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Gas Monitoring Addendum Report

LOCATION	Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF
ISSUE DATE	January 2017
FOR	Holloway Jennings Consulting Engineers
CLIENT REF.	
OUR REF.	G16304c

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1.Final Gas Monitoring Results

The initial results of gas monitoring in the shallow boreholes at the site are presented in Table 1 below.

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 (G16304b).

Table 1 Summary of Initial Gas Monitoring Data

Borehole	Number of Visits	CH_4 (%)		CO_2 (%)		O_2 (%)		Flow Rate (l/hr)	Atmospheric Pressure (mb)
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum		
BH1	6	0	0.2	0	0.4	18.6	20.6	<0.1	995
BH5	6	0	0.1	0	0.4	19.6	20.3	<0.1	to
BH6	6	0	0.3	0.1	1.2	18.8	20.2	<0.1	1012

The results of gas levels recorded at the site at pressures of between 995mb and 1012mb returned normal levels of O_2 between 18.6% and 20.6%, with a CO_2 content of between 0.0% and 1.2% and CH_4 content of upto 0.3%. Gas flow rates were below detectable limits (<0.01lt/hr) on each monitoring occasion.

On the basis of the of the above gas results, the sections below will review the potential risk to site and ground conditions encountered. This information will be utilised with CL:AIRE Research Bulletin 17 to provide an comprehensive overview of the gas risk and associated classification for the site.

2.Review of sources and ground conditions encountered.

2.1 Review of sources

The earlier Phase 1 Desk Study Report suggested that the likely presence of made/in-filled ground adjacent to site (former quarry) and underground coal measures (likely a lower risk) are likely to provide the most plausible source for hazardous gas to exist at site.

The extract of the 1:50,000 Solid & Drift geological maps (BGS Sheet 87 - Barnsley) indicate the site to be underlain by Grenoside Sandstone with the Pennine Lower Coal Measures to the North and outside the site boundary. No superficial geology has been recorded on site.

BGS borehole records within the area indicate the site is likely to be underlain by shallow bedrock with the sandstone outcropping noted from the adjacent quarry to the south. Additional boreholes suggest clayey gravel and shale with hard rock can be encountered to 11.80m with sandstone directly beneath this.

The site is potentially underlain by the Better Bed Coal Seam with a fault noted to the North of the site.

2.2 Review of ground conditions encountered

In general, BH1 to BH8 encountered similar ground conditions comprising turf underlain by topsoil to depths of between 0.20m and 0.30m underlain generally by medium dense natural slightly clayey gravelly sand to depths of between 0.45m and 1.10m.

Below the gravelly sand stratum, BH1, BH2, BH5, BH7 and BH8 encountered a horizon of moderately strong weathered silty sandstone bordering on sandy siltstone rock to depths of between 1.20m and 1.70m. Below this moderately strong coarse grained sandstone was encountered.

In BH3, BH4 and BH6 the weathered silty sandstone / sandy siltstone was absent, and the soil was directly underlain by the coarse-grained sandstone.

The trial pits encountered similar conditions to the boreholes, with thin turf and topsoil encountered to depths of between 0.10m and 0.25m.

Below the turf and topsoil TPA moderately strong silty sandstone / sandy siltstone commenced below 0.40m, whilst in TPB the aforementioned rock was found directly below the turf and topsoil. In TPC made ground comprising sandy gravel and cobbles of sandstone was found between depths of 0.20m and 0.50m with coarse grained sandstone commencing below this. In TPD a thin horizon of weak to moderately strong weathered sandy siltstone commenced below 0.35m underlain by moderately strong silty sandstone to 0.80m. TPE was similar to TPB where moderately strong silty sandstone / sandy siltstone rock was encountered below the turf and topsoil.

3.CL:AIRE Research Bulletin 17

A research bulletin posted by Contaminated Land – Applications in Real Environments (CL:AIRE) has reviewed and presented potential scope for sites that can be considered low risk and therefore require no to limited gas testing.

It considers that many sites, including sites in Radon risk areas, are likely to have Radon measures or air tight construction has led to measures that are likely to provide good measures against ground gas ingress. This is specific to sites that may have no sources, assumptions can be made about protection measures or small volumes of ground gas present in soil pores.

Assumptions are made for sites that have less need for monitoring include sites with high carbonate natural soils, organic soils with potential methane content that may be slow to be released (eg 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 made ground values exceeding 6% Total Organic Carbon and sites where shallow mine workings exist at the surface or where the site is within 20m of a shaft or adit would need monitoring. The bulletin provides the table to indicate requirements for gas testing based on common scenarios. The scenario most likely to fit with the current site is highlighted:

Table A1: Application of approach to common scenarios

Scenario and source of ground gas	Gas monitoring	Gas protection
Natural soils with no Made Ground eg 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 eg 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 eg 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% eg 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.	✗	✗

4. Gas Risk Conclusions

Given there was no likelihood of highly organic soils and limited made ground at site (only located in a singular trial pit, less then 1m in depth and contained low gas generating materials), it is likely that there is significantly reduced potentially for a hazards gas risk to exist at site. It is not likely that this site has been quarried and backfilled due to the shallow nature of the bedrock encountered and the previous phase 1 report (G16304a) found that coal mining was unlikely to have occurred at site. Never the less, six (6) gas monitoring visits were conducted at site and given support from the CL:AIRE research bulletin, the conclusions in line with the Modified Wilson and Card classification and NHBC Traffic Light System can be considered to be sufficient for the hazardous gas risk present at site.

Six (6) set of gas monitoring returned results which indicate that the gassing regime of the ground falls within Characteristic Situation 1" 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.)

Consequently on the basis of these results, gas measures characterisation according to the above classifications should be incorporated into the construction of the new buildings at the site.Please see illustrative tables of common measures below for classification and associated measures for the above characterisation schemes. Please note that these tables are illustrative and further information can be found in BRE 414.

Table 3: Typical scope of protective measures for NHBC Modified Wilson and Card classification

Characteristic situation	Residential building (Not low – rise traditional housing)[1]		Office/commercial/industrial development	
	Number of levels of protection	Typical scope of protective measures	Number of levels of protection	Typical scope of protective measures
1	None	No special precautions	None	No special precautions
2	2	A) Reinforced concrete cast in situ floor slab (suspended, non-suspended or a raft) with at least 1200g DPM[9] and underfloor venting. B) Beam and block or pre-cast concrete and 2000g DPM/reinforced gas membrane and underfloor venting. All joints and penetrations sealed.	1 to 2	A) Reinforced concrete cast in situ floor slab (suspended, non-suspended or a raft) with at least 1200g DPM[9]. B) Beam and block pre-cast concrete slab and minimum 2000g DPM/reinforced gas membrane. C) Possibly underfloor venting or pressurisation in combination with A) or B) depending on use. All joints and penetrations sealed.
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space.	1 to 2	All types of floor slab as above. All joints and penetrations sealed. Minimum 2000g/reinforced gas proof membrane and passively ventilated sub-space or positively pressurised underfloor sub-space.
4	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space, oversite capping or binding and in ground venting layer.	2 to 3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility.
5	4	Reinforced concrete cast in situ floor slab (suspended, non – suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space, oversite capping and in ground venting layer and in ground venting wells or barriers.	3 to 4	Reinforced concrete cast in situ floor slab (suspended, non – suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility. In ground venting wells or barriers.
6	5	Not suitable unless gas regime reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design.	4 to 5	Reinforced concrete cast in situ floor slab (suspended, non – suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and actively ventilated or positively pressurised underfloor sub-space with monitoring facility, with monitoring. In ground venting wells and reduction of gas regime.

*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)

Table 4: 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 irsk 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)

END OF REPORT



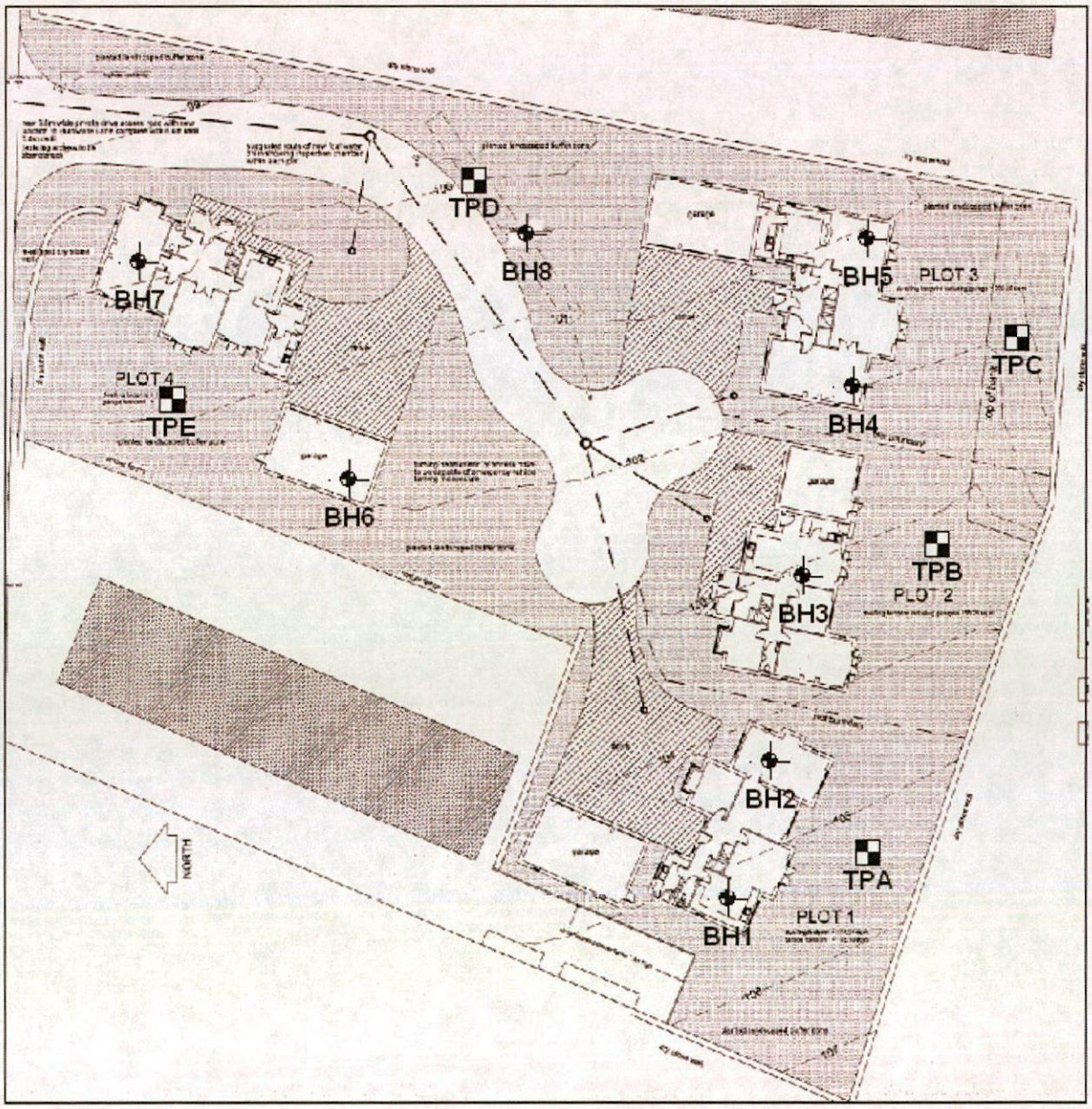
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APPENDIX 1

SITE PLAN

GEOINVESTIGATE Ltd.

OUR REF:G16304	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE:08/09/16	LOCATION: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF	



APPENDIX 2

COMPLETE GAS MONITORING RESULTS

Job Number	G16304
Client	Holloway Jennings Consulting Engineers
Site	Huthwaite lane
Instrument	GFM 406 and GFM 410

Monitoring personal	BG	Date	30/09/2016	Weather	Sunny with a breeze		Temperature		15°C		
Monitoring point	Flow range (l/hr)	Atmospheric pressure	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water level (mbgl)	Depth of well (m)	Volume of gas in well (m3)	Hydrogen Sulphide (%)	Carbon Monoxide (%)
BH1	<0.1	995	0.2		0.1	20.4	dry				
BH5	<0.1	995	0.1		0.1	20.3	dry				
BH6	<0.1	995	0.3		1.2	18.8	dry				

Monitoring personal	BG	Date	26/09/2016	Weather	Overcast		Temperature		14°C		
Monitoring point	Flow range (l/hr)	Atmospheric pressure	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water level (mbgl)	Depth of well (m)	Volume of gas in well (m3)	Hydrogen Sulphide (%)	Carbon Monoxide (%)
BH1	<0.1	997	0		0.4	18.6	dry				
BH5	<0.1	997	0		0.1	19.9	dry				
BH6	<0.1	997	0		0.2	19.7	dry				

Monitoring personal	PM	Date	09/12/2016	Weather	Overcast		Temperature		8°C		
Monitoring point	Flow range (l/hr)	Atmospheric pressure	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water level (mbgl)	Depth of well (m)	Volume of gas in well (m3)	Hydrogen Sulphide (%)	Carbon Monoxide (%)
BH1	<0.1	998	0		0	19.6	dry				
BH5	<0.1	998	0		0	19.7	dry				
BH6	<0.1	998	0		0.2	19	dry				

Monitoring personal	PM	Date	14/12/2016	Weather	Cloudy		Temperature		10°C		
Monitoring point	Flow range (l/hr)	Atmospheric pressure	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water level (mbgl)	Depth of well (m)	Volume of gas in well (m3)	Hydrogen Sulphide (%)	Carbon Monoxide (%)
BH1	<0.1	1012	0		0	19.5	dry				
BH5	<0.1	1012	0		0	19.6	dry				
BH6	<0.1	1012	0		0.1	19.6	dry				

Monitoring personal	PM	Date	06/01/2017	Weather	Rain and wind		Temperature		20°C		
Monitoring point	Flow range (l/hr)	Atmospheric pressure	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water level (mbgl)	Depth of well (m)	Volume of gas in well (m3)	Hydrogen Sulphide (%)	Carbon Monoxide (%)
BH1	<0.1	1002	0		0.3	20.6	dry				
BH5	<0.1	1002	0		0.4	20	dry				
BH6	<0.1	1002	0		0.7	20.2	dry				

Monitoring personal	PM	Date	17/01/2017	Weather	Overcast		Temperature		7°C		
Monitoring point	Flow range (l/hr)	Atmospheric pressure	Methane % (v/v)	Methane % LEL	Carbon dioxide % (v/v)	Oxygen % (v/v)	Water level (mbgl)	Depth of well (m)	Volume of gas in well (m3)	Hydrogen Sulphide (%)	Carbon Monoxide (%)
BH1	<0.1	1000	0		0.3	20	dry				
BH5	<0.1	1000	0		0.3	20	dry				
BH6	<0.1	1000	0		0.6	19.9	dry				