MAXI DEVELOPMENTS (NW) LTD

RESIDENTIAL DEVELOPMENT AT BRYN RODYN, DOLWEN ROAD, COLWYN BAY LL29 8UU

GROUND GAS INVESTIGATION AND RISK ASSESSMENT REPORT

REPORT No. E1191.GRA.R3

JANUARY 2021

Client : **MAXI DEVELOPMENTS (NW) LTD**

Project Title : **RESIDENTIAL DEVELOPMENT AT BRYN RODYN, DOLWEN ROAD, COLWYN BAY LL29 8UU**

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Date. **JANUARY 2021**

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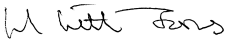
Report Ref:	**E1191.GRA.R3**		
Signed:			

1. INTRODUCTION.

1.1 Background and Terms of Reference

1.1.1 In July 2020 e-geo Solutions Ltd were commissioned by Mr M Jones to undertake a Ground Gas Contamination Investigation and Risk Assessment on land adjacent to Bryn Rodyn, Dolwen Road, Colwyn Bay. It is proposed to develop the land which is within 75m of an unlicenced landfill for residential development. The objective of the ground gas investigation is to determine if hazardous or flammable gasses are migrating from the landfill onto the development site and if there are any risks to the development.

1.1.2 This report presents the findings of the ground gas investigation, detailing the ground conditions encountered, results of landfill gas monitoring and assesses the risks through the development of a conceptual model.

1.1.3 The report has been prepared by e-geo Solutions Ltd for the sole use of the Client, for the purposes described and no extended duty of care applies to other parties. The comments given, and opinions expressed in this report are based on the information collated from site observations, and gas monitoring of borehole installation, however there may be outstanding information and data which becomes available at a later date which has an impact on the overall conclusions. No warranty is given that the information represents all ground conditions prevailing at the site.

1.2 Report Contents

1.2.1 The report includes sections on:-

- Present site description, profile and setting.
- The scope of the investigation and its justification
- The geological and hydro-geological conditions at the site
- The results of gas monitoring
- The development of a conceptual model for ground gasses in relation to the proposed development and risk assessment

2. SITE LOCATION, DESCRIPTION AND PROFILE.

2.1 Site Location

2.1.1 The development site is on land situated west of Bryn Rodyn which is 1.5km to the southeast of the centre of Colwyn Bay on Dolwen Road. The development site location is shown on Figure 1 and is centred at Grid Reference SH 87620 76703, with the boundaries shown on Figure 2.

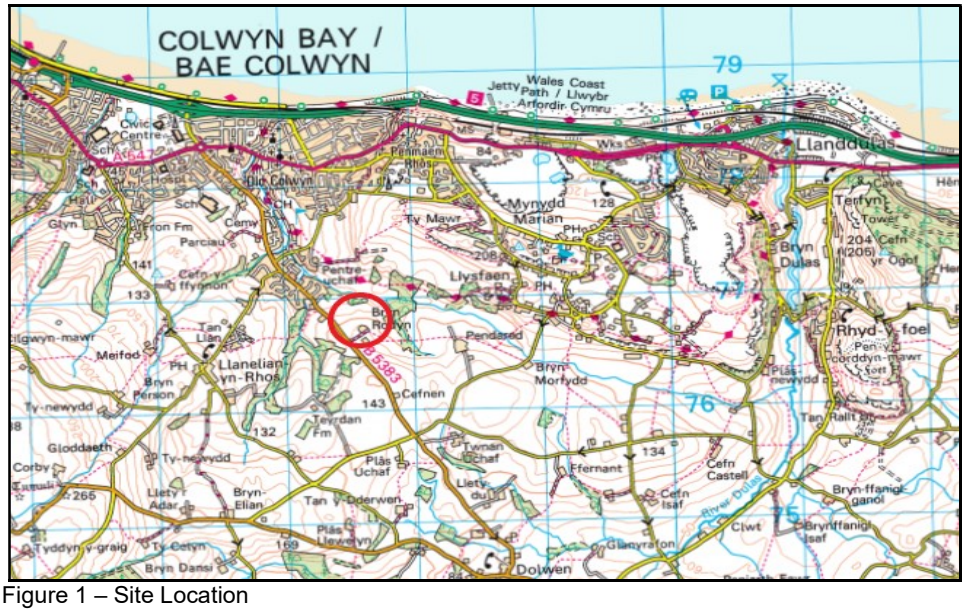


Figure 1 – Site Location

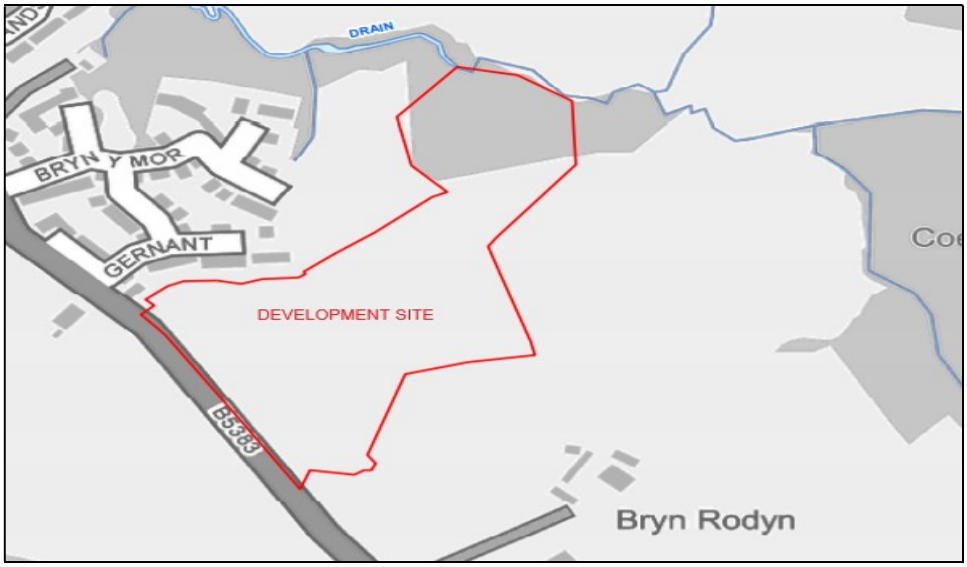


Figure 2 – Development site boundaries

2.2 Site Description and Topography

2.2.1 The proposed residential development site adjacent to Bryn Rodyn presently comprises agricultural land used for grazing and pasture. The ground within the site slopes gently from south to north towards the north boundary of the site which is about 75m from the former unlicensed landfill to the east. The land surrounding the former landfill is agricultural land with woodland to the northeast and east. An aerial photograph shown as Figure 3.

Figure 3– Aerial Photograph

2.2.2 The proposed development is for 73 residential properties constructed over 2.9 hectares of the site area, with the extreme northern portion of the site allocated for open space and sustainable drainage features.

2.3 Site Profile

2.3.1 A desk-based study has been undertaken to collate information on the development site and the former landfill and a summary of the findings and site profile are presented below:

Profile Item	Summary
Site Status and Topography:	The residential development site adjacent to Bryn Rodyn presently comprises agricultural land used for grazing and pasture. Approximately 75m to the northeast is a former landfill within a shallow valley surrounded by agricultural land and woodland. The overall topography in the area slopes from south to north with the development site approximately 15m to 20m above the level of the landfill.
Landfill History: (Appendix 1)	In 1900 the area of the landfill was agricultural land and woodland and it remained as such until at least 1972. By 1989 the landfill was in existence and is shown as made-up ground. It is understood that unlicensed landfilling took place between 1975 and the early 1980s. The landfill received inert and non-inert waste from skips. There are no formal records of the wastes received or of the landfill construction, but it appears that the wastes were placed in a shallow ravine and valley.
Services:	There are no known services running directly between the landfill and the development site, however there is a gas pipeline crossing the development site from southeast to northwest.

Geology:	The geological map indicates that the ground conditions at the site comprise glacial till (boulder clay) overlying siltstone and mudstone bedrock of the Elwy Formation. The glacial till will comprise an over-consolidated gravely sandy clay with occasional cobbles and possibly boulders, with some horizons of less and more granular material. The glacial till extends for 100s of metres in all directions from the site area and is likely to be typically 8 to 12m thick. There are no BGS borehole records in the area however investigations undertaken to the northwest indicate a stiff clay with varying proportions of gravel to at least 5m depth.
Ground Permeability :	The glacial till will have to low to very low permeability. The siltstone bedrock will be of low permeability with permeability governed by the fracture state of the rock.
Hydrogeology:	The site is underlain by a minor aquifer of low leaching potential within the bedrock. Groundwater is likely to be absent from the glacial till due to the low permeability, but perched and trapped water may be present in more granular and sandy horizons.
Hydrology:	There are no watercourses near the development site, however there is a watercourse in the valley bottom to the northeast of the landfill.
Mining/Quarry:	There are no quarries within 300m of the site.
Landfill Data:	There is no information on the construction of the landfill however as the landfill was unlicensed it is likely that the landfill is not lined or has an engineered capping system. There is no information on the type of wastes received other than inert and non-inert wastes and there is no monitoring data available.

3. GROUND GAS INVESTIGATION AND MONITORING.

3.1 Justification and Investigation Approach

3.1.1 The Local Authority have a record of a former unlicensed landfill 'Bryn Rodyn Landfill' on land approximately 75m to the east of the development site. However there is no information on the way the landfill was constructed, operated or managed. There is also no information on gas monitoring at the unlicensed landfill or in its immediate vicinity.

3.1.2 Possible migration routes for gas may exist from the wastes that infill the shallow valley which form the landfill, through the near surface glacial till deposits, towards the development site.

3.2 Ground Gas Investigation Scope of Work

3.2.1 In the absence of gas monitoring data at the landfill an investigation was designed and the scope work included the following:

- Construction of 4 No. gas monitoring boreholes to a depth of 3m along the boundary closest to the unlicensed landfill site. Borehole records are presented in Appendix 2 and locations are indicated on Figure 4.
- Completion of all boreholes with dedicated gas monitoring standpipes, gravel response zones, bentonite seals, gas taps and covers. Response zones comprised 50mm diameter geowrapped slotted section HDPE pipe from 0.50m bgl to 3.00m bgl with plain HDPE pipe from 0.50m bgl to ground level.
- Monitoring of all boreholes for gas composition (methane, carbon dioxide, oxygen) pressure and flow on 6 occasions over a period of 6 weeks (approximately) including two (19/08/20, 04/09/20) during periods of low (<1000mb) atmospheric pressure.

3.2.2 Monitoring of the gas monitoring installations for methane (% volume and lower explosive limit), carbon dioxide, oxygen, and flow was undertaken with a GA5000 Gas Analyser Serial Nr.G502441 on 29/07/20, 05/08/20, 12/08/20, 19/08/20, 26/08/20, 04/09/20. Gas monitoring results and the GA5000 calibration certificate (G502441_2/26139) are presented in Appendix 3.

3.3 Location of Gas Monitoring Installations

3.3.1 Borehole and gas monitoring installation locations are indicated on the proposed development plan layout in Figure 4. The boreholes were located along the northeast boundary of the development site closest to the unlicensed landfill to intercept any gasses migrating through ground strata.

Figure 4 – Borehole Locations

4. GROUND CONDITIONS AND GEOLOGY.

4.1 Ground Conditions

4.1.1 Full details of the ground conditions at the northeast boundary of the development site and within the site are given on the borehole records (WS5, WS6, WS7, WS8) in Appendix 2. The ground conditions in the area of investigation are as follows:

Stratum	Description	Depth to base (m)	Thickness (m)
TOPSOIL	Dark brown silty clayey TOPSOIL	0.25	0.25
GLACIAL TILL 1	Stiff and firm to stiff light brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.	1.00	0.75
GLACIAL TILL 2	Stiff and firm to stiff medium brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.	2.00 to 3.00+	0.50 to 3.00+
GLACIAL TILL 3 (WS7, WS8)	Stiff and firm to stiff medium brown slightly gravely sandy silty CLAY. Lens of coarse sand 2.50-2.65/2.80-3.00mbgl	3.00+	

4.1.2 The ground strata found in the boreholes is considered representative of the ground stratum between the development site and the unlicensed landfill 75m northeast, and of ground present below the development site itself.

4.1.3 Over the response zones in the window sample boreholes and to a depth of at least 3.0m the ground conditions comprised a stiff and firm to stiff light brown becoming medium brown gravely slightly sandy silty CLAY which will have a low to very low permeability. Ground permeability tests undertaken by others (Waterco 12707 Drainage Strategy Nov 2020) confirmed that the clay strata to a depth of 1.30m is effectively impermeable.

4.1.4 The glacial till was a homogenous clay no granular layers with the exception of two thin, 15 to 20cm bands of coarse sand in WS7 and WS8 at depth of 2.50 and 2.80m bgl. No evidence was found in other boreholes and the sand is very likely to be isolated, discontinuous sand lenses within the clay stratum.

4.2 Groundwater

4.2.1 No groundwater was encountered in the boreholes at the time of construction or during monitoring.

5. GROUND GAS ASSESSMENT

5.1 Reference Values

5.1.1 The results of ground gas monitoring in boreholes WS5, WS6, WS7, WS8 are presented in Appendix 3. In the assessment of soil gasses reference has been made to the NHBC Guidance on Methane and Carbon Dioxide Report Edition No04 (March 2007), BS8485 and CIRIA Publication C659 Assessing Risks Posed by Hazardous Ground Gases To Buildings. The monitoring results have been compared to the standard trigger concentrations of 1% v/v for methane and 5.0% v/v for carbon dioxide.

5.2 Ground Gas Monitoring Results Assessment

5.2.1 No detectable concentrations of methane were recorded in boreholes WS5, WS6, WS7, WS8 by % volume or % lower explosive limit (LEL) on any of the 6 monitoring visits.

5.2.2 Very low concentrations of carbon dioxide, with slightly depleted oxygen concentrations were detected in all monitoring installations (WS5, WS6, WS7, WS8) on most occasions but concentrations were only in the range 0.3% to 4.2% (steady readings) with a maximum of 4.8% (peak reading) detected in all installations on 04/09/20. All concentrations were consistent during the monitoring period and below the 5.0% trigger concentration.

5.2.3 When the gas monitoring equipment (GA5000 Gas Analyser Serial Nr. G502441) potential margin of error is taken into consideration the potential maximum peak carbon dioxide concentration could be 5.0%, which is at but not above the trigger concentration for carbon dioxide. The maximum steady state concentration when considering the potential margin of error is 4.375%.

5.2.4 Gas flows in all monitoring installations were less than 0.1 l/hr.

5.2.5 With reference to the CIRIA and NHBC Guidance and the ‘Traffic Light’ system of ground gas risk assessment the results have been screened using the method for low rise housing developments. No methane was detected. For a maximum peak carbon dioxide concentration of 4.8% and a flow rate of <0.1l/hr the Gas Screening Value (GSV) is 0.0048l/hr. With a GSV of 0.0048 and maximum carbon dioxide concentration of 4.8% the site would be classified as ‘Characteristic Situation1’. Taking potential margin of error into consideration for a maximum peak carbon dioxide concentration of 5.0% and a flow rate of <0.1l/hr the Gas Screening Value (GSV) is 0.005l/hr. With a GSV of 0.005 and maximum carbon dioxide concentration of 5.0% the site would be classified as ‘Characteristic Situation1’ as the peak carbon dioxide concentration is not greater than 5%, and the steady state concentration is less than 5%.

6. GAS RISK ASSESSMENT AND REMEDIATION REQUIREMENTS.

6.1 Introduction

6.1.1 The assessment of risk undertaken follows a 'Tier 1 Generic Risk Assessment' approach which follows a source-pathway-target model prior. For a risk to exist there must be gases present at Concentrations which potentially could create a risk to human health or structures.

6.2 Gas Source Off-site

6.2.1 An unlicensed landfill which received inert and non-inert wastes is situated approximately 75m east of the proposed residential development. Although there is no gas monitoring data for the landfill itself the findings of the ground investigation and gas monitoring at the boundary between the proposed residential development and the unlicensed landfill has indicated that there is no evidence that hazardous gasses are migrating across land from the landfill onto the proposed residential development site at concentrations which present a risk to the proposed development.

6.3 Gas Source On-site

6.3.1 No significantly elevated concentrations of gasses have been detected in the ground at the boundary between the proposed residential development and land to the east which extends approximately 75m to the unlicensed landfill. No methane has been detected but detectable concentrations of carbon dioxide recorded with maximum steady state concentrations of 4.2% (4.375% adjusted for error margin) and a peak concentration of 4.8% (5% adjusted for error margin). With reference to the NHBC Guidance and the 'Traffic Light' system of ground gas risk assessment the land would be classified as 'Green' and 'Characteristic Situation 1' based on these results.

6.4 Migration Pathways

6.4.1 The ground strata within the development site and at the boundary between the unlicensed landfill and the proposed residential properties comprises a stiff and firm to stiff gravely slightly sandy silty clay (Glacial Till) which will have a low permeability. The glacial clay is extensive and extends for 100s of metres in all directions from the development site area and is likely to be at least 8m thick. Although a thin sand lens was found at 2.50 to2.80m depth in the site boundary boreholes these granular layers will not be continuous and as the clay is stiff, homogenous and consolidated it will be of very low permeability or impermeable. There is no likelihood of migration of any gasses from the landfill site through the glacial clay or through any sand lenses if they are of limited extent and un-continuous.

6.4.2 Although there are no known services directly between the unlicensed landfill and the proposed residential development site that could allow hazardous gasses to migrate, the proposed development includes a sustainable surface water drainage system to the northeast of the residential properties and situated between the dwellings and the landfill. The surface water drainage system will comprise cascading ponds, a reed area and larger attenuation pond and will be constructed above ground. If constructed above ground with no buried pipework and within the low permeability glacial clay that is present across the site, gas migration pathways between the landfill and the development site will not be created.

6.5 Risk Assessment

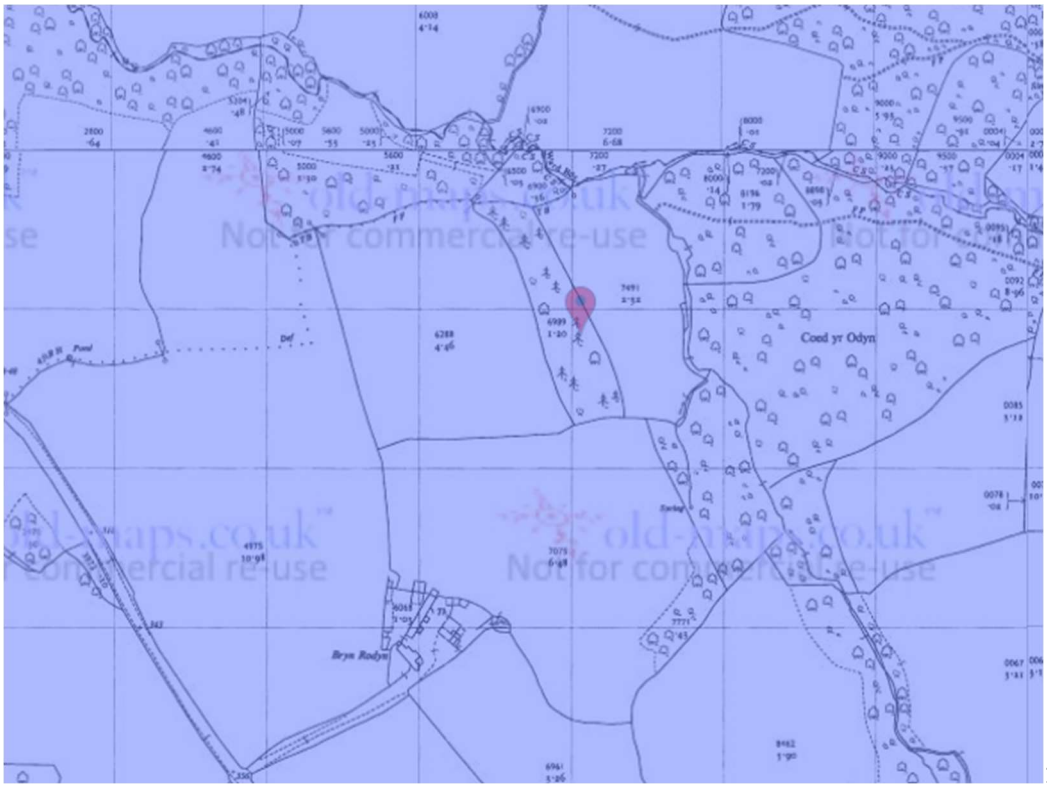
6.5.1 From the results of the available ground gas monitoring data collected to date, which indicate no elevated gas concentrations, and in the absence of any migration pathways within the low permeability glacial clay, there is considered to be no risk from hazardous gasses that may be present in the unlicensed landfill to the proposed residential development.

6.5.2 From the gas monitoring results and a GSV of 0.0048l/hr or 0.005l/hr the area would be classed as a 'Green' and 'Characteristic situation 1'.

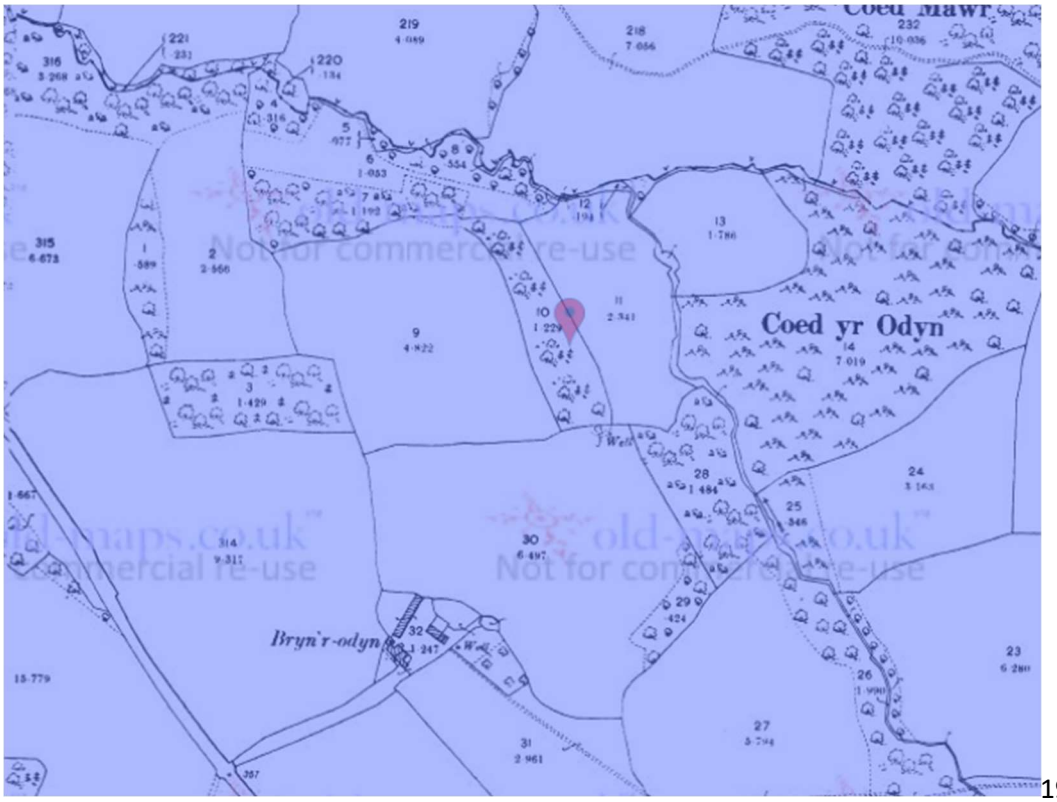
Appendix 1 - Historical OS Maps

1989 1:10,000

1972 1:10,000



1960 1:2,500



1900 1:2,500

Appendix 2 - Borehole Records

E-GEO SOLUTIONS LTD, GLASGOW HOUSE, HIGH STREET, ST. ASAPH, LL17 0RD
Tel: 01745 828494. Mob: 07899980958

WINDOW SAMPLE BOREHOLE RECORD

SITE: UNITS AT BRYN RODYN, DOLWEN ROAD, COLWYN BAY LL29 8UU	BOREHOLE No:
PROJECT: GAS MONITORING AT UNITS AT BRYN RODYN, OLD COLWYN	**WS5**
CLIENT: MAXI DEVELOPMENTS	Sheet 1 of 1
Dates : 28/07/2020	Project Ref: E1191
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)
				Dark brown silty clayey TOPSOIL		
			0.25	Stiff and firm to stiff light brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
			1.00	Stiff and firm to stiff medium brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
				very gravely 1.20-1.70		
				very gravely 2.00-2.50		
			3.00	Borehole complete at 3.00m		

Remarks
50mm HDPE gas monitoring pipe installed to 3.00m. 3.00-0.50m slotted. 0.50-0.00 plain
Borehole dry

E-GEO SOLUTIONS LTD, GLASGOW HOUSE, HIGH STREET, ST. ASAPH, LL17 0RD
Tel: 01745 828494. Mob: 07899980958

WINDOW SAMPLE BOREHOLE RECORD

SITE: UNITS AT BRYN RODYN, DOLWEN ROAD, COLWYN BAY LL29 8UU	BOREHOLE No:
PROJECT: GAS MONITORING AT UNITS AT BRYN RODYN, OLD COLWYN	**WS6**
CLIENT: MAXI DEVELOPMENTS	Sheet 1 of 1
Dates : 28/07/2020	Project Ref: E1191
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)
				Dark brown silty clayey TOPSOIL		
			0.25	Stiff and firm to stiff light brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
			1.00	Stiff and firm to stiff medium brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
			3.00	Borehole complete at 3.00m		

Remarks
50mm HDPE gas monitoring pipe installed to 3.00m. 3.00-0.50m slotted. 0.50-0.00 plain
Borehole dry

E-GEO SOLUTIONS LTD, GLASGOW HOUSE, HIGH STREET, ST. ASAPH, LL17 0RD
Tel: 01745 828494. Mob: 07899980958

WINDOW SAMPLE BOREHOLE RECORD

SITE: UNITS AT BRYN RODYN, DOLWEN ROAD, COLWYN BAY LL29 8UU	BOREHOLE No:
PROJECT: GAS MONITORING AT UNITS AT BRYN RODYN, OLD COLWYN	**WS7**
CLIENT: MAXI DEVELOPMENTS	Sheet 1 of 1
Dates : 28/07/2020	Project Ref: E1191
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)
				Dark brown silty clayey TOPSOIL		
			0.25	Stiff and firm to stiff light brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
			1.50	Stiff and firm to stiff medium brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
			2.00	Stiff and firm to stiff medium brown slightly gravely sandy silty CLAY. Lens of coarse sand 2.50-2.65mbgl		
			3.00	Borehole complete at 3.00m		

Remarks
50mm HDPE gas monitoring pipe installed to 3.00m. 3.00-0.50m slotted. 0.50-0.00 plain
Borehole dry

E-GEO SOLUTIONS LTD, GLASGOW HOUSE, HIGH STREET, ST. ASAPH, LL17 0RD
Tel: 01745 828494. Mob: 07899980958

WINDOW SAMPLE BOREHOLE RECORD

SITE: UNITS AT BRYN RODYN, DOLWEN ROAD, COLWYN BAY LL29 8UU	BOREHOLE No:
PROJECT: GAS MONITORING AT UNITS AT BRYN RODYN, OLD COLWYN	**WS8**
CLIENT: MAXI DEVELOPMENTS	Sheet 1 of 1
Dates : 28/07/2020	Project Ref: E1191
Elev (maOD) :	
Casing dia : 100mm	Logged By: HLJ
Engineer : e-geo Solutions Ltd	

Depth (m)	Sample/ Test	Field Record	Depth (m)	Strata Description	Casing Depth(m)	Water Depth(m)
				Dark brown silty clayey TOPSOIL		
			0.25	Stiff and firm to stiff light brown gravely slightly sandy silty CLAY. Gravel is fine to coarse angular to subangular siltstone and limestone. Low cobble content.		
			2.20	Stiff and firm to stiff medium brown slightly gravely sandy silty CLAY. Lens of coarse sand 2.80-3.00mbgl		
			3.00	Borehole complete at 3.00m		

Remarks
50mm HDPE gas monitoring pipe installed to 3.00m. 3.00-0.50m slotted. 0.50-0.00 plain
Borehole dry

Appendix 3 - Gas Monitoring Results and Calibration Certificate

Residential Development at Bryn Rodyn, Colwyn Bay

Monitoring Date	29/07/2020			
	BH5	BH6	BH7	BH8
CH4 by VOL % (Max)	0.10%	0.10%	0.10%	0.10%
CO2 by VOL % (Max)	0.40%	2.10%	0.30%	0.40%
O2 by VOL %	16.10%	15.30%	15.60%	15.40%
BAL	83.40%	82.50%	83.90%	84.00%
LEL CH4	1%	1%	1%	1%
PEAK CH4 by VOL % (Max)	0.10%	0.10%	0.10%	0.10%
PEAK CO2 by VOL % (Max)	3.00%	3.00%	3.00%	3.00%
MIN O2 by VOL %	14.40%	14.40%	14.40%	14.40%
BARO PRESSURE	1009mb	1009mb	1009mb	1009mb
FLOW l/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr

Residential Development at Bryn Rodyn, Colwyn Bay

Monitoring Date	05/08/2020			
	BH5	BH6	BH7	BH8
CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
CO2 by VOL %	2.60%	2.50%	0.40%	0.50%
O2 by VOL %	15.10%	15.20%	15.30%	15.20%
BAL	82.10%	82.20%	84.20%	84.10%
LEL CH4	1%	1%	1%	1%
PEAK CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
PEAK CO2 by VOL % (Max)	3.00%	3.00%	3.00%	3.00%
MIN O2 by VOL %	14.90%	14.90%	14.90%	14.90%
BARO PRESSURE	1004mb	1004mb	1004mb	1004mb
FLOW l/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr

Residential Development at Bryn Rodyn, Colwyn Bay

Monitoring Date	12/08/2020			
	BH5	BH6	BH7	BH8
CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
CO2 by VOL %	3.60%	4.20%	1.20%	1.00%
O2 by VOL %	14.70%	14.80%	14.20%	14.80%
BAL	80.40%	79.40%	82.40%	82.40%
LEL CH4	1%	1%	1%	1%
PEAK CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
PEAK CO2 by VOL % (Max)	3.50%	4.40%	4.60%	4.60%
MIN O2 by VOL %	14.40%	14.40%	14.20%	14.10%
BARO PRESSURE	1003mb	1003mb	1003mb	1003mb
FLOW l/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr

Residential Development at Bryn Rodyn, Colwyn Bay

Monitoring Date	19/08/2020			
	BH5	BH6	BH7	BH8
CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
CO2 by VOL %	2.80%	2.80%	1.30%	1.00%
O2 by VOL %	14.80%	14.70%	14.00%	14.60%
BAL	82.00%	82.00%	84.00%	83.30%
LEL CH4	1%	1%	1%	1%
PEAK CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
PEAK CO2 by VOL % (Max)	3.30%	3.30%	3.30%	3.30%
MIN O2 by VOL %	14.20%	14.20%	14.00%	14.00%
BARO PRESSURE	0988mb	0988mb	0988mb	0988mb
FLOW l/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr

Residential Development at Bryn Rodyn, Colwyn Bay

Monitoring Date	26/08/2020			
	BH5	BH6	BH7	BH8
CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
CO2 by VOL %	2.30%	2.30%	0.90%	0.80%
O2 by VOL %	15.50%	15.50%	15.80%	15.60%
BAL	82.00%	81.90%	83.10%	83.50%
LEL CH4	1%	1%	1%	1%
PEAK CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
PEAK CO2 by VOL % (Max)	3.10%	3.10%	3.10%	3.10%
MIN O2 by VOL %	14.50%	14.50%	14.50%	14.50%
BARO PRESSURE	1003mb	1003mb	1003mb	1003mb
FLOW l/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr

Residential Development at Bryn Rodyn, Colwyn Bay

Monitoring Date	04/09/2020			
	BH5	BH6	BH7	BH8
CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
CO2 by VOL %	2.50%	2.70%	2.90%	0.80%
O2 by VOL %	14.70%	14.40%	14.00%	14.40%
BAL	82.50%	82.60%	82.90%	84.60%
LEL CH4	1%	1%	1%	1%
PEAK CH4 by VOL %	0.10%	0.10%	0.10%	0.10%
PEAK CO2 by VOL % (Max)	4.80%	4.80%	4.80%	4.80%
MIN O2 by VOL %	13.70%	13.70%	13.70%	13.70%
BARO PRESSURE	0998mb	0998mb	0998mb	0998mb
FLOW l/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr	0.0 1/hr

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 30-Jul-2020

Certificate Number: G502441_2/26139

Issued by: QED Environmental Systems Ltd.

Customer: **Egniol Environmental Ltd**
Llys Onnen Ffordd Y Llyn Parc Menai
Bangor LL57 4DF UNITED KINGDOM

Description: Gas Analyser

Model: GA5000

Serial Number: G502441

UKAS Accredited results:

Methane (CH_4)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	4.8	0.41
15.0	14.9	0.64
60.0	59.7	0.94

Carbon Dioxide (CO_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	4.8	0.43
15.0	14.7	0.70
39.9	39.9	1.1

Oxygen (O_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
21.1	21.2	0.31

All concentrations are molar.

CH_4, CO_2 readings recorded at : 32.5 °C ± 2.5 °C

O2 readings recorded at : 22.6 °C ± 2.5 °C

Barometric Pressure : 1008 mbar ± 4 mbar

Method of Test : The analyser is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure LP004.

www.qedenv.com +44 (0) 333 800 0088 sales@qedenv.co.uk

QED Environmental Systems Ltd. Cyan Park - Unit 3, Jimmy Hill Way, Coventry, CV2 4QP, UNITED KINGDOM

Registered in England and Wales 1898734

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The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Calibrations marked 'Non-UKAS Accredited results' on this certificate have been included for completeness.

Non-UKAS accredited results after adjustment:

Barometer (mbar)	
Reference	**Instrument Reading**
1008	1009

Additional Gas Cells		
Gas	**Certified Gas (ppm)**	**Instrument Reading (ppm)**
CO	508	513
H_2S	261	261

Date of Issue : 31-Jul-2020 **Approved by Signatory**

Laura McBride

Laboratory Inspection

Calibration Instance:110 IGC Instance:110

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