Phase 2 (ground investigation) report

120 Dog Drove North, Spalding

Produced for JC Architectural Consultants

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Ground investigation report

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EXECUTIVE SUMMARY

DESK STUDY INFORMATION	*Proposed works*	Demolition of existing house, garage and greenhouse. Construction of a residential dwelling with infrastructure and garage
	Site location and size	*Location:* 120 Dog Drove North, Spalding, post code PE12 0SA, grid reference 532100, 312340 *Size:* about 80m in length and about 28m in width.
	Site description	Residential plot including bungalow with garage and associated hardstanding and a large glass greenhouse to the rear of site
	Published geology	*Drift (superficial soils):* Tidal flat deposits (TFD) *Solid (bedrock):* Oxford Clay Formation (OXC)
	Topography	Site ground levels: c.1m or 2m above Ordnance Datum (AOD)
	History	The site was open fields until mid to late 50s when the existing bungalow on the eastern section of the site is potentially shown, the existing smaller outbuildings within the centre of site were subsequently added at a later date shown on mapping from 1976. The existing large structure (glass greenhouse) on the western section was constructed within the 80's or early 90's, contemporary trade directory mapping noted the structure as a Nursery.
	Hydrology	The location of the groundwater table is unknown. The site's moderately low elevation suggests there could be some shallow groundwater present. BGS historical boreholes suggest a water strikes at circa 2.6m below ground level
	Hydrogeology	Possible ditch or small land drain adjacent the western boundary of the site which appears to drain west to Diversion Drain circa 250m west
	Radon	The site is not in an area affected by Radon; no protection needed
	Landfills	There are no nearby landfills
RECENT SITE INVESTIGATION WORKS	*14th September 2022*	Six windowless sampler boreholes (WS1 to WS6) – to 2.0m deep Two hand dug trial holes (HP1 and HP2) – to 0.5m deep
	Revealed ground conditions (in descending order)	• Made ground: o Asphalt concrete surfacing (WS1) – to a depth of about 0.10m o Concrete (WS1 & 3) – to depths from 0.07-0.20m o Limestone fill (WS1) – to a depth of 0.35m o Brick fill (WS1) – to a depth of 0.45m • Tidal Flat Deposits: o Topsoil (WS2, WS4-WS6, HP1 & HP2) – to depths from 0.20-0.35m

		o Firm to stiff or stiff occasionally sandy SILT/CLAY (WS2-WS6, HP1 & HP2) – to depths from 0.45-2.0m
	Groundwater	No standing groundwater; strike within WS1 only at 1.9m bgl
CONTAMINATION & REMEDIATION	*Scope of contamination testing*	Two shallow made ground samples and seven shallow TFD samples were analysed for the following.
	Contamination test results	No elevated levels of metals, PAHs or TPHs. No asbestos contamination. No pesticides or herbicides have been recorded above detection limits.
	Contamination risk assessment	No significant risk has been identified with respect to the health of future site users. No potential contaminants have been detected at concentrations that might be considered hazardous.
	Remediation solution	No contamination remediation should be required at the site. This is subject to agreement with the LPA.
	Required gas protection	The ground gas regime could be classed as CIRIA CS-1 or NHBC/RSK Traffic Light Green. No ground gas or vapour protection measures should be required
	Buried concrete	Buried concrete should be designed to resist any sulphate attack from in situ ground conditions, based on BRE Special Digest 1
	Water pipework	The specification for water supply pipework should be agreed with the water authority before placement.
	Waste management	The revealed in situ natural sandy silts/clays beneath the made ground should be suitable for reuse around the site. However, excavated made ground will not be suitable for reuse on the site (unless covered by an appropriate permit, exemption or protocol) and allowance should be made to remove dug up made ground (e.g. excavated from garden areas) off site as waste (and the paperwork retained as evidence)
	Unforeseen contamination	Work must be halted if any unforeseen contamination (for example, petroleum odours or staining or asbestos containing materials) is encountered during the development. Such contamination must be immediately reported to the local authority
	Further works / next steps	No further works required at this stage depending on approval from the local planning authority

1 Introduction

The client, JC Architectural Consultant, has engaged Humberside Materials Laboratory Limited (HML) to undertake a Phase 2 (ground investigation) report in advance of proposed residential development at 120 Dog Drove North, Spalding. The land will be hereinafter referred to as *the site*.

1.1 Aims

The aim is to investigate the geo-environmental ground conditions and to carry out assessments to determine the nature and extent of contamination-related risks and possible required remediation measures.

1.2 Scope

The scope of the investigation includes:

- An updated review of desk study information (including the Phase 1 report)
- Intrusive investigation works (boreholes and hand excavated trial pits)
- Geochemical laboratory testing
- Revised conceptual site model of potential contamination linkages
- Revised assessment of contamination risks (source-pathway-receptor approach)
- Recommendations for remediation or further works, where appropriate

1.3 Conditions and Limitations

This report is produced solely for the client and should only be copied in full. When transmitted electronically, the definitive copy of the report is held by Humberside Materials Laboratory Ltd.

This report is prepared on the assumption that all facts have been disclosed.

The comments given in this report and the opinions expressed assume that conditions do not vary beyond the range revealed by this study and the information provided in the production of this report is complete and reliable.

2 Desk study information

2.1 Sources of site information

The main source of desk study information is the recent HML Phase 1 (desk study) report:

- HML Phase 1 Desktop Report 120 Dog Drove North, Spalding (HML ref.: 1488/5885/P) dated August 2022

A summary review of the key findings of the desk study is presented as follows (in the rest of Section 2).

2.2 Proposed development

The proposed works consist of demolition of existing residential bungalow, garage and glass greenhouse and construct a new residential dwelling. The house will include gardens, parking garages and off-road parking areas.

Final ground levels are expected to be similar to existing. Nevertheless, there might be some slight raising of ground levels (e.g. to mitigate flood risks).

2.3 Desk study factual information

2.3.1 Site location and description

The site is located off (and to the west of) Dog Drove North, Spalding, post code PE12 0SA. The site is centred around grid reference 532100, 312340.

The site occupies an irregular tract of land which is about 80m in length and about 28m in width with a pinch point around the centre of the site which reduces to a width of about 15m. It covers a total area of about 0.19 hectares.

The site is currently a vacant residential dwelling with associated hardstanding, garage and large glass greenhouse to the rear of site. The ground surface is a mixture of glass to the front of the bungalow and to the rear of site around the greenhouse, the centre of the site between the bungalow and garage is hardstanding construction of asphalt concrete and concrete.

There were not noted to be any trees or shrubs within the site, but some trees were noted along the northern boundary of the site.

2.3.2 Site history

The site is shown as a vacant plot until at least 1952. By 1959 available mapping shows the existing bungalow to be present, with additional associated outbuildings shown by 1976. A large glass greenhouse in the western section of the site was added in the late 80's or early 90's, noted as a nursery.

Nearby historical activity includes:

- Residential structure on the northern boundary and 500m east
- Repair garage (southern boundary) – 1981 to present (unused at present)
- Commercial structures (80-120m north and northeast) – 1976 to 2021

2.3.3 Anticipated geology

Based on reviewed desk top information, the provisionally anticipated ground conditions are as shown below (in Table 1).

Table 1: Anticipated geology (subject to confirmation with site works)

Strata	*Description*	*Thickness (m)*	*Depth to base (m bgl)*
Made ground	Possible cohesive fill, construction waste and reworked natural soils	<1	<1
Tidal flat deposits (TFD)	Soft (organic) silts and clays or silts and sands	10 – 20	10 – 20
Oxford Clay Formation (OXC)	Silicate-mudstone, grey, generally smooth to slightly silty, with sporadic beds of argillaceous limestone nodules	>50	>70

2.3.4 Hydrogeology (i.e. groundwater) and hydrology (i.e. surface water)

The location of the groundwater table is unknown. The site's moderately low elevation suggests there could be some shallow groundwater present. There could also be shallow perched groundwater (e.g. in granular layers underlain by clay).

BGS historical boreholes suggest a water strikes at circa 2.6m below ground level, no resting water levels were recorded.

There is a surface water feature (possible ditch or small land drain) adjacent the western boundary of the site which appears to drain west to Diversion Drain circa 250m west of the site. There are various other possible ditches or small drains within 100m of the site which drain west and east to Diversion Drain and Lambert Drain circa 730m east of the site.

The site is not within an area of potential for groundwater flooding. Land directly adjacent to the northeast is reported to be potential for groundwater flooding at the surface based on BGS data.

The site is reported to be within the extent of flooding and extreme flooding from rivers or sea without defences.

The site is not reported to be in an *Area Benefitting from Flood Defences* and there are no nearby reported flood water storage areas or flood defences (within 1km of the site).

The site is shown by www.gov.uk (flood maps for planning) to be in a Flood Zone 1. Land and property in *Flood Zone 1* have a reported *low* probability of flooding. Land south of the site is within a *Flood Zone 2* area.

2.3.5 Other environmental data

No evidence has been found of significant nearby pollution incidents or controls.

There are no nearby landfills within about 1km of the site.

The site should not be affected by radon. No radon protection measures are necessary in the construction of the proposed dwellings.

2.3.6 Industrial land use

Nearby commercial and industrial use includes:

- Vehicle repair garage (adjacent land); status: Unknown (appears inactive)
- Engineering Services (209m southwest); status: Inactive
- WH Fowler bus and coach operation & stations (336m northwest); status: inactive
- Stores and filling station (478m east); status: active2.3.7Sensitive land use

There are no identified sensitive land uses at or near the site.

2.4 Initial Contaminated Land Assessment

2.4.1 Initial conceptual site model (CSM)

The following potential sources of contamination were identified for the site.

1. Made ground beneath the site
2. Former land use: domestic gardens including domestic garage
3. Thick organic tidal flat deposits
4. Former land use (nursery)
5. Nearby former garage (southern boundary)

Contaminants of concern include metals, PAHs, asbestos, pesticides and petroleum hydrocarbons. Considered possible pathways for these contaminants include inhalation, ingestion, absorption, migration. Considered environmental receptors include humans, ecology and controlled waters.

2.4.2 Preliminary risk assessment (PRA)

The preliminary risk assessment from the Phase 1 report identified two potential contamination linkages (PCL1 and PCL2) with unacceptable (Low/Moderate) risk, as summarised below (in Table 2). These linkages merit further consideration.

Table 2: Unacceptable contamination risks (from preliminary risk assessment)

Ref.	*Source*	*Pathway*	*Receptor*	*Risk rating*
PCL1	1. Made ground (probably shallow) beneath the site, e.g. of hardstanding driveway and greenhouse base PAHs, metals, asbestos	Inhalation, ingestion, absorption	Site users	Low / Moderate
PCL2	4. Former land use (nursery) above ground heating oil tank Metals, TPHs 5. Nearby former garage TPHs	Inhalation, ingestion, absorption	Site users	Low / Moderate

2.4.3 Remediation options and further works

At the Phase 1 desk study stage, no remediation options were evaluated but further investigation was recommended. It was advised that several sample holes be carried out around the site to determine the ground conditions and provide samples of near surface ground material to be tested for contaminants of concern and the results used to complete a revised assessment.

2.4.4 Site management

The Phase 1 Desk Study stated that clean natural soil materials should be suitable for reuse, but any excavated made ground or grubbed up hardstanding might need to be removed off site as waste (unless covered by a suitable environmental or waste permit, exemption or protocol). It was noted that any unforeseen contamination encountered will need to be reported to the local authority immediately.

2.4.5 Water supply pipework

The Phase 1 Desk Study recommended allowance be made for the provision of barrier piping.

3 Site Investigation Works

The procedures adopted for the site investigation were based on BS 5930 (2015) – Code of Practice for Site Investigations and BS 10175 (2011 + A2, 2017). The soils and rocks encountered have been described based on BS5930 (2015), BS EN ISO 14688-1 (2018), BS EN ISO 14688-2 (2018) and BS EN ISO 14689-1 (2018).

3.1 Fieldwork

Fieldwork took place on the following date.

- 14th September 2022:
    - *Six windowless sampler boreholes (WS1 to WS6)*
    - *Two hand dug trial pits (HP1 and HP2)*

The purpose of the trial pits was to investigate the ground conditions for several reasons, as detailed below (in Table 3). The objectives were to determine (1) the general ground conditions and (2) the nature and extent of potential contamination.

Table 3: Rationale for site works

Location	*Type*	*Rationale*
WS1, WS2, WS3, WS4, WS5, WS6	Windowless sampler boreholes	Reveal near surface ground conditions Provide soil samples for testing
HP1, HP2	Hand dug trial pit	Reveal near surface ground conditions Provide soil samples for testing

Approximate locations of the site works are shown in the exploratory hole location plan which is presented later (in Appendix A).

The positions of the exploratory holes were established relative to existing site features and using GPS locating equipment. The depths to sub-strata and groundwater were measured from existing ground level.

Logs for the exploratory holes are presented later (in Appendix B).

3.1.1 Windowless sampler boreholes (WS1 to WS6)

The six boreholes (WSs 1 to 6) were drilled by HML using a Dando Terrier tracked windowless sampler (also known as a dynamic sampler) drilling rig. This extracted 1m-long tubes of ground material which were between about 60mm and 110mm in diameter. No casing was used. The tubes of ground material were promptly logged and sub-sampled by an HML engineer.

The boreholes reached sampling depths of 2.0m below ground level (bgl).

3.1.2 *Hand dug trial pits (HP1 and HP2)*

Two hand dug trial pits (HP1 and HP2) were dug below the site. Both hand pits were located within the existing glass greenhouse. The pits were dug under the supervision of an HML engineer using hand tools to depths of 0.50m below existing ground level (BEGL). The engineer logged the pits and took suitable samples for testing.

3.2 Laboratory testing

Geotechnical testing was undertaken by HML at our UKAS accredited laboratory based on BS1377 (1990). The scope of geochemical testing comprised the following.

- No geotechnical testing

Geochemical testing was undertaken by Chemtech Environmental (Chemtech) and Chemtest, a UKAS and MCERTS accredited laboratory. The scope of geochemical testing comprised the following.

- 7 number tests for metals and metalloids
- 7 number tests for polycyclic aromatic hydrocarbons (PAHs)
- 5 number tests for the presence of asbestos
- 5 number tests for total petroleum hydrocarbons by aliphatic and aromatic (equivalent) carbon chain fractions (i.e. TPH by CWG)
- 2 number tests for total organic carbon (TOC)
- 3 number tests for pesticides and herbicides

A schedule of testing is shown below (in Table 4). Results for all the laboratory testing undertaken are included later in this report (in Appendix C).

Table 4: Laboratory test schedule

Sample hole	*Sample location*	*HML Sample ref. (S/__)*	*Chemtech or Chemtest sample ref.*	*Depth (m BEGL)*	*Metals / Metalloids*	*PAHs*	*Asbestos ID*	*TPH by CWG*	*TOC*	*Pesticides*
	WS1-1	64811	113953-1	0.1-0.45	**P**	**P**	**P**	**P**		
WS1	WS1-3	64812	113953-2	1.30-1.70					**P**	
	WS1-4	64813	113953-3	1.70-2.00					**P**	
WS2	WS2-1	64814	113953-4	0.10-0.50	**P**	**P**	**P**	**P**		
WS3	WS3-1	64815	113953-5	0.07-0.45	**P**	**P**		**P**		
WS4	WS4-1	64816	113953-6	0.10-0.50	**P**	**P**		**P**		
WS5	WS5-1	64817	113953-7	0.10-0.50	**P**	**P**	**P**	**P**		
WS6	WS6-1	64818	1512908	0.10-0.30	**P**	**P**	**P**			**P**
HP1	HP1-1	64819	1512909	0.1-0.5	**P**	**P**	**P**			**P**
HP2	HP2-1	64820	1512910	0.1-0.5						**P**

4 Ground and Groundwater Conditions

4.1 Sequence of sub-strata

Table 5: Summary of revealed ground conditions									
Strata		*Exploratory hole*							
		WS1	WS2	WS3	WS4	WS5	WS6	HP1	HP2
		Depth to base of strata in m BEGL							
MADE GROUND	Asphalt surfacing	0.10							
	Concrete (*cracked and crazed)	0.20		0.07*					
	Fine to coarse limestone gravels with occasional cobble limestone and some silty sand	0.35							
	Cobble brick with some medium to coarse brick gravels	0.45							
TIDAL FLAT DEPOSITS	Topsoil		0.2		0.3	0.35	0.2	0.31	0.32
	Firm, firm to stiff or stiff SILT/CLAY				0.45	1.00	1.00	0.50	0.50
	Firm, firm to stiff or Stiff CLAY (*sandy)		2.0	0.45					
	Soft to firm SILT/CLAY	1.3		1.8	1.8	2.00	2.00		
	Soft SILT/CLAY	1.70		2.0	2.0				
	Soft sandy or slightly sandy SILT/CLAY	2.00							

The sub-strata as revealed at the site are summarised below (in Table 5). Copies of the exploratory hole logs are presented later (in Appendix B).

The revealed ground conditions were generally as expected based on geological and historical desktop information. There was a thin layer of made ground limited to the access driveway and hardstanding area to the rear of the bungalow and front elevation of the garage underlain by occasionally sandy silts and or clays of presumed tidal flat deposits. No made ground was encountered within the existing glass greenhouse.

The ground conditions were relatively uniform around the site. With minimal depths of made ground.

4.2 Made ground

A access driveway constructed of asphalt concrete, concrete and made ground was recorded to the rear of the bungalow were a hardstanding area of thin concrete was encountered between the bungalow and garage.

The driveway construction included asphalt concrete surfacing, concrete, limestone fill onto a brick fill with a maximum depth of 0.45m bgl recorded.

4.3 Tidal flat deposits (TFD) – occasionally sandy silty clays

TFD occasionally sandy silty clays or clays were logged across the site to the maximum depth of exploration (of 0.50m to 2.00m). They were recorded in all eight test locations.

The TFD were logged as grey brown (or brown) with brown, light brown or black mottling and were found to comprise silt/clay or occasionally clay. Such material is reasonably typical of tidal flat deposits (TFD) in the local area. Bore hole logs have noted soil strengths from firm to stiff to depths from 0.45m-1.0mm, soft to firm (occasionally soft) to depths from 1.3m – 2.0m.

No sign of any potential contamination was identified within the shallow TFD. No staining, odours or anthropogenic material were recorded.

4.4 Groundwater observations

One observations of groundwater ingresses/inflows were recorded in one of the eight test locations, as detailed below (in Table 6). Nevertheless, the depth of investigation (0.50m to 2.0m depth) may not have encountered the ground water across the site, phase 1 desk study information estimated ground water levels at circa 2.6m bgl.

Table 6: Groundwater observations from recent site works

Borehole	*Hole total depth (m)*	*Ground conditions (in descending order)*	*Groundwater observations*		*Date*
			Depth (m BEGL)	*Comment*	
WS1	0.00	MG, TFD	1.90	Water strike during drilling	14 September 2022
WS2	2.00	TFD	-	-	
WS3	2.00	MG, TFD	-	-	
WS4	2.00	TFD	-	-	
WS5	2.00	TFD	-	-	
WS6	2.00	TFD	-	-	
HP1	0.50	TFD	-	-	
HP2	0.50	TFD	-	-	

GW – groundwater, GWL groundwater level, MG – made ground, TDF tidal flat deposits

5 Soil contamination screening

Tests for the presence of contaminants of concern were carried out on samples of near surface ground material, as follows:

- Made ground: WS1 (0.10m to 0.45m depth) – metals, PAHs, asbestos & TPH
- TFD: WS1 (1.30m to 1.70m and 1.70m to 2.0m) - TOC
- TFD: WS2 (0.10m to 0.50m depth) – metals, PAHs, asbestos & TPH
- Made ground: WS3 (0.07m to 0.60m depth) – metals, PAHs & TPH
- TFD: WS4 (0.10m to 0.50m) – metals, PAHs & TPH
- TFD: WS5 (0.10m to 0.50m) – metals, PAHs, asbestos & TPH
- TFD: WS6 (0.10m to 0.30m) – metals, PAHs, asbestos, pesticides & herbicides
- TFD: HP1 (0.10m to 0.50m) – metals, PAHs, pesticides & herbicides
- TFD: HP2 (0.10m to 0.50m) – pesticides & herbicides

The complete test results are presented later (in Appendix C).

Detected contaminant concentrations have been compared against assessment criteria taken from current best practice publications.

5.1 Assessment criteria

Several sources have been used to determine suitable generic acceptance criteria (GAC), including the following, shown in general order of selected preference.

- *Land Quality Management Ltd/Chartered Institute of Environmental Health suitable for use levels* (LQM/CIEH S4Uls) report (LQM/CIEH, 2015).
- Category 4 Screening Levels (C4SL), e.g. as published for lead by Defra (2014)
- GAC from EIC/AGS/CL:AIRE (2010)

The GAC are based on the context of a residential scenario with the consumption of homegrown produce (also known as residential with plant uptake) which is relevant to the proposed development.

Where detected concentrations are consistently below the GAC then the hazard from the contaminant is usually considered to be acceptable. If a pollutant is recorded at concentrations higher than the GAC then an unacceptable hazard is not necessarily present, but it does indicate that further consideration is merited.

5.2 Metals and metalloids

Table 7 (below) gives the adopted GAC for metal (and metalloid) contaminants considered for the site.

Table 7: Generic assessment criteria for metals - *Residential with plant uptake*	
Element	*(mg/kg)*
Arsenic	37
Beryllium	1.7
Boron	290
Cadmium	11
Chromium III	910
Chromium VI	6
Copper	2400
Lead**	200
Mercury element	1.2
Mercury inorganic	40
Mercury methyl	11
Nickel	130
Selenium	250
Vanadium	410
Zinc	3700
* from LQM/CIEH (2015) except: ** from Defra (2014)	

Two shallow made ground samples and five shallow TFD samples were analysed for metals/metalloids. None of the detected concentrations of metals were found to be above the relevant generic acceptance criteria (GAC). That is, no elevated levels of metals were detected in the seven samples analysed.

The complete metals results are presented later (in Appendix C).

5.3 Polycyclic aromatic hydrocarbons (PAHs)

Table 8 (below) gives the adopted GAC (from LQM/CIEH, 2015) for speciated PAH contaminants. These vary with soil organic matter (SOM) content. At this stage, the most onerous SOM of 1% is assumed, which should be reasonably conservative.

Table 8: Soil GACs for PAH - Residential with plant uptake			
Element	*SOM of 1%*	*SOM of 2.5%*	*SOM of 6%*
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Anthracene	2400	5400	11000
Benzo(a)anthracene	7.2	11	13
Benzo(a)pyrene	2.2	2.7	3.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(k)fluoranthene	77	93	100
Benzo(ghi)perylene	320	340	350
Chrysene	15	22	27
Dibenzo(ah)anthracene	0.24	0.28	0.30
Fluoranthene	280	560	890
Fluorene	170	400	860
Indeno(123-cd) pyrene	27	36	41
Naphthalene	2.3	5.6	13
Phenanthrene	95	220	440
Pyrene	620	1200	2000
BaP as Surrogate marker	0.79	0.98	1.1

Two shallow made ground samples and five shallow TFD samples were analysed for PAHs. None of the detected concentrations of PAHs were found to be above the relevant generic acceptance criteria (GAC). That is, no elevated levels of PAHs were detected in the seven samples analysed.

The complete metals results are presented later (in Appendix C).

5.4 Asbestos

The results show that no asbestos fibres were detected in the five tested near surface samples, as summarised below (in Table 9). The complete results are presented later (in Appendix C).

Table 9: Summary of asbestos testing (soil)						
Location:		WS1	WS2	WS5	WS6	HP1
Depth (m bgl):		0.10-0.45	0.10-0.50	0.10-0.50	0.10-0.30	0.10-0.50
Soil type:		Made ground	TFD	TFD	TFD	TFD
HML sample ref:		64811	61814	64817	64818	64819
Subcontractor ref.:		113953-1	113953-4	113953-7	1512908	1512909
Element	*GAC* (mg/kg)*	*Asbestos detected*				
Asbestos fibres	-	NAD	NAD	NAD	NAD	NAD
NAD – no asbestos detected						

5.5 Total petroleum hydrocarbons (TPH)

Table 10 (below) gives the adopted GAC (from LQM/CIEH, 2015) for speciated TPH fractions. These vary with soil organic matter (SOM) content. At this stage, the most onerous SOM of 1% is assumed, which should be reasonably conservative.

Table 10 - Total Petroleum hydrocarbons (TPHs) generic acceptance criteria – residential with plant uptake				
Compound		*1% SOM*	*2.5% SOM*	*6% SOM*
TPH Aliphatic	C5-6	42	78	160
	C6-8	100	230	530
	C8-10	27	65	150
	C10-12	130 (48)	330 (118)	760 (283)
	C12-16	1100 (24)	2400 (59)	4300 (142)
	C16-35	65000 (8.5)	92000 (21)	110000
	C35-44	65000 (8.5)	92000 (21)	110000
TPH Aromatic	C5-7	70	140	300
	C7-8	130	290	660
	C8-10	34	83	190
	C10-12	74	180	380
	C12-16	140	330	660
	C16-21	260	540	930
	C21-35	1100	1500	1700
Note: values in parentheses indicate vapour saturation limit (v) or limit of solubility (s)				

Two shallow made ground samples and three shallow TFD samples were analysed for TPHs. None of the detected concentrations of TPHs were found to be above the relevant generic acceptance criteria (GAC). That is, no elevated levels of TPHs were detected in the five samples analysed.

The complete results are presented later (in Appendix C).

5.5.1 Hazard to water supply pipework from TPH

The detected concentrations of TPH in the two tested made ground samples and three tested TFD samples appear to be below levels that might potentially adversely affect plastic water supply pipework. However, some levels slightly above detection limits have been recorded. The specification for water supply pipework should be agreed with the water authority before placement.

5.6 Pesticides & Herbicides

Three samples of TDF were tested for a suite of both pesticides and herbicides. The complete results are presented later (in Appendix C). None of the pesticides or herbicides were above the limit of test detection (0.001mg/kg or 0.02mg/kg). Therefore, the tested pesticides are considered to be at acceptably low concentrations.

6 Revised Contamination Assessment

6.1 Revised conceptual site model (CSM)

The sources, pathways and receptors of contamination at the site have been revised in light of the findings of recent site works and laboratory testing. Generally, the same sources, pathways and receptors are still considered to be potentially relevant, as detailed previously (in Section 2).

6.2 Revised risk assessment

The results of the desk study review, site works, lab testing and screening have been used to carry out a revised qualitative risk assessment, as shown below (in Table 11) using a source-pathway-receptor model of potential pollution linkages. The risk assessment has yielded no unacceptable risk to the health of future residential occupants.

Table 11: Initial conceptual site model and preliminary risk assessment

Initial conceptual site model			*Preliminary risk assessment*			
Potential source	*Potential pathway*	*Potential receptor*	*Probability*	*Severity*	*Risk rating*	*Comments*
1. Made ground (probably shallow) beneath the site, e.g. of Hardstanding driveway & greenhouse base PAHs, metals, asbestos 4. Former land use (nursery) Metals, TPHs 5. Nearby former garage TPHs	Inhalation, ingestion, absorption	Site users	Low likelihood	Medium	Low	No elevated levels of metals, PAHs, TPHs have been recorded. No asbestos has been identified. No pesticides or herbicides have been recorded. No visible surface staining has been noted within areas of potential sources. No odours or staining has been recorded with any of the eight test locations.
		Site workers	Low likelihood	Mild	Low	
	Inhalation of vapours	Site users	Low likelihood	Medium	Low	
		Site workers	Unlikely	Mild	Very low	
	Migration	Aquifer waters	Unlikely	Medium	Low	
	Migration	Surface waters	Unlikely	Mild	Very low	
	Ingestion, absorption	Local flora and fauna	Unlikely	Mild	Very low	
	Aggressive attack	Building materials	Unlikely	Mild	Very low	

6.2.1 Risks to human health (future site users)

No significant risk has been identified with respect to the health of future site users. No potential contaminants have been detected at concentrations that might be considered hazardous.

6.2.2 Risks to human health (construction workers)

No significant risk has been identified with respect to the health of construction workers. Any risks should be acceptable when they are dealt with by a competent contractor.

6.2.3 Risks to controlled waters

No significant risk to controlled waters has been identified. No elevated levels of contamination have been found.

6.3 Remediation options

No contamination remediation should be required at the site. This is subject to agreement with the LPA.

6.4 Further works

At this stage, it is considered that sufficient investigation has been carried out to provide a robust analysis and assessment of potential contamination risks at the site. However, this is subject to agreement with the local planning authority (LPA).

6.5 Waste management and reuse of site won material

Where waste is created during construction works, e.g. soil arisings from trench excavations, then waste regulations require the reuse is covered by an environmental permit or a suitable waste exemption (e.g. a T5 Exemption) or protocol (such as the WRAP Protocol or the CL:AIRE Definition of Waste: Code of Practice). However, the revised Waste Framework Directive (2008/98/EC) explains that the following does not need to be classed as waste and can be reused on site: "*uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated*".

Accordingly, the revealed *in situ* natural TFD sandy silts/clays (beneath the made ground) should be suitable for reuse around the site provided no contamination is found or suspected. However, should any evidence of potential contamination be found (e.g. unusual odours or staining) then this material would be unsuitable for reuse without further assessment by a competent environmental engineer.

It should be noted that excavated (potentially contaminated) made ground or grubbed up hardstanding will not be suitable for reuse on the site (unless covered by an appropriate permit, exemption or protocol). It is generally recommended that allowance be made to remove such materials off site as waste (by a licensed waste handler),

including the made ground taken from garden areas and out of trenches. All relevant paperwork (including waste transfer notes) will need to be retained to provide documentary evidence of suitable waste disposal.

It is potentially possible that some clean, uncontaminated, excavated sub-surface made ground may prove to be suitable for reuse within the site, for example, as granular fill or cohesive fill material in line with the WRAP Protocol (2013), but this is subject to favorable results from compliance testing. Any identified excavated materials potentially suitable for reuse should be stored separately within the site until an appropriate permit, exemption or protocol has been put in place for reuse on the site. At this stage, no feasible potential for reuse of the *in situ* made ground is anticipated.

It would, at the earliest opportunity, be prudent to carry out WAC testing on materials for likely removal, in consultation with a local landfill or soil treatment facility. The required classification and costs could then be estimated for the removal off site of *in situ* made ground, grubbed up hardstand, etc.

6.6 Unforeseen contamination

Any unforeseen contamination (for example, petroleum odours or staining or asbestos containing materials) encountered during the development of the site must be monitored and immediately reported to the local authority. Work shall be halted in any area of the revealed potential contamination and the contamination investigated and assessed to the satisfaction of the local planning authority and any other relevant regulatory bodies.

In the event of unforeseen contamination being encountered then remediation measures may need to be re-evaluated.

6.7 Water supply pipework

The detected concentrations of TPH appear to be below levels that might potentially adversely affect plastic water supply pipework. However, some levels slightly above detection limits have been recorded. The specification for water supply pipework should be agreed with the water authority before placement.

6.8 Ground gas and vapour protection measures

As discussed, no significant risk has been identified from hazardous permanent ground gas (e.g. carbon dioxide) or volatile vapour-producing pollutants. Therefore, the ground gas regime could be suitable for a CIRIA classification of CS-1 or an NHBC/RSK Traffic Light Classification of Green. No ground gas protection measures should be required

except those required by Building Standards (e.g. covering basic domestic ventilation requirements).

6.9 Buried concrete

Buried concrete should be designed to resist any sulphate attack from the *in situ* ground conditions. The design of the concrete should follow guidance in BRE Special Digest 1 (2005): Concrete in Aggressive Ground.

7 SUMMARY & CONCLUSIONS

7.1 Desk study information

7.1.1 Proposed development

The proposed works consist of demolition of existing residential bungalow, garage and glass greenhouse and construct a new residential dwelling. The house will include gardens, parking garages and off-road parking areas.

7.1.2 Site location and description

The site is located off (and to the west of) Dog Drove North, Spalding, post code PE12 0SA. The site is centred around grid reference 532100, 312340.

The site occupies an irregular tract of land which is about 80m in length and about 28m in width with a pinch point around the centre of the site which reduces to a width of about 15m. It covers a total area of about 0.19 hectares.

7.1.3 Site history

The site is shown as a vacant plot until at least 1952. By 1959 available mapping shows the existing bungalow to be present, with additional associated outbuildings shown by 1976. A large glass greenhouse in the western section of the site was added in the late 80's or early 90's, noted as a nursery.

Nearby historical activity includes:

- Residential structure on the northern boundary and 500m east
- Repair garage (southern boundary) – 1981 to present (unused at present)
- Commercial structures (80-120m north and northeast) – 1976 to 2021

7.1.4 Anticipated geology

The local geology map indicates:

- Superficial/Drift: Tidal flat deposits (TFD) – sandy silts and clays
- Solid/Bedrock: Oxford Clay Formation (OXC) – mudstone

7.1.5 Hydrogeology and hydrology

The location of the groundwater table is unknown. The site's moderately low elevation suggests there could be some shallow groundwater present. BGS historical boreholes

suggest a water strikes at circa 2.6m below ground level, no resting water levels were recorded.

There is a surface water feature (possible ditch or small land drain) adjacent the western boundary of the site which appears to drain west to Diversion Drain circa 250m west of the site.

The site is not within an area of potential for groundwater flooding. Land directly adjacent to the northeast is reported to be potential for groundwater flooding at the surface based on BGS data.

The site is reported to be within the extent of flooding and extreme flooding from rivers or sea without defences.

The site is not reported to be in an *Area Benefitting from Flood Defences* and there are no nearby reported flood water storage areas or flood defences (within 1km of the site).

The site is shown by www.gov.uk (flood maps for planning) to be in a Flood Zone 1. Land and property in *Flood Zone 1* have a reported *low* probability of flooding.

7.1.6 Other environmental data

There are no nearby landfills within about 1km of the site.

The site should not be affected by radon. No radon protection measures are necessary.

7.2 Revealed ground conditions

The findings of the recent HML investigation indicate the following sub-strata at the site.

- Made ground:
  - Asphalt concrete surfacing (WS1) – to a depth of about 0.10m
  - Concrete (WS1 & 3) – to depths from 0.07-0.20m
  - Limestone fill (WS1) – to a depth of 0.35m
  - Brick fill (WS1) – to a depth of 0.45m
- Tidal Flat Deposits:
  - Topsoil (WS2, WS4-WS6, HP1 & HP2) – to depths from 0.20-0.35m
  - Firm to stiff or stiff occasionally sandy SILT/CLAY (WS2-WS6, HP1 & HP2) – to depths from 0.45-2.0m
  - Soft or soft to firm occasionally sandy SILT/CLAY (WS1-WS6) – to a depth of 2.0m

Only WS1 encountered a noted water strike during site works at 1.9m bgl. No other test location encountered groundwater.

7.3 Contamination assessment

7.3.1 Scope of contamination testing

Two shallow made ground samples and seven shallow TFD samples were analysed for the following.

- Made ground: WS1 (0.10m to 0.45m depth) – metals, PAHs, asbestos & TPH
- TFD: WS1 (1.30m to 1.70m and 1.70m to 2.0m) - TOC
- TFD: WS2 (0.10m to 0.50m depth) – metals, PAHs, asbestos & TPH
- Made ground: WS3 (0.07m to 0.60m depth) – metals, PAHs & TPH
- TFD: WS4 (0.10m to 0.50m) – metals, PAHs & TPH
- TFD: WS5 (0.10m to 0.50m) – metals, PAHs, asbestos & TPH
- TFD: WS6 (0.10m to 0.30m) – metals, PAHs, asbestos, pesticides & herbicides
- TFD: HP1 (0.10m to 0.50m) – metals, PAHs, pesticides & herbicides
- TFD: HP2 (0.10m to 0.50m) – pesticides & herbicides

7.3.2 Contamination test results

No elevated levels of metals, PAHs or TPHs have been identified when compared to relevant GAC assessment criteria. No asbestos contamination or asbestos containing material has been identified at the site. No pesticides or herbicides have been recorded above detection limits.

7.3.3 Revised risk assessment

No significant risk has been identified with respect to the health of future site users. No potential contaminants have been detected at concentrations that might be considered hazardous.

No significant risk has been identified with respect to the health of construction workers. Any risks should be acceptable when they are dealt with by a competent contractor.

No significant risk to controlled waters has been identified. No elevated levels of contamination have been found.

7.3.4 Remediation proposals

No contamination remediation should be required at the site. This is subject to agreement with the LPA.

7.3.5 Further works

At this stage, it is considered that sufficient investigation has been carried out to provide a robust analysis and assessment of potential contamination risks at the site. However, this is subject to agreement with the local planning authority (LPA).

7.3.6 Waste management and reuse of site won material

The revealed *in situ* natural silty sands beneath the made ground should be suitable for reuse around the site. However, excavated made ground will not be suitable for reuse on the site (unless covered by an appropriate permit, exemption or protocol) and allowance should be made to remove made ground (e.g. excavated from garden areas) off site as waste (and the paperwork retained as evidence).

7.3.7 Unforeseen contamination

If any unforeseen contamination (for example, petroleum odours or staining or asbestos containing materials) encountered, it must be monitored and immediately reported to the local authority and work halted in any area of the revealed potential contamination.

7.3.8 Water supply pipework

The detected concentrations of TPH appear to be below levels that might potentially adversely affect plastic water supply pipework. However, some levels slightly above detection limits have been recorded. The specification for water supply pipework should be agreed with the water authority before placement.

7.3.9 Ground gas and vapour protection measures

The ground gas regime could be classed as CIRIA CS-1 or NHBC/RSK Traffic Light Green. No ground gas or vapour protection measures should be required.

7.3.10 Buried concrete and sulphate resistance

Buried concrete should be designed to resist any sulphate attack from in situ ground conditions, based on BRE Special Digest 1 (2005).

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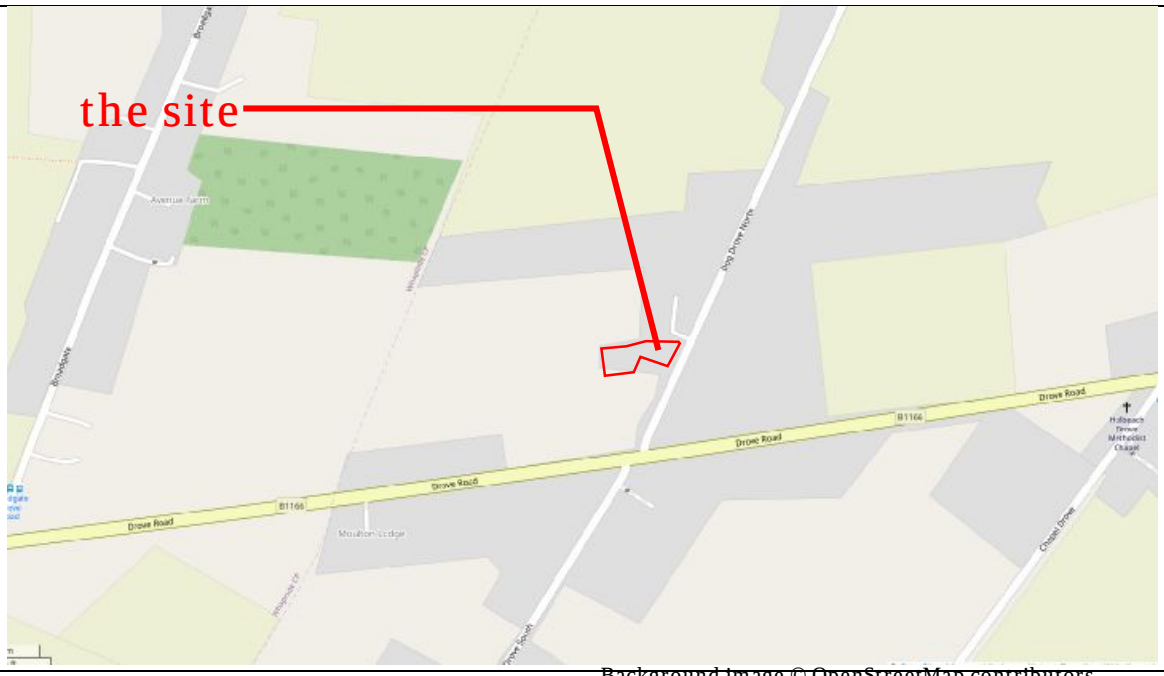
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Appendix A

Plans & Photographs



Background image © OpenStreetMap contributors

Site location plan *Date copied:* 16 August 2022 *Source:* openstreetmap.org



Background image © 2022 Getmapping plc

Imagery date: 1999

Historical aerial photograph: 1; Date copied: 16 Aug 2022; *Source:* Getmapping plc



Background image © 2022 Getmapping plc

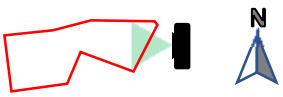
Imagery date: 2021

Historical aerial photograph: 2; Date copied: 16 Aug 2022; *Source:* Getmapping plc



Site Photo: 1 *Date:* 16 Aug 2022
Photo direction: West
Description: Site access and front elevation of property

Camera position:





Site Photo: 2 *Date:* 16 Aug 2022 *Photo direction:* Southwest *Description:* Hardstanding driveway	Camera position: 

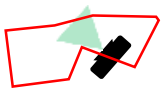


Site Photo: 3 *Date:* 16 Aug 2022 *Photo direction:* North *Description:* Hardstanding area between property and garage	Camera position: 



Site photo: 4 *Date:* 16 Aug 2022
Photo direction: Northwest
Description: Existing garage

Camera position:



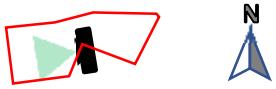


Site photo: 5 *Date:* 16 Aug 2022
Photo direction: South
Description: Adjacent garage heating oil tank

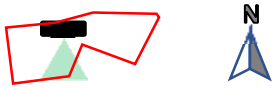
Camera position:





Site photo: 6 *Date:* 16 Aug 2022 *Photo direction:* Southwest *Description:* Existing greenhouse and previous above ground plinth for heating oil tank	Camera position: 



Site photo: 7 *Date:* 16 Aug 2022 *Photo direction:* South *Description:* General view (grassed area)	Camera position: 



Site photo: 8 *Date:* 16 Aug 2022 *Photo direction:* Southwest *Description:* Inside existing greenhouse (above ground planting)	Camera position: 

Appendix B

Exploratory hole logs

HUMBERSIDE MATERIALS LABATORY Ltd.
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BOREHOLE LOG

Borehole No **1**

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Dando Terrier
Drilled by :- MD & CC (of HML Ltd)

Depth (m)	Lithology / Description / Depth (thickness)	Elevation	Samples		Water level	DCP super heavy blows per100mm / SPT	Notes
0	Asphalt concrete surfacing 0.1	0					
0.2	Concrete 0.2	0.2	1	D			
0.4	Fine to coarse gravels of limestone with occasional cobble limestone and some silty sand - MADE GROUND 0.35	0.4					
0.6	Cobble brick with some medium to coarse brick gravels - MADE GROUND 0.45	0.6	2	D			HSV - 57kPa
0.8	Soft to firm brown SILT/CLAY with occasional fine rootlets	0.8					HSV - 82kPa
1	0.95	1					
1.2	Soft to firm grey brown SILT/CLAY 1.3	1.2					
1.4	Soft grey brown with rare black mottling SILT/CLAY	1.4	3	D			
1.6	1.7	1.6					
1.8	Soft grey brown, light grey slightly sandy SILT/CLAY with occasional black mottling	1.8	4	D	Water level after 20mins		HSV - 22kPa
2	2	2					HSV - 22kPa
2.2		2.2					
2.4		2.4					
2.6		2.6					
2.8		2.8					
3		3					
3.2		3.2					
3.4		3.4					
3.6		3.6					
3.8		3.8					

Sample Key
B Bulk
D Disturbed
U Undisturbed
W Water
SS Split spoon
DCP Dynamic Cone

Casing depth (m) :-
Depth drilled (m) :- 2
Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- DD (of HML Ltd)

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BOREHOLE LOG

Borehole No **2**

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Dando Terrier
Drilled by :- MD & CC (of HML Ltd)

Depth (m)	Lithology / Description / Depth (thickness)	Elevation	Samples	Water level	DCP super heavy blows per100mm / SPT	Notes
0	Brown silty sandy TOPSOIL with occasional rootlets	0				
0.2	0.2	0.2	1 D			
	Stiff brown sandy CLAY					
0.4	0.5	0.4				
	Firm brown grey and light brown mottled CLAY					
0.6		0.6				
0.8		0.8				
1		1				
1.2		1.2	2 D			
1.4		1.4				
1.6		1.6				
1.8		1.8	3 D			HSV - 66kPa HSV - 74kPa
2	2	2				
2.2		2.2				
2.4		2.4				
2.6		2.6				
2.8		2.8				
3		3				
3.2		3.2				
3.4		3.4				
3.6		3.6				
3.8		3.8				

Sample Key
B Bulk
D Disturbed
U Undisturbed
W Water
SS Split spoon
DCP Dynamic Cone

Casing depth (m) :-
Depth drilled (m) :- 2
Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- DD (of HML Ltd)

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BOREHOLE LOG

Borehole No **3**

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Dando Terrier
Drilled by :- MD & CC (of HML Ltd)

Depth (m)	Lithology / Description / Depth (thickness)	Elevation	Samples	Water level	DCP super heavy blows per100mm / SPT	Notes
0	Concrete - cracked and crazed 0.07	0				
0.2	Firm brown slightly sandy CLAY	0.2	1 D			
0.4	0.45	0.4				
0.6	Soft to firm light grey/brown occasional light brown mottled sandy SILT/CLAY	0.6	2 D			
0.8	0.7 Soft to firm brown grey mottled SILT/CLAY	0.8				HSV - 49kPa
1		1				HSV - 66kPa
1.2		1.2	3 D			
1.4		1.4				
1.6		1.6				
1.8	1.8 Soft brown grey mottled SILT/CLAY	1.8				HSV - 52kPa
2	2	2				HSV - 46kPa
2.2		2.2				
2.4		2.4				
2.6		2.6				
2.8		2.8				
3		3				
3.2		3.2				
3.4		3.4				
3.6		3.6				
3.8		3.8				

Sample Key
B Bulk
D Disturbed
U Undisturbed
W Water
SS Split spoon
DCP Dynamic Cone

Casing depth (m) :-
Depth drilled (m) :- 2
Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- DD (of HML Ltd)

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BOREHOLE LOG

Borehole No **4**

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Dando Terrier
Drilled by :- MD & CC (of HML Ltd)

Depth (m)	Lithology / Description / Depth (thickness)	Elevation	Samples		Water level	DCP super heavy blows per100mm / SPT	Notes
0	Dark brown silty sandy clayey TOPSOIL with occasional rootlets	0					
0.3	Stiff brown slightly sandy SILT/CLAY	0.3	1	D			
0.7	Firm to stiff brown grey/light brown mottled slightly sandy CLAY	0.7	2	D			HSV - 150kPa HSV - 90kPa
0.9	Firm brown grey mottled locally light brown mottled CLAY	0.9	3	D			
1.65	Soft to firm brown grey mottled locally light brown mottled SILT/CLAY	1.65					HSV - 38kPa HSV - 27kPa
1.9	Soft brown grey mottled locally light brown mottled SILT/CLAY	1.9					
2		2					

Sample Key
B Bulk
D Disturbed
U Undisturbed
W Water
SS Split spoon
DCP Dynamic Cone

Casing depth (m) :-
Depth drilled (m) :- 2
Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- DD (of HML Ltd)

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BOREHOLE LOG

Borehole No **5**

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Dando Terrier
Drilled by :- MD & CC (of HML Ltd)

Depth (m)	Lithology / Description / Depth (thickness)	Elevation	Samples	Water level	DCP super heavy blows per100mm / SPT	Notes
0	Dark brown slightly sandy clayey TOPSOIL with occasional rootlets	0				
0.35		0.35	1 D			
0.5	Stiff friable dark brown, brown mottled SILT/CLAY with rare rootlets	0.5				
0.9	Stiff dark brown, brown mottled SILT/CLAY	0.9	2 D			HSV - 136kPa HSV - 150kPa
1	Firm to stiff dark brown, brown mottled SILT/CLAY	1				
2	Soft to firm dark brown, brown mottled SILT/CLAY	2	3 D			HSV - 60kPa HSV - 70kPa

Sample Key
B Bulk
D Disturbed
U Undisturbed
W Water
SS Split spoon
DCP Dynamic Cone

Casing depth (m) :-
Depth drilled (m) :- 2
Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- DD (of HML Ltd)

HUMBERSIDE MATERIALS LABATORY Ltd.
Atherton Way, Brigg
North Lincs DN20 8AR
Tel & Fax 01652 652753

email info@humbersidematerialslab.co.uk

BOREHOLE LOG

Borehole No

6

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Dando Terrier
Drilled by :- MD & CC (of HML Ltd)

Depth (m)	Lithology / Description / Depth (thickness)	Elevation	Samples	Water level	DCP super heavy blows per100mm / SPT	Notes
0	Dark brown slightly sandy clayey TOPSOIL with occasional rootlets	0	1 D			
0.2	0.2	0.2				
0.4	Stiff friable dark brown, brown mottled SILT/CLAY with rare rootlets	0.4				
0.5	Stiff dark brown, brown mottled SILT/CLAY	0.5				
0.6		0.6				
0.8		0.8				
0.9	Firm to stiff dark brown, brown mottled SILT/CLAY	0.9				
1	Soft to firm dark brown, brown mottled SILT/CLAY	1				
1.2		1.2				
1.4		1.4				
1.6		1.6				
1.8		1.8				
2	2	2				
2.2		2.2				
2.4		2.4				
2.6		2.6				
2.8		2.8				
3		3				
3.2		3.2				
3.4		3.4				
3.6		3.6				
3.8		3.8				

Sample Key
B Bulk
D Disturbed
U Undisturbed
W Water
SS Split spoon
DCP Dynamic Cone

Casing depth (m) :-
Depth drilled (m) :- 2
Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- DD (of HML Ltd)

HUMBERSIDE MATERIALS LABORATORY Ltd.
Atherton Way, Brigg
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TRIAL PIT LOG

Trial pit No

HP1

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Hand

Depth (m)	Lithology / Description / Depth / (thickness)	Elevation	Samples	Water level	Mackintosh Probe 0 5 10 15 20	Notes
0	Dark brown slightly sandy clayey TOPSOIL with occasional rootlets	0				
0.31	Stiff friable dark brown, brown mottled SILT/CLAY with rare rootlets	0.3	1 D			
0.5		0.5				

Sample Key
B Bulk
D Disturbed
W Water
SS Split spoon
C Cone

Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- MD (of HML Ltd)

HUMBERSIDE MATERIALS LABORATORY Ltd.
Atherton Way, Brigg
North Lincs DN20 8AR
Tel & Fax 01652 652753

email info@humbersidematerialslab.co.uk

TRIAL PIT LOG

Trial pit No

HP2

Client :- JC Architectural Consultants
Site :- Dog Drove North, Spalding
Project No :- 5885

Location :- see site plan
Date :- 14th Sept 2022

Coordinates E: N:
Elevation :-
Excavated by :- Hand

Depth (m)	Lithology / Description / Depth / (thickness)	Elevation	Samples	Water level	Mackintosh Probe 0 5 10 15 20	Notes
0 – 0.32	Dark brown slightly sandy clayey TOPSOIL with occasional rootlets	0 – 0.32	1 D			
0.32 – 0.5	Stiff friable dark brown, brown mottled SILT/CLAY with rare rootlets	0.32 – 0.5				

Sample Key
B Bulk
D Disturbed
W Water
SS Split spoon
C Cone

Notes :- HSV - Hand shear vane (uncorrected)

File Ref :- 1488 / 5885
Logged by :- MD (of HML Ltd)

Appendix C

Test results

ANALYTICAL TEST REPORT

Contract no: 113953

Contract name: Dog Drove North, nr Spalding

Client reference: 1488/5885

Clients name: Humberside Materials Laboratory

Clients address: Atherton Way
Brigg
North Lincolnshire
DN20 8AR

Samples received: 26 September 2022

Analysis started: 26 September 2022

Analysis completed: 04 October 2022

Report issued: 04 October 2022

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing
NAD	No Asbestos Detected

Approved by:

Abbie Neasham-Bourn

Senior Reporting Administrator

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
113953-1	S/64811	0.10-0.45	Sand with Gravel	-	-	13.0
113953-4	S/64814	0.10-0.50	Sandy Clayey Loam with Gravel & Roots	-	-	10.4
113953-5	S/64815	0.07-0.45	Clay	-	-	22.1
113953-6	S/64816	0.10-0.50	Sandy Clay with Gravel & Roots	-	-	12.3
113953-7	S/64817	0.10-0.50	Sandy Clay with Gravel & Roots	-	-	10.9

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SOILS

Lab number			113953-1	113953-2	113953-3	113953-4	113953-5	113953-6
Sample id			S/64811	S/64812	S/64813	S/64814	S/64815	S/64816
			WS1-1	WS1-3	WS1-4	WS2-1	WS3-1	WS4-1
Depth (m)			0.10-0.45	1.30-1.70	1.70-2.00	0.10-0.50	0.07-0.45	0.10-0.50
Date sampled			14/09/2022	14/09/2022	14/09/2022	14/09/2022	14/09/2022	14/09/2022
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	7.0	-	-	16	9.3	17
Beryllium (total)	CE127 U	mg/kg Be	<1	-	-	1.7	1.0	1.2
Boron (water soluble)	CE063 U	mg/kg B	0.6	-	-	2.8	3.3	2.9
Cadmium (total)	CE127 M	mg/kg Cd	<0.2	-	-	0.4	<0.2	0.2
Chromium (total)	CE127 M	mg/kg Cr	44	-	-	55	50	53
Chromium (III)	CE208	mg/kg CrIII	44	-	-	55	50	53
Chromium (VI)	CE146	mg/kg CrVI	<1	-	-	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	7.5	-	-	32	13	18
Lead (total)	CE127 M	mg/kg Pb	11	-	-	66	17	31
Mercury (total)	CE127 M	mg/kg Hg	<0.5	-	-	<0.5	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	22	-	-	34	28	32
Selenium (total)	CE127 M	mg/kg Se	0.6	-	-	1.8	1.2	1.5
Vanadium (total)	CE127 M	mg/kg V	23	-	-	47	37	53
Zinc (total)	CE127 M	mg/kg Zn	27	-	-	189	54	137
Total Organic Carbon (TOC)	CE197	% w/w C	-	0.9	2.6	-	-	-
PAH								
Naphthalene	CE087 M	mg/kg	<0.02	-	-	0.02	<0.02	<0.02
Acenaphthylene	CE087 M	mg/kg	<0.02	-	-	0.02	<0.02	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02	-	-	0.04	<0.02	<0.02
Fluorene	CE087 U	mg/kg	<0.02	-	-	0.02	<0.02	<0.02
Phenanthrene	CE087 M	mg/kg	0.17	-	-	0.58	<0.02	0.08
Anthracene	CE087 U	mg/kg	0.04	-	-	0.15	<0.02	<0.02
Fluoranthene	CE087 M	mg/kg	0.39	-	-	1.93	<0.02	0.19
Pyrene	CE087 M	mg/kg	0.39	-	-	1.75	<0.02	0.17
Benzo(a)anthracene	CE087 U	mg/kg	0.23	-	-	0.92	<0.02	0.12
Chrysene	CE087 M	mg/kg	0.26	-	-	1.06	<0.03	0.13
Benzo(b)fluoranthene	CE087 M	mg/kg	0.39	-	-	1.39	<0.02	0.17
Benzo(k)fluoranthene	CE087 M	mg/kg	0.14	-	-	0.53	<0.03	0.06
Benzo(a)pyrene	CE087 U	mg/kg	0.27	-	-	1.06	<0.02	0.11
Indeno(123cd)pyrene	CE087 M	mg/kg	0.27	-	-	0.88	<0.02	0.11
Dibenz(ah)anthracene	CE087 M	mg/kg	0.05	-	-	0.17	<0.02	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	0.24	-	-	0.75	<0.02	0.08
PAH (total of USEPA 16)	CE087	mg/kg	2.85	-	-	11.3	<0.34	1.22
TPH								
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	-	-	<0.01	<0.01	<0.01
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	-	-	<0.01	<0.01	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	-	-	<0.01	<0.01	<0.01
EPH Aromatic (>EC10-EC12)	CE250	mg/kg	2	-	-	2	1	<1
EPH Aromatic (>EC12-EC16)	CE250	mg/kg	7	-	-	5	4	2
EPH Aromatic (>EC16-EC21)	CE250	mg/kg	7	-	-	15	6	2

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SOILS

Lab number			113953-1	113953-2	113953-3	113953-4	113953-5	113953-6
Sample id			S/64811	S/64812	S/64813	S/64814	S/64815	S/64816
			WS1-1	WS1-3	WS1-4	WS2-1	WS3-1	WS4-1
Depth (m)			0.10-0.45	1.30-1.70	1.70-2.00	0.10-0.50	0.07-0.45	0.10-0.50
Date sampled			14/09/2022	14/09/2022	14/09/2022	14/09/2022	14/09/2022	14/09/2022
Test	**Method**	**Units**						
EPH Aromatic (>EC21-EC35)	CE250	mg/kg	190	-	-	65	39	11
EPH Aromatic (>EC35-EC44)	CE250	mg/kg	148	-	-	15	7	1
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	-	-	<0.1	<0.1	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	-	-	<0.1	<0.1	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	-	-	<0.1	<0.1	<0.1
EPH Aliphatic (>C10-C12)	CE250	mg/kg	<6	-	-	<6	<6	<6
EPH Aliphatic (>C12-C16)	CE250	mg/kg	<6	-	-	<6	<6	<6
EPH Aliphatic (>C16-C35)	CE250	mg/kg	92	-	-	19	17	<15
EPH Aliphatic (>C35-C44)	CE250	mg/kg	49	-	-	<10	<10	<10
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	-	-	NAD	-	-

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SOILS

Lab number			113953-7
Sample id			S/64817 WS5-1
Depth (m)			0.10-0.50
Date sampled			14/09/2022
Test	**Method**	**Units**	
Arsenic (total)	CE127 M	mg/kg As	18
Beryllium (total)	CE127 U	mg/kg Be	1.2
Boron (water soluble)	CE063 U	mg/kg B	3.0
Cadmium (total)	CE127 M	mg/kg Cd	<0.2
Chromium (total)	CE127 M	mg/kg Cr	54
Chromium (III)	CE208	mg/kg CrIII	54
Chromium (VI)	CE146	mg/kg CrVI	<1
Copper (total)	CE127 M	mg/kg Cu	17
Lead (total)	CE127 M	mg/kg Pb	28
Mercury (total)	CE127 M	mg/kg Hg	<0.5
Nickel (total)	CE127 M	mg/kg Ni	34
Selenium (total)	CE127 M	mg/kg Se	1.6
Vanadium (total)	CE127 M	mg/kg V	59
Zinc (total)	CE127 M	mg/kg Zn	83
Total Organic Carbon (TOC)	CE197	% w/w C	-
PAH			
Naphthalene	CE087 M	mg/kg	<0.02
Acenaphthylene	CE087 M	mg/kg	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02
Fluorene	CE087 U	mg/kg	<0.02
Phenanthrene	CE087 M	mg/kg	0.03
Anthracene	CE087 U	mg/kg	<0.02
Fluoranthene	CE087 M	mg/kg	0.06
Pyrene	CE087 M	mg/kg	0.05
Benzo(a)anthracene	CE087 U	mg/kg	0.05
Chrysene	CE087 M	mg/kg	0.03
Benzo(b)fluoranthene	CE087 M	mg/kg	0.04
Benzo(k)fluoranthene	CE087 M	mg/kg	<0.03
Benzo(a)pyrene	CE087 U	mg/kg	0.03
Indeno(123cd)pyrene	CE087 M	mg/kg	<0.02
Dibenz(ah)anthracene	CE087 M	mg/kg	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	<0.02
PAH (total of USEPA 16)	CE087	mg/kg	<0.34
TPH			
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01
EPH Aromatic (>EC10-EC12)	CE250	mg/kg	<1
EPH Aromatic (>EC12-EC16)	CE250	mg/kg	<1
EPH Aromatic (>EC16-EC21)	CE250	mg/kg	<1

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SOILS

Lab number			113953-7
Sample id			S/64817 WS5-1
Depth (m)			0.10-0.50
Date sampled			14/09/2022
Test	**Method**	**Units**	
EPH Aromatic (>EC21-EC35)	CE250	mg/kg	3
EPH Aromatic (>EC35-EC44)	CE250	mg/kg	<1
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1
EPH Aliphatic (>C10-C12)	CE250	mg/kg	<6
EPH Aliphatic (>C12-C16)	CE250	mg/kg	<6
EPH Aliphatic (>C16-C35)	CE250	mg/kg	<15
EPH Aliphatic (>C35-C44)	CE250	mg/kg	<10
Subcontracted analysis			
Asbestos (qualitative)	$	-	NAD

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Beryllium (total)	Aqua regia digest, ICP-MS	Dry	U	1	mg/kg Be
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	U	0.5	mg/kg B
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
CE208	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Vanadium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg V
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.01	mg/kg
CE250	EPH Aromatic (>EC10-EC12)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC12-EC16)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC16-EC21)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC21-EC35)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC35-EC44)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE067	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.1	mg/kg
CE250	EPH Aliphatic (>C10-C12)	Solvent extraction, GCxGC-FID	As received		6	mg/kg

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE250	EPH Aliphatic (>C12-C16)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C16-C35)	Solvent extraction, GCxGC-FID	As received		15	mg/kg
CE250	EPH Aliphatic (>C35-C44)	Solvent extraction, GCxGC-FID	As received		10	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
113953-1	S/64811	0.10-0.45	N	
113953-2	S/64812	1.30-1.70	N	
113953-3	S/64813	1.70-2.00	N	
113953-4	S/64814	0.10-0.50	N	
113953-5	S/64815	0.07-0.45	N	
113953-6	S/64816	0.10-0.50	N	
113953-7	S/64817	0.10-0.50	N	

Chemtech Environmental Limited

ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

For soils and solids, analytical results are inclusive of stones, where applicable.