



GEO

Environmental Engineering



GROUND GAS RISK ASSESSMENT

REPORT

**RESIDENTIAL REDEVELOPMENT OF LAND AT
MILL HILL (NORTHERN SITE AREA – PHASE 4)**

CLEATOR

CUMBRIA

GEO Environmental Engineering

DOCUMENT CONTROL SHEET

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Client Title: High Grange Developments

Consultant: Alpha Design

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1.0 Introduction

Geo Environmental Engineering (GEO) Ltd has completed supplementary ground investigation works as part of a Ground Gas Risk Assessment Report for a piece of land considered for residential redevelopment at Mill Hill, Cleator (Phase 4). The Client, High Grange Developments is proposing to construct a residential housing estate which includes mixed-type residential properties with access road, areas of vehicle parking, private gardens and general areas of soft landscaping.

The site was previously investigated and assessed by Cumbria Environmental and Geological Services (CEGS) during 2008 (report ref: GB/ADAS/CONT/MIN/HGD/MH/CM/1206, dated 19 April 2011), with the scope of works comprising a Phase 1 Desk Top Study report and Phase 2 Ground Investigation with reporting. This information was submitted to the Local Planning Authority as part of the planning process.

The information provided by CEGS identified some potential ground gas issues, with some elevated levels being noted. As this assessment was over seven years ago the Client deemed it prudent to undertake additional monitoring as construction had commenced. GEO therefore completed a re-assessment of the southern site area during 2014. The GEO assessment identified a reduction in ground gas levels and flow rates to those previously identified by CEGS. Since that time the Client has now completed a series of works across the northern site (Phase 4) area that has included the removal of made ground and the capping of a mine shaft.

Consequently, as significant variations have taken place on site since the CEGS assessment in 2008 (i.e. removal of some made ground and capping of the former mine shaft) GEO was requested to undertake the additional works detailed within this report.

2.0 Ground Gas Risk Assessment Report

2.1 Aims and Objectives

The aims and objectives of this Ground Gas Risk Assessment Report are to assess the geo-environmental properties of the ground, groundwater and ground gas conditions across the development area as a whole, with specialist monitoring wells positioned to allow the long-term monitoring of potential ground gases to confirm the ground gas regime and to determine if the proposed structures require ground gas protection measures. Consequently, any items not specifically mentioned cannot be assumed to be covered.

This Ground Investigation Report has generally been completed in accordance with the following documents:

- CLR11: Model Procedures for the Management of Land Contamination. DEFRA/EA, 2004.
- BS10175: 2011: Code of Practice for the Investigation of Potentially Contaminated Sites.
- BS5930: 12015: Code of Practice for Site Investigations.
- BS1377: 1990: Methods of test for soils for civil engineering purposes.
- BS8485: 2007: Code of practice for the characterisation and remediation from ground gas affected developments
- CIRIA Report C665: 2007
- CIRIA Report C735: 2014
- Eurocode 7 – Geotechnical Design (Part 1: General Rules and; Part 2: Ground Investigation and Testing).
- UK Specification for Ground Investigation, 2nd Edition. Site Investigation Steering Group, 2011.
- Effective Site Investigation. Site Investigation Steering Group, 2013.

2.0 Ground Gas Risk Assessment Report (Cont'd)

2.2 Limitations of Use

Consideration must be made for variations to occur in the ground conditions between the exploratory hole locations, particularly between borehole locations as they are typically 100mm in diameter, for which GEO holds no responsibility and areas where limited access was available and it is therefore recommended that a “watching brief” and “observational technique” be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

The recommendations and opinions expressed in this report are based on the strata observed within the exploratory holes in addition to the results of the site and laboratory tests commissioned by GEO. Consequently GEO takes no responsibility for conditions that have not been revealed or which occur between them. GEO takes no responsibility for the accuracy of third party information.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders in order to seek their approval of the findings prior to undertaking any works on site.

This Ground Investigation Report and its contents are limited to the boundaries of the site, as indicated on the Plan in Appendix I. No reliance, copying or use of this report (in part or whole) by any Third Party is permitted without prior Geo Environmental Engineering Ltd written approval, with intellectual copyright remaining the sole property of the author. Geo Environmental Engineering Ltd Terms and Conditions are available on request.

This report has been commissioned to assess potential ground gas levels across the northern site area only and therefore any items not mentioned cannot be assumed to be covered.

3.0 Development Site Details and Proposals

The site comprises an irregular shaped piece of land on the western fringe of Cleator. For further information relating to the site and the environs reference should be made to the Alpha Design and CEGS documentation submitted during the planning process.

4.0 Basis for Ground Gas Risk Assessment

4.1 Extent of Intrusive Investigation Works

GEO was aware that works completed by CEGS during 2008 had identified some elevated levels of ground gas. In summary (from the information presented to GEO) CEGS completed six ground gas monitoring visits between 9th May 2008 and the 11th December 2008 (seven month monitoring period), with several of the visits being at atmospheric pressures of less than 1000mb.

During this time period a single elevated level of Methane (CH₄) was noted (16/06/2008 - 9.0%v/v) with the majority of the monitoring visits recording levels around 0.0%v/v to 0.1%v/v (trace). The single elevated levels was at MH12 within the grounds of the former mining related features and not the area currently under development in which this report refers. On two occasions elevated levels of Carbon Dioxide (CO₂) were noted (5.0%v/v and 9.0%v/v) on the 31st July 2008 and the 11th December 2008 at MH13, within the area currently under development. During both visits flow rates were negligible.

4.0 Basis for Ground Gas Risk Assessment (Cont'd)

4.1 Extent of Intrusive Investigation Works (Cont'd)

Due to the age of the CEGS information the Client deemed it prudent to undertake additional monitoring as construction had commenced. GEO therefore completed a re-assessment of the southern site area during 2014, which is detailed within the report GEO2014-908. The GEO assessment identified a reduction in ground gas levels and flow rates to those previously identified by CEGS.

Since that time the Client has now completed a series of works across the northern site area (Phase 4) that has included the removal of made ground and the capping of a mine shaft. It was therefore considered prudent to complete a reassessment of the northern site area (Phase 4).

Consequently GEO installed three additional ground gas monitoring wells (BH01, BH02A and BH03) as per the plan in Appendix I and the investigation works comprised of the following:

- Three Dynamic (Windowless) Sampling Mini Percussion Boreholes (BH01 to BH03 inclusive) utilising a lightweight, tracked, self-propelled Competitor C130 drilling rig operated by a suitably qualified and experienced driller and supervised by a suitably qualified and experienced geo-environmental engineer. The boreholes were drilled using casing with the samples recovered from windowless sample tubes with disposable sample liners.
- Three in-situ ground gas monitoring wells (BH01 to BH03 inclusive) to depths of up to c.3.00m using c.50mm internal diameter HDPE monitoring screen. The monitoring screen comprised solid pipe along the upper section surrounded by an impermeable bentonite seal. The seal section extended to depths of c.1.00m below current ground levels. The remaining monitoring screen (to the base of the wells) comprised slotted pipe with a ("clean") pea gravel surround and geosock. The design of the monitoring well was to allow any ground gases to find the "path of least resistance" and collect within the monitoring well. Each well was finished at ground level with a gas bung and protective metal cover.
- Six ground gas monitoring visits were completed over a three month period (June 2015 to September 2014) during a range of atmospheric pressures (falling pressure under 1000mb) with readings taken using a GFM436 Ground Gas Analyser with integral Flow Pod.

All the exploratory hole locations were positioned to provide an even site coverage of the northern area determine ground conditions and to allow the installation of ground gas monitoring wells.

4.2 Exploratory Hole Locations

Investigation works were undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II) and the exploratory hole locations are presented on the plan in Appendix II. It should be noted that the plan provided is an extract of the proposed development area and is for orientation purposes only, as the locations are approximate and not to a standardised scale. No topographical survey was requested or undertaken as part of these investigation works.

At each exploratory hole location the surfacing type, made ground, natural ground and groundwater conditions were observed, with in-situ testing undertaken and samples recovered. The ground investigation data including the exploratory hole logs is contained in Appendix II.

5.0 Ground and Groundwater Conditions

5.1 Stratigraphy

The exploratory hole logs are presented in Appendix II, providing an accurate description of the ground conditions at each individual location, with a summary of the stratigraphy noted in sub-sections 5.1.1 to 5.1.3 on the following page.

5.1.1 Made Ground

Made ground at the borehole locations was varied with mixed natural materials (topsoil, sand and gravel) with some anthropogenic debris (clag, brick, etc.). During the investigation GEO did not identify any potentially biodegradable or putrescible materials.

5.1.2 Drift Geological Deposits

The natural ground conditions encountered within the GEO boreholes comprised layers of sandy silty gravelly clay and sandy gravel. The natural appearing soils did not appear particularly organic and no odours were noted.

5.1.3 Solid Geological Deposits

During the investigation works the Solid Geological deposits (i.e. bedrock) were not encountered.

5.2 Groundwater Ingress

The exploratory hole locations remained dry during the site works (one day). Some groundwater ingress has since been noted which corresponds with levels identified by CEGS. As a result it may be the case that a continuous shallow groundwater surface (water table) is present at shallow depth below the site.

6.0 Source – Pathway – Receptor Pollutant Linkage Model

A Conceptual Site Model (CSM) has been designed using the information presented within the CEGS report (ref: GB/ADAS/CONT/MIN/HGD/MH/CM/1206) to provide a graphical representation of the anticipated ground gas regime below the development area (Existing Site CSM).

The CSM utilises the established *Source – Pathway – Receptor* pollutant linkage model and is designed to provide an improved understanding of the site characteristics.

During the Ground Gas Risk Assessment the CSM can be refined depending upon the outcomes of the intrusive works to ensure that appropriate remediation (if required) is completed to ensure the development area is “fit for purpose” in relation to the proposed end use. The CSM is presented within Sections 6.1 to 6.3 presented below and continuing on the following page.

6.1 Anticipated Sources

Sources:
S1 = Ground Gas originating from deep coal workings and made ground

6.0 Source – Pathway – Receptor Pollutant Linkage Model (Cont'd)

6.2 Anticipated Pathways

Pathways:
<p>P1 = Direct Inhalation of indoor / outdoor air/vapours via the following:</p> <ul style="list-style-type: none"> ■ Horizontal and Vertical Migration through Drift Geological Deposits ■ Horizontal and Vertical Migration through Solid Geological Deposits ■ Diffusion of gases through service ducts, construction joints etc.

6.3 Anticipated Receptors

Receptors:
R1 = Human Health (Residents)

7.0 Ground Gas Risk Assessment

To assess the on-site potential for hazardous ground gases GEO boreholes BH01, BH02A and BH03 were installed with ground gas monitoring wells to undertake an in-situ period of ground gas monitoring as per the information in Section 4.1.

The monitoring and assessment has been completed in accordance with BS8485: 2007: Code of practice for the characterisation and remediation from ground gas affected developments, CIRIA Report C665, November 2007 and the NHBC Document; Guidance on the evaluation of development proposals on site where methane and carbon dioxide are present, March 2007.

Due to the residential nature of the development the monitoring of ground gas took place over six site visits over a three month monitoring period (June 2015 to September 2015), generally in accordance with CIRIA C665 (Table 5.5a and 5.5b) using a GFM436 Gas Analyser with integral flow pod. The results of the six monitoring visits completed are summarised below and detailed on the Ground Gas Monitoring Record Sheets contained in Appendix III.

Throughout the monitoring visits completed the atmospheric pressures ranged from 1011mb to 0987mb (falling), with three of the six monitoring visits being at periods of low atmospheric pressure (i.e. below 1000mb). During this period no levels of Methane (CH₄) were noted and the maximum Carbon Dioxide (CO₂) concentration recorded was 3.3%v/v (BH01, 18/06/2015). The lowest Oxygen (O₂) concentration observed was 9.2%v/v and the maximum flow rate recorded was +1.3l/h.

In accordance with CIRIA C665 the maximum recorded CO₂ concentration has been converted to a Gas Screening Value (GSV) for assessment. As no CH₄ was observed there is no requirement for a site specific GSV.

- **CO₂ GSV = (Max CO₂ (%) / 100) x Max Flow (l/h),**
- **Therefore; (3.3 / 100) x 1.3 = 0.0429 l/hr GSV**

In accordance with CIRIA C665 Table 8.5 and 8.6 the site derived CO₂ GSV of 0.0429 l/hr equates to a CIRIA R149 Characteristic Situation 1 (Very Low Risk) and as a result no gas protection measures are required within the proposed residential structures.

7.0 Ground Gas Risk Assessment (Cont'd)

In addition, the CO₂ GSV of 0.0429 l/hr also equates to Green Classification when using the NHBC Traffic Light System for proposed residential properties with a 150mm void. The NHBC Green Classification does not require gas protection measures to be incorporated within new structures.

8.0 General Comments

When considering the observations made during this ground gas risk assessment it can be seen that whilst potential sources of ground gas have been observed, no elevated levels of ground gas have been recorded and as a result the site is not considered to be at risk, with no ground gas protection measures currently required within the proposed residential properties.

It is therefore recommended that this information be passed to the relevant authorities so that they can perform their assessment and determine if they are satisfied that the properties no longer require ground gas protection measures.

This report has been commissioned to assess potential ground gas levels across the northern site area only and therefore any items not mentioned cannot be assumed to be covered.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders in order to seek their approval of the findings prior to undertaking any works on site.

End of Report

Appendix I

- Exploratory Hole Location Plan

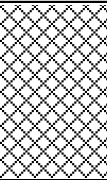

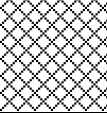

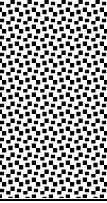
Approximate Locations – Not to Scale



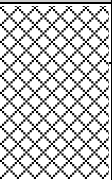

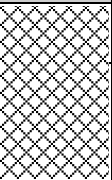
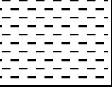
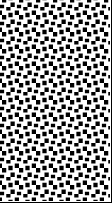
Appendix II

- Borehole Log Record Sheets

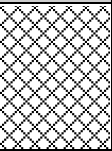

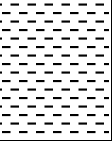
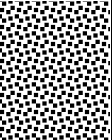
GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.10	MADE GROUND: Grey clayey, gravelly fine to coarse SAND.			
0.10	0.40	MADE GROUND: Dark brown and grey ash-clinker FILL with some slag, concrete and brick.			
0.40	0.60	Reddish brown fine to medium SAND.			
0.60	1.05	Very dense light grey and reddish brown slightly sandy fine to coarse limestone GRAVEL with many cobbles.		SPT = N50/140mm	
1.05		End of Borehole due to sample tube and SPT refusal Borehole noted as dry and stable Installation details: 0.00-0.50m Solid Pipe with Bentonite Surround 0.50-1.00m Slotted Pipe with Gravel Surround Bentonite at base/End Cap/Gas Bung/Protective Cover			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

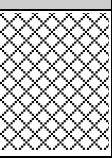

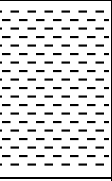
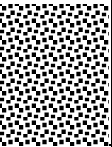
GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH01A

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.10	MADE GROUND: Grey clayey, gravelly fine to coarse SAND.			
0.10	0.35	MADE GROUND: Dark brown and grey ash-clinker FILL with some slag, concrete and brick.			
0.35	0.50	Reddish brown very sandy CLAY.			
0.50	1.00	Very dense light grey and reddish brown slightly sandy fine to coarse limestone GRAVEL with many cobbles.		SPT = N50/95mm	
1.00		End of Borehole due to sample tube and SPT refusal Borehole noted as dry and stable Installation details: Borehole backfilled with arisings on completion			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

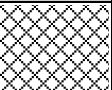

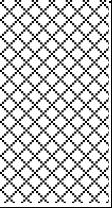

GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH01B

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.35	MADE GROUND: Dark brown clayey, gravelly, sandy TOPSOIL.			
0.35	0.70	Orange brown sandy, gravelly CLAY.			
0.70	0.95	Very dense light grey and reddish brown slightly sandy fine to coarse limestone GRAVEL with many cobbles.		SPT = N50/130mm	
0.95		End of Borehole due to sample tube and SPT refusal Borehole noted as dry and stable Installation details: Borehole backfilled with arisings on completion			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

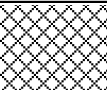

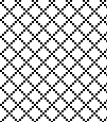
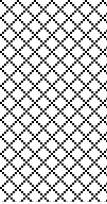
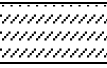

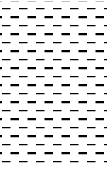
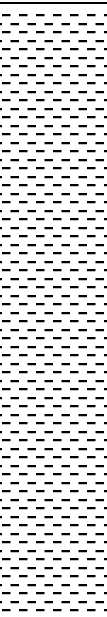

GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH01C

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.40	MADE GROUND: Dark brown clayey, gravelly, sandy TOPSOIL.			
0.40	0.75	Orange brown sandy, gravelly CLAY.			
0.75	1.10	Very dense light grey and reddish brown slightly sandy fine to coarse limestone GRAVEL with many cobbles.		SPT = N50/65mm	
1.10		End of Borehole due to sample tube and SPT refusal Borehole noted as dry and stable Installation details: Borehole backfilled with arisings on completion			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

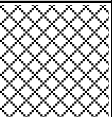

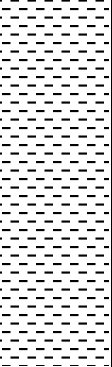
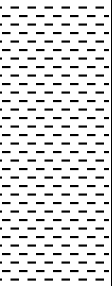
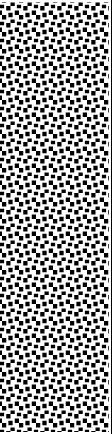
GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.20	MADE GROUND: Dark brown clayey, gravelly, sandy TOPSOIL.			
0.20	0.70	MADE GROUND: Reddish brown GRAVEL + COBBLES of red shale with much metal wire.			
0.70		End of Borehole due to presence of metal wire. Borehole noted as dry and stable Installation details: Borehole backfilled with arisings on completion			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH02A

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.25	MADE GROUND: Dark brown clayey, gravelly, sandy TOPSOIL.			
0.25	0.45	MADE GROUND: Reddish brown GRAVEL + COBBLES of red shale with much metal wire.			
0.45	0.90	MADE GROUND: Dark grey shale, some slag and brick GRAVEL.			
0.90	1.00	Relic TOPSOIL.			
1.00	1.50	Soft light grey and light brown very sandy CLAY.			
1.50	3.00	Firm reddish brown silty, sandy CLAY with much gravel.			
3.00		End of Borehole. Borehole noted as dry and stable Installation details: 0.00-1.00m Solid Pipe with Bentonite Surround 1.00-3.00m Slotted Pipe with Gravel Surround Bentonite at base/End Cap/Gas Bung/Protective Cover			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

GEO2015-1559: Mill Hill, Cleator Moor Phase 2. BH03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples	Install
0.00	0.35	MADE GROUND: Grey sandy fine to coarse slag, concrete, brick, limestone and occasional clinker GRAVEL and some cobbles.			
0.35	1.10	Grey very sandy, slightly silty CLAY.			
1.10	1.85	Firm reddish brown silty, sandy CLAY with much gravel.			
1.85	3.00	Reddish brown slightly clayey, sandy fine to coarse limestone and sandstone GRAVEL.			
3.00		End of Borehole. Borehole noted as dry and stable Installation details: 0.00-1.00m Solid Pipe with Bentonite Surround 1.00-3.00m Slotted Pipe with Gravel Surround Bentonite at base/End Cap/Gas Bung/Protective Cover			
Site: GEO2015-1559 Engineer: GE Driller: GE Site Works Date: 17/06/2015 Plant: Competitor C130 Dynamic Sampling Drilling Rig			Log Notes: HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

Appendix III

- Ground Gas Monitoring Record Sheets

Ground Gas & Groundwater Monitoring Record Sheet 01

Site: Mill Hill, Cleator Moor Phase 2

Project No: 2015-1559

Date: 18/06/2015

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
1	1011	0	0	3.3	0.8	18.0	19.4	1.2	-	1.00	-
2A	1011	0	0	1.2	1.0	18.9	19.2	1.3	1.1	3.00	-
3	1011	0	0	0.3	0.1	18.0	18.2	1.2	2.2	3.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

Monitoring Completed By: GE

Equipment Used: GFM436 Gas Analyser with Integral Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Cloudy with light rain. Temp c.12 deg C. Light winds noted.

Additional Comments: N/A

Ground Gas & Groundwater Monitoring Record Sheet 02

Site: Mill Hill, Cleator Moor Phase 2

Project No: 2015-1559

Date: 14/07/2015

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
1	1010	0	0	3.1	0.9	18.3	19.0	1.0	-	1.00	-
2A	1010	0	0	1.6	0.6	18.5	19.1	1.1	1.13	3.00	-
3	1010	0	0	0.6	0.3	18.1	18.7	0.8	2.21	3.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
 Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

Monitoring Completed By: GE

Equipment Used: GFM436 Gas Analyser with Integral Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Warm and cloudy with light rain. Temp c.16 deg C. Light winds noted.

Additional Comments: N/A

Ground Gas & Groundwater Monitoring Record Sheet 03

Site: Mill Hill, Cleator Moor Phase 2

Project No: 2015-1559

Date: 27/07/2015

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
1	0988	0	0	1.9	1.1	11.7	14.4	0.6	0.60	1.00	-
2A	0988	0	0	1.5	1.1	18.3	19.2	0.9	1.1	3.00	-
3	0988	Covered by pallets									

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.

Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

Monitoring Completed By: GE

Equipment Used: GFM436 Gas Analyser with Integral Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Cloudy with light rain. Temp c.14 deg C. Light winds noted.

Additional Comments: N/A

Ground Gas & Groundwater Monitoring Record Sheet 04

Site: Mill Hill, Cleator Moor Phase 2

Project No: 2015-1559

Date: 17/08/2015

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
1	1010	0	0	1.8	0.8	17.0	18.2	0.4	0.85	1.00	-
2A	1010	0	0	1.1	0.8	18.7	19.2	0.2	0.80	3.00	-
3	1010	0	0	1.6	0.6	14.0	18.4	0.6	2.20	3.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
 Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

Monitoring Completed By: GE

Equipment Used: GFM436 Gas Analyser with Integral Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Cloudy and dry. Temp c.16 deg C. Light winds noted.

Additional Comments: N/A

Ground Gas & Groundwater Monitoring Record Sheet 05

Site: Mill Hill, Cleator Moor Phase 2

Project No: 2015-1559

Date: 25/08/2015

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
1	0999	0	0	1.8	0.6	9.2	16.0	0.8	-	1.00	-
2A	0999	0	0	1.3	0.3	18.3	19.1	0.7	0.95	3.00	-
3	0999	0	0	2.0	0.4	15.6	18.0	0.9	2.33	3.00	-

Notes:

Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
 Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

Monitoring Completed By: GE

Equipment Used: GFM436 Gas Analyser with Integral Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Cloudy and dry. Temp c.19 deg C. Light winds noted.

Additional Comments: N/A

Ground Gas & Groundwater Monitoring Record Sheet 06

Site: Mill Hill, Cleator Moor Phase 2

Project No: 2015-1559

Date: 17/09/2015

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
1	0987	0	0	1.5	0.3	15.4	17.9	0.2	-	1.00	-
2A	0987	0	0	1.3	0.3	19.2	19.7	0.2	1.05	3.00	-
3	0987	0	0	2.9	0.4	15.4	18.5	0.1	2.38	3.00	-

Notes:
 Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
 Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.

Monitoring Completed By: GE

Equipment Used: GFM436 Gas Analyser with Integral Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Sunny and dry. Temp c.15 deg C. Light winds noted.

Additional Comments: N/A



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