GEOLOGICAL
GEOTECHNICAL
GEOENVIRONMENTAL
DATA ACQUISITION
CONSULTANCY



Gas Addendum Letter Report

LOCATION	19 Church Lane, Rhosllanerchrugog, Wales LL14 2BN
ISSUE DATE	September 2025
FOR	A Richards c/o Glyn Roberts Associates
CLIENT REF.	-
OUR REF.	G25148

Prepared by

[redacted]

Jason Pratt BSc (Hons) FGS
Senior Geoenvironmental Engineer

Checked by

[redacted]

Stuart Howe BSc (Hons) FGS
Senior Geotechnical Engineer

Head Office
Units 3a and 4 Terry Dicken Industrial Estate
Ellerbeck Way
Stokesley
North Yorkshire
TS9 7AE
[redacted]

Nottingham
Unit 4 Bailey Brook Industrial Estate
Amber Drive, Langley Mill
Nottingham
NG16 4BE
[redacted]

Manchester
Suite 26 Atlantic Business Centre
Atlantic Street
Altrincham
WA14 5NQ
[redacted]

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1. Review of Sources and Ground Conditions Encountered

1.1 Review of Sources

The findings of the Phase 2 intrusive site investigations suggested that the most likely source of hazardous gas at the site would be probable shallow historical coal mine workings.

The extract of the 1:50,000 Solid & Drift geological map indicates the site to be underlain by bedrock geology belonging to the Pennine Lower Coal Measures Formation (Sandstone).

The area is obviously within a coal mining area but is not within close proximity (100m) to landfills, cemeteries or other gas generating historical activity. No peat or alluvial soils are shown close to the site.

1.2 Review of Ground Conditions

2.2.1 Boreholes BH1 to BH5

The ground conditions were relatively uniform across the site and comprised topsoil underlain by made ground underlain by strata predominantly comprising highly weathered mudstone with sandstone gravel, and small inclusions of coal. Sandstone cobbles were noted at

The made ground comprised highly weathered mudstone with gravel constituents of brick and pot. This stratum was encountered to depths of between 0.40mbgl (BH2) and 1.20mbgl (BH3).

Gas monitoring wells were installed in boreholes BH1, BH2 and BH3

2.2.2 Boreholes RH1-RH3

The findings of the CMRA report necessitated that rotary open hole boreholes be sunk at the site as part of this investigation to explore for possible shallow coal workings. These were drilled using the Geoinvestigate custom-built and trademarked Microdrill system, a lightweight tracked drilling rig which uses water flush.

Two (2) holes were drilled to depths of 30.00mbgl (RH1 & RH2) and logs of the findings are presented in Appendix 1.

The rock descriptions are tentative and generally based on the contents of returned water flush, drilling progress (speed of advance) and water pressures observed during drilling; no cores were recovered from the boreholes to verify these though at several times during excavation the drill-string is withdrawn from the ground to inspect the composition of the build-up on the drill bit.

Gas monitoring was undertaken during and following drilling. No hazardous gas concentrations were detected. The boreholes were sealed rapidly on completion, following drilling.

The rotary boreholes encountered very similar conditions with rockhead at depths between 2.10mbgl and 2.30mbgl initially comprising yellowish/brown mudstone becoming grey from 5.10mbgl. This is underlain by grey siltstone from 6.70mbgl to 16.60mbgl. Below this a 1.30m (RH1) & 1.20m (RH2) thick horizon of very weak shaley, poor quality coal is present, underlain by grey mudstone which extends to 23.40mbgl which is further underlain by grey siltstone to termination at 30.00mbgl.

Full water flush was maintained throughout the 30.00m and no voids/worked ground was encountered.

2. Final Gas Monitoring Results

Six (6) gas monitoring visits to three monitoring installations at the above site were carried out by Geoinvestigate as part of the phase 2 site investigation (G25148).

A summary of the results of gas monitoring in the boreholes at the site is presented in Table 1 below.

Table 1: Summary of Gas Monitoring Data

Job Number	G25148
Client	G Roberts / A Richards
Site	19 Church Street, Rhos, LL14 2BN

	CH_4 (%)	CO_2 (%)	O_2 (%)
Mininum	0	0.1	14
Maximum	0	1.9	20.7

Borehole	Number of Visits	CH_4 (%)		CO_2 (%)		O_2 (%)		Flow Rate (l/hr)	H_2S (ppm)	CO (ppm)	Atmospheric Pressure (mb)
		Min.	Max.	Min.	Max.	Min.	Max.				
1	6	0	0	0.8	1.2	14	19.9	<0.1	0	2	968
2	6	0	0	0.5	1.9	14.3	20.7	<0.1	0	0	to
3	6	0	0	0.1	0.5	14.3	20.5	<0.1	1	0	1027

The monitoring has returned the following:

- Atmospheric pressures of between 968mb and 1027mb.
- Levels of O_2 between 14% and 20.7%.
- CO_2 content ranging from below detectable limits up to 1.9%.
- CH_4 content below detectable limits in each case
- H_2S and CO content ranging from below detectable limits up to 2ppm.
- Gas flow rates below detectable limits (<0.01lt/hr) at all locations on each monitoring occasion.
- All of the wells were dry on each monitoring visit.

This addendum report will review the potential risk to the site based on the above gas results and ground conditions encountered by the site investigation works. This information will be used in association with CL:AIRE Research Bulletin 17 to provide a comprehensive overview of the gas risk and associated classification for the site, and to provide comment regarding any implications when considering the specific nature of the proposed development.

2.1 CL:AIRE Research Bulletin 17

A research bulletin posted by Contaminated Land – Applications in Real Environments (CL:AIRE) has reviewed the process of gas monitoring and risk assessment and presents potential scope to classify sites without the need for lengthy and costly gas monitoring exercises, including for example scope for some sites to be considered low risk and therefore require no or only limited gas monitoring and/or protection measures.

It includes consideration to the fact that many new developments will include features which offer a good level of ground gas protection regardless of whatever gas risk might exist associated with a site's setting, i.e. features intrinsic to the proposed construction design which are not specifically intended to offer ground gas protection but do so regardless as an incidental consequence of their use. This includes, for example, sites in radon risk areas which will include radon protection measures, or developments which will feature airtight construction; both of which are likely to provide good protection against ground gas ingress. Where a site may have no obvious apparent gas sources, assumptions can also be made about protection measures or small volumes of ground gas present in soil pores.

Assumptions are also made for sites that have less need for monitoring including sites with high carbonate natural soils, organic soils with potential methane content that may be slow to be released (e.g. peat and alluvium), made ground with low organic content, and mine workings flooded or abandoned in the early 20th century.

The report does make mention that monitoring will still normally be required for sites featuring made ground deposits of considerable depth and/or in excess of 6% Total Organic Carbon and sites where shallow mine workings exist or where the site is within 20m of a shaft or adit. The research bulletin provides a table to indicate the likelihood for gas monitoring and/or protection measures to be required for any given site based on common scenarios.

The Current study site, however, does not closely match any of the scenarios set out in Table A1 below and as such a monitoring exercise has been carried out due to probable shallow mine workings.

Table A1 of CL:AIRE RB17: Application of approach to common scenarios

Scenario and source of ground gas	Gas monitoring	Gas protection
Natural soils with no Made Ground e.g. London Clay, Mercia Mudstone, Lias Clay, Chalk, Gault Clay or Glacial Till.	✗	✗
Natural soils with no Made Ground. In an area where radon protection is required.	✗	✓ Gas/radon measures required
Natural soils with low organic content. Less than 1m of Made ground that comprises general infill and car park construction materials e.g. Made ground over London Clay, Mercia Mudstone, Lias, Clay, Chalk, Gault Clay or Glacial Till.	✗	✗
Natural soils with high organic content. Less than 1m of Made ground that comprises general infill and car park construction materials e.g. Alluvium, Peat over natural soils such as London Clay, Mercia Mudstone, Lias, Clay, Chalk, Gault Clay or Glacial Till.	✗	✓ CS3 Gas measures required
Natural Soils with low organic content and 1m to 5m of Made Ground (average <3m) that compromises general infill and car park construction materials. TOC is less than 6% e.g. Made Ground over London Clay, Mercia Mudstone, Lias Clay, Chalk , Gault Clay or Glacial Till.	✗	? Determine gas protection using TOC of Made Ground and Table 2
Old landfill with 6m of older refuse material. Identified as old on historical maps.	✓ determine TOC content and use gas generation modelling to assist with the interpretation of results	? To be determined from gas monitoring data
Old Mine workings that were abandoned before the early 20th century.	? To be determined based on preliminary conceptual model using desk study data	?
Glacial drift deposits over Coal Measures strata with no former mine workings.	✗	✗

3. Gas Risk Conclusions

3.1 Ground Gas

Table 1: Summary of Gas Monitoring Data

Job Number	G25148
Client	G Roberts / A Richards
Site	19 Church Street, Rhos, LL14 2BN

	CH_4 (%)	CO_2 (%)	O_2 (%)
Mininum	0	0.1	14
Maximum	0	1.9	20.7

Borehole	Number of Visits	CH_4 (%)		CO_2 (%)		O_2 (%)		Flow Rate (l/hr)	H_2S (ppm)	CO (ppm)	Atmospheric Pressure (mb)
		Min.	Max.	Min.	Max.	Min.	Max.				
1	6	0	0	0.8	1.2	14	19.9	<0.1	0	2	968
2	6	0	0	0.5	1.9	14.3	20.7	<0.1	0	0	to
3	6	0	0	0.1	0.5	14.3	20.5	<0.1	1	0	1027

The returned gas monitoring results have consistently fallen within the limits for Characteristic Situation 1 (CS1) classifications*. With a maximum GSV of 0.0112l/hr and CO_2/CH_4 levels consistently below trigger levels (5% and 1% respectively), no ground gas protection will be required in the proposed structure(s).

*Modified Wilson and Card Classification, CIRIA C665.

Historical weather records have been consulted to gain an indication of barometric pressure trends. These appear to have been rising on the second, third, fourth and fifth monitoring visits, falling on the sixth visits, and roughly constant on the day of the first visit. No correlation between the elevated CO_2 and atmospheric pressure trends is apparent with the elevated CO_2 levels being returned on days of both rising and falling pressure.

Therefore, on the basis of the monitoring data, the site is concluded to fall into "Characteristic Situation 1" (CS1) of the Modified Wilson and Card classification or "Green" of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665.) meaning that **ground gas protection measures will not be required in the proposed structure(s)**.

Additional

Reference to Tables 2 and 3 (appendix 3 of this report) and BS 8485: 2015 guidance, the proposed development would be classified as a Type "A" building, but with a site classification of CS1 will require no protection measures and hence a mitigation point score of 0 (Table 3).

Please note that these tables are illustrative and further information can be found in BRE 414 and BS8485:2015.

3.2 Radon Gas

The site lies within a radon affected area where between 10%-30% of the properties are above the action level. Therefore, full radon protection is likely to be required for the proposed development.

END OF REPORT

The findings and contents of this (intrusive) Site Investigation Report pertain solely to the study area(s) outlined herein and are based solely on the findings of the excavations undertaken as part of the current exercise unless otherwise stated. The findings and/or recommendations of this report do not take into account any ground conditions that may be present but have hitherto not been encountered and as such further investigation and/or a reconsideration of the findings of this report should be undertaken if such conditions are subsequently encountered or an alternative development plan or land use is subsequently proposed.

This report considers various environmental and/or geological risks posed to the site and/or proposed development and offers advice accordingly as guidance only. The findings of this report will remain valid provided no change of ground or groundwater conditions, either natural or anthropogenic, take place and no warrantee is offered or implied.

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Head Office
Units 3a and 4 Terry Dicken Industrial Estate
Ellerbeck Way
Stokesley
North Yorkshire
TS9 7AE
[redacted]

Nottingham
Unit 4 Bailey Brook Industrial Estate
Amber Drive, Langley Mill
Nottingham
NG16 4BE
[redacted]

Manchester
Suite 26 Atlantic Business Centre
Atlantic Street
Altrincham
WA14 5NQ
[redacted]

APPENDIX 1

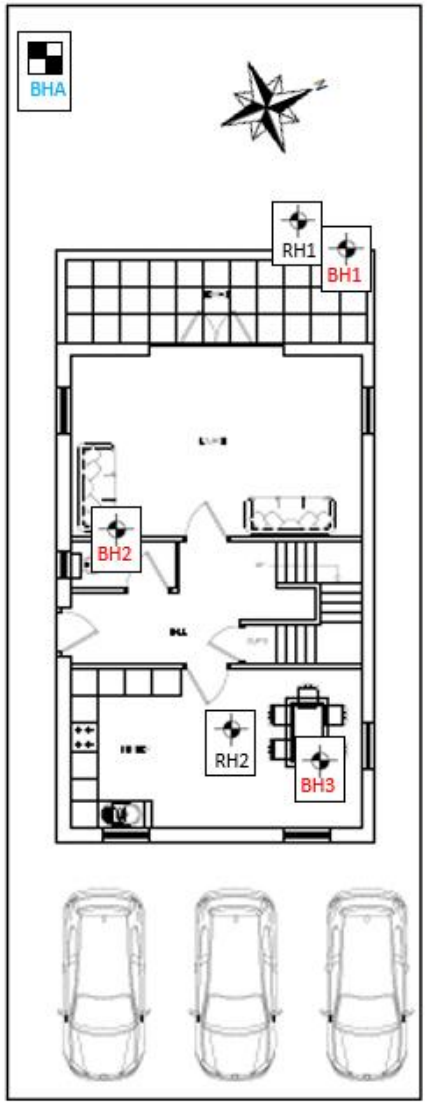
Site Plans

and

Exploratory Hole Logs

GEOINVESTIGATE Ltd.

OUR REF: G25148	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE:20/05/2025	LOCATION: 19 Church Street, Rhos, LL14 2BN	





Key:

- BH1 — Borehole location with gas well
- BHA — Borehole for soakaway testing
- RH1 — Deep Rotary Probe Drilling

GEO INVESTIGATE
Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location: 19 Church Street, Rhos, LL14 2BN
Comments: Borehole for soakaway testing

BHA
Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

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	TURF AND TOPSOIL brown sandy, very gravelly clay. Gravel is fine brick and sandstone	200				Cv kN/m^2			0.25
0.60	MADE GROUND grey slightly clayey, gravelly, highly weathered mudstone. Gravel is fine to coarse pot	400							0.50
	Grey mottled orange highly weathered MUDSTONE. Recovered as gravel.	1400							0.75
									1.00
									1.25
	Inclusion of coal at 1.60m								1.50
									1.75
2.00	Inclusion of coal at 2.00m								2.00
	Borehole terminated at 2.00m for soakaway testing								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 2.00 mbgl
Borehole remained open and dry 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

BHA

GEO INVESTIGATE

Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location: 19 Church Street, Rhos, LL14 2BN
Comments:

BH 1

Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

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	TURF AND TOPSOIL brown, sandy, gravelly clay. Gravel is fine to coarse sandstone and pot	200				Cv kN/m^2			0.25
0.60	MADE GROUND grey, gravelly, highly weathered mudstone recovered as gravel. Gravel of coarse pot	400							0.50
1.00	Grey mottled orange highly weathered MUDSTONE recovered as gravel	400							0.75 1.00
1.80	Grey mottled black highly weathered MUDSTONE Coal inclusion at 1.50m	800							1.25 1.50 1.75
2.00	Grey mottled orange highly weathered MUDSTONE	200							2.00
3.40	Light brown and orange gravelly, highly weathered MUDSTONE. Gravel is coarse and cobbles of sandstone	1400							2.25 2.50 2.75 3.00 3.25 3.40
	Borehole terminated at 3.40m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.40 mbgl
Borehole remained open and dry on completion
Gas well installed to 3.40m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH 1

GEO INVESTIGATE

Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location:
Comments:

BH 2

Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TURF AND TOPSOIL brown sandy, gravelly clay. Gravel is fine to coarse brick, pot and sandstone	400				Cv kN/m^2			0.25
0.40									0.50
	Grey highly weathered MUDSTONE								0.75
	Coal inclusion at 0.80m	1400							1.00
									1.25
									1.50
1.80	Coal inclusion at 1.80m								1.75
	Orange slightly gravelly highly weathered MUDSTONE recovered as clay. Gravel is fine to coarse weathered mudstone	1200							2.00
									2.25
									2.50
									2.75
3.00									3.00
	Orange clayey highly weathered MUDSTONE recovered as gravel. Cobbles of sandstone noted	400							3.25
3.40									3.40
	Borehole terminated at 3.40m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.40 mbgl
Borehole remained open and dry on completion
Gas well installed to 3.40m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH 2

GEO INVESTIGATE

Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location:
Comments:

BH 3

Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

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	TURF AND TOPSOIL brown sandy, gravelly, clay. Gravel is fine to coarse brick and mudstone	200				Cv kN/m^2			0.25
1.20	MADE GROUND Grey mottled black, gravelly, highly weathered mudstone. Gravel is fine brick	1000							0.50 0.75 1.00
1.80	Orange mottled brown slightly gravelly, hightly weathered MUDSTONE recovered as clay. Gravel is fine to coarse coal and sandstone	600							1.25 1.50 1.75
3.10	Grey mottled orange highly weathered MUDSTONE Sandstone cobbles present	1300							2.00 2.25 2.50 2.75 3.00 3.10
	Borehole terminated at 3.10m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.10 mbgl
Borehole remained open and dry on completion
Gas well installed to 3.10m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH 3

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 1

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
2.10	TURF / brown DRIFT.	2,100			
6.40	Light yellowish brown MUDSTONE. >Becoming grey from 4.90m	4,300			2.50 5.00
16.50	Grey SILTSTONE.	10,100			7.50 10.00 12.50 15.00
17.80	Darl grey SHALEY COAL / COALEY SHALE. Very weak.	1,300			17.50
23.10	Grey MUDSTONE.	5,300			20.00 22.50
	Grey SILTSTONE. Rotary hole continued on page 2	6,900			25.00

Remarks:

Casing to 3.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 1

Drilled by: AM
Logged by: AM

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 1

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
	Grey SILTSTONE.	6,900			27.50
30.00				Full Flush	30.00
	Rotary hole terminated at 30.00m				

Remarks:

Casing to 3.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 1

Drilled by: AM
Logged by: AM

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 2

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
2.30	TURF / brown DRIFT.	2,300			2.50
6.70	Light yellowish brown MUDSTONE. >Becoming grey from 5.10m	4,400			5.00
16.60	Grey SILTSTONE.	9,900			7.50 10.00 12.50 15.00
17.80	Dark grey SHALEY COAL / COALEY SHALE. Very weak.	1,200			17.50
23.40	Grey MUDSTONE.	5,600			20.00 22.50
	Grey SILTSTONE. Rotary hole continued on page 2	6,600			25.00

Remarks:

Casing to 2.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 2

Drilled by: AM
Logged by: AM

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 2

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
	Grey SILTSTONE.	6,600			27.50
30.00				Full Flush	30.00
	Rotary hole terminated at 30.00m				

Remarks:

Casing to 2.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 2

Drilled by: AM
Logged by: AM

APPENDIX 2

Complete Gas Monitoring Results

Job Number	G25148
Client	G Roberts / A Richards
Site	19 Church Street, Rhos, LL14 2BN
Instrument	GFM 406 + 410

Key	
WL	Water Logged
<0.1	Below Detectable Levels
NB	No Bung
WD/I	Well destroyed / inaccessible

Monitoring Personal	Carl	Date	02/06/2025	Weather	Cloudy	Temperature	17°c	Starting Pressure		989	Trend	Steady
Monitoring Point	Well condition	Flow range (l/hr)	Atmospheric Pressure (mb)	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water Level (mbgl)	Depth of Well (m)	Volume of gas in well (m^3)	Hydrogen Suphide (ppm)	Carbon Monoxide (ppm)
BH1	Fine	<0.1	989	0.0	0	1.2	15.2	0	3.4		0	0
BH2	Fine	<0.1	989	0.0	0	0.9	15.5	0	3.4		0	0
BH3	Fine	<0.1	989	0.0	0	0.2	15.6	0	3.1		0	0

Monitoring Personal	Connor	Date	13/06/2025	Weather	Sunny	Temperature	19°c	Starting Pressure		1027	Trend	Rising
Monitoring Point	Well condition	Flow range (l/hr)	Atmospheric Pressure (mb)	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water Level (mbgl)	Depth of Well (m)	Volume of gas in well (m^3)	Hydrogen Suphide (ppm)	Carbon Monoxide (ppm)
BH1	Fine	<0.1	1027	0.0	0	1.0	15.8	0	3.4		0	0
BH2	Fine	<0.1	1027	0.0	0	0.5	15.9	0	3.4		0	0
BH3	Fine	<0.1	1027	0.0	0	0.1	15.9	0	3.1		0	0

Monitoring Personal	Jason	Date	02/07/2025	Weather	Sunny	Temperature	20°c	Starting Pressure		996	Trend	rising
Monitoring Point	Well condition	Flow range (l/hr)	Atmospheric Pressure (mb)	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water Level (mbgl)	Depth of Well (m)	Volume of gas in well (m^3)	Hydrogen Suphide (ppm)	Carbon Monoxide (ppm)
BH1	Fine	<0.1	996	0.0	0	0.8	14.8	0	3.4		0	2
BH2	Fine	<0.1	996	0.0	0	0.7	15.0	0	3.4		0	0
BH3	Fine	<0.1	996	0.0	0	0.2	15.1	0	3.1		0	0

Monitoring Personal	RG	Date	16/07/2025	Weather	Clear	Temperature	17°c	Starting Pressure		995	Trend	rising
Monitoring Point	Well condition	Flow range (l/hr)	Atmospheric Pressure (mb)	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water Level (mbgl)	Depth of Well (m)	Volume of gas in well (m^3)	Hydrogen Suphide (ppm)	Carbon Monoxide (ppm)
BH1	Fine	<0.1	995	0.0	0	0.9	14.0	0	3.4		0	0
BH2	Fine	<0.1	995	0.0	0	0.6	14.3	0	3.4		0	0
BH3	Fine	<0.1	995	0.0	0	0.1	14.3	0	3.1		0	0

Monitoring Personal	RG	Date	04/09/2025	Weather	Clear	Temperature	15	Starting Pressure		974	Trend	rising
Monitoring Point	Well condition	Flow range (l/hr)	Atmospheric Pressure (mb)	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water Level (mbgl)	Depth of Well (m)	Volume of gas in well (m^3)	Hydrogen Suphide (ppm)	Carbon Monoxide (ppm)
BH1	Fine	<0.1	974	0.0	0	0.8	19.9	0	3.4		0	0
BH2	Fine	<0.1	974	0.0	0	0.5	20.7	0	3.4		0	0
BH3	Fine	<0.1	974	0.0	0	0.4	20.5	0	3.1		0	0

Monitoring Personal	JP	Date	11/09/2025	Weather	Cloudy	Temperature	14	Starting Pressure		968	Trend	falling
Monitoring Point	Well condition	Flow range (l/hr)	Atmospheric Pressure (mb)	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water Level (mbgl)	Depth of Well (m)	Volume of gas in well (m^3)	Hydrogen Suphide (ppm)	Carbon Monoxide (ppm)
BH1	Fine	<0.1	968	0.0	0	1.0	18.9	0	3.4		0	0
BH2	Fine	<0.1	968	0.0	0	1.9	17.6	0	3.4		0	0
BH3	Fine	<0.1	968	0.0	0	0.5	20.0	0	3.1		1	0

APPENDIX 3

Additional Notes on Gas Classification and Mitigation Options

New guidance published in BS 8485: 2015 has indicated a new system of design and implementation of gas protection measures. The new guidance works to identify the risk to a site using the sensitivity of the receptors and the risk associated with potential sources of hazardous ground gas. The most applicable building type for this site is inferred to be Type A as shown in table 3 below.

Table 2: Building types for site classification as per BS 8485:2015

	High Risk		Medium Risk	Low Risk
	Type A Building	**Type B Building**	**Type C Building**	**Type D Building**
Ownership	Private	Private or commercial/public, possible multiple	Commercial/public	Commercial/public
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room sizes	Small	Small/medium	Small to large	Large industrial/retail park style

Building type highlighted blue considered most applicable to current study site.

Using the building types listed in Table 2 above, BS 8485:2015 has incorporated a scoring system dependent on building type and the characteristic situation of the site in order to select the appropriate measures for hazardous gas protection. This provides a Gas protection Score (assigned using Table 3 below).

Once the required gas protection score has been determined, various potential protective measures can be considered for inclusion in the proposed structures, each of which have their own gas protection score. These measures can be combined and their gas protection scores summed to match or exceed the required gas protection score determined by Table 3. These measures include structural barriers, ventilation measures and gas resistant membranes which are graded separately within the points system. In order to ensure sufficient measures are in place; one measure is normally selected from each category (see tables for gas protection).

Table 3: Gas Protection Scoring by CS Level and Building Type

Characteristic Situation	Minimum gas protection score (points)			
	High Risk		Medium Risk	Low Risk
	Type A Building	**Type B Building**	**Type C Building**	**Type D Building**
CS1	0	0	0	0
CS2	3.5	3.5	2.5	1.5
CS3	4.5	4	3	2.5
CS4	6.5	5.5	4.5	3.5
CS5		6.5	5.5	4.5
CS6			7.5	6.5

Table A: Gas Protection Scores – Ventilation Protection Measures

Protection element/system	Score	Comments
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.
(b) Passive sub floor dispersal layer: Very good performance: Good performance: Media used to provide the dispersal layer are: • Clear void • Polystyrene void former blanket • Geocomposite void former blanket • No-fines gravel layer with gas drains • No-fines gravel layer	 2.5 1.5	Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation should be designed to meet at least "good performance", see Annex B
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex B.
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000*, *Approved Document F* [9].

Table B: Gas Protection Scores – Structural Barriers

Floor and substructure design (see Annex A)	Score[A]
Precast suspended segmental subfloor (i.e. beam and block)	0
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations 1 or 1.5	1 or 1.5[B]
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing [C]	2
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing [C)]	2.5

A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed.

B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see **A.2.2.2**).

C) The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (see **C.3**, Note 4).

Table C: Gas Protection Score – Gas Resistant Membranes

Protection element/system	Score	Comments
Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and verified in accordance with CIRIA C735 [N1]	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m2 for polyethelene) reinforced membrane (virgin polymer) meets the performance criteria in Table 7 (see **C.3**). If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.

Table D: Gas protection measures for low-rise housing development based upon NHBC Traffic Light system

Traffic Light Classification	Protection measures required
Green	Negligible gas regime identified and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low – level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be prescribed as per BRE Report 414. Ventilation of sub – floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high – level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be prescribed as per BRE Report 414. Gas membranes should always be fitted by a specialist contractor. As with Amber 1, Ventilation of sub – floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not be normally acceptable without a further gas risk assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

*Table is for illustration only; please see BRE 414 for more information on designing appropriate measures. (BRE 414 - Protective measures for housing on gas-contaminated land)