GEOLOGICAL
GEOTECHNICAL
GEOENVIRONMENTAL
DATA ACQUISITION
CONSULTANCY

Phase 2 Intrusive Site Investigation Report

LOCATION	Garden Centre, Barton upon Humber, DN18 5RF
ISSUE DATE	July 2024
FOR	Humber Bridge Garden Centre c/o P&N Design
CLIENT REF.	
OUR REF.	G24176

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1. Introduction

In accordance with your instruction, Geoinvestigate Limited has carried out an intrusive site investigation at Garden Centre, Barton upon Humber, DN18 5RF.

A Phase 1 Desk Study has previously been completed by Geoinvestigate Limited (G24098, May 2024). The most pertinent findings of the desk study comprised the following:

Site Suitability	**Desk Study Finding**	**Preliminary Assessment**
Normal Foundations	Competent clay anticipated.	Likely to be suitable
Soakaways	Clay soils unlikely to offer sufficient permeability.	Unlikely to be suitable
Potential Risks	**Desk Study Finding**	**Preliminary Risk Assessment**
Radon Gas	Less than 1% of properties affected.	Negligible
Chemical Contamination	Historical nearby and on-site land uses potentially giving rise to a range of inorganic and organic contaminants including asbestos, metals/metalloids, PAHs and petroleum hydrocarbons.	Moderate
Hazardous Gas	Unlikely to be any significant potential source of hazardous gas.	Moderate to Low
Ground Instability/ subsidence	Potential for compressible deposits.	Moderate
Ground Instability/ subsidence	Potential for significant deposits of compressible made/infilled ground.	Low

NB. Arbitrary potential hazard assessment: High (Red), Moderate (Amber), Low (Yellow), Very Low (Green), Negligible (uncoloured)

It is understood that it is proposed to erect a conservatory to the southern edge of the garden centre. The boundary of the current study area and the proposed developmental layout are presented on the site plans included within Appendix 1 of this report.

The purpose of this Phase 2 investigation has been to establish the true nature of the ground conditions at the site with regard to the potential contamination and geotechnical risks that have been identified during preliminary research, and to determine appropriate foundation solutions for the proposed new structure(s).

2. Scope of Phase 2 Investigation

2.1 Scope of Works

Given the above, the following investigation was carried out to assess the potential risks to the proposed development:

- Three (3) boreholes (ref. BH1 to BH3) were undertaken at the site to depths of between 4.00m below ground level (bgl) with associated soil sampling, logging and supervision of the works by a suitably

qualified geo-environmental engineer / technician. The boreholes were commenced using windowless sampling techniques with a Dando Terrier 2002 mini drilling rig.

- Two (2) hand excavated trial pits (re. TPA to TPB) to provide additional information on near-surface ground conditions, and to collect additional samples for contamination analysis in garden areas.

- The installation of three (3) ground gas monitoring wells in boreholes BH1, BH2 and BH3 with allowance for up to six (6) gas monitoring visits over a period of up to three (3) months (if appropriate), including readings below 1000mb and where possible following a sharp drop in atmospheric pressure.

- Geotechnical testing comprising twenty-four (24) moisture content determinations, two (2) Atterberg Limit plasticity tests, and a number of water-soluble sulphate concentrations and pH tests to allow suitable foundations and concrete design advice, including assessment of the shrinkage potential of any clay soils.

- Contamination analyses of five (5) samples of made ground recovered at depths of between 0.50m and 2.00m. Analysis was variably undertaken for a general suite of potential metal/metalloid contaminants, polycyclic aromatic hydrocarbons (PAHs), asbestos, and petroleum hydrocarbons (including BTEX*). Chemical analyses were based on the attending engineer's assessment of soils and ground conditions at the site. Leachate from one (1) of these samples was tested to check the mobility of potential contaminants given the likely presence of permeable strata and shallow groundwater.
  *Benzene, toluene, ethyl benzene and xylenes

- Provision of a factual and interpretative report including site plan, borehole logs, trial pit logs, geotechnical and contamination soil analysis results, ground gas monitoring results, water infiltration testing results, advice on the contamination and gas, appropriate foundation advice, and advice regarding any remediation and validation works that may be necessary.

The trial pit and borehole positions are shown on the plan provided in Appendix 1.

The excavations were sampled and logged at site by a geoenvironmental engineer and the ground conditions encountered are described on the trial pit and borehole logs also provided in Appendix 1.

The results of geotechnical soil testing and soil moisture profiles are included in Appendix 2, together water infiltration test results sheets.

The results of the contamination testing are included in Appendix 3 (i2 Analytical Ltd. report no. 24-026686).

2.2 Sampling Rationale

The borehole positions were chosen to give an indication of the ground conditions generally throughout the extension footprint and garden, both in terms of geotechnical appraisal and assessment of soil contamination. The soils encountered in the boreholes are considered to be broadly representative of

soils throughout the site. The hand excavated trial pit positions were specifically chosen to target proposed areas of soft landscaping or gardens.

3. Phase 2 Investigation Findings

3.1 Ground Conditions

3.1.1 Windowless Sample Boreholes

BH1 encountered a surface horizon of 100mm thick paving underlain by made ground to 2.20m. Clay was then encountered to 3.40m underlain by sandy clay to 4.00m.

BH2 encountered made ground to 1.40m, underlain by silty sandy clay to 4.00m.

BH3 encountered a surface horizon of turf/topsoil to 0.30m, underlain by made ground to 2.30m. Silty organic clay was then encountered to 3.80m, underlain by silty sandy clay to 4.00m.

Hand shear vane tests returned values between 4kN/m^2 and 56kN/m^2, indicating generally very soft to firm conditions.

Standard Penetration Tests (SPTs) were undertaken commencing at 1m and 2m in BH1 and BH3. SPT N_{300} values were between N=1 and N=9 was recorded, indicating generally very loose to loose conditions.

Groundwater was encountered at 3.10m in BH1 and 1.80m in BH3.

BH1 and BH2 remained open on completion, however BH3 closed below 2.40m.

3.2 Soil Moisture and Plasticity Testing

Borehole moisture profiles are presented in Appendix 2. Moisture contents between 11.0% and 60.6% were reported within the made ground. The natural strata recorded moisture contents between 28.0% and 105.2%

Atterberg Limit testing returned Plasticity Indices (PIs) of 22.1% and 24.9%. The cohesive soils are classified as Silt of High Plasticity (MH) and borderline Clay / Silt of Intermediate and High Plasticity (CI/MI/CH/MH) according to BS 5930. This corresponds to Medium Shrinkage Soils (volume change potential) according to NHBC Section 4.2 Building Near Trees.

The moisture profiles indicate no significant vegetation related moisture depletion currently present at the site, although the elevated moisture values in BH1 and 2.50m reflect the weaker / wetter soils at this location.

Therefore, given the above and the considerable vegetation currently onsite, it is considered that there is a elevated risk of seasonal soil volumetric changes attributable to vegetation. Therefore, it is recommended that foundations are designed to mitigate against this accordingly.

4. Contamination Testing

As mentioned in Section 1, the potential for chemical contamination was determined to be moderate due to the presence of a brick yard, railway sidings and pitting on, or in close proximity to, the site.

The soils most likely to contain contamination were expected to be the made ground deposits. Soils close to surface would be the most relevant regarding human health risk assessment though analysis of deeper underlying natural subsoils and leachate from the made ground was also considered appropriate to ensure no risk to local ground and surface waters exists through potential contaminant leaching and mobilisation.

Other than the presence of made ground, there was no obvious visual or olfactory evidence of potential contamination or contaminative materials. However, given the site's history and its proximity to a brick yard, unspecified works, pits, railway sidings, ground workings and a 'heap', the potential for contamination to have affected the site could not be ruled out without soil analyses.

Due to the presence of deep made ground, all samples were taken within made ground strata.

The results of the contamination testing are included in Appendix 3 (i2 Analytical Ltd. report no. 24-026686).

5. Risk Assessment

5.1 Method

Geoinvestigate Ltd. uses a combination of assessment criterion provided by the Environment Agency, DEFRA and by the Chartered Institute of Environmental Health in order to assess the presence of potentially harmful chemicals within soils and water. These include: Environment Agency Environmental Quality Standards (EQSs), Site Specific Assessment Criteria (SSAC) generated using CLEA software version 1.06 site specific risk assessment modelling, DEFRA Category 4 Screening Levels (C4SLs), and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Safe for Use Levels (S4ULs).

As the site is to remain and be developed as a commercial development to the existing garden centre (conservatory extension), it falls within the commercial end-use category.

No site-specific assessment criteria (SSAC) have been created for the site as no unusual circumstances (i.e., occupation periods etc.) are considered to be present/likely at the site that would render the generic commercial assessment criteria unsuitable.

The results of the contamination testing that has been carried out have been compared to the soil quality values from the above sources. Where they fall below these limit values, they have been deemed safe for a commercial end use.

An appraisal of the chemical results and relevant limits is set out in the Contamination Risk Assessment that follows.

5.2 Contamination Risk to Sensitive Receptors

5.2.1 Human Health

Made ground was encountered to a maximum depth of 2.30mbgl (BH3). Made ground was underlain by cohesive natural clay subsoils with localised areas of organic clay.

No visual and/or olfactory evidence of contamination was found in any of the encountered soils, including no visible evidence of asbestos contamination.

As discussed earlier in the report, levels of determinands have been compared to the soil assessment criteria for commercial end-use, as published by DEFRA and LQM/CIEH, with DEFRA C4SLs taking priority where more than one target value exists due to their "more pragmatic whist still strongly precautionary" nature (quote from SP1010 C4SL Policy companion Document).

A mean Soil Organic Matter Content (SOM) of 1.54% were returned from the soil analyses. Therefore, the LQM/CIEH GAC for PAHs and other hydrocarbons were chosen using the lowest Soil Organic Matter (SOM) option of 1.0%, which is considered the most representative (and a conservative) value for the samples returned.

A summary of the results is shown in Table 1 below.

Table 1: Summary of Chemical Determinands in Soil

Determinand	Units	Limits of Detection	Total Samples	Returned Concentrations		Threshold Ranges S4UL / C4SL
				Min	Max	Min
pH	pH Unit	N/a	5	8.3	9	-
Water Soluble Sulphate as SO4 (2:1)	mg/l	< 10	5	0.5	130	-
Moisture Content	%	< 0.01	5	3.3	21	-
Organic Matter	%	< 0.1	5	0.5	2.4	-
Arsenic	mg/kg	< 0.2	5	3.3	19	640
Boron (Water Soluble)	mg/kg	< 1	5	< 1	< 1	240000
Cadmium	mg/kg	< 0.2	5	< 0.2	< 0.2	190
Copper	mg/kg	< 4	5	5.6	62	68000
Chromium III	mg/kg	< 2	5	5.3	41	8600
Hexavalent Chromium	mg/kg	< 1.8	5	< 2	< 2	33
Free Cyanide	mg/kg	< 1	5	< 1	< 1	12000
Total Cyanide	mg/kg	< 1	5	< 1	< 1	12000
Lead	mg/kg	< 1	5	6.4	430	2300
Mercury (Aqua regia extractable)	mg/kg	< 0.3	5	< 1	< 1	9000
Nickel	mg/kg	< 1	5	7.3	38	440
Selenium	mg/kg	< 1	5	< 2	< 2	12000
Zinc	mg/kg	< 1	5	21	350	730000
Asbestos Screen	-	-	3	Not Detected		Detection
Total Phenols (Monohydric)	mg/kg	< 1	5	< 2	< 2	440
Naphthalene	mg/kg	< 0.05	5	< 0.05	0.1	190
Acenaphthylene	mg/kg	< 0.05	5	< 0.05	0.12	83000
Acenaphthene	mg/kg	< 0.05	5	< 0.05	0.11	84000
Fluorene	mg/kg	< 0.05	5	< 0.05	0.18	63000
Phenanthrene	mg/kg	< 0.05	5	0.22	2.1	22000
Anthracene	mg/kg	< 0.05	5	< 0.05	0.57	520000
Fluoranthene	mg/kg	< 0.05	5	0.29	4.3	23000
Pyrene	mg/kg	< 0.05	5	0.25	3.8	54000
Benzo(a)anthracene	mg/kg	< 0.05	5	0.11	2.1	170
Chrysene	mg/kg	< 0.05	5	0.11	2.1	350
Benzo(b)fluoranthene	mg/kg	< 0.05	5	0.13	2.4	44
Benzo(k)fluoranthene	mg/kg	< 0.05	5	< 0.05	1	1200
Benzo(a)pyrene	mg/kg	< 0.05	5	0.09	2.1	77
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.05	5	< 0.05	1	500
Dibenz(a,h)anthracene	mg/kg	< 0.05	5	< 0.05	0.29	3.5
Benzo(ghi)perylene	mg/kg	< 0.05	5	0.07	1.2	3900
Speciated Total EPA-16 PAHs	mg/kg	< 0.08	5	1.28	23.5	-

Table 1 continued on next page

*For commercial use with no allowance for plant uptake / consumption of homegrown produce and SOM of 1% where relevant.

**Value in parentheses denotes estimated soil saturation limit above which a possibility of free-phase contamination *might* exist in soil.

Exceedances shown in **BOLD** text

Table 1 (Ctd): Summary of Chemical Determinands in Soil

Determinand	Units	Limits of Detection	Total Samples	Returned Concentrations		Threshold Ranges S4UL / C4SL
				Min	Max	Min
Ali >C5-C6	mg/kg	< 0.02	3	< 0.02	< 0.02	3200
Ali >C6-C8	mg/kg	< 0.02	3	< 0.02	< 0.02	7800
Ali >C8-C10	mg/kg	< 0.05	3	< 0.05	< 0.05	2000
Ali >C10-C12	mg/kg	< 1	3	< 1	< 1	9700
Ali >C12-C16	mg/kg	< 2	3	< 2	< 2	59000
Ali >C16-C21	mg/kg	< 8	3	< 8	< 8	1600000
Ali >C21-C35	mg/kg	< 8	3	< 8	45	1600000
Ali >C35-C44	mg/kg	< 8.4	3	< 8.4	42	1600000
Ali >C5-44	mg/kg	< 10	3	< 10	88	-
Aro >C5-C7	mg/kg	< 0.01	3	< 0.01	< 0.01	26000
Aro >C7-C8	mg/kg	< 0.01	3	< 0.01	< 0.01	56000
Aro >C8-C10	mg/kg	< 1	3	< 1	< 1	3500
Aro >C10-C12	mg/kg	< 1	3	< 1	< 1	16000
Aro >C12-C16	mg/kg	< 2	3	< 2	< 2	36000
Aro >C16-C21	mg/kg	< 10	3	< 10	11	28000
Aro >C21-C35	mg/kg	< 10	3	< 10	63	28000
Aro >C35-C44	mg/kg	< 8.4	3	< 8.4	56	28000
Aro >C5-44	mg/kg	< 10	3	< 10	130	-
Benzene	ug/kg	< 2	3	< 2	< 2	98
Toluene	ug/kg	< 5	3	< 5	< 5	56000
Ethylbenzene	ug/kg	< 2	3	< 2	< 2	5700
p & m-xylene	ug/kg	< 2	3	< 2	< 2	6200
o-Xylene	ug/kg	< 2	3	< 2	< 2	6600
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	< 5	3	< 5	< 5	7900

*For commercial use with no allowance for plant uptake / consumption of homegrown produce and SOM of 1% where relevant.

**Value in parentheses denotes estimated soil saturation limit above which a possibility of free-phase contamination *might* exist in soil.

Exceedances shown in **BOLD** text

No exceedances have been observed against commercial thresholds at 1% SOM.

5.2.2 Controlled Waters

Given the possible historical contamination sources and deep made ground, leachate was analysed from one (1) sample to investigate possible contaminant mobility. These samples were obtained from BH1 (0.20m), BH6 (0.20m) and BH1 (0.50m).

The leaching test is an aggressive test (de-ionised water) and is not in aqueous equilibrium (steady state) with the solid sample, this may cause overestimation of the aqueous phase concentrations compared to groundwater in contact with the same contaminated soils and therefore may not give results that are an accurate representation of the groundwater risk on site.

Levels for domestic water supply, or the protection of aquatic life levels, as published by the Environment Agency are presented as the assessment criteria, but these are not strictly target values. They are not directly applicable to leachates because these standards would represent the total concentration in the receiving water bodies following mixing and attenuation of the leached contaminants. As such, the standards are included as an example of good water quality for consideration of how leachable contamination might affect such waters.

A Summary of the leachate testing is shown in table 3 below.

Table 3: Chemical Determinands in Leachate

Determinant	Units	LOD	Total Samples	Returned Concentrations		Recommended Thresholds	
				Min	Max	Risks to Groundwater	Risks to Surface Water
Inorganics							
pH (automated)	-	n/a	1	8.50	8.50	5.5 - 10 (UKDWS)	
Arsenic (dissolved)	µg/l	<1	1	1.90	1.90	10	50
Barium (dissolved)	µg/l	<0.06	0	-	-	-	100
Beryllium (dissolved)	µg/l	<0.1	0	-	-	-	-
Boron (dissolved)	µg/l	<10	1	11.00	11.00	1000	1000
Cadmium (dissolved)	µg/l	<0.08	1	<0.08	<0.08	5	0.45 - 1.5
Chromium (dissolved)	µg/l	<0.4	1	0.70	0.70	50	3.4
Hexavalent Chromium	µg/l	<5	0	-	-	-	3.4
Copper (dissolved)	µg/l	<0.7	1	3.70	3.70	2000	1 - 28
Lead (dissolved)	µg/l	<1	1	<1	<1	10	7.2
Mercury (dissolved)	µg/l	<0.5	1	<0.5	<0.5	20	20
Nickel (dissolved)	µg/l	<0.3	1	0.30	0.30	20	20
Selenium (dissolved)	µg/l	<4	1	<4	<4	10	10
Vanadium (dissolved)	µg/l	<0.2	0	-	-	-	-
Zinc (dissolved)	µg/l	<0.4	1	2.00	2.00	3750	8 - 125
Calcium (dissolved)	µg/l	<0.012	0	-	-	-	-
Monohydric Phenols	µg/l	<10	0	-	-	50	7.7
Organics.							
Total Cyanide	µg/l	<0.01	1	<10	<10	250000	250000
Free Cyanide	µg/l	<0.01	1	<10	<10	-	-
Naphthalene	µg/l	<0.01	1	<0.01	<0.01	70	-
Acenaphthylene	µg/l	<0.01	1	<0.01	<0.01	210	-
Acenaphthene	µg/l	<0.01	1	<0.01	<0.01	210	-
Fluorene	µg/l	<0.01	1	<0.01	<0.01	140	-
Phenanthrene	µg/l	<0.01	1	<0.01	<0.01	43.8	-
Anthracene	µg/l	<0.01	1	<0.01	<0.01	1050	0.4
Fluoranthene	µg/l	<0.01	1	<0.01	<0.01	43.8	1
Pyrene	µg/l	<0.01	1	<0.01	<0.01	105	-
Benzo(a)anthracene	µg/l	<0.01	1	<0.01	<0.01	0.543	-
Chrysene	µg/l	<0.01	1	<0.01	<0.01	1.09	-
Benzo(b)fluoranthene	µg/l	<0.01	1	<0.01	<0.01	0.137	-
Benzo(k)fluoranthene	µg/l	<0.01	1	<0.01	<0.01	3.61	-
Benzo(a)pyrene	µg/l	<0.01	1	<0.01	<0.01	0.01	0.1
Indeno(1,2,3-cd)pyrene	µg/l	<0.01	1	<0.01	<0.01	1.55	-
Dibenz(a,h)anthracene	µg/l	<0.01	1	<0.01	<0.01	0.011	-
Benzo(ghi)perylene	µg/l	<0.01	1	<0.01	<0.01	12	-
Total EPA-16 PAHs	µg/l	<0.01	1	<0.01	<0.01	-	-

As can be seen from Table 3 and the detailed results presented in i2 Environmental Ltd. report (Appendix 3), soils at the site have generally been shown to not be leaching any potential contaminants at levels that would be expected to have any significant impact on local ground and surface water bodies.

5.3 Hazardous Gas / Ground Gas

5.3.1 Gas Regime

Given the depth of made ground at the site and the potential for deep infilled ground at nearby sites, a ground gas monitoring exercise has been undertaken at the site to quantify the risk in this regard. Gas monitoring wells were installed in boreholes BH1, BH2 and BH3.

Made ground deposits have been found to be between 1.40-2.30mbgl across the site with no significant putrescible materials identified.

The results of three (3) gas monitoring visit at the site are presented in Table 4 below. A further visit may be required to complete the gas risk assessment at the site.

Table 4: Summary of Gas Monitoring Data

Borehole	Number of Visits	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH1	3	<0.01	0.7-1.6	15.2-16.3	<0.01	1003 to 1023
BH2			0.9-1.4	13.5-14.3		
BH3			5.4-6.1	13.5-15.4		

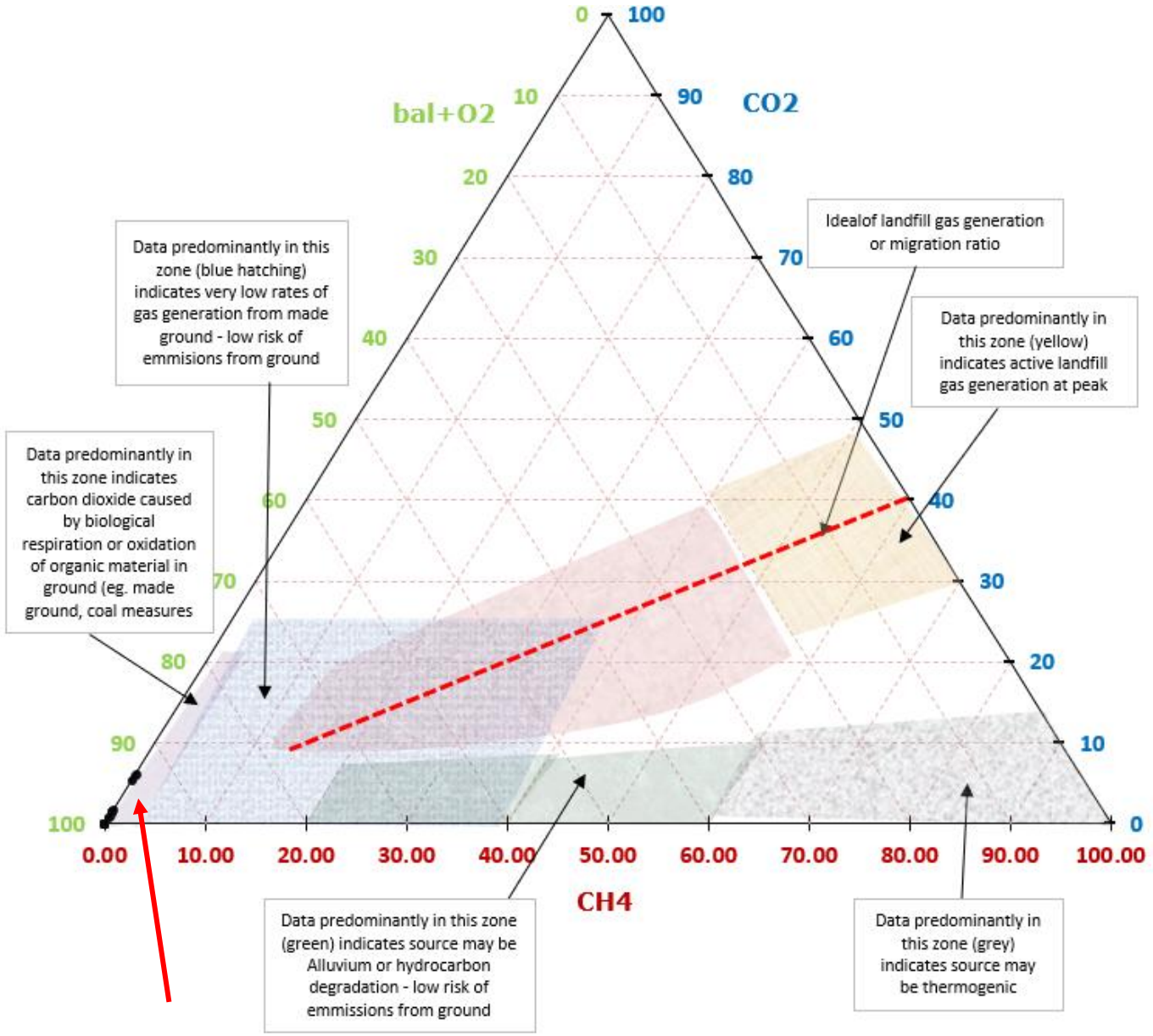
The gas monitoring visit carried out to date at atmospheric pressures of 1003mb to 1023mb returned:

- Elevated readings of CO_2 in BH3 only.
- Consistently negligible or very low levels of CH_4.
- Marginally reduced oxygen levels in BH2 and BH3.
- Consistently negligible H_2S and CO levels below detectable limits (<1ppm).
- Consistently negligible flow rates below detectable limits (<0.1 l/hr).

Assuming worst-case scenario maximum gas concentrations and flow for each borehole have been used to calculate the Gas Screening Value (GSV). The GSV can be used to determine the characteristic situation (CS) for the proposed development.

Using the data from BH3, a GSV of 0.006l/h. which is below the 0.007l/h threshold for CS2. Further assessment of the source of the ground gas has been made using a gas ternary plot. As shown on Graph 2 below.

Graph 2: Gas Ternary Plot



As can be seen on graph 2, the most likely source of the gas is biological respiration/oxidation of made ground.

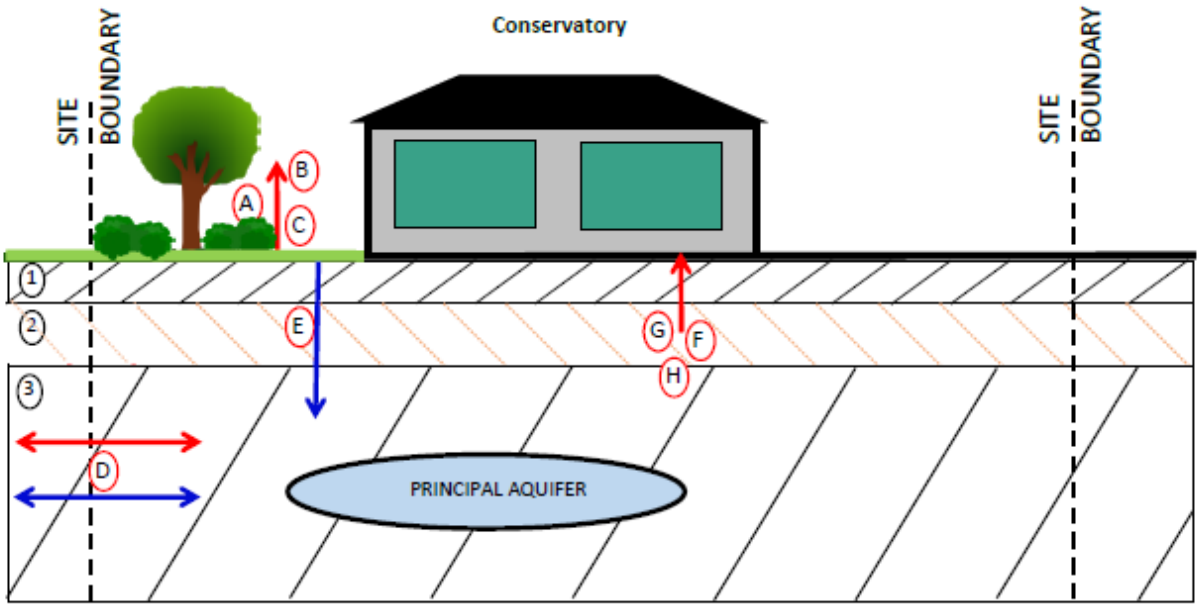
5.3.2 Radon Gas

The site in an area where just <1% of properties are above the radon action level. Therefore, no radon protection measures will be required in the new structure(s).

6. Conceptual Ground Hazard Model (CGHM)

The conceptual ground hazard model (CGHM) presented on the following page shows the potential hazards and pollutant linkages which have been considered at the site and those which may still be complete, or would be complete, if the site were to be developed as a residential unit in its current condition.

Figure 1: CGHM – Conceptual cross section of site including a Source, Pathway and Receptor Model



(1) SURFACE: TOPSOIL EXPECTED potentially underlain by MADE GROUND of unknown composition and depth.

(2) SUPERFICIAL GEOLOGY: TIDAL FLATS (CLAY & SILT)

(3) BEDROCK GEOLOGY: ANCHOLME GROUP (MUDSTONE)

IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

-Presence of made ground and potential historical contamination.

-Potentially contaminative historical land uses on nearby/adjacent sites including; brickyard, ponds/marshland and railway.

-Potential for made ground to generate hazardous gases either within the study site or on adjacent / nearby sites.

-Potential ground stability issues associated with; vegetation influence and shrink-swell clays, potentially weak and compressible made ground and compressible natural deposits.

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

A— End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard standing will encompass much of the site, removing any pathway to end users through direct contact in these areas.

B— Plants and Trees through uptake, likely given the intended end use.

C— End Users through cultivation and consumption of vegetables / fruit. Considered inactive given the intended end use.

D— Neighbouring Sites through lateral migration (in soil and water, including surface water run off).

E— Groundwater through leaching of sub-soil.

F— Buildings and services through direct contact.

Linkages A-F considered disproven due to absence of any noteworthy contaminant levels.

See Report Section 7.4 for appropriate concrete design advice.

G— End users and buildings through ground gas migration.

Ground gas monitoring exercise ongoing. No significant risk identified to date.

H— Geotechnical risks to buildings and services.

See report section 7.4 for appropriate foundation advice.

7. Conclusions

7.1 Soil & Water Contamination

Soil and leachate analysis results have confirmed that no noteworthy or significant contamination risk exists to potential receptors either within or close to the site (including water receptors).

As such, no remedial works will be required prior to the redevelopment of the site.

Though unlikely, if the development plan were to change significantly, or obvious evidence were uncovered during groundworks of potential contamination that has hitherto not been encountered, then both Geoinvestigate Ltd. and the local planning authority should be notified and, if appropriate, redevelopment works halted/postponed while further assessment and/or remediation work is undertaken.

7.2 Hazardous Gas / Ground Gas

Ground gas monitoring is ongoing at the site with three of a potential six monitoring visits having been undertaken to date. The monitoring undertaken to date has returned no significantly elevated GSVs.

Based the data gathered to date, and likely source of what concentrations are present, the site is expected fall into Characteristic situation 1 (CS1) of the Modified Wilson and Card classification. If the continued monitoring returns comparable data, no gas protection will be required in the new building(s). No final decision should be made without further monitoring, however.

No radon protection measures will be required for the new development.

Note that these conclusions are provisional and that the gas monitoring exercise is not yet completed. Final recommendations regarding gas protection will be issued in due course in a Gas Monitoring Addendum Report following completion of the gas monitoring exercise.

7.3 Foundation Design

The boreholes encoutered found comparably compact made ground to a depth of 0.90m (BH1), 1.40m (BH2) and 0.90m (BH3) underlain soft and firm clay made ground (BH1 and BH3 respectively) and further compact granular fill to 2.30m in BH3. Below the fill the boreholes encoutered mostly soft organic silty clay to the full depth of each excavation. Occasionally, the clay was in a firm condition.

Given the presence of the above it is recommended that if minimal settlement was required against the existing structure and to ensure the gabion wall not subject to additional loadings, then a piled foundation would be necessary, taking loading through the fill and weak initial clay.

Alternatively, as the proposed structure is a lightweight conservatory building, which can be isolated from the existing building, given the above, although the clay fill and underlaying weak organic clay will likely lead to some differential settlement, it is possible that this may be tolerated by an engineer-designed, heavily reinforced raft / slab foundation, seated within and immediately underlain by the compact granular fill. The slab may be designed to a net bearing pressure of 30kN/m^2. Given the *anticipated*

settlement, the new extension *would need to be* isolated from the existing structure and care should be taken in the design to ensure that it can tolerate the anticipated differential settlement.

The raft foundation solution would also *require* a structural assessment as to the competency of the gabion wall to the edge of the raised patio, as, given the distance to the structure and loadings involved, this raft will likely exhibit addition loadings onto the soil platform and supporting wall.

Therefore, given the forgoing, to avoid any settlement against the existing structure and loading of the fill behind the gabion wall, it is considered that a piled foundation would be the most safe and practical foundation to ensure minimal long-term settlement of both the fill and surrounding structures.

Groundwater was recorded at depths between 1.80m and 3.20mbgl, and the boreholes were also noted to collapse during the drilling works. The latter is indicative of running sand and excavation instability. Therefore, an allowance should be made for dewatering and shoring during excavations.

7.4 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 27mgl^{-1} and 130mgl^{-1} and pH levels of between 8.3 and 9.0. Additionally, the site is inferred to classify as made ground soils with no mobile water.

On this basis concrete in contact with the ground may be designed to ACEC Class DS-1 AC-1s of “BRE Special Digest 1 – Concrete in aggressive ground”.

END OF REPORT

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APPENDIX 1

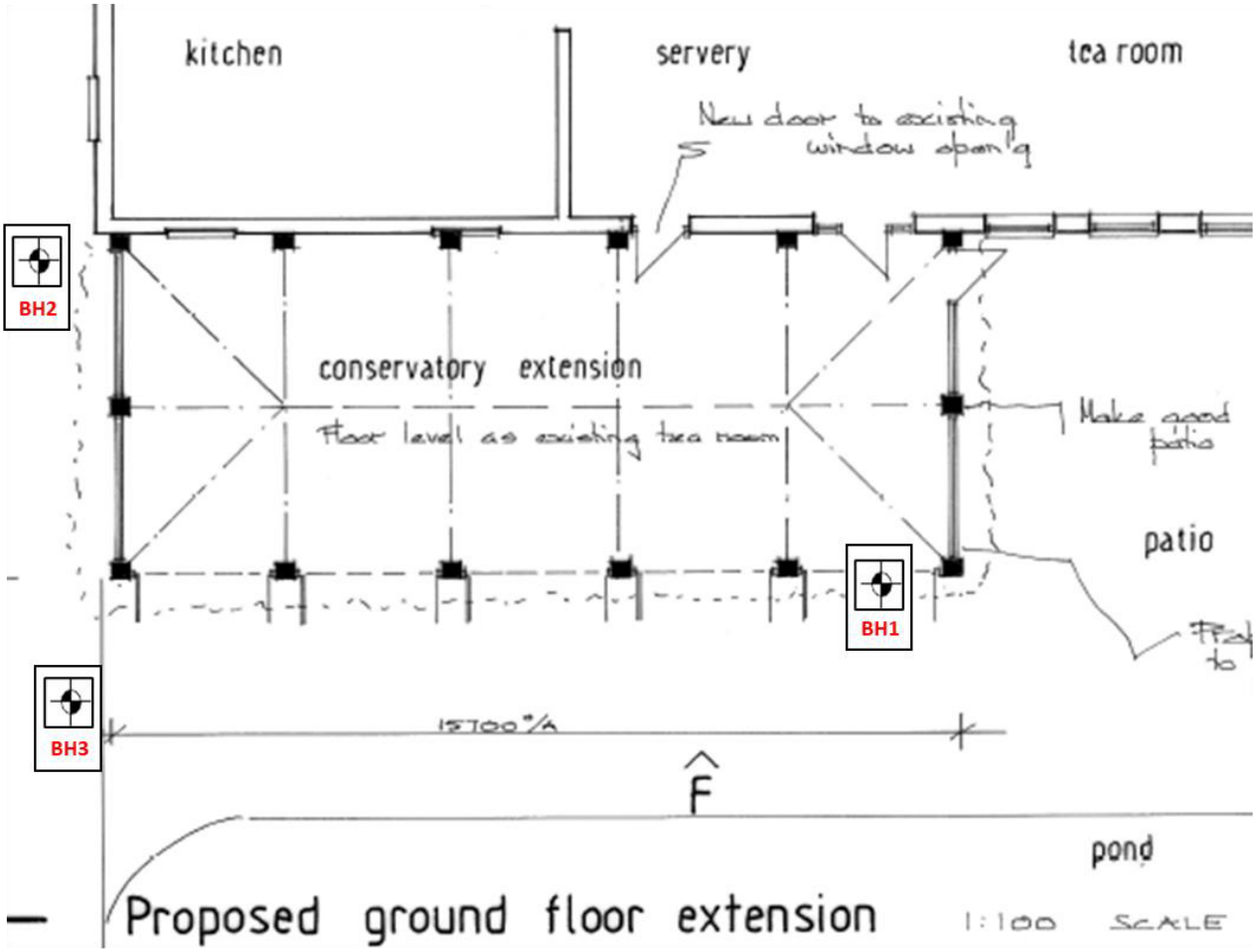
Site Plan

and

Exploratory Hole Logs

GEOINVESTIGATE Ltd.

OUR REF: G24176	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE: 12/06/24	LOCATION: Humber Bridge Garden Centre, Barton DN18 5RF	



Key

BH1 Windowless Sample Borehole Location

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G24176 **BH No.1** **Sheet No. 1 of 1**
Location: Humber Garden Centre, Barton upon Humber, DN18 5RF **DATE**: 12/06/24

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	PAVING. Underlain by weak concrete.	100				Cv kN/m^2			
0.20	MADE GROUND. Compact orange sandy gravel. Gravel is fine to coarse of dolomite.	100			O				0.25
	MADE GROUND. Dense sandy gravel and gravel. Gravel and cobbles are fine to coarse of chalk and sandstone.	700			O				0.50
0.90							1.00m-1.45m 3/2/1/1/1/2 N=5		0.75
	MADE GROUND. Soft brown very sandy gravelly clay. Gravel is fine to coarse of brick and occasional cobbles. Old land drain at 2.10m.	1300			O S				1.00
					O	30			1.25
									1.50
									1.75
2.20					O		2.00m-2.45m 1/0/0/1/0/0 N=1		2.00
	Very soft black organic CLAY.	1200			O	20			2.25
									2.50
									2.75
					O	21			3.00
3.40								3.20m	3.25
	Soft to firm brown slightly orange sandy CLAY with occasional silty inclusions.	600			O	40			3.50
									3.75
4.00					O	46			4.00
	Borehole Terminated at 4.00m								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole remained open on completion
Gas well installed to 3.00m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH1

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref**. G24176 **BH No.2** **Sheet No. 1 of 1**

Location: Humber Garden Centre, Barton upon Humber, DN18 5RF **DATE**: 12/06/24

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	MADE GROUND. Compact red sandy gravel. Gravel is fine to coarse of crushed brick. Horizon of dolomite from 0.80m to 1.10m.	1400			O	Cv kN/m^2			0.25
					O				0.50
									0.75
					O				1.00
									1.25
1.40									
	Firm and soft to firm in places slightly silty sandy CLAY with occasional blackish brown soft organic inclusions. Soft below 1.80m	2600			O	50			1.50
									1.75
					O	10			2.00
									2.25
					O	20			2.50
									2.75
					O	36			3.00
									3.25
					O	20			3.50
									3.75
4.00					O	4			4.00
	Borehole Terminated at 4.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 4.00m

Borehole remained open and dry on completion

Gas well installed to 4.00m with gas bung and cover

Key:

Slotted Pipe

Plain Pipe

Bentonite

Gravel Filter

O Disturbed sample

Cv Shear vane

W Water sample

S Standard Penetration Test

C Cone Penetration Test

BH2

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref**. G24176 **BH No.3** **Sheet No. 1 of 1**

Location: Humber Garden Centre, Barton upon Humber, DN18 5RF **DATE**: 12/06/24

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TURF/TOPSOIL. Soft brown very sandy gravelly clay. Gravel is fine to coarse of chalk and occasional brick.	300			O	Cv kN/m^2			0.25
0.30	MADE GROUND. Dense white and brown slightly clayey gravel. Gravel is fine to coarse of chalk. Occasional cobbles noted.	600			O				0.50
									0.75
0.90	MADE GROUND. Firm brown sandy clay with occasional fine to coarse gravel of brick. Occasional cobbes noted.				O S		1.00m-1.45m 2/3/2/1/2/2 N=7		1.00
		900							1.25
					O	56			1.50
1.80	MADE GROUND. Dense white sandy wet gravel. Gravel is fine to coarse of chalk. Occasional cobbles noted.	500			O S		2.00m-2.45m 4/7/5/3/1/0 N=9	1.80m	1.75
2.30	Soft black and brown silty organic CLAY.								2.00
									2.25
					O	10			2.50
									2.75
		1700			O	14			3.00
									3.25
					O	20			3.50
3.80									3.75
4.00	Soft to firm brown silty sandy CLAY.	200			O	28			4.00
	Borehole Terminated at 4.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 4.00m

Borehole closed below 2.40m

Gas well installed to 2.40m with gas bung and cover

Key:

Slotted Pipe

Plain Pipe

Bentonite

Gravel Filter

O Disturbed sample

Cv Shear vane

W Water sample

S Standard Penetration Test

C Cone Penetration Test

BH3

APPENDIX 2

Geotechnical Testing

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G24176 **Table 1**

Your ref. **Location**: Humber Garden Centre, Barton upon Humber, DN18 5RF

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
1	0.20	11.0						
	1.00	15.9						
	1.50	25.3						
	2.00	15.4						
	2.50	105.2						
	3.00	41.0						
	3.50	36.2	>95	36.2	27.9	50.0	22.1	CI/CH MI/MH
	4.00	38.1						
2	0.20	12.1						
	0.50	12.8						
	1.50	28.0	>95	28.0	33.1	58.0	24.9	MH
	2.00	28.0						
	2.50	46.2						
	3.00	45.4						
	3.50	46.8						
	4.00	53.4						

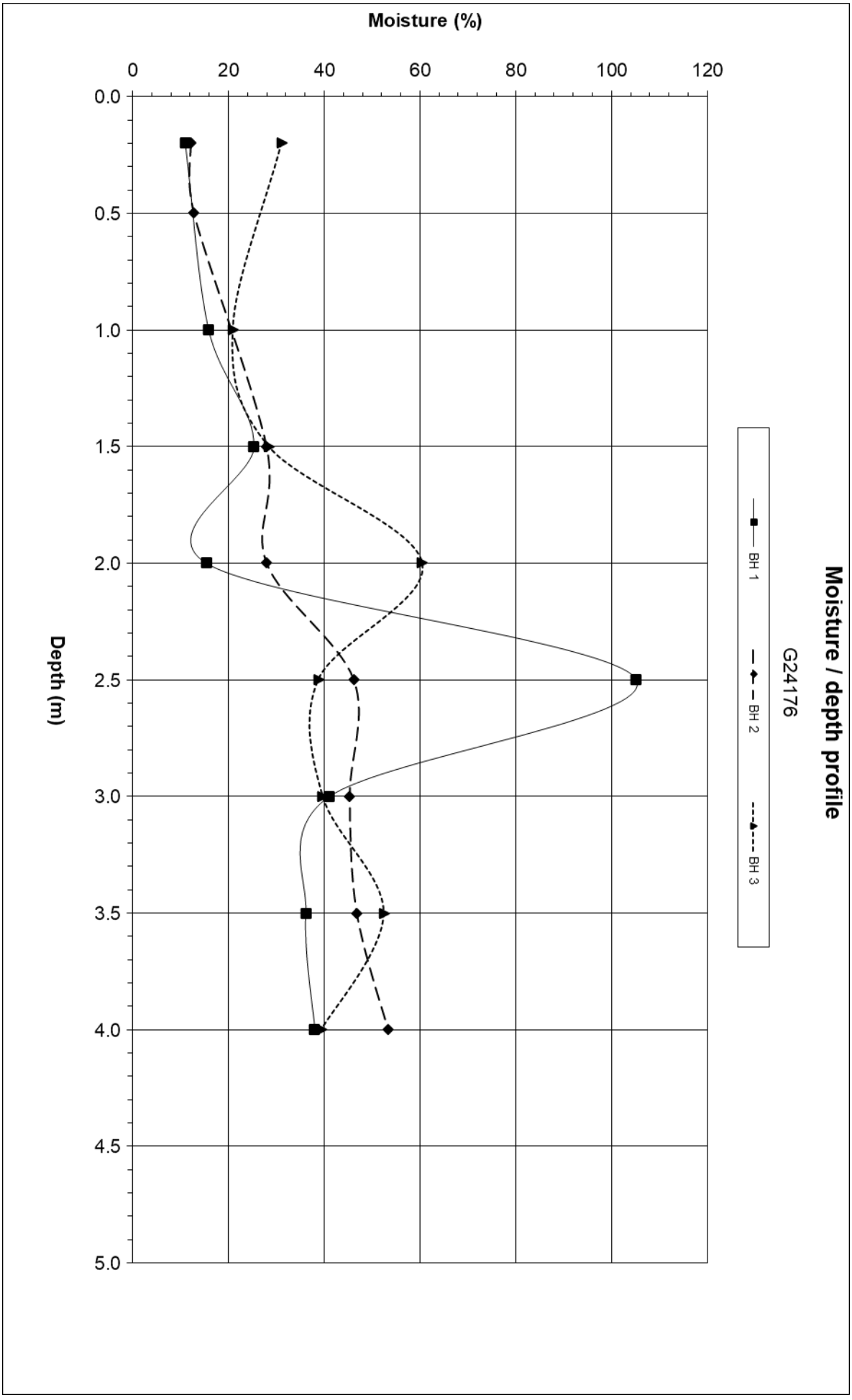
GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G24176 **Table 1**

Your ref. **Location**: Humber Garden Centre, Barton upon Humber, DN18 5RF

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
3	0.20	31.2						
	1.00	21.0						
	1.50	28.5						
	2.00	60.6						
	2.50	38.9						
	3.00	39.8						
	3.50	52.6						
	4.00	39.5						


Moisture (%)
0
20
40
60
80
100
120
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)
BH 1
BH 2
BH 3
Moisture / depth profile
G24176

APPENDIX 3

Chemtech Analytical Test Report

Geoinvestigate
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Watford,
Herts,
WD18 8YS

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 24-026686

Project / Site name:	Humber Bridge Garden Center, DN18 5RF	**Samples received on:**	21.06.2024
Your job number:	G54176	**Samples instructed on/ Analysis started on:**	21.06.2024
Your order number:	G24176	**Analysis completed by:**	01.07.2024
Report Issue Number:	1	**Report issued on:**	01.07.2024
Samples Analysed:	5 soil samples - 1 leachate sample		

Signed: [redacted]

Rafał Szczepańczyk
Technical Reviewer
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: 24-026686
Project / Site name: Humber Bridge Garden Center, DN18 5RF
Your Order No: G24176

Lab Sample Number				235851	235852	235853	235854	235855
Sample Reference				BH1	BH1	BH2	BH3	BH3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	2.00	1.00	0.50	1.50
Date Sampled				12/06/2024	12/06/2024	12/06/2024	12/06/2024	12/06/2024
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	8	21	16	9.6	18
Total mass of sample received	kg	0.1	NONE	1.1	0.4	1.2	1	0.4
Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	MJN	-	MJN	MJN	-
General Inorganics								
pH (L099)	pH Units	N/A	MCERTS	8.7	8.3	9	8.5	8.7
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	53	200	260	79	260
Water Soluble SO_4 16hr extraction (2:1)	mg/l	1.25	MCERTS	26.7	98.4	130	39.3	128
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	32	1.4	6.2
Organic Matter (automated)	%	0.1	MCERTS	0.5	1.5	2.4	1	2.3
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.1	< 0.05	0.1
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.12	< 0.05	0.06
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.1	< 0.05	0.11
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.16	< 0.05	0.18
Phenanthrene	mg/kg	0.05	MCERTS	0.24	0.23	2.1	0.22	2.1
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.56	0.05	0.57
Fluoranthene	mg/kg	0.05	MCERTS	0.4	0.29	4.3	0.35	3.8
Pyrene	mg/kg	0.05	MCERTS	0.34	0.25	3.8	0.3	3.2
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.16	0.11	2.1	0.13	1.6
Chrysene	mg/kg	0.05	MCERTS	0.19	0.11	2.1	0.16	1.8
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.16	0.13	2.4	0.15	1.5
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.11	< 0.05	1	0.08	0.98
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.14	0.09	2.1	0.13	1.5
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.09	< 0.05	1	0.07	0.7
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.29	< 0.05	0.2
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.1	0.07	1.2	0.08	0.73
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	1.93	1.28	23.5	1.71	19

Analytical Report Number: 24-026686
Project / Site name: Humber Bridge Garden Center, DN18 5RF
Your Order No: G24176

Lab Sample Number				235851	235852	235853	235854	235855
Sample Reference				BH1	BH1	BH2	BH3	BH3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	2.00	1.00	0.50	1.50
Date Sampled				12/06/2024	12/06/2024	12/06/2024	12/06/2024	12/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3.3	19	12	4.7	18
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	2.4	0.3	0.3	1
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (III)	mg/kg	1	NONE	5.3	41	27	7.4	20
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	5.3	41	27	7.4	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	5.6	16	17	8.4	62
Lead (aqua regia extractable)	mg/kg	1	MCERTS	6.4	23	31	12	430
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	7.3	38	20	10	16
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	1.2	< 1.0	< 1.0	1.2
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	21	95	70	31	350
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020	-	< 0.020	< 0.020	-
TPHCWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020	-	< 0.020	< 0.020	-
TPHCWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.05	NONE	< 0.050	-	< 0.050	< 0.050	-
TPHCWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	-
TPHCWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	< 2.0	-	< 2.0	< 2.0	-
TPHCWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	-	< 8.0	< 8.0	-
TPHCWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	-	45	< 8.0	-
TPHCWG - Aliphatic >EC35 - EC44 $_{EH\_CU\_1D\_AL}$	mg/kg	8.4	NONE	< 8.4	-	42	< 8.4	-
TPHCWG - Aliphatic >EC5 - EC35 $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	< 10	-	45	< 10	-
TPHCWG - Aliphatic >EC5 - EC44 $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	< 10	-	88	< 10	-
TPHCWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010	-	< 0.010	< 0.010	-
TPHCWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010	-	< 0.010	< 0.010	-
TPHCWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.05	NONE	< 0.050	-	< 0.050	< 0.050	-
TPHCWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	-
TPHCWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	< 2.0	-	< 2.0	< 2.0	-
TPHCWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	-	11	< 10	-
TPHCWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	-	63	< 10	-
TPHCWG - Aromatic >EC35 - EC44 $_{EH\_CU\_1D\_AR}$	mg/kg	8.4	NONE	< 8.4	-	56	< 8.4	-
TPHCWG - Aromatic >EC5 - EC35 $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	< 10	-	74	< 10	-
TPHCWG - Aromatic >EC5 - EC44 $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	< 10	-	130	< 10	-
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	-	< 5.0	< 5.0	-
Benzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-
Toluene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-
o-Xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-

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

Analytical Report Number: 24-026686
Project / Site name: Humber Bridge Garden Center, DN18 5RF

Your Order No: G24176

Lab Sample Number				235851
Sample Reference				BH1
Sample Number				None Supplied
Depth (m)				0.50
Date Sampled				12/06/2024
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
General Inorganics				
pH (automated)	pH Units	N/A	ISO 17025	8.5
Total Cyanide	µg/l	10	ISO 17025	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10
Thiocyanate as SCN	µg/l	200	ISO 17025	< 200
Sulphate as SO_4	mg/l	0.045	ISO 17025	5
Total Sulphur	mg/l	0.015	NONE	1.67
Sulphide	µg/l	5	NONE	< 5.0
Total Phenols				
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10
Speciated PAHs				
Naphthalene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01
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	NONE	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01
Total PAH				
Total EPA-16 PAHs	µg/l	0.16	NONE	< 0.16
Heavy Metals / Metalloids				
Arsenic (dissolved)	µg/l	1	ISO 17025	1.9
Boron (dissolved)	µg/l	10	ISO 17025	11
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08
Chromium (dissolved)	µg/l	0.4	ISO 17025	0.7
Copper (dissolved)	µg/l	0.7	ISO 17025	3.7
Lead (dissolved)	µg/l	1	ISO 17025	< 1.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	0.3
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	2

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

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* 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 *
235851	BH1	None Supplied	0.5	Beige clay and sand with chalk
235852	BH1	None Supplied	2	Brown clay with brick
235853	BH2	None Supplied	1	Brown clay and sand with gravel and brick
235854	BH3	None Supplied	0.5	Brown loam and sand with chalk and vegetation
235855	BH3	None Supplied	1.5	Brown loam and sand with gravel and vegetation

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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
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, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	In-house method	L010	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
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.	L019B	D	NONE
Sulphide in leachate	Determination of sulphide in leachate by ion selective electrode	In-house method	L029	W	NONE
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	L038B	D	MCERTS
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	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Chromium III in soil	In-house method by calculation from total Cr and Cr VI	In-house method by calculation	L080	W	NONE
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	W	MCERTS
Free cyanide in leachate	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	ISO 17025

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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
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
Monohydric phenols in leachate	Determination of phenols in leachate by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	ISO 17025
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	L080	W	MCERTS
Total cyanide in leachate	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	ISO 17025
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	L080	W	MCERTS
Thiocyanate in soil	Determination of thiocyanate in soil by extraction in water followed by acidification followed by addition of ferric nitrate followed by discrete analyser (spectrophotometer)	In-house method	L082B	D	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS
pH at 20°C in leachate (automated)	Determination of pH in leachate by electrometric measurement	In-house method	L099	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in leachate	SVOCs and PAHs in leachate	In-house method	L102B		ISO 17025
Thiocyanate in leachate	Determination of thiocyanate in water by discrete analyser (colorimetry)	In-house method based on SMWW 4500-CN-M	L082B	W	ISO 17025

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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
Total Sulphur in leachates	Determination of total sulphur in leachates by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	NONE

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 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 - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

Sample Deviation Report

Analytical Report Number : 24-026686

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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
BH1	N/A	S	235851	c	Free cyanide in soil	L080	c
BH1	N/A	S	235851	c	Sulphide in soil	L010	c
BH1	N/A	S	235851	c	Total cyanide in soil	L080	c
BH1	N/A	S	235852	c	Free cyanide in soil	L080	c
BH1	N/A	S	235852	c	Sulphide in soil	L010	c
BH1	N/A	S	235852	c	Total cyanide in soil	L080	c
BH2	N/A	S	235853	c	Free cyanide in soil	L080	c
BH2	N/A	S	235853	c	Sulphide in soil	L010	c
BH2	N/A	S	235853	c	Total cyanide in soil	L080	c
BH3	N/A	S	235854	bc	BTEX and/or Volatile organic compounds in soil	L073B	b
BH3	N/A	S	235854	bc	Free cyanide in soil	L080	c
BH3	N/A	S	235854	bc	Sulphide in soil	L010	c
BH3	N/A	S	235854	bc	Total cyanide in soil	L080	c
BH3	N/A	S	235854	bc	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088	b
BH3	N/A	S	235855	c	Free cyanide in soil	L080	c
BH3	N/A	S	235855	c	Sulphide in soil	L010	c
BH3	N/A	S	235855	c	Total cyanide in soil	L080	c