



Phase 2 Intrusive Site Investigation Report

LOCATION	Proposed Bew Dwelling, Salamander Cottage, Bay Horse, Lancaster
ISSUE DATE	25 th February 2015
FOR	Mr I Simpson c/o VDG Group
CLIENT REF.	
OUR REF.	G15002b

Prepared by



Stuart Howe BSc(Hons) FGS
Engineering Geologist

Checked by



Ross Nicolson BSc(Hons) MSc(Eng) CEng MIMM
Principal Geotechnical Engineer

Table of Contents

Section	Content	Page
1	Introduction	3
2	Scope of Phase 2 Investigation	3
2.1	Scope of works	3
2.2	Sampling Rationale	4
3	Phase 2 Investigation Findings	4
3.1	Encountered ground conditions	4
3.1.1	Windowless Sampling Boreholes	4
3.1.1.1	BH1 to BH5	4
3.1.1.2	BH6	5
3.1.2	Review of ground conditions encountered	5
3.2	Soil Plasticity and Vegetation Influence	5
4	Contamination Testing	5
5	Risk Assessment	6
5.1	Method	6
5.2	Contamination Risk to Identified Receptors	6
5.2.1	Contamination Risk to Human Health	6
5.2.2	Contamination Risk to Controlled Waters	8
5.3	Review of Results	9
5.3.1	Elevated Analytical Results and Exceedances of Assessment Criteria	9
6	Hazardous Gas	11
6.1	Gas Regime	11
6.2	Radon Gas	11
7	Conclusions	11
7.1	Contamination	11
7.2	Hazardous Gas	11
7.3	Foundations & Floors	12
7.4	Concrete Design	12
Appendix 1	Site Plan and Borehole Logs	
Appendix 2	Moisture Content / Shear Strength Profiles and Atterberg Limit Test Results (Table 4)	
Appendix 3	Chemtech Analytical Test Report	
Appendix 4	CLEA v1.06 Risk Assessment: Results, Settings and Notes	



Units 4 and 5 Terry Dicken Industrial Estate
 Ellerbeck Way
 Stokesley
 North Yorkshire
 TS9 7AE
 Tel. 01642 713779
 Fax 01642713923
 Email enquiries@geoinvestigate.co.uk

1. Introduction

Following submission of a Phase 1 Desk Study (ref Report No G15002a issued 12 February 2015) and in accordance with your instruction, Geoinvestigate Ltd subsequently carried out a Phase 2 investigation on a plot of land currently occupied by a cluster of small buildings within the rear garden of an existing dwelling.

The purpose of the Phase 2 investigation was to establish the true nature of the ground conditions at the site for foundation design and to assess the risks highlighted in the Phase 1 report's conceptual ground hazard model (CGHM) with regard to geotechnical hazards and the potential for hazardous gas and contamination to occur at the site.

2. Scope of Phase 2 Investigation

2.1 Scope of Works

The previous Phase 1 report concluded that the following investigation would be appropriate for to assess the potential risks highlighted in that study:

- The sinking of six (6) boreholes (BH1 to BH6) to depths of between 2.00m and 5.00m within the proposed building footprints and external areas of the development, with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were sunk by windowless sampling drilling techniques, using a Dando Terrier drill rig.
- Geotechnical Testing comprising two (2) Atterberg Limits and forty six (46) moisture determinations to provide information with regard to soil plasticity on the site.
- Contamination analyses of four (4) samples of soil recovered at shallow depth (<0.50m) and deeper natural soils (1.50m) to confirm that metals, Asbestos and polycyclic aromatic hydrocarbons (PAHs) are absent or within acceptable limits. (Chemical analyses based on findings of the Phase 1 Desk Study Report). Leachate from a single (1) sample was tested to check the mobility of the contaminants.
- Provision of a factual and interpretative report including; site plan, borehole logs, contamination analysis results and gas measurements; together with advice on suitable foundation types and, if required, remediation and validation

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

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

Moisture and Atterberg Limit test results together with shear strength profiles are provided in Appendix 2.

The results of the contamination testing and CLEA v1.06 software are included in Appendices 3 and 4.

2.2 Sampling Rationale

BHs 1 to 5 were positioned principally to establish the ground conditions beneath the proposed building and the rear gardens. Their purpose was to recover soil samples for geotechnical and contamination testing.

BH6 was positioned close to the area of the proposed sewage treatment unit.

3. Phase 2 Investigation Findings

3.1 Encountered Ground Conditions

It was anticipated from the Phase 1 Desk Study findings that made ground would be encountered possibly arising from the historic adjacent quarrying and ground-works activities. It was anticipated that the fill would be underlain directly by the Glacial Till then the Acerhill Sandstone formation.

3.1.1 Windowless Sampling Boreholes

3.1.1.1 BH1 to BH5.

The boreholes within or close to the proposed footprint of the building (BH1 to BH5) encountered similar ground conditions, comprising a thin horizon of Topsoil or granular made ground to depths of between 0.20m and 0.35m. This was underlain by generally firm (with some soft to firm horizons) clay fill to depths of between 2.10m and 2.40m.

Below the made ground a horizon of wet very soft / loose natural sandy gravelly clay / clayey gravelly sand was found extending to depths of between 2.75m and 3.30m. Below this (with the exception of BH5), very stiff very sandy gravelly clay (of possible Glacial Till origin) was encountered to the base of the borehole or refusal. In BH5, clay of similar composition was firm in strength.

BH2 and BH5 encountered slightly weathered Mudstone rock beneath the very stiff and firm very sandy clay below depths of 4.10m and 4.65m respectively.

Shear vane values of between 35kN/m^2 and 60kN/m^2 were recorded in the clay fill horizon with values between 10kN/m^2 and 20kN/m^2 returned in the underlying very soft very sandy clay / clayey sand. The basal very stiff very sandy gravelly clay in BH1 to BH4 returned values of 130kN/m^2 whilst the firm clay in BH5 returned values between 48kN/m^2 and 55kN/m^2 .

In Situ SPT testing (carried out with a solid cone sampler) in BH1 and BH2 returned field values of $N=1$ and $N=2$ at 2.00m and 3.00m within the weak very sandy clay / clayey sand, with refusal values of $N=50/100\text{mm}$ at 4.30m in the Mudstone at BH2 and $N=50/50\text{mm}$ at 4.60m in the very stiff very sandy clay horizon at BH3.

No roots were recovered from the boreholes.

Standing water level was noted in all five boreholes at depths of between 2.50m and 3.60m.

3.1.1.2 BH6

BH6 encountered topsoil comprising loose/very soft clayey sand/very sandy clay to 0.90m underlain by natural, wet, loose/soft clayey sand/very sandy clay.

No strength testing was requested in the borehole.

3.1.2 Review of ground conditions encountered

The boreholes have confirmed that clay fill of generally firm strength is present at the site to depths of up to 2.40m, and was underlain by an horizon of weak (possibly alluvial) natural very sandy clay / clayey sand to a maximum depth of 3.30m. Below this (save for BH5) very stiff very Boulder Clay was encountered. BH5 found the boulder clay deposit in a firm condition. Mudstone rock was encountered below the boulder clay in BH2 and BH5.

It is construed that the origin of the fill on the site is from the historic adjacent quarrying works, and that the mudstone encountered below the clay in places was of the Millstone Grit Group.

3.2. Soil Plasticity and Vegetation Influence.

Cohesive soils at the site generally classify as Clay of borderline Low to Intermediate (CL/CI) and Clay of Intermediate (CI) Plasticity according to BS5930. These equate to NHBC Low and Medium Shrinkage Soils.

The absence of significant vegetation, together with presence of cohesive soils of borderline Low to Intermediate and Intermediate Plasticity and with the depth and condition of the clay fill at the site, would mean that no consideration would need to be made with regard to potential soil shrinkage and swelling and foundation depth / type.

4. Contamination Testing

The Phase 1 desk study had identified that the probable presence of made ground within the site from the adjacent sandstone quarrying would provide the most credible source of contamination within the site.

It was considered that if former land uses within the site had caused contamination the contaminants would most probably occur in the near surface or deeper made ground or topsoil horizons, however, given the age of the fill and the probability that it has originated from the 'overburden strip' from the adjacent quarries (dating back to 1846) it was considered unlikely that the fill would not contain overly elevated concentrations of contaminants.

Therefore four (4) samples of generally near surface ($\leq 0.50\text{m}$) fill, and deeper natural strata (1.50m) recovered from across the site were tested for a range of substances. These included common contaminants such as Arsenic, Lead and Cadmium which are normally included in a general human health contamination suite together with analysis for Speciated PAHs and Asbestos.

The results of the contamination testing are included in Appendix 3 of this report and have been used in the contamination risk assessment set out in the following sections.

5. Risk Assessment

5.1 Method

Geoinvestigate Ltd. uses a combination of assessment criterion provided by the environment agency and by the Chartered Institute of Environmental Health; Environment Agency published Soil Guideline Values (SGVs) and Environmental Quality Standards (EQSs), Site Specific Assessment Criteria (SSAC) generated using CLEA software version 1.06 site specific risk assessment modelling, and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Generic Assessment Criteria (GAC) in order to assess the presence of potentially harmful chemicals within soils and water.

As the site is to be developed as housing it falls within the residential end-use category. As it is possible that persons living on the site may cultivate vegetables / fruit for consumption it is considered appropriate to use the Residential SGV as the stock limit.

In addition to the published SGVs and LQM/CIEH values, site specific assessment criteria (SSAC) have been created using the CLEA model which is presented in Appendix 4. The model was created using CLEA version 1.06 software and has been tailored to the site's intended use as housing with an allowance for plant up take.

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 residential end use.

Where results are above the intervention values, an assessment of the available pathways and receptors has been carried out to determine whether further investigation or remediation is necessary.

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

5.2 Contamination Risk to Identified Receptors

5.2.1 Contamination Risk to Human Health

Topsoil and made ground, the latter comprising ostensibly reworked natural clay fill with sandstone constituents, extended generally to depths of between 2.10m to 2.40m.

No hydrocarbon staining, odours, obvious chemical substances or signs of physical contamination such as glass or metal shards were noted in any of the material uncovered in the boreholes. Neither was there any visible evidence of Asbestos contamination such as roofing board. In light of this it was not anticipated that chemical or physical contamination would pose a significant hazard for the new development and its users.

As discussed earlier in the report, levels of determinands have been compared to the SGVs for residential end-use (as published by the Environment Agency in their individual SGV and toxicology reports and accompanying documents), LQM/CIEH values, and site specific criteria generated from the CLEA software version 1.06.

The results of the analyses of four (4) samples of topsoil and made ground recovered from the site from depths up to 1.50m returned concentrations of a range of substances generally falling below respective assessment criteria adopted from the sources named above.

The results of the analyses are shown in Table 1 (below) along with the published SGV values, LQM/CIEH (GAC) values and site specific assessment criteria (SSAC). Soil analysis returned a Total Organic Carbon content (TOC) of 7.40% with an estimated Soil Organic Matter (SOM) content of 12.76% (calculated from the TOC), therefore the LQM/CIEH GAC for PAHs and Hydrocarbons were chosen using the highest Soil Organic Matter (SOM) option of 6.0%. SSAC were generated using a SOM of 7.40%, the value calculated for TOC; this represents a conservative estimate as TOC is by definition lower than the actual SOM.

Table 1: Chemical Determinands

	Range of Returned concentrations (mg/kg)	Residential SGV (mg/kg)	Generic Assessment Criterion – LQM/CIEH (mg/kg)	Site Specific Assessment Criterion (mg/kg)
Boron	<0.05-0.9		291	376
Chromium VI	<1		4.3	12.4
Chromium III	82-106		627	6.27
Arsenic	6.9-18	32		32.4
Cadmium	<0.2-0.5	10	3	5.17
Copper	13-47		2330	2330
Mercury (elemental)	<0.5	1		2.66
Lead	14-562	450*		
Nickel	12-34	130		127
Selenium	1.0-1.9	350		350
Zinc	43-218		3750	3750
Total PAH	<0.16-1.93			
PAH Naphthalene	<0.01-0.02		3.7	20
PAH Acenaphthylene	<0.01		400	1020
PAH Acenaphthene	<0.01		480	1200
PAH Fluorene	<0.01-0.02		380	914
PAH Phenanthrene	<0.01-0.21		200	428
PAH Anthracene	<0.01-0.04		4900	10500
PAH Fluoranthene	<0.01-0.32		460	720

Table continued overleaf

*Old SGV

Values presented in **bold type** represent exceedances of assessment criteria and/or unacceptably high results

Table 1: (Contd) Chemical Determinands

	Range of Returned concentrations (mg/kg)	Residential SGV (mg/kg)	Generic Assessment Criterion – LQM/CIEH (mg/kg)	Site Specific Assessment Criterion (mg/kg)
PAH Pyrene	<0.01-0.30		1000	1670
PAH Benzo[a]anthracene	0.01-0.18		4.7	6.42
PAH Chrysene	<0.01-0.20		8.0	9.58
PAH Benzo(b)fluoranthene	<0.01-0.20		6.5	7.12
PAH Benzo(k)fluoranthene	<0.01-0.08		9.6	10.1
PAH Benzo(a)pyrene	<0.01-0.14		0.94	10.1
PAH Dibenzo(a,h)anthracene	<0.01		0.86	0.91
PAH Indeno(123-cd)pyrene	<0.01-0.11		3.9	4.26
PAH Benzo(ghi)perylene	<0.01-0.10		46	47.0
Phenol	<0.5	420		486

*Old SGV

Values presented in **bold type** represent exceedances of assessment criteria and/or unacceptably high results.

Analysis of soils from the site returned values generally within SGVs, GAC and SSAC limits for all determinands. However, an elevated concentration of Lead (562mgkg^{-1}) slightly exceeding the old SGV value of 450mgkg^{-1} was returned for the sample recovered from BH5 at 0.20m.

Discussion on the impact of this exceedance is provided later in this report in section 5.3.1 (Elevated Analytical Results and Exceedances of Assessment Criteria).

No Asbestos fibres were detected in the analysed sample.

5.2.2 Contamination Risk to Controlled Waters

Concentrations of potential contaminants returned in four (4) soil samples generally fell below the chosen assessment criteria. Therefore there was considered to be a low risk to underlying groundwater from leaching.

Notwithstanding, leachate from a single (1) sample obtained from 0.25m in BH3 was analysed for potential contaminants. This screening returned generally negligible concentrations and concentrations below detectable limits and/or safe levels for domestic water supply or the protection of aquatic life (Environmental Quality Standards published by the Environment Agency) which were used as the assessment criteria. The results of the testing and the assessment criteria are shown Table 2 overleaf.

Table 2: Chemical Determinands in Leachate

	Returned Concentrations (µg/l)	UK Standard for Surface Waters intended for Drinking Water Abstraction* (DW) and/or protection of Aquatic Life in surface waters* (Aq) (µg/l)
<i>Inorganic Chemicals</i>		
Arsenic	0.33	50 (DW, range: 50-100) (No Aq standard)
Boron	<6	1000 (DW & Aq)
Cadmium	<0.07	5 (DW & Aq)
Chromium	<0.2	50 (DW) / 5 (Aq, range: 5-250)
Copper	1.9	50 (DW) / 5 (Aq, range: 5-112)
Lead	<0.2	50 (DW) / 4 (Aq, range: 4-250)
Mercury (elemental Hg)	<0.008	1 (DW & Aq)
Nickel	<0.5	20** (DW) / 50 (Aq, range: 50-200)
Selenium	0.17	10 (DW) (No Aq standard)
Zinc	<1	3000 (DW, range: 3000-5000) / 30 (Aq, range: 30-2000)
<i>Organic Chemicals</i>		
Phenols	<10	50**(DW) / 300 (Aq)
PAHs (total)	<1.6***	0.2 (DW, range: 0.2-1.0) (No Aq standard)

*sourced from Environment Agency database at <http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx>.

If more than one option is available (dependant on other water properties or environmental setting) the lowest value has been adopted.

**Standard for water supply as no standard available for surface water abstraction for drinking water.

***Sum of USEPA 16, each at Lower Limit of Detection of <0.1

Concentrations of PAH and Phenol are below detectable limits and would not be considered to pose a risk to controlled waters.

In summary the leachate testing returned negligible concentrations of determinands which would generally pass local drinking water and ground water quality standards.

5.3 Review of Results

The data presented in Tables 1 and 2 show that, in the majority of soil samples analysed, returned concentrations of potential contaminants in soil and leachate fall below the adopted assessment criteria and as such, excluding the exception noted below, surface and sub-soils at the site are considered to be generally uncontaminated and fit for purpose in the context of a residential end use.

The majority of SSAC generated using the CLEA v1.06 software are presented in green in the assessment output (Appendix 3) suggesting that there are unlikely to be any unusual circumstances at the site that would present a danger of free phase contamination existing in the soil.

SSAC presented in amber highlight instances where the generated SSAC exceed the estimated soil saturation limits for the associated chemical species. Where this has occurred the analyses have returned soil concentrations either below soil saturation limits, below lower limits of analytical detection, or well below the generated SSAC and generic GAC against which they have been appraised and as such there is considered to be a minimal risk of free phase contamination to exist at the site with regard to these chemicals.

5.3.1 Elevated Analytical Results and Exceedances of Assessment Criteria

As can be seen in Table 1 (Section 5.2.1) and in the analytical results presented in Appendix 3, a single sample recovered from a depth of 0.20m in BH5 has been found to contain a concentration of lead in

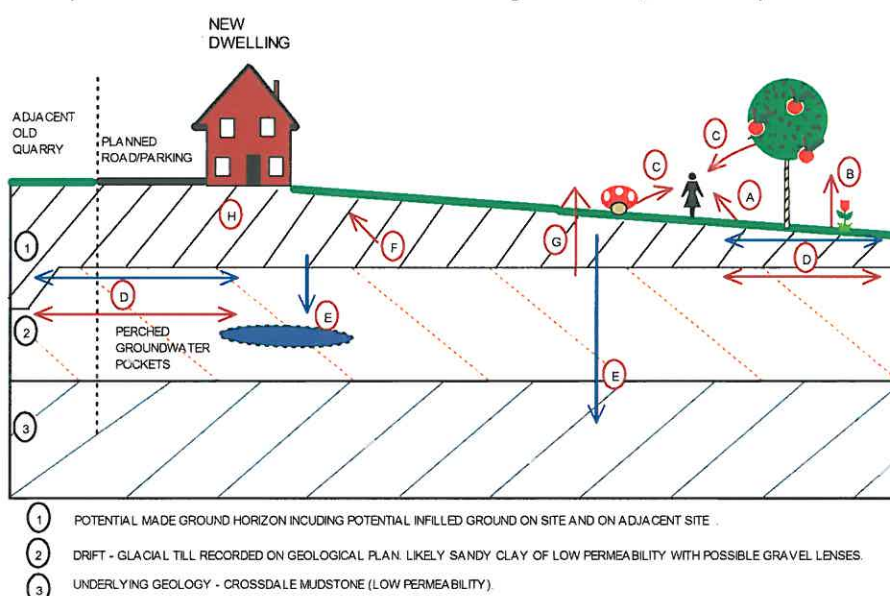
excess of the adopted assessment criteria at 562mgkg^{-1} .

The sample tested was of near surface topsoil and the remainder of the results for Lead concentrations at the site were between 14mgkg^{-1} and 202mgkg^{-1} , therefore the result might be considered anomalous. Furthermore, there is considered to be a negligible risk to the underlying aquifer as negligible amounts of lead were observed in leachate from a sample from a similar depth in BH3.

BH5 is positioned close to the footprint of the building, in an area that is likely to be stripped during construction of the dwelling, and will subsequently surfaced with hard-standing. The presence of hardstanding would be considered sufficient to break the pollutant linkage between the soil and the end users of the site though the additional strip would further remove any residual risk to end users at the site. A small scale remediation and validation exercise may need to be completed to confirm that this has occurred at the discretion of the local authority.

The conceptual model presented overleaf shows pollutant linkages which were considered at the site between shallow soils and four main receptor groups. These are the site's end users and construction workers, plants and vegetation, neighbouring sites and the underlying aquifer.

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



IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

Slightly elevated concentration of Lead at the site in one location. Likely to be removed during site works.

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

- A - Construction Workers & End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard-standing will encompass some of the site, removing any pathway to end users through direct contact in these areas.
- B - Plants and Trees through uptake.
- C - End Users through cultivation and consumption of vegetables / fruit. Currently considered highly unlikely due to nature of intended site use and development plan. Elevated lead contaminant at shallow depth likely to be removed during site works.
- D - Neighbouring Sites through lateral migration (in soil and water, including surface water run-off and ingress of contaminants into site from external sources).
- E - Ground water through leaching of sub-soil. Unlikely due to underlying low permeability mudstone.
- F - Building and services through direct contact.
- G - End users and buildings through ground gas migration. Installation of 'Amber 1' Gas mitigation measures, due to adjacent quarry and clay fill on site.
- H - Building through settlement on possible made ground. Piled foundation solution or deep trench fill to carry building loads.

6. Hazardous Gas

6.1 Gas Regime

As outlined in the Phase 1 Desk Study Report (Ref. Report G15002a) made ground on the site associated with the adjacent site's use as a quarry would provide the most plausible source of hazardous gas. The Desk Study assessed this risk to be Low to Moderate.

In lieu of a gas monitoring at the site (which was not carried out as it was outside the scope of works provided by the client) it is considered that mitigation measures are required to be incorporated into the construction of the dwelling, given the presence of clay fill on the site. Although, due to the absence of significant organic material within the essentially reworked natural clay material, there is not considered to be a high risk of large quantities of gas being present at the site.

Notwithstanding the gas conditions at the site might be expected to fall within "Amber 2" of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665).

6.2 Radon Gas

The desk study findings confirmed that Radon protection is not necessary for new buildings at the site.

7. Conclusions

7.1 Contamination

Analysis of the ground conditions at the site and an assessment of the potential pathways have confirmed that the ground is generally uncontaminated and therefore unlikely to pose a significant risk to human health in the context of the proposed residential end-use of this site. Neither would the strata pose a significant risk to surface and underground waters, due to the presence of negligible levels of contaminants leaching from the material.

However a small scale remediation exercise is recommended to confirm that the topsoil material in the locality of BH5 is removed from site. Given that this area will be overlain by hard-standing in the final development there is unlikely to be a significant pathway by which end users may come into contact with the soils though the local authority may stipulate that these works be carried out. In this eventuality waste acceptance criteria (WAC) testing should be carried out on the implicated soil to determine appropriate landfill disposal and a formal remediation strategy may also be required by the LA prior to the commencement of works.

7.2 Hazardous Gas

As discussed in 6.1 earlier in lieu of a gas monitoring exercise (which was outside the remit of this report), and given that there is large quantity of fill at the site (although this essentially comprises reworked clay) the site would be expected to fall within "Amber 2" of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665). Therefore, gas mitigation measures may be designed accordingly.

7.3 Foundations & Floors

Were foundations to be placed at a depth of 1.00m then they would be subject to damaging settlement due to the presence of both a thick pile of fill to a depth of 2.40m and underlying weak wet very sandy clay / clayey sand horizon to a maximum depth of 3.30m. Therefore, deep trench fill foundations would need to extend to a depth of around 3.50m to ensure that bases were underlain by competent firm or very stiff very sandy Boulder Clay.

However, the very weak saturated sandy clay / clayey sand beneath the clay fill may provide considerable stability problems with such deep excavations, especially given the high water table encountered, necessitating sheet piling during trench excavations and possible large scale sump pumping.

Therefore, the most practicable foundation type would be a bored pile solution, with pile bases seated within the very stiff very sandy Boulder Clay, or Mudstone. The piles should be sleeved in the upper portion to allow for possible ongoing settlement of the fill, although this might be considered minimal given the anticipated length of time that the fill has been in place. This solution would also minimise the quantity of fill having to be removed from site.

A suspended block and beam floor should be incorporated into the construction of the dwellings, incorporating a minimum void of 100mm.

7.4 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between <10mg/l and 17mg/l (SO_4) and pH levels of between 6.8 and 7.9. 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



Units 4 and 5 Terry Dicken Industrial Estate
Ellerbeck Way
Stokesley
North Yorkshire
TS9 7AE

Tel. 01642 713779

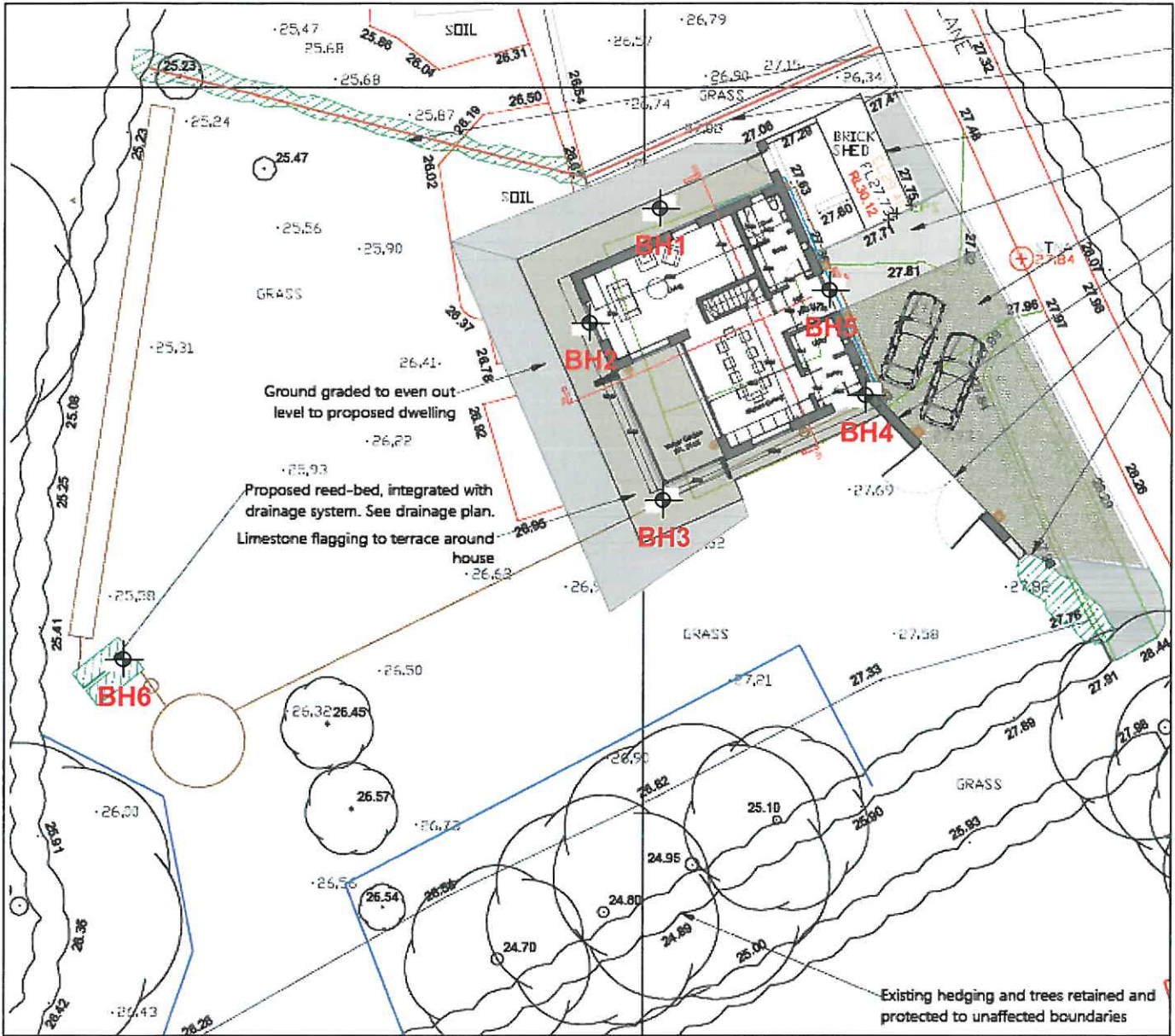
Fax 01642713923

Email enquiries@geoinvestigate.co.uk

APPENDIX 1
SITE PLAN &
BOREHOLE LOGS

GEOINVESTIGATE Ltd.

OUR REF:G15002	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE:28/01/15	LOCATION:Salamander Cottage, Bay Horse, Lancaster	



GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G15002

BH No.1

Sheet No. 1 of 1

Location: Salamander Cottage, Bay Horse, Lancaster

DATE: 28/01/15

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.35	TURF / TOPSOIL Soft to firm dark brown very sandy gravelly clay. Gravel is fine to coarse sandstone and mudstone.	350			O	Cv kN/m ²			0.30
2.20	MADE GROUND Firm dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone. Many cobbles noted. Possible reworked natural.	1850			O	52			0.50
					O	48			0.75
					O	52			1.00
					O	52			1.25
					O	55			1.50
					O	55			1.75
					O	55			2.00
					O	55			2.25
2.75	Very soft / loose orangish brown very sandy gravelly CLAY / clayey gravelly SAND. Wet.	550			O	20			2.50
								2.70m	2.75
3.70	Very stiff dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and limestone. Many sandstone cobbles noted.	950			O	130			3.00
					O	130			3.25
					O	130			3.50
	Large cobble / boulder at 3.70m				O		3.70-3.75 N=50/50mm		3.70
	Borehole Terminated at 3.70m due to refusal.								

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 3.70m
 Standing water level at 2.70m on completion

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.

G15002

BH No.2 Sheet No. 1 of 1

Location: Salamander Cottage, Bay Horse, Lancaster

DATE: 28/01/15

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.35	MADE GROUND Loose grey and red sandy gravel of brick, concrete and occasional limestone.	350			O	Cv kN/m ²			0.20
2.10	MADE GROUND Firm dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone. Many cobbles noted. Possible reworked natural. Some clayey gravelly sand inclusions. Soft to firm in places	1750			O	50			0.50
					O	40			0.75
					O	60			1.00
					O	55			1.25
					O	10			1.50
					O	10			1.75
3.30	Very soft / loose orangish brown very sandy gravelly CLAY / clayey gravelly SAND. Wet.	1200			O	10		2.50m	2.00
					O		3.00-3.45 1/0/0/0/0/1 N=1		2.25
					O				2.50
					O				2.75
					O				3.00
					O				3.25
4.10	Very stiff dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and limestone. Many sandstone cobbles noted.	800			O				3.50
					O				3.75
					O				4.00
4.30	Moderately strong grey slightly weathered silty MUDSTONE.	200			O		4.30-4.40 N=50/100mm		4.30
	Borehole Terminated at 4.30m due to refusal								

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 4.30m
 Standing water level at 2.50m on completion
 Borehole closed below 3.80m on completion

Key:

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter
- Disturbed sample
- Cv Shear vane
- W Water sample
- S Standard Penetration Test
- C Cone Penetration Test

BH2

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G15002

BH No.3

Sheet No. 1 of 1

Location: Salamander Cottage, Bay Horse, Lancaster

DATE: 28/01/15

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	MADE GROUND Loose grey and red sandy gravel of brick, concrete and occasional limestone.	300			O	Cv kN/m ²			0.25
2.10	MADE GROUND Soft to firm orangish brown very sandy gravelly clay / clayey gravelly sand. Gravel is fine to coarse of sandstone.	1800			O	40			0.50
					O	50			0.75
					O	40			1.00
					O		2.00-2.45 1/0/0/0/1/0 N=1		1.25
					O				1.50
					O				1.75
					O				2.00
3.70	Very soft / loose orangish brown very sandy gravelly CLAY / clayey gravelly SAND. Wet. Becoming very gravelly with poor sample recovery from 3.40m	1600			O				2.25
					O				2.50
					O				2.75
					O		3.00-3.45 2/1/0/0/1/1 N=2		3.00
					O				3.25
					O			3.60m	3.50
4.60	Very stiff dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and limestone. Many sandstone cobbles noted.	900			O	130			3.75
					O				4.00
					O				4.25
					O	130	4.60-4.65 N=50/50mm		4.50
									4.60
	Borehole Terminated at 4.60m due to refusal								

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 4.60m
 Standing water level at 3.60m on completion

Key:

- | | | | |
|--|---------------|--|-----------------------------|
| | Slotted Pipe | | Disturbed sample |
| | Plain Pipe | | Cv Shear vane |
| | Bentonite | | W Water sample |
| | Gravel Filter | | S Standard Penetration Test |
| | | | C Cone Penetration Test |

BH3

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

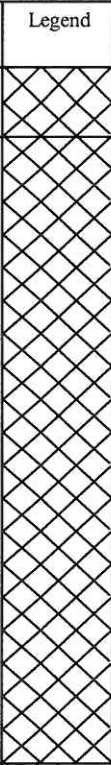
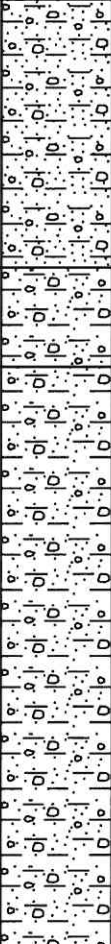
G15002

BH No.4

Sheet No. 1 of 1

Location: Salamander Cottage, Bay Horse, Lancaster










DATE: 28/01/15

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	MADE GROUND Blackish brown and orange sandy gravel. Gravel is fine to coarse of sandstone. Cobbles noted.	200				Cv kN/m ²			0.20
	MADE GROUND Soft orangish brown very sandy clay / clayey sand with occasional fine to coarse gravel of sandstone.					O	45		0.50
						O	40		0.75
						O	40		1.00
	Large cobble at 1.30m	1900				O	35		1.25
						O	40		1.50
						O	40		1.75
						O	40		2.00
						O	40		2.25
						O	40		2.50
2.10					O	40		2.75	
	Very soft / loose orangish brown very sandy gravelly CLAY / clayey gravelly SAND. Wet.	800						2.60m	2.25
2.90						O	10		2.50
						O	130		2.75
						O	130		3.00
3.20	Very stiff dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and limestone. Many sandstone cobbles noted.	300				O	130		3.25
	Very stiff grey very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and limestone. Cobbles noted.					O	130		3.50
						O	130		3.75
						O	130		4.00
		1800				O	130		4.25
						O	130		4.50
					O	130		4.75	
5.00	Borehole Terminated at 5.00m				O	130		5.00	

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 5.00m
 Standing water level at 2.60m on completion

Key:

-  Slotted Pipe
-  Plain Pipe
-  Bentonite
-  Gravel Filter
-  Disturbed sample
-  Shear vane
-  Water sample
-  Standard Penetration Test
-  Cone Penetration Test

BH4

GEOINVESTIGATE Ltd.

Your Ref.






Our Ref.

G15002

BH No.5 Sheet No. 1 of 1

Location: Salamander Cottage, Bay Horse, Lancaster










DATE: 28/01/15

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.35	TOPSOIL Loose dark brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and coal.	350			O	Cv kN/m ²			0.20
2.40	MADE GROUND Soft to firm orangish brown very sandy gravelly clay / clayey gravelly sand. Gravel is fine to coarse of sandstone.	2050			O	45			0.50
					O	40			0.75
					O	35			1.00
					O	30			1.25
					O	30			1.50
					O	30			1.75
					O	30			2.00
					O	30			2.25
					O	10			2.50
					O	10		2.80m	2.75
3.10	Very soft / loose orangish brown very sandy gravelly CLAY / clayey gravelly SAND. Wet.	700			O	10			3.00
					O	10			3.25
					O	55			3.50
					O	55			3.75
					O	52			4.00
					O	52			4.25
					O	48			4.50
4.65	Firm dark orangish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and limestone. Many sandstone cobbles noted.	1550			O	48			4.75
					O	130			5.00
5.00	Moderately strong grey slightly weathered silty MUDSTONE Borehole Terminated at 5.00m	350			O	130			

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 5.00m
 Borehole closed below 4.30m on completion
 Standing water level at 2.80m on completion

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

BH5

GEOINVESTIGATE Ltd.

Your Ref.

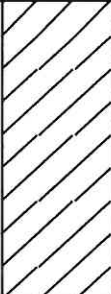
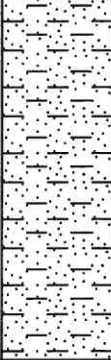
Our Ref.

G15002

BH No.6 Sheet No. 1 of 1

Location: Salamander Cottage, Bay Horse, Lancaster





DATE: 28/01/15






Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.90	TOPSOIL Loose / Soft dark brown very sandy gravelly clay / clayey gravelly sand. Gravel is fine to coarse of sandstone. Many sandstone cobbles.	900				Cv kN/m ²			0.25 0.50 0.75
2.00	"Loose" / Soft orangish brown clayey SAND / very sandy CLAY with occasional fine to coarse gravel of sandstone. Wet.	1100							1.00 1.25 1.50 1.75 2.00
	Borehole Terminated at 2.00m								

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 2.00m
 Borehole completed for soakaway

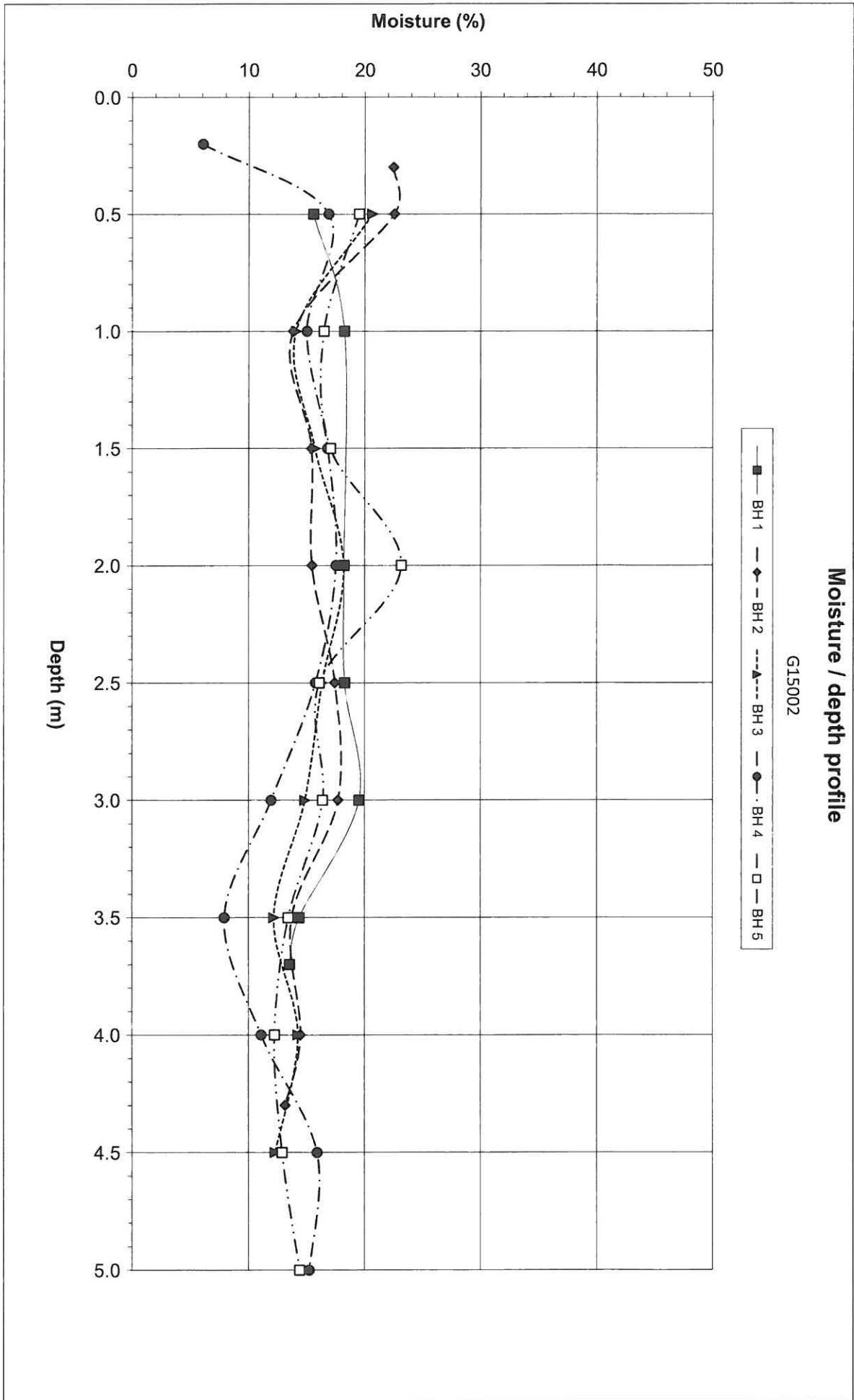
Key:

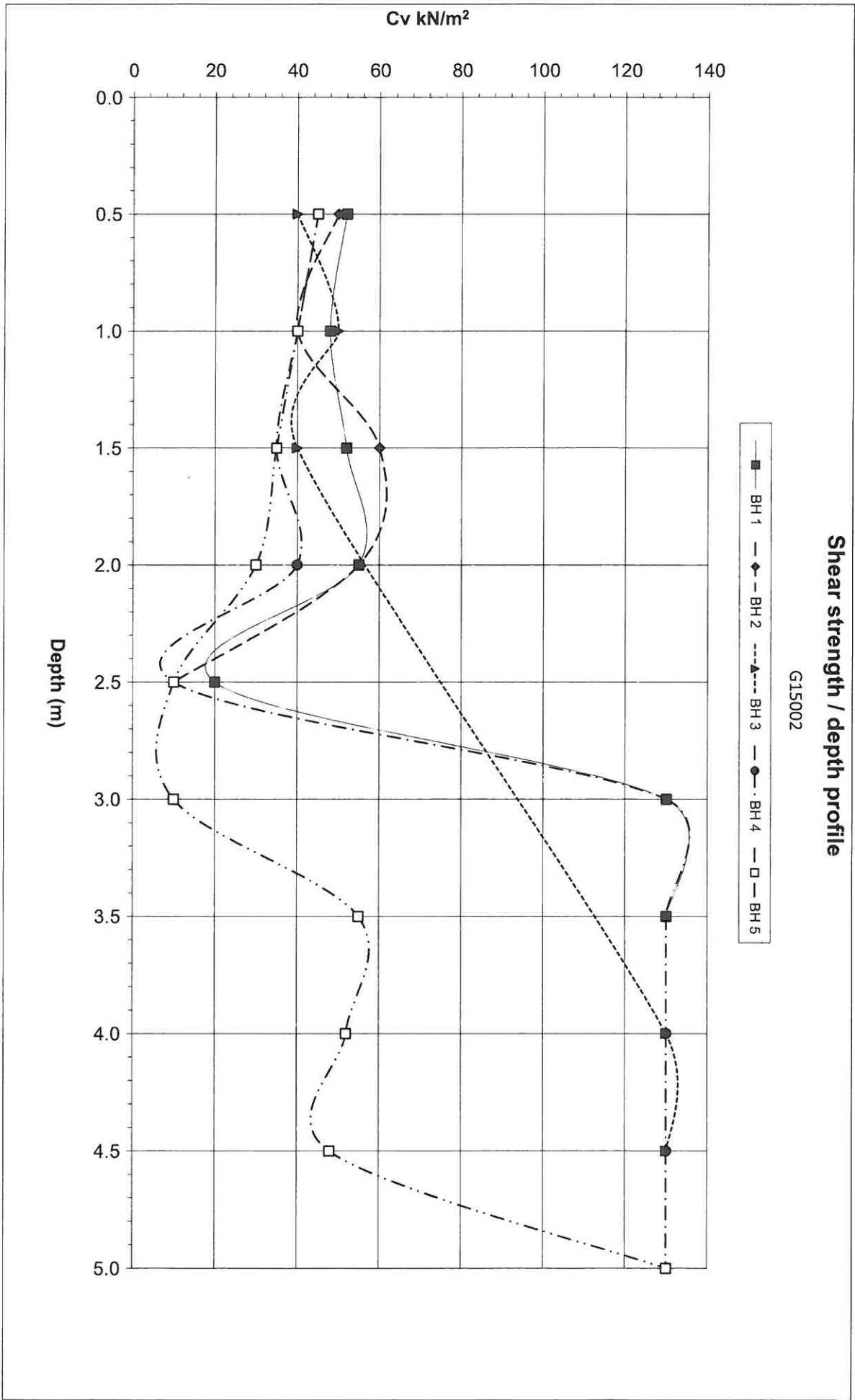
-  Slotted Pipe
-  Plain Pipe
-  Bentonite
-  Gravel Filter

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

BH6

APPENDIX 2
MOISTURE CONTENT / SHEAR STRENGTH PROFILES
and
ATTERBERG LIMIT TEST RESULTS (TABLE 4)





GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G15002

Table 4

Your ref.

Location: Salamander Cottage, Bay Horse, Lancaster

TP / BH No.	Sample Depth (m)	In situ Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification
1	0.50	15.6	69.9		18.8	38.2	19.4	CI
	1.00	18.2						
	2.00	18.2						
	2.50	18.3						
	3.00	19.5						
	3.50	14.3						
	3.70	13.5						
2	0.30	22.5						
	0.50	22.5						
	1.00	13.8						
	1.50	15.4						
	2.00	15.4						
	2.50	17.4						
	3.00	17.7						
	3.50	13.7						
	4.00	14.5						
4.30	13.1							

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G15002

Table 4

Your ref.

Location: Salamander Cottage, Bay Horse, Lancaster

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
3	0.50	20.6						
	1.00	14.1						
	1.50	15.7						
	2.00	18.2						
	2.50	16.3						
	3.00	14.8						
	3.50	12.2						
	4.00	14.2	74.2		18.1	35.8	17.7	CL/CI
	4.50	12.3						
4	0.20	6.1						
	0.50	16.9						
	1.00	15.0						
	1.50	16.8						
	2.00	17.5						
	2.50	15.8						
	3.00	11.9						
	3.50	7.9						
	4.00	11.1						
	4.50	15.9						
5.00	15.2							

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G15002

Table 4

Your ref.

Location: Salamander Cottage, Bay Horse, Lancaster

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
5	0.50	19.5						
	1.00	16.5						
	1.50	17.0						
	2.00	23.2						
	2.50	16.1						
	3.00	16.4						
	3.50	13.4						
	4.00	12.2						
	4.50	12.9						
	5.00	14.4						

APPENDIX 3
CHEMTECH ANALYTICAL
TEST REPORT



ANALYTICAL TEST REPORT

Contract no: 54280
Contract name: Proposed Development, Salamander Cottage, Bay Horse, Lancaster
Client reference: G15002
Clients name: Geo Investigate
Clients address: Units 4 & 5, Terry Dicken Industrial Estate
Ellerbeck Way, Stockesley
North Yorkshire
TS9 7AE

Samples received: 06 February 2015

Analysis started: 06 February 2015

Analysis completed 13 February 2015

Report issued: 13 February 2015

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope. Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling. 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 6 weeks from initial receipt unless otherwise instructed.

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:

Karan Campbell
Director

John Campbell
Director

Dave Bowerbank
Customer Services Co-ordinator

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.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
54280-1	BH 01	0.30	Loam	-	-	26.8
54280-2	BH 01	1.50	Clay	-	-	4.6
54280-3	BH 03	0.25	Clay and Sand	-	-	20.9
54280-4	BH 05	0.20	Clay	-	-	19.1

Chemtech Environmental Limited

SOILS

Lab number			54280-1	54280-2	54280-3	54280-4
Sample id			BH 01	BH 01	BH 03	BH 05
Depth (m)			0.30	1.50	0.25	0.20
Date sampled			28/01/2015	28/01/2015	28/01/2015	28/01/2015
Test	Method	Units				
Arsenic (total)	CE127 ^M	mg/kg As	23	9.6	6.9	18
Boron (water soluble)	CE063 ^M	mg/kg B	0.9	0.7	<0.5	0.7
Cadmium (total)	CE127 ^M	mg/kg Cd	0.5	<0.2	<0.2	0.3
Chromium (total)	CE127 ^M	mg/kg Cr	91	106	82	82
Chromium (III)	-	mg/kg CrIII	91	106	82	82
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	72	32	13	47
Lead (total)	CE127 ^M	mg/kg Pb	202	14	38	562
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	30	34	12	21
Selenium (total)	CE127 ^M	mg/kg Se	1.3	1.9	1.0	1.0
Zinc (total)	CE127 ^M	mg/kg Zn	218	47	43	139
pH	CE004 ^M	units	6.8	7.6	7.8	7.9
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄	17	<10	19	12
Sulphur (total)	CE127	mg/kg S	616	<100	<100	255
Sulphide	CE079	mg/kg S ²⁻	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2
Cyanide (total)	CE077	mg/kg CN	<2	<2	<2	<2
Thiocyanate	CE014 ^M	mg/kg SCN	1.1	<1	<1	<1
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5
Total Organic Carbon (TOC)	CE072 ^M	% w/w C	7.40	-	-	-
Estimate of OMC (calculated from TOC)	CE072	% w/w	12.76	-	-	-
PAH						
Naphthalene	CE087	mg/kg	0.02	<0.01	<0.01	<0.01
Acenaphthylene	CE087	mg/kg	<0.01	<0.01	<0.01	<0.01
Acenaphthene	CE087	mg/kg	<0.01	<0.01	<0.01	<0.01
Fluorene	CE087	mg/kg	0.02	<0.01	<0.01	<0.01
Phenanthrene	CE087	mg/kg	0.21	<0.01	0.07	<0.01
Anthracene	CE087	mg/kg	0.04	<0.01	0.02	<0.01
Fluoranthene	CE087	mg/kg	0.32	<0.01	0.10	0.02
Pyrene	CE087	mg/kg	0.30	<0.01	0.09	0.02
Benzo(a)anthracene	CE087	mg/kg	0.18	0.01	0.06	0.02
Chrysene	CE087	mg/kg	0.20	<0.01	0.06	0.03
Benzo(b)fluoranthene	CE087	mg/kg	0.20	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	CE087	mg/kg	0.08	<0.01	<0.01	<0.01
Benzo(a)pyrene	CE087	mg/kg	0.14	<0.01	<0.01	<0.01
Indeno(123cd)pyrene	CE087	mg/kg	0.11	<0.01	<0.01	<0.01
Dibenz(ah)anthracene	CE087	mg/kg	<0.01	<0.01	<0.01	<0.01
Benzo(ghi)perylene	CE087	mg/kg	0.10	<0.01	<0.01	<0.01
PAH (total of USEPA 16)	CE087	mg/kg	1.93	<0.16	0.39	<0.16
Subcontracted analysis						

Chemtech Environmental Limited

SOILS

Lab number			54280-1	54280-2	54280-3	54280-4
Sample id			BH 01	BH 01	BH 03	BH 05
Depth (m)			0.30	1.50	0.25	0.20
Date sampled			28/01/2015	28/01/2015	28/01/2015	28/01/2015
Test	Method	Units				
Asbestos	\$	-	NAD	-	-	-

Chemtech Environmental Limited

LEACHATES

Lab number			54280-3L
Sample id			BH 03
Depth (m)			0.25
Test	Method	Units	
Arsenic (dissolved)	CE128 ^u	µg/l As	0.33
Boron (dissolved)	CE128 ^u	µg/l B	<6
Cadmium (dissolved)	CE128 ^u	µg/l Cd	<0.07
Chromium (dissolved)	CE128 ^u	µg/l Cr	<0.2
Copper (dissolved)	CE128 ^u	µg/l Cu	1.9
Lead (dissolved)	CE128 ^u	µg/l Pb	<0.2
Mercury (dissolved)	CE128 ^u	µg/l Hg	<0.008
Nickel (dissolved)	CE128 ^u	µg/l Ni	<0.5
Selenium (dissolved)	CE128 ^u	µg/l Se	0.17
Zinc (dissolved)	CE128 ^u	µg/l Zn	<1
pH	CE004 ^u	units	7.6
Sulphate	CE049 ^u	mg/l SO ₄	<10
Sulphur (dissolved)	CE128 ^u	mg/l S	2.6
Sulphide	CE079	µg/l S ²⁻	<100
Cyanide (free)	CE077	µg/l CN	<20
Cyanide (total)	CE077	µg/l CN	<20
Thiocyanate	CE014	µg/l SCN	<200
Phenols (total)	CE078	µg/l PhOH	<10
PAH			
PAH (total of USEPA 16)	CE087	µg/l	<1.6

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
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	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
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE050	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	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO ₄
CE127	Sulphur (total)	Acid extraction, ICP-MS	Dry		100	mg/kg S
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S ²⁻
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE014	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE072	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry		0.1	% w/w
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.01	mg/kg
§	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

METHOD DETAILS

METHOD	LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE128	Arsenic (dissolved)	ICP-MS	U	0.06	µg/l As
CE128	Boron (dissolved)	ICP-MS	U	6	µg/l B
CE128	Cadmium (dissolved)	ICP-MS	U	0.07	µg/l Cd
CE128	Chromium (dissolved)	ICP-MS	U	0.2	µg/l Cr
CE128	Copper (dissolved)	ICP-MS	U	0.4	µg/l Cu
CE128	Lead (dissolved)	ICP-MS	U	0.2	µg/l Pb
CE128	Mercury (dissolved)	ICP-MS	U	0.008	µg/l Hg
CE128	Nickel (dissolved)	ICP-MS	U	0.5	µg/l Ni
CE128	Selenium (dissolved)	ICP-MS	U	0.07	µg/l Se
CE128	Zinc (dissolved)	ICP-MS	U	1	µg/l Zn
CE004	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO ₄
CE128	Sulphur (dissolved)	ICP-MS	U	0.2	mg/l S
CE079	Sulphide	Continuous Flow Colorimetry		100	µg/l S ₂ -
CE077	Cyanide (free)	Distillation, Colorimetry		20	µg/l CN
CE077	Cyanide (total)	Continuous Flow Colorimetry		20	µg/l CN
CE014	Thiocyanate	Colorimetry		200	µg/l SCN
CE078	Phenols (total)	Continuous Flow Colorimetry		10	µg/l PhOH
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l

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)
- A Sampling date not provided
- B Sampling time not provided (waters only)
- C Sample exceeded holding time(s)
- D Sample not received in appropriate containers
- E Headspace present in sample container
- F Sample not chemically fixed (where appropriate)
- G Sample not cooled
- H Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
54280-1	BH 01	0.30	N	
54280-2	BH 01	1.50	N	
54280-3	BH 03	0.25	N	
54280-4	BH 05	0.20	N	

APPENDIX 4
CLEA v1.06 RISK ASSESSMENT:
RESULTS, SETTINGS and NOTES

CLEA Software Version 1.06

Report generated 24-Feb-15

Report title Salamander Cottage, Bay Horse, Lancaster

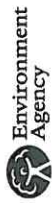
Created by Stuart Howe at Geoinvestigate Ltd.



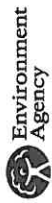
RESULTS



	Assessment Criterion (mg kg ⁻¹)			Ratio of ADE to HCV			Saturation Limit (mg kg ⁻¹)		50% rule?	
	oral	inhalation	combined	oral	inhalation	combined	oral	inhal	Oral	Inhal
1 Arsenic	3.24E+01	8.50E+01	NR	1.00	0.38	NR			No	No
2 Boron	3.76E+02	1.22E+05	3.75E+02	1.00	0.00	1.00			Yes	No
3 Cadmium	5.45E+00	2.97E+01	5.17E+00	0.91	0.10	1.00			Yes	Yes
4 Chromium III	1.95E+04	6.37E+02	6.27E+02	0.03	0.97	1.00			No	Yes
5 Chromium VI	1.24E+01	NR	NR	1.00	NR	NR			Yes	No
6 Copper	2.66E+03	1.04E+04	2.33E+03	0.78	0.22	1.00			Yes	No
7 Mercury, elemental	NR	2.66E+00	NR	NR	1.00	NR	3.18E+01 (vap)		No	No
8 Nickel	5.31E+02	1.27E+02	NR	0.14	1.00	NR			Yes	Yes
9 Selenium	3.50E+02	NR	NR	1.00	NR	NR			Yes	No
10 Zinc	3.75E+03	2.55E+07	3.75E+03	1.00	0.00	1.00			Yes	No
11 PAH Naphthalene	1.73E+02	2.27E+01	2.00E+01	0.12	0.88	1.00	5.32E+02 (sol)		No	No
12 PAH Acenaphthylene	1.05E+03	3.46E+04	1.02E+03	0.97	0.03	1.00	6.23E+02 (sol)		No	No
13 PAH Acenaphthene	1.24E+03	3.77E+04	1.20E+03	0.97	0.03	1.00	4.15E+02 (sol)		No	No
14 PAH Fluorene	9.33E+02	4.47E+04	9.14E+02	0.98	0.02	1.00	2.26E+02 (sol)		No	No
15 PAH Phenanthrene	4.31E+02	5.16E+04	4.28E+02	0.99	0.01	1.00	2.65E+02 (sol)		No	No
16 PAH Anthracene	1.06E+04	1.09E+06	1.05E+04	0.99	0.01	1.00	8.59E+00 (vap)		No	No
17 PAH Fluoranthene	7.22E+02	2.16E+05	7.20E+02	1.00	0.00	1.00	1.40E+02 (vap)		No	No
18 PAH Pyrene	1.67E+03	5.10E+05	1.67E+03	1.00	0.00	1.00	1.62E+01 (vap)		No	No
19 PAH Benz[a]anthracene	1.03E+01	1.71E+01	6.42E+00	0.62	0.38	1.00	1.27E+01 (sol)		No	No
20 PAH Chrysene	1.44E+01	2.86E+01	9.58E+00	0.67	0.33	1.00	3.25E+00 (vap)		No	No



	Assessment Criterion (mg kg ⁻¹)		Ratio of ADE to HCV		Saturation Limit (mg kg ⁻¹)	50% rule?	
	oral	inhalation	oral	inhalation		Oral	Inhal
21 PAH Benzo[b]fluoranthene	1.08E+01	2.09E+01	0.66	0.34	8.99E+00 (sol)	No	No
22 PAH Benzo[k]fluoranthene	1.55E+01	2.94E+01	0.66	0.34	5.08E+00 (sol)	No	No
23 PAH Benzo[a]pyrene	1.54E+00	2.93E+00	0.66	0.34	6.74E+00 (vap)	No	No
24 PAH Indeno[123-cd]pyrene	6.46E+00	1.25E+01	0.66	0.34	4.54E-01 (vap)	No	No
25 PAH Dibenz[ah]anthracene	1.40E+00	2.63E+00	0.65	0.35	2.91E-02 (vap)	No	No
26 PAH Benzo[ghi]perylene	7.21E+01	1.35E+02	0.65	0.35	1.14E-01 (vap)	No	No
27 Phenol	2.49E+03	6.04E+02	0.20	0.80	2.14E+05 (vap)	No	No
28 Petroleum HC, aliphatic: C>16-35	8.84E+04	NR	1.00	NR	6.27E+01 (sol)	Yes	No
29							
30							



Media Concentrations

Soil Distribution

	Soil Distribution			Media Concentrations															
	Sorbed	Dissolved	Vapour	Total	Soil	Soil gas	Indoor Dust	Outdoor dust at 0.8m	Outdoor dust at 1.6m	Indoor Vapour	Outdoor vapour at 0.8m	Outdoor vapour at 1.6m	Green Vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit	
	%	%	%	%	mg kg ⁻¹	mg m ⁻³	mg kg ⁻¹	mg m ⁻³	mg m ⁻³	mg m ⁻³	mg m ⁻³	mg m ⁻³	mg kg ⁻¹ FW	mg kg ⁻¹ FW	mg kg ⁻¹ FW	mg kg ⁻¹ FW	mg kg ⁻¹ FW	mg kg ⁻¹ FW	mg kg ⁻¹ FW
1 Arsenic	99.9	0.1	0.0	100.0	3.24E+01	NR	1.62E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-02	1.30E-02	7.45E-03	1.07E-02	6.48E-03	3.56E-02	
2 Boron	96.9	3.1	0.0	100.0	3.75E+02	NR	1.88E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E+02	7.51E+01	7.51E+01	7.51E+01	7.51E+01	1.18E-02	
3 Cadmium	99.7	0.3	0.0	100.0	5.17E+00	NR	2.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.69E-01	1.50E-01	1.60E-01	8.28E-02	1.60E-02	7.24E-03	
4 Chromium III	100.0	0.0	0.0	100.0	6.27E+02	NR	3.14E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02	
5 Chromium VI	98.3	1.7	0.0	100.0	1.24E+01	NR	6.21E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E-03	1.24E-03	1.24E-03	1.12E+00	3.72E-03	1.12E+00	
6 Copper	99.7	0.3	0.0	100.0	2.33E+03	NR	1.16E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E+01	4.79E+01	4.79E+01	5.42E+01	4.79E+01	4.79E+01	
7 Mercury, elemental	99.9	0.0	0.0	100.0	2.66E+00	5.00E-01	1.33E+00	0.00E+00	0.00E+00	6.15E-05	3.13E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
8 Nickel	99.9	0.1	0.0	100.0	1.27E+02	NR	6.37E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.84E-01	5.48E-01	2.42E-01	3.19E-01	3.19E-01	4.33E-01	
9 Selenium	99.4	0.6	0.0	100.0	3.50E+02	NR	1.75E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.78E+00	1.27E+00	2.91E-01	9.49E-01	1.05E+00	1.05E+00	
10 Zinc	99.2	0.8	0.0	100.0	3.75E+03	NR	1.87E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E+02	2.02E+02	2.02E+02	5.36E+02	2.02E+02	2.02E+02	
11 PAH Naphthalene	98.9	1.1	0.0	100.0	2.00E+01	4.74E+00	1.00E+01	8.53E-09	0.00E+00	6.59E-04	2.87E-06	0.00E+00	2.92E+00	3.99E+00	1.03E+00	0.00E+00	0.00E+00	1.31E+00	
12 PAH Acenaphthylene	99.6	0.4	0.0	100.0	1.02E+03	7.40E+00	5.11E+02	4.35E-07	0.00E+00	1.88E-03	4.09E-05	0.00E+00	7.49E+01	9.97E+01	2.58E+01	0.00E+00	0.00E+00	1.45E+01	
13 PAH Acenaphthene	99.7	0.3	0.0	100.0	1.20E+03	9.05E+00	6.01E+02	5.12E-07	0.00E+00	2.04E-03	4.40E-05	0.00E+00	7.15E+01	9.54E+01	2.73E+01	0.00E+00	0.00E+00	1.16E+01	
14 PAH Fluorene	99.7	0.3	0.0	100.0	9.14E+02	3.10E+00	4.57E+02	3.89E-07	0.00E+00	8.59E-04	2.71E-05	0.00E+00	4.65E+01	6.23E+01	1.83E+01	0.00E+00	0.00E+00	6.48E+00	
15 PAH Phenanthrene	99.9	0.1	0.0	100.0	4.28E+02	2.59E-01	2.14E+02	1.82E-07	0.00E+00	1.00E-04	8.22E-06	0.00E+00	1.16E+01	1.63E+01	5.85E+00	0.00E+00	0.00E+00	9.22E-01	
16 PAH Anthracene	99.9	0.1	0.0	100.0	1.05E+04	7.83E+00	5.23E+03	4.45E-06	0.00E+00	2.85E-03	2.02E-04	0.00E+00	2.78E+02	3.90E+02	1.40E+02	0.00E+00	0.00E+00	2.20E+01	
17 PAH Fluoranthene	100.0	0.0	0.0	100.0	7.20E+02	5.79E-02	3.60E+02	3.08E-07	0.00E+00	2.65E-05	7.21E-06	0.00E+00	4.86E+00	8.89E+00	4.71E+00	0.00E+00	0.00E+00	1.50E-01	
18 PAH Pyrene	100.0	0.0	0.0	100.0	1.67E+03	1.35E-01	8.34E+02	7.10E-07	0.00E+00	6.29E-05	1.77E-05	0.00E+00	1.30E+01	2.31E+01	1.19E+01	0.00E+00	0.00E+00	4.32E-01	
19 PAH Benz[a]anthracene	100.0	0.0	0.0	100.0	6.42E+00	6.09E-05	3.21E+00	2.73E-09	0.00E+00	3.01E-08	2.96E-08	0.00E+00	5.12E-03	1.91E-02	1.32E-02	0.00E+00	0.00E+00	4.86E-05	
20 PAH Chrysene	100.0	0.0	0.0	100.0	9.58E+00	1.29E-05	4.79E+00	4.08E-09	0.00E+00	7.22E-09	5.17E-08	0.00E+00	1.32E-02	4.01E-02	2.62E-02	0.00E+00	0.00E+00	1.65E-04	



	Average Daily Exposure (mg kg ⁻¹ bw day ⁻¹)										Distribution by Pathway (%)						
	Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour	Background (oral)	Background (inhalation)	Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour (indoor)	Inhalation of vapour (outdoor)	Background (oral)	Background (inhalation)		
1 Arsenic	2.40E-04	2.27E-05	3.70E-05	7.62E-07	0.00E+00	0.00E+00	0.00E+00	79.89	7.54	12.31	0.25	0.00	0.00	0.00	0.00		
2 Boron	2.78E-03	7.71E-02	0.00E+00	8.83E-06	0.00E+00	2.08E-01	2.41E-05	1.74	48.25	0.00	0.01	0.00	0.00	49.99	0.01		
3 Cadmium	3.84E-05	1.32E-04	1.97E-07	1.22E-07	0.00E+00	7.54E-04	1.21E-06	11.21	38.70	0.06	0.04	0.00	0.00	49.96	0.04		
4 Chromium III	4.65E-03	7.37E-05	0.00E+00	1.48E-05	0.00E+00	3.39E-03	1.64E-05	57.13	0.91	0.00	0.18	0.00	0.00	41.60	0.18		
5 Chromium VI	9.20E-05	5.31E-04	0.00E+00	2.92E-07	0.00E+00	3.77E-04	0.00E+00	9.20	53.10	0.00	0.00	0.00	0.00	37.70	0.00		
6 Copper	1.73E-02	5.26E-02	0.00E+00	5.48E-05	0.00E+00	3.94E-01	4.12E-05	12.34	37.63	0.00	0.04	0.00	0.00	49.97	0.03		
7 Mercury, elemental	1.97E-05	2.27E-07	0.00E+00	6.25E-08	5.69E-05	0.00E+00	3.03E-06	0.00	0.00	0.00	0.10	94.82	0.02	0.00	5.05		
8 Nickel	9.45E-04	4.66E-04	2.43E-05	3.00E-06	0.00E+00	7.31E-03	3.64E-06	32.77	16.18	0.84	0.10	0.00	0.00	49.90	0.10		
9 Selenium	2.60E-03	1.82E-03	0.00E+00	8.24E-06	0.00E+00	1.97E-03	3.64E-06	40.59	28.46	0.00	0.13	0.00	0.00	30.82	0.00		
10 Zinc	2.78E-02	2.72E-01	0.00E+00	8.81E-05	0.00E+00	1.52E+00	1.45E-04	4.63	45.36	0.00	0.01	0.00	0.00	49.99	0.01		
11 PAH Naphthalene	1.49E-04	2.03E-03	9.93E-05	4.72E-07	6.10E-04	3.94E-04	1.70E-04	4.31	58.77	2.88	0.01	17.68	0.00	11.42	4.92		
12 PAH Acenaphthylene	7.58E-03	4.56E-02	5.06E-03	2.40E-05	1.74E-03	7.88E-06	6.67E-07	12.62	75.98	8.43	0.04	2.90	0.00	0.01	0.00		
13 PAH Acenaphthene	8.92E-03	4.32E-02	5.96E-03	2.83E-05	1.89E-03	5.51E-05	1.52E-06	14.87	71.92	9.93	0.05	3.14	0.00	0.09	0.00		
14 PAH Fluorene	6.78E-03	2.78E-02	4.53E-03	2.15E-05	7.96E-04	3.32E-05	5.82E-06	16.94	69.61	11.31	0.05	1.99	0.00	0.08	0.01		
15 PAH Phenanthrene	3.17E-03	7.02E-03	2.12E-03	1.01E-05	9.32E-05	8.68E-05	3.14E-05	25.31	56.02	16.90	0.08	0.74	0.00	0.69	0.25		
16 PAH Anthracene	7.75E-02	1.68E-01	5.18E-02	2.46E-04	2.64E-03	4.50E-06	2.49E-06	25.84	55.93	17.26	0.08	0.88	0.00	0.00	0.00		
17 PAH Fluoranthene	5.34E-03	3.54E-03	3.56E-03	1.69E-05	2.48E-05	1.97E-05	5.09E-06	42.68	28.28	28.51	0.14	0.20	0.00	0.16	0.04		
18 PAH Pyrene	1.24E-02	9.24E-03	8.27E-03	3.93E-05	5.89E-05	1.97E-05	3.94E-06	41.25	30.79	27.55	0.13	0.19	0.00	0.07	0.01		
19 PAH Benz[a]anthracene	4.76E-05	6.85E-06	3.18E-05	1.51E-07	2.91E-08	3.38E-06	6.67E-07	55.08	7.93	36.79	0.17	0.03	0.00	0.00	0.00		
20 PAH Chrysene	7.10E-05	1.46E-05	4.74E-05	2.25E-07	8.84E-09	6.19E-06	1.03E-06	53.30	10.93	35.60	0.17	0.01	0.00	0.00	0.00		



	Oral Health Criteria Value ($\mu\text{g kg}^{-1} \text{BW day}^{-1}$)	Inhalation Health Criteria Value ($\mu\text{g kg}^{-1} \text{BW day}^{-1}$)	Oral Mean Daily Intake ($\mu\text{g day}^{-1}$)	Inhalation Mean Daily Intake ($\mu\text{g day}^{-1}$)	Air-water partition coefficient (K_{aw}) ($\text{cm}^3 \text{cm}^{-3}$)	Coefficient of Diffusion in Air ($\text{m}^2 \text{s}^{-1}$)	Coefficient of Diffusion in Water ($\text{m}^2 \text{s}^{-1}$)	$\log K_{oc}$ ($\text{cm}^3 \text{g}^{-1}$)	$\log K_{ow}$ (dimensionless)	Dermal Absorption Fraction (dimensionless)	Soil-to-dust transport factor ($\text{g}^{-1} \text{DW}$)	Sub-surface soil to indoor air correction factor (dimensionless)	Relative bioavailability via soil ingestion (unitless)	Relative bioavailability via dust inhalation (unitless)
1 Arsenic	ID 0.3	ID 0.002	NR	NR	NR	NR	NR	NR	NR	0.03	0.5	1	1	1
2 Boron	TDI 160	TDI 2.9	3700	0.398	NR	NR	NR	NR	NR	0	0.5	1	1	1
3 Cadmium	TDI 0.36	TDI 0.0014	13.4	0.02	NR	NR	NR	NR	NR	0.001	0.5	1	1	1
4 Chromium III	TDI 150	TDI 0.03	60.2	0.27	NR	NR	NR	NR	NR	0	0.5	1	1	1
5 Chromium VI	TDI 1	NR	6.7	NR	NR	NR	NR	NR	NR	0	0.5	1	1	1
6 Copper	TDI 160	TDI 0.286	7000	0.68	NR	NR	NR	NR	NR	0	0.5	1	1	1
7 Mercury, elemental	NR 0	TDI 0.06	0	0.05	1.17E-01	6.34E-06	2.00E-09	4.16	0.62	0	0.5	1	1	1
8 Nickel	TDI 12	TDI 0.006	130	0.06	NR	NR	NR	NR	NR	0.005	0.5	1	1	1
9 Selenium	TDI 6.4	NR	35	0.06	NR	NR	NR	NR	NR	0	0.5	1	1	1
10 Zinc	TDI 600	TDI 600	27000	2.4	NR	NR	NR	NR	NR	0	0.5	1	1	1
11 PAH Naphthalene	TDI 20	TDI 0.86	7	2.8	6.62E-03	6.52E-06	5.16E-10	2.81	3.34	0.13	0.5	1	1	1
12 PAH Acenaphthylene	TDI 60	TDI 60	0.14	0.011	5.68E-04	5.97E-06	4.82E-10	3.26	3.91	0.13	0.5	1	1	1
13 PAH Acenaphthene	TDI 60	TDI 60	0.98	0.025	7.59E-04	5.85E-06	4.70E-10	3.37	4.03	0.13	0.5	1	1	1
14 PAH Fluorene	TDI 40	TDI 40	0.59	0.096	4.12E-04	5.88E-06	4.47E-10	3.45	4.13	0.13	0.5	1	1	1
15 PAH Phenanthrene	TDI 12.5	TDI 12.5	1.54	0.518	1.43E-04	5.34E-06	4.32E-10	3.74	4.5	0.13	0.5	1	1	1
16 PAH Anthracene	TDI 300	TDI 300	0.08	0.041	1.81E-04	5.36E-06	4.36E-10	3.75	4.5	0.13	0.5	1	1	1
17 PAH Fluoranthene	TDI 12.5	TDI 12.5	0.35	0.084	6.29E-05	5.01E-06	4.11E-10	4.26	5.13	0.13	0.5	1	1	1
18 PAH Pyrene	TDI 30	TDI 30	0.35	0.065	5.64E-05	5.01E-06	4.15E-10	4.21	5.08	0.13	0.5	1	1	1
19 PAH Benz[a]anthracene	ID 0.138	ID 0.00048	0.06	0.011	3.16E-05	4.60E-06	3.80E-10	4.89	5.91	0.13	0.5	1	1	1
20 PAH Chrysene	ID 0.2	ID 0.0007	0.11	0.017	3.18E-06	4.57E-06	3.77E-10	4.74	5.73	0.13	0.5	1	1	1

CLEA Software Version 1.06

Report generated 24/02/2015

Report title Salamander Cottage, Bay Horse, Lancaster

Created by Stuart Howe at Geoinvestigate Ltd.



BASIC SETTINGS

Land Use	Residential with homegrown produce	Start age class	1	End age class	6	Exposure Duration	6 years	
Building	Detached house							
Receptor	Female (res)							
Soil	Sandy clay loam							
Exposure Pathways								
	Direct soil and dust ingestion		<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>
	Consumption of homegrown produce		<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>
	Soil attached to homegrown produce		<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>
				Dermal contact with indoor dust				<input checked="" type="checkbox"/>
				Dermal contact with soil				<input checked="" type="checkbox"/>
								<input checked="" type="checkbox"/>
								<input checked="" type="checkbox"/>
								<input checked="" type="checkbox"/>
								<input checked="" type="checkbox"/>



Land Use Residential with homegrown produce

Age Class	Exposure Frequencies (days yr ⁻¹)						Occupation Periods (hr day ⁻¹)		Soil to skin adherence factors (mg cm ²)		Direct soil ingestion rate (g day ⁻¹)
	Direct soil ingestion	Consumption of homegrown produce	Dermal contact with indoor dust	Dermal contact with soil	Inhalation of dust and vapour, indoor	Inhalation of dust and vapour, outdoor	Indoors	Outdoors	Indoor	Outdoor	
1	180	180	180	180	365	365	23.0	1.0	0.06	1.00	0.10
2	365	365	365	365	365	365	23.0	1.0	0.06	1.00	0.10
3	365	365	365	365	365	365	23.0	1.0	0.06	1.00	0.10
4	365	365	365	365	365	365	23.0	1.0	0.06	1.00	0.10
5	365	365	365	365	365	365	19.0	1.0	0.06	1.00	0.10
6	365	365	365	365	365	365	19.0	1.0	0.06	1.00	0.10
7	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
8	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
9	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
10	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
11	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
12	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
13	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
14	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
15	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
16	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
17	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
18	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00



Receptor Female (res)

Age Class	Body weight (kg)	Body height (m)	Inhalation rate (m ³ day ⁻¹)	Max exposed skin factor		Total skin area (m ²)	Consumption rates (g FW kg ⁻¹ BW day ⁻¹)					
				Indoor (m ² m ⁻²)	Outdoor (m ² m ⁻²)		Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
1	5.60	0.7	8.5	0.32	0.26	3.43E-01	7.12	10.69	16.03	1.83	2.23	3.82
2	9.80	0.8	13.3	0.33	0.26	4.84E-01	6.85	3.30	5.46	3.96	0.54	11.96
3	12.70	0.9	12.7	0.32	0.25	5.82E-01	6.85	3.30	5.46	3.96	0.54	11.96
4	15.10	0.9	12.2	0.35	0.28	6.36E-01	6.85	3.30	5.46	3.96	0.54	11.96
5	16.90	1.0	12.2	0.35	0.28	7.04E-01	3.74	1.77	3.38	1.85	0.16	4.26
6	19.70	1.1	12.2	0.33	0.26	7.94E-01	3.74	1.77	3.38	1.85	0.16	4.26
7	22.10	1.2	12.4	0.22	0.15	8.73E-01	3.74	1.77	3.38	1.85	0.16	4.26
8	25.30	1.2	12.4	0.22	0.15	9.36E-01	3.74	1.77	3.38	1.85	0.16	4.26
9	27.50	1.3	12.4	0.22	0.15	1.01E+00	3.74	1.77	3.38	1.85	0.16	4.26
10	31.40	1.3	12.4	0.22	0.15	1.08E+00	3.74	1.77	3.38	1.85	0.16	4.26
11	35.70	1.4	12.4	0.22	0.14	1.19E+00	3.74	1.77	3.38	1.85	0.16	4.26
12	41.30	1.4	13.4	0.22	0.14	1.29E+00	3.74	1.77	3.38	1.85	0.16	4.26
13	47.20	1.5	13.4	0.22	0.14	1.42E+00	3.74	1.77	3.38	1.85	0.16	4.26
14	51.20	1.6	13.4	0.22	0.14	1.52E+00	3.74	1.77	3.38	1.85	0.16	4.26
15	56.70	1.6	13.4	0.21	0.14	1.60E+00	3.74	1.77	3.38	1.85	0.16	4.26
16	59.00	1.6	13.4	0.21	0.14	1.63E+00	3.74	1.77	3.38	1.85	0.16	4.26
17	70.00	1.6	14.8	0.33	0.27	1.78E+00	2.94	1.40	1.79	1.61	0.22	2.97
18	70.90	1.6	12.0	0.33	0.27	1.80E+00	2.94	1.40	1.79	1.61	0.22	2.97

Building Detached house

Soil Sandy clay loam

Environment
Agency

Building footprint (m ²)	6.80E+01	Porosity, Total (cm ³ cm ⁻³)	5.30E-01
Living space air exchange rate (hr ⁻¹)	5.00E-01	Porosity, Air-Filled (cm ³ cm ⁻³)	1.60E-01
Living space height (above ground, m)	4.80E+00	Porosity, Water-Filled (cm ³ cm ⁻³)	3.70E-01
Living space height (below ground, m)	0.00E+00	Residual soil water content (cm ³ cm ⁻³)	1.50E-01
Pressure difference (soil to enclosed space, Pa)	3.10E+00	Saturated hydraulic conductivity (cm s ⁻¹)	2.37E-03
Foundation thickness (m)	1.50E-01	van Genuchten shape parameter <i>m</i> (dimensionless)	3.10E-01
Floor crack area (cm ²)	6.60E+02	Bulk density (g cm ⁻³)	1.20E+00
Dust loading factor (µg m ⁻³)	5.00E+01	Threshold value of wind speed at 10m (m s ⁻¹)	7.20E+00
		Empirical function (F _w) for dust model (dimensionless)	1.22E+00
		Ambient soil temperature (K)	2.83E+02
		Soil pH	7.53E+00
		Soil Organic Matter content (%)	7.40E+00
		Fraction of organic carbon (g g ⁻¹)	4.29E-02
		Effective total fluid saturation (unitless)	5.79E-01
		Intrinsic soil permeability (cm ²)	3.16E-08
		Relative soil air permeability (unitless)	5.78E-01
		Effective air permeability (cm ²)	1.83E-08



Soil - Vapour Model

Depth to top of source (no building) (cm)	0
Depth to top of source (beneath building) (cm)	65
Default soil gas ingress rate?	Yes
Soil gas ingress rate (cm ³ s ⁻¹)	2.50E+01
Building ventilation rate (cm ³ s ⁻¹)	4.53E+04
Averaging time surface emissions (yr)	6
Finite vapour source model?	No
Thickness of contaminated layer (cm)	200

Air Dispersion Model

Mean annual windspeed at 10m (m s ⁻¹)	5.00
Air dispersion factor at height of 0.8m *	2400.00
Air dispersion factor at height of 1.6m *	0.00
Fraction of site cover (m ² m ⁻²)	0.75

* Air dispersion factor in g m⁻² s⁻¹ per kg m⁻³

Soil - Plant Model

	Dry weight conversion factor		Homegrown fraction		Soil loading factor	Preparation correction factor
	g DW g ⁻¹ FW		Average	High		
Green vegetables	0.096	dimensionless	0.05	0.33	g g ⁻¹ DW	dimensionless
Root vegetables	0.103	0.06	0.06	0.40	1.00E-03	2.00E-01
Tuber vegetables	0.210	0.02	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	0.058	0.06	0.06	0.40	1.00E-03	1.00E+00
Shrub fruit	0.166	0.09	0.09	0.60	1.00E-03	6.00E-01
Tree fruit	0.157	0.04	0.04	0.27	1.00E-03	6.00E-01

Gardener type Average

CLEA v1.06 RISK ASSESSMENT: NOTES

Justification of Settings Utilised in CLEA v1.06 to generate Site Specific Assessment Criteria

Basic Settings		
Setting	Elected Option	Justification
Land Use	Residential with home-grown produce	Best fit to current intended development
Building Type	Semi-detached house -unaltered	Best fit to current intended development
Receptor Type	Female (residential) -unaltered	Default setting representing most vulnerable receptor
Soil Type	Sandy loam -unaltered	Majority of soils encountered during intrusive works
Soil Organic matter	7.4	Conservative choice given analytically derived value from soil sampled at site of 12.76%. (TOC = 7.40%)
pH	7.5	Average analytically derived value from soils sampled at site
Alterations to Advanced settings: None		