Beech Hill Stores
Eddeys Lane
Headley Down
Bordon

Quantitative Ground Contamination Risk Assessment Report

Report Beneficiary:
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EXECUTIVE SUMMARY

The following presents a summary of the main findings of the report. It is emphasised that no reliance should be placed on any individual point until the whole of the report has been read as other sections of the report may put into context the information contained herein.

It is proposed to develop Beech Hill Stores located at Eddeys Lane, Headley Down, Bordon. The development proposals are understood to comprise the demolition of the existing buildings and the construction of six residential dwellings together with associated parking and landscaping.

A Phase 1 Contaminated Land Assessment has previously been undertaken for the site. The risk assessment has identified several potential sources of contamination, both on and off-site. An investigation proposal was developed to investigate the potential sources of contamination identified by the Phase 1 assessment. The proposal was submitted to and approved by the Local Authority.

The ground investigation was undertaken as per the investigation proposal, though a number of exploratory holes were slightly repositioned due to the presence of dense undergrowth on the site.

Reference to geological datasets indicates that the site is expected to be underlain by the Hythe Formation. The ground investigation confirmed the underlying soils to comprise a shallow thickness of made ground, overlying the expected Hythe Formation deposits.

The Hythe Formation is classed as a Principal Aquifer. The site lies within an Environment Agency Source Protection Zone III (Total Catchment Area) with regard to the protection of the quality of groundwater that is abstracted for potable supply. No groundwater or surface water abstraction licences are recorded to be within 1km of the site. Groundwater was encountered at depths of between 0.83m and 1.72m in standpipes installed as part of the ground investigation.

Testing of shallow samples of made ground soils identified elevated concentrations of lead and PAH compounds in excess of generic soil screening values. The concentrations of contaminants are considered to pose an unacceptable risk to end users of the site where made ground soils remain unremediated within soft landscaped areas. Remedial measures are therefore considered to be required within soft landscaped areas.

No visual or olfactory evidence of petroleum hydrocarbon or volatile organic compounds were recorded during the ground investigation and the concentrations of these contaminants within the made ground soils that have been recorded are not considered to pose an unacceptable risk to end users. However, the concentrations did exceed the threshold value for the use of polyethylene water supply pipework and the local water supply company should be consulted as to whether protective measures are required.

Monitoring of standpipes installed at the site has not identified elevated concentrations of ground gases or flow rates, and no protective measures in respect of gases are considered to be required, beyond the installation of a sub floor void.

This report should be submitted to the Local Authority in relation to Condition 5(b) and the recommendations made should be considered to be provisional until such time as the report is approved and the condition has been discharged.

A remediation strategy will be required to detail those remedial works necessary to safe guard end users, along with a verification plan as to how the measures will be verified.

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1. INTRODUCTION

It is proposed to develop Beech Hill Stores located at Eddeys Lane, Headley Down, Bordon. The development proposals are understood to comprise the demolition of the existing buildings and the construction of six residential dwellings together with associated parking and landscaping. A copy of the proposed development layout is presented in Appendix A.

Planning conditions[1] have been imposed, with respect to contaminated land, in relation to the development.

GeoSmart Information Ltd. has undertaken a Phase 1 Contaminated Land Assessment for the site[2]. The risk assessment has identified several potential sources of contamination, both on and off-site. The on-site potential sources identified comprise historical use of the site as a laundry, coal yard and commercial premises. The off-site potential sources identified comprise a garage/filling station 80m to the north west and a historical landfill site 195m to the north west.

The report recommended that a "proportionate programme of site investigation and monitoring works be undertaken in order to establish the presence or absence of contamination and to enable a quantitative assessment of the associated environmental risks."

On the basis of the Phase 1 assessment, Ashdown Site Investigation Ltd. has prepared an investigation proposal[3]. The proposal set out the locations of proposed exploratory holes, testing and monitoring regime, and assessment criteria that would be used to allow a quantitative assessment of the risk to be undertaken.

A copy of the report was submitted to East Hampshire District Council and condition 5(a) was subsequently discharged. A copy of the discharge notice is included as Appendix B.

Ashdown Site Investigation Ltd. was requested to undertake the ground investigation as specified within the investigation proposal and to prepare a quantitative ground contamination risk assessment in relation to Condition 5(b).

The specific objectives of the works were to:

a) Investigate the shallow ground and groundwater conditions prevailing at the site;
b) Test for the presence of contaminants identified by the preliminary conceptual model; and
c) Develop a quantitative conceptual model of the site, refining the preliminary model to identify any pollutant linkages that may be present.

The scope of the works covered by this report, and the terms and conditions under which they were undertaken, were set out within the offer letter Q10638/Rev1, dated 19th March 2021. The instruction to proceed was received from the client, Cimbrone Developments TWO Ltd.

This report should be read in conjunction with the previous reports prepared for the site.

[1] East Hampshire District Council, Planning Application Ref: 58616
[2] EnviroSmart Plus, Report Ref: 74457R1, February 2021.
[3] Project Ref: P15095, Report No. R14774, Issue No. 1, dated 9th April 2021

2. SITE CONTEXT

2.1 Site Description

The site comprises an irregular shaped plot of land located to the south of Eddeys Lane and to the east of Beech Hill, Headley Down, Bordon and is centred on the approximate Ordnance Survey national grid reference 483780 136470. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively.

At the time of the intrusive works, a number of derelict buildings were located along the northern and western boundaries of the site, with a concrete access road running adjacent to the buildings, the remainder of the site comprised heavily overgrown former yard areas.

2.2 Geological and Hydrogeological Information

Detailed information pertaining to the geological and hydrogeological setting of the site is presented within the Phase 1 assessment. A summary is provided below.

2.2.1 Expected Geology and Aquifer Designation

The stratigraphic unit that may be expected to underlie the site is presented in the following table.

Table 1. Expected Strata and Aquifer Designation

Type	Stratum	Aquifer Designation
Bedrock	Hythe Formation	Principal Aquifer

The lithology of the Hythe Formation is quite variable. In the western Weald, the formation comprises mainly fine grained to medium grained, sparsely glauconitic sands, sandstones and silts, locally pebbly, with calcareous or siliceous cement in beds or lenses in some areas. In Kent and eastern Sussex the formation comprises alternating sandy limestones ("Ragstone") and glauconitic sandy mudstones ("Hassock").

2.2.2 Radon

The site is reported to be within an area where less than 1% of properties are at or above the action level requiring radon gas protection measures to be installed in new buildings. No radon protection measures are reported by the British Geological Survey to be necessary in the construction of new dwellings or extensions.

2.2.3 Groundwater Abstractions

No groundwater abstraction licences are indicated within 1km of the site.

2.2.4 Surface Water Abstractions

No surface water abstraction licences are indicated within 1km of the site.

2.2.5 Groundwater Source Protection Zones

The site lies within an Environment Agency Source Protection Zone III (Total Catchment Area).

2.2.6 Surface Water Features

The nearest recorded significant surface water feature is a drain, located ~170m east of the site.

3. GROUND INVESTIGATION

3.1 Introduction

The ground investigation comprised the excavation of a series of dynamic sampler boreholes and hand dug pits. Gas and groundwater monitoring standpipes were installed in selected exploratory holes and monitored on subsequent site visits. The fieldwork was carried out on 10th June 2021. The exploratory hole locations are shown on Figure 2.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records given in Appendix C, together with notes to assist in their interpretation.

3.2 Exploratory Holes

3.2.1 Dynamic Sampler Boreholes

Six boreholes, designated WS01 to WS06, were drilled to depths of between 1.70m and 2.00m below ground level.

The boreholes were formed by a series of 1.0m long, open ended, hollow steel tubes of up to 100mm diameter, each containing a removable plastic liner. The tubes, progressively reducing in diameter, were driven into the ground by means of a track-mounted drop weight. Each tube was extracted from the ground using a hydraulically operated jack and the enclosed sample was recovered in its plastic liner.

The system enables sub-samples to be taken for detailed examination and laboratory testing.

3.2.2 Trial Pits

Two trial pits, designated TP01 and TP02, were dug using hand tools to a depth of 0.50m below ground level to enable samples of the underlying soils to be obtained.

3.3 Sampling

Disturbed samples of soil were taken at the depths shown in the exploratory hole records and were collected in plastic bags, plastic tubs or amber jars fitted with gas tight lids.

On collection the amber jars were stored in cool boxes with cooling blocks to maintain temperatures below 4°C until transferred to refrigerators upon return to the office and subsequently forwarded to the external accredited chemical testing laboratory.

3.4 Installations

Gas and groundwater monitoring standpipes were installed to depths of 1.90m or 2.00m in three of the boreholes. Descriptions of the installations are shown on the exploratory hole records in Appendix C.

The concentrations of gases and depths to groundwater were recorded within the standpipes on three occasions between 15th June 2021 and 30th June 2021. The readings are presented in Appendix C.

3.5 Laboratory Testing

Laboratory testing was scheduled by Ashdown Site Investigation Ltd. Results from the laboratory tests are provided in Appendix D.

Testing of selected samples was undertaken by a laboratory with recognised (UKAS and MCERTS) accreditation for quality control.

4. GROUND CONDITIONS

4.1 Stratigraphy

4.1.1 Surface Covering

Boreholes WS01, WS02 and WS04-WS06 were excavated through a surface cover of concrete some 100mm to 150mm in thickness.

Within exploratory holes WS03, TP01 and TP02, topsoil some 100mm to 300mm thick was recorded.

4.1.2 Made Ground

Made ground, generally comprising gravelly sand was recorded within the boreholes to depths of between 0.35m and 0.80m below ground level. The made ground persisted to the full depth of the shallow hand dug trial pits.

The gravel fraction comprised variable quantities of brick, sandstone, charcoal like material, clinker like material, concrete, flint, plastic and slate.

4.1.3 Hythe Formation

Underlying the made ground, where penetrated, the investigation progressed into undisturbed slightly gravelly silty sand deposits to full depth of the boreholes.

These soils are considered to represent the Hythe deposits indicated on the published geological map.

4.2 Stability

Each of the exploratory holes was recorded to remain stable during the course of drilling.

4.3 Groundwater Conditions

Standing water depths of between 0.83m and 1.72m were recorded within two of the standpipes during the monitoring period; the third standpipe was recorded to be dry on all 3 occasions.

It should be noted that water levels within the boreholes/stand-pipes may not have equilibrated with the groundwater table at the time the readings were recorded and that groundwater levels should be expected to fluctuate seasonally.

5. QUANTITATIVE CONTAMINATION ASSESSMENT

5.1 Introduction

The investigation proposal set out the rationale for the locations of the exploratory holes, as well as the proposals for laboratory testing and monitoring.

A number of the proposed locations of the boreholes as shown within the investigation proposal had to be relocated due to significantly overgrown areas of the site. However, the exploratory holes are still considered to be located within a herringbone layout within a regular grid, and in accordance with the centres specified within the investigation proposal.

5.2 Analysis of Contamination Test Results

As discussed within the proposal, comparison of the results of the laboratory testing has been made against the 'Suitable For Use Levels' (S4UL)[4] or, in lieu of an S4UL being developed for lead, the Category 4 Screening Level (C4SL)[5]. These are collectively referred to as soil screening values (SSV).

In view of the development proposal, the SSV utilised in this assessment are those calculated for the generic "Residential" land use[6]. The critical receptor for this land use is considered to be a young female child resident on site from birth to age 6. Exposure routes that are considered include the potential for direct ingestion of the soil, the outdoor and indoor ingestion of dust, the potential inhalation of dust and vapours, ingestion of site grown vegetables and ingestion of soil attached to vegetables.

For the assessment of risk to controlled waters a qualitative assessment has been undertaken based upon the concentrations of contaminants recorded within the soil samples and the information obtained about the sensitivity of the underlying strata or nearby surface water receptors.

5.3 Made Ground

As discussed in Section 4.1.2, the made ground persisted to depths of up to 0.80m below ground level. Samples of the made ground were obtained from each of the exploratory holes at depths of between 0.20m and 0.40m below ground level. The samples were tested for concentrations of heavy metals and polycyclic aromatic hydrocarbon (PAH) compounds, and also screened for asbestos containing materials.

The results of the testing are discussed below.

[4] Nathanail, C.P, et al., The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015, Land Quality Press, Nottingham. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3071.
[5] SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report, published by DEFRA, 2014.
[6] As defined within Science Report SC050021/SR3, January 2009, with the amendments discussed in the LQM/CIEH report.

5.3.1 Heavy Metals

The following table summarises the SSV along with the maximum and minimum concentrations of the heavy metals tested for.

Table 2. Summary of Test Results for Heavy Metals

Contaminant	SSV (mg/kg)	No. of Samples	Minimum Concentration (mg/kg)	Maximum concentration (mg/kg)	Limit of Detection (mg/kg)	No of exceedances
Arsenic	37	8	6	23.4	1	0
Cadmium	11	8	<LOD	1.6	0.5	0
Chromium	910	8	10.7	30	5	0
Copper	2400	8	9	61.3	5	0
Lead	200	8	15.4	402	5	**2**
Mercury	40	8	<LOD	<LOD	0.5	0
Nickel	180	8	6.8	29.3	5	0
Selenium	250	8	<LOD	<LOD	1	0
Zinc	3700	8	59.4	1170	5	0
Hexavalent Chromium	6	8	<LOD	<LOD	0.8	0
Water Soluble Boron	290	8	<LOD	0.8	0.5	0

Two of the eight samples of made ground (tested from exploratory holes WS02 and TP02) recorded elevated concentrations of lead in comparison to its SSV. There is no indication within the soils that would designate the soils within these areas of the site as a "hot spot" or an outlier compared to made ground elsewhere on the site, given that the made ground was recorded as gravelly sand across the entire site, and given also the distance between the two exploratory holes.

Therefore, there is the possibility for equally high concentrations of lead to be present in made ground elsewhere on the site, which would pose an unacceptable risk to future end users of the site were it to remain unremediated in areas of soft landscaping.

In general, very low concentrations of heavy metals were recorded and at the concentrations recorded heavy metals would not be considered to show significant mobility as to pose an unacceptable risk to controlled waters beneath the site.

Isolated more elevated concentrations of lead would still not be considered to show mobility within the soils and similarly are unlikely to pose an unacceptable risk to controlled waters beneath the site.

5.3.2 Asbestos

No suspected asbestos materials were noted within any of the exploratory holes undertaken at the site. Eight samples of the made ground were screened for the presence of asbestos. None of the samples recorded the presence of any asbestos materials.

In view of the screening carried out, there does not appear to be a significant risk to end users from asbestos materials within soils. However, due to the heterogeneity of made ground, there will always remain the potential for localised asbestos materials to be encountered during construction works, though the likelihood of this is considered to be very low. All workers at the site should be made aware of what actions to take in the event that suspected asbestos materials are identified at any time during the development works.

An asbestos survey of existing structures and infrastructure[7] was beyond the scope of this investigation. The potential for asbestos containing materials to be present within the fabric of buildings or infrastructure located on the site cannot be dismissed by reference to the soil test results contained within this report. It is recommended that an asbestos survey be undertaken prior to commencing any demolition works at the site. Where asbestos is identified to be present within buildings or infrastructure, these materials should be appropriately removed by licensed contractors and asbestos materials disposed of in accordance with legal requirements prior to demolition to avoid contaminating soils at the site.

5.3.3 Polycyclic Aromatic Hydrocarbon (PAH) Compounds

The following table summarises the soil screening values, maximum and minimum concentrations for the PAH compounds tested for.

Table 3. Summary of Test Results for PAH Compounds

Contaminant	SSV (mg/kg)	No. of Samples	Minimum Concentration (mg/kg)	Maximum concentration (mg/kg)	Limit of Detection (mg/kg)	No of exceedances
Naphthalene	2.3	8	<LOD	1	0.1	0
Acenaphthylene	170	8	<LOD	2.3	0.1	0
Acenaphthene	210	8	<LOD	2	0.1	0
Fluorene	170	8	<LOD	3.1	0.1	0
Phenanthrene	95	8	<LOD	23.5	0.1	0
Anthracene	2400	8	<LOD	14.8	0.1	0
Fluoranthene	280	8	<LOD	51.2	0.1	0
Pyrene	620	8	<LOD	43	0.1	0
Benz(a)anthracene	7.2	8	<LOD	25.8	0.1	**1**
Chrysene	15	8	<LOD	23.6	0.1	**1**
Benzo(b)fluoranthene	2.6	8	<LOD	18.8	0.1	**1**

[7] As defined under Section 5(a) of the Control of Asbestos Regulations, 2012.

Benzo(k)fluoranthene	77	8	<LOD	20.1	0.1	0
Benzo(a)pyrene	2.2	8	<LOD	21.2	0.1	**1**
Indeno(123-cd)pyrene	27	8	<LOD	16.1	0.1	0
Dibenz(ah)anthracene	0.24	8	<LOD	3.5	0.1	**2**
Benzo(ghi)perylene	320	8	<LOD	13.2	0.1	0

Two of the eight samples of made ground (tested from boreholes WS01 and WS02) recorded elevated concentrations of at least one PAH compound in comparison to their respective SSV. As with the concentrations of lead, there is no indication within the soils to designate the soils within this area of the site as a "hot spot" or an outlier compared to made ground elsewhere on the site.

Therefore, there is the possibility for equally high concentrations of PAH compounds to be present in made ground elsewhere on the site, which would pose an unacceptable risk to future end users of the site were it to remain unremediated in areas of soft landscaping.

PAH compounds are not considered significantly soluble, and would therefore not be considered to show significant mobility as to pose an unacceptable risk to controlled waters beneath the site.

5.4 Petroleum Hydrocarbons and Volatile Organic Compounds (VOC)

No visual or olfactory evidence of petroleum hydrocarbon or volatile organic compound (VOC) were identified in any exploratory hole during the investigation.

As recommended by the investigation proposal, shallow samples of the soils were tested for concentrations of petroleum hydrocarbons (with the results speciated into 5 equivalent carbon weight fractions between C8 and C35) and VOC.

In total, eight samples were tested for concentrations of petroleum hydrocarbons, four of which were also tested for concentrations of VOC.

The following tables list the screening values for petroleum hydrocarbon equivalent carbon weight fractions and BTEX compounds calculated for 1% organic content.

Table 4. Soil Screening Values for petroleum hydrocarbon equivalent carbon weight fractions

Petroleum Hydrocarbon Fraction	SSV (mg/kg)	Petroleum Hydrocarbon Fraction	SSV (mg/kg)
Aliphatic EC 5-6	42	Aromatic EC 5-7	70
Aliphatic EC >6-8	100	Aromatic EC >7-8	130
Aliphatic EC >8-10	27	Aromatic EC >8-10	34
Aliphatic EC >10-12	130	Aromatic EC >10-12	74
Aliphatic EC >12-16	1100	Aromatic EC >12-16	140
Aliphatic EC >16-35	65000	Aromatic EC >16-21	260
Aliphatic EC >35-44	65000	Aromatic EC >21-35	1100
		Aromatic EC >35-44	1100

Table 5. Soil Screening Values for BTEX Compounds

Compound	SSV (mg/kg)
Benzene	0.087
Toluene	130
Ethylbenzene	47
p-Xylene[1]	56

[1] Xylene has three structural isomers, the SSV presented is for *p*-Xylene, which has the most conservative SSV.

None of the samples tested recorded concentrations of petroleum hydrocarbons fractions above the more conservative SSV. No detectable BTEX compounds were recorded. No unacceptable risk to end users is considered to be present from petroleum hydrocarbons or BTEX compounds within the soils at the site.

Where detectable concentrations of petroleum hydrocarbons were recorded, they tended to be in the longer, less mobile >C16 fractions. Given this, the concentrations of petroleum hydrocarbons recorded are not considered to pose an unacceptable risk to controlled waters beneath the site.

Only two of the samples tested for VOC recorded concentrations above the limit of detection of the test. A concentration of 44µg/kg of naphthalene, significantly below its SSV (as presented in Section 5.3.3.) and a concentration of 10.1µg/kg of 1,3,5-trimethylbenzene. Currently there is no published screening value for 1,3,5-trimethylbenzene. However, given the concentration is only marginally above the limit of detection of the test (10µg/kg), it is not considered to pose an unacceptable risk to end users or controlled waters beneath the site.

At the low concentrations recorded, petroleum hydrocarbons or BTEX compounds would not be expected to exhibit significant mobility and are not considered to pose an unacceptable risk to controlled waters beneath the site.

Comparison of the test results with screening criteria for the use of PE water supply pipes[8] indicates that the protection of water supply services is likely to be required. Notwithstanding the above it is strongly recommended that designers consult with the proposed water supply company to ascertain if further laboratory testing and assessment specific to proposed routes of services is required.

[8] Set out within Table 3.1 of the Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UK Water Industry Research, 2010.

5.5 Analysis of Ground Gas Monitoring Results

5.5.1 Summary of Monitoring

Gas monitoring standpipes were installed within three of the boreholes. As set out within the investigation proposal, given that the depth of the made ground was <1m, the slotted section of the standpipe was sealed below the made ground within the slightly gravelly silty sand deposits of the Hythe Formation.

Monitoring of the gas concentrations within the standpipes was carried out on three occasions using a GFM435 and a MiniRae 3000, a photo-ionisation device (PID).

Peak concentrations of carbon dioxide of up to 1.9% by volume and no concentrations of methane were recorded. Negative gas flows were recorded in the boreholes of between -0.4/hr and -0.7l/hr. The PID consistently recorded values of <1ppm, with the maximum being 0.3ppm.

Atmospheric pressures varied between 999mb and 1003mb during the monitoring period. Monitoring was carried out during periods of both rising and falling atmospheric pressure.

5.5.2 Assessment of Monitoring Results

Assessment of the results of the monitoring has been carried out in general accordance with the current guidance[9].

The guidance provides a methodology for assessing the risk from ground gases by the calculation of site-specific gas screening values (GSV) for each key asphyxiating or explosive gas (carbon dioxide and methane). These are calculated by multiplying the concentration (percentage/volume) of a gas by a gas flow rate (l/hr).

Initial screening has been carried out by calculating the GSV using the highest consistent flow rate recorded multiplied by the highest gas concentration recorded across all three stand-pipes. This is considered to represent a highly conservative assessment of the risk posed by ground gases. For the purpose of this initial assessment, it has been assumed that the negative flow rates are positive.

Where no detectable gas concentrations are recorded, the GSV are calculated assuming values equal to the limit of detection of the instrument are present.

The following table summarises the calculated GSV:

Table 6. Calculated GSV for Carbon Dioxide and Methane

Gas	GSV
Carbon Dioxide	0.019 x 0.7 = 0.0133
Methane	0.001 x 0.7 = 0.0007

[9] CIRIA document C665, Assessing risks posed by hazardous ground gases to buildings, 2007.

5.5.3 Assessment of Monitoring Data

As specified within the investigation proposal, an assessment has been undertaken in accordance with Appendix F of BS8576[10] as to whether sufficient monitoring has been undertaken.

Table 7. Assessing sufficient of data (Appendix F of BS8576)

Action	Results
From current results (concentration, flow rates & pressure), estimate likely risk associated with ground gas	Current estimate of risk: GSV (carbon dioxide) = 0.0133 l/hr GSV (methane) = 0.0007 l/hr Site characterisation = Green Max limit: 0.16/hr (methane), 0.78l/hr (carbon dioxide)
What increase in gas concentration is required to increase the estimate risk and the form of gas protection to be provided.	Keeping the flow rate constant (assuming positive 0.7l/hr, when actually a negative flow has been recorded): The concentration of carbon dioxide required would need to exceed 100% to move into next risk band. This is not feasible. The concentration of methane required would need to exceed ~22% to move into the next risk band. Given the distance of the potential source from the site (190m north west), it is not considered feasible that such concentrations of ground gases could reach the site.
What increase in flow rate is required to increase the estimated risk and the level of gas protection to be provided?	Keeping the gas concentrations constant, the flow rate would need to exceed ~40l/hr to move to the next risk band, i.e. it would need to increase more than 50 times current levels. From the current data and knowledge of the source, this is not considered feasible.
Is the increase in gas concentration feasible given the known source of gas?	No. The carbon dioxide would need to increase to over 100%, which is not possible. The concentrations of methane would need to be 22%, which is not likely when no detectable concentrations have been recorded to date.
Is the increase in flow rate feasible when compared to gas generation and migration model results, the collected gas monitoring data and the conceptual site model?	No. The existing flow rates recorded (on only one of the monitoring visits) are negative, indicating air is being sucked into the standpipe, rather than gas flows emitting from the ground or other positive pressure. It is likely the negative flows recorded are a result of the piston effect due to the varying groundwater levels within the standpipe. It is considered highly unlikely, based on the distance from the source, that gas flows could increase to over 50l/hr.
Decide whether further monitoring is required.	Based on the above analysis, further gas monitoring is not required.

5.5.4 Assessment of Risk from Ground Gases

CIRIA C665 identifies two types of development "Situation A" and "Situation B". Situation B is low rise housing, with a ventilated underfloor void of a minimum of 150mm. Situation A is for all other housing types that are not Situation B. The site is considered to be Situation B type development.

[10] BS8576:2013 Guidance on investigation for ground gas – Permanent gases and Volatile Organic Compounds (VOCs), April 2013.

For standard low rise housing, the NHBC have developed a characterisation system which assigns calculated GSV and typical maximum gas concentrations to four difference "traffic light" scenarios. Elements of Table 8.7 of CIRIA C665, which sets out the typical maximum gas concentrations and GSV for the "Traffic Light Classification", are reproduced below.

Table 8. Reproduction of elements of Table 8.7 of C665

Traffic Light Classification	Methane		Carbon Dioxide	
	Typical Maximum Concentration (%)	Gas Screening Value (l/hr)	Typical Maximum Concentration (%)	Gas Screening Value (l/hr)
Green				
	1	0.16	5	0.78
Amber 1				
	5	0.63	10	1.56
Amber 2				
	20	1.56	30	3.10
Red				

On the basis of the data obtained and the calculated GSVs, it is considered that the site may be classified as "Green" for low rise housing with a minimum of 150mm sub floor void. Therefore, no specific gas protection measures are deemed to be necessary at the site.

5.6 Quantitative Contamination Risk Assessment

5.6.1 Introduction

The risk assessment for the site considers the sources of contamination identified, the receptors that may be present in view of the development proposals and the contaminant pathways by which these may be linked.

A complete pollutant linkage is only deemed to exist where all three are present and a site is considered suitable for use where no complete pollutant linkages are identified.

Where a complete pollutant linkage is considered to be present, an assessment of the level of risk associated with the pollutant linkage has been carried out in line with published guidance[11].

The level of risk is determined using the risk matrix presented in the following table. Classifications of probability, consequence and risk are presented in Appendix E.

Table 9. Risk Assessment Matrix

		Probability			
		Very Low	**Low**	**Moderate**	**High**
Consequence	**Very Minor**	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

5.6.2 Basis of Assessment

The development is to comprise new residential buildings together with areas of private garden where end users can expect to come into contact with the underlying soils, where soil derived dusts may be generated and where the growing of fruit and vegetables may feasibly occur.

The proposed development layout is presented in Appendix A. Should the proposed development plans be altered, a revised risk assessment may be required.

5.6.3 Contamination Sources Identified

The following source of contamination has been identified by the quantitative contamination risk assessment:

- Made ground soils containing elevated concentrations of lead and PAH compounds, as well as petroleum hydrocarbons above the threshold value for the use of PE water supply pipework.

[11] Contaminated Land Risk Assessment: A guide to good practice, CIRIA C552, 2001.

5.6.4 Quantitative Conceptual Model

The quantitative conceptual model for the proposed development is presented in Appendix F.

5.7 Risks to Other Potential Receptors

All construction workers must undertake their own risk assessment, based upon the works to be carried out and the proposed method by which this will be achieved, in accordance with current health and safety legislation. Their assessment should take into account all available information about the site, including that presented within this and other reports prepared for the site.

Appropriate working procedures and PPE should be adopted to ensure the health and safety of the site operatives. Instruction should be given in the recognition of potentially hazardous materials. All site personnel should be appropriately briefed on the discovery strategy, presented below, and what actions they must take in the event that further evidence of contamination is identified or suspected.

5.8 Recommendations

A complete pollutant linkage relating to end users has been identified at the site, it is considered that remedial measures will be required as part of the proposed development.

Given the source of contamination identified at the site it is considered that the remedial works likely to be required would comprise the removal of the contaminant source (the made ground soils) or, where deeper made ground is present for example, the provision of a cover system of suitable soils within any soft landscaped areas at the site.

It is recommended that the local water supply company are consulted as to whether protective water supply pipework (i.e. barrier pipe) is required as part of the development.

An asbestos survey must be undertaken prior to commencement of any demolition works at the site. Where asbestos is identified to be present within buildings or infrastructure, these materials should be appropriately removed by licensed contractors and asbestos materials disposed of in accordance with legal requirements prior to demolition to avoid contaminating soils at the site.

The remediation works ultimately adopted should be detailed within a separate remediation strategy, along with a verification plan. This should be produced once this risk assessment report has been reviewed and approved by the appropriate authority.

5.9 Discovery Strategy

In addition, if, during the course of the site clearance and development works, any materials not previously identified by the investigation that are suspected of being 'contaminants' are encountered, then the following procedure should apply:

- All works in that area should cease and the site manager should be informed.
- Advice should be sought from suitably qualified and experienced personnel as to whether any further site inspection, sampling, testing and/or assessment is deemed necessary.
- If required, the conclusions of any assessment and any proposed remedial works (if required) should be agreed by the local authority.

- If necessary, full details of any remedial works should be included in the verification report for the site.

Suspected 'contamination' may take the following form, though it is noted that this list is not exhaustive and site operatives should ask if they are at all unsure of any findings:

- Soil or water looks oily and/or has an oily odour
- Soil or water has a solvent type of odour
- Significant quantities of man-made materials within fill such as paint cans, car parts, glass fragments
- Suspected asbestos containing materials (insulating boards, cement, loose fibres etc.)
- Significant volumes of clinker like or ashy material
- Sand bags, and/or subsurface concrete structures
- Animal carcasses or evidence of animal burial pits

6. REGULATORY APPROVAL

It is recommended that this report be submitted to the Local Authority in discharge of Condition 5(b) and that their feedback is obtained prior to producing a remediation strategy for the site, which would be required for the discharge of Condition 5(c).

This report and the recommendations made should be considered to be provisional until such time as the Local Authority approve the report and the condition is discharged.

Ashdown Site Investigation Ltd.

FIGURES

ASHDOWN SITE INVESTIGATION LIMITED	Site Location Plan	Site Name	Figure No.	Project Reference
		Beech Hill Stores, Eddeys Lane, Headley Down, Bordon	1	P15204

ReQuestAPlan

Map number: TQRQM21134145713264

Title: Beech Hill Stores Eddeys Lane GU35 8HU
Map Produced for: Clive Davis

Project ID:
Date of Purchase: 14-05-2021

N

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D

Unit 3
The Old Grain Store
Ditchling Common Business Park
Ditchling
East Sussex
BN6 8SG
01273 483119
contact@ashdownsi.co.uk

Site:

Beech Hill Stores
Eddeys Lane
Headley Down
Bordon

Project Ref:

P15204

Figure No.

2

Drawing Title

Site Plan

Scale

NTS

APPENDIX A

Proposed Development Layout

ReQuestAPlan

Map number: TQRQM21134145713264

Title: Beech Hill Stores Eddeys Lane GU35 8HU
Map Produced for: Clive Davis

Project ID:
Date of Purchase: 14-05-2021
1 Years subscription from 14-05-2021 for 1 workstation.

10 m 50 m 100 m

APPENDIX B

Discharge Notice

East Hampshire DISTRICT COUNCIL

Penns Place, Petersfield, Hampshire GU31 4EX
Telephone 01730 266551 • DX100403 Petersfield
info@easthants.gov.uk • www.easthants.gov.uk
@EastHantsDC
/EastHampshireDistrictCouncil

Mr C Davis
Clive Davis Architect
137 Harrowdene Gardens
Teddington
TW11 0DN

Case Officer: Jon Holmes
Direct Dial: 01730 234243
Our Ref: 58616
Your Ref:
Date: 27 May 2021
email: jon.holmes@easthants.gov.uk

Dear Mr Davis

Town and Country Planning (Development Management Procedure) (England) Order 2015
Discharge of Conditions Application

Location: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon, GU35 8HU
Planning No: 58616

This letter confirms that the following condition has been DISCHARGED.

5 Site Investigation and Risk Assessment
The submitted details are agreed and allow for the discharge of the condition.

This decision does not in any way affect Conditions which may have been imposed previously, which continue to apply.

Yours sincerely

Simon Jenkins
Director of Regeneration and Place

APPENDIX C

Exploratory Hole Notes
Exploratory Hole Records
Gas Concentration and Groundwater Monitoring Results

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U 'Undisturbed' Sample: - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
U_o Sample not obtained
U* Full penetration of sample not obtained
Pi Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D Disturbed Sample
R Root Sample
B Bulk Disturbed Sample
W Water Sample
J Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T Tub Sample
Vi Vial Sample

In situ Testing

S Standard penetration test (SPT): Using the split spoon sampler.

C Standard Penetration Test (SPT): using a solid cone instead of the sampler - conducted usually in coarse grained soils or weak rocks.

V Shear Vane Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

H Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

P Perth Penetrometer Test: Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column.

Excavation Method

CP Cable Percussion Borehole
WLS Dynamic Sampler Borehole using windowless sampler tubes
WS Dynamic Sampler Borehole using window sampler tubes
TP Trial Pit excavated using mechanic excavator
HDP Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1) and Part 2 Principles of classification (BS EN 14688-2) as well as the BS5930 code of Practice for Ground Investigations.

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1) as well as the BS5930 code of Practice for Ground Investigations. TCR – Total Core Recovery, SCR – Solid Core Recovery, RQD – Rock Quality Designation, NI – Non Intact, If – indicative fracture spacing (min/ave/max), FI – Fracture Index.

4 Chalk Description

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk.

ASHDOWN SITE INVESTIGATION LIMITED
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Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Borehole Number: **WS01**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Concrete.
	J T	0.20				0.10	MADE GROUND: Brown sandy angular to subrounded fine to coarse gravel of flint, brick and concrete.
	D	0.30					
	J T	0.50				0.40	Orange and light brown slightly gravelly silty fine to coarse SAND. Gravel is angular to subrounded fine to coarse sandstone. (Hythe Formation)
	D	0.60					
	J T	1.30					
	D	1.50				2.00	End of borehole at 2.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 2.00m depth; 2.00m to 1.00m slotted pipe with gravel surround; 1.00m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: KS

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Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Borehole Number: **WS02**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Concrete.
	J T	0.20				0.15	MADE GROUND: Grey gravelly silty sand. Gravel is angular to subrounded fine to coarse brick, clinker-like material, charcoal-like material and flint.
	D	0.30				0.35	Orange and light brown slightly gravelly fine to coarse SAND. (Hythe Formation)
	D	0.50					
	J T	0.60					
	J T	1.20					becoming slightly clayey below 1.20m depth.
	D	1.50					
						2.00	End of borehole at 2.00m

Remarks

Groundwater: Standing water at 1.65m depth on completion.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 2.00m depth; 2.00m to 1.00m slotted pipe with gravel surround; 1.00m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: KS

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Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Borehole Number: **WS03**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
	J T	0.05				0.00	Topsoil.
						0.10	MADE GROUND: Light brown slightly gravelly sand. Gravel is angular to rounded fine to coarse sandstone, charcoal-like material, clinker-like material and concrete.
	J T	0.30					
	D	0.40					
						0.70	Orange brown slightly gravelly silty fine to coarse SAND. Gravel is angular to subrounded fine to coarse sandstone. (Hythe Formation)
	J T	0.80					
	D	0.90					
						1.60	Orange brown slightly gravelly very sandy CLAY. Gravel is angular to subrounded fine to coarse sandstone. (Hythe Formation)
	J T	1.70					
	D	1.80					
						2.00	End of borehole at 2.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: KS

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Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Borehole Number: **WS04**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Concrete.
	J T	0.20				0.10	MADE GROUND: Orange and light brown gravelly sand. Gravel is angular to subrounded fine to coarse sandstone, ironstone, flint and rare charcoal-like material.
	D	0.40					
	J T	0.70				0.60	Brown, orange brown and light brown slightly gravelly silty fine to coarse SAND. Gravel is angular to subrounded fine to coarse sandstone. (Hythe Formation)
	D	0.80					becoming clayey below 1.00m depth.
	J T	1.20					
	D	1.50					
						2.00	End of borehole at 2.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: KS

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Tel: 01273 483119

Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Borehole Number: **WS05**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Concrete.
	J T	0.20				0.10	MADE GROUND: Grey gravelly sand. Gravel is angular to subrounded fine to coarse brick and concrete.
	D	0.25				0.30	MADE GROUND: Light brown slightly gravelly silty sand. Gravel is angular to subrounded fine to coarse sandstone and brick.
	J T	0.40					
	D	0.50				0.60	Orange and light brown slightly gravelly silty fine to coarse SAND. Gravel is angular to subrounded fine to coarse sandstone. (Hythe Formation)
	J T	0.70					
	D	0.80					
	J T	1.40					becoming clayey below 1.60m depth.
	D	1.50				1.90	End of borehole at 1.90m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: No further progress below 1.90m depth - too hard/ dense.
Standpipe installed to 1.90m depth; 1.90m to 0.90m slotted pipe with gravel surround; 0.90m to ground level plain pipe with bentonite seal; completed with gas tap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: KS

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Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Borehole Number: **WS06**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Concrete.
	J T	0.20				0.10	MADE GROUND: Brown mottled orange brown gravelly sand. Gravel is angular to subrounded fine to coarse flint, slate and brick.
	D	0.30					
	J T	0.90				0.80	Light brown mottled orange brown slightly gravelly silty fine to coarse SAND. Gravel is angular to subrounded fine to coarse sandstone. (Hythe Formation)
	D	1.20					
	J T	1.30					
	D	1.60				1.70	End of borehole at 1.70m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: No further progress below 1.70m depth - too hard/ dense.

Excavation Method: WLS

Borehole Diameter: Various

Made By: KS

ASHDOWN SITE INVESTIGATION
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Tel: 01273 483119

Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Trial Pit Number: **TP01**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
J T	0.10				0.00	Topsoil.
					0.20	
D	0.30					MADE GROUND: Light brown mottled orange slightly gravelly sand. Gravel is angular to subrounded fine to coarse glass, clinker-like material and charcoal-like material, brick and sandstone.
J T	0.40					
					0.50	End of trial pit at 0.50m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: n/a

Pit Width: n/a

Made By: KS

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Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: Beech Hill Stores, Eddeys Lane, Headley Down, Bordon

Job Number: P15204

Start Date: 10/06/2021

End Date: 10/06/2021

Trial Pit Number: **TP02**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
J T	0.10				0.00	Topsoil.
					0.30	MADE GROUND: Light brown slightly gravelly sand. Gravel is angular to subrounded fine to coarse sandstone, plastic, flint and slate.
J T	0.40					
D	0.45				0.50	End of trial pit at 0.50m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: n/a

Pit Width: n/a

Made By: KS

Gas Concentrations and Groundwater Monitoring Results

Site Name:	Beech Hill Stores, Eddeys Lane, Headley Down, Bordon
Project Ref:	P15204

Position	Date	Time	Dynamic Pressure (pa)	Atmospheric Pressure (mbar)	Atmospheric Trend	Standing Water Depth (m bgl)	Flow Rate (l/hr)				Methane (%)				Carbon Dioxide (%)				Oxygen (%)				CO (ppm)	H_2S (ppm)	PID (ppm)			
							Seconds				Seconds				Seconds				Seconds						Seconds			
							15	30	45	60	15	30	45	60	15	30	45	60	15	30	45	60			15	30	45	60
WS01	15/06/2021	14:26	0	1002	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	21.1	20.3	20.2	20.1	0	0	0.3	0.2	0.2	0.2
WS02	15/06/2021	14:33	0	1003	Falling	1.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	21.5	21.2	21.2	21.2	0	0	0.1	0.1	0.1	0.1
WS05	15/06/2021	14:36	0	1002	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.6	1.6	1.9	19.7	19.3	19.3	19.2	0	0	0.0	0.0	0.0	0.0
WS01	22/06/2021	12:07	-3	1000	Rising	1.72	-0.7	-0.7	-0.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2	20.4	20.4	20.4	0	0	0.1	0.0	0.0	0.0
WS02	22/06/2021	11:55	-2	1000	Rising	0.83	-0.4	-0.4	-0.4	-0.4	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.1	20.3	20.3	20.3	20.3	0	0	0.0	0.0	0.0	0.0
WS05	22/06/2021	12:15	-1	1000	Rising	1.63	-0.3	-0.4	-0.6	-0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.4	20.1	20.0	20.0	20.0	0	0	0.0	0.0	0.0	0.0
WS01	30/06/2021	14:14	0	1000	Falling	Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.0	1.1	1.1	19.7	19.0	18.8	18.8	0	0	0.0	0.0	0.0	0.0
WS02	30/06/2021	14:08	0	1000	Falling	1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.1	20.6	20.6	20.6	20.6	0	0	0.0	0.0	0.0	0.0
WS05	30/06/2021	14:18	0	999	Falling	1.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.9	0.9	19.9	19.9	19.8	19.7	0	0	0.0	0.0	0.0	0.0

APPENDIX D

Contamination Test Results

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618

cs@elab-uk.co.uk
info@elab-uk.co.uk

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	21-34257
Issue:	1
Date of Issue:	18/06/2021
Contact:	Lab Results
Customer Details:	Ashdown Site Investigation Ltd Unit 3 The Grain Store Ditchling Common Business Park Ditchling Common West SussexBN6 8SG
Quotation No:	Q15-00267
Order No:	9616
Customer Reference:	P15204
Date Received:	11/06/2021
Date Approved:	18/06/2021
Details:	Beech Hill Stores, Eddeys Lane, Headley Down, Bordon
Approved by:	

Mike Varley, Technical Manager

Sample Summary

Report No.: 21-34257, issue number 1

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
240420	WS01 0.20	10/06/2021	11/06/2021	Stones + concrete	
240421	WS02 0.20	10/06/2021	11/06/2021	Loamy sand	
240422	WS03 0.30	10/06/2021	11/06/2021	Loamy sand	
240423	WS04 0.20	10/06/2021	11/06/2021	Sand	
240424	WS05 0.20	10/06/2021	11/06/2021	Sand + stone + brick	
240425	WS06 0.20	10/06/2021	11/06/2021	Loamy sand	
240426	TP01 0.40	10/06/2021	11/06/2021	Loamy sand	
240427	TP02 0.40	10/06/2021	11/06/2021	Loamy sand	

Results Summary

Report No.: 21-34257, issue number 1

			ELAB Reference	240420	240421	240422	240423	240424
			Customer Reference					
			Sample ID					
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	WS01	WS02	WS03	WS04	WS05
			Sample Depth (m)	0.20	0.20	0.30	0.20	0.20
			Sampling Date	10/06/2021	10/06/2021	10/06/2021	10/06/2021	10/06/2021
Determinand	**Codes**	**Units**	**LOD**					
Soil sample preparation parameters								
Material removed	N	%	0.1	n/a	66.7	13.3	32.3	n/a
Description of Inert material removed	N		0	n/a	Stones,concrete	Stones	Stones	n.a
Metals								
Arsenic	M	mg/kg	1	^ 11.3	18.0	7.9	23.4	^ 12.5
Cadmium	M	mg/kg	0.5	^ < 0.5	1.0	< 0.5	< 0.5	^ < 0.5
Chromium	M	mg/kg	5	^ 29.7	24.5	12.5	10.7	^ 26.2
Copper	M	mg/kg	5	^ 43.2	61.3	15.4	10.1	^ 23.0
Lead	M	mg/kg	5	^ 193	402	99.3	15.4	^ 19.0
Mercury	M	mg/kg	0.5	^ < 0.5	< 0.5	< 0.5	< 0.5	^ < 0.5
Nickel	M	mg/kg	5	^ 25.2	25.9	11.7	20.0	^ 15.0
Selenium	M	mg/kg	1	^ < 1.0	< 1.0	< 1.0	< 1.0	^ < 1.0
Zinc	M	mg/kg	5	^ 230	537	210	89.9	^ 59.4
Inorganics								
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Acid Soluble Sulphate (SO4)	U	%	0.02	0.37	0.20	< 0.02	0.02	0.20
Acid Soluble Sulphate (SO4)	N	mg/kg	200	3700	2000	< 200	240	2000
Water Soluble Boron	N	mg/kg	0.5	0.8	0.8	< 0.5	< 0.5	0.5
Miscellaneous								
pH	M	pH units	0.1	^ 11.5	10.1	9.1	9.9	^ 11.3
Soil Organic Matter	U	%	0.1	1.6	4.3	1.3	0.2	0.3
Organics								
>C8-C10 BCB	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C10-C12 BCB	N	mg/kg	1	2.4	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16 BCB	N	mg/kg	1	21.8	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21 BCB	N	mg/kg	1	89.5	2.7	< 1.0	< 1.0	< 1.0
>C21-C35 BCB	N	mg/kg	1	667	62.1	14.0	1.9	5.8
>C35-C40 BCB	N	mg/kg	1	144	40.2	7.0	2.0	< 1.0
Total (>C8-C40) BCB	N	mg/kg	1	925	105	21.1	3.8	5.8
Polyaromatic hydrocarbons								
Naphthalene	M	mg/kg	0.1	^ 1.0	0.2	< 0.1	< 0.1	^ < 0.1
Acenaphthylene	M	mg/kg	0.1	^ 2.3	< 0.1	< 0.1	< 0.1	^ < 0.1
Acenaphthene	M	mg/kg	0.1	^ 2.0	< 0.1	< 0.1	< 0.1	^ < 0.1
Fluorene	M	mg/kg	0.1	^ 3.1	< 0.1	< 0.1	< 0.1	^ < 0.1
Phenanthrene	M	mg/kg	0.1	^ 23.5	0.7	0.4	< 0.1	^ < 0.1
Anthracene	M	mg/kg	0.1	^ 14.8	0.2	< 0.1	< 0.1	^ < 0.1
Fluoranthene	M	mg/kg	0.1	^ 51.2	1.5	1.4	< 0.1	^ < 0.1
Pyrene	M	mg/kg	0.1	^ 43.0	1.2	1.3	< 0.1	^ < 0.1
Benzo(a)anthracene	M	mg/kg	0.1	^ 25.8	0.9	0.5	< 0.1	^ < 0.1
Chrysene	M	mg/kg	0.1	^ 23.6	1.2	0.7	< 0.1	^ < 0.1
Benzo(b)fluoranthene	M	mg/kg	0.1	^ 18.8	1.3	0.7	< 0.1	^ < 0.1
Benzo(k)fluoranthene	M	mg/kg	0.1	^ 20.1	1.7	0.7	< 0.1	^ < 0.1
Benzo(a)pyrene	M	mg/kg	0.1	^ 21.2	0.9	0.7	< 0.1	^ < 0.1
Indeno(1,2,3-cd)pyrene	M	mg/kg	0.1	^ 16.1	1.0	0.6	< 0.1	^ < 0.1
Dibenzo(a,h)anthracene	M	mg/kg	0.1	^ 3.5	0.3	0.1	< 0.1	^ < 0.1
Benzo[g,h,i]perylene	M	mg/kg	0.1	^ 13.2	0.9	0.6	< 0.1	^ < 0.1
Total PAH(16)	M	mg/kg	0.4	^ 283	12.3	8.0	< 0.4	^ < 0.4

Tests marked N are not UKAS accredited.

Results Summary

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			ELAB Reference	240425	240426	240427
			Customer Reference			
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	WS06	TP01	TP02
			Sample Depth (m)	0.20	0.40	0.40
			Sampling Date	10/06/2021	10/06/2021	10/06/2021
Determinand	**Codes**	**Units**	**LOD**			
Soil sample preparation parameters						
Material removed	N	%	0.1	34.2	14.2	< 0.1
Description of Inert material removed	N		0	Stones	Stones	None
Metals						
Arsenic	M	mg/kg	1	11.6	6.9	6.0
Cadmium	M	mg/kg	0.5	1.6	< 0.5	0.6
Chromium	M	mg/kg	5	30.0	16.2	13.8
Copper	M	mg/kg	5	31.5	9.0	25.4
Lead	M	mg/kg	5	120	29.3	232
Mercury	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Nickel	M	mg/kg	5	29.3	7.3	6.8
Selenium	M	mg/kg	1	< 1.0	< 1.0	< 1.0
Zinc	M	mg/kg	5	1170	84.8	241
Inorganics						
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8
Acid Soluble Sulphate (SO4)	U	%	0.02	0.07	< 0.02	0.03
Acid Soluble Sulphate (SO4)	N	mg/kg	200	720	< 200	280
Water Soluble Boron	N	mg/kg	0.5	< 0.5	< 0.5	0.8
Miscellaneous						
pH	M	pH units	0.1	10.3	8.5	7.7
Soil Organic Matter	U	%	0.1	1.6	0.9	3.0
Organics						
>C8-C10 BCB	N	mg/kg	1	< 1.0	< 1.0	< 1.0
>C10-C12 BCB	N	mg/kg	1	< 1.0	< 1.0	< 1.0
>C12-C16 BCB	N	mg/kg	1	< 1.0	< 1.0	< 1.0
>C16-C21 BCB	N	mg/kg	1	1.6	< 1.0	< 1.0
>C21-C35 BCB	N	mg/kg	1	33.5	< 1.0	2.2
>C35-C40 BCB	N	mg/kg	1	5.3	< 1.0	< 1.0
Total (>C8-C40) BCB	N	mg/kg	1	40.5	< 1.0	2.2
Polyaromatic hydrocarbons						
Naphthalene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Fluorene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	M	mg/kg	0.1	0.3	0.1	< 0.1
Anthracene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	M	mg/kg	0.1	0.6	0.3	0.2
Pyrene	M	mg/kg	0.1	0.5	0.3	0.2
Benzo(a)anthracene	M	mg/kg	0.1	0.2	0.1	0.1
Chrysene	M	mg/kg	0.1	0.3	0.1	0.1
Benzo(b)fluoranthene	M	mg/kg	0.1	0.5	0.2	0.1
Benzo(k)fluoranthene	M	mg/kg	0.1	0.4	0.1	0.1
Benzo(a)pyrene	M	mg/kg	0.1	0.3	0.2	0.1
Indeno(1,2,3-cd)pyrene	M	mg/kg	0.1	0.2	0.1	< 0.1
Dibenzo(a,h)anthracene	M	mg/kg	0.1	0.2	< 0.1	< 0.1
Benzo[g,h,i]perylene	M	mg/kg	0.1	0.9	0.1	0.2
Total PAH(16)	M	mg/kg	0.4	4.4	1.9	1.2

Results Summary

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				ELAB Reference	240420	240421	240423	240424
				Customer Reference				
				Sample ID				
				Sample Type	SOIL	SOIL	SOIL	SOIL
				Sample Location	WS01	WS02	WS04	WS05
				Sample Depth (m)	0.20	0.20	0.20	0.20
				Sampling Date	10/06/2021	10/06/2021	10/06/2021	10/06/2021
Determinand	**Codes**	**Units**	**LOD**					
VOC								
Heptane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Octane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Nonane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Benzene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Toluene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Ethylbenzene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
m+p-xylene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
o-xylene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
cis-1,2-dichloroethene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,1-Dichloroethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Chloroform	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Tetrachloromethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
1,1,1-Trichloroethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Trichloroethylene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Tetrachloroethylene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
1,1,1,2-Tetrachloroethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
1,1,2,2-Tetrachloroetha	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Chlorobenzene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Bromobenzene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Bromodichloromethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Methylethylbenzene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
1,1-Dichloro-1-propene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Trans - 1-2 -dichloroethylene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
2,2-Dichloropropane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Bromochloromethane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichloroethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
Dibromomethane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
1,2-Dichloropropane	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
cis-1,3-Dichloro-1-propene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
trans-1,3-Dichloro-1-propene	M	ug/kg	10		^ < 10.0	^ < 10.0	< 10.0	^ < 10.0
1,1,2-Trichloroethane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Dibromochloromethane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,3-Dichloropropane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,2-dibromoethane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Styrene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Propylbenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
2-Chlorotoluene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,2,4-Trimethylbenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
4-Chlorotoluene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
t-butylbenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,3,5-Trimethylbenzene	N	ug/kg	10		< 10.0	10.1	< 10.0	< 10.0
1-methylpropylbenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
p-cymene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,3-Dichlorobenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Butylbenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dibromo-3-chloropropane	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Hexachlorobutadiene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1-2-3 - Trichlorobenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Naphthalene	N	ug/kg	10		44.2	< 10.0	< 10.0	< 10.0
1-2-4 - Trichlorobenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,4-Dichlorobenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichlorobenzene	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0
Bromoform	N	ug/kg	10		< 10.0	< 10.0	< 10.0	< 10.0

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Results Summary

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Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #)
in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos	Gravimetric Analysis Total	Gravimetric Analysis by ACM Type	Free Fibre Analysis	Total Asbestos
240420	0.20	WS01	Brown sandy soil, crushed concrete, brick, road-stone	No asbestos detected	n/t	n/t	n/t	n/t
240421	0.20	WS02	Brown sandy soil, crushed concrete, stones	No asbestos detected	n/t	n/t	n/t	n/t
240422	0.30	WS03	Brown sandy soil, stones	No asbestos detected	n/t	n/t	n/t	n/t
240423	0.20	WS04	Sand and stones	No asbestos detected	n/t	n/t	n/t	n/t
240424	0.20	WS05	Crushed brick and concrete	No asbestos detected	n/t	n/t	n/t	n/t
240425	0.20	WS06	Brown sandy soil, crushed concrete, slate, plant-material,	No asbestos detected	n/t	n/t	n/t	n/t
240426	0.40	TP01	Brown sandy soil, stones, clinker	No asbestos detected	n/t	n/t	n/t	n/t
240427	0.40	TP02	Brown sandy soil, stones, clinker	No asbestos detected	n/t	n/t	n/t	n/t

Method Summary

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Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Hexavalent chromium	N	As submitted sample	15/06/2021	110	Colorimetry
pH	M	Air dried sample	15/06/2021	113	Electromeric
Acid Soluble Sulphate	U	Air dried sample	16/06/2021	115	Ion Chromatography
PAH (GC-FID)	M	As submitted sample	15/06/2021	133	GC-FID
VOC in solids	M	As submitted sample	16/06/2021	181	GC-MS
Water soluble boron	N	Air dried sample	15/06/2021	202	Colorimetry
Basic carbon banding in soil	N	As submitted sample	15/06/2021	218	GC-FID
Asbestos identification	U	Air dried sample	15/06/2021	280	Microscopy
Aqua regia extractable metals	M	Air dried sample	15/06/2021	300	ICPMS
Soil organic matter	U	Air dried sample	16/06/2021	BS1377:P3	Titrimetry

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Report Information

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Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"
LOD	LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination.

Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed.

ELAB are unable to provide an interpretation or opinion on the content of this report.

The results relate only to the sample received.

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Deviation Codes

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

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

Sample Retention and Disposal

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

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

Charges may apply to extended sample storage

APPENDIX E

Classification of Probability, Consequence and Risk

Probability of risk being realised	
Classification	Definition
High	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Moderate	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Very Low	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Consequence of risk being realised		
Classification	Category	Definition
Severe	Human Health	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA.
	Controlled Waters	Short term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource.
	Property	Catastrophic damage to buildings/property.
	Ecological Systems	A short term risk to a particular ecosystem or organisation forming part of such ecosystem.
Moderate	Human Health	Chronic damage to Human Health.
	Controlled Waters	Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution).
	Ecological System	A significant change in a particular ecosystem or organism forming part of such ecosystem.
Minor	Controlled Waters	Pollution of non-sensitive water resources.
	Property	Significant damage to crops, buildings, structures and services.
	Ecological Systems	Damage to sensitive buildings/structures/services or the environment.
Very Minor	Human Health	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc).
	Property	Easily repairable effects of damage to buildings, structures and services.
	Project	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve.

Risk classification definitions	
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but there is a low likelihood of this hazard occurring and if realised, harm would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

APPENDIX F

Quantitative Conceptual Model

Beech Hill Stores, Eddeys Lane, Headley Down, Bordon				Quantitative Conceptual Model		P15204	
Source	**Receptor**	**Contaminants**	**Pathway**	**Complete Linkage Present?**	**Probability**	**Consequence**	**Risk**
Made ground soils containing elevated concentrations of lead and PAH compounds, as well as petroleum hydrocarbons above the threshold value for the use of PE water supply pipework.	End Users	Lead and PAH Compounds	Dermal contact with soil and dust (indoor & outdoor)	Yes	P3: Moderate	C3: Moderate	Moderate
			Ingestion of soil and indoor dust	Yes	P3: Moderate	C3: Moderate	Moderate
			Consumption of home-grown produce and attached soil	Yes	P3: Moderate	C3: Moderate	Moderate
			Inhalation of soil dust (indoor and outdoor)	Yes	P2: Low	C3: Moderate	Low/Moderate
			Inhalation of soil vapours	Identified contaminants do not pose a risk via this pathway			N/A
			Inhalation of soil gases/ Risk of explosion	Identified contaminants do not pose a risk via this pathway			N/A
	End Users (via Water Supply Pipework)	Petroleum Hydrocarbons	Contamination of incoming services	Yes	P2: Low	C3: Moderate	Low/Moderate
	Groundwater		Migration to groundwater	Identified contaminants do not pose a risk via this pathway at the concentrations recorded.			N/A