



CAMPBELL ROAD, EASTLEIGH - VALIDATION REPORT

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Prepared For:

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B30 3HX

Remediation Validation Report (R1)

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EXECUTIVE SUMMARY

Objectives	ADI Group appointed Envirotreat to provide technical support during the requisite enabling works for the redevelopment of Area 2 (western area) of the former industrial site at Campbell Road, Eastleigh.
Scope of work	• Provision of a “watching brief” during enabling works and earthworks including the management of surplus soil stockpiles on site to minimise risks to the client (especially in respect to potentially hazardous soils) • Provision of a “Discovery Strategy” for any unexpected contamination or contamination encountered in areas not previously investigated. • Decommissioning of existing on site deep boreholes • Supervision of enabling works activities (stockpile management) in accordance with the agreed Materials Management Plan (MMP). • Supervision of any required off site disposal of surplus soils • Verification of gas membrane installation (a gas membrane was installed notwithstanding the site being re-assessed as CS1) • Verification of clean service corridor installation • Verification of clean capping • Provide a comprehensive Validation Report which will detail all works undertaken, analysis (including analytical reports), a full photographic record and include all consignment notes, all licences and permits
Ground model	The Delta Simons – Report Ref 17-1080.05. dated March 2019 recorded the following for the site as a whole: Ground conditions were found to comprise generally granular Made Ground with localised areas of cohesive deposits to depths <1.0m bgl although locally to 2.5m bgl. The underlying natural strata was found to comprise a band of firm clay depths between 2.0 and 2.5m bearing onto River Terrace Gravels and in turn the London Clay Formation at approximately 6m bgl. Groundwater was consistently recorded at depths between 3.5m and 4.0m bgl.
Human health risk assessment	Human Health risks would be addressed by the development itself (gas membrane, concrete slab / hardstanding) and the 300 mm clean capping layer in soft landscaped areas.
Controlled waters risk assessment	Elevated contaminants of concern were not recorded in groundwater sampled from beneath the site (Area 2 – western area) that exceeded the adopted assessment criteria.
Further work	This report is the Final Validation Report

This executive summary is to be read in conjunction with the remainder of the report and should not be relied upon in isolation.

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A. INTRODUCTION

1. Terms of Reference

Envirotreast Solutions Ltd (hereinafter referred to as Envirotreast) was appointed by ADI Group (hereinafter referred to as 'the client') to validate remediation of contaminant linkages associated with the development of Area 2 of the Former Eastleigh Works site, Campbell Road, Eastleigh ('the site').

2. Aims and Objectives

The aim of this Validation Report is to present details on the remediation works undertaken at the site to mitigate risks to human health and to confirm that works have been completed in accordance with the approved Remediation Strategy.

3. Previous Reports

Envirotreast has been provide with the following previous reports pertaining to the site *as a whole*:

- Delta Simons - *Geo-Environmental Assessment, Eastleigh Works, prepared for Diageo Investment Fund Limited* (report ref: 17-1080.15) Dated March 2019

The following report relates to the development area only (Area 2):

- *Envirotreast Solutions Limited* – Supplementary Site Investigation. Dated 21st February 2022 (relating to site works undertaken on the 3rd February 2022)
- Envirotreast Solutions Ltd – Eastleigh Works Units 200, 205 and 210 Ground Gas Risk Assessment. Dated May 2023
- Materials Management Plan

This report shall be read in conjunction with the above reports. Particular attention shall be made to the Remediation Strategy and Method Statement, which sets out the scope of works presented herein.

4. Regulatory Liaison

4.1. Planning Conditions

Planning permission has been granted for the redevelopment of the site (F/20/87841). This decision notice includes contamination related pre-commencement planning conditions (planning condition 30). These stipulate that prior to commencement, a site investigation is undertaken, a Remediation Strategy submitted including measures for addressing any unexpected contamination and the submission of a Validation and Verification Report.

During construction works, Envirotreast liaised with the LPA regarding the level of ground gas risk. Additional investigation of the plots under construction concluded that the ground gas regime could be reclassified as CS1 (characteristic situation 1) and thus gas protection measures were not required. These findings were submitted to the LPA on 22nd February 2023, with a response received on 4th May 2023. The LPA confirmed that, subject to provision of additional information, the conclusions were supported, and ground gas mitigation measures could be removed form the development. The additional information was submitted on 22nd May 2023.

It is intended that this report be submitted to the local planning authority to facilitate discharge of planning condition 31.

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4.2. Regulatory Controls/ Permits

Due to the scale and nature of the works, formal deployment of the ESL Mobile Treatment License was not necessary.

The works were undertaken in accordance with the submitted Remediation Method Statement.

Soil movement and reuse was undertaken under a CL:AIRE approved Materials Management Plan.

B. BACKGROUND INFORMATION

5. Basic Site Details

5.1. Site Location

The **whole** site comprises an irregular parcel of land located off Campbell Road, 0.5 km south-east of Eastleigh town centre (see Figure 1). It occupies an area of around 18,000m² (Area 2). The Site is split into two phases, comprising Phase I in the north and Phase II in the south.

Surrounding land use comprises residential properties with gardens backing onto the southwest boundary, with the London to Southampton mainline forming the southwest boundary in the north of the site along with Campbell Road. The eastern boundary of the site is formed by Eastleigh Works comprising a series of railway sidings, maintenance depot, above ground tanks and plastic and metal recycling yards. The southern boundary is formed by Southampton Airport.

The development works formed a part of whole site as shown in Figure 2 below, the development area consisted of Plot 305.

Envirotreast understands that the proposed development works at the site will comprise the demolition of existing buildings and erection of a new unit (split into units 200, 205 and 210), see Figure 3

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Figure 1 – Site Location

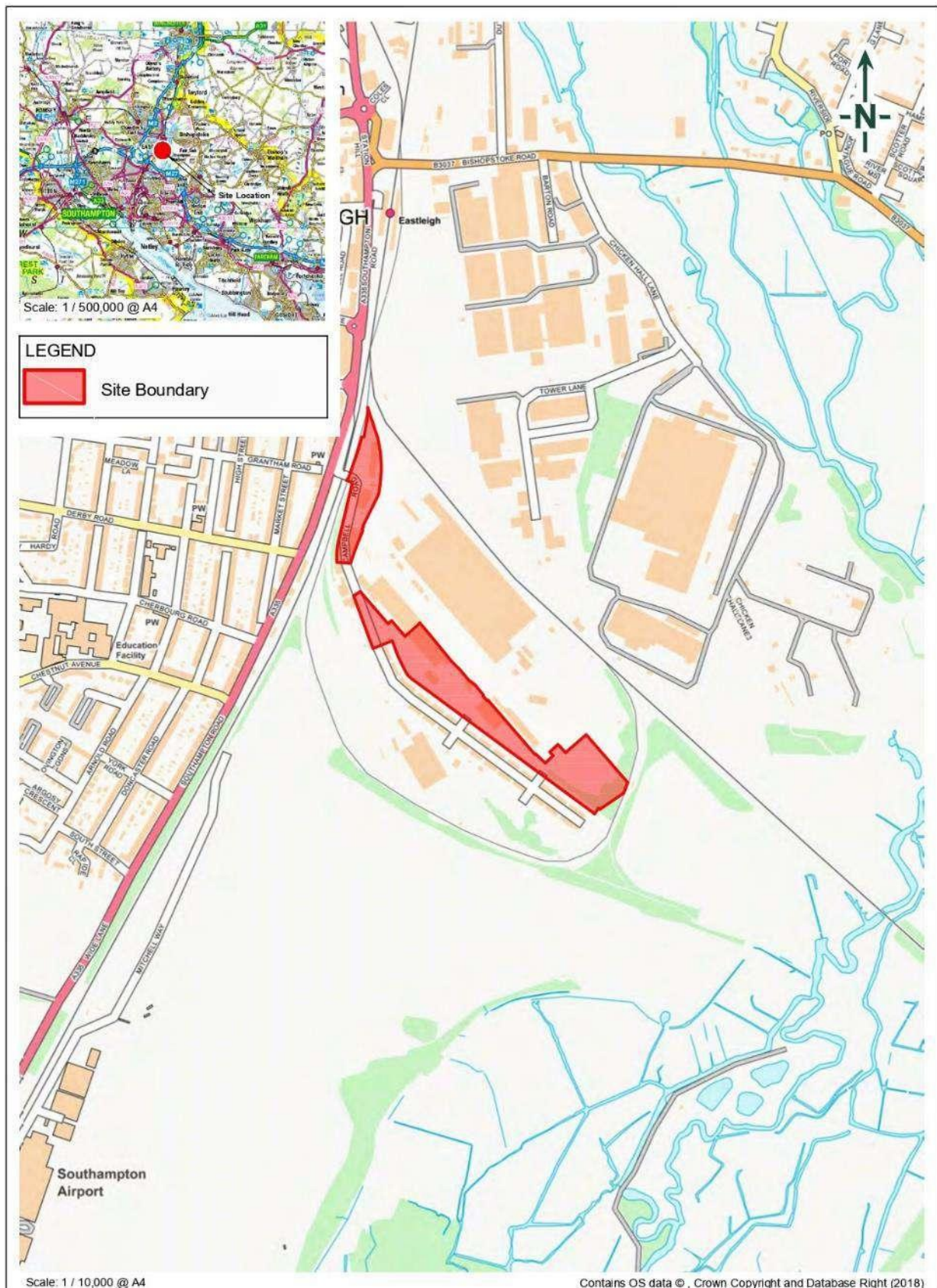
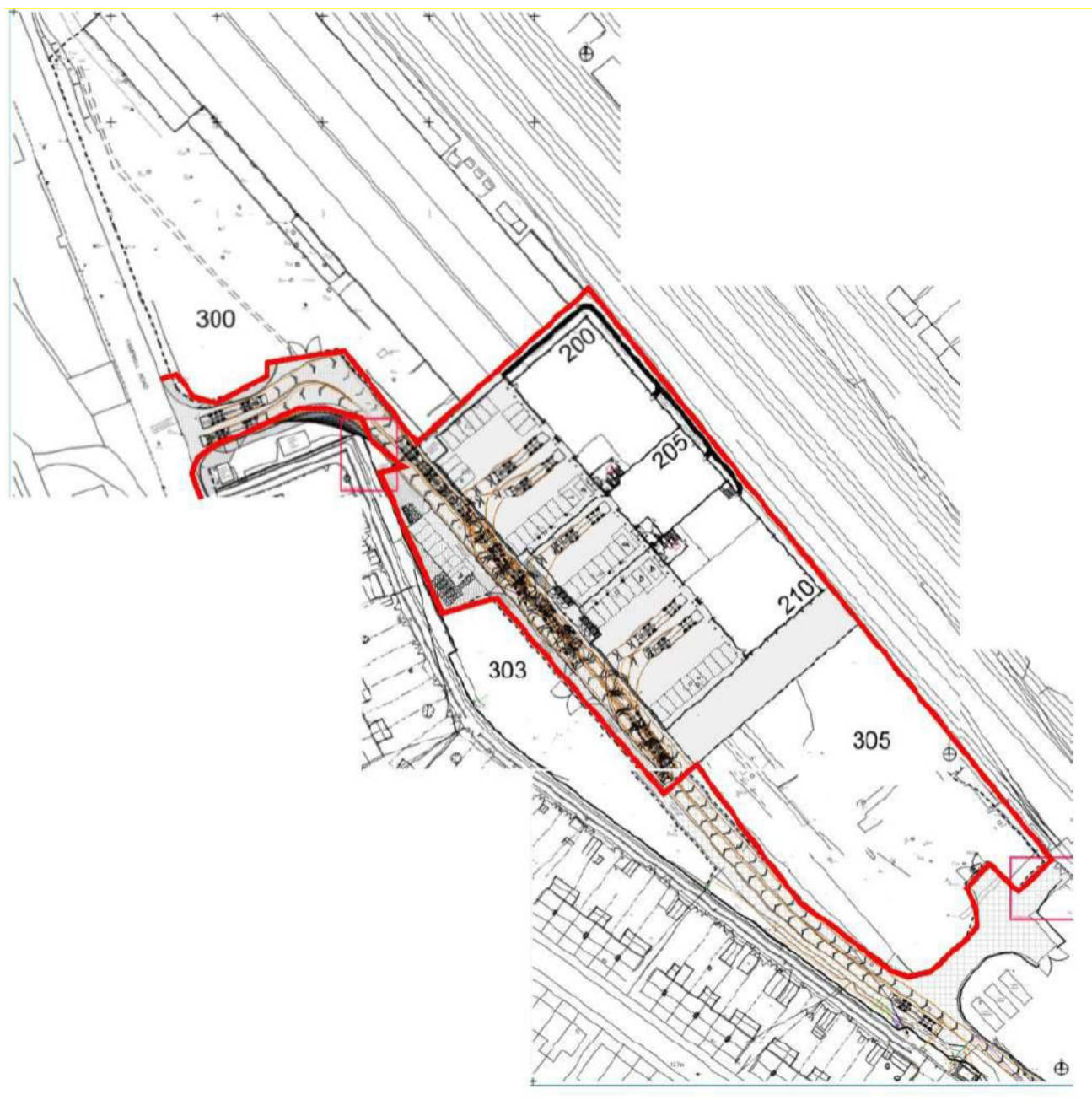


Figure 2 – Plot 305 in relation to whole site.



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Figure 3 – Development within Plot 305 ie 200, 205 and 210.



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5.2. Overall Objectives

Delta Simons identified potential contaminant linkages relating to the historic use of the site and receptors.

The following scope of works is proposed to address the remediation requirements:

- Decommissioning of existing on site deep boreholes
- Provision of a “watching brief” during enabling works
- Provision of a “Discovery Strategy”.
- Provision of a comprehensive Validation and Verification Report detailing the works undertaken, supporting documentation and photographic record.
- Human Health risks will be addressed by the development itself (gas membrane, concrete slab / hardstanding) and the 300 mm clean capping layer in soft landscaped areas.

5.3. Summary of Environmental Setting

5.3.1. Historical Site Uses

The site has seen historical uses as a locomotive repair and maintenance works (Eastleigh Works). The development area (Area 2) has been used for various manufacturing units / storage sheds more recently. The remaining Eastleigh Works, maintenance depot and railway sidings form the eastern boundary, with residential properties to the west.

5.3.2. Ground Conditions for the site as a whole

Geology - Published British Geological Survey mapping (1:50,000 ‘Solid and Drift’, Sheet Number 315, Southampton, dated 1987), indicates the entire Site to be underlain superficial deposits comprising the River Terrace deposits consisting of loam and clay, bearing onto gravels. The underlying solid strata is indicated to comprise the Wittering Formation in the south east consisting of sand, silt and clay bearing onto the London Clay Formation which is indicated to outcrop in the north west. The London Clay Formation is indicated to comprise clay bearing onto bands of sand and gravel. Deeper strata beneath the London Clay Formation is expected to comprise the Lambeth Group bearing onto the White Chalk Subgroup.

Ground conditions beneath the subject site typically comprised a thin veneer of granular Made Ground overlying cohesive natural soils. Made Ground was proven to between 0.3m and >1.1m and was generally black with tarmac and clinker. The underlying natural soils comprised orange-brown clay, occasionally slightly gravelly. This was interpreted as the uppermost, cohesive strata of the River Terrace Deposit. This deposit coarsened downwards through slightly sandy slightly gravelly clay to sand and gravel by circa 3.5m bgl.

The underlying London Clay was rarely identified in the window sample borehole but has been identified at depths ranging from 4.5m to 6.3m bgl in 3no positions.

Hydrogeology - The Environment Agency classify the River Terrace Deposits as a Secondary Undifferentiated Aquifer, the Wittering Formations as a Secondary A Aquifer and the London Clay Formation as an Unproductive Stratum. The deeper Lambeth Group is also expected to be classified as a Secondary A Aquifer whilst the deeper White Chalk Subgroup is expected to be classified as a Principal Aquifer.

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The Environment Agency data also indicates that the Site is not in a designated groundwater Source Protection Zone. According to the Envirocheck® Report, there are no licensed abstraction records from groundwater located within 2 km of the Site.

Hydrology The following controlled water / environmental receptors have been identified:

- A surface water drain feature 140 m to the east; and
- The River Itchen running north to south approximately 500 m south east of the Site

During the previous site investigation works groundwater was noted in 3no boreholes within the granular River Terrace Deposits at depths ranging from 4.0m to 4.4m bgl (9.33m to 9.98m AOD (above ordnance datum)). Groundwater was estimated to flow from north to south.

5.4. Development Proposal

5.4.1. Development Team

The site will be redeveloped for commercial end use with associated parking, access and landscaped areas.

The development will be carried out by:

ADI Group

66 Melchett Rd,

Kings Norton Business Centre,

Birmingham

B30 3HX

5.4.2. Proposed Development

The Proposed development is shown in Figure 4 below.

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Figure 4 - Proposed Development



Remediation Verification Report

C. REMEDIATION WORKS

6. Introduction

The CSM carried out by Delta Simons for the site as a whole identified risks to human health (asbestos and heavy metals) and controlled waters (TPH and PAH). Envirotreat evaluated the contamination relating to Plot 305 and considered that human health risks (namely asbestos and heavy metals) would be mitigated by the import of clean capping material and the areas of hardstanding to be incorporated within the proposed development. These would provide an effective pathway break between any contamination (source) and human receptors.

Boreholes installed in this area (namely BH106, BH107, BH105, BH109 and BH110) did not record contaminants that exceeded the appropriate screening criteria, therefore groundwater remediation in this area is not required.

Additional ground gas risk assessment completed by Envirotreat has concluded that mitigation of ground gas risk is not required in the subject plots.

The overall approach for remediation was as follows:

1. Provision of a “watching brief” during enabling works and earthworks including the management of surplus soil stockpiles on site to minimise risks to the client (especially in respect to potentially hazardous soils) in accordance with the agreed Materials Management Plan (MMP).
2. Provision of a “Discovery Strategy” for any unexpected contamination or contamination encountered in areas not previously investigated.
3. Decommissioning of existing on site deep boreholes
4. Supervision of any required off site disposal of surplus soils
5. Verification of gas membrane installation
6. Verification of clean service corridor installation
7. Verification of clean capping

7. Watching Brief

Envirotreat provided a watching brief during enabling and earthworks operations at the site. This related to the following elements:

Reduced Level Dig

The development required a reduced level dig to accommodate the floor slab makeup.

The Site Investigation carried out by Delta Simons (relating to the site as a whole) and the Supplementary Site Investigation carried by Envirotreat (relating to Plot 305 only) confirmed the site to be underlain by a thin layer of ash / clinker made ground (approx. 100 mm – 500 mm increasing in depth toward the southwest of the development site). Under the declared MMP the intention was to reuse Made Ground on site as far as practically possible (assuming chemical and geotechnical suitability). A cut and fill assessment indicated a net surplus of soils for the development, this would consist of natural soils and unsuitable Made Ground. All surplus soils were to be removed from site to a suitably licenced facility.

Remediation Verification Report

Hardstanding areas (predominantly reinforced concrete) were broken out and stockpiled to await crushing. The underlying ashy made ground was removed and stockpiled as per the agreed stockpile management plan (see Appendices D of declared MMP), there were deviations from this in terms of actual stockpile locations, however the basic principles were adhered to. Equally, the underlying natural clay was removed to the required depth and stockpiled separately. All materials were visually inspected prior to stockpiling. During each watching brief visit, a check was carried out to ensure stockpiles were appropriately separated to avoid potential cross contamination.

On site geotechnical assessments undertaken by the groundworks company at formation level, indicated that the required ground bearing capacities had not been achieved. The client took the decision to further reduce the formation level to enable an increase in slab make up. This resulted in an additional off site disposal volume.

Figure 5 – Demolition Stockpile (prior to crushing).



Remediation Verification Report

Figure 6 – Made Ground Stockpile.



Figure 7 – Natural Soils Stockpile.



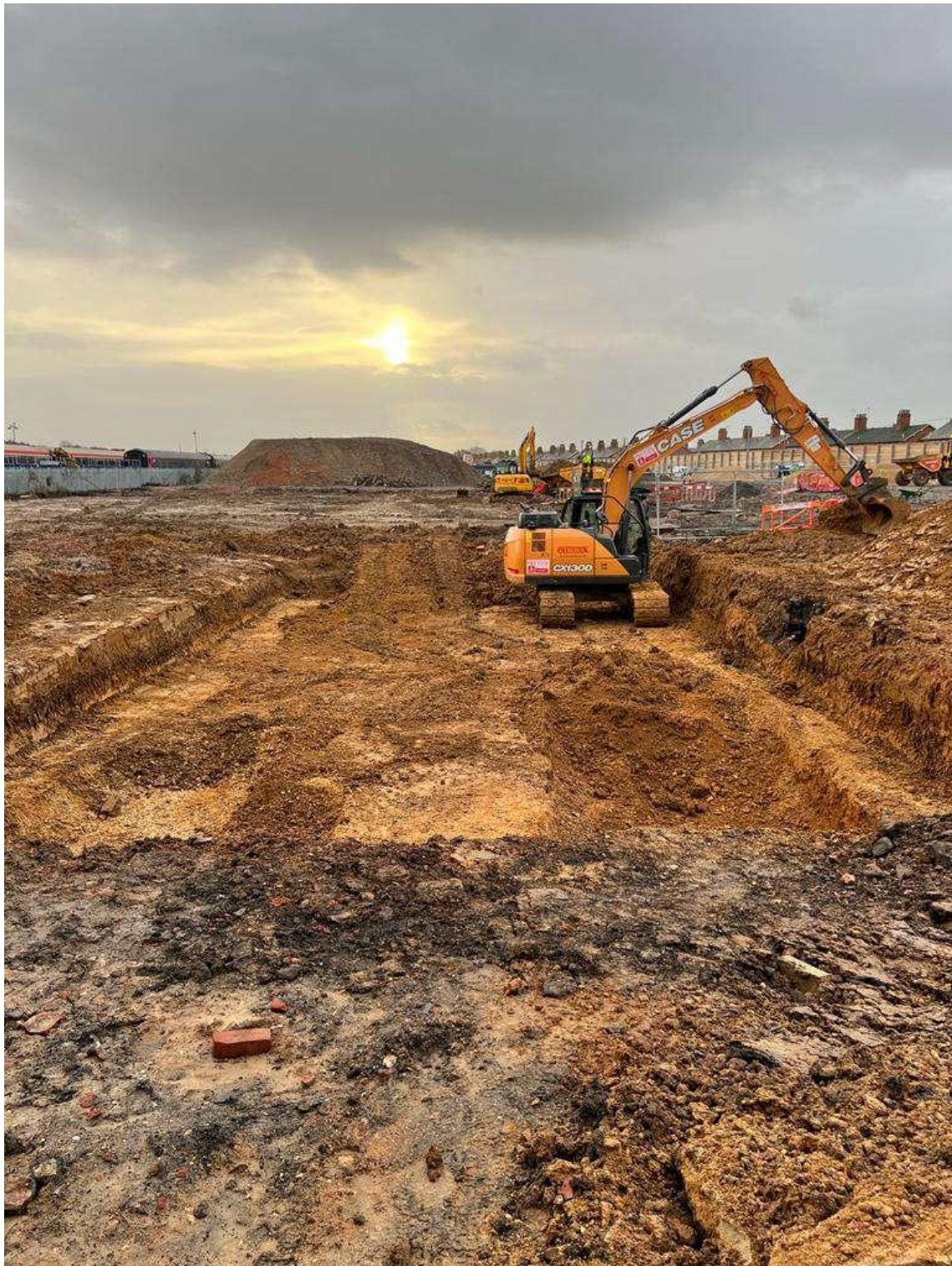
Remediation Verification Report

Figure 8 – Watching brief during groundworks.



Remediation Verification Report

Figure 9 – Watching brief during groundworks.



7.1.1. Installation of Drainage & Service Ducts

Excavated soils from the installation of attenuation tanks, manhole installations, storm / foul drainage runs and required service ducts were visually inspected and stockpiled in accordance
November 2023

Remediation Verification Report

with the requirements of the stockpile management plan and agreed MMP. All materials that visually appeared to be ashy in appearance was stockpiled accordingly. All natural soils / clays were stockpiled accordingly.

Figure 10 – Watching brief during drainage & service ducts.



8. Decommissioning of onsite Deep Boreholes

A full and thorough investigation of the development site was undertaken to identify historical (deep) boreholes. These were decommissioned to ensure potential onsite contamination was not transported to the underlying aquifer (river terrace deposits) via the preferential pathway offered by the borehole installation.

Remediation Verification Report

The boreholes Envirotreast installed as part of the gas monitoring investigation (albeit shallow) were equally decommissioned on completion of this part of the works.

Figure 11 – Decommissioning boreholes.



Remediation Verification Report

9. Supervision of Off-Site Disposal of Surplus Soil

Excavated soil from the various groundworks' activities were stockpiled (as set out in section 7 above) in accordance with the requirements of the agreed MMP.

Soils were transported off site as per the summary spreadsheet / waste transfer notes.

The soils were taken to

Four Dell Waste Facility Poles Lane Otterbourne Winchester Hampshire SO21 2DY Permit EPR/JP3890VC.

Under EWC 17.05.04 (non-hazardous soils and stones)

10. Provision of a Discovery Strategy

Throughout the enabling works and subsequent groundworks no unexpected contamination was encountered. Below ground conditions in areas not previously investigated were observed to be consistent with the conditions recorded in the site investigation works.

11. Verification of Gas Membrane Installation

The ground gas risk assessment concluded the wider site should be classified as CS (characteristic situation) 2 and thus ground gas mitigation was required. The client commissioned Envirotreat to undertake a further assessment specific to the development area.

The subsequent works demonstrated that the gas risk for these units could be reclassified as CS1. See appended report.

A gas membrane was installed.

12. Verification of Clean Service Corridor Installation / Barrier Pipe

The excavation of service duct corridors was carried out as per the requirements / recommendations of the Delta Simons Site Investigation report.

Clean imported materials were used around the services.

At the time of writing there were no water pipe installations.

Remediation Verification Report

Figure 12 – Services Installation.



13. Verification of Clean Capping / Topsoil

The quality of imported clean capping material and topsoil was verified prior to import. See appended documentation.

D. CONCLUSIONS AND RECOMMENDATIONS

14. Conclusions

Envirotreat has completed the designated remediation works at the former Eastleigh Works, Eastleigh in accordance with the requirements of the agreed Delta Simon Remediation and Verification Strategy (dated January 2021).

The remediation works comprised a watching brief during earthworks / enabling works, verification of service ducts / corridors, barrier pipe, decommissioning of remaining deep boreholes within the development area and verification of clean capping. Verification of gas membrane installation was determined not required.

15. Recommendations

Based on the above assessment, the following actions are recommended:

- This report be submitted to Eastleigh Borough Council for their approval.

21st February 2022

ADI,
66 Melchett Road,
Kings Norton Business Centre,
Kings Norton,
Birmingham,
B30 3HX

Reference – Supplementary Site Investigation 3rd February 2022.

Dear John / Russell,

Please find below a summary of our site investigation works undertaken on 3rd February 2022.

Six number windowless borehole were advanced across the development area. The areas were chosen based on:-

- Data gaps in our understanding of the underlying soils for specific areas of the site
- Coincide with areas where there is understood to be a cut
- Coincide with area where there may be a requirement for a borrow pit
- Better testing data to facilitate offsite disposal

The location of the windowless boreholes is shown in Figure 1 below.

Figure 1 – Borehole locations.



Borehole were extended to prove the natural soils (clays).

No installations were required in any of the boreholes

Six (6 No.) samples (WS01 to WS06 inclusive) of the natural soils were sent to i2 Analytical for environmental assessment.

Two (2 No.) samples (WS05 and WS06) of the made ground soils were sent to i2 Analytical for environmental assessment.

There was insufficient sample from WS04 to obtain a representative sample for environmental testing.

The borehole logs below show the absence of made ground in WS01 to WS03 (inclusive) with the natural clay laying directly below the concrete hardstanding and associated sub-base.

Made ground was present ranging between 100 mm in WS04 and 500 mm in WS05.

The made ground was black ash / clinker type material.

The natural soils were anticipated, and environmental testing indicated the soils to be **non-hazardous**. Although WAC testing was not undertaken, it is anticipated that these soils would be **inert**. No asbestos was detected in any of the samples.

Figure 2 – Typical Natural Soils encountered.



Environmental testing of the made ground indicated the soils to be **non-hazardous**. Although WAC testing was not undertaken, it is anticipated that these soils would **not** meet the **inert** thresholds. No asbestos was detected in either of the samples.

Figure 3 – Typical made ground soils encountered.



Table 1 – Summary of environmental assessment of the Natural Soils (Clay) (one of two).

Lab Sample Number		2164369	2164370	2164371
Sample Reference		WS01	WS02	WS03
Depth (m)		0.25-1.00	0.25-1.00	0.30-1.00
Date Sampled		03/02/2022	03/02/2022	03/02/2022
Time Taken		None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units			
Moisture Content	%	13	13	15
Asbestos in Soil	Type	Not-detected	Not-detected	Not-detected
Total PAH				
Speciated Total EPA-16 PAHs	mg/kg	< 0.80	< 0.80	< 0.80
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	5.0	4.1	5.9
Boron (water soluble)	mg/kg	< 0.2	< 0.2	0.2
Cadmium (aqua regia extractable)	mg/kg	< 0.2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	31	16	17
Copper (aqua regia extractable)	mg/kg	22	11	17
Lead (aqua regia extractable)	mg/kg	15	13	21
Mercury (aqua regia extractable)	mg/kg	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	30	12	14
Selenium (aqua regia extractable)	mg/kg	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	54	43	46
Petroleum Hydrocarbons				
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	< 10	< 10	< 10
TPH-CWG - Aliphatic & Aromatic (EC5 - EC35)	mg/kg	< 10	< 10	< 10

Table 2 – Summary of environmental assessment of the Natural Soils (Clay) (two of two).

Lab Sample Number		2164372	2164374	2164376
Sample Reference		WS04	WS05	WS06
Depth (m)		0.23-1.00	0.70-1.00	0.50-1.00
Date Sampled		03/02/2022	03/02/2022	03/02/2022
Time Taken		None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units			
Moisture Content	%	15	14	18
Asbestos in Soil	Type	Not-detected	Not-detected	Not-detected
Total PAH				
Speciated Total EPA-16 PAHs	mg/kg	< 0.80	< 0.80	< 0.80
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	3.7	4.4	5.8
Boron (water soluble)	mg/kg	< 0.2	0.3	0.2
Cadmium (aqua regia extractable)	mg/kg	< 0.2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	23	24	24
Copper (aqua regia extractable)	mg/kg	18	16	16
Lead (aqua regia extractable)	mg/kg	19	12	16
Mercury (aqua regia extractable)	mg/kg	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	20	19	18
Selenium (aqua regia extractable)	mg/kg	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	40	49	52
Petroleum Hydrocarbons				
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	< 10	< 10	< 10
TPH-CWG - Aliphatic & Aromatic (EC5 - EC35)	mg/kg	< 10	< 10	< 10

Table 3 – Summary of environmental assessment of the Made Ground Soils.

Lab Sample Number		2164373	2164375
Sample Reference		WS05	WS06
Depth (m)		0.15-0.65	0.15-0.50
Date Sampled		03/02/2022	03/02/2022
Time Taken		None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units		
Moisture Content	%	17	16
Asbestos in Soil	Type	Not-detected	Not-detected
Total PAH			
Speciated Total EPA-16 PAHs	mg/kg	10.1	< 0.80
Heavy Metals / Metalloids			
Arsenic (aqua regia extractable)	mg/kg	33	49
Boron (water soluble)	mg/kg	0.3	0.4
Cadmium (aqua regia extractable)	mg/kg	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	35	40
Copper (aqua regia extractable)	mg/kg	380	730
Lead (aqua regia extractable)	mg/kg	260	94
Mercury (aqua regia extractable)	mg/kg	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	69	120
Selenium (aqua regia extractable)	mg/kg	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	170	110
Petroleum Hydrocarbons			
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	8.1	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	17	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	37	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	62	< 10
TPH-CWG - Aliphatic & Aromatic (EC5 - EC35)	mg/kg	62	< 10



Envirotreat Solutions Limited,
LCP House,
The Pensnett Estate,
Kingswinford,
West Midlands,
DY6 7NA

Conclusions.

Based on the three borehole installations undertaken, it would appear that the existing building slab of Plot 303 is directly overlaying the natural soils and no made ground was encountered.

Outside of the building footprint, made ground was encountered beneath the concrete hardstanding and subbase, ranging from 100 mm (WS04) to 500 mm (WS05).

No groundwater was encountered within any of the boreholes

The findings of the site investigation support the proposed Remediation Strategy, where there is a surplus of materials as part of the development, natural soils should primarily be removed in lieu of the made ground. The costs / logistics associated with the offsite disposal of the natural soils will be more favourable / sustainable. The made ground have been shown to be suitable for reuse onsite.

Indicative (based on one quote) costs for off site disposal ranged from circa **£21/tonne** for natural soils and circa **£36/tonne** for non-hazardous soils (with no asbestos detected).

Yours faithfully,

Simon Farr

Envirotreat Solutions Limited

Enc / Att

Certificates of Analysis.



Borehole Logs

Borehole	WS01	
Date	03-02-2022	
Depth (mm bgl)	Strata description	
0 - 150	Concrete floor slab	
150 - 225	Type 1 sub-base	
225 – 1,000	Brown sandy CLAY	Env sample taken 0.25 – 1.00 m

Borehole	WS02	
Date	03-02-2022	
Depth (mm bgl)	Strata description	
0 - 150	Concrete floor slab	
150 - 225	Type 1 sub-base	
225 – 1,000	Brown sandy CLAY	Env sample taken 0.25 – 1.00 m

Borehole	WS03	
Date	03-02-2022	
Depth (mm bgl)	Strata description	
0 - 200	Concrete floor slab	
200 - 250	Type 1 sub-base	
250 – 1,000	Brown sandy CLAY	Env sample taken 0.30 – 1.00 m

Borehole	WS04	
Date	03-02-2022	
Depth (mm bgl)	Strata description	
0 - 150	Concrete hardstanding	
150 - 250	Ash / clinker sub-base	No odour / no VOC
250 – 1,000	Brown sandy CLAY	Env sample taken 0.23 – 1.00 m

Borehole	WS05	
Date	03-02-2022	
Depth (mm bgl)	Strata description	
0 - 150	Concrete floor slab	
150 - 650	Ash / clinker sub-base	No odour / no VOC Env sample taken 0.15 – 0.65
650 – 1,000	Brown sandy CLAY	Env sample taken 0.70 – 1.00 m

Borehole	WS06	
Date	03-02-2022	
Depth (mm bgl)	Strata description	
0 - 150	Concrete floor slab	
150 - 350	Type 1 sub-base	No odour / no VOC Env sample taken 0.15 – 0.50
350– 1,000	Brown sandy CLAY	Env sample taken 0.50 – 1.00 m



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-

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Analytical Report Number : 22-38060

Project / Site name: Eastleigh

Samples received on: 07/02/2022

Your job number:

**Samples instructed on/
Analysis started on:** 08/02/2022

Your order number:

Analysis completed by: 21/02/2022

Report Issue Number: 1

Report issued on: 21/02/2022

Samples Analysed: 8 soil samples



Izabela Wójcik
Technical Reviewer (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: 22-38060
Project / Site name: Eastleigh

Lab Sample Number				2164369	2164370	2164371	2164372	2164373
Sample Reference				WS01	WS02	WS03	WS04	WS05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-0.50
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
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	42
Moisture Content	%	0.01	NONE	13	13	15	15	17
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50	0.50	0.50

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	JSW	JSW	JSW	JSW	EC

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.41
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1.7
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1.9
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1.1
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1.1
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1.1
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.62
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.44
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.64

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	10.1
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	5.0	4.1	5.9	3.7	33
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.2	< 0.2	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	16	17	23	35
Copper (aqua regia extractable)	mg/kg	1	MCERTS	22	11	17	18	380
Lead (aqua regia extractable)	mg/kg	1	MCERTS	15	13	21	19	260
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	30	12	14	20	69
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	54	43	46	40	170

Analytical Report Number: 22-38060
Project / Site name: Eastleigh

Lab Sample Number				2164369	2164370	2164371	2164372	2164373
Sample Reference				WS01	WS02	WS03	WS04	WS05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-0.50
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	8.1
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	17
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	37
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	62

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 22-38060
Project / Site name: Eastleigh

Lab Sample Number				2164374	2164375	2164376
Sample Reference				WS05	WS06	WS06
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.50-1.00	0.00-0.35	0.35-1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				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
Moisture Content	%	0.01	NONE	14	16	18
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	4.4	49	5.8
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3	0.4	0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	24	40	24
Copper (aqua regia extractable)	mg/kg	1	MCERTS	16	730	16
Lead (aqua regia extractable)	mg/kg	1	MCERTS	12	94	16
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19	120	18
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	49	110	52

Analytical Report Number: 22-38060
Project / Site name: Eastleigh

Lab Sample Number				2164374	2164375	2164376
Sample Reference				WS05	WS06	WS06
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.50-1.00	0.00-0.35	0.35-1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Monoaromatics & Oxygenates						
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons						
TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number : 22-38060

Project / Site name: Eastleigh

* 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 *
2164369	WS01	None Supplied	0.00-1.00	Brown clay and sand.
2164370	WS02	None Supplied	0.00-1.00	Brown clay and sand.
2164371	WS03	None Supplied	0.00-1.00	Brown clay and sand.
2164372	WS04	None Supplied	0.00-1.00	Brown clay and sand.
2164373	WS05	None Supplied	0.00-0.50	Brown clay and sand with stones.
2164374	WS05	None Supplied	0.50-1.00	Brown clay and sand with vegetation.
2164375	WS06	None Supplied	0.00-0.35	Brown sandy gravel.**
2164376	WS06	None Supplied	0.35-1.00	Brown clay and loam.

**Non MCERTS Matrix.

Analytical Report Number : 22-38060

Project / Site name: Eastleigh

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 disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	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
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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 30oC.

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 +)



Analytical Report Number : 22-38060

Project / Site name: Eastleigh

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
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+ Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Sample Deviation Report



Analytical Report Number : 22-38060

Project / Site name: Eastleigh

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.

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS01	None Supplied	S	2164369	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS01	None Supplied	S	2164369	ab	TPHCWG (Soil)	L088/76-PL	b
WS02	None Supplied	S	2164370	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS02	None Supplied	S	2164370	ab	TPHCWG (Soil)	L088/76-PL	b
WS03	None Supplied	S	2164371	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS03	None Supplied	S	2164371	ab	TPHCWG (Soil)	L088/76-PL	b
WS04	None Supplied	S	2164372	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS04	None Supplied	S	2164372	ab	TPHCWG (Soil)	L088/76-PL	b
WS05	None Supplied	S	2164373	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS05	None Supplied	S	2164373	ab	TPHCWG (Soil)	L088/76-PL	b
WS05	None Supplied	S	2164374	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS05	None Supplied	S	2164374	ab	TPHCWG (Soil)	L088/76-PL	b
WS06	None Supplied	S	2164375	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS06	None Supplied	S	2164375	ab	TPHCWG (Soil)	L088/76-PL	b
WS06	None Supplied	S	2164376	ab	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS06	None Supplied	S	2164376	ab	TPHCWG (Soil)	L088/76-PL	b

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

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EASTLEIGH WORKS UNITS 200, 205 AND 210 GROUND GAS RISK ASSESSMENT

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APPENDICES

Appendix A – Limitations

Appendix B – Figures

Appendix C – Borehole logs

Appendix D – Field monitoring records

EXECUTIVE SUMMARY

Objectives	The site is being developed for a commercial end use. It has been the subject of ground investigation that included surrounding plots, which are beyond the client's site extents. The ground gas risk assessment concluded the wider site should be classified as CS (characteristic situation) 2 and thus ground gas mitigation was required. The client has requested that further data be gathered on the ground gas regime to allow this conclusion to be reviewed.
Scope of work	In order to allow the gas risk to be reassessed, the following tasks were undertaken: • Drilling of 6no boreholes and installation of shallow ground gas monitoring points. • 4no ground gas monitoring rounds. • Revised ground gas risk assessment.
Ground model	Made Ground was noted in 3no boreholes to a maximum thickness of 0.6m bgl. It comprised a black ashy granular soil. This had been identified as absent from beneath the northern part of the subject site in previous works, and further removed from other parts of the site during cut and fill works. The underlying natural soils consisted of a coarsening downwards sequence of orange-brown clays, sandy gravelly clay and sandy gravel, interpreted as River Terrace Deposits. No evidence of readily degradable material / hydrocarbon impact to was noted. Groundwater was not encountered in any of the boreholes drilled during this phase of work.
Gas monitoring results	4no gas spot monitoring visits were completed over 4 weeks in December 2022 and January 2023. No detectable methane or flow rates were recorded. A maximum CO ₂ concentration of 2% was identified in one well during one visit. A maximum PID value of 0.6ppmV was also noted in one borehole.
Gas risk assessment	A maximum CO ₂ concentration of 7.1% was recorded during the previous phase of work, with a maximum peak flow rate of 0.3l/hr. The wider site was classified as CS ₂ based on the presence of CO ₂ above 5% in areas of deepened fill in 6no boreholes, 2no of which were within the subject site. Elevated PID readings were also identified in 1no borehole within the subject site. The cut and fill works have resulted in removal of Made ground from beneath the buildings and replacement with a pile mat comprising inert aggregate. Made ground was noted to a maximum thickness of 0.9m during this phase of work. The readings from the 4no gas monitoring visits are consistent with the ground conditions beneath the subject site. Furthermore, the borehole with most elevated CO ₂ and PID values is present beneath plot 305, which is not being developed with buildings. Boreholes between this location and the proposed units from both phases of gas risk assessment did not produce significant concentrations of CO ₂ or VOC. It has therefore been concluded that the gas risk for these units can be reclassified as CS ₁ .
Recommendations	It is recommended this report be forwarded to the Local Planning Authority for their approval.

This executive summary is to be read in conjunction with the remainder of the report and should not be relied upon in isolation.

A. INTRODUCTION

1. Terms of Reference

Envirotreat Technologies Ltd ('Envirotreat') was appointed by ADI Group Ltd ('the client') to complete a ground gas risk assessment for the development at Eastleigh ('the site'). The site location is included on Figure 1 in Appendix B.

2. Study Objectives

The site is being developed for a commercial use. It has been the subject of ground investigation for the wider Eastleigh site, which included ground gas risk assessment. That risk assessment made conclusions for the wider site based on worst case conditions from across the site. The client has requested that further data be gathered on the ground gas regime beneath their specific units to ascertain whether the site-wide conclusions are overly conservative for their development.

Study limitations are provided in Appendix A.

3. Scope of Work

In order to allow the gas risk to be reassessed, the following tasks were undertaken:

- Drilling of 6no boreholes (WS301 through WS306) and installation of shallow ground gas monitoring points.
- 4no ground gas monitoring rounds.
- Revised ground gas risk assessment.

4. Previous Reports

Envirotreat holds copies of the following reports for the site:

- Preliminary geo-environmental risk assessment, Eastleigh Works, Campbell Road, Eastleigh. Issued by Delta-Simons, 18th January 2019.
- Geo-environmental assessment, Eastleigh Works. Issued by Delta-Simons, March 2019.
- Remediation and Validation Strategy, Eastleigh Works. Issued by Delta-Simon, January 2021.
- Supplementary Site Investigation letter report. Issued by Envirotreat Solutions Ltd, 21st February 2022.

5. Proposed Development

Permission was granted for redevelopment of the site by Eastleigh Borough Council in 2021 (F/20/87841). The condition allows the demolition of existing buildings and erection of units/ open storage (class B1(c) and B2 and/or B8). We understand that our client's development area comprises 3no commercial/ industrial units (units 200, 205 and 210) and 2no areas of open storage (plots 303 and 305).

The decision notice includes conditions relating to land contamination. Condition 30 comprises 3no parts covering (i) preliminary risk assessment, (ii) intrusive ground investigation and risk assessment and (ii) a remediation strategy. We understand this condition has been discharged as a pre-commencement condition.

Condition 31 requires the submission of a remediation validation report prior to occupation.

B. THIRD PARTY REPORTS

Information pertinent to the ground gas regime and risk assessment is summarised in the following section. These reports cover the entire Eastleigh site, of which the current subject site forms a small part.

6. Delta-Simons Preliminary Risk Assessment, 2019

Delta-Simons were commissioned by Diageo Investment Fund Ltd to complete a preliminary risk assessment for an industrial/ commercial redevelopment.

6.1 Historic Site Uses

A review of historic mapping shows the wider site has been used as railway land since the 1880s. A gravel pit was noted along the northern boundary between 1886 and 1896. This is anticipated to be circa 390m north/ northwest of the subject site. Several potential point sources of contamination have been noted within the railway land, namely tanks in the centre of the site (1951-1967) and in the east of the site (1984). 1no suspected UST (underground storage tank) was reported in the vicinity of the ASTs (above ground storage tanks) in the southeast of the site (anticipated to be east of the subject site). A diesel leak was reported in the area, with groundwater monitoring identifying LNAPL (light non-aqueous phase liquid) in 2007.

Earthworks have been noted across the wider site, indicating areas likely to be underlain by Made Ground.

6.2 Environmental Site Setting

The site is reportedly mapped as being underlain by River Terrace Deposit, consisting of silt and loam, bearing onto gravel. Underlying bedrock reportedly comprises the Wittering Formation in the south east, comprising sand, silt and clay, bearing onto the London Clay Formation, which outcrops in the northwest of the site. It is not clear how the subject site boundary relates to this mapped geological boundary.

The Environment Agency classify the River Terrace Deposit as a secondary A aquifer, the Wittering Formation as a secondary A aquifer and the London Clay Formation as unproductive strata. The site is reportedly not situated within a source protection zone and there are no licensed groundwater abstractions within 2km of the site.

The site is not located in an area affected by radon.

6.3 Outline CSM

Delta-Simons identified potential contaminant linkages associated with hazardous ground gas and VOCs (volatile organic compounds) in their outline CSM. Potential sources of hazardous gases were site wide. Made Ground and potential sources of VOCs were the point sources of hydrocarbon contamination, including LNAPL, and off-site contaminated soil and groundwater.

7. Delta Simons Geo-environmental Assessment report, 2019

Subsequent to their preliminary risk assessment, Delta-Simons were commissioned by Diageo Investment Fund Ltd to complete an intrusive phase 2 geo-environmental risk assessment for an industrial / commercial redevelopment.

7.1 Scope of Work

The intrusive works covered the entire 6 hectare site. A total of 44no windowless sampler boreholes, 10no cable percussion boreholes, 3no handheld windowless boreholes, 5no hand pits, 26no trial pits and 3no soakaway tests were completed. Of these, 17no windowless (WS107 through WS118 and WS120 through WS124) and 1no cable percussion borehole (BH107) were situated within the subject site.

4no rounds of ground gas monitoring were undertaken on newly installed and 1no historic borehole between January and February 2019.

7.2 Ground Conditions

Ground conditions beneath the subject site typically comprised a thin veneer of granular Made Ground overlying cohesive natural soils. Made Ground was proven to between 0.3m and >1.1m and was generally black with tarmac and clinker. The underlying natural soils comprised orange-brown clay, occasionally slightly gravelly. This was interpreted as the uppermost, cohesive strata of the River Terrace Deposit. This deposit coarsened downwards through slightly sandy slightly gravelly clay to sand and gravel by circa 3.5m bgl.

The underlying London Clay was rarely identified in the window sample borehole but has been identified at depths ranging from 4.5m to 6.3m bgl in 3no positions.

Groundwater was noted in 3no boreholes within the granular River Terrace Deposits at depths ranging from 4.0m to 4.4m bgl (9.33m to 9.98m AOD (above ordnance datum)). Groundwater was estimated to flow from north to south.

PHC contamination was noted in boreholes to the east of the site. Delta Simons estimates this to be hydraulically downgradient from the site. No significant PHC contamination was noted within the subject site. Trace concentrations of PHC were noted in groundwater within the gravels in borehole BH107, in the centre of the site.

7.3 Ground Gas Findings

14no ground gas and groundwater monitoring wells were installed in the subject site. Of these, 1no was screened across the Made Ground (WS124 shallow) with the remainder screened across natural soils.

Within the subject site, flow rates were predominantly below the limit of detection, with maximum peak and steady flows of 0.3l/hr and 0.2l/hr respectively. No detectable flow rates were noted in the monitoring well screened across the Made Ground.

Within the subject site, maximum steady carbon dioxide and methane concentrations of 7.1% and 0.7% respectively were noted. These equate to worst-case GSV (gas screening values) from boreholes within the subject site of 0.014l/hr and 0.0014l/hr for carbon dioxide and methane respectively. 3no boreholes across the subject site contained peak carbon dioxide concentrations above 5% (DS116, DS124a and DS124b), with only 1no of these located near the proposed units (DS116).

A maximum PID reading of 60.0ppmV (parts per million by volume) was recorded in borehole BH107, located in the centre of the site.

The CS (characteristic situation) was designated based on CO₂ concentrations being identified above 5% in 6no boreholes, of which 3no were on site and methane above 1% in 4no boreholes, all of which were off-site.

8. Remediation and Validation Strategy, 2021

Delta Simons was commissioned by Diageo Investments Ltd to prepare a remediation and validation strategy. This sets out the measures required to ensure the development is safe and suitable for use, with relevant pollutant linkages remediated. It also sets out the measures required to validate these works.

The report recommended ground gas mitigation measures comprise a cast in-situ ground bearing floor slab with minimal mesh reinforcement and installation and validation of a proprietary gas membrane.

Sources of VOC were identified including groundwater contamination and LNAPL, predominantly hydraulically downgradient of the subject site. Unless this contamination is addressed, it was recommended the gas membrane be upgraded to be VOC resistant.

The installation of the gas membrane should be validated in accordance with CIRIA C735¹.

9. Supplementary Site Investigation letter report, 2022

6no windowless boreholes (WS01 through WS06) were drilled in areas occupied by the former buildings to inform the soil management strategy arising from cut and fill works. It did not include soil testing for TOC or gas monitoring but does provide additional information on the nature and extent of the potential sources of ground gas.

Natural clay soils were noted directly beneath the floor slabs in 3no of the 6no boreholes (WS01 through WS03). These boreholes were in the northeastern half of the site, beneath the proposed building footprints. Made Ground was noted to between 0.1m and 0.5m in boreholes WS04 through WS06, comprising black slightly clayey ashy sandy gravel. Shallow underlying natural soils comprised orange-brown clay.

No evidence of PHC contamination was noted during this phase of work.

¹ CIRIA C735

C. GROUND GAS CONCEPTUAL SITE MODEL

10. Outline Conceptual Site Model

An outline CSM was produced by Delta Simons in their desk study. Potential sources of ground gases were identified as Made Ground and PHC (petroleum hydrocarbon) impacted soils and groundwater.

A ground gas CSM has been produced herein based on information contained within the preceding reports.

10.2 Potential sources of contamination

Delta Simons identified 2no potential sources of ground gas. Both are discussed below, with the findings of the previous ground investigation discussed cognisant of the subject site boundary.

10.2.1 Made Ground

Made Ground was identified to a maximum depth of >1.1m across the subject site during the Delta Simons phase of work. Made Ground was typically granular and contaminated with ash and clinker. No evidence of readily putrescible material, such as wood, cloth or paper, was noted. Ash is known to have a high organic carbon content but is not readily degradable.

Made Ground beneath the proposed building footprint was not identified in boreholes WS01 to WS03, drilled by Envirotreat in 2022. At the time of the field works reported herein, the Made ground had been at least partially removed to enable construction. Following this reduction, it is unlikely that significant deep pockets of Made ground, that could act as ground gas source, are present. As noted above, the pre-existing buildings were noted to be directly underlain by natural soils.

Made Ground has been identified beyond the subject site. Any gases generated by off-site soils would need to migrate laterally before presenting a risk to the development.

10.2.2 PHC contamination

PHC contamination has been identified to the east of the site, which has been estimated to be hydraulically downgradient of the site. Trace PHC has been identified in groundwater within the subject site (monitoring well WS124 deep). No observations of PHC contamination were identified within soils from that borehole. A natural soil sample obtained from 0.9m bgl, below the base of the well at 0.6m bgl, contained mid-to heavy-end PHC fractions (>EC10), with the majority of PHC contamination comprising heavy-end fractions (>EC16). No samples of the Made Ground have been analysed and no PID screening results are presented. However, it is noted that this borehole sits outside of the proposed building footprint and the VOC readings noted do not extend into nearby wells (DS120, DS122, DS123).

10.3 Receptors

Potential receptors that may be adversely affected by land contamination include the following:

- Future building spaces (units 200, 205 and 210).
- Future site users.

10.4 Pathways and Potential Pollutant Linkages

The primary pathway of gas ingress will be vertically through cracks in the ground bearing floor slab. In order for gases to ingress into the building, they will need to be generated within a source and migrate and accumulate beneath the slab. Where a source is present directly beneath the building, the migration will simply be vertical. Ground gases from off-site sources, including VOCs, will need to migrate laterally, before migrating vertically to accumulate beneath the floor slab. It is noted that there are well understood attenuation factors for VOCs within aerobic air spaces, principally oxidation and biodegradation.

D. SITE INVESTIGATION METHODOLOGY

11. Investigation Scope

The intrusive scope of works comprised the drilling of 6no windowless boreholes (WS301 to WS306) around the footprints of the proposed units. The boreholes were progressed to allow soil logging and installation of shallow ground gas monitoring wells.

12. Investigation Rationale

12.1 Exploratory Hole Rationale

The boreholes were non-targeted and located to provide even coverage of the development area. 4no boreholes were placed around the proposed units and 2no were placed within an accessible area east of them. Whilst there is no above ground development proposed in the eastern part of the site (i.e., in the area occupied by plot 305), boreholes were placed here to extend coverage cognisant of the findings in borehole WS124, located in this area.

4no boreholes around the building provide one borehole per 500m², or one per 22m. This exceeds the requirements for a low sensitivity development on a low-risk site as set out in CIRIA C665². Boreholes were designed with the gas response zone starting from 0.3m to target Mage Ground, where present, and superficial soils. The plain pipe was surrounded by hydrated bentonite and left proud of the surface, surrounded by temporary fencing.

12.2 Gas Monitoring Rationale

Guidance on gas monitoring requirements is provided in BS8576³. The guidance defines general risk levels for sites based on potential gas sources. Very low source generation potential sites are defined as sites underlain by

- carbonate soils, such as chalk,
- soils with low degradable organic carbon content such as Alluvium and Peat and
- Made Ground with low degradable organic content (defined as up to 5% organics such as wood, paper and cloth and excluding food or easily degradable wastes).

For sites where very low gas generation exists, they recommend a range of monitoring possibilities, starting from a point where gas monitoring is not required up to monitoring over 2 months.

CIRIA C665 sets out the idealised monitoring requirements for different development types. Commercial buildings are classed as low sensitivity. Sites where the gas source has been identified as very low generation potential and where the development is low risk required 4no visits over 1 month. Given the availability of previous gas monitoring data, 4no visits over 1 month was deemed sufficient for the site.

² Assessing risks posed by hazardous ground gases to buildings. CIRIA C665, 2007.

³ Guidance on investigations for ground gas – Permanent and volatile organic compounds (VOCs). BS 8576:2013. British Standards Institute, 2013.

13. Investigation Tasks

13.1 Fieldwork dates

The intrusive works were completed on Monday 8th December 2022. All intrusive works were supervised by an Envirotreat engineer. The weather during the intrusive works was cold and dry.

13.2 Investigation methods

13.2.1 Borehole drilling

The boreholes were advanced using a tracked windowless drilling rig. The boreholes were drilled at 101mm diameter by Regional Drilling. Disposable plastic sample barrel liners were used for each run to avoid cross-contamination of samples. No water was added to the boreholes during drilling.

13.2.2 Ground gas monitoring point installation

Ground gas monitoring standpipes were installed in each borehole upon completion. The standpipe was constructed of 63mm outer diameter HDPE wrapped in filter material. The annulus around the response zone was filled with washed filter gravel. The plain section was surrounded with hydrated bentonite. Boreholes were left proud of the ground and fenced off.

The monitoring wells were constructed with a 0.3m plain section at the top, which was the shallowest possible whilst allowing adequate sealing of the well. The response zones were designed to allow gas conditions within the underling Made Ground (potential source material) and shallow natural soils (potential pathway) to be monitored.

Details on monitoring well design are included on the borehole logs in Appendix C.

13.2.3 Ground gas monitoring

The gas monitoring program comprised 4no visits over four weeks between 14th December 2022 and 13th January 2023.

Wells were monitored for bulk ground gases and VOCs (volatile organic compounds). The wells were monitored for flow rate. Methane, carbon dioxide, carbon monoxide, oxygen and hydrogen sulphide using a GA5000 infra-red gas analyser. VOCs were monitored using a MiniRae PID (photoionising detector) with 10.6eV bulb.

The atmospheric pressure conditions for the 48 hours preceding each monitoring visit, as recorded at Southampton Airport weather station, are summarised in the following table.

Table 1: Atmospheric pressure trends

Visit	Date	Preceding pressure
1	14 th December 2022	1007mb remaining falling to 1004mb 24 hours before visit, then remaining steady during the visit.
2	20 th December 2022	1012mb falling to 1005mb 24 hours before visit, rising to 1008mb during the visit.
3	5 th January 2023	1018mb falling to 1015mb 24 hours before visit, before rising to 1019mb during the visit.
4	13 th January 2023	1006mb rising to 1010mb 24 hours before the visit, before falling to 1003mbar during the visit.

E. SITE INVESTIGATION FINDINGS

14. Ground Conditions

Ground conditions identified during this phase of work are detailed on the exploratory hole logs, with the general geological succession summarised in the following table.

14.1 Geological Sequence

The general geological sequence identified beneath the site is summarised as follows.

Table 2: Ground model

Depth from (m)	Depth to (m)	Max thickness (m)	Soil type	Description
0.00	0.15/ 0.6	0.6	Granular Made Ground	Typically black slightly clayey ashy sandy gravel.
0.00/ 0.9	1.3/ 2.5	2.35	River Terrace Gravel	Grey, becoming orange-brown CLAY
1.3/ 2.5	1.8/ 2.0	1.7		Orange-brown slightly sandy slightly gravelly CLAY
1.8/2.0	>3.5	>1.5		Orange-brown and yellow-brown sandy angular to rounded fine to coarse flint GRAVEL

Ground conditions were broadly consistent with the previously issued reports. It should be noted that at the time of the field works, the concrete hardstanding had been removed from the site and a reduced level dig was underway. The ground level around borehole WS306 had been reduced by approximately 500mm and no Made Ground was noted in this location. The groundworks contractor was in the process of laying a pile mat of granular material as the drilling works progressed. The boreholes are typically at lower than pre-construction ground level. Given the reduced level dig, the likelihood of significant thicknesses of Made Ground beneath the site are low.

14.2 Obstructions

No obstructions were encountered during the intrusive works.

14.3 Contamination

No visual or olfactory evidence of contamination was noted during the site works.

15. Hydrogeological Observations

14.1 Groundwater Strikes

No groundwater was encountered during the monitoring visits.

F. BULK GAS RISK ASSESSMENT

16. Introduction

The results of the spot monitoring during this phase of work are presented and interpreted in the following section.

17. Spot Monitoring Results

17.1 Methodology

Gas risk will be calculated for each borehole per visit, in line with BS84845. A worst-case check, whereby the maximum flow rates and gas concentrations from across the monitoring period are used to calculate GSVs (gas screening values), will be undertaken to assess reliability of the gas dataset.

17.2 Ground Gas Monitoring Results

The maximum gas readings from each monitoring visit are summarised in the following table (minimum readings for oxygen). Full monitoring results are included in Appendix D.

Table 3: Maximum ground gas monitoring results

Date	No. wells	CO ₂ (%)	CH ₄ (%)	O ₂ (%)	PID (ppmV)	Flow (l/hr)	CO (ppm)	H ₂ S (ppm)
14/12/22	5	2.0	<0.1	16.2	0.6	<0.1	<1	<1
20/12/22	6	0.5	<0.1	17.4	0.1	<0.1	<1	<1
05/01/23	6	1.0	<0.1	18.7	0.1	<0.1	<1	<1
13/01/23	6	0.9	<0.1	18.1	<0.1	<0.1	<1	<1

The bung had been removed from borehole WS302 prior to the first visit – WS302 was therefore not monitored during the first visit. It was replaced during that visit and monitored on subsequent visits.

No detectable gas flow rates or methane were identified across the 4 monitoring rounds. Only low concentrations of carbon dioxide and VOCs were identified, with the majority of readings below the detection limit of the equipment used.

18. Ground Gas Risk Assessment

GSV have been calculated in line with CIRIA C665. Maximum borehole flow rates and gas concentrations have been multiplied, as summarised in the following table.

18.1 Carbon Dioxide GSV

Borehole GSVs for carbon dioxide calculated based on maximum gas concentrations and steady flow rates are summarised in the following tables.

Table 4: Carbon dioxide GSVs

Borehole	14 th December 2022	20 th December 2022	5 th January 2023	13 th January 2023
WS301	0.0002	0.0002	0.0002	0.0001
WS302	N/A	0.0001	0.0004	0.0002
WS303	0.0001	0.0001	0.0003	0.0001
WS304	0.002	0.0004	0.0002	0.0002
WS305	0.0007	0.0001	0.0009	0.0004
WS306	0.0013	0.0005	0.001	0.0009
Site-wide worst case GSV				0.002

No notably elevated CO₂ has been identified and no detectable flow rates have been recorded. Accordingly, the calculated GSVs are at least an order of magnitude below the CS₂ limit.

Given the absence of detectable flow rates, the worst case site-wide GSV correlates with the GSV calculated for the highest measured CO₂ concentration. The data do not indicate that the borehole GSVs are an under representation of worst case conditions.

18.2 Methane GSV

Borehole GSVs for methane calculated based on maximum gas concentrations and steady flow rates are summarised in the following table.

Table 5: Methane GSVs

Borehole	14 th December 2022	20 th December 2022	5 th January 2023	13 th January 2023
WS301	0.0001	0.0001	0.0001	0.0001
WS302	N/A	0.0001	0.0001	0.0001
WS303	0.0001	0.0001	0.0001	0.0001
WS304	0.0001	0.0001	0.0001	0.0001
WS305	0.0001	0.0001	0.0001	0.0001
WS306	0.0001	0.0001	0.0001	0.0001
Site-wide worst case GSV				0.0001

No detectable methane gas concentrations or gas flow rates have been identified. As such the calculated GSV are the lowest possible value.

18.3 VOC risk assessment

Delta Simons had previously identified 2no boreholes containing elevated PID readings during their monitoring program. These were boreholes DS102, located in the far northwestern corner of the wider site (475ppmV), and borehole DS124, located to the east of the current site (60ppmV). The boreholes between these 2no positions and the site were not reported to contain elevated VOC readings. Despite these readings, Delta Simons do not require a VOC-resistance gas membrane, as set out in the RVS. Mitigation measures are only required to meet bulk gas ingress associated with a CS 2 classification.

The maximum VOC reading identified during this phase of work was 0.6%, i.e., 1% of the lower value reported above. No field evidence of PHC impact to soils was noted during the boreholes drilled during this phase of work or the works covered under Envirotreat's Supplementary Site Investigation. This is

consistent with the findings of Delta Simons' site-wide investigation, that did not identify PHC hotspots within the subject buildings' curtilage. Therefore it is concluded that there is no credible source of significant gaseous VOC contamination and therefore vapour intrusion into the subject buildings is not a significant risk.

18.4 Risk Evaluation

All GSVs, including worst case site-wide values, are at least an order of magnitude below the CS2 limit. Maximum gas concentrations are significantly below levels at which reclassification as CS2 should be considered. No elevated PID readings have been identified, which is consistent with the absence of field observations of PHC impacts. Such contamination was limited to 1no borehole from the previous phase of work, and was not identified in surrounding boreholes from that study.

The gas monitoring results are consistent with the CSM and ground model. No credible sources of ground gas have been identified beneath the subject site. Made Ground is thin, predominantly comprising imported inert aggregate for the pile mat. This material is laterally discontinuous and does not extend beyond the site boundary. The underlying natural soils are of low permeability and transmissivity. Therefore, no credible pathway for the on-site migration of off-site ground gases have been identified.

It is recommended that subject site be reclassified as CS1, and the requirement for ground gas mitigation measures be withdrawn.

This does not affect the conclusions drawn for the remainder of the site, where different potential sources and ground conditions may exist, and the CSM may vary from that presented herein.

19. Conclusion

The additional spot monitoring, intrusive investigation and logging shows there to be no credible source of significant hazardous gases beneath the site. Similarly, no credible pathways for the on-site migration of off-site ground gases have been identified.

Gas concentrations are consistent with a low-risk site. GSVs have not been identified within an order of magnitude of the CS2 threshold.

It is concluded that the subject site can be reclassified as CS1 and the requirement for gas mitigation measures be withdrawn. This does not affect the conclusions previously drawn for the remainder of the wider site.

20. Recommendations

The following recommendations are made:

- This report should be forwarded to the local Planning authority for their approval.