



TIER 2 CONTAMINATED LAND GENERIC QUANTITATIVE RISK ASSESSMENT

LAND SOUTH OF BROADFORD LANE, CHOBHAM, GU24 8EL

REFERENCE: P1057/R1/V2

REPORT PREPARED FOR: SURREY HEATH BOROUGH COUNCIL

REPORT PREPARED BY: EPS CONSULTING

SEPTEMBER 2023



PLANNING | DUE DILIGENCE | CONSTRUCTION



QUALITY ASSURANCE

Issue/revision	Version 1 September 2023	Version 2 April 2024
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EXECUTIVE SUMMARY	
Site Address	Land South of Broadford Lane, Chobham, GU24 8EL
National Grid Reference	SU9750361159
Site Area	c. 1.80ha
Current Site Use	Vacant open land. The west of the site is used for grazing.
Proposed Development	Additional gypsy / traveller provision with two possible options for the development ranging between 10 and 13 pitches.
Previous works	<p>Environmental Desk Study and Preliminary Risk Assessment produced by Apple Environmental in May 2022 (ref. CL/3326/SH) which covered this and the wider site area for a proposed residential end use. The scope of the site investigation was based on the recommendations contained within the report.</p> <p>Ground gas and groundwater monitoring undertaken on the site by Surrey County Council between 2018 and 2023.</p>
Site History	<p>Excavations noted in the 1930's on the eastern part of the site. The site was relatively undeveloped until it formed part of a large refuse tip between the 1950's and 1970's.</p> <p>The adjacent sewage treatment works were constructed in the c. 1970's.</p>
Environmental Setting	<p>Geology</p> <ul style="list-style-type: none"> ▶ Superficial: None, although Alluvium noted to the north; and ▶ Bedrock: Windlesham Formation (Sand, Silt and Clay) and Bagshot Formation (Sand). <p>Groundwater</p> <ul style="list-style-type: none"> ▶ Secondary A Aquifer contained within bedrock; ▶ Not located within a groundwater Source Protection Zone (SPZ); and ▶ No potable groundwater abstractions nearby. <p>Surface Waters</p> <ul style="list-style-type: none"> ▶ Narrow drain located c. 33m to the north of the site which runs into the River Bourne situated c. 175m north of the site.



<p>Conceptual Site Model (CSM)</p>	<p>Potential “Active” Sources</p> <p>On-site</p> <ul style="list-style-type: none"> ▶ Historic Landfilling <p>Off site</p> <ul style="list-style-type: none"> ▶ Historic Landfilling at Broadford Farm and large area to the south of the site as part of the same former refuse tip; and ▶ Historic Sludge Beds on south-western boundary. <p>Pathways</p> <ul style="list-style-type: none"> ▶ Migration of mobile contaminants on or off site via services, sewers and manmade conduits; ▶ Direct contact, ingestion and inhalation of contaminants on site; ▶ Migration of mobile contaminants into controlled waters; ▶ Migration of hazardous gases through permeable soils; ▶ Permeation of potable water supply pipes. <p>Human Receptors</p> <ul style="list-style-type: none"> ▶ Future site users (residents) <p>Controlled Water Receptors</p> <ul style="list-style-type: none"> ▶ Secondary A aquifer contained within the underlying Windlesham Formation and Bagshot Formation bedrock; and ▶ Drain and River Bourne to the north of the site.
<p>Ground Investigation Works</p>	<ul style="list-style-type: none"> ▶ Four window sample boreholes across the site; ▶ Installation of ground gas and groundwater monitoring wells within three locations and a single return monitoring visit; and ▶ Chemical laboratory analysis of soil and groundwater samples.
<p>Summary of Ground Conditions</p>	<ul style="list-style-type: none"> ▶ Made Ground of between 0.80 and 1.00mbgl within western and central areas; ▶ Made Ground of >3.0mbgl in eastern areas; ▶ Alluvium below Made Ground in WS101 and WS102 in western areas only to depths of 2.40mbgl; ▶ Windlesham Formation below the Made Ground and / or Alluvium at 1.00 to 2.40mbgl persisting to the full depth of the investigation (3.0mbgl); and ▶ Groundwater strike at 2.60mbgl in WS104 only.





<p>Identified Contamination</p>	<ul style="list-style-type: none"> ▶ Hydrocarbon odour was noted within the Made Ground within WS104; ▶ Heavy metals and PAH's have been identified within Made Ground soils at concentrations above the relevant human health assessment criteria within a single location (WS104); ▶ Fragment of chrysotile asbestos cement identified in WS103; ▶ Peak concentrations of carbon dioxide encountered during a single return monitoring visit and historical data provided indicate that the ground gas regime can be classified as Characteristic Situation 2 (CS2); and ▶ Concentrations of some heavy metal and PAH species within samples of perched water collected from WS104 exceed the environmental quality standards (EQS).
<p>Conclusions</p>	<ul style="list-style-type: none"> ▶ From the limited data set obtained, historical landfilling appears to be of greater thickness in the eastern areas of the site (>3.0mbgl), compared to the western and central areas (0.80 to 1.00mbgl); ▶ Should the eastern sector of the site be developed, then it is likely that significant cut and filling maybe required in order to provide a suitable development platform. It is likely that these near surface soils would predominantly comprise Made Ground relating to historical landfilling. Less cut and filling is likely to required within the western area; ▶ The proposed presence of hard standing across the majority of the site will break the pollutant pathway between identified soil contamination and future site users; ▶ Should any vegetated borders be proposed, it is assumed that a nominal thickness of clean imported soil will be required to act as a suitable growing medium and this would also act as a barrier preventing human health exposure; ▶ Basic gas mitigation measures will be required for any enclosed living spaces constructed directly onto the ground. However, where enclosed living spaces are raised above the ground allowing ground gases to freely disperse no significant risk will be present; ▶ In the absence of targeted analysis of soils along the route of any proposed water supply, it would be prudent to install barrier pipe to ensure drinking water supply for the proposed properties is not adversely affected; ▶ It is not considered that a significant risk to drinking water is present given that the site is not located within a groundwater SPZ and there are no potable groundwater abstractions within influencing distance of the site; and ▶ Should a pathway be present for perched water underlying the site to reach the nearby drain and River Bourne, it is considered likely that the following dilution with river water the concentrations would fall below the EQS.



**Recommendations**

Should the development be progressed beyond the feasibility stage it is recommended that:

- ▶ Given the size of the site, further site investigation works is undertaken to increase the data set, especially in areas where a significant thickness of Made Ground is expected;
- ▶ Further assessment is undertaken in order to confirm that the drain and River Bourne are not significantly affected by contaminants identified within the perched water underlying the site. This could include sampling of river water upstream and downstream of the site. However, potential impacts from the adjacent Waste Water Treatment Works would also need to be considered;
- ▶ Further ground gas monitoring is undertaken in accordance with published guidance to expand the existing data set and confirm the initial ground gas assessment;
- ▶ Following the above, a remediation strategy and verification plan is prepared for approval by the regulators prior to commencement of development works; and
- ▶ The design of any proposed foundations or roadways should take into consideration the significant thickness of heterogenous Made Ground beneath the site and the potential for chemicals to be present within the ground which could adversely affect concrete structures installed within. Soft alluvial soils were also encountered within the eastern areas.





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1.0 INTRODUCTION

1.1 Background

Environmental Planning Solution (EPS) Ltd has been commissioned by ET Planning on behalf of Surrey Heath Borough Council (“the Client”) to undertake a Tier 2 Contaminated Land Generic Quantitative Risk Assessment at the site known as Land South of Broadford Lane, Chobham, GU24 8EL. A Site Location Plan is presented as Figure 1 within Appendix I.

1.2 Proposed Development

EPS understands that the Client is in the process of determining the feasibility of providing additional allocation for Gypsy, Traveller and Travelling Showpeople at the site. The provisional indicative proposed development plans provided (ref. 2022-51-510 C Site Layout As Proposed – West Site and 2022-51-511 C Site Layout As Proposed - East Site, both dated 02/11/2022) show two possible options for the development of the site ranging between 10 and 13 pitches.

Each pitch is indicated to comprise a mobile home, a touring caravan, parking for 1-2 vehicles, waste recycling/storage, an amenity block comprising bath/shower room/ W.C and kitchen/amenity area. These drawings have been presented as drawing Figure 3 and Figure 4 within Appendix I.

1.3 Objectives

This Tier 2 Contaminated Land Generic Quantitative Risk Assessment Report has been commissioned in order to assist with determining the initial feasibility of developing the site from a contaminated land perspective and to determine any key constraints pertaining to the scheme. The layout of the site investigation was limited due to the following:

- ▶ Accessible areas which did not require significant vegetation clearance;
- ▶ The presence of active badger setts which required a ‘no drill’ easement of c. 30m; and
- ▶ Thames water sewage utilities which crossed the site.

This report has been compiled in accordance with Land Contamination Risk Management (LCRM) guidance produced by the Environment Agency dated October 2020 (updated 2023).

1.4 Sources of Information

Background information provided by the Client in relation to the scheme is detailed below:

- ▶ Martin Peacock Architectural Services Limited: 2022-51 Proposed Traveller Site to Land off Broadford Lane (ref. 2022-51): Location Plans (ref. 400 revA and revB), Site Layout as Existing (ref. 500revA and revB), and Site Layout as Proposed (ref. 510revA and revB) Existing Site, all dated November 2022;
- ▶ Apple Environmental Limited: Environmental Desk Study and Preliminary Risk Assessment (ref. CL/3326/SH, dated May 2022) which covered this and a wider site area for a proposed





residential end use;

- ▶ aLyne Ecology Limited: Broadford Lane, Chobham Badger Sett Monitoring Report (version 001, dated April 2023); and
- ▶ Historical Ground Gas Monitoring Results dated February 2018 to June 2023 inclusive and Ground Gas Monitoring Location Plan dated 7th November 2018 (unreferenced).

1.5 Confidentiality

EPS has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from EPS. A charge may be levied against such approval.

1.6 Limitations

The full limitations of this report are presented in Appendix II.





2.0 SITE SETTING

2.1 Site Details

The site is located at National Grid Reference (NGR) is SU9750361159. Reduced levels of exploratory hole locations surveyed on site ranged between c. 25 and 29mAOD.

The site is accessed via a gate off Broadford Lane and along a lane surfaced with concrete which runs from north to south. The site is divided into two distinct areas; east of the lane and west of the lane. Land to the west of the concrete lane was at a similar grade to Broadford Lane, with land to the east generally situated at a higher elevation compared to the adjacent road.

Given the site's former use as a refuse tip between c. 1950 and 1977, ground surface is undulating. A number of historical boreholes with monitoring installation wells were noted. From information provided by the Closed Landfill Manager at Surrey County Council, the site has been monitored for ground gas since c. 2013 as part of the landowner's responsibilities. This information was not included in the Environmental Desk Study undertaken by Apple Environmental in May 2022.

A sewage works is present to the immediate southeast of the site. Some organic odours were noted on the eastern portion of the site during the site investigation works.

Ground cover comprised a mixture of grass, vegetation and trees. Badger setts were present on the eastern sector with 'no dig' exclusions zones placed around them by the Client's ecology consultants (A-Lyne Ecology). A-Lyne ecology also provided a 'watching brief' during the site investigation works.

2.2 Initial Conceptual Site Model

The initial CSM was developed within the Environmental Desk Study prepared by Apple Environmental as summarised below, albeit for a much larger site area (4.71ha). With regards to risk to controlled waters their initial CSM has been updated based on the historical groundwater monitoring data provided by Surrey County Council which shows potential shallow groundwater on site.

Potential "Active" Sources

On-site

- ▶ **Historic Landfilling** - Potential for contaminated soils and ground gases associated with deposition of commercial and industrial waste within the historical landfill between c. 1950's and 1970's.

Off-site

- ▶ **Historic Landfilling** - Potential for contaminated soils and ground gases associated with deposition of inert waste within a historical landfill at Broadford Farm c. 12m to the north of the site in c. 1986. However, it is recorded that this could have been used for ground engineering purposes given the short duration of the waste license (April 1986 to December 1986);
- ▶ **Historical sludge beds** - adjacent to the south-western boundary of the site between the 1930's and 1950's.





Given the low potential of these off-sites sources to pose a significant risk, compared to the former refuse tip historically located on site, they have not been taken forward within the contaminated land assessment.

With regards to the potential for contaminated soils and ground gases associated with deposition of commercial and industrial waste within the wider historical landfill to the south of the site between c. 1950 and 1977, it has been assumed that this poses no more or a risk than on-site sources and as such has not been taken forward within this assessment.

Pathways

- ▶ Migration of mobile contaminants on or off site via services, sewers and manmade conduits;
- ▶ Direct contact, ingestion and inhalation of contaminants on site;
- ▶ Migration of mobile contaminants into groundwater / transport into surface waters;
- ▶ Migration of hazardous gases through permeable soils; and
- ▶ Permeation of potable water supply pipes.

Human Health Receptors

- ▶ **Future site users** (residents).

Construction workers are not considered to be a plausible receptor as exposure will be managed through the use of appropriate PPE and hygienic working practices, as required under HSE/ CDM regulations. Furthermore, potential exposure to possible contaminants is not expected to be over prolonged work duration thereby limiting any impact to ground workers.

Controlled Water Receptors

- ▶ **Secondary A aquifer** contained within the underlying Windlesham Formation and Bagshot Formation bedrock; and
- ▶ **Narrow drain located c. 33m** to the north of the site which runs into the River Bourne situated c. 175m north of the site.





3.0 SITE INVESTIGATION

3.1 Summary of Fieldwork

Site investigation works were carried out on 27th July 2023 and comprised the following scope:

Table 3.1 Summary of Fieldwork

Hole Reference	Rationale	Depth (mbgl)
WS101	Tracked window samples to determine ground conditions and obtain soil samples for subsequent chemical laboratory analysis.	2.00
WS102		3.00
WS103	Installation of ground gas and groundwater monitoring locations within WS101, WS102 and WS104.	2.00
WS104		3.00

Notes: mbgl – metres below ground level. WS – Window sample

An Exploratory Hole Location Plan is presented as Figure 2 within Appendix I and a selection of photographs is presented within Appendix V.

All samples were collected using appropriate PPE and sampling equipment that was cleaned at each sampling location. A detailed copy of sampling methodology, QA procedures and laboratory chain of custody forms can be provided upon request.

3.2 Site Investigation Standards

All exploratory works, associated sampling, in-situ testing, and logging were carried out broadly in accordance with techniques outlined in:

- ▶ BS5930:2015+A1:2020 Code of Practice for Ground Investigations;
- ▶ BS EN ISO 14688-1 Identification of Soil;
- ▶ BS EN ISO 14688-2 Classification of Soil;
- ▶ BS EN ISO 22475 Sampling methods and groundwater measurements; and
- ▶ BS EN ISO 22476 Field Testing, as appropriate.





4.0 LABORATORY ANALYSIS

4.1 Chemical Laboratory Analysis

Chemical laboratory testing was carried out by I2 Analytical based in Watford who are a UKAS and MCERTS accredited laboratory.

The number of tests scheduled are listed in Table 4.1 below:

Table 4.1 Summary of Chemical Analysis of Soil Samples

Test Type and Determinands	No. Scheduled	Remarks
EPS Standard Soil Suite (organic matter, asbestos in soil, heavy metals, PAH's, TPH CWG, BTEX, MTBE, cyanide and phenols)	6	Chemical test certificates presented in Appendix VI. Results discussed in Section 6.
Asbestos Identification	1	

A single groundwater sample was scheduled for the following analysis:

- ▶ pH;
- ▶ Heavy metals;
- ▶ Cyanide;
- ▶ Total hardness;
- ▶ TPH Criteria Working Group (CWG);
- ▶ BTEX and MTBE;
- ▶ Speciated PAH; and
- ▶ Phenols.

Chemical test certificates are presented in Appendix VI and the results are discussed in Section 6.





5.0 GROUND AND GROUNDWATER CONDITIONS

5.1 Summary of Ground Conditions

Ground conditions encountered generally comprised Made Ground relating to the historical waste tip recorded on site, overlying superficial deposits of Alluvium overlying bedrock geology of Windlesham Formation. Further details are provided below with exploratory hole logs presented in Appendix IV.

Made Ground

Western and Central Areas

Made Ground within the western and central areas of the site (exploratory hole locations WS101 to WS103 inclusive), was encountered at ground level and persisted to depths ranging between 0.80 and 1.00mbgl. Soils comprised very sandy clay with varying quantities of secondary constituents such as polythene, iron, timber, flint, brick and concrete. Some cobbles of brick were also noted. Possible combustion waste material and a fragment of asbestos cement (later confirmed to contain chrysotile asbestos) was encountered within WS103.

No further visual or olfactory evidence of contamination was recorded within the Made Ground within exploratory holes WS101 to WS103 inclusive.

Eastern Area

Made ground within exploratory hole location WS104, undertaken within the eastern sector of the site, was also encountered at ground level but persisted to depths >3.0mbgl. The soils encountered within this exploratory hole were more typical of landfill type waste comprising brown and black slightly sandy clay with secondary constituents of flint, brick, paper (remnants of a cigarette packet), ceramic, plastic, metal, rubber and fabric. A hydrocarbon and organic odour was encountered at a depth of 1.50mbgl where soils were noted to be stained black.

Superficial Deposits – Alluvium

Soil that have been assumed to be Alluvium was encountered directly below the Made Ground in exploratory holes WS101 and WS102 within the western area and persisted to depths ranging between 1.10 and 2.40mbgl. This stratum was generally uniform in composition comprising very soft light grey very sandy CLAY with occasional rootlets and semi decomposed plant matter.

Alluvium was not encountered in exploratory holes WS103 and WS104.

No visual or olfactory evidence of contamination was recorded within this stratum.





Bedrock Geology - Windlesham Formation

Soils resembling those of the Windlesham Formation (predominantly clay opposed to sand) were encountered in exploratory holes WS101 to WS103 at depths varying between 1.00 and 2.40mbgl persisting to the full depth of the investigation (>3.0mbgl). This stratum was generally uniform in composition comprising brown, orangish brown, mottled black and light grey slightly sandy CLAY. Slight organic odours were noted.

No visual or olfactory evidence of contamination was recorded within this stratum.

5.2 Groundwater

Groundwater was encountered in a single exploratory hole location (WS104) as detailed further below:

Table 9.1 Summary of Groundwater Strikes

Location	Depth to Water Strike (mbgl)	Stratum	In flow Rate
WS104	2.60	Made Ground	Strike

Groundwater was encountered in the same exploratory hole location (WS104) at a depth of 2.55mbgl during a single return monitoring visit. All remaining monitoring installations were recorded as dry. The results of groundwater level monitoring are presented within Appendix VII.

5.3 In-situ Testing

In-situ hand shear vane testing (HSV) was undertaken at regular intervals during window sampling. The results of the in-situ testing are presented on the exploratory hole logs included within Appendix IV.

Volatile Organic Compound (VOC) vapour monitoring was undertaken using a MiniRAE photoionisation detector (PID) in order to determine the presence / absence of any potential hazardous vapours. Soil samples were placed inside an air-tight bag and then the resulting headspace monitored after a period of 30 minutes. Results are summarised within Table 5.1 overleaf:

Table 5.1 Volatile Organic Compounds (VOCs) Vapour Monitoring

Hole Reference	Depth (mbgl)	VOC Readings (ppm)
WS101	0.40 to 0.60	<0.1
WS102	0.40 to 0.60	<0.1
WS103	0.30 to 0.50	<0.1
WS104	0.40 to 0.60	<0.1
	1.70 to 1.80	<0.1
	2.70 to 2.90	<0.1



5.4 Ground Gas and Groundwater Monitoring

A single return monitoring visit was carried out on 9th August 2023. During the visit gas flow and gas concentrations of methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide were recorded using an infrared gas analyser. Depth to groundwater and base of borehole were recorded using a water level dip meter. The results of the ground gas and groundwater monitoring are presented in Appendix VII.

During this round of monitoring, groundwater encountered within the installation of WS104 was purged by three well volumes and a groundwater sample was collected using a disposable bailer. Chemical Laboratory Analysis is presented in Appendix VI.





6.0 TIER II GENERIC QUANTITATIVE CONTAMINATED LAND RISK ASSESSMENT

6.1 Human Health

The long term (chronic) toxicity risk to human health is assessed by utilising appropriate and conservative generic assessment criteria (GAC) to determine whether potentially unacceptable risks may be present.

To undertake the Tier 2 assessment within the context of the development proposal, EPS has determined that the most appropriate GAC values available will be those based upon a residential end use without plant uptake.

Soil Organic Matter varied between 1.50% and 10% with an average of 3.70%. In order to provide a conservative assessment, GAC based on 2.5% soil organic matter have been utilised where applicable.

The following assessment, summarised in Table 6.1, has primarily adopted the S4UL (Suitable for Use Levels) reference values published by LQM/CIEH in 2015, however for determinants where no S4UL GAC is available, generally either GAC published by EIC/AGS/CL:AIRE or Atkins ATRISK^{soil} soil screening value (SSV) has been used. Due to the absence of a published lead GAC for direct use within the planning regime, the 2014 Defra C4SL (Category 4 Screening Level) has been used as this value is considered to incorporate the latest toxicological, bio-accessibility and exposure modelling research to date.

Table 6.1 Summary of Generic Human Health Toxicity Assessment for Residential End Use (without plant uptake)

Determinand	Units	GAC	GAC Source	No.	[mc]	Location / Stratum	Primary Pathways	Assessment
Inorganics								
Arsenic	mg/kg	40	(i)	6	22		1	
Cadmium	mg/kg	85	(i)	6	1.70		1, 2	
Chromium	mg/kg	910	(i)	6	39		1, 2, 3	
Chromium (VI)	mg/kg	6	(i)	6	2.5		1, 2, 3	
Copper	mg/kg	7,100	(i)	6	110		1, 2	
Lead	mg/kg	310	(iv)	6	470	WS104 @ 1.70 - 1.80	1, 2	See discussion
Mercury [Inorganic]	mg/kg	56	(i)	6	1		1, 2	
Nickel	mg/kg	180	(i)	6	33		1	
Selenium	mg/kg	430	(i)	6	<1.0		1, 2	
Zinc	mg/kg	40,000	(i)	6	570		1, 2	
Cyanide (Total)	mg/kg	34	(iii)	6	40	WS104 @ 1.70 - 1.80	1	See discussion
Asbestos	-	D.	-	6	D	WS103 @ 0.70	3	





Organics PAHs and Phenol								
Phenols	mg/kg	690	(i)	6	<1	N/A	2	No Further Action
Acenaphthene	mg/kg	4,700	(i)	6	1.60		2	
Acenaphthylene	mg/kg	4,600	(i)	6	0.11		2	
Anthracene	mg/kg	35,000	(i)	6	0.78		2	
Benzo(a) Anthracene	mg/kg	14	(i)	6	1.10		1	
Benzo(a)Pyrene	mg/kg	3.20	(i)	6	0.98		1	
Benzo(b) Fluoranthene	mg/kg	4.0	(i)	6	1.4		1	
Benzo(ghi) Perylene	mg/kg	360	(i)	6	0.62		1	
Benzo(k) Fluoranthene	mg/kg	110	(i)	6	0.55		1	
Chrysene	mg/kg	31	(i)	6	1.20		1	
Dibenzo(a,h) Anthracene	mg/kg	0.32	(i)	6	0.14		1	
Fluoranthene	mg/kg	1,600	(i)	6	3.80		1, 2	
Fluorene	mg/kg	3,800	(i)	6	1.60		2	
Indeno (123-cd)Pyrene	mg/kg	46	(i)	6	0.54		1	
Naphthalene	mg/kg	5.6	(i)	6	0.68		4	
Phenanthrene	mg/kg	1,500	(i)	6	3.80		2	
Pyrene	mg/kg	3,800	(i)	6	3.30	1, 2		
BTEX								
Benzene	ug/kg	700	(i)	6	<5.0	N/A	1	No Further Action
Toluene	ug/kg	1,900,000	(i)	6	<5.0		1	
EthylBenzene	ug/kg	190,000	(i)	6	<5.0		1	
M-Xylene	ug/kg	190,000	(i)	6	<5.0		1	
P-Xylene	ug/kg	180,000	(i)	6	<5.0		1	
O-Xylene	ug/kg	210,000	(i)	6	<5.0		1	
Methyl tert-Butyl Ether	ug/kg	120,000	(ii)	6	<5.0		1	
TPH								
Aliphatic C5-C6	mg/kg	78	(i)	6	<0.10	N/A	4	No Further Action
Aliphatic C6-C8	mg/kg	230	(i)	6	<0.10		4	
Aliphatic C8-C10	mg/kg	65	(i)	6	<0.10		4	
Aliphatic C10-C12	mg/kg	330	(i)	6	9		4	
Aliphatic C12-C16	mg/kg	2,400	(i)	6	83		1,4	
Aliphatic C16-C35	mg/kg	92,000	(i)	6	1,120		1	
Aromatic C5-C7	mg/kg	690	(i)	6	<0.10		4	
Aromatic C7-C8	mg/kg	1,800	(i)	6	<0.10		4	
Aromatic C8-C10	mg/kg	110	(i)	6	<0.10		4	
Aromatic C10-C12	mg/kg	590	(i)	6	4		4	
Aromatic C12-C16	mg/kg	2,300	(i)	6	43		1,4	
Aromatic C16-C21	mg/kg	1,900	(i)	6	180		1	
Aromatic C21-C35	mg/kg	1,900	(i)	6	730		1	
Key								
MG	Made Ground							
[mc]	Maximum Concentration Recorded							
D.	Detected							
N.D.	None Detected (Limit of Detection = <0.0001%)							
Primary Pathways								
1	Ingestion of soil and indoor dust and / or oral background exposure;							
2	Consumption of home-grown produce and attached soil;							



3	Inhalation of dust (background and indoor);
4	Inhalation of vapour (background and indoor).
Generic Assessment Criteria (GAC) Source	
(i)	LQM/CIEH Suitable For Use Level (S4UL) (2015);
(ii)	EIC/AGS/CL:AIRE;
(iii)	Atkins ATRISK ^{soil} soil screening value (SSV);
(iv)	Defra Category 4 Screening Level (2014);

The following exceedances to the relevant GAC have been identified:

- ▶ **Lead and Cyanide** – within a sample of Made Ground collected from WS104 at 1.70 – 1.80 bgl; and
- ▶ **Asbestos** – identified to be Chrysotile Cement from WS103 at 0.70mbgl.

Whilst exceedances have been identified in only two locations, given the limited number of sample locations and the inherent heterogenous nature of Made Ground soils, it is considered likely that further exceedances will be present within locations not yet investigated. As such, it is considered that the Made Ground soils across the site may pose a risk to human health.

The primary pathway for Lead is ingestion of soil and indoor dust and / or oral background exposure.

The primary pathway for Cyanide is ingestion of soil and indoor dust.

The primary pathway for asbestos is inhalation of dust (background and indoor), albeit the material was recorded as being cement bound.

Within areas of proposed hardstanding, understood to occupy the vast majority of the site based on current proposals, the pathway will be effectively broken and no significant risk will be posed to future site users.

However, should any vegetated borders be proposed, it is assumed that a nominal thickness of clean imported soil will be required to act as a suitable growing medium. This would also act as a barrier breaking the contamination pathway to future site users. It is also suggested that a no dig membrane is placed between any clean imported soil and underlying Made Ground to prevent accidental exposure in the event of unauthorised alterations. This is understood to be of increased likelihood given the proposed use of the site.





6.2 Controlled Waters

The results of groundwater analysis carried out on samples collected from WS104 have been compared with freshwater Environmental Quality Standards (EQS), UK Drinking Water Standards (DWS) and the World Health Organization (WHO) DWS), as summarised within Table 6.2 below:

Table 6.2 Groundwater Analysis Results and Comparison with Generic Assessment Values

Determinand	Units	Environmental Quality Standard	UK DWS	WHO DWS	WS104
Arsenic	µg/l	50	10	10	2.07
Cadmium	µg/l	0.08	5	3	0.02
Chromium III	µg/l	4.7	50	50	2.7
Copper	µg/l	1	2,000	2000	1.20
Lead	µg/l	1.2	10	10	0.70
Mercury	µg/l	0.07	1	6	<0.05
Nickel	µg/l	4	20	70	13
Zinc	µg/l	10.9	-	-	4.6
Cyanide (Total)	µg/l	1	50	-	1.40
Phenol	µg/l	7.7	-	-	1.20
Anthracene	µg/l	0.1	-	0.05	0.28
Naphthalene	µg/l	2	-	-	0.21
Benzo(a)Pyrene	µg/l	0.27	0.010	0.7	<0.01
Benzo[b] fluoranthene	µg/l	0.017	-	-	<0.01
Benzo[k] fluoranthene	µg/l	0.017	-	-	<0.01
Benzo(ghi)perylene	µg/l	0.0082	-	-	<0.01
Fluoranthene	µg/l	0.0063	-	-	0.88
TPH Ali (C5-C6)	µg/l	-	-	1	<1.0
TPH Ali (C6-C8)	µg/l	-	-	1	<1.0
TPH Ali (C8-C10)	µg/l	-	-	300	<1.0
TPH Ali (C10-C12)	µg/l	-	-	90	<1.0
TPH Ali (C12-C16)	µg/l	-	-	90	<1.0
TPH Ali (C16-C21)	µg/l	-	-	90	<1.0
TPH Ali (C21-C35)	µg/l	-	-	90	<1.0
TPH Aro (C5-C7)	µg/l	-	-	1	<1.0
TPH Aro (C7-C8)	µg/l	-	-	1	<1.0
TPH Aro (C8-C10)	µg/l	-	-	300	<1.0
TPH Aro (C10-C12)	µg/l	-	-	90	15
TPH Aro (C12-C16)	µg/l	-	-	90	60
TPH Aro (C16-C21)	µg/l	-	-	90	70
TPH Aro (C21-C35)	µg/l	-	-	90	35

In cases where the concentration is below the limit of detection (LOD) however the LOD is greater than the screening criteria this has not been considered as an exceedance.

The results of this direct comparison indicates that the screening criteria have been exceeded for the following determinants:

- ▶ **Copper** – EQS exceeded;
- ▶ **Nickel** – EQS exceeded;
- ▶ **Total Cyanide** – EQS exceeded;
- ▶ **Anthracene** – EQS and WHO DWS exceeded; and



- ▶ **Fluoranthene** - EQS exceeded.

No significant risk is posed to drinking water due to the following:

- ▶ The UK DWS have not been exceeded for any determinants based on the limited data set;
- ▶ The site is not located within a groundwater source protection zone (SPZ);
- ▶ No drinking water abstractions are present within 2km of the site; and
- ▶ The fine grained clay deposits of the Windlesham Formation are likely to be of low permeability thus limiting vertical and lateral migration of contaminants.

No significant risk is posed to surface waters due to the following:

- ▶ Although the freshwater EQS have been exceeded for heavy metals and PAH's, these concentrations are considered to be largely representative of perched water within the Made Ground / former refuse tip which is likely to be somewhat locally confined; and
- ▶ In the event that an active pathway to the nearby drain and then into the River Bourne situated c. 175m north of the site is present, it is considered that the concentrations of identified contaminants would be significantly diluted prior to and upon reaching the identified surface water receptor. As such, it is considered that concentrations of identified contaminants within the surface watercourse are not likely to be of significant concern, particularly given that the River Bourne is indicated to have a chemical rating of fail. Additionally, it is not considered that the proposed development would introduce any additional pathways or cause any increase the risk.

6.3 Ground Gas

In accordance with BS8485:2015+A1:2019 and as presented in Table 6.3 below. The worst-case hazardous gas flow rates (Q_{hg}) have been calculated for the single monitoring visit undertaken in addition to the historical information provided by SCC. These results have been calculated by multiplying the maximum recorded stabilised flow (0.1l/h) in any standpipe in a stratum with the maximum peak gas concentration in any other standpipe in that stratum.

Table 6.3 Summary of Ground Gas Monitoring Results

Source of Monitoring Data	Ground Gas	Worst case Gas Flow Rate (l/hr)	Maximum Peak Steady Concentration (% by vol)	Hazardous Gas Flow Rates (Q_{hg})	Indicated Ground Gas Regime
2023 eps site investigation	Methane	<0.1	0.2	0.0002	Characteristic Situation 2 (CS-2)
	Carbon Dioxide	<0.1	12.0	0.012	
SCC Historical Monitoring Data (2018 to 2023)	Methane	0.2	6.60*	0.0132	
	Carbon Dioxide	0.2	16.1*	0.0322	

Key: *assumed to be steady peak concentrations.

The hazardous flow rates in the table above would indicate that the ground gas regime for the site could be classified as Characteristic Situation 1 (CS1). However, given that steady concentrations of





carbon dioxide of greater than 5% have been consistently encountered with monitoring wells installed during the recent site investigation within unsaturated response zones, plus within historical boreholes, it is considered that classification of **Characteristic Situation 2 (CS2)** with **low** hazard potential is more appropriate. This classification should be confirmed via undertaking of further gas monitoring prior to determining appropriate mitigation measures for the proposed development.

It is understood that the majority of proposed enclosed living spaces are likely to be raised above ground such that any ground gas emanating from the soils beneath (eg. touring caravans and mobile homes) would take the path of least resistance and naturally disperse laterally rather than migrate into the structures above. However, for any enclosed living spaces constructed directly onto the ground, the risk will need to be mitigated by the incorporation of suitable gas mitigation measures.





6.4 Developed Conceptual Side Model

EPS has utilised the above investigation findings to develop the site Conceptual Site Model (CSM) and identify unacceptable risks to receptors within the study area as detailed in Table 10.3 below:

Table 10.3 Developed Conceptual Site Model

Source	Containment	Receptors	Migration Pathway	Risk
Heavy metal and Asbestos contamination within Made Ground	On-site	Future Site Users	Ingestion of soils Dermal contact with soils	In areas of proposed hardstanding the pathway will be broken. Should any vegetated borders be proposed, it is assumed that a nominal thickness of clean imported soil will be required to act as a suitable growing medium and this would also act as a barrier preventing human health exposure.
			Permeation of potable water supply pipes	In the absence of targeted analysis of soils along the route of any proposed water supply, it would be prudent to install barrier pipe to ensure drinking water supply for the proposed properties is not adversely affected.
Ground gases	On-site	Future site users	Build up and inhalation of gases within enclosed living spaces	No risk is present where structures are raised allowing free dispersal of ground gas beneath. Where structures are constructed directly onto the ground gas mitigation measures will be required.
Heavy metal and PAH within perched water	On-site	Narrow drain / River Bourne	Lateral migration	The relatively low concentrations identified within perched water are likely to significantly reduce following dilution and as such are unlikely to pose a significant risk.
		Secondary Aquifer	Vertical and lateral migration	Given that the site is not located within a groundwater SPZ and that no drinking water abstractions are present within 2km of the site, this is not considered to pose a significant risk to drinking water. Fine grained clay deposits of the Windlesham Formation are likely to be of low permeability thus limiting vertical and lateral migration of contaminants.





7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Based on the findings of this report, the following conclusions have been made:

- ▶ From the limited data set obtained, historical landfilling appears to be of greater thickness in the eastern areas of the site (>3.0mbgl), compared to the western and central areas (0.80 to 1.00mbgl);
- ▶ Should the eastern sector of the site be developed, then it is likely that significant cut and filling maybe required in order to provide a suitable development platform. It is likely that these near surface soils would predominantly comprise Made Ground relating to historical landfilling. Less cut and filling would be required for the western area;
- ▶ The proposed presence of hard standing across the majority of the site will break the pollutant pathway between identified soil contamination and future site users;
- ▶ Should any vegetated borders be proposed, it is assumed that a nominal thickness of clean imported soil will be required to act as a suitable growing medium and this would also act as a barrier preventing human health exposure;
- ▶ Basic gas mitigation measures will be required for any enclosed living spaces constructed directly onto the ground. However, where enclosed living spaces are raised above the ground allowing ground gases to freely disperse no significant risk will be present;
- ▶ In the absence of targeted analysis of soils along the route of any proposed water supply, it would be prudent to install barrier pipe to ensure drinking water supply for the proposed properties is not adversely affected;
- ▶ It is not considered that a significant risk to drinking water is present given that the site is not located within a groundwater SPZ and there are no potable groundwater abstractions within influencing distance of the site; and
- ▶ Should a pathway be present for perched water underlying the site to reach the nearby drain and River Bourne, it is considered likely that the following dilution with river water the concentrations would fall below the EQS.

7.2 Recommendations

Should the development be progressed beyond the feasibility stage it is recommended that:

- ▶ Given the size of the site, further site investigation works is required to increase the data set, especially in areas where a significant thickness of Made Ground is expected;
- ▶ Further assessment is undertaken in order to confirm that the drain and River Bourne are not significantly affected by contaminants identified within the perched water underlying the site. This could include sampling of river water upstream and downstream of the site. However, potential impacts from the adjacent Waste Water Treatment Works would also need to be considered;
- ▶ Further ground gas monitoring is undertaken in accordance with published guidance to expand the existing data set and confirm the initial ground gas assessment;
- ▶ Following the above, a remediation strategy and verification plan is prepared for approval by





the regulators prior to commencement of development works; and

- ▶ The design of any proposed foundations or roadways should take into consideration the significant thickness of heterogenous Made Ground beneath the site and the potential for chemicals to be present within the ground which could adversely affect concrete structures installed within. Soft alluvial soils were also encountered within the eastern areas.

END OF REPORT



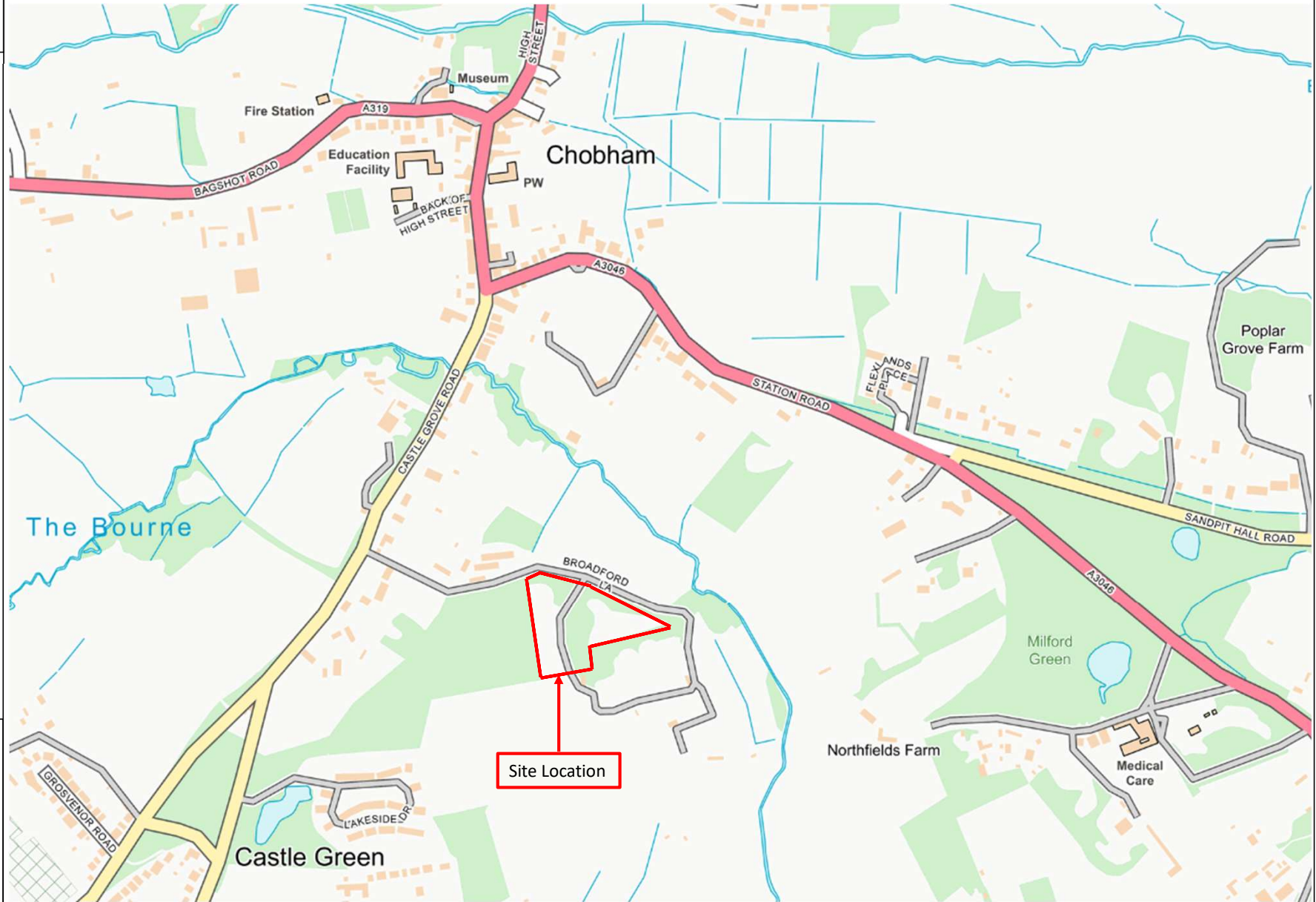


APPENDIX I

DRAWINGS



KEY:



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Job No. & Title:

P1057
Land South of
Broadford Lane

Client:

Surrey Heath
Borough Council

Drawn by: TC

Approved by: SP

Date: September 2023

Notes:

NOT DRAWN TO SCALE

Drawing Title:

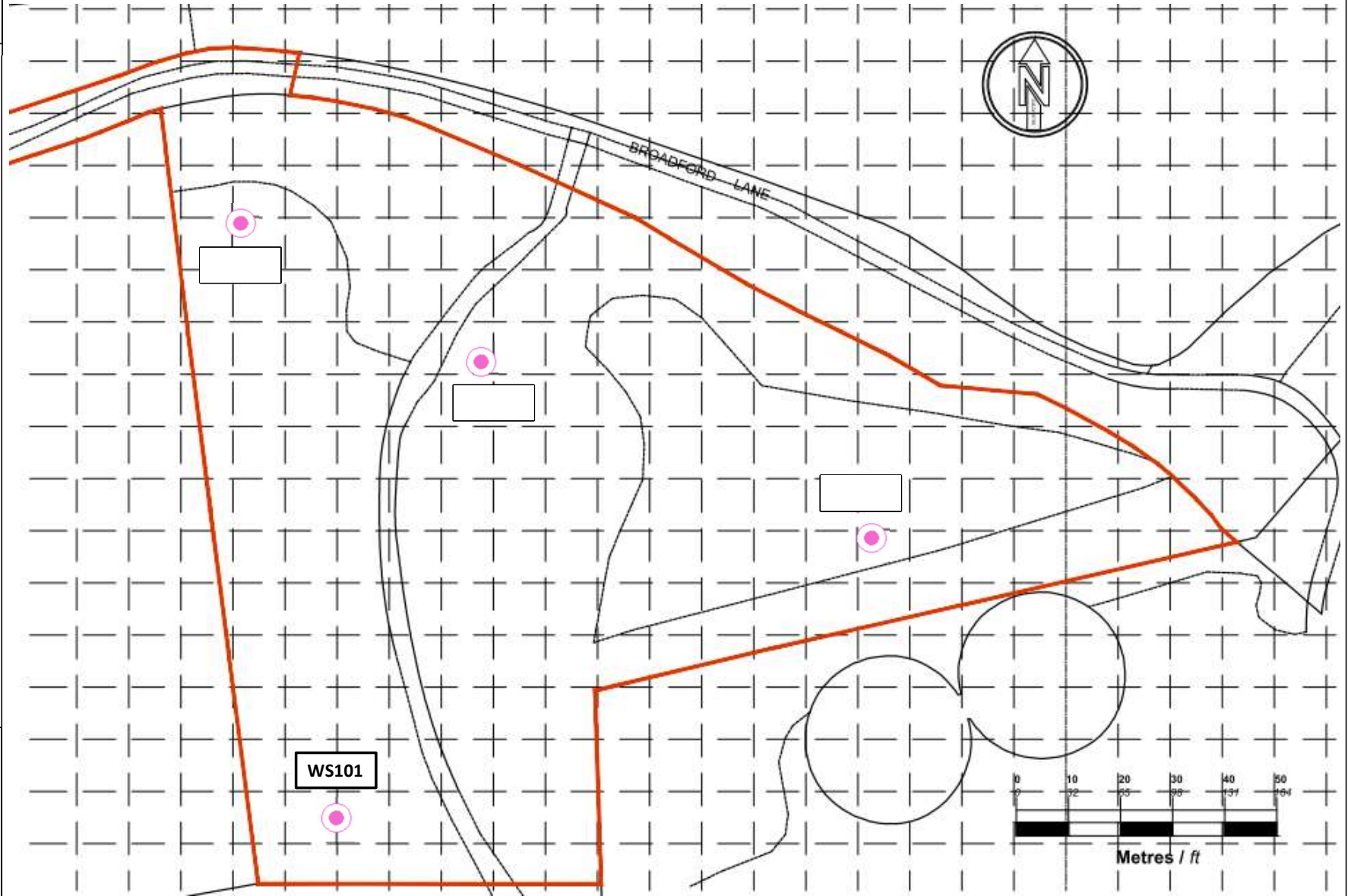
Figure 1
Site Location Plan

KEY:



 Window Sample

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




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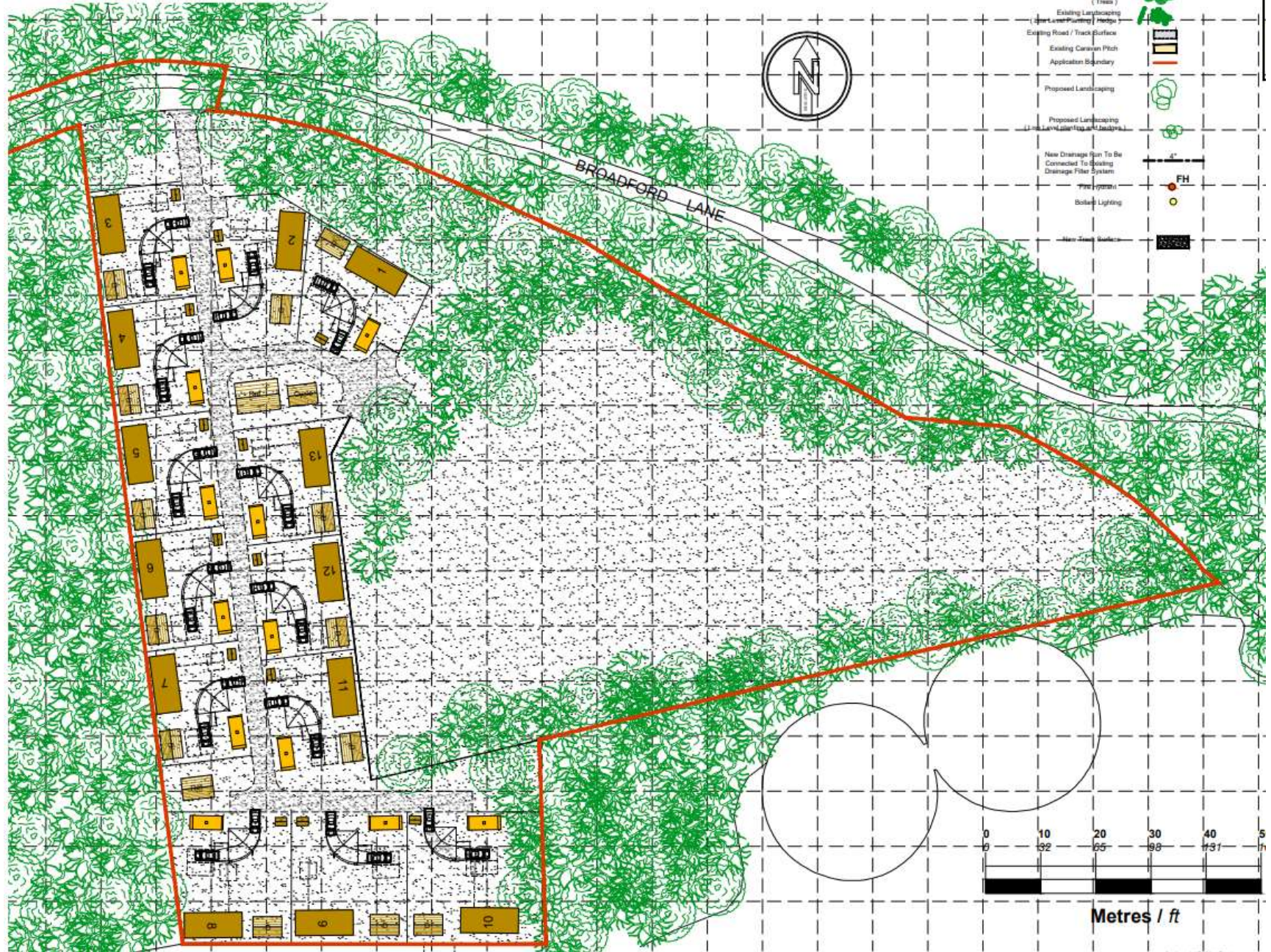
Figure 2
Exploratory Hole
Location Plan

KEY:



Key

- Existing Landscaping (Trees) 
- Existing Landscaping (Shrubs / Plants / Hedggs) 
- Existing Road / Track Surface 
- Existing Caravan Pitch 
- Application Boundary 
- Proposed Landscaping 
- Proposed Landscaping (Line Planting / Hedggs) 
- New Drainage Run To Be Connected To Existing Drainage Filter System 
- Fire Hydrant 
- Bottle Lighting 
- New Tree Markers 



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P1057
Land South of
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Client:

Surrey Heath
Borough Council

Drawn by: TC

Approved by: SP

Date: September 2023

Notes:

NOT DRAWN TO SCALE

Drawing Title:

Figure 3
Proposed Development Plan
(West Site)

KEY:



Key

- Existing Landscaping (Trees) 
- Existing Landscaping (Hedges) 
- Level-Planting Hedges 
- Existing Road / Track Surface 
- Existing Caravan Pitch 
- Application Boundary 
- Proposed Landscaping 
- Proposed Landscaping (Level-planting and hedges) 
- New Drainage Run To Be Connected To Existing Drainage Filter System 
- New Track Surface 



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Job No. & Title:

P1057
Land South of
Broadford Lane

Client:

Surrey Heath
Borough Council

Drawn by: TC

Approved by: SP

Date: September 2023

Notes:

NOT DRAWN TO SCALE

Drawing Title:

Figure 4
Proposed Development Plan
(East Site)



APPENDIX II – LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between EPS and the Client.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. Reasonable effort has been made to obtain an overview of the site conditions. However, during the site works no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. In addition to the above EPS note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Different ground conditions may be identified following the removal of the buildings or hard standing.
7. Site sensitivity assessments (where applicable) have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
8. Where mention has been made (where applicable) to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
9. Where applicable, the executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently, there may be conditions present not revealed by this investigation.
11. EPS cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by EPS is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by EPS in this connection without their explicit written agreement there to by EPS.
12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.





APPENDIX III - GLOSSARY

TERMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation





APPENDIX IV

EXPLORATORY HOLE LOGS





Site Land South of Broadford Lane	Number WS101
---	-------------------------------

Excavation Method Drive-in Windowless Sampler	Dimensions	Ground Level (mOD) 29.35	Client Surrey Heath Borough Council	Job Number P1057
	Location 497450 E 161109 N	Dates 27/07/2023	Engineer Stuart Phillips	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40-0.60	ES1		PID=0.0ppm		(1.00)	Grass over very dry and dessicated light brown very sandy CLAY with occasional roots and sunagular to subrounded gravel of flint, brick and concrete. (MADE GROUND) ...at 0.50mbgl: polythene bag encountered. ...at 0.60mbgl: brick obstruction encountered.		
1.00-1.45	SPT(C) N=6		PID=0.0ppm 2,2/3,1,1,1	28.35 28.25	1.00 (0.10) 1.10	... at 0.90mbgl: section of cast iron pipework encountered. Very soft light grey very sandy CLAY with occasional rootlets and angular to subrounded fine to medium flint gravel. (ALLUVIUM) Firm to stiff light brown and light grey slightly sandy CLAY with some black mottling and slight organic odour. (WINDLESHAM FORMATION)		
2.00-2.45	SPT(C) N=14		2,2/3,4,4,3	27.35	2.00	Complete at 2.00m		

Remarks Specialist utility clearance survey carried out prior to commencement. No groundwater encountered. HDPE standpipe (50mm internal diameter) installed to 2.00mbgl; plain pipe from ground level to 1.00mbgl and slotted pipe from 1.00m to 2.00mbgl. Finished with an upstanding cover.	Scale (approx)	Logged By
	1:20	SP
	Figure No. P1057.WS101	



Site Land South of Broadford Lane	Number WS102
---	-------------------------------

Excavation Method Drive-in Windowless Sampler	Dimensions	Ground Level (mOD) 27.49	Client Surrey Heath Borough Council	Job Number P1057
	Location 497435 E 161218 N	Dates 27/07/2023	Engineer Stuart Phillips	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40-0.60	ES1		PID=0.0ppm PID=0.0ppm		(0.85)	Grass over desiccated slightly silty very sandy CLAY with occasional roots, rootlets, and subangular to subrounded fine to coarse gravel of flint, brick and concrete. (MADE GROUND) ...at 0.50mbgl: cobbles of brick encountered. ...at 0.60mbgl: brick obstruction encountered.		
1.00-1.45	SPT(C) N=4		1,1/1,1,1,1	26.64	0.85	Very soft to soft grey mottled black sandy CLAY with semi-decomposed plant matter throughout. (ALLUVIUM) ...at 1.10mbgl: decomposed tree matter encountered.		
2.00-2.45	SPT(C) N=12		1,2/2,3,3,4	25.09	2.40	Soft to firm light brown and orangeish brown mottled light grey slightly sandy CLAY. (WINDLESHAM FORMATION)		
				24.49	3.00	Complete at 3.00m		

Remarks Specialist utility clearance survey carried out prior to commencement. No groundwater encountered. HDPE standpipe (50mm internal diameter) installed to 3.00mbgl; plain pipe from ground level to 1.00mbgl and slotted pipe from 1.00m to 3.00mbgl. Finished with an upstanding borehole cover.	Scale (approx)	Logged By
	1:20	SP
	Figure No. P1057.WS102	



Site Land South of Broadford Lane	Number WS103
---	-------------------------------

Excavation Method Drive-in Windowless Sampler	Dimensions	Ground Level (mOD) 25.63	Client Surrey Heath Borough Council	Job Number P1057
	Location 497475 E 161202 N	Dates 27/07/2023	Engineer Stuart Phillips	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30-0.50	ES1 PID=0.0		PID=0.0ppm		(1.00)	Light vegetation over dessicated light brown and dark brown sandy CLAY with occasional rootlets, timber fragments and subangular to subrounded fine to coarse gravel of flint, brick, furnace waste and concrete. (MADE GROUND) ...at 0.30mbgl: cobbles of brick and furnace waste encountered. ...at 0.70mbgl: fragment of chrysotile asbestos cement encountered.		
1.00-1.45	SPT(C) N=6		1,1/2,1,1,2	24.63	1.00	Soft to firm light brown and light grey mottled orangish brown slightly sandy CLAY with occasional rootlets. (WINDLESHAM FORMATION)		
1.10	HSV 40kPa		PID=0.0ppm 40,40,40/Av. 40.00	24.43	1.20	Soft to firm light grey mottled brown slightly sandy CLAY with organic odour. (WINDLESHAM FORMATION)		
				24.03	1.60	Firm light brown and orangish brown slightly sandy CLAY. (WINDLESHAM FORMATION)		
2.00	HSV 50kPa		50,50,50/Av. 50.00	23.63	2.00	Complete at 2.00m		

Remarks Specialist utility clearance survey undertaken prior to commencement. No groundwater encountered. Hole backfilled with arisings and made safe upon completion.	Scale (approx)	Logged By
	1:20	SP
	Figure No. P1057.WS103	



Site Land South of Broadford Lane	Number WS104
---	-------------------------------

Excavation Method Drive-in Windowless Sampler	Dimensions	Ground Level (mOD) 27.35	Client Surrey Heath Borough Council	Job Number P1057
	Location 497549 E 161168 N	Dates 27/07/2023	Engineer Stuart Phillips	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40-0.60	ES1		PID=0.0ppm		(1.50)	Grass over dessicated light brown slightly sandy CLAY with occasional roots, rootlets and subangular to subrounded fine to coarse gravel of flint and brick. (MADE GROUND)		
1.00-1.45	SPT(C) N=8		2,3/2,3,2,1					
1.70-1.80	ES2		PID=0.0ppm	25.85	1.50 (0.50)	Very stiff black and dark grey slightly sandy CLAY with slight hydrocarbon odour and occasional gravel sized fragements of paper, brick, flint, ceramic, plastic, metal, rubber and fabric. (MADE GROUND)		
2.00-2.45	SPT(C) N=3		1,2/1,1,0,1	25.35	2.00 (1.00)	Very soft black, brown and bluish green slightly sandy CLAY with occasional rootlets and gravel sized fragments of metal, rubber, paper and cigarette packets. (MADE GROUND)		
2.70-2.90	ES3		Rapid.(1) at 2.60m.	24.35	3.00	Complete at 3.00m		▽1

Remarks Specialist utility clearance survey undertaken prior to commencement. Groundwater strike at 2.60mbgl. HDPE standpipe (50mm internal diameter) installed to 3.00mbgl; plain pipe from ground level to 1.00mbgl and slotted pipe from 1.00m to 3.00mbgl. Finished with an upstanding borehole cover.	Scale (approx)	Logged By
	1:20	SP
	Figure No. P1057.WS104	



APPENDIX V

PHOTOGRAPHS





Photograph 1 – WS101 1.0m to 1.40m



Photograph 2 – WS101 1.4m to 2.0m





Photograph 3 – WS101 Inspection Pit Arisings



Photograph 4 – WS102 1.0 to 2.0m





Photograph 5 – WS102.0 to 3.0m



Photograph 6 – WS102 Inspection Pit Arisings





Photograph 7 – WS103 1.0 to 2.0m



Photograph 8 – WS103 Inspection Pit Arisings





Photograph 9 – WS104 2.0 to 3.0mbgl





APPENDIX VI

CHEMICAL TESTING RESULTS



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Analytical Report Number : 23-48032

Project / Site name:	Broadford Lane	Samples received on:	28/07/2023
Your job number:	P1057	Samples instructed on/ Analysis started on:	31/07/2023
Your order number:	P1057-05-I2-BROADFORD LAN	Analysis completed by:	14/08/2023
Report Issue Number:	1	Report issued on:	14/08/2023
Samples Analysed:	1 bulk sample - 5 soil samples		

Signed:



Ashleigh Cunningham
Customer Service Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-48032
 Project / Site name: Broadford Lane
 Your Order No: P1057-05-12-BROADFORD LAN

Lab Sample Number	2765562	2765563	2765564	2765566	2765567			
Sample Reference	WS101 ES1	WS102 ES1	WS103 ES1	WS104 ES2	WS104 ES3			
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			
Depth (m)	0.40-0.60	0.40-0.60	0.30-0.50	1.70-1.80	2.70-2.90			
Date Sampled	27/07/2023	27/07/2023	27/07/2023	27/07/2023	27/07/2023			
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	4.7	9	8.6	41	23
Total mass of sample received	kg	0.001	NONE	1.8	1.8	1.2	0.8	0.8

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	WEM	WEM	WEM	WEM	WEM

General Inorganics

Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	40	5.6
Organic Matter (automated)	%	0.1	MCERTS	2.4	1.5	1.7	10	2.9

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.68	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.05	0.11	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.05	0.07	0.05	1.6	0.07
Fluorene	mg/kg	0.05	MCERTS	0.05	0.08	0.07	1.6	0.09
Phenanthrene	mg/kg	0.05	MCERTS	0.66	1.2	0.87	3.8	0.44
Anthracene	mg/kg	0.05	MCERTS	0.18	0.29	0.21	0.78	0.11
Fluoranthene	mg/kg	0.05	MCERTS	1.6	2.2	2.1	3.8	1.1
Pyrene	mg/kg	0.05	MCERTS	1.6	1.9	1.8	3.3	0.94
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.77	0.85	0.96	1.1	0.46
Chrysene	mg/kg	0.05	MCERTS	0.86	0.84	1	1.2	0.44
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	1.1	1.2	1.4	1.4	0.57
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.55	0.32	0.42	0.36	0.27
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.95	0.81	0.98	0.82	0.42
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.46	0.42	0.54	0.46	0.22
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.12	0.1	< 0.05	0.14	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.56	0.45	0.62	0.53	0.23

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	9.47	10.6	11.1	21.6	5.39
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.4	10	16	22	9.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	1.7	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	U/S**	2.5
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	22	33	29	39
Copper (aqua regia extractable)	mg/kg	1	MCERTS	48	19	61	110	32
Lead (aqua regia extractable)	mg/kg	1	MCERTS	40	170	140	470	69
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	1	0.5
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	7.7	11	24	33	19
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	41	92	480	570	220

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Analytical Report Number: 23-48032
 Project / Site name: Broadford Lane
 Your Order No: P1057-05-I2-BROADFORD LAN

Lab Sample Number	2765562	2765563	2765564	2765566	2765567			
Sample Reference	WS101 ES1	WS102 ES1	WS103 ES1	WS104 ES2	WS104 ES3			
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			
Depth (m)	0.40-0.60	0.40-0.60	0.30-0.50	1.70-1.80	2.70-2.90			
Date Sampled	27/07/2023	27/07/2023	27/07/2023	27/07/2023	27/07/2023			
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS,1D,AL}	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
TPH-CWG - Aliphatic >EC6 - EC8 _{HS,1D,AL}	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
TPH-CWG - Aliphatic >EC8 - EC10 _{HS,1D,AL}	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
TPH-CWG - Aliphatic >EC10 - EC12 _{EH,CU,1D,AL}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	9	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 _{EH,CU,1D,AL}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	83	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 _{EH,CU,1D,AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	120	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 _{EH,CU,1D,AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	11	1000	39
TPH-CWG - Aliphatic (EC5 - EC35) _{EH,CU+HS,1D,AL}	mg/kg	10	NONE	< 10	< 10	14	1200	41

TPH-CWG - Aromatic >EC5 - EC7 _{HS,1D,AR}	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
TPH-CWG - Aromatic >EC7 - EC8 _{HS,1D,AR}	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
TPH-CWG - Aromatic >EC8 - EC10 _{HS,1D,AR}	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
TPH-CWG - Aromatic >EC10 - EC12 _{EH,CU,1D,AR}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	4	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 _{EH,CU,1D,AR}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	43	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 _{EH,CU,1D,AR}	mg/kg	10	MCERTS	< 10	< 10	< 10	180	13
TPH-CWG - Aromatic >EC21 - EC35 _{EH,CU,1D,AR}	mg/kg	10	MCERTS	10	< 10	12	730	60
TPH-CWG - Aromatic (EC5 - EC35) _{EH,CU+HS,1D,AR}	mg/kg	10	NONE	13	16	17	950	73

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



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Analytical Report Number: 23-48032
Project / Site name: Broadford Lane

Your Order No: P1057-05-12-BROADFORD LAN

Lab Sample Number	2765565		
Sample Reference	WS103 ASB1		
Sample Number	None Supplied		
Depth (m)	0.70		
Date Sampled	27/07/2023		
Time Taken	None Supplied		
Analytical Parameter (Bulk Analysis)	Units	Limit of detection	Accreditation Status

Asbestos Identification	Type	N/A	ISO 17025	Chrysotile-Asbestos Cement
Asbestos Analyst ID	N/A	N/A	N/A	WEM

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-48032
Project / Site name: Broadford Lane

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2765562	WS101 ES1	None Supplied	0.40-0.60	Brown sandy loam with vegetation and gravel
2765563	WS102 ES1	None Supplied	0.40-0.60	Brown loam and sand with brick and gravel
2765564	WS103 ES1	None Supplied	0.30-0.50	Brown loam and sand with vegetation and gravel.
2765566	WS104 ES2	None Supplied	1.70-1.80	Brown clay and sand with vegetation.
2765567	WS104 ES3	None Supplied	2.70-2.90	Brown clay and sand with gravel.

Analytical Report Number : 23-48032
Project / Site name: Broadford Lane

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in Bulks	Asbestos Identification in bulk material with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	W	ISO 17025
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 °C)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Analytical Report Number : 23-48032
 Project / Site name: Broadford Lane

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Acronym	Descriptions				
HS	Headspace Analysis				
MS	Mass spectrometry				
FID	Flame Ionisation Detector				
GC	Gas Chromatography				
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))				
CU	Clean-up - e.g. by Florisil®, silica gel				
1D	GC - Single coil/column gas chromatography				
2D	GC-GC - Double coil/column gas chromatography				
Total	Aliphatics & Aromatics				
AL	Aliphatics				
AR	Aromatics				
#1	EH_2D_Total but with humics mathematically subtracted				
#2	EH_2D_Total but with fatty acids mathematically subtracted				
_	Operator - understore to separate acronyms (exception for +)				
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total				

**U/S due to colour interferences.



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Environmental Science

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Analytical Report Number : 23-50517

Project / Site name:	Broadford Lane	Samples received on:	11/08/2023
Your job number:	P1057	Samples instructed on/ Analysis started on:	11/08/2023
Your order number:	P-1057-06-I2-BROAD	Analysis completed by:	21/08/2023
Report Issue Number:	1	Report issued on:	21/08/2023
Samples Analysed:	1 water sample		

Signed:

Joanna Szwagrak
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



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Environmental Science

Analytical Report Number: 23-50517

Project / Site name: Broadford Lane

Your Order No: P-1057-06-12-BROAD

Lab Sample Number				2778722
Sample Reference				WS104
Sample Number				GW1
Depth (m)				2.55
Date Sampled				09/08/2023
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	1.4
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Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	1.2
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	0.21
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	1.29
Fluorene	µg/l	0.01	ISO 17025	1.08
Phenanthrene	µg/l	0.01	ISO 17025	1.73
Anthracene	µg/l	0.01	ISO 17025	0.28
Fluoranthene	µg/l	0.01	ISO 17025	0.88
Pyrene	µg/l	0.01	ISO 17025	0.68
Benzo(a)anthracene	µg/l	0.01	ISO 17025	0.17
Chrysene	µg/l	0.01	ISO 17025	0.16
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	6.48
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Heavy Metals / Metalloids

Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
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Arsenic (dissolved)	µg/l	0.15	ISO 17025	2.07
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	2.7
Copper (dissolved)	µg/l	0.5	ISO 17025	1.2
Lead (dissolved)	µg/l	0.2	ISO 17025	0.7
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	13
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7
Zinc (dissolved)	µg/l	0.5	ISO 17025	4.6

Monoaromatics & Oxygenates

Benzene	µg/l	3	ISO 17025	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0



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Environmental Science

Analytical Report Number: 23-50517

Project / Site name: Broadford Lane

Your Order No: P-1057-06-12-BROAD

Lab Sample Number				2778722
Sample Reference				WS104
Sample Number				GW1
Depth (m)				2.55
Date Sampled				09/08/2023
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

Petroleum Hydrocarbons

TPH-CWG - Aliphatic## >C5 - C6 _{HS_1D_AL}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic## >C6 - C8 _{HS_1D_AL}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic## >C8 - C10 _{HS_1D_AL}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C10 - C12 _{EH_1D_AL_MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C12 - C16 _{EH_1D_AL_MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C16 - C21 _{EH_1D_AL_MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C21 - C35 _{EH_1D_AL_MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic (C5 - C35) _{HS+EH_1D_AL_MS}	µg/l	10	NONE	< 10

TPH-CWG - Aromatic >C5 - C7 _{HS_1D_AR}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C7 - C8 _{HS_1D_AR}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C8 - C10 _{HS_1D_AR}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C10 - C12 _{EH_1D_AR_MS}	µg/l	10	NONE	15
TPH-CWG - Aromatic >C12 - C16 _{EH_1D_AR_MS}	µg/l	10	NONE	60
TPH-CWG - Aromatic >C16 - C21 _{EH_1D_AR_MS}	µg/l	10	NONE	70
TPH-CWG - Aromatic >C21 - C35 _{EH_1D_AR_MS}	µg/l	10	NONE	35
TPH-CWG - Aromatic (C5 - C35) _{HS+EH_1D_AR_MS}	µg/l	10	NONE	180

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



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Environmental Science

Analytical Report Number : 23-50517

Project / Site name: Broadford Lane

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

- Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised.



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Analytical Report Number : 23-54964

Project / Site name:	Broadford	Samples received on:	18/08/2023
Your job number:	P1057	Samples instructed on/ Analysis started on:	07/09/2023
Your order number:	P1057-07	Analysis completed by:	12/09/2023
Report Issue Number:	1	Report issued on:	12/09/2023
Samples Analysed:	1 soil sample		

Signed: _____
Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-54964
 Project / Site name: Broadford
 Your Order No: P1057-07

Lab Sample Number		2802683		
Sample Reference		WS104 ES1		
Sample Number		None Supplied		
Depth (m)		0.40-0.60		
Date Sampled		27/07/2023		
Time Taken		1700		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	9.7
Total mass of sample received	kg	0.001	NONE	0.8

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	PDO

General Inorganics

Total Cyanide	mg/kg	1	MCERTS	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	3.2

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.22
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.5
Pyrene	mg/kg	0.05	MCERTS	0.45
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.22
Chrysene	mg/kg	0.05	MCERTS	0.25
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.29
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.13
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.25
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.14
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.16

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	2.61
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	13
Copper (aqua regia extractable)	mg/kg	1	MCERTS	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	42
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	5.5
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	51

Analytical Report Number: 23-54964
 Project / Site name: Broadford
 Your Order No: P1057-07

Lab Sample Number	2802683		
Sample Reference	WS104 ES1		
Sample Number	None Supplied		
Depth (m)	0.40-0.60		
Date Sampled	27/07/2023		
Time Taken	1700		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Monoaromatics & Oxygenates

Compound	Units	Limit of detection	Accreditation Status	Result
Benzene	µg/kg	5	MCERTS	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0

Petroleum Hydrocarbons

Compound	Units	Limit of detection	Accreditation Status	Result
TPH-CWG - Aliphatic >EC5 - EC6 _{HS,1D,AL}	mg/kg	0.1	NONE	< 0.10
TPH-CWG - Aliphatic >EC6 - EC8 _{HS,1D,AL}	mg/kg	0.1	NONE	< 0.10
TPH-CWG - Aliphatic >EC8 - EC10 _{HS,1D,AL}	mg/kg	0.1	NONE	< 0.10
TPH-CWG - Aliphatic >EC10 - EC12 _{EH,CU,1D,AL}	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 _{EH,CU,1D,AL}	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 _{EH,CU,1D,AL}	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 _{EH,CU,1D,AL}	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) _{EH,CU+HS,1D,AL}	mg/kg	10	NONE	< 10

Compound	Units	Limit of detection	Accreditation Status	Result
TPH-CWG - Aromatic >EC5 - EC7 _{HS,1D,AR}	mg/kg	0.1	NONE	< 0.10
TPH-CWG - Aromatic >EC7 - EC8 _{HS,1D,AR}	mg/kg	0.1	NONE	< 0.10
TPH-CWG - Aromatic >EC8 - EC10 _{HS,1D,AR}	mg/kg	0.1	NONE	< 0.10
TPH-CWG - Aromatic >EC10 - EC12 _{EH,CU,1D,AR}	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 _{EH,CU,1D,AR}	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 _{EH,CU,1D,AR}	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic >EC21 - EC35 _{EH,CU,1D,AR}	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic (EC5 - EC35) _{EH,CU+HS,1D,AR}	mg/kg	10	NONE	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



Analytical Report Number : 23-54964
Project / Site name: Broadford

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2802683	WS104 ES1	None Supplied	0.40-0.60	Brown loam and sand with gravel and vegetation.

Analytical Report Number : 23-54964
Project / Site name: Broadford

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS

**For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.**

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics



Analytical Report Number : 23-54964
 Project / Site name: Broadford

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
AL	Aliphatics				
AR	Aromatics				
#1	EH_2D_Total but with humics mathematically subtracted				
#2	EH_2D_Total but with fatty acids mathematically subtracted				
-	Operator - understore to separate acronyms (exception for +)				
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total				

Sample Deviation Report



Analytical Report Number : 23-54964

Project / Site name: Broadford

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS104 ES1	None Supplied	S	2802683	c	Hexavalent chromium in soil	L080-PL	c
WS104 ES1	None Supplied	S	2802683	c	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	c
WS104 ES1	None Supplied	S	2802683	c	Monohydric phenols in soil	L080-PL	c
WS104 ES1	None Supplied	S	2802683	c	Organic matter (Automated) in soil	L009-PL	c
WS104 ES1	None Supplied	S	2802683	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS104 ES1	None Supplied	S	2802683	c	TPHCWG (Soil)	L088/76-PL	c
WS104 ES1	None Supplied	S	2802683	c	Total cyanide in soil	L080-PL	c



APPENDIX VII

GROUND GAS AND GROUNDWATER MONITORING RESULTS



Project no: P1057
 Project: Land south of Broadford Lane
 Client: Surrey Heath Borough Council

Monitored by: Tim Conibear / Stuart Phillips



Date	Time	Hole Location	Response zone (m)	Depth m		Relative Pressure (mbar)	Flow Rate (l/h)		Methane CH ₄ (% v/v)		Carbon dioxide CO ₂ (% v/v)		Oxygen % v/v (Low)	Carbon monoxide CO ppm (Peak)	Hydrogen sulphide H ₂ S ppm (Peak)	Comments
				Water	Base		Initial	Steady	Peak	Steady	Peak	Steady				
09/08/2023	10:00am	WS101	1.00 - 2.00	Dry	2.00	1019	<0.1	<0.1	0.1	0.0	4.5	1.3	17.0	<1	<1	Damp at base
	10:30am	WS102	1.00 - 3.00	Dry	2.88	1017	<0.1	<0.1	0.2	0.2	12.0	12.0	7.4	5	<1	Damp at base
	11:00am	WS104	1.00 - 3.00	2.55	2.89	1018	<0.1	<0.1	0.1	0.1	8.7	8.7	11.9	6	<1	

Monitoring date	Atmospheric Pressure Trend
09/08/2022	1017 mbar rising to 1018 mbar