earth movement or a general fall in sea level.

Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation

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

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

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

2.5.1. BGS Borehole Records

Several BGS borehole records in the area have revealed ~8-9m of superficial deposits generally comprising dense gravel overlying the chalk. No groundwater was noted.

2.6. Hydrogeology and Hydrology

A study of the aquifer maps on the DEFRA website revealed the site was underlain by a **Secondary (A) Aquifer** comprising the superficial Head Deposits and Raised Beach Deposits, underlain by a **Principal Aquifer** comprising bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.

Secondary aquifers include a wide range of drift deposits with an equally wide range of water permeability and storage capacities. **Secondary (A) Aquifers** consist of deposits with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

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

Examination of the Environment Agency records showed that the majority of the site was located within an Outer Zone (Zone II) Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater. Descriptions of each classification have been provided below:

- An Outer Zone (Zone II) Groundwater source Protection Zone 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.

No surface water features were present within a 250m radius of the site. The nearest surface water feature was an unnamed pond associated with the Cannizaro Park located ~775m west of the site. The River Wandle was located ~2km south-east/east of the site and it was flowing in a north-west to south-east direction. The River Thames located ~4.50km north of the site, flowing in a north-east to south-west direction.

From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth within the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk

Formation. Some amounts of groundwater however may be present at shallower depths within Made ground, parts of the Head Deposits or silty/sandy pockets of the Raised Beach Deposits, especially after periods of intense or prolonged rainfall. It was considered that groundwater was flowing in a southerly direction in line with local topography.

Examination of the Environment Agency records showed that the site was located within a Flood Zone 1, i.e. an area with a very low probability of flooding.

2.7. Radon

BRE 211 (2015) Map 4 of the Hampshire, Berkshire and south Oxfordshire area indicated that the site **was located within an area where basic mandatory protection measures against the ingress of radon were likely to be required.**

A review of the freely available Public Health England radon database, UK Radon, indicated that the site was located within a 1km grid square, where the maximum radon potential of 3 – 5%. Basic radon protection measures are required in areas where more than 3% of houses are at or above the Action Level. The site was in an area where a risk assessment was required.

A BGS Radon Risk Assessment was commissioned for the site which indicated that basic radon protection measures are not required to be installed in new buildings. The risk assessment can be seen in Appendix B.

2.8. Internet Search (Site Setting)

2.8.1. Available Unexploded Ordnance (UXO) Map Review

A review of the data available on www.zeticauxo.com/ revealed the site was located within a low-risk area associated with unexploded ordnance (UXO), as indicated by having <15 bombs dropped per 1000 acres. 1No. known Luftwaffe Bombing Target site was located 1.00km south-west of the site.

2.8.2. Historical Landfill Tool Review

A review of the data available on www.groundsure.io/ revealed that an area of Historical Landfilling approximately 450m north-east of the site associated with the Slindon Bottom Gravel Pit operational between 31/12/1954 and 31/12/1975. Further review identified a second area of Historical Landfilling located approximately 1.13km south-west of the site.

2.9. Preliminary Risk Assessment

The tabulated Conceptual Site Model developed as part of the Ground and Water Ltd Desk Study (GWPR4206/DS/July 2021) is outlined overleaf. For ease of reference and understanding, the risks have been classified within this risk assessment against four possible levels / categories, summarised in the table overpage.

Risk Categories used in the Tabulated CSM	
Negligible	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is no plausible risk. Therefore, there is no need to further assess this potential source of contamination.
Low Risk	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is not considered to be an unacceptable risk to receptors. However, it is considered that further investigation to confirm this is recommended.
Moderate Risk	Regarding this potential SPR linkage, the site may not be suitable for the proposed end-use in its current condition and there may be an unacceptable risk to receptors. Further investigation is required to confirm this.
High Risk	Regarding this potential SPR linkage, the site is probably or certainly not suitable for proposed end-use and there is likely to be an unacceptable risk to receptors. Contaminants probably or certainly present and urgent action required in the short term.

Tabulated Conceptual Site Model – Pollutant Linkage Summary				(On-Site Sources)
Potential Sources	Potential Absorption Pathways	Potential Receptors		Risk Classification
Made Ground from on-site activities: - Asbestos, - PAHs, - TPHs, - VOCs, - Sulphates, and - Metals.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Ingestion of home-grown produce, and soils attached - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbours and public		Low
	- Direct uptake of groundwater - Direct uptake of determinands in the soil	Flora and Fauna Vegetation within soft landscaped area		Low
	- Anthropogenic (man-made) pathways - Vertical and lateral migration in permeable strata - Surface water runoff	Controlled Waters - Secondary (A) Aquifer (Head Deposits and Raised Beach Deposits) - Principal Aquifer (Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation).		Low
Aggressive ground conditions with Made Ground and natural ground, including groundwater: - Sulphates, - PAH/TPH.	Direct contact with aggressive ground conditions	Building Materials and Services - Buried Concrete - Underground services (water pipes)		High
Ground gases generated by Made Ground: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide.	- Migration through anthropogenic & natural pathways - Inhalation of Asphyxiating gases - Explosion (methane only)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces - Neighbours and public		Low
	- Migration through anthropogenic & natural pathways - Explosion (methane only)	Building Materials and Services - Buildings - Confined spaces - Underground services		Low

3. SITE WORKS

3.1. Scope of Works

Site works were undertaken in two phases.

Phase I was undertaken between the 13th – 18th May 2021 25 No. Super Heavy Dynamic Probes (DP1 – DP25) were undertaken to between 10.00 – 11.00m bgl at predetermined proposed pile locations.

Phase II was undertaken on the 27th and 28th May 2021 and comprised the drilling of 2No. Cable Percussion Boreholes (BH1 and BH2) to 15.45m bgl. Standard Penetration Tests (SPTs) were carried out at 1.00m intervals in the boreholes to a depth of 5.00m bgl and at 1.50m intervals thereafter.

A combined ground-gas and groundwater monitoring well was installed in BH1 to a depth of 5.00m bgl in BH1. The construction of the well installed can be seen tabulated below.

Combined Ground-gas and Groundwater Monitoring Well Construction				
Trial Hole	Depth of Installation (m bgl)	Thickness of slotted piping with gravel filter pack (m)	Depth of plain piping with bentonite seal (m bgl)	Piping internal diameter (mm)
BH1	5.00	4.00	1.00	50

The approximate location 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, the exploratory position was relocated away from these areas.

As a further precautionary measure, the positions were hand excavated to 1.20m bgl and scanned with a Cable Avoidance Tool (CAT scanner) to minimise the risk to services.

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

3.2. Sampling Procedures

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

A selection of samples were despatched for geotechnical testing purposes. A programme of chemical laboratory testing, scheduled by Ground and Water Limited and carried out by DETS Limited, was undertaken on soils samples recovered from the trial holes and in accordance with the contaminants scoped into the conceptual site model from the Phase 1 Desk Study Report referenced GWPR4206/DS/July 2021.

4. ENCOUNTERED GROUND CONDITIONS

4.1. Soil Conditions

The trial holes were logged by a Ground and Water Limited representative, generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'. The chalk samples were logged in accordance with CIRIA 574.

The ground conditions encountered within the trial holes constructed on the site did generally conform to that anticipated from examination of the geology map. A capping of Made Ground (BH2 only) was noted to overlie the superficial Head Deposits and Raised Beach Deposits and the bedrock of the Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.

The succession of conditions and description of soils encountered in the trial holes in descending order is tabulated below.

Summary of Strata Encountered (BH1 – BH2)			
Strata	Top Depth (m bgl)	Base Depth (m bgl)	Thickness (m)
MADE GROUND (BH2 only): Dark brown slightly sandy gravelly CLAY. The sand was fine to coarse grained. The gravel was sub-angular to sub-rounded, fine to coarse flint (50%), chalk (30%), brick (15%) and carbonaceous material (charcoal) (5%).*	GL	2.20m	2.20m
HEAD DEPOSITS (BH1 only): Dark brown slightly sandy gravelly CLAY. The sand was fine to coarse grained. The gravel was sub-angular to sub-rounded, fine to coarse flint.	GL	2.10m	2.10m
RAISED BEACH DEPOSITS: Brown slightly clayey sandy GRAVEL. The sand was fine to coarse grained. The gravel was sub-angular to sub-rounded, fine to coarse flint.	2.10 – 2.20m	4.00 – 4.70m	1.80 – 2.60m
RAISED BEACH DEPOSITS: Orange fine grained SAND.	4.00 – 4.70m	8.00m	2.90 – 3.30m
UNDIFFERENTIATED LEWES NODULAR CHALK FORMATION, NEWHAVEN CHALK FORMATION, SEAFORD CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION: Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is weak, white and sub-angular. (CIRIA 574: Grade Dm)	7.90 – 8.00m	15.45m bgl	>7.45 - >7.55m

***The Made Ground noted within BH2 was due to the regrading/reprofiling of the area to allow plant access**

For details of the composition of the soils encountered at particular points, reference must be made to the individual trial hole logs within Appendix C of this report. A trial hole location plan can also be viewed within Figure 5.

4.2. Roots Encountered

No roots were noted in the boreholes. 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 in the boreholes. It should be noted that groundwater strikes may have been obscured by the drilling process.

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

The site investigation was conducted in May 2021, when groundwater levels are in the process of falling to their annual minimum (lowest elevation). The long-term groundwater elevation might increase/decrease at some time in the future due to seasonal fluctuation in weather conditions.

4.4. Obstructions

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

5. IN-SITU STRENGTH AND GEOTECHNICAL LABORATORY TESTING

5.1. In-Situ Strength Testing

5.1.1. Standard Penetration Tests (SPTs)

Standard Penetration Tests (SPTs) were undertaken as part of the site investigation. The results of the SPT's have not been amended to consider hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. The test results are presented on the borehole logs within Appendix C.

Cable Percussion Boreholes provide samples of the ground for assessment but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50mm and an inside diameter of 35mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. The sample tube is driven 150mm into the ground and then the number of blows needed for the tube to penetrate each 75mm up to a depth of 450mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

The cohesive soils encountered were classified based on the table below.

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

The granular soils encountered were classified based on the table below.

Correlation Between Normalised SPT Blow Counts (N_{160}) and Granular Classification.	
Classification	Equivalent SPT Blow Counts (N_1)
Extremely Dense	>58
Very Dense	42 – 58
Dense	25 – 42
Medium Dense	8 – 25
Loose	3 – 8
Very Loose	0 – 3

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

Interpretation of In-situ Geotechnical Testing Results					
Strata	SPT "N" Blow Counts	Equivalent Undrained	Soil Type		Trial Hole/s
			Granular (Density)	Cohesive (Cu)	

		Shear Strength (Cu) (kPa)			
Made Ground (cohesive)	3	-	-	-	BH2/GL – 2.20
Head Deposits (cohesive)	5	25	-	Low	BH1/GL – 2.10
Raised Beach Deposits (granular)	12 – 29	-	Medium Dense – Dense	-	BH1/2.10 – 8.00
	12 – 19	-	Medium Dense	-	BH2/2.20 – 6.90
Raised Beach Deposits (cohesive)	21	105	-	High	BH2/6.90 – 7.900
Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation	31 – 39	-	-	-	BH1/8.00 – 15.45
	30 – 39	-	-	-	BH2/7.90 – 15.45

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

5.1.2. Super Heavy Dynamic Probes (SHDPs)

Super Heavy Dynamic Probes (SHDPs) were undertaken as part of the site investigation. The results of the SHDPs have not been amended to consider hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. The test results are presented within Appendix C.

Dynamic Probing involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 63.5kg (SHDP) hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published, based on dynamic energy, which permits engineering parameters to be generated. (The Dynamic Probe 'Super Heavy' (SHDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).

A diagrammatic representation of the SHDP results has been presented within Figure 6. Soft spots/potential dissolution related features are identified where the Equivalent SPT 'N' Values are ≤8. Where values of 0 – 3 were recorded, these have been highlighted in red. Values between 4 – 6 have been highlighted orange and values between 7 – 10 have been highlighted in yellow.

The results of the SHDP (DP01 – DP25) are tabulated overleaf(s). Table I outlines where soft and extremely soft soils/loose and/or potential dissolution related features were recorded within the Made Ground, Head Deposits, Raised Beach Deposits and the Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation from analysis of the probe data. Table II overleaf(s) provides a summary of where competent strata of the Head Deposits, Raised Beach Deposits and Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation was encountered.

The SHDP results displayed within Table I - Table II, Figure 6 and Appendix C are not corrected for torque. It should be noted that SHDP may underestimate the strength of soils, particularly in cohesive soils.

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

Table I: Interpretation of In-situ Geotechnical Testing Results			
Strata	Trial Hole	Equivalent SPT "N" Blow Counts	Depth m bgl)
<i>Inferred Made Ground, Head Deposits, Raised Beach Deposits and Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation – SOFT SPOTS</i>	DP01	6 – 8	0.30 – 0.90
			5.40 – 6.90
			8.40 – 8.70
			9.90 – 10.00
	DP02	6 – 8	0.00 – 2.10
			2.10 – 3.30
			3.90 – 5.10
			5.70 – 6.00
			6.60 – 7.20
			9.90 – 10.20
			0.00 – 0.90
			4.20 – 4.80
	DP03	1 – 3	0.90 – 2.70
			3.00 – 4.20
			4.80 – 6.00
			0.00 – 0.60
	DP04	4 – 8	0.90 – 1.50
			3.00 – 3.60
			0.60 – 0.90
			1.50 – 3.00
			3.60 – 6.30
			6.60 – 6.90
			7.20 – 7.50
			0.00 – 0.60
	DP05	1 – 2	0.60 – 1.20
			1.50 – 2.10
			0.00 – 0.30
			1.80 – 2.10
	DP06	4 – 8	3.60 – 5.40
			6.30 – 6.90
			0.60 – 0.90
			1.20 – 2.40
			3.30 – 3.60
			5.70 – 6.30
			6.90 – 7.20
			7.50 – 8.10
			9.30 – 9.60
			9.90 – 10.20
			0.00 – 0.90
			3.90 – 4.20
	DP07	4 – 8	0.90 – 1.20
			3.60 – 3.90
			4.20 – 6.60
			6.90 – 7.50
			8.70 – 9.90
			9.90 – 10.20
			0.30 – 0.60
			0.30 – 0.60
	DP08	0 – 3	0.30 – 0.60

			2.70 – 4.50
			4.80 – 6.30
			6.90 – 7.80
	4 – 7		0.60 – 2.70
			4.50 – 4.80
			6.30 – 6.60
			7.80 – 8.10
			9.90 – 10.20
	0 – 3		0.00 – 0.60
			6.90 – 7.50
	4 – 8		3.60 – 3.90
			4.50 – 5.40
			6.00 – 6.60
			7.20 – 7.80
			8.70 – 9.00
			9.90 – 10.20
	3		0.60 – 3.00
			3.90 – 4.80
	4 – 8		6.90 – 7.20
			0.30 – 0.60
			3.00 – 3.90
			4.80 – 5.70
			6.60 – 6.90
	3		8.40 – 9.00
			9.90 – 10.20
			0.30 – 0.60
			0.00 – 0.30
			0.60 – 0.90
			2.70 – 3.90
	4 – 8		4.20 – 4.80
			5.70 – 8.10
			9.90 – 10.20
	0 – 3		0.00 – 0.60
			3.30 – 3.90
			6.30 – 9.90
	5 – 8		0.60 – 1.20
			3.00 – 3.30
			3.90 – 6.30
			9.90 – 10.20
			10.80 – 11.10
	0 – 2		0.00 – 0.30
			1.80 – 2.10
			3.90 – 5.40
			6.30 – 6.90
	4 – 8		0.60 – 0.90
			1.20 – 1.80
			2.10 – 2.40
			3.30 – 3.60
			5.40 – 6.30
			6.90 – 7.20
			7.50 – 8.10
			9.30 – 9.60
			9.90 – 10.20
	DP14	3	0.30 – 0.60

		5 – 7	0.00 – 0.30
			7.20 – 7.80
			9.90 – 10.20
	DP15	1 – 2	5.70 – 8.40
			0.00 – 1.20
		4 – 8	1.50 – 2.10
			4.50 – 5.10
			5.40 – 5.70
			8.70 – 9.00
			9.90 – 10.20
	DP16	1 – 3	0.30 – 0.60
			4.50 – 5.40
			6.00 – 6.60
		4 – 8	3.90 – 4.50
			5.40 – 6.00
			6.60 – 7.80
	DP17	5 – 8	8.40 – 8.70
			9.90 – 10.20
			3.90 – 4.20
	DP18	8	6.60 – 6.90
	DP19	4 – 6	9.90 – 10.20
			0.30 – 0.60
			0.00 – 0.30
	DP20	0 – 3	9.90 – 10.20
			0.30 – 0.60
		6 – 8	0.00 – 0.30
			5.70 – 6.00
			6.30 – 7.50
	DP21	4 – 8	0.30 – 1.20
			5.70 – 6.30
			6.60 – 7.20
			9.90 – 10.20
	DP22	8	9.90 – 10.20
	DP23	8	9.90 – 10.20
	DP24	0 – 3	0.30 – 1.80
			3.00 – 4.20
			4.80 – 6.00
		4 – 8	1.80 – 3.00
			4.20 – 4.80
			6.00 – 6.60
			8.40 – 9.30
	DP25	0 – 3	9.90 – 10.20
			0.90 – 7.50
			8.10 – 7.80
			8.10 – 8.40
		4 – 8	9.90 – 10.20
			0.30 – 0.90
			8.40 – 9.00

Table II: Interpretation of In-situ Geotechnical Testing Results

Strata	Trial Hole	Equivalent SPT "N" Blow Counts	Depth m bgl)
<i>Inferred Made Ground, Head Deposits, Raised Beach Deposits and Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsmouth Chalk Formation – COMPETENT SOILS</i>	DP01	9 – 24	0.00 – 0.30 0.90 – 5.40 6.90 – 8.40 8.70 – 9.90
	DP02	9 – 23	3.30 – 3.90 5.10 – 5.70 6.00 – 6.60 7.20 – 9.90
	DP03	9 – 52	2.70 – 3.00 6.00 – 10.20
	DP04	9 – 28	6.30 – 6.60 7.50 – 10.20
	DP05	9 – 75	1.20 – 1.50 2.10 – 8.10
	DP06	9 – 13	0.30 – 0.60 0.90 – 1.20 2.40 – 3.30 7.20 – 7.50 8.10 – 9.30 9.60 – 9.90
	DP07	9 – 27	1.20 – 3.60 6.60 – 6.90 7.20 – 8.70 9.00 – 9.90
	DP08	9 – 19	0.00 – 0.30 6.60 – 6.90 8.10 – 9.90
	DP09	9 – 28	0.60 – 3.60 3.90 – 4.80 5.70 – 6.00 7.80 – 8.70 9.00 – 9.90
	DP10	9 – 25	0.00 – 0.30 3.00 – 3.30 5.70 – 6.60 7.50 – 8.40 9.00 – 9.60
	DP11	9 – 23	0.90 – 2.40 3.90 – 4.20 4.80 – 5.70 8.10 – 9.90
	DP12	9 – 14	0.90 – 3.00 10.20 – 10.80
	DP13	9 – 13	0.30 – 0.60 0.90 – 1.20 2.40 – 3.30 7.20 – 7.50 8.10 – 9.30 9.60 – 9.90
	DP14	11 – 26	0.60 – 7.20 7.80 – 9.90

	DP15	9 – 20	1.20 – 1.50
			2.10 – 4.50
			5.10 – 5.40
			9.00 – 9.90
	DP16	9 – 22	0.00 – 0.30
			0.60 – 3.90
			7.80 – 8.40
			8.70 – 9.90
	DP17	9 – 49	0.00 – 3.90
			4.20 – 6.60
			6.90 – 9.90
	DP18	9 – 27	0.00 – 9.90
	DP19	11 – 33	0.60 – 9.90
	DP20	9 – 19	0.60 – 5.40
			6.00 – 6.30
			7.50 – 9.90
	DP21	9 – 28	0.00 – 0.30
			1.20 – 5.40
			6.30 – 6.60
			7.20 – 8.70
			9.00 – 9.90
	DP22	9 – 32	0.00 – 9.90
	DP23	9 – 40	0.00 – 9.90
	DP24	9 – 23	6.60 – 8.40
			9.30 – 9.90
	DP25	9 – 13	0.00 – 0.30
			9.00 – 9.90

5.2. Geotechnical Laboratory Testing

A programme of geotechnical laboratory testing, scheduled by Ground and Water Limited and carried out by an accredited geotechnical testing laboratory was undertaken on samples recovered. Details of the specific tests used in each case are given below.

Standard Methodology for Laboratory Geotechnical Testing		
Test	Standard	Number of Tests
Atterberg Limit Tests	BS1377:2016:Part 2:Clauses 3.2, 4.3 & 5	3
Particle Size Distribution Tests	BS1377:2016:Part 2:Clause 9	4
Determination of Saturation Moisture Content of Chalk	Determination of Saturation Moisture Content of Chalk	1
Water Soluble Sulphate and pH Test	BS1377:2018:Part 3:Clause 5	1
BRE Special Digest 1 Tests	BRE Special Digest 1 "Concrete in Aggressive Ground (BRE, 2005).	2

5.2.1. Atterberg Limit Testing

A précis of Atterberg limit testing undertaken can be seen tabulated overpage. The test results are presented within Appendix D.

Atterberg Limit Tests Results Summary							
Stratum	Moisture Content (%)	Passing 425 µm sieve (%)	Modified PI (%)	Soil Class	Consistency Index (Ic)	Volume Change Potential	
						BRE	NHBC
Head Deposits	21	56	7.28	CL	Very Stiff	NP	Low
Raised Beach Deposits	18 – 19	90 – 100	18.00 – 26.00	CI	Very Stiff	Low – Medium	Low - Medium
- NP – Non-plastic - BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results) - Soil Classification based on British Soil Classification System. - Consistency Index (Ic) based on BS EN ISO 14688-2:2018.							

5.2.2. Liquidity Limit Analysis

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

Liquidity Index Calculations Summary					
Sample	Moisture Content (%)	Plastic Limit (%)	Modified Plasticity Index (%)	Liquidity Index	Result
Head Deposits (BH1/0.80m bgl): <i>Laboratory description – Orangish brown fine to coarse gravelly silty sandy CLAY</i>	21	20	7.28	0.14	Heavily Overconsolidated
Raised Beach Deposits (BH1/7.20m bgl): <i>Laboratory description – Orangish brown slightly mottled grey fine to medium slightly gravelly sandy silty sandy CLAY</i>	18	19	18	-0.06	Potential Moisture Deficit
Raised Beach Deposits (BH2/7.70m bgl): <i>Laboratory description – Orangish brown slightly mottled grey slightly sandy silty CLAY with occasional chalk deposits</i>	19	21	26	-0.08	Potential Moisture Deficit

Liquidity Index analyses indicated that there was a potential moisture deficit within two samples tested. Interpretation of these can be viewed below.

- A potential moisture deficit was noted at a depth of 7.20m bgl in BH1 within the Raised Beach Deposits. This sample was described as a fine to coarse gravelly silty sandy clay by the laboratory. No roots were encountered within the trial hole; therefore the potential moisture deficit is likely due to the lithology (heavily overconsolidated cohesive soils with granular/sandy bands) rather than the uptake of water from the roots of nearby trees and vegetation.
- A potential moisture deficit was noted at a depth of 7.70m bgl in BH2 within the Raised Beach Deposits. This sample was described as a slightly sand silty clay by the laboratory. No roots were encountered within the trial hole; therefore the potential moisture deficit is likely due to the lithology (heavily overconsolidated cohesive soils) rather than the uptake of water from the roots of nearby trees and vegetation.

Liquidity Index analyses indicated that there were no potential moisture deficits within the remaining sample tested.

5.2.3. Liquid Limit Analysis

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

Moisture Content vs. Liquid Limit				
Sample	Moisture Content (%)	Liquid Limit (%)	40% Liquid Limit (%)	Result
Head Deposits (BH1/0.80m bgl): <i>Laboratory description</i> – Orangish brown fine to coarse gravelly silty sandy CLAY	21	33	13.2	MC < 0.4 x LL (Potential Significant Moisture Deficit)
Raised Beach Deposits (BH1/7.20m bgl): <i>Laboratory description</i> – Orangish brown slightly mottled grey fine to medium slightly gravelly sandy silty sandy CLAY	18	39	15.6	MC < 0.4 x LL (Potential Significant Moisture Deficit)
Raised Beach Deposits (BH2/7.70m bgl): <i>Laboratory description</i> – Orangish brown slightly mottled grey slightly sandy silty CLAY with occasional chalk deposits	19	47	18.8	MC < 0.4 x LL (Potential Significant Moisture Deficit)

Liquid Limit analyses revealed that potential significant moisture deficit was present within each of the three samples tested.

- A potential moisture deficit was noted at a depth of 0.80m bgl in BH1 within the Head Deposits. This sample was described as a fine to coarse gravelly silty sandy clay by the laboratory. No roots were encountered within the trial hole; therefore the potential moisture deficit is likely due to the lithology (heavily overconsolidated cohesive soils with granular/sandy bands) rather than the uptake of water from the roots of nearby trees and vegetation.
- A potential moisture deficit was noted at a depth of 7.20m bgl in BH1 within the Raised Beach Deposits. This sample was described as a fine to coarse gravelly silty sandy clay by the laboratory. No roots were encountered within the trial hole; therefore the potential moisture deficit is likely due to the lithology (heavily overconsolidated cohesive soils with granular/sandy bands) rather than the uptake of water from the roots of nearby trees and vegetation.
- A potential moisture deficit was noted at a depth of 7.70m bgl in BH2 within the Raised Beach Deposits. This sample was described as a slightly sand silty clay by the laboratory. No roots were encountered within the trial hole; therefore the potential moisture deficit is likely due to the lithology (heavily overconsolidated cohesive soils) rather than the uptake of water from the roots of nearby trees and vegetation.

5.2.4. Particle Size Distribution Testing

The results of particle size distribution (PSD) testing undertaken are tabulated below. The results of the PSD testing can be viewed within Appendix D.

Summary of PSD Test Results			
Stratum	Volume Change Potential Range		Passing 63µm sieve Range (%)
	BRE	NHBC	
Raised Beach Deposits (BH1/2.70m bgl): Brown very sandy very clayey GRAVEL (gravel is fmc and sub-angular to sub-rounded)	Yes	No	25
Raised Beach Deposits (BH1/4.70m bgl): Orangish brown clayey very gravelly SAND (gravel is fmc and sub-angular)	Yes	No	18
Raised Beach Deposits (BH2/3.70m bgl): Brown very sandy very clayey GRAVEL (gravel is fmc and sub-angular)	Yes	No	22
Raised Beach Deposits (BH1/4.70m bgl): Brown gravelly clayey SAND (gravel is fmc and sub-angular)	Yes	No	19
• Volume Change Potential refers to BRE Digest 240 (based on Grading test results). • Shrinkability refers to NHBC Standards Chapter 4.2 (based on Grading test results). • BRE 240 states that a soil has a volume change potential when the clay fraction exceeds 15%. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. • NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.			

5.2.5. Determination of Saturation Moisture Content of Chalk

The results of saturation moisture content testing undertaken are tabulated below. The results can be seen in Appendix D.

Summary of Saturation Moisture Content Test Results					
Stratum	Moisture Content (%)	Saturation Moisture Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)	CIRIA Dry Density Classification
Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation BH1/10.10m bgl (Off white fm intact CHALK fragments in a chalk clay matrix.	22	24	2.00	1.64	Medium Density
Density in accordance with CIRIA 574 Chapter 3.0, Table 3.7					

5.2.6. Water Soluble Sulphate and pH Testing

A tabulated summary of the water soluble sulphate and pH testing can be viewed below. The results of the water-soluble sulphate and pH testing can be viewed within Appendix D.

Summary of Water Soluble Sulphate and pH Test Results		
Stratum	Water Soluble Sulphate (mg/l)	pH
Raised Beach Deposits	270	7.7

5.2.7. BRE Special Digest 1 Testing

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground' (BRE, 2005), samples were scheduled for laboratory analysis to determine parameters for concrete specification. The results of the chemical analysis undertaken are given within Appendix E and a summary is tabulated below.

Summary of BRE Special Digest 1 Testing Results			
Determinand	Unit	Head Deposits	Raised Beach Deposits
pH	-	6.2	6.9
Total Sulphate as SO ₄	%	0.03	<0.02
Water Soluble Sulphate as SO ₄	mg/l	85	26
Total Sulphur	%	<0.02	<0.02
Ammonium as NH ₄	mg/l	0.11	0.11
Water Soluble Chloride (2:1)	mg/l	8.2	2.0
Water Soluble Nitrate (2:1) as NO ₃	mg/l	1.9	<1.5
Water Soluble Magnesium	mg/l	2.5	1.3

6. ENGINEERING CONSIDERATIONS

6.1. Chalk Mining and Dissolution Risk Assessment

The presence of dissolution features on-site can prove problematic, as they often provide inconsistency within the underlying geology. Often formed during glacial and periglacial conditions, the depth and width of these features can vary substantially, often providing inconsistency in geological strength data.

If a dissolution feature is suspected, a geotechnical engineer and structural engineer should be contacted for suitable engineering designs, based on further works identifying and classifying the area the feature occupies.

The Groundsure Geosight datasheets, presented Appendix the Desk Study Report of this report, revealed the following information which may be pertinent to this risk assessment.

- Ground Dissolution of Soluble Rocks – The site was classified as a Low risk of ground dissolution of soluble rocks across the site. *Low Risk was described as “Soluble rocks are present within the ground. Some dissolution features may be present. Potential for difficult ground conditions are at a level where they may be considered, localised subsidence need not to be considered except in exceptional circumstances”.*
- An on-site Class A Historical Mining area was identified on-site. A Class A area was described as *“Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level, where they need not be considered”.* However, this is generally a precautionary statement attributed to all areas associated with chalk within the ground profile. Therefore, this does not identify any underground chalk features at the site location.
- 4No. on-site surface ground workings were identified comprising: sand pit (1896 – 1940) and a refuse heap (1969).
- 1No. BritPit was identified comprising 1x Westfield Sand Pit (sand).
- No records of Underground workings, Natural Cavities, Mining Cavities or JPB Mining Areas were noted within a 500m radius of the site.

The historical mapping review undertaken in section 3.1 of Desk Study Report confirmed the findings of the groundsure datasheets discussed above. A former sand pit was located across the eastern portion of the site.

A review of the data available on www.lidarfinder.com showed no features of concern (e.g. potential infilled ground or potential indication for dissolution related features) on or in a close proximity to the site.

The Ground and Water Limited intrusive investigation encountered Head Deposits in BH1 to 2.10m bgl and Made Ground to a depth of 2.20m bgl in BH2, overlying superficial deposits of the Raised Beach Deposits to a depth of 7.90 – 8.00m bgl. Underlying this was bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation for the remainder of the boreholes to a depth of 15.45m bgl. As a result of sample disturbance caused by the drilling process, the chalk was found to be Grade Dm, in accordance with CIRIA 574. The geotechnical laboratory

testing indicated the chalk clasts within the boreholes to be of medium density, with a dry density of 1.64mg/m^3 . The Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation was anticipated to have no volume change potential in accordance with CIRIA C574.

The SHDP equivalent SPT “N” blow counts displayed within Section 5.1.2 and within Figure 6 of this report showed numerous soft spots and great inconsistency within the strength profile of the soils within the assumed Made Ground, Head Deposits and Raised Beach Deposits within DP02 – DP16, DP24 and 25. The ground conditions were generally more competent in DP1 and DP17 – 23. Assuming that the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation is encountered at a depth of $\sim 8.00\text{m bgl}$, soft spots were noted extending into the chalk in DP12 to $\sim 12.00\text{m bgl}$, in DP15 to 8.70m bgl and DP25 to 8.40m bgl .

In-situ strength testing within WS02 – WS05 recorded SPT “N” blow counts of 30 – 39 within the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation between the depths of $8.00\text{m} - 15.45\text{m bgl}$, **which are considered high with regards to geotechnical assessment.**

No groundwater was encountered during the intrusive investigation.

6.2. Soil Characteristics and Foundation Considerations

A summary of the soil characteristics following the intrusive site investigation and laboratory testing and the relevant foundation considerations has been provided below. The following information from the ground investigation was considered pertinent to the design of foundations.

- Made Ground was encountered from ground level in BH2 to a proved depth of 2.20m bgl . No Made Ground was encountered within BH1. Made Ground may be locally deeper across the site, especially where regrading of the slope crossing the site or where trees have been uprooted.

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

- Cohesive soils of the Head Deposits described as dark brown slightly sandy slightly gravelly clay were encountered from ground level to a depth of 2.10m bgl in BH1. These soils were classified as having a low volume change potential in accordance with BRE240 and no volume change potential in accordance with NHBC Standards Chapter 4.2.
- Underlying the Head Deposits in BH1 and the Made Ground in BH2 were granular soils of the Raised Beach Deposits ranging from a brown slightly clayey sandy gravel to an orange fine grained sand. Bands of cohesive soils were encountered comprising a brown slightly sandy silty clay were also encountered. The granular soils of the Raised Beach Deposits were tested to have a (low) volume change potential in accordance with BRE240 and no volume change

potential in accordance with NHBC Standards Chapter 4.2.

- Chalk soils were anticipated to have no volume change potential in accordance with CIRIA C574.

Shallow foundations in contact with only the Head Deposits, should be designed in accordance with low volume change potential, and therefore having an absolute minimum foundation depth of 0.75m bgl.

Deeper foundations, such as piles, which extend through the Raised Beach Deposits, should be designed in accordance with medium volume change potential

Given the presence of cohesive soils at shallow depth, special foundation precautions may be required to prevent possible future shrinkage/swelling of the soils affecting the integrity of the faces of foundations (underfloor void diameter/compressible material/void formers etc). A compressible layer must be provided to accommodate potential seasonal movement, based on NHBC guidance.

- In-situ testing classified the Head Deposits as having a low undrained shear strength (C_u of between 25kPa). The SHDP equivalent SPT "N" blow counts displayed within Section 5.1.2 and within Figure 6 of this report showed numerous soft spots and great inconsistency within the strength profile of the soils within the assumed Made Ground, Head Deposits and Raised Beach Deposits within DP02 – DP16, DP24 and 25. The ground conditions were generally more competent in DP1 and DP17 – 23.

The loads of proposed foundations should not exceed the allowable bearing capacity of the soils they are founding upon, nor should >25mm of load-induced settlement occur. Bearing capacity and settlement analysis is provided within the following sections. If soft spots are encountered, they should be bypassed. Care should be taken not to overdig foundations as this may stress underlying soft spots, should they be present.

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

- No roots were encountered during the site investigation. 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.

Foundations must not be placed within root penetrated and/or desiccated soils with volume change potential. It is recommended that foundations are taken at least 300mm into non-root penetrated strata if the soils have volume change potential, or into soils of no volume change potential. The influence of trees on or surrounding the site will need to be taken into account in final design (NHBC Standards Chapter 4. 2) (tree rings).

- No groundwater strike or seepage was noted. It should be noted that groundwater strikes may have been obstructed by the drilling process.

Any groundwater or surface water ingress must be prevented from entering foundation trenches. Excavations must be kept dry and either concreted or blinded as soon after excavation as possible. If water were allowed to accumulate on the formation for even a short time not only would an increase in heave occur resulting from the soil increasing in volume by taking up water, but also the shear strength and hence the bearing capacity would also be reduced, and this could result in increased settlements. Perched water may be recorded within the excavation of foundation trenches, especially after a period of prolonged or intense rainfall. Instability issues may arise within the foundation trenches, in case of perched water being present.

6.3. Shallow Foundations

At the time of reporting, July 2021, the proposed development was understood to comprise the erection of a two storey detached residential property with a detached garage, associated car parking and garden areas. No lower ground floor level or basement was anticipated. It was understood that the main building was to have piled foundations and the detached garage was to be founded on a raft. The proposed development plan can be seen within Figure 4.

It was understood that the raft foundation was to be 10.02m long and 6.62m wide.

The undrained cohesion used was based upon the SPT results in BH1. Given the low volume change potential of the Head Deposits, a minimum foundation depth of 0.75m bgl is required.

The software uses commonly derived equations for bearing capacity to derive figures based on the ground model formed, using layer weighted averages. The bearing capacities are calculated via several methods (Hansen, Terzaghi, Meyerhof, Vesic, Brinch – Hansen, Meyerhof & Hanna) and the most conservative outputs are selected as proposed bearing capacities.

The following allowable bearing capacities and load induced settlements were anticipated for foundation at 0.75m bgl, based on the soil profiles within BH1. This is based on trial hole records, the results of the in-situ testing, inspection of samples recovered, and referral to BS 8004:2015, Code of Practice for Foundations and based on a 10.02m long by 6.62m wide foundation and a maximum settlement of 25mm.

Allowable Bearing Capacities Calculated				
Foundation Depth (m bgl)	Foundation Type	Limit State	Serviceability State	
		Allowable Bearing Capacity (kN/m ²)	Load (kN/m ²)	Settlement (mm)
0.75 (BH1)	10.02m by 6.62m raft foundation	34.78	30	<17

The infill for a raft will need be a minimum of ~50% of the proposed foundation depth and would need to be constructed and compacted in layers in accordance with NHBC specifications. The fill would also need to extend beyond the edge of the foundation by the natural angle of repose of the infill plus

0.50m. The raft will need to have a side ratio of not more than 2:1 and the raft should be sufficiently stiff to be able to resist any differential movement.

Based on a literature review Bowles (1996) indicates an appropriate Modulus of Subgrade Reaction at ~0.75m bgl of ~12,000kN/m²/m.

6.3.1. Additional Comments

A number of comments and recommendations has been provided below.

- It is prudent to avoid having a foundation spanning across materials of different consistency, like clay and gravel, in order to avoid potential differential settlements. If unavoidable, foundations must be reinforced to allow for such potential differential movement. It should be noted that differential settlement may also occur between strip and isolated pad foundations.
- Foundation excavations must be carefully bottomed out and any loose soil or soft spots removed prior to the foundation concrete or blinding being placed. Failure to ensure that foundation excavations are suitably bottomed out could result in additional settlements.
- Inspection of foundation excavations, prior to concreting, must be made by a competent and suitably qualified person to check for soft spots and to check for the presence of roots.
- Given soils of volume change potential were encountered, a suspended slab is required.
- Isolated Pad Foundations must be at least 1.5 times the width of the widest pad apart to keep to the anticipated settlements.
- Foundations must not be cast over foundations of former structures and/or other hard spots.
- Final designs for the foundations should be carried out by a suitably qualified Engineer based on the findings of this investigation and with reference to the anticipated loadings, serviceability requirements for the structure and the developments proximity to former, present, and proposed trees. 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.

6.4. Piled Foundations

At the time of reporting, July 2021, the proposed development was understood to comprise the erection of a two storey detached residential property with a detached garage, associated car parking and garden areas. No lower ground floor level or basement was anticipated. It was understood that the main building was to have piled foundations and the detached garage was to be founded on a raft. The proposed development plan can be seen within Figure 4.

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

The foundation would most likely comprise a piled foundation with suspended slab at ground level. Given the low volume change potential of the cohesive Head Deposits, heave precautions will be required to prevent possible future shrinkage/swelling within clay strata affecting the integrity of the foundation/pile-slab or other system.

Piles must extend to a minimum of 12.00m bgl to bypass the soft horizons, and into the competent Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation and should be designed in accordance with guidance given in CIRIA C574 Part 8.

Given the ground conditions encountered at shallow depths, the design of the piles is recommended to rely entirely upon the end bearing capacity of the pile, subject to contractor's comments and recommendations.

6.5. Excavations and Stability

Shallow excavations in the Made Ground and Head Deposits are likely to be marginally stable at best. Long, deep excavations, through these strata and into the underlying Raised Beach Deposits are likely to become unstable.

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

6.6. Sub-Surface Concrete Design

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground' considering the pH of the soils. For the classification given below, the "mobile" and "natural" case was adopted given the geology encountered and the residential use of the site.

Made Ground

The water-soluble sulphates in the Made Ground was noted to be 16mg/l, with a pH of 7.1.

Head Deposits

The water-soluble sulphates in the Head Deposits was noted to be 85mg/l, with a pH of 6.2, from chemical and geotechnical laboratory testing. The total potential sulphate (3x total sulphur) was <0.06%, from chemical laboratory testing.

Raised Beach Deposits

The water-soluble sulphates in the Raised Beach Deposits was noted to be 26 - 270mg/l, with a pH of 6.9 - 7.7, from chemical laboratory testing. The total potential sulphate (3x total sulphur) was <0.06%, from chemical laboratory testing.

Therefore, sulphate concentrations measured in 2:1 water/soil extracts taken from the Head Deposits and Raised Beach Deposits and total potential sulphate concentrations, fell into Class **DS-1** of the BRE Special Digest 1, 2005, 'Concrete in Aggressive Ground'. Table C1 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) classification of **AC-1**.

6.7. Roads and Hardstanding Design

This section provides information relating to the construction of roads and hardstanding, for each strata encountered.

6.7.1. Anticipated CBR Values and Frost Susceptibility

Topsoil

Roads and hardstanding should bypass Topsoil given the likely low strength, high compressibility and general variability.

Made Ground

Roads and hardstanding should not be constructed on Made Ground given its variability in composition and likely low strength/density. Where these cannot be bypassed a CBR value of 1% should be adopted for Made Ground. Given that Made Ground encountered beneath the site comprised a mixture of poorly drained clayey sandy gravel based soils, these deposits are likely to be **frost susceptible**.

Head Deposits (cohesive)

Roads and hardstanding constructed on the cohesive Head Deposits should be designed based on a CBR value of 4.0%. This is based on reference to Table C1 of TRL1132 and average construction conditions. Based on wet conditions a CBR of 2.5% should be adopted, with dry conditions a CBR of 4.5% being applicable. These clay-based soils (poorly drained) with plasticity indexes below 20% are likely to be frost susceptible.

All formation levels for roads and hardstanding should be proof rolled to highlight any soft areas which should then be dug out and replaced with selected granular material compacted in thin layers to a suitable specification.

6.8. Surface Water Disposal

Infiltration testing was beyond the scope of the investigation.

The proposed development was located on the superficial Head Deposits and Raised Beach Deposits classified as a Secondary (Undifferentiated) Aquifer, underlain by bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation, classified as a Principal Aquifer. The ground conditions encountered generally comprised a capping of Made Ground overlying superficial cohesive Head Deposits and granular Raised Beach Deposits, underlain by the Undifferentiated Lewes Nodular Chalk Formation, Newhaven Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.

Additional drainage may be considered should significant amounts of water be encountered. Based on a visual and physical appraisal of the soils, it was considered that all granular and chalk soils may have sufficient infiltration rates for soakaway systems; however, cohesive soils were not considered likely to have sufficient rates. Soakage testing in accordance with BRE 365 could be undertaken to confirm infiltration rates. These tests were beyond the scope of this project.

Any soakaways should be located sufficiently away from buildings and infrastructure, in order to prevent undermining of foundations.

Consultation with the Environment Agency must be sought regarding any use that may have an impact on groundwater resources, abstractions and surface water features/watercourses.

It should be noted that water discharge into the chalk may worsen / create dissolution features. Therefore, soakaways should be remote from structures and undertaken in accordance with available guidance.

A number of published information sources make reference to an appropriate distance at which a soakaway should be sited in relation to any building foundations in the vicinity:

- The British Standard BS8301 :1985 “Code of practice for building drainage” (1985), suggests that: “A soakaway is not desirable nearer to a building than about 5 metres nor in such a position that the ground below foundations is likely to be adversely affected.”
- The Building Research Establishment Digest 365 “Soakaway design” (1991), suggests that “Soakaways should not normally be constructed closer than 5m to building foundations. In chalk or other soil and fill material subject to modification or instability, the advice of a specialist geotechnologist should be sought as to the advisability and siting of a soakaway”.

In addition, the distance a soakaway is located from any foundations can be informed by both the soakaway type and chalk density present at the site.

- The Kent County Council Soakaway Design Guide (July 2000) states that “Highway soakaways shall be situated the following minimum distances from dwellings (measured from the outside edge of the soakaway): (1) 5 metres for conventional perforated soakaway; (2) 10 metres for deep bored soakaway. In addition, adjacent soakaways of a similar type shall also be spaced a minimum of 10 metres apart.
- CIRIA 574 states that soakaways should be sited at least 5-10m away from any structure, depending on the chalk density. Where the chalk present is of low or unknown density, soakaways should be sited at least 10m from any foundations, and where the chalk is of medium density or higher, any foundations should be sited at least 5m from any foundations.

The submission of a Sustainable Urban Drainage Scheme (SUDS) is likely to be required for this site due to the proposed development increasing the amounts of hardstanding.

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

7. CONTAMINATION RISK ASSESSMENT

7.1. Results of the Phase I Risk Assessment

The tabulated Conceptual Site Model (CSM) developed by the Ground and Water Desk Study (ref. GWPR4206/DS/July 2021) is reproduced in this section and can be seen below. This version of the CSM has omitted the assigned risk rating and any linkage classified as Negligible. For the complete information please see the Desk Study report and Section 2.8.

No additional source of contamination, pathway or receptor was identified between the desk study and the ground investigation and as such, it was not necessary to modify the CSM.

Tabulated Conceptual Site Model – Pollutant Linkage Summary (on-site sources).		
Potential Sources	Potential Absorption Pathways	Potential Receptors
Made Ground from on-site activities: - Asbestos, - PAHs, - TPHs, - VOCs, - Sulphates, and - Metals.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Ingestion of home-grown produce, and soils attached - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbours and public
	- Direct uptake of groundwater - Direct uptake of determinands in the soil	Flora and Fauna Vegetation within soft landscaped areas
	- Anthropogenic (man-made) pathways - Vertical and lateral migration in permeable strata - Surface water runoff	Controlled Waters - Secondary (A) Aquifer (Head Deposits and Raised Beach Deposits) - Principal Aquifer (Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation).
Aggressive ground conditions with Made Ground and natural ground, including groundwater: - Sulphates, - PAH/TPH.	Direct contact with aggressive ground conditions	Building Materials and Services - Buried Concrete - Underground services (water pipes)
Ground gases generated by Made Ground: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide.	- Migration through anthropogenic & natural pathways - Inhalation of Asphyxiating gases - Explosion (methane only)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces - Neighbours and public

Tabulated Conceptual Site Model – Pollutant Linkage Summary (on-site sources)		
Potential Sources	Potential Absorption Pathways	Potential Receptors
	- Migration through anthropogenic & natural pathways - Explosion (methane only)	Building Materials and Services - Buildings - Confined spaces - Underground services

In the UK, the assessment of risk from contamination follows the source-pathway-receptor (SPR) approach. For a risk to be present there must be a source of contamination, a receptor or receptors, and a pathway for contaminants to migrate or be absorbed. If there is a linkage between any given source and receptor, then a quantitative risk assessment is used to assess the significance or impact of the pollutant linkage.

7.2. Sampling Locations

The synopsis for the trial hole locations and their final depth can be seen tabulated below. A trial hole location plan is provided within Figure 5. The table also indicates whether any locations targeted a source of contamination as well as the proposed end-use. The proposed development can be seen in Figure 4.

Trial Hole Location Synopsis		
Trial Hole/Final Depth	Sampling Strategy	Proposed End-Use
BH1/15.45m	Random	Footprint of Proposed Building
BH2/15.45m	Random	Footprint of Proposed Building

The investigation area totals approximately 1,500m² and with two sampling locations, given an unknown hotspot shape, the sampling density means that a hotspot with an area of approximately 1125m² and a radius of approximately 18.9m would be encountered (CLR 4).

Sampling depths were chosen to reflect the receptor of concern (e.g. human health, controlled waters and vegetation) and typically comprised a surface or near surface sample and at approximately 0.5m depth increments thereafter, extending into the underlying natural soils. Any horizon where olfactory or visual evidence of contamination was present was also sampled. The receptors relevant to the sampling depths are tabulated overpage.

Summary of Receptors per Sample Depth	
Depth	Receptors
Shallow Samples (< 0.75m bgl)	- End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbors and public - Vegetation within soft landscaped areas (shallow rooted) - Secondary A Aquifer (Head Deposits and Raised Beach Deposits) - Principal Aquifer (Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation). - Buried Concrete - Receiving landfill

The depth of the soil samples at each trial hole location can be seen on the trial hole logs within Appendix C.

7.3. Soil Risk Assessment

Chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by DETS Limited, was undertaken on one sample as tabulated below.

Sample Location Synopsis			
Sample ID	Sampling Strategy	Strata	Proposed End-Use
BH2/0.20m	Random	Made Ground	Footprint of Proposed Building

The samples were subjected to a combination of analysis that comprised:

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

A breakdown of the number of tests undertaken for each determinand is discussed in further sections. The chemical laboratory results are presented in Appendix E.

7.3.1. Soil Assessment Criteria and Results

At the time of reporting, July 2021, the proposed development was understood to comprise the erection of a two storey detached residential property with a detached garage, associated car parking and garden areas. No lower ground floor level or basement was anticipated. It was understood that the main building was to have piled foundations and the detached garage was to be founded on a raft. The proposed development plan can be seen within Figure 4.

Based on the proposed development, the results of the chemical laboratory testing were compared to the Generic Assessment Criteria (GAC) for a '**Residential with homegrown produce**' land-use scenario, as this was considered the most appropriate land-use scenario. The derivation of Soil Assessment Criteria used within this report can be seen within Appendix F.

Where a contaminant of concern's GAC varies according to the Soil's Organic Matter (SOM), the SOM recorded for each uncontaminated soil type was used to derive the appropriate GAC for each soil type. A SOM value of 1%, the most conservative value, was utilised.

A summary of the analytical results and the comparison to the determinands adopted screening value are presented in the table overleaf.

Soil Contamination Test Results and Screening Values					
Determinand	Number of Samples	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Adopted Screening Value (mg/kg)	Was the adopted screening value exceeded for relevant land-use scenario?
INORGANICS					
Asbestos	1	-	<0.001	ND	No
Cyanide (total)	1	-	< 2	24	No
Phenols	1	-	< 2	280	No
METALS					
Arsenic	1	-	9	37	No
Boron	1	-	< 1	290	No
Cadmium	1	-	0.3	11	No
Chromium (III)	1	-	19	910	No
Chromium (Hexavalent)	1	-	< 2	6	No
Copper	1	-	18	2,400	No
Lead	1	-	51	200	No
Mercury	1	-	< 1	1.2	No
Nickel	1	-	9	130	No
Selenium	1	-	< 3	250	No
Vanadium	1	-	27	410	No
Zinc	1	-	79	3,700	No
TOTAL PETROLEUM HYDROCARBONS (TPHs)					
Aliphatic >C5 - C6	1	-	< 0.01	42	No
Aliphatic >C6 - C8	1	-	< 0.05	100	No
Aliphatic >C8 - C10	1	-	< 2	27	No
Aliphatic >C10 - C12	1	-	< 2	130	No
Aliphatic >C12 - C16	1	-	< 3	1,100	No
Aliphatic >C16 - C21	1	-	< 3	65,000	No
Aliphatic >C21 - C34	1	-	< 10		No
Aromatic >C5 - C7	1	-	< 0.01	65,000	No
Aromatic >C7 - C8	1	-	< 0.05	70	No
Aromatic >C8 - C10	1	-	< 2	130	No
Aromatic >C10 - C12	1	-	< 2	34	No
Aromatic >C12 - C16	1	-	< 2	74	No
Aromatic >C16 - C21	1	-	14	140	No
Aromatic >C21 - C35	1	-	26	260	No
Benzene	1	-	< 0.002	1,100	No
Toluene	1	-	< 0.005	0.087	No
Ethylbenzene	1	-	< 0.002	130	No
m,p-Xylene	1	-	< 0.002	47	No
o-Xylene	1	-	< 0.002	56	No
POLYCYCLIC-AROMATIC HYDROCARBONS					
Acenaphthene	1	-	0.13	210	No
Acenaphthylene	1	-	0.18	170	No
Anthracene	1	-	0.45	2,400	No
Benzo(a)anthracene	1	-	2.42	7.2	No
Benzo(a)pyrene	1	-	2.15	2.2	No
Benzo(b)fluoranthene	1	-	2.78	2.6	No
Benzo(ghi)perylene	1	-	1.41	320	No
Benzo(k)fluoranthene	1	-	0.94	77	No
Chrysene	1	-	2.32	15	No
Dibenzo(a,h)anthracene	1	-	0.19	0.24	No

Fluoranthene	1	-	5.14	280	No
Fluorene	1	-	0.20	170	No
Indeno(1,2,3-cd)pyrene	1	-	1.63	27	No
Naphthalene	1	-	< 0.1	2.3	No
Phenanthrene	1	-	2.05	95	No
Pyrene	1	-	4.66	620	No
MARKER FOR VOLATILE ORGANIC COMPOUND					
Methyl tert-butyl ether (MTBE)	1	-	< 0.005	49	No
The derivation of the Soil Assessment Criteria used within this report can be seen within Appendix G. The soil concentrations were typically compared to the LQM/CIEH Suitable for Use Levels (S4UL) (2014), based upon the assumption of 1% soil organic matter. A screening value for Lead is based on the Category 4 Screening Levels (C4SLs). Where no S4UL or C4SL is available for Cyanide, a SoBRA acute GAC is assigned. Where no S4UL or C4SL is available for MTBE, a CL:AIRE 2010 GAC is assigned. Where exceedances are noted, the trial hole and depth of sample is recorded.					

The proposed development includes areas of soft-landscaping, where shallow rooted vegetation may be exposed to aggressive ground conditions. The previous table compares the results of the laboratory analysis to GAC that is protective of Human Health and therefore different GAC is required for vegetation. The derivation of Soil Assessment Criteria used within this report can be seen within Appendix G.

Soil Contamination Test Results and Screening Value					
Determinand	Number of Samples	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Adopted Screening Value (mg/kg)	Was the adopted screening value exceeded for relevant land-use scenario?
Copper	1	-	18	250	No
Zinc	1	-	79	1,000	No
The derivation of the Soil Assessment Criteria used within this report can be seen within Appendix G. The soil concentrations were compared to the ICRL 70/90: <i>Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing</i>. Where exceedances are noted, the trial hole and depth of sample is recorded.					

7.3.2. Soil Assessment

The comparison between the laboratory analysis and the assessment criteria indicates that the determinands were identified at below the respective adopted screening values and are not considered to represent an unacceptable risk to future receptors. **No remediation required as part of any site development.**

No asbestos has been identified during the testing, however, an **Asbestos Management Strategy** should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.

7.3.3. Water Supply Pipe Risk Assessment

As part of the proposed development it is expected that new water supply pipes will be installed at the site. Water supply pipes have the potential to be exposed to contaminants in the ground that can lead to unacceptable concentrations within the drinking water. If a risk is identified, specialist pipes that are protective of the drinking water are required.

A pipe selection risk assessment should be submitted to the water supply company as part of the development based on the supplier's assessment criteria. An indication of whether there is likely to be a risk can be seen tabulated below, where the PE pipe thresholds are based on *UKWIR Contaminated Land Assessment Guidance, 2014*.

Pipe Selection Risk Assessment			
Determinand	PE Pipe Threshold (mg/kg)	Laboratory Analysis Range (mg/kg)	Was the Threshold Exceeded?
Total BTEX and MTBE	0.1	< 0.018	No
Total VOCs	0.5		No
Total SVOCs	2		No
Phenols	2	< 2	No
TPH EC5 – EC10 (aliphatics and aromatics)	2	< 2	No
TPH EC10 – EC16 (aliphatics and aromatics)	10	< 5	No
TPH EC16 – EC40 (aliphatics and aromatics)	500	43	No
Naphthalene	5	< 0.1	No

The results indicate that no determinands were above the threshold for the use of a PE pipe at the site.

7.4. Groundwater Risk Assessment

In the UK, the water environment is protected under a number of regulatory regimes, mainly governed by the Environment Agency. The Environment Agency is consulted when there may be a risk to Controlled Waters, or where a pollution incident has occurred historically. The Water Framework Directive is implemented in various guises covering groundwater, surface water and drinking water supply.

The soil sample analysed as part of the risk assessments has been used to undertake a Level 1 (soils) Controlled Waters risk assessment. At Level 1 (soils), the conceptual site model and the determinand concentrations of the soils are used to indicate whether the concentrations are sufficient to impact the receptor. At this stage, dilution, dispersion and attenuation along the pathway are not considered.

A study of the aquifer maps on the DEFRA website revealed the site was underlain by a **Secondary (A) Aquifer** comprising the superficial Head Deposits and Raised Beach Deposits, underlain by a **Principal Aquifer** comprising bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.

Examination of the Environment Agency records showed that the majority of the site was located within an Outer Zone (Zone II) Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater. Descriptions of each classification have been provided below:

No surface water features were present within a 250m radius of the site.

From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth within the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk

Formation. Some amounts of groundwater however may be present at shallower depths within Made ground, parts of the Head Deposits or silty/sandy pockets of the Raised Beach Deposits, especially after periods of intense or prolonged rainfall. It was considered that groundwater was flowing in a southerly direction in line with local topography.

During the investigation encountered Head Deposits in BH1 to 2.10m bgl and Made Ground to a depth of 2.20m bgl in BH2, overlying superficial deposits of the Raised Beach Deposits to a depth of 7.90 – 8.00m bgl. Underlying this was bedrock deposits of the Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation for the remainder of the boreholes to a depth of 15.45m bgl. No discoloured or malodorous soils were encountered in the boreholes. Groundwater was not encountered.

Comparison between the soil laboratory analysis and the derived Level 1 (soils) target concentrations indicated some values of metal and PAH concentrations above the target value.

In other PAH values, where a determinand is identified at the laboratory limit of detection, no further assessment is considered necessary.

Given the Level 1 risk assessment does not consider dilution, dispersion or attenuation, the low levels and the likely low mobility of contaminants across the site, it is not expected that the soils on-site represent an unacceptable risk to controlled water receptors, including the Secondary A Aquifer and the Principal Aquifer. No further action is considered necessary.

The findings of this risk assessment should be agreed with the Environment Agency.

7.5. Ground Gas Risk Assessment

A review of freely available information prior to site works, including historical mapping and landfill registers/Phase I desk study, did not identify any source of ground gas on-site or within influencing distance of the site that warranted investigation through ground gas monitoring. The only source of ground gases was anticipated to be potential Made Ground and therefore classified as 'Low risk', where the pragmatic approach to ground gas risk assessment presented within the CL:AIRE research bulletin RB17 and included within Annex D of BS8485:2015+A1:2019 can be considered.

7.5.1. Pragmatic Approach

The alternative approach to ground gas risk assessment considers the uncertainty from the measurement of ground gas concentrations and flow rates in monitoring wells for low-risk sites and removes the need for monitoring. Low risk sites typically comprise:

- Natural soils with high carbonate content (e.g. chalk);
- Natural soils that can produce gases (e.g. alluvium, peat etc.);
- Made Ground between 1.00m to 5.00m, with low organic content; and
- Areas of flooded mine workings, unless a building is to be within 20m of shaft or adit.

The method considers the gas generation potential of the soils from data that is not subject to external influences, for example atmospheric pressure can change the recorded flow and concentrations of ground gas during spot monitoring, or a rising groundwater level can displace ground gases in pore

spaces. Determination of the characteristic situation is based on the total organic carbon (TOC) of the soils, coupled with any organic-rich material identified within the borehole logs, such as wood gravels. TOC is easily analysed by the laboratory and can also be calculated by the equation outlined below.

$$\text{Total Organic Carbon (TOC)} = 0.58 \times \text{Soil Organic Matter (SOM)} = 1.33 \times \text{Degradable Organic Carbon (DOC)}$$

As part of the ground investigation works, two samples were submitted to the laboratory for analysis, which identified TOC to vary between 1.2 and 1.5% in the Made Ground. The trial hole logs identified the gravels within the Made Ground to comprise; flint, chalk, brick and carbonaceous material (charcoal) (5-30%). Made Ground was identified to a maximum depth of 2.20m bgl.

7.5.2. Data Quality

A review was made of the quality of the available data for the site, which can be viewed in the table below. CIRIA Report C665 (2007), BS 8485:2015+A1:2019 and BS 8576:2013 stress the need for risk assessments to be based on good quality data and give guidance as to best practice in this respect.

Review of Data Quality			
Data Type	Current Understanding	UK Practice	Recommendation
Geological and hydro-geological conditions	The CSM identified the site to be located on localised Made Ground, deep in some areas and absent in others, overlying both permeable and impermeable strata of the Head Deposits/Raised Beach Deposits/Chalk. No groundwater was noted in the boreholes. It should be noted that groundwater strikes may have been obscured by the drilling process.	CIRIA C665 & C659, Wilson and Card (1999) and BS 8485 recommend that geology and hydrogeology be fully understood.	The geological and hydrogeological model is understood to a standard that will not comprise the findings of the risk assessment. No further action required.
Soil Laboratory Analysis	A dataset of soil analysis from 2No. samples of Made Ground have identified a range of TOC concentrations between 1.2% and 1.5%.	CL:AIRE RB17 outlines an approach to ground gas risk assessment away from the influences that directly affect ground gas monitoring. It should typically be used on sites with limited sources identified in the CSM and Made Ground with average thickness <3m and maximum thickness <5m. TOC should be < 4/6%.	The TOC concentrations are below the limit of 6% in order to use the soil derived approach for the risk assessment. No further action required.

7.5.3. Risk Assessment

The intrusive investigation has revealed a maximum thickness of Made Ground of 2.20m overlying Head Deposits and Raised Beach Deposits comprising cohesive and granular soils. Site has undergone a phase of tree removal and negligible degradable material has been identified. The introduction of oxygen to the Made Ground through redevelopment may lead to an initial increase of ground gas

generation as degradable material within the soils present on-site may act as source of ground gas. The soils at the site are considered to be of variable permeability (low to high) in nature and pathways for ground gas migration will be present.

Using the soil derived method, it is considered the Made Ground on the site has been in place for more than 20 years and therefore a TOC value of <1% within soil is unlikely to pose an unacceptable risk from ground gases and the site could be characterised as Characteristic Situation CS1. Any value between 1 and 3% would warrant a classification as a Characteristic Situation CS2. Any value between 3 and 6% would warrant a classification as a Characteristic Situation CS3. Any value over 6% would require investigation through ground gas monitoring. Any site with Made Ground <1.00m bgl will have a limited gas generation potential from the organic carbon present and consideration should be given to this thickness within the risk assessment.

An alternative approach for ground gas risk assessment (CL:AIRE RB17) can be considered utilising measured concentrations from soil parameters that are independent of influencing factors such as atmospheric pressure and groundwater level. Total Organic Carbon (TOC) was tested on 2No. samples of Made Ground with the analytical results ranging between 1.2 and 1.5%. Furthermore, it is considered that the negligible degradable content of the Made Ground would not generate sufficient ground gas to pose an unacceptable risk.

The investigation has revealed Made Ground in BH2 to 2.20m bgl. Based on the soil derived method outlined, an assessment of the soils encountered and the maximum TOC concentration encountered (1.5%), the soils from site would warrant classification as **Characteristic Situation CS1**. It should be noted that this only represents the assessment from an on-site source.

A period of ground gas monitoring could be considered to provide reassurance and finalise this risk assessment.

Boreholes can act as preferential pathways for ground gas and therefore prior to construction, all boreholes should be suitably decommissioned in line with Environment Agency guidance. This usually comprises pumping liquid grout down a tremie pipe to the base of the borehole, raising as the borehole fills.

7.6. Updated Conceptual Site Model

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

For ease of reference and understanding, the risks have been re-assigned within this risk assessment against three possible levels / categories, summarised in the table below.

Risk Categories used in the Tabulated CSM	
Low Risk	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is not considered to be an unacceptable risk to receptors.
Moderate Risk	Regarding this potential SPR linkage, the site is suitable for the proposed end-use however remediation and/or further investigation is required.
High Risk	Regarding this potential SPR linkage, the site is not suitable for proposed end-use and there is an unacceptable risk to receptors. Urgent action required in the short term.

Tabulated Conceptual Site Model – Pollutant Linkage Summary				(On-Site Sources)
Potential Sources	Potential Absorption Pathways	Potential Receptors	Risk Classification	
Made Ground from on-site activities: - Asbestos, - PAHs, - TPHs, - VOCs, - Sulphates, and - Metals.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Ingestion of home-grown produce, and soils attached - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbours and public	Low	
	- Direct uptake of groundwater - Direct uptake of determinands in the soil	Flora and Fauna Vegetation within soft landscaped area	Low	
	- Anthropogenic (man-made) pathways - Vertical and lateral migration in permeable strata - Surface water runoff	Controlled Waters - Secondary (A) Aquifer (Head Deposits and Raised Beach Deposits) - Principal Aquifer (Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation).	Low	
Aggressive ground conditions with Made Ground and natural ground, including groundwater: - Sulphates, - PAH/TPH. DS1/AC1 classification	Direct contact with aggressive ground conditions	Building Materials and Services - Buried Concrete - Underground services (water pipes)	High	
Ground gases generated by Made Ground: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide. CS1 classification	- Migration through anthropogenic & natural pathways - Inhalation of Asphyxiating gases - Explosion (methane only)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces - Neighbours and public	Low	
	- Migration through anthropogenic & natural pathways - Explosion (methane only)	Building Materials and Services - Buildings - Confined spaces - Underground services	Low	

7.7. Recommendations and Remediation Strategy

Based on the results of the intrusive works, chemical analyses and risk assessments undertaken, the following recommendation have been identified.

An Asbestos Management Strategy should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.

No formal remedial measures are required to soils on site. Soft landscaped areas will however need a 100-150mm thick clean topsoil layer to act as a growing medium.

7.7.1.1. Water Supply Pipes

The Water Supply pipe risk assessment indicated that the use of PE pipes is appropriate at the site and no further measures are required.

7.7.2. Groundwater

Given the Level 1 risk assessment does not consider dilution, dispersion or attenuation, the low levels and the likely low mobility of contaminants across the site, it is not expected that the soils on-site represent an unacceptable risk to controlled water receptors, including the Secondary A Aquifer and the Principal Aquifer. No further action is considered necessary.

The findings of this risk assessment should be agreed with the Environment Agency.

7.7.3. Ground Gas

Based on risk assessment undertaken, the site warrants classification as **Characteristic Situation CS1**, where no precautions to prevent the ingress of ground-gas. **A period of ground gas monitoring could be considered to provide reassurance and finalise this risk assessment.**

7.8. Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation. Such occurrences may be discovered during the demolition and construction phases for the redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

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

7.9. Imported Material

It is required that clean soils will be brought onto site as part of the validation works. 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 soil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, prior to placing (ideally) and after placing, to ensure that the future receptors (human health and vegetation) cannot come into contact with compounds that could be detrimental to their health. The compounds that are to be tested for are those given in the Generic Assessment Criteria, which can be viewed in Appendix F of this report.

7.10. Waste Disposal

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

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

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

The Environment Agency's Hazardous Waste Technical Guidance (WM3) 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.

Following the investigation, 1No. sample was submitted to the analytical laboratory to undergo a suite of testing for contamination testing, as discussed in the previous sections. Sampling depths were chosen to reflect the receptor of concern, human health, and typically comprised a surface or near surface sample. Any horizon where olfactory or visual evidence of contamination was present was also sampled.

Based on a risk phase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive and undertaken by Ground and Water Limited, the sample of Made Ground encountered on-site was **NON-HAZARDOUS**. The results of the assessment are given within Appendix G.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM3, therefore producing an initial classification in accordance with the guidance, this method classifies soils as either non-hazardous or hazardous and 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.

In addition to the samples described above, 1No. sample (BH1/0.80m bgl) was scheduled to undergo Waste Acceptance Criteria (WAC) testing with single batch leachate. The results indicate that the sample conforms to the **inert waste** classification. The results can be seen in Appendix E. The locations of these samples can be seen on Figure 5.

It should be noted that the receiving landfill may see the presence of Made Ground within the soils to be indicative of a non-hazardous classification despite the presence of the WAC testing certificates

indicating that it is inert. Therefore, it should be considered that all Made Ground is classified as Non-hazardous, subject to finalising with the receiving landfill.

Where contaminated soils are to be removed, they should be placed on an impermeable membrane (visqueen or similar) to ensure that no cross-contamination of soils occurs.

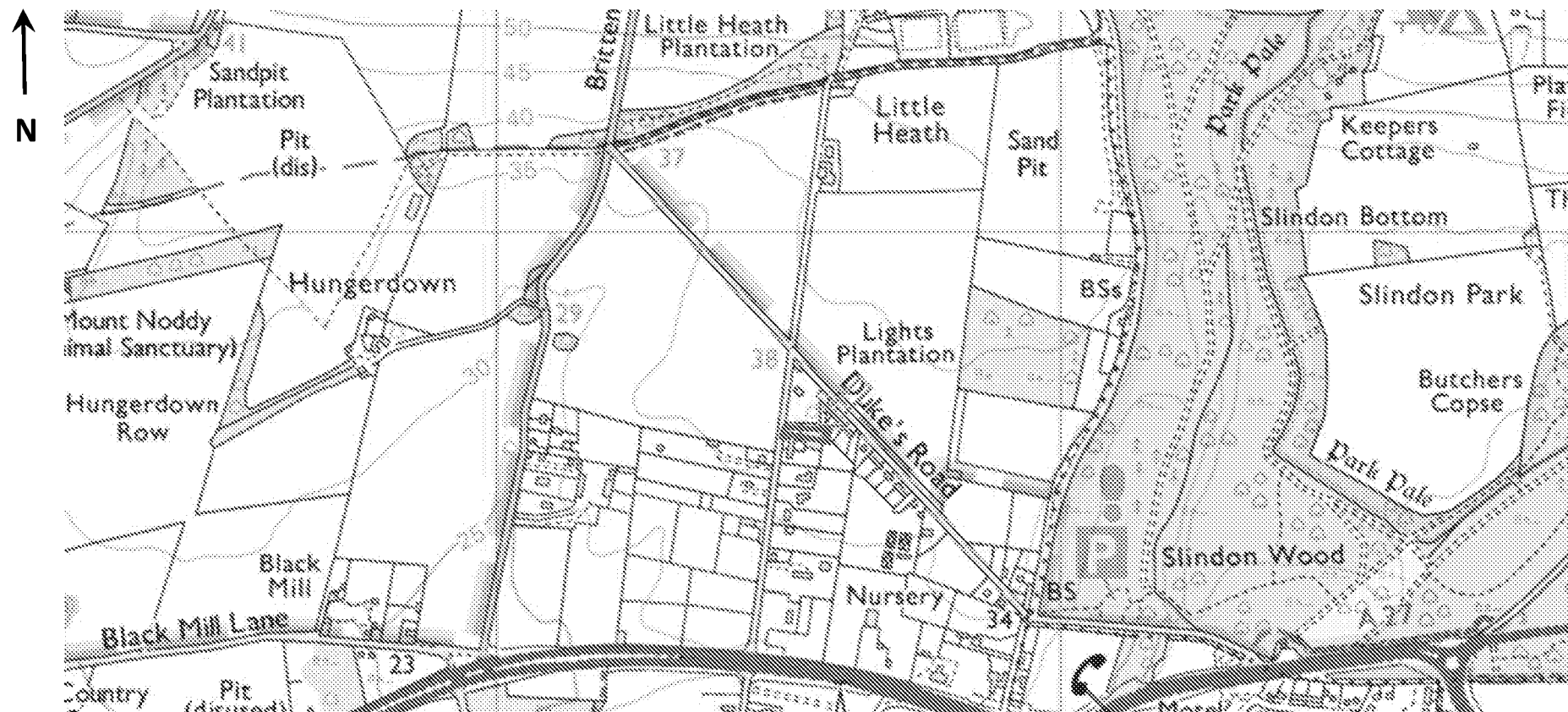
7.11. Duty of Care

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

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is 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.

FIGURES



Approximate Site Boundary

NOT TO SCALE

Project:
Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR

Client:
Richard Brookes

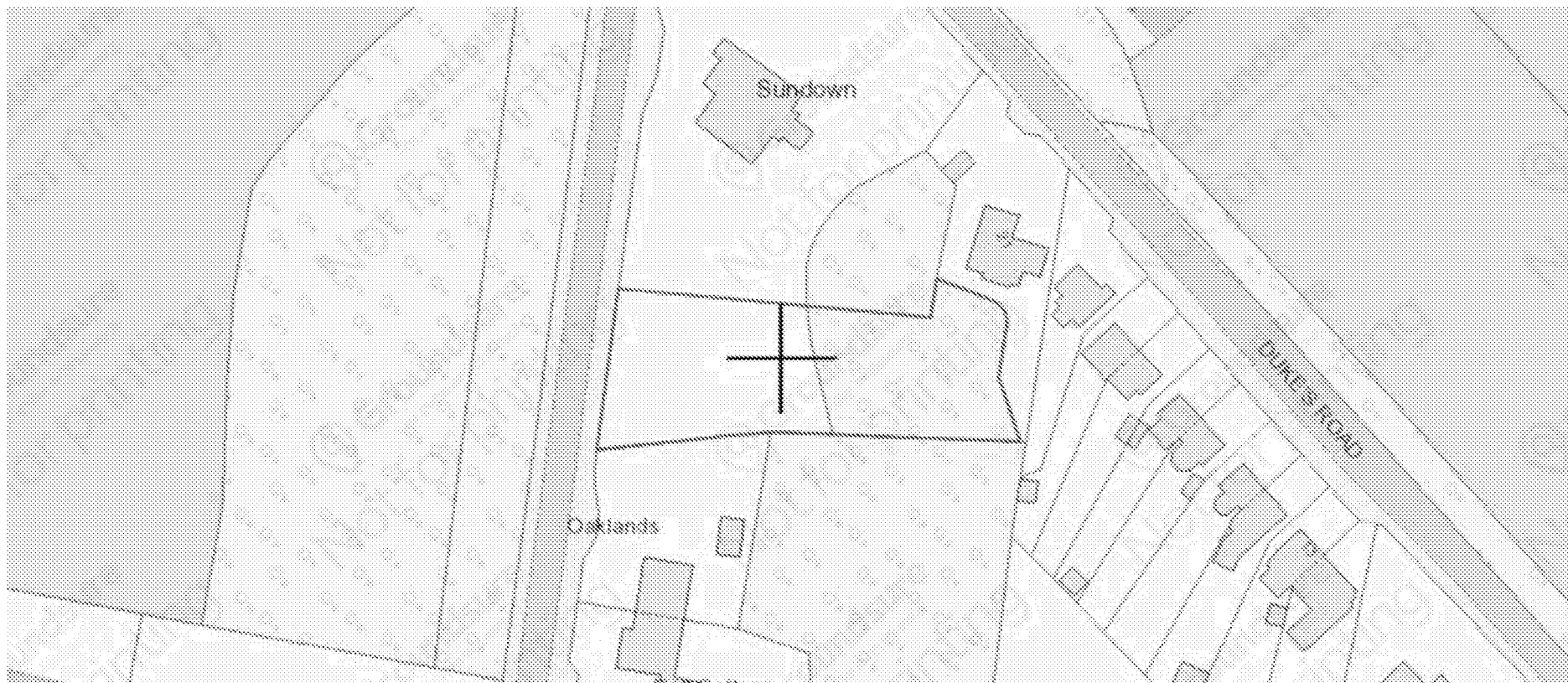
Date:
July 2021

Site Location Plan

Ref:
GWPR4206

Figure 1





Approximate Site Boundary



NOT TO SCALE

Project:

Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR

Client:

Richard Brookes

Date:

July 2021

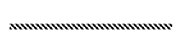
Site Development Area

Ref:

GWPR4206

Figure 2





Approximate Site Boundary

NOT TO SCALE

Project:

Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR

Client:

Richard Brookes

Date:

July 2021

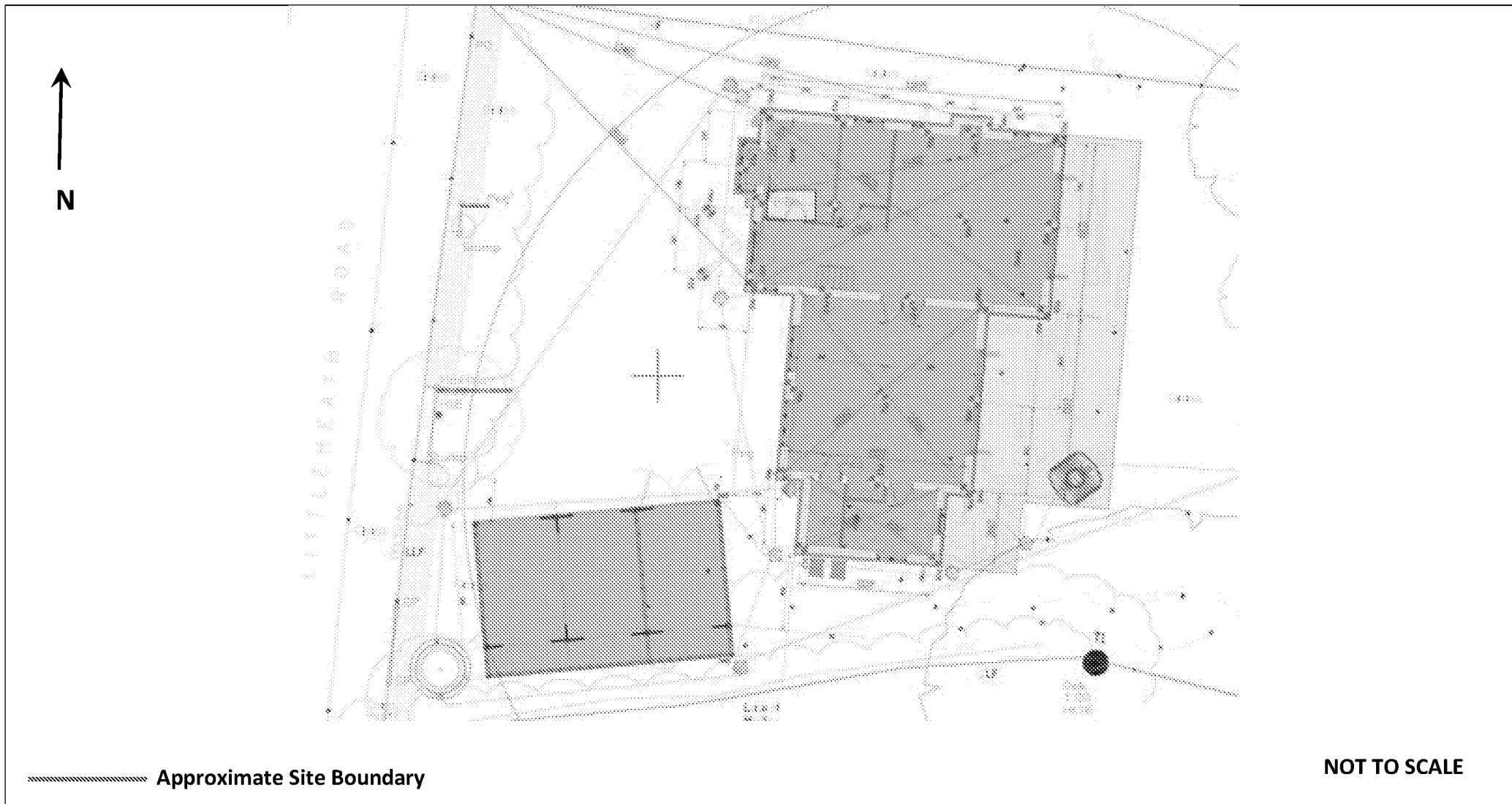
Aerial View of Site

Ref:

GWPR4206

Figure 3





Project:
Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR

Client:
Richard Brookes

Date:
July 2021

Proposed Development – Plan View

Ref:
GWPR4206

Figure 4





Project: Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR		Figure 5 
Client: Richard Brookes	Date: July 2021	
Trial Hole Location Plan	Ref: GWPR4206	

Depth (m bgl) v	Interpretation of In-Situ SHDP Results (DP01 - DP25)																								
	DP01	DP02	DP03	DP04	DP05	DP06	DP07	DP08	DP09	DP10	DP11	DP12	DP13	DP14	DP15	DP16	DP17	DP18	DP19	DP20	DP21	DP22	DP23	DP24	DP25
0-0.3	14	2	3	3	1	2	3	9	1	9	8	3	2	5	6	9	12	10	4	8	14	12	9	14	9
0.3-0.6	8	1	1	1	2	11	2	3	0	6	1	2	11	3	6	3	17	13	1	0	8	19	16	5	6
0.6-0.9	7	1	2	7	4	8	2	5	27	3	6	7	8	17	5	12	15	12	18	9	7	22	21	2	5
0.9-1.2	11	0	5	3	6	12	7	6	32	3	12	9	12	22	5	27	15	18	22	13	8	29	26	0	1
1.2-1.5	13	0	5	3	11	8	11	7	22	3	23	10	8	21	9	15	19	20	16	13	15	26	25	0	0
1.5-1.8	9	0	5	7	5	6	13	7	22	3	15	9	6	18	6	13	16	26	17	16	9	30	27	3	1
1.8-2.1	12	2	6	6	7	3	15	6	28	3	15	12	9	18	5	12	32	27	20	18	11	32	18	4	2
2.1-2.4	10	6	7	8	11	5	16	7	27	3	15	14	5	21	10	13	49	24	21	13	11	26	19	3	0
2.4-2.7	11	6	6	8	21	11	16	6	23	0	11	13	11	22	13	12	21	27	25	19	11	28	28	4	0
2.7-3	10	6	12	9	26	12	15	3	14	3	7	10	12	26	11	18	28	24	33	23	9	28	24	4	0
3-3.3	23	8	6	2	27	10	19	2	13	9	7	6	10	24	15	22	24	15	22	16	19	21	25	2	0
3.3-3.6	25	11	4	3	21	4	15	2	13	6	5	2	4	23	9	18	13	16	9	17	28	15	23	2	0
3.6-3.9	15	9	8	6	12	3	8	2	7	4	6	2	9	16	10	9	9	12	15	14	15	11	19	1	1
3.9-4.2	14	6	5	4	9	1	1	3	9	3	10	5	1	11	16	6	7	13	19	16	15	10	14	2	3
4.2-4.5	13	7	2	5	10	0	7	2	9	3	8	3	0	13	14	6	10	14	19	13	14	11	9	4	4
4.5-4.8	9	7	2	6	9	3	6	5	8	3	8	8	1	12	5	3	11	16	20	10	9	15	12	5	3
4.8-5.1	10	8	8	6	10	1	5	2	6	6	12	7	1	12	6	3	10	20	22	9	9	14	9	1	2
5.1-5.4	9	11	5	6	9	1	6	3	6	6	14	8	1	10	11	2	13	18	18	9	10	14	11	2	0
5.4-5.7	6	11	6	6	10	5	6	0	8	7	14	6	5	11	7	4	13	18	17	8	7	17	9	1	3
5.7-6	6	7	8	5	9	6	8	0	12	9	8	6	6	10	2	4	14	16	17	6	6	16	9	1	3
6-6.3	6	14	14	6	9	5	8	0	7	9	8	3	3	11	2	3	26	24	17	9	6	16	10	6	1
6.3-6.6	6	9	16	12	28	2	8	6	4	12	6	3	2	13	2	9	11	13	21	6	9	13	11	7	3
6.6-6.9	7	6	9	5	13	2	15	9	3	7	6	0	2	22	1	4	8	9	17	6	7	9	9	15	6
6.9-7.2	9	8	12	3	12	7	5	2	3	3	7	1	7	17	2	4	10	10	11	6	8	12	11	19	3
7.2-7.5	16	16	29	7	30	11	9	1	5	4	7	1	11	7	3	4	16	26	11	7	14	23	27	23	4
7.5-7.8	16	19	37	21	75	8	27	1	8	13	4	0	6	6	1	7	12	20	18	10	17	30	40	11	2
7.8-8.1	14	20	42	22	33	6	16	5	10	25	3	2	6	11	2	20	17	14	21	19	13	20	26	15	4
8.1-8.4	16	23	36	23	N/A	10	12	9	14	14	9	0	10	12	2	13	20	16	22	16	17	13	12	12	2
8.4-8.7	6	22	46	18	N/A	12	11	11	10	8	10	1	12	19	2	8	21	16	22	9	9	14	15	6	6
8.7-9	10	14	52	24	N/A	9	8	10	8	8	13	0	9	25	8	11	14	12	18	11	6	18	19	4	6
9-9.3	19	11	46	21	N/A	10	19	16	13	14	18	0	10	19	16	11	13	17	14	12	10	16	18	8	13
9.3-9.6	24	12	47	22	N/A	8	15	19	17	12	13	1	8	16	20	10	25	26	20	11	13	13	19	9	12
9.6-9.9	17	17	44	28	N/A	13	15	17	15	10	12	1	13	20	13	14	13	23	21	10	10	24	25	12	10
9.9-10.2	5	5	14	9	N/A	5	6	5	4	4	4	6	5	7	4	6	5	8	6	2	4	8	8	5	4
10.2-10.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.5-10.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.8-11.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project:

Land to the south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR

Client:

Richard Brookes

Date:

July 2021

SHDP Data Diagram (DP01 – DP25)

Ref:

GWPR4206

Figure 6



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 south of Sundown, Littleheath Road, Fontwell, West Sussex BN18 0SR.

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:

BGS Radon

Report

Roger Foord
Ground and Water Limited
2 The Iond Barn
Norton farm
Selborne Road
Alton
GU34 3NB

Radon Report

Advisory report on the requirement for radon protective measures in new buildings, conversions and extensions to existing buildings. The report also indicates whether a site is located within a radon Affected Area

Report Id: *BGS_318602/24003*

Client reference: GWPR4206 Land to the South of Sundown,
Littleheath Road, Fontwell, West Sussex BN18 0SR

Search location



Contains OS data © Crown Copyright and database right 2021. OS OpenMap Local: Scale: 1:5 000 (1cm = 50 m)
Search location indicated in red

*This report describes a site located at National Grid Reference 494545, 107675.
Note that for sites of irregular shape, this point may lie outside the site boundary.
Where the client has submitted a site plan the assessment will be based on the area given.*

Radon Report: UK

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales, Scotland and Northern Ireland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

This is an advisory report on the requirement for radon protective measures in new buildings, conversions and extensions. The report also indicates whether a site is located within a radon Affected Area

Requirement for radon protective measures

The determination below follows advice in *BR211 Radon: Guidance on protective measures for new buildings (2015 edition)*, which also provides guidance on what to do if the result indicates that protective measures are required.

Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2015 edition) Radon: Guidance on protective measures for new buildings?

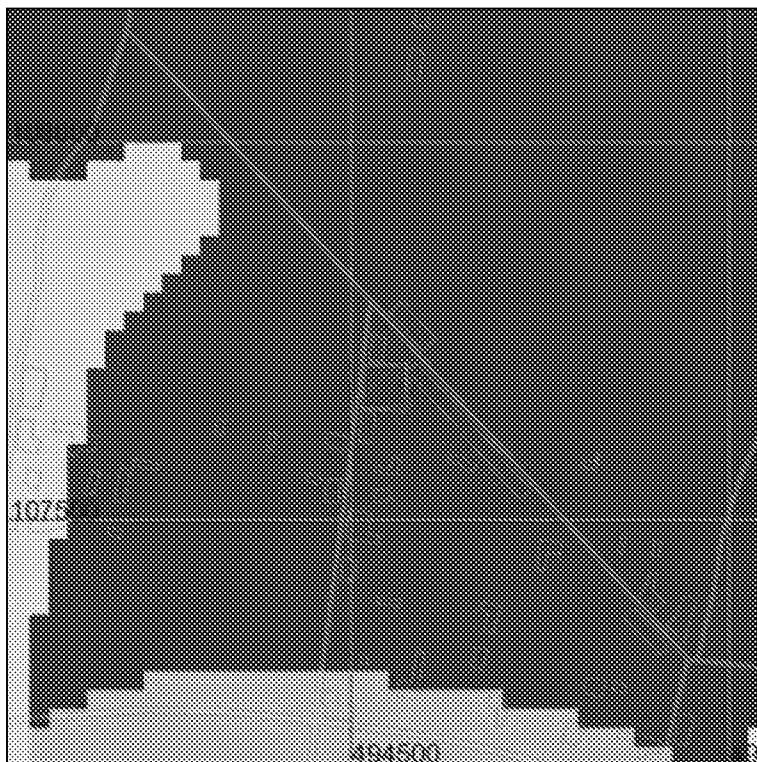
NO RADON PROTECTIVE MEASURES ARE REQUIRED FOR THE REPORT AREA.

More details of the protective measures required are available in *BR211 Radon: Guidance on protective measures for new buildings (2015 Edition)*. Additional information and guidance is available from the Building Research Establishment website (<http://www.bre.co.uk/radon/>).

Whether or not the radon level in a building is above or below the radon Action Level can only be established by having the building tested. The PHE provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622).

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

Radon Affected Area



	% Homes estimated to be at or above the action level
	0-1%
	1-3%
	3-5%
	5-10%
	10-30%
	30-100%

Contains OS data © Crown Copyright and database right 2021
Scale: 1:10 000 (1cm = 100 m)
Search area indicated in red

Is the property in a radon Affected Area as defined by Public Health England (PHE) and if so what percentage of homes are estimated to be above the Action Level? NO

Additional Information

THE PROPERTY IS IN AN AREA WHERE LESS THAN 1% OF HOMES ARE ESTIMATED TO BE AT OR ABOVE THE ACTION LEVEL. THE PROPERTY IS NOT IN A RADON AFFECTED AREA.

PHE recommends a radon 'Action Level' of 200 Becquerels per cubic metre of air (Bq m^{-3}) for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to exceed the Action Level the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level at this location. Being in an Affected Area does not necessarily mean there is a radon problem in the property; the only way to find out whether the radon level is above or below the Action Level is to carry out a radon measurement.

PHE advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels above the Action Level (200 Bq m⁻³) should be remediated. Householders with levels between the Target Level (100 Bq m⁻³) and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. PHE provides a validated radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as Law Society CON29 Enquiries of the Local Authority (2016); 3.14 Radon Gas: Do records indicate that the property is in a “Radon Affected Area” as identified by PHE. The data can also be used to advise house buyers and sellers in Scotland and Northern Ireland.

If you are buying a new build property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

If you are buying a currently occupied property in a radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were above the radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from PHE at www.ukradon.org.

What is radon?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary according to how particular buildings and spaces are used.

Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level exceeds the Action Level, measures should be taken to reduce the concentration.

Radon in workplaces

The Ionising Radiation Regulations, 1999, require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293): **Radon in the workplace**. BRE publications may be obtained from the BRE Bookshop, Tel: 01923 664262, email: bookshop@bre.co.uk website: www.brebookshop.com

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Terms and Conditions

General Terms & Conditions

This Report is supplied in accordance with the GeoReports Terms & Conditions available on the BGS website at <https://shop.bgs.ac.uk/georeports> and also available from the BGS Enquiry Service at the above address.

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- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
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- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

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**Report issued by
BGS Enquiry Service**

APPENDIX C:

Trial Hole

Logs



Percussion Drilling Log

Project Name: Land to the south of Sundown, Littleheath Road.			Client: Richard Brooks		Date: 27/05/2021
Location: Aldingbourne, Fontwell, West Sussex BN18 0SR			Contractor: DB		
Project No. : GWPR4206			Crew Name:		Drilling Equipment:
Borehole Number BH1	Hole Type CP	Level	Logged By		Scale 1:50
					Page Number Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		0.50 - 1.00	B	N=5 (1,0/1,1,1,2)	2.10		Dark brown slightly sandy gravelly CLAY. The sand was fine to coarse grained and the gravel was frequent, fine to coarse, sub-angular to sub-rounded flint. (HEAD DEPOSITS)	1				
		1.20 - 1.65	SPTL S									
		1.20	SPT									
		1.70	D									
		2.20 - 2.65	SPTL S	N=12 (2,2/2,3,3,4)				Brown slight clayey sandy GRAVEL. The sand was fine to coarse grained and the gravel was fine to coarse sub-angular to sub-rounded flint (RAISED BEACH DEPOSITS).	2			
		2.20	SPT									
		2.70	D									
		3.20 - 3.65	SPTL S	N=14 (4,3/3,3,4,4)						3		
		3.20	SPT									
		3.70	D									
		4.20 - 4.65	SPTL S	N=12 (2,1/3,3,3,3)	4.70					4		
		4.20	SPT									
		4.70	D									
		5.20 - 5.65	SPTL S	N=26 (4,7/6,7,7,6)					Orange fine grained SAND. (RAISED BEACH DEPOSITS).	5		
		5.20	SPT									
		5.90	D									
		6.50 - 6.95	SPTL S	N=29 (7,6/7,7,7,8)						6		
		6.50	SPT									
		7.20	D									
		8.00 - 8.45	SPTL S	N=36 (4,9/8,9,9,10)	8.00				Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is weak, white and sub-angular. (CIRIA 574: Grade Dm) (UNDIFFERENTIATED LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION).	7		
		8.00	SPT									
		8.70	D									
		9.50 - 9.95	SPTL S	N=31 (8,9/8,7,7,9)							8	
		9.50	SPT									
												10
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	
15.45	150	8.00	150									

Remarks





Percussion Drilling Log

Project Name: Land to the south of Sundown, Littleheath Road.		Client: Richard Brooks		Date: 27/05/2021	
Location: Aldingbourne, Fontwell, West Sussex BN18 0SR		Contractor: DB			
Project No. : GWPR4206		Crew Name:		Drilling Equipment:	
Borehole Number BH1	Hole Type CP	Level	Logged By	Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		10.20	D	N=39 (6,6/9,9,10,11)	15.45		Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is weak, white and sub-angular. (CIRIA 574: Grade Dm) (UNDIFFERENTIATED LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION).	11				
		11.00 - 11.45	SPTL S									
		11.00	SPT									
		11.70	D					12				
		12.50 - 12.95	SPTL S	N=34 (4,7/8,8,9,9)								
		12.50	SPT					13				
		13.20	D									
		14.00 - 14.45	SPTL S	N=31 (5,7/7,7,9,8)				14				
		14.00	SPT									
		14.70	D									
		15.00 - 15.45	SPTL S	N=31 (4,4/6,7,8,10)				15				
		15.00	SPT									
		End of Borehole at 15.450m							16			
									17			
									18			
									19			
									20			

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
15.45	150	8.00	150								

Remarks	
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Percussion Drilling Log

Project Name: Land to the south of Sundown, Littleheath Road.			Client: Richard Brooks		Date: 28/05/2021	
Location: Aldingbourne, Fontwell, West Sussex BN18 0SR			Contractor: DB			
Project No. : GWPR4206			Crew Name:		Drilling Equipment:	
Borehole Number BH2		Hole Type CP		Level	Logged By	Scale 1:50
						Page Number Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.20	D	N=3 (1,1/1,0,1,1)	2.20		Dark brown slightly sandy gravelly CLAY. The sand was fine to medium grained and the gravel was frequent, fine to medium sub-angular to sub-rounded flint (50%), chalk (30%), brick (15%), and carbonaceous material (charcoal) (5%). (MADE GROUND).	1		
		0.50	D							
		0.80	D							
		1.20 - 1.65	SPTL S							
		1.20	SPT							
		1.70	D					2		
		2.20 - 2.65	SPTL S	N=13 (2,2/3,3,4,3)	4.00		Orange brown sandy GRAVEL. The sand was fine to coarse grained and the gravel was fine to coarse, sub-angular to sub-rounded flint. (RAISED BEACH DEPOSITS).			
		2.20	SPT							
		2.70	D					3		
		3.20 - 3.65	SPTL S	N=15 (4,4/4,4,3,4)	6.90		Orange fine grained SAND. (RAISED BEACH DEPOSITS).			
		3.20	SPT							
		3.70	D					4		
		4.20 - 4.65	SPTL S	N=12 (2,2/3,3,3,3)	7.90		Brown slightly sandy silty CLAY. The sand was fine grained. (RAISED BEACH DEPOSITS).			
		4.20	SPT							
		4.70	D					5		
		5.20 - 5.65	SPTL S	N=13 (3,4/3,2,3,5)			Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is weak, white and sub-angular. (CIRIA 574: Grade Dm) (UNDIFFERENTIATED LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION).			
		5.20	SPT							
		5.90	D					6		
		6.00 - 6.45	SPTL S	N=19 (4,4/4,5,5,5)						
		6.00	SPT					7		
		6.70	D							
		7.50 - 7.95	SPTL S	N=21 (3,3/3,4,6,8)						
		7.50	SPT						8	
		8.20	D							
		9.00 - 9.45	SPTL S	N=30 (4,7/7,7,8,8)						
		9.00	SPT						9	
		9.70	D						10	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
15.45	150	8.00	150								

Remarks										

COUNCIL AL/66/21/PL									
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Percussion Drilling Log

Project Name: Land to the south of Sundown, Littleheath Road.		Client: Richard Brooks		Date: 28/05/2021	
Location: Aldingbourne, Fontwell, West Sussex BN18 0SR		Contractor: DB			
Project No. : GWPR4206		Crew Name:		Drilling Equipment:	
Borehole Number BH2	Hole Type CP	Level	Logged By	Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description							
		Depth (m)	Type	Results											
		10.50 - 10.95	SPTL S	N=34 (6,6/6,9,9,10)	15.45		Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is weak, white and sub-angular. (CIRIA 574: Grade Dm) (UNDIFFERENTIATED LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION).	11							
		10.50	SPT												
		11.20	D												
		12.00 - 12.45	SPTL S	N=36 (7,8/7,9,9,11)				12							
		12.00	SPT												
		12.70	D					13							
		13.50 - 13.95	SPTL S	N=39 (7,8/9,9,10,11)				14							
		13.50	SPT												
		14.20	D					15							
		15.00 - 15.45	SPTL S	N=34 (6,6/8,8,9,9)				End of Borehole at 15.450m	16						
		15.00	SPT						17						
									18						
									19						
									20						
		Hole Diameter		Casing Diameter				Chiselling				Inclination and Orientation			
		Depth Base	Diameter	Depth Base				Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination
15.45		150	8.00	150											

Remarks										

COUNCIL AL/66/21/PL									
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Probe Log

Probe No
DP01
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Probe Log

Probe No
DP01
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Probe Log

Probe No
DP02
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Probe Log

Probe No
DP02
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Probe Log

Probe No
DP03
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																										Torque (Nm)
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Remarks:	Fall Height	750	Cone Base Diameter	
	Hammer Wt	64	Final Depth	10.00
	Probe Type	DPSH-B		



Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B



Probe Log

Probe No
DP03
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Probe Log

Probe No
DP04
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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	Remarks:		Fall Height 750												Cone Base Diameter										
		Hammer Wt 64												Final Depth 10.00											
		Probe Type DPSH-B																							
																									

Probe Log

Probe No
DP05
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Probe Log

Probe No
DP07
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

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Probe Log

Probe No
DP08
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

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Probe Log

Probe No
DP08
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

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Probe Log

Probe No
DP09
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 18/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B



Probe Log

Probe No
DP11
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																									Torque (Nm)
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Remarks:																										
										Fall Height	750	Cone Base Diameter														
										Hammer Wt	64	Final Depth										10.00				
										Probe Type	DPSH-B															







Probe Log

Probe No
DP12
Sheet 1 of 3

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

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Probe Log

Probe No
DP12
Sheet 2 of 3

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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Remarks:																									
Fall Height												750													
Hammer Wt												64													
Probe Type												DPSH-B													
												Cone Base Diameter													
												Final Depth													
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Probe Log

Probe No
DP12
Sheet 3 of 3

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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Remarks:	Fall Height	750	Cone Base Diameter	
	Hammer Wt	64	Final Depth	11.00
	Probe Type	DPSH-B		



Probe Log

Probe No
DP13
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)	
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Remarks:																										
Fall Height												750														
Hammer Wt												64														
Probe Type												DPSH-B														
												Cone Base Diameter														
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												10.00														





Probe Log

Probe No
DP13
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 17/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B



Probe Log

Probe No
DP14
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B



Probe Log

Probe No
DP15
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B





Probe Log

Probe No
DP16
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 14/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)	
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48		
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Remarks:		Fall Height 750										Cone Base Diameter												AGS		
		Hammer Wt 64										Final Depth 10.00														
		Probe Type DPSH-B																								

Probe Log

Probe No
DP17
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

Depth (m)	Blows/100mm																									Torque (Nm)
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Remarks:	Fall Height	750	Cone Base Diameter
	Hammer Wt	64	Final Depth 10.00
	Probe Type	DPSH-B	



Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B



Probe Log

Probe No
DP20
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 14/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B



Probe Log

Probe No
DP20
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 14/05/2021

Logged By

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Probe Log

Probe No
DP21
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)	
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Remarks:	Fall Height	750	Cone Base Diameter
	Hammer Wt	64	Final Depth 10.00
	Probe Type	DPSH-B	



Probe Log

Probe No
DP22
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B





Probe Log

Probe No
DP22
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)
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Remarks:

Fall Height 750

Cone Base Diameter

Hammer Wt 64

Final Depth 10.00

Probe Type DPSH-B





Probe Log

Probe No
DP23
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

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Probe Log

Probe No
DP23
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 12/05/2021

Logged By

Depth (m)	Blows/100mm																								Torque (Nm)				
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Remarks:																													
Fall Height										750					Cone Base Diameter														
Hammer Wt										64					Final Depth										10.00				
Probe Type										DPSH-B																			
																													

Probe Log

Probe No
DP24
Sheet 2 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 13/05/2021

Logged By

Depth (m)	Blows/100mm																																																Torque (Nm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Probe Log

Probe No
DP25
Sheet 1 of 2

Project Name: Land to the south of Sundown,
Littleheath Road,

Project No.
GWPR4206

Co-ords:

Hole Type
DP

Location: Aldingbourne, Fontwell, West Sussex BN18 0SR

Level:

Scale
1:25

Client: Richard Brooks

Dates: 14/05/2021

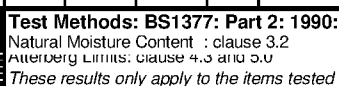
Logged By

Depth (m)	Blows/100mm																												Torque (Nm)
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48					
1	4																											0	
	3																												
	2																												
	2																												
	2																												
	2																												
	2																												
	2																												
	1																												
	1																												
2	1																											10	
3																												10	
4																												5	
5																												10	
Remarks:		Fall Height 750										Cone Base Diameter																	
		Hammer Wt 64										Final Depth 10.00																	
		Probe Type DPSH-B																											

APPENDIX D:

Geotechnical

Laboratory Testing

[illegible]

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

Checked and
Approved

2519

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

MSF-5-R1(b)

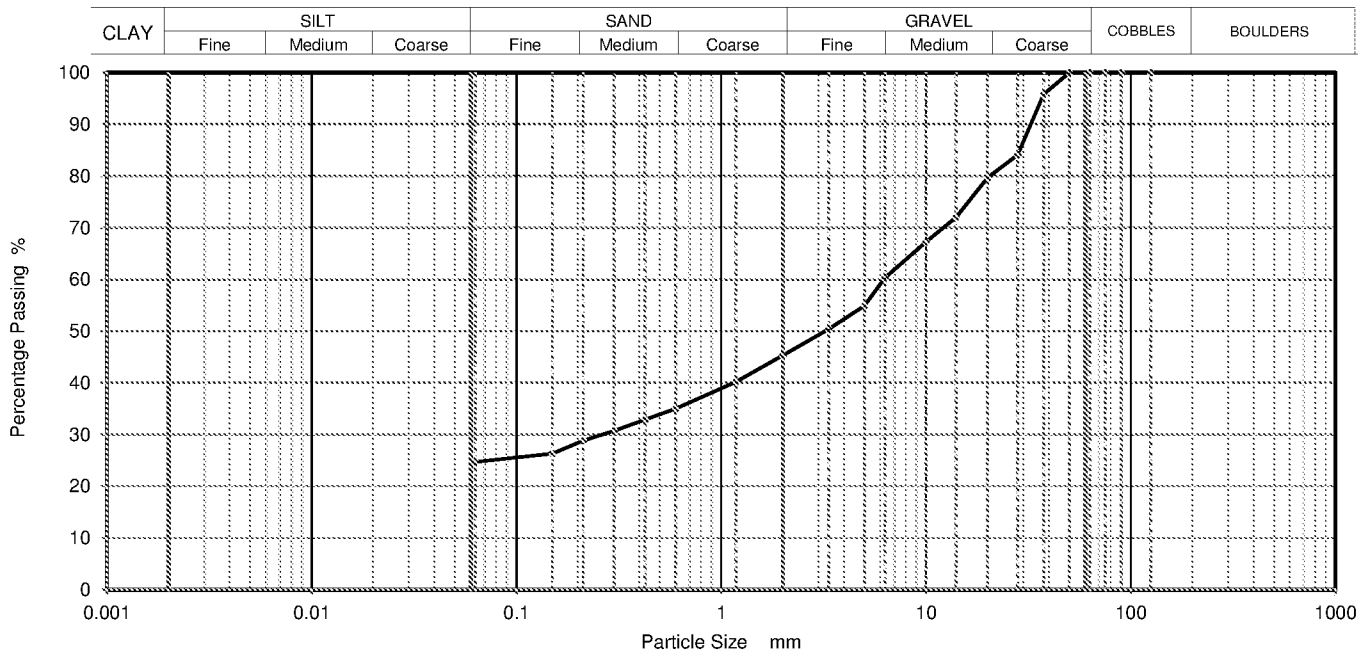


PARTICLE SIZE DISTRIBUTION

Job Ref	30229
Borehole/Pit No.	BH1
Sample No.	-
Depth Top	2.70 m
Depth Base	- m
Sample Type	D
Samples received	07/06/2021
Schedules received	03/06/2021
Project started	08/06/2021
Date tested	28/06/2021

Site Name	Littleheath Road, Fontwell, West Sussex BN18 0SR		
Project No.	GWPR4206	Client	Ground & Water Ltd
Soil Description	Brown very sandy very clayey GRAVEL (gravel is fmc and sub-angular to sub-rounded)		
Test Method	BS1377:Part 2: 1990, clause 9.0		

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	96		
28	84		
20	80		
14	72		
10	67		
6.3	60		
5	55		
3.35	50		
2	45		
1.18	40		
0.6	35		
0.425	33		
0.3	31		
0.212	29		
0.15	26		
0.063	25		

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	54.7
Sand	20.6
Fines <0.063mm	24.7

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

Remarks
Preparation and testing in accordance with BS1377 unless noted below

NOTE: The report shall not be reproduced except in full without approval of the laboratory



K4 Soils Laboratory

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

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Approved Signatories: K.Phaure

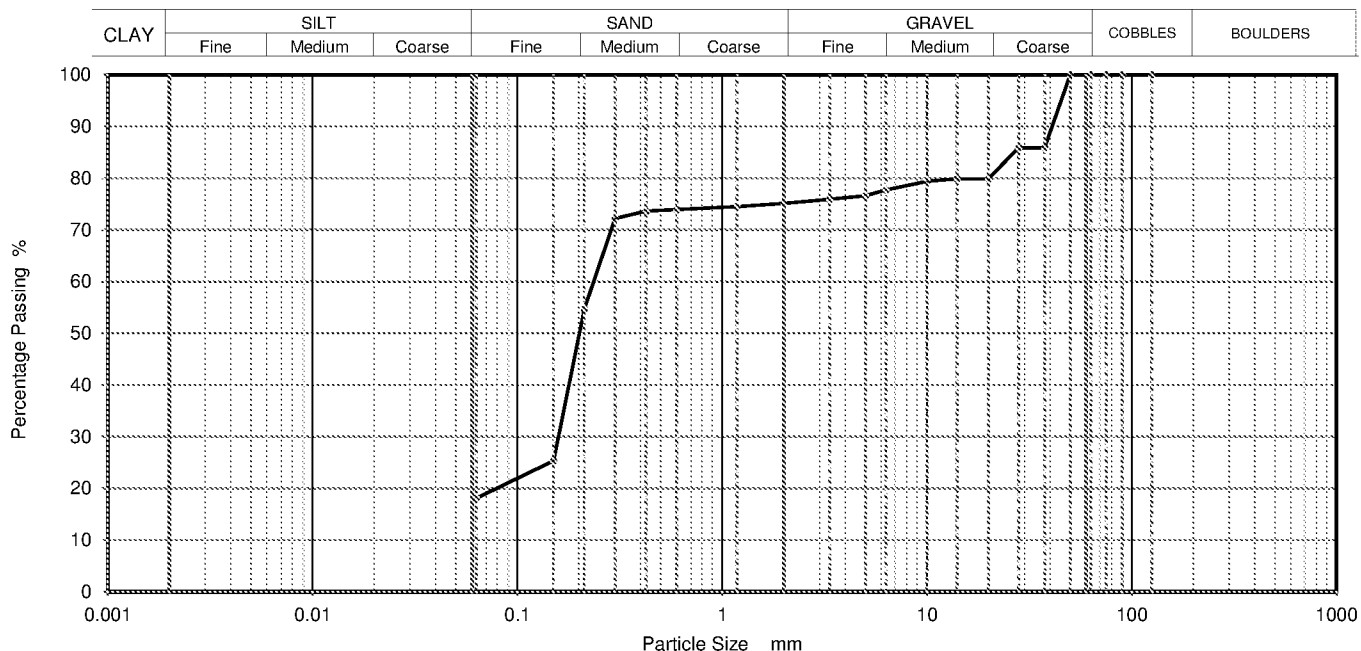


PARTICLE SIZE DISTRIBUTION

Job Ref	30229
Borehole/Pit No.	BH1
Sample No.	-
Depth Top	4.70 m
Depth Base	- m
Sample Type	D
Samples received	07/06/2021
Schedules received	03/06/2021
Project started	08/06/2021
Date tested	28/06/2021

Site Name	Littleheath Road, Fontwell, West Sussex BN18 0SR		
Project No.	GWPR4206	Client	Ground & Water Ltd
Soil Description	Orangish brown clayey very gravelly SAND (gravel is fmc and sub-angular)		
Test Method	BS1377:Part 2: 1990, clause 9.0		

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	86		
28	86		
20	80		
14	80		
10	79		
6.3	78		
5	77		
3.35	76		
2	75		
1.18	75		
0.6	74		
0.425	74		
0.3	72		
0.212	55		
0.15	25		
0.063	18		

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	24.9
Sand	57.0
Fines <0.063mm	18.1

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Checked and Approved

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

MGR-3-RS

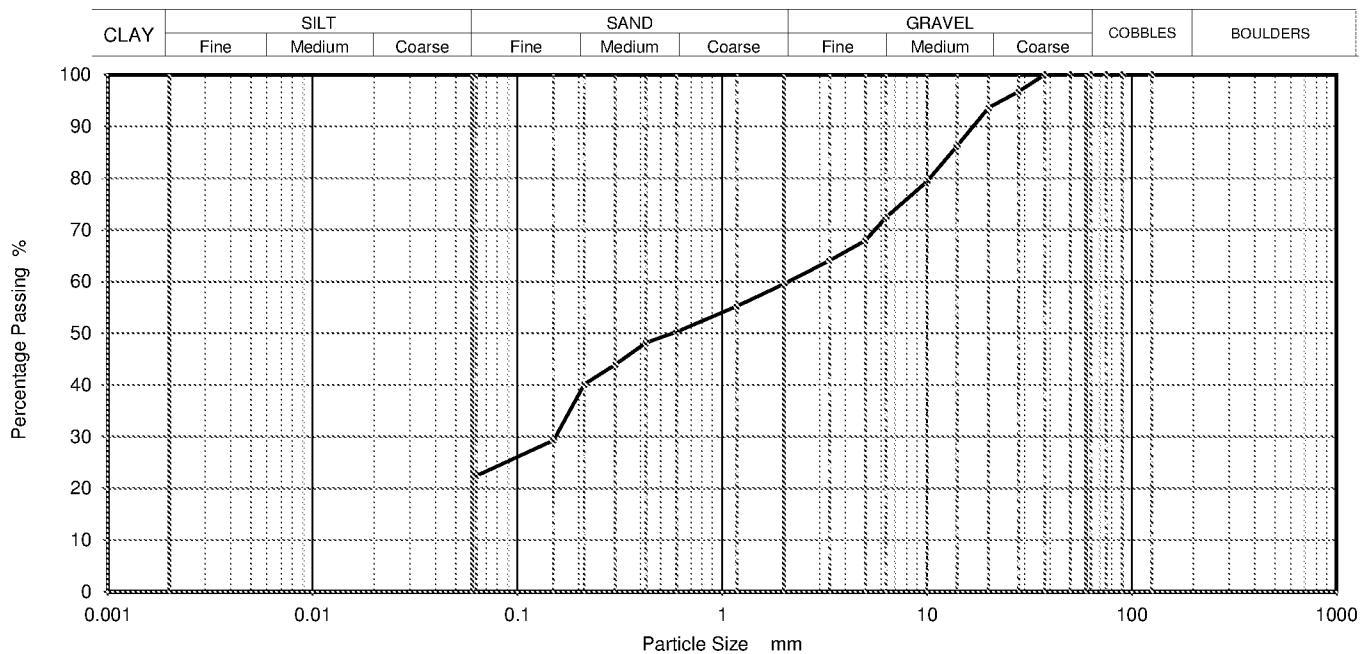


PARTICLE SIZE DISTRIBUTION

Job Ref	30229
Borehole/Pit No.	BH2
Sample No.	-
Depth Top	3.70 m
Depth Base	- m
Sample Type	D
Samples received	07/06/2021
Schedules received	03/06/2021
Project started	08/06/2021
Date tested	28/06/2021

Site Name	Littleheath Road, Fontwell, West Sussex BN18 0SR		
Project No.	GWPR4206	Client	Ground & Water Ltd
Soil Description	Brown very clayey very sandy GRAVEL (gravel is fmc and sub-angular)		
Test Method	BS1377:Part 2: 1990, clause 9.0		

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	94		
14	86		
10	79		
6.3	72		
5	68		
3.35	64		
2	60		
1.18	55		
0.6	50		
0.425	48		
0.3	44		
0.212	40		
0.15	29		
0.063	22		

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	40.5
Sand	37.2
Fines <0.063mm	22.4

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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K4 Soils Laboratory

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

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Approved Signatories: K.Ph

MSF-3-RS

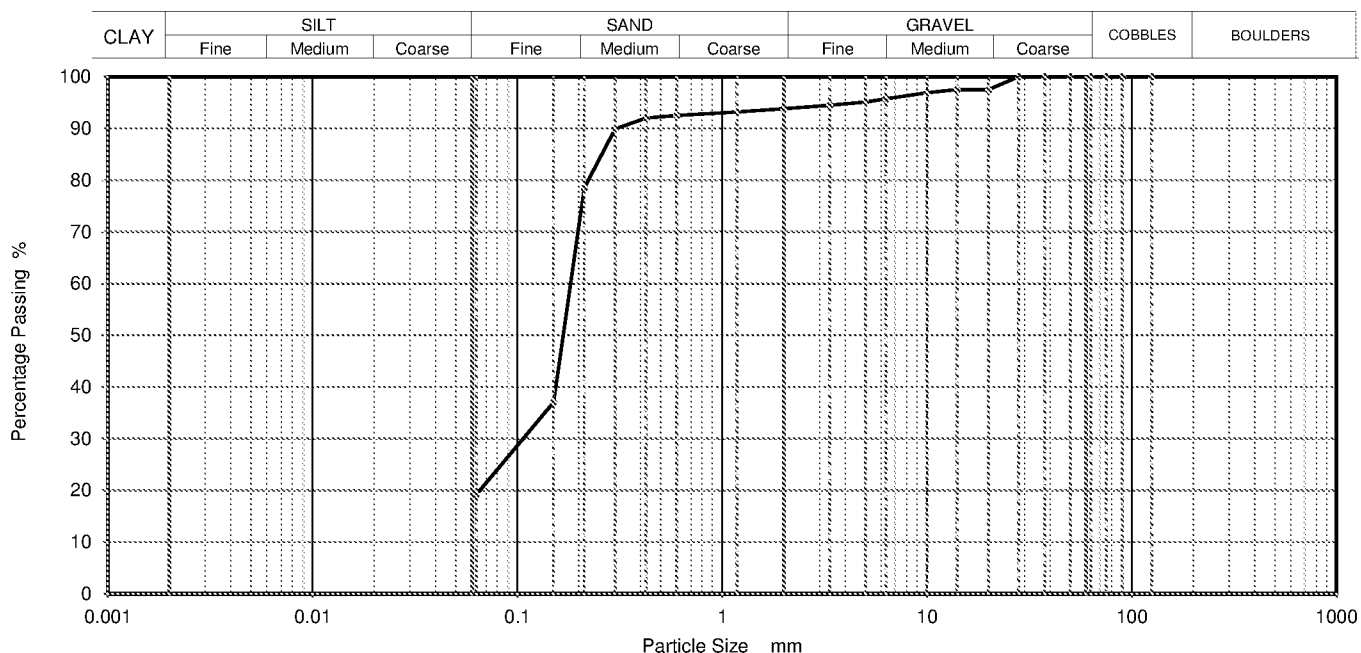


PARTICLE SIZE DISTRIBUTION

Job Ref	30229
Borehole/Pit No.	BH2
Sample No.	-
Depth Top	6.90 m
Depth Base	- m
Sample Type	D
Samples received	07/06/2021
Schedules received	03/06/2021
Project started	08/06/2021
Date tested	28/06/2021

Site Name	Littleheath Road, Fontwell, West Sussex BN18 0SR		
Project No.	GWPR4206	Client	Ground & Water Ltd
Soil Description	Brown gravelly clayey SAND (gravel is fmc and sub-angular)		
Test Method	BS1377:Part 2: 1990, clause 9.0		

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	98		
10	97		
6.3	96		
5	95		
3.35	95		
2	94		
1.18	93		
0.6	93		
0.425	92		
0.3	90		
0.212	79		
0.15	37		
0.063	19		

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	6.2
Sand	74.6
Fines <0.063mm	19.2

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

Remarks
Preparation and testing in accordance with BS1377 unless noted below

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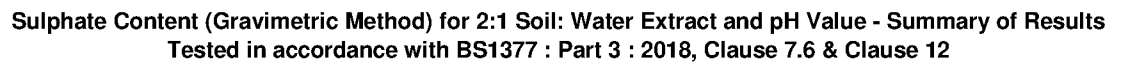
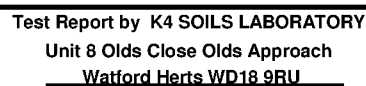
K4 Soils Laboratory

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

Checked and Approved

2519

Approved Signatories: K.Phaure (T)

[illegible]

Checked and
Approved

2519

Approved Signatories	b.Mgr)
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APPENDIX E: Chemical Laboratory Testing



Roger Foord
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

DETS Report No: 21-07253

Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR

Project / Job Ref: GWPR4206

Order No: None Supplied

Sample Receipt Date: 04/06/2021

Sample Scheduled Date: 04/06/2021

Report Issue Number: 1

Reporting Date: 14/06/2021

Authorised by:

Ela Myslara
Quality Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

For Topsoil and WAC analysis the expanded uncertainty measurement should be considered while evaluating results against compliance values.



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Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN



Soil Analysis Certificate

DETS Report No: 21-07253	Date Sampled	28/05/21	28/05/21	28/05/21		
Ground & Water Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Littleheath Road, Fontwell, West	TP / BH No	BH1	BH2	BH2		
Sussex BN18 0SR	Additional Refs	None Supplied	None Supplied	None Supplied		
Project / Job Ref: GWPR4206	Depth (m)	1.70	4.20	0.20		
Order No: None Supplied	DETS Sample No	547777	547778	547779		
Reporting Date: 14/06/2021						

Determinand	Unit	RL	Accreditation			
Asbestos Screen ⁽⁵⁾	N/a	N/a	ISO17025			Not Detected
pH	pH Units	N/a	MCERTS	6.2	6.9	7.1
Total Cyanide	mg/kg	< 2	NONE			< 2
Total Sulphate as SO ₄	mg/kg	< 200	MCERTS	308	< 200	
Total Sulphate as SO ₄	%	< 0.02	MCERTS	0.03	< 0.02	
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	85	26	16
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.08	0.03	0.02
Total Sulphur	%	< 0.02	NONE	< 0.02	< 0.02	
Organic Matter (SOM)	%	< 0.1	MCERTS			2.5
TOC (Total Organic Carbon)	%	< 0.1	MCERTS			1.5
Ammonium as NH ₄	mg/kg	< 0.5	MCERTS	1.1	1.1	
Ammonium as NH ₄	mg/l	< 0.05	MCERTS	0.11	0.11	
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	16	4	
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	8.2	2	
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	< 3	MCERTS	4	< 3	
Water Soluble Nitrate (2:1) as NO ₃	mg/l	< 1.5	MCERTS	1.9	< 1.5	
Arsenic (As)	mg/kg	< 2	MCERTS			9
W/S Boron	mg/kg	< 1	NONE			< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE			0.3
Chromium (Cr)	mg/kg	< 2	MCERTS			19
Chromium (hexavalent)	mg/kg	< 2	NONE			< 2
Copper (Cu)	mg/kg	< 4	MCERTS			18
Lead (Pb)	mg/kg	< 3	MCERTS			51
W/S Magnesium	mg/l	< 0.1	NONE	2.5	1.3	
Mercury (Hg)	mg/kg	< 1	MCERTS			< 1
Nickel (Ni)	mg/kg	< 3	MCERTS			9
Selenium (Se)	mg/kg	< 2	MCERTS			< 3
Vanadium (V)	mg/kg	< 1	MCERTS			27
Zinc (Zn)	mg/kg	< 3	MCERTS			79
Total Phenols (monohydric)	mg/kg	< 2	NONE			< 2

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
 Subcontracted analysis (S)



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Rose Lane
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Maidstone
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Soil Analysis Certificate - Speciated PAHs

DETS Report No: 21-07253	Date Sampled	28/05/21				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR	TP / BH No	BH2				
Project / Job Ref: GWPR4206	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 14/06/2021	DETS Sample No	547779				

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1			
Acenaphthylene	mg/kg	< 0.1	MCERTS	0.18			
Acenaphthene	mg/kg	< 0.1	MCERTS	0.13			
Fluorene	mg/kg	< 0.1	MCERTS	0.20			
Phenanthrene	mg/kg	< 0.1	MCERTS	2.05			
Anthracene	mg/kg	< 0.1	MCERTS	0.45			
Fluoranthene	mg/kg	< 0.1	MCERTS	5.14			
Pyrene	mg/kg	< 0.1	MCERTS	4.66			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	2.42			
Chrysene	mg/kg	< 0.1	MCERTS	2.32			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	2.78			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.94			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	2.15			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	1.63			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	0.19			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	1.41			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	26.6			



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Rose Lane
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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 21-07253	Date Sampled	28/05/21				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR	TP / BH No	BH2				
Project / Job Ref: GWPR4206	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 14/06/2021	DETS Sample No	547779				

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	14			
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	26			
Aromatic (C5 - C35)	mg/kg	< 21	NONE	39			
Total >C5 - C35	mg/kg	< 42	NONE	< 42			



DETS Ltd
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Maidstone
Kent ME17 2JN



Soil Analysis Certificate - BTEX / MTBE

DETS Report No: 21-07253	Date Sampled	28/05/21				
Ground & Water Ltd	Time Sampled	None Supplied				
Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR	TP / BH No	BH2				
Project / Job Ref: GWPR4206	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 14/06/2021	DETS Sample No	547779				

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			



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L, Rose Lane Industrial Estate
Rose Lane
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Maidstone
Kent ME17 2JN



Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2

DETS Report No: 21-07253		Date Sampled	28/05/21		Landfill Waste Acceptance Criteria Limits			
Ground & Water Ltd		Time Sampled	None Supplied					
Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR		TP / BH No	BH2					
Project / Job Ref: GWPR4206		Additional Refs	None Supplied					
Order No: None Supplied		Depth (m)	0.80					
Reporting Date: 14/06/2021		DETS Sample No	547780					
Determinand	Unit	MDL			Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	
TOC ^{MU}	%	< 0.1	1.2		3%	5%	6%	
Loss on Ignition	%	< 0.01	6.10		--	--	10%	
BTEX ^{MU}	mg/kg	< 0.05	< 0.05		6	--	--	
Sum of PCBs	mg/kg	< 0.1	< 0.1		1	--	--	
Mineral Oil ^{MU}	mg/kg	< 10	< 10		500	--	--	
Total PAH ^{MU}	mg/kg	< 1.7	7.1		100	--	--	
pH ^{MU}	pH Units	N/a	7.2		--	>6	--	
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	2.2		--	To be evaluated	To be evaluated	
Eluate Analysis			10:1 mg/l		Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic ^U		< 0.01			< 0.1	0.5	2	25
Barium ^U		< 0.02			< 0.2	20	100	300
Cadmium ^U		< 0.0005			< 0.005	0.04	1	5
Chromium ^U		< 0.005			< 0.05	0.5	10	70
Copper ^U		0.01			0.1	2	50	100
Mercury ^U		< 0.0005			< 0.005	0.01	0.2	2
Molybdenum ^U		0.004			0.04	0.5	10	30
Nickel ^U		< 0.007			< 0.07	0.4	10	40
Lead ^U		< 0.005			< 0.05	0.5	10	50
Antimony ^U		< 0.005			< 0.05	0.06	0.7	5
Selenium ^U		< 0.005			< 0.05	0.1	0.5	7
Zinc ^U		0.007			0.07	4	50	200
Chloride ^U		5.3			53	800	15000	25000
Fluoride ^U		< 0.5			< 5	10	150	500
Sulphate ^U		6.7			67	1000	20000	50000
TDS		91			910	4000	60000	100000
Phenol Index		< 0.01			< 0.1	1	-	-
DOC		11.2			112	500	800	1000
Leach Test Information								
Sample Mass (kg)			0.11					
Dry Matter (%)			83.4					
Moisture (%)			20					
Stage 1								
Volume Eluate L10 (litres)			0.88					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
 Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepancies with current legislation
 M Denotes MCERTS accredited test
 U Denotes ISO17025 accredited test



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Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN



Soil Analysis Certificate - Sample Descriptions

DETS Report No: 21-07253	
Ground & Water Ltd	
Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR	
Project / Job Ref: GWPR4206	
Order No: None Supplied	
Reporting Date: 14/06/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
547777	BH1	None Supplied	1.70	8.2	Light brown sandy clay with stones
547778	BH2	None Supplied	4.20	4.5	Light brown sandy clay with stones
547779	BH2	None Supplied	0.20	14.8	Light brown sandy clay
547780	BH2	None Supplied	0.80	16.6	Brown sandy clay with chalk and brick

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

Insufficient Sample ^{IS}

Unsuitable Sample ^{US}



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



Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 21-07253

Ground & Water Ltd

Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR

Project / Job Ref: GWPR4206

Order No: None Supplied

Reporting Date: 14/06/2021

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	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
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
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Water Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 21-07253

Ground & Water Ltd

Site Reference: Littleheath Road, Fontwell, West Sussex BN18 0SR

Project / Job Ref: GWPR4206

Order No: None Supplied

Reporting Date: 14/06/2021

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	F	Ammoniacal Nitrogen	Determination of ammoniacal nitrogen by discrete analyser.	E126
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	UF	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazide followed by	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR detection	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichloromethane	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	TPH CWG (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered
UF Unfiltered

Parameter	Matrix Type	Suite Reference	Expanded Uncertainty Measurement	Unit
TOC	Soil	BS EN 12457	20.0	%
Loss on Ignition	Soil	BS EN 12457	35.0	%
BTEX	Soil	BS EN 12457	14.0	%
Sum of PCBs	Soil	BS EN 12457	23.0	%
Mineral Oil	Soil	BS EN 12457	9.0	%
Total PAH	Soil	BS EN 12457	11.6	%
pH	Soil	BS EN 12457	0.28	Units
Acid Neutralisation Capacity	Soil	BS EN 12457	18.0	%
Arsenic	Leachate	BS EN 12457	18.7	%
Barium	Leachate	BS EN 12457	11.6	%
Cadmium	Leachate	BS EN 12457	20.3	%
Chromium	Leachate	BS EN 12457	18.3	%
Copper	Leachate	BS EN 12457	24.3	%
Mercury	Leachate	BS EN 12457	23.7	%
Molybdenum	Leachate	BS EN 12457	14.7	%
Nickel	Leachate	BS EN 12457	16.1	%
Lead	Leachate	BS EN 12457	15.7	%
Antimony	Leachate	BS EN 12457	17.9	%
Selenium	Leachate	BS EN 12457	22.0	%
Zinc	Leachate	BS EN 12457	17.4	%
Chloride	Leachate	BS EN 12457	15.3	%
Fluoride	Leachate	BS EN 12457	16.4	%
Sulphate	Leachate	BS EN 12457	20.6	%
TDS	Leachate	BS EN 12457	12.0	%
Phenol Index	Leachate	BS EN 12457	14.0	%
DOC	Leachate	BS EN 12457	10.0	%
Clay Content	Soil	BS 3882: 2015	15.0	%
Silt Content	Soil	BS 3882: 2015	14.0	%
Sand Content	Soil	BS 3882: 2015	13.0	%
Loss on Ignition	Soil	BS 3882: 2015	35.0	%
pH	Soil	BS 3882: 2015	0.14	Units
Carbonate	Soil	BS 3882: 2015	16.0	%
Total Nitrogen	Soil	BS 3882: 2015	12.0	%
Phosphorus (Extractable)	Soil	BS 3882: 2015	24.0	%
Potassium (Extractable)	Soil	BS 3882: 2015	20.0	%
Magnesium (Extractable)	Soil	BS 3882: 2015	26.0	%
Zinc	Soil	BS 3882: 2015	14.9	%
Copper	Soil	BS 3882: 2015	16.0	%
Nickel	Soil	BS 3882: 2015	17.7	%
Available Sodium	Soil	BS 3882: 2015	23.0	%
Available Calcium	Soil	BS 3882: 2015	23.0	%
Electrical Conductivity	Soil	BS 3882: 2015	10.0	%

APPENDIX F: Soil Assessment Criteria

Ground and Water Limited

Soil Guideline Values and Generic Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'. At preliminary risk assessment stage, risks are evaluated qualitatively. As the site investigation progresses to a generic or detailed quantitative risk assessment, data is collected and assessment criteria are utilised to evaluate whether the contaminants represent an unacceptable risk to the identified receptors.

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; and
- 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.

1.1. Land-use Scenarios

The CLEA model uses a range of standard land-use scenarios to develop conceptual exposure models outlined in the following sections.

1.1.1. 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)).

1.1.2. 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.

1.1.3. 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).

2. 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

2.1. S4UL Background

The Land Quality Management/Chartered Institute of Environmental Health (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 S4ULs have been derived for substances based on various generic land use and soil organic matter contents.

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.

2.2. S4UL Land-use

S4UL's have been derived for the basic CLEA land-uses, as described in section 1.2, and for two new land uses:

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

2.2.1. 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.

2.2.2. Public Park (POSpark)

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

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

3. 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.

4. 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, Contaminated Land: Applications in Real Environments (CL:AIRE) provided Generic Assessment Criteria (GAC) in accordance with the CLEA software and the principles outlined previously for a further 35 contaminants sometimes encountered on land affected by contamination.

5. SoBRA Acute GAC

The Society of Brownfield Risk Assessment (SoBRA) identified that most human health risk assessments focus on the chronic risks arising from long-term exposure to specific substances. As chronic risks often occur at lower doses than acute risks, they are often the key drivers, however, in some instances the acute dose may also be an important consideration within risk assessments.

The methodology for deriving the acute GAC were related to two distinct receptor groups:

- Members of the public, where the 'critical' receptor for this group will typically be a female child, which is consistent with CLEA residential and Public Open Space/allotments land-uses;
- Workers involved with excavations. The critical receptor for this group is assumed to be a female working adult, without the use of PPE.

The acute GACs relate to short term exposure of high concentrations of a substance that lead to acute effects. They are not considered to be average exposures across a specific / defined area. As a result, the GACs should be normally be compared with the maximum likely concentration that the individual may be exposed to, and not the average concentration within a specific area.

The SoBRA acute GAC will primarily be used for contaminants that do not currently have any GAC, most notably Cyanide.

6. Detailed Quantitative Risk Assessments (DQRA)

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

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

7. Phytotoxicity

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

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

8. Statistical Tests

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

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

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

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

CL:AIRE published guidance in 2020, *Guidance in comparing soil contamination data with a critical concentration*, superseding the CL:AIRE/CIEH 2008 report of the same name. The guidance provides ways to assist land contamination stakeholders to apply statistical methods to their data to enable decisions under the legislative framework; either planning system or Part 2A of the Environmental Protection Act 1990.

The use of the statistical tests should only be applied if the following statements are valid for the datasets:

- Averaging areas, as well as the smallest area of concern have been identified on the basis of the CSM, including the desk study and/or the site walkover;
- The sample locations were chosen using a simple random, stratified random or stratified systematic (square, herringbone or triangular grid) sampling pattern, rather than being targeted to locations suspected of being contaminated;
- The sample locations are relatively evenly spread across the area and are not clustered, to avoid giving undue weight to some parts of the site over others in the calculated statistics;
- The analyses do not suggest a hotspot or outlier of contamination that should be treated as a separate zone. This has been established by a histogram and/or a names statistical test;
- The sample locations are all taken from one population (i.e. the same material);
- Where an averaging zone encompasses several averaging areas, analyses do not show a spatial trend or other spatial pattern across that zone; and
- The number of samples has been shown to be sufficient for a statistical analysis.

Any included statistical spreadsheet is based on an in-house method of statistical analysis, in line with those outlined within the CL:AIRE guidance (2020).

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.

9. Ground and Water Limited Soil Assessment Criteria

The Soil Assessment Criteria used in the preparation of the Generic Quantitative Risk Assessment are tabulated in the following pages, where the source of each has been outlined in the previous sections.

9.1. Inorganics

SoBRA – Acute Generic Assessment Criteria						
Determinand	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Cyanide	24	24	24	1400	24	24

9.2. Metals

C4SL Low Level of Toxicological Concern						
Determinand	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Lead	< 200	< 310	< 80	< 2300	< 630	< 1300

LQM/CIEH Suitable 4 Use Levels – Metals and Semi-metals						
Determinand	RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
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	220
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	130	180	53	980	230	800
Selenium	250	430	88	12000	1100	1800
Vanadium	410	1200	91	9000	2000	5000
Zinc	3700	40000	620	730000	81000	170000

Phytotoxicity (Harmful to Plants) Threshold Trigger Values	
Copper	250mg/kg
Zinc	1000mg/kg
Notes:	
Phytotoxicity Recommendations – ICRL 70/90 <i>Restoration of metalliferous mining areas</i>	
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.	

CL:AIRE Soil Generic Assessment Criteria				
Determinand	Residential (mg/kg)	Residential without plant uptake (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
Antimony	ND	550	ND	7500
Barium	ND	1300	ND	22000
Molybdenum	ND	670	ND	17000
ND – Not derived				

9.3. Total Petroleum Hydrocarbons (TPHs)

9.3.1. BTEX Compounds

LQM/CIEH Suitable 4 Use Levels – BTEX Compounds							
Determinand	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

SOM = Soil Organic Matter Content (%)

9.3.2. Total Petroleum Hydrocarbons – Aliphatic

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 (1150) sol	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	760 (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

SOM = Soil Organic Matter Content (%)

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.

9.3.3. Total Petroleum Hydrocarbons – Aromatic

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 (%)							
^{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.							

9.4. Polycyclic Aromatic Hydrocarbons (PAHs)

LOM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAHs)							
Determinands		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	3.50	0.57	1.30
	6.0% SOM	0.30	0.32	0.43	3.60	0.58	1.40
Fluoranthene	1.0% SOM	280	1,500	52	23,000	3,100	6,300
	2.5% SOM	560	1,600	130	23,000	3,100	6,300
	6.0% SOM	890	1,600	290	23,000	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
Naphthalene	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}	15	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
SOM = Soil Organic Matter Content (%)							
^{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.							

9.5. Volatile and Semi-volatile Organic Compounds

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

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

LOM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds							
Determinands		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
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
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}
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}
^{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.							

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds							
Determinands		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)	POSresi (mg/kg)	POSpark (mg/kg)
Chlorobenzenes (cont.)							
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
Phenols & Chlorophenols							
BTEX	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
^{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.							

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds					
Determinands		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
1,1,2 Trichloroethane	1.0% SOM	0.60	0.88	0.28	94
	2.5% SOM	1.20	1.8	0.61	190
	6.0% SOM	2.70	3.9	1.40	400
1,1-Dichloroethane	1.0% SOM	2.40	2.50	9.20	280
	2.5% SOM	3.90	4.10	17	450
	6.0% SOM	7.40	7.70	35	850
1,1-Dichloroethene	1.0% SOM	0.23	0.23	2.80	26
	2.5% SOM	0.40	0.41	5.60	46
	6.0% SOM	0.82	0.82	12	92
1,2,4-Trimethylbenzene	1.0% SOM	0.35	0.41	0.38	42
	2.5% SOM	0.85	0.99	0.93	99
	6.0% SOM	2.00	2.30	2.20	220
1,2-Dichloropropane	1.0% SOM	0.024	0.024	0.62	3.3
	2.5% SOM	0.042	0.042	1.20	5.9
	6.0% SOM	0.084	0.085	2.60	12
2,4-Dimethylphenol	1.0% SOM	19	210	3.10	16000*
	2.5% SOM	43	410	7.20	24000*
	6.0% SOM	97	730	17	30000*
2,4-Dinitrotoluene	1.0% SOM	1.50	170*	0.22	3700*
	2.5% SOM	3.20	170	0.49	3700*
	6.0% SOM	7.20	170	1.10	3800*
2,6-Dinitrotoluene	1.0% SOM	0.78	78	0.12	1900*
	2.5% SOM	1.70	84	0.27	1900*
	6.0% SOM	3.90	87	0.61	1900*
2-Chloronaphthalene	1.0% SOM	3.70	3.80	40	390*
	2.5% SOM	9.20	9.30	98	960*
	6.0% SOM	22	22	230	2200*
Biphenyl	1.0% SOM	66*	220*	14	18000*
	2.5% SOM	160	500*	35	33000*
	6.0% SOM	360	980*	83	48000*
Bis (2-ethylhexyl) phthalate	1.0% SOM	280*	2700*	47*	85000*
	2.5% SOM	610*	2800*	120*	86000*
	6.0% SOM	1100*	2800*	280*	86000*
Bromobenzene	1.0% SOM	0.87	0.91	3.2	97
	2.5% SOM	2.0	2.1	7.6	220
	6.0% SOM	4.7	4.9	18	520
Bromodichloromethane	1.0% SOM	0.016	0.019	0.016	2.1
	2.5% SOM	0.030	0.034	0.032	3.7
	6.0% SOM	0.061	0.070	0.068	7.6
Bromoform	1.0% SOM	2.8	5.2	0.95	760
	2.5% SOM	5.9	11	2.1	1500
	6.0% SOM	13	23	4.6	3100
Butyl benzyl phthalate	1.0% SOM	1400*	42000*	220*	940000*
	2.5% SOM	3300*	44000*	550*	940000*
	6.0% SOM	7200*	44000*	1300*	950000*

*soil concentration above saturation limit

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds					
Determinands		RwHP (mg/kg)	RwoHP (mg/kg)	Allotment (mg/kg)	Commercial (mg/kg)
Chloroethane	1.0% SOM	8.3	8.4	110	960
	2.5% SOM	11	11	200	1300
	6.0% SOM	18	18	380	2100
Chloromethane	1.0% SOM	0.0083	0.0085	0.066	1.0
	2.5% SOM	0.0098	0.0099	0.13	1.2
	6.0% SOM	0.013	0.013	0.23	1.6
<i>Cis</i> 1,2 Dichloroethene	1.0% SOM	0.11	0.12	0.26	14
	2.5% SOM	0.19	0.20	0.50	24
	6.0% SOM	0.37	0.39	1.0	47
Dichloromethane	1.0% SOM	0.58	2.10	0.10	270
	2.5% SOM	0.98	2.80	0.19	360
	6.0% SOM	1.70	4.50	0.34	560
Diethyl Phthalate	1.0% SOM	120*	1800*	19*	150000*
	2.5% SOM	260*	3500*	41*	220000*
	6.0% SOM	570*	6300*	94*	290000*
Di- <i>n</i> -butyl phthalate	1.0% SOM	13*	450*	2.00	15000*
	2.5% SOM	31*	450*	5.00	15000*
	6.0% SOM	67*	450*	12	15000*
Di- <i>n</i> -octyl phthalate	1.0% SOM	2300*	3400*	940*	89000*
	2.5% SOM	2800*	3400*	2100*	89000*
	6.0% SOM	3100*	3400*	3900*	89000*
Hexachloroethane	1.0% SOM	0.20	0.22	0.27	22*
	2.5% SOM	0.48	0.54	0.67	53*
	6.0% SOM	1.10	1.30	1.60	120*
Isopropylbenzene	1.0% SOM	11	12	32	1400*
	2.5% SOM	27	28	79	3300*
	6.0% SOM	64	67	190	7700*
Methyl <i>tert</i> -butyl ether (MTBE)	1.0% SOM	49	73	23	7900
	2.5% SOM	84	120	44	13000
	6.0% SOM	160	220	90	24000
Propylbenzene	1.0% SOM	34	40	34	4100*
	2.5% SOM	82	97	83	9700*
	6.0% SOM	190	230	200	21000*
Styrene	1.0% SOM	8.10	35	1.60	3300*
	2.5% SOM	19	78	3.70	6500*
	6.0% SOM	43	170	8.70	11000*
Total Cresols (2-, 3-, and 4-methylphenol)	1.0% SOM	80	3700	12	160000
	2.5% SOM	180	5400	27	180000*
	6.0% SOM	400	6900	63	180000*
<i>Trans</i> 1,2 Dichloroethene	1.0% SOM	0.19	0.19	0.93	22
	2.5% SOM	0.34	0.35	1.90	40
	6.0% SOM	0.70	0.71	0.24	81
Tributyl tin oxide	1.0% SOM	0.25	1.40	0.042	130*
	2.5% SOM	0.59	3.10	0.100	180*
	6.0% SOM	1.30	5.70	0.240	200*

*soil concentration above saturation limit

APPENDIX G: Waste Hazard Assessment

Waste Classification Report

HazWasteOnline™ classifies waste as either **hazardous** or **non-hazardous** based on its chemical composition, related legislation and the rules and data defined in the current UK or EU technical guidance (Appendix C) (note that HP 9 Infectious is not assessed). It is the responsibility of the classifier named below to:

- understand the origin of the waste
- select the correct List of Waste code(s)
- confirm that the list of determinands, results and sampling plan are fit for purpose
- select and justify the chosen metal species (Appendix B)
- correctly apply moisture correction and other available corrections
- add the meta data for their user-defined substances (Appendix A)
- check that the classification engine is suitable with respect to the national destination of the waste (Appendix C)



5BWLF-QEGF5-8RBV5

To aid the reviewer, the laboratory results, assumptions and justifications managed by the classifier are highlighted in pale yellow.

Job name

GWPR4206

Description/Comments

Project

GWPR4206

Site

Classified by

Name:

Roger Foord

Date:

19 Jul 2021 12:50 GMT

Telephone:

0333 600 1221

Company:

Ground and Water
Brighton

HazWasteOnline™ provides a two day, hazardous waste classification course that covers the use of the software and both basic and advanced waste classification techniques. Certification has to be renewed every 3 years.

HazWasteOnline™ Certification:

Course

Hazardous Waste Classification

Date

Job summary

#	Sample name	Depth [m]	Classification Result	Hazard properties	Page
1	GWPR4206 BH2/0.20m	0.2	Non Hazardous		2

Related documents

#	Name	Description
1	Ground and Water V2 PA	waste stream template used to create this Job

Report

Created by: Roger Foord

Created date: 19 Jul 2021 12:50 GMT

Appendices	Page
Appendix A: Classifier defined and non CLP determinands	5
Appendix B: Rationale for selection of metal species	7
Appendix C: Version	7

Classification of sample: GWPR4206 BH2/0.20m

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

Sample details

Sample name: **GWPR4206 BH2/0.20m** LoW Code: Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth: **0.2 m** Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content: **14.8%**
(no correction)

Hazard properties

None identified

Determinands

Moisture content: 14.8% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
1	pH				7.1	pH		7.1	pH	7.1 pH		
2	cyanides { * salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<2	mg/kg	1.884	<3.768	mg/kg	<0.000377 %		<LOD
3	arsenic { arsenic trioxide }				9	mg/kg	1.32	11.883	mg/kg	0.00119 %		
4	boron { * boron tribromide/trichloride/trifluoride (combined) }				<1	mg/kg	13.43	<13.43	mg/kg	<0.00134 %		<LOD
5	cadmium { cadmium sulfide }			1	0.3	mg/kg	1.285	0.386	mg/kg	0.00003 %		
6	Chromium (III) Sulphate				19	mg/kg		19	mg/kg	0.0019 %		
7	chromium { chromium(VI) oxide }				<2	mg/kg	1.923	<3.846	mg/kg	<0.000385 %		<LOD
8	copper { * dicopper oxide; copper (I) oxide }				18	mg/kg	1.126	20.266	mg/kg	0.00203 %		
9	lead { lead chromate }			1	51	mg/kg	1.56	79.551	mg/kg	0.0051 %		
10	mercury { mercury dichloride }				<1	mg/kg	1.353	<1.353	mg/kg	<0.000135 %		<LOD
11	nickel { nickel dihydroxide }				9	mg/kg	1.579	14.215	mg/kg	0.00142 %		
12	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				<3	mg/kg	1.405	<4.215	mg/kg	<0.000422 %		<LOD
13	vanadium { divanadium pentaoxide; vanadium pentoxide }				27	mg/kg	1.785	48.2	mg/kg	0.00482 %		

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
14	zinc { zinc chromate }				79	mg/kg	2.774	219.158	mg/kg	0.0219 %		
	024-007-00-3	236-878-9	13530-65-9									
15	phenol				<2	mg/kg		<2	mg/kg	<0.0002 %		<LOD
	604-001-00-2	203-632-7	108-95-2									
16	naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3									
17	acenaphthylene				0.18	mg/kg		0.18	mg/kg	0.000018 %		
		205-917-1	208-96-8									
18	acenaphthene				0.13	mg/kg		0.13	mg/kg	0.000013 %		
		201-469-6	83-32-9									
19	fluorene				0.2	mg/kg		0.2	mg/kg	0.00002 %		
		201-695-5	86-73-7									
20	phenanthrene				2.05	mg/kg		2.05	mg/kg	0.000205 %		
		201-561-5	85-01-8									
21	anthracene				0.45	mg/kg		0.45	mg/kg	0.000045 %		
		204-371-1	120-12-7									
22	fluoranthene				5.14	mg/kg		5.14	mg/kg	0.000514 %		
		205-912-4	206-44-0									
23	pyrene				4.66	mg/kg		4.66	mg/kg	0.000466 %		
		204-927-3	129-00-0									
24	benzo[a]anthracene				2.42	mg/kg		2.42	mg/kg	0.000242 %		
	601-033-00-9	200-280-6	56-55-3									
25	chrysene				2.32	mg/kg		2.32	mg/kg	0.000232 %		
	601-048-00-0	205-923-4	218-01-9									
26	benzo[b]fluoranthene				2.78	mg/kg		2.78	mg/kg	0.000278 %		
	601-034-00-4	205-911-9	205-99-2									
27	benzo[k]fluoranthene				0.94	mg/kg		0.94	mg/kg	0.000094 %		
	601-036-00-5	205-916-6	207-03-9									
28	benzo[a]pyrene; benzo[def]chrysene				2.15	mg/kg		2.15	mg/kg	0.000215 %		
	601-032-00-3	200-028-5	50-32-8									
29	indeno[123-cd]pyrene				1.63	mg/kg		1.63	mg/kg	0.000163 %		
		205-693-2	183-39-5									
30	dibenz[a,h]anthracene				0.19	mg/kg		0.19	mg/kg	0.000019 %		
	601-041-00-2	200-181-8	53-70-3									
31	benzo[ghi]perylene				1.41	mg/kg		1.41	mg/kg	0.000141 %		
		205-883-8	191-24-2									
32	benzene				<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		<LOD
	601-020-00-8	200-753-7	71-43-2									
33	toluene				<0.005	mg/kg		<0.005	mg/kg	<0.0000005 %		<LOD
	601-021-00-3	203-624-9	108-88-3									
34	ethylbenzene				<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		<LOD
	601-023-00-4	202-849-4	100-41-4									
35	xylene				<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-98-3 [3] 1330-20-7 [4]									
36	o-xylene; [1] p-xylene; [2] m-xylene; [3] xylene [4]				<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-98-3 [3] 1330-20-7 [4]									
37	diesel petroleum group				<3	mg/kg		<3	mg/kg	<0.0003 %		<LOD
			66334-30-5, 66476-34-6, 94114-59-7, 1159170-26-9									
38	TPH (C6 to C40) petroleum group				<42	mg/kg		<42	mg/kg	<0.0042 %		<LOD
			TPH									
Total:										0.0484 %		

Key

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

Appendix A: Classifier defined and non CLP determinands

* pH (CAS Number: PH)

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

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

CLP index number: 006-007-00-5
Description/Comments: Conversion factor based on a worst case compound: sodium cyanide
Data source: Commission Regulation (EC) No 790/2009 - 1st Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP1)
Additional Risk Phrases: None.
Additional Hazard Statement(s): EUH032 >= 0.2 %
Reason for additional Hazards Statement(s):
14 Dec 2015 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

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

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

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

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

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

CLP index number: 029-002-00-X
Description/Comments: M-factor for long-term aquatic hazard not included as per paragraph (5), ATP9
Data source: Regulation (EU) 2016/1179 of 19 July 2016 (ATP9)
Additional Risk Phrases: N R50/53 , N R50/53 >= 0.25 %
Additional Hazard Statement(s): None.
Reason for additional Hazards Statement(s):
10 Oct 2016 - N R50/53 risk phrase sourced from: WM3 v1 still uses ecotoxic risk phrases
10 Oct 2016 - N R50/53 >= 0.25 % risk phrase sourced from: WM3 v1 still uses ecotoxic risk phrases

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

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

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

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

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

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

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

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Risk Phrases: R22, R36, R37, R38, R40, R43, N R50/53
Hazard Statements: Acute Tox. 4 H302, Eye Irrit. 2 H319, STOT SE 3 H335, Carc. 2 H351, Skin Sens. 1 H317, Aquatic Acute 1 H400, Aquatic Chronic 1 H410, Skin Irrit. 2 H315

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

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 17 Jul 2015
Risk Phrases: R36, R37, R38, R43, N R50/53
Hazard Statements: Eye Irrit. 2 H319, STOT SE 3 H335, Skin Irrit. 2 H315, Skin Sens. 1 H317, Aquatic Acute 1 H400, Aquatic Chronic 1 H410

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

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 21 Aug 2015
Risk Phrases: Xn R22, N R50/53
Hazard Statements: Acute Tox. 4 H302, Aquatic Acute 1 H400, Aquatic Chronic 1 H410

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

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 21 Aug 2015
Risk Phrases: Xi R36/37/38, N R50/53
Hazard Statements: Skin Irrit. 2 H315, Eye Irrit. 2 H319, STOT SE 3 H335, Aquatic Acute 1 H400, Aquatic Chronic 1 H410

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

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Risk Phrases: R40
Hazard Statements: Carc. 2 H351

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

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 23 Jul 2015
Risk Phrases: N R50/53
Hazard Statements: Aquatic Acute 1 H400, Aquatic Chronic 1 H410

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

CLP index number: 601-023-00-4
Description/Comments:
Data source: Commission Regulation (EU) No 605/2014 – 6th Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP6)
Additional Risk Phrases: None.
Additional Hazard Statement(s): Carc. 2 H351
Reason for additional Hazards Statement(s):
03 Jun 2015 - Carc. 2 H351 hazard statement sourced from: IARC Group 2B (77) 2000

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

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R40, R51/53, R65, R66
Hazard Statements: Flam. Liq. 3 H226, Skin Irrit. 2 H315, Acute Tox. 4 H332, Carc. 2 H351, Asp. Tox. 1 H304, STOT RE 2 H373, Aquatic Chronic 2 H411

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

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R10, R45, R46, R51/53, R63, R65
Hazard Statements: Flam. Liq. 3 H226, Asp. Tox. 1 H304, STOT RE 2 H373, Muta. 1B H340, Carc. 1B H350, Repr. 2 H361d, Aquatic Chronic 2 H411

Appendix B: Rationale for selection of metal species

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

Worst case species

arsenic {arsenic trioxide}

Worst case species based on risk phrases

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

Worst case species based on risk phrases

cadmium {cadmium sulfide}

Worst case species based on risk phrases

chromium {chromium(VI) oxide}

Worst case species based on risk phrases

copper {dicopper oxide; copper (I) oxide}

Most likely common species

lead {lead chromate}

Worst case species based on risk phrases

mercury {mercury dichloride}

Worst case species based on risk phrases

nickel {nickel dihydroxide}

Worst case species based on risk phrases

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

Worst case species based on risk phrases

vanadium {divanadium pentaoxide; vanadium pentoxide}

most common form

zinc {zinc chromate}

Worst case species based on risk phrases

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition, May 2015

HazWasteOnline Classification Engine Version: 2021.197.4823.9172 (16 Jul 2021)

HazWasteOnline Database: 2021.197.4823.9172 (16 Jul 2021)

This classification utilises the following guidance and legislation:

WM3 - Waste Classification - May 2015

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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