

LR/NA/4513/rp-200123

20th January 2023

Mr. Ralph Pedersen
Development Director
Vita
The Box, Horseshoe Farm
Elkington Way
Alderley Edge
Cheshire
SK9 7GU

Dear Ralph

RE: House of Social, First Street Ground Gas Addendum

We have now completed all 6 rounds of Ground Gas monitoring at Plot 10B First Street in Manchester. This letter presents an overview to the findings of Ground Gas monitoring undertaken during the period 16th November 2022 through 5th January 2023.

Background Information

The Scope of Ground Gas monitoring was designed to take into account the sites previous operations, the proposed site development and structure layout, and has been undertaken in accordance with BS8576-2013 and CIRIA C665. The risk assessment has been founded on the following Conceptual Exposure Model reviewed below in Table 1.

Table 1. Ground Gas Conceptual Model

Source	Pathway	Receptor
Site-wide made ground deposits from historic development. Potentially containing ground gasses (CH ₄ , CO ₂ , H ₂ S, CO) and reduced levels of O ₂ .	Ground Gas migration and entry into buildings via structure defects or construction joints in floor slabs and/or service entry points, resulting in accumulation and explosion/ poisoning/ asphyxiation.	Future site/construction workers; Future site employees/occupiers of future buildings.

Risk Assessment Assumptions

It is considered there will be no significant change to the existing site Ground Gas levels as a result of the development, and that the proposed structures will undergo traditional construction including a ground bearing floor slab. While it is anticipated that the ground floor will be constructed beneath existing site levels in the southern part of the site, owing to changes in elevation onsite, significant basements are not anticipated.

Risk Assessment methodology according to CIRIA 665 requires classification of developments as Situation A or Situation B, where Situation B comprises Low rise housing with a ventilated underfloor void and is subject to different assessment methodology, while Situation A includes all other developments. This development is classified as Situation A.

Ground Gas Monitoring Results Overview

A total of 6 rounds of Ground Gas monitoring has been completed, the results from which are appended to this letter. A summary of results is reported below:

- Maximum CH₄ Value = 0% volume
- Maximum CO₂ Value = 2.2% volume (WS105) on 16th November 2022
- Minimum O₂ Value = 12.6% volume (WS102) on 23rd November 2022
- Maximum flow rate = 1.3l/s (RBH101) on 23rd November 2022
- H₂S and CO values 0ppm for all measurements
- Variable atmospheric pressures between 981 and 1025Mb

Monitoring works were completed during the period between 16th November 2022 and 5th January 2023 under varying atmospheric pressure conditions including periods of falling and rising pressure. The works were completed using a GFM 435 portable gas analyser which was suitably calibrated by the supplier throughout the duration of monitoring works, the calibration certification for which is presented in Appendix B.

Ground Gas Preliminary Risk Assessment

A standard Ground Gas risk assessment has been undertaken to consider the risks posed to future site users from CO₂ and CH₄. The assessment undertaken followed guidelines in accordance with the principles outlined in the CIRIA guidance document (Assessing risk posed by hazardous ground gases to buildings, CIRIA C665).

The method used to categorise the site ground gas regime is covered in the CIRIA C665 document and defines gas concentrations and borehole flow rates to calculate a gas volume flow (Gas Screening Value) and classify a characteristic situation.

Gas Screening Values (GSVs) have been calculated using the formula:

$$\text{GSV (l/hr)} = \text{borehole flow rate (l/hr)} \times \text{gas concentration (v / v \%)} / 100$$

This calculation has been applied to the maximum Carbon Dioxide and flow rates recorded of the course of monitoring to represent a reasonable worst-case scenario for the entire site. In most cases, ground gas measurements from the site found no change in flow rates which remained at 0.0% for most of the six measurement visits. Where this has occurred a nominal flow rate of 0.1l/hr has been adopted for calculation purposes.

Table 2. Summary of GSVs

Monitoring Visit	Highest Flow Rate (l/hr)	Highest CO ₂ (% v / v)	CO ₂ GSV (l/hr)	Characteristic Situation*
Visit 1	0.1	2.2	0.0022	1 (Very Low Risk)
Visit 2	1.3	1.7	0.0221	1 (Very Low Risk)
Visit 3	0.0	0.3	0.01	1 (Very Low Risk)
Visit 4	0	0	0.00	1 (Very Low Risk)
Visit 5	0	0	0.00	1 (Very Low Risk)
Visit 6	0	0	0.00	1 (Very Low Risk)
*Where Characteristic Situation 2 < 0.07l/hr				

In addition to the above, CIRIA665 Table 8.5 also recommends that Characteristic Situation 2 (CS2) is adopted in instances where methane and carbon dioxide concentrations typically exceed the thresholds of 1% and 5% respectively. This recommendation is not applicable in this instance.

It is also noted that recorded oxygen levels at the site ranges between 12.3 and 21.6%v/v. Comparable oxygen concentrations are not uncommon in gas monitoring. However, CIRIA 665 notes that physiological effects will occur should oxygen concentration deplete below 18%v/v in confined spaces. Assuming no basements and below ground structures are present in the future then the risks from reduced oxygen to human health in the future development are considered to be Low. However, during the construction phase confined spaces protocols for the safety of personnel should always be used where human entry into excavations is to be undertaken as low oxygen conditions may be present.

Recommendations and Conclusions

The worst-case scenario for the site corresponds with Characteristic Situation 1 (very low risk), with 'typical Made Ground' the likely source of any ground gas generation. The typical scope of ground gas protection measures recommended for Residential uses under this characteristic level, as detailed in CIRIA 665, should include:

- Characteristic situation 1 – No special precautions

We trust the above is satisfactory, however please do not hesitate to contact me should you require any further information.

Copies of this addendum should be submitted to the Local Authority for consideration.

Yours sincerely



Linden Richardson
Senior Geo-environmental Engineer
 On behalf of R&C Consulting

Enclosed:
 Appendix A: Gas Monitoring Results
 Appendix B: Equipment Calibration Certificates

 Civil, Structural & Environmental Engineers Commercial Wharf, 6 Commercial St, MCR, M15 4PZ	Job No:	4513	Site:	Plot 10b First Street
	Date:	16/11/2022	Client:	Vita
	Engineer:	JV	Equipment:	GA5000

	2 Days Prior	1 Day Prior	On day of Monitoring
Weather Conditions:	Overcast	Raining	Overcast
Barometric Pressure Trend:	Falling	Falling	Falling
Surface Ground Conditions:	Dry		

VISIT ONE	Start	Finish
Time:	0940	1206
Barometric Pressure:	987	
Background Oxygen:	20.9	20.9

Monitoring Point	Flow Rate (l/h)	Gas Concentration											Groundwater			Remarks
		Peak						Flow Rate (l/h)	Steady					Depth to Water	Depth to Base	
BH N°	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)	CH ₄ %	CO ₂ %		O ₂ %	LEL %	H ₂ S/C O (ppm)	Depth to Water	Depth to Base			Head of water
WSI01	0	0	0.1	20.7	0	0/0	0	0	0.1	20.7	0	0/0	1.13	1.18	0.05	
WSI02	0.1	0	0.1	17.7	0	0/0	0	0	0	18	0	0/0	3.00	3.20	0.20	
WSI05	0	0	2.2	16.9	0	0/0	0	0	2.2	16.9	0	0/0	Dry	2.89	N/A	
WSI06	0	0	0.1	20.8	0	0/0	0	0	0.1	20.8	0	0/0	Dry	1.28		
RBH101	0	0	0.1	21.6	0	8/0	0	0	0.1	21.6	0	8/0	4.94	18.86	13.92	
RBH102	0.1	0	0.2	16.3	0	76/0	0.1	0	0.2	16.3	0	45/0	6.38	11.34	4.96	

Comments:

 Civil, Structural & Environmental Engineers Commercial Wharf, 6 Commercial St, MCR, M15 4PZ	Job No:	4513	Site:	Plot 10b First Street
	Date:	23/11/2022	Client:	Vita
	Engineer:	JV	Equipment:	GA5000

	2 Days Prior	1 Day Prior	On day of Monitoring
Weather Conditions:	Rain	Cloudy	Rain
Barometric Pressure Trend:	Falling	Rising	Fluctuating
Surface Ground Conditions:	Wet		

VISIT TWO	Start	Finish
Time:	1038	1528
Barometric Pressure:	981	983
Background Oxygen:	21.1	21.1

Monitoring Point	Flow Rate (l/h)	Gas Concentration											Groundwater			Remarks
		Peak						Steady					Depth to Water	Depth to Base	Head of water	
BH N°		CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)	Flow Rate (l/h)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)				
WSI01	0.1	0	0.1	21.4	0	0/0	0	0	0.1	21.4	0	0/0	0.96	1.2	0.24	
WSI02	0.1	0	0.1	12.6	0	0/0	0	0	0.1	12.6	0	0/0	2.9	3.2	0.3	
WSI05	0	0	0.2	19.6	0	0/0	0	0	0.1	19.6	0	0/0	Dry	2.89	N/A	
WSI06	0	0	0.1	17.3	0	0/0	0	0	0.1	17.3	0	0/0	N/A	N/A	N/A	Install damaged bung not removable.
RBH101	1.3	0	0.2	20.6	0	10/0	1.3	0	0.2	20.6	0	7/0	4.98	18.85	13.87	
RBH102	0	0	1.7	14.4	0	6/0	0	0	0.6	14.4	0	0/0	6.59	11.32	4.73	

Comments:

 Civil, Structural & Environmental Engineers Commercial Wharf, 6 Commercial St, MCR, M15 4PZ	Job No:	4513	Site:	Plot 10b First Street
	Date:	02/12/2022	Client:	Vita
	Engineer:	RM	Equipment:	GFM435

	2 Days Prior	1 Day Prior	On day of Monitoring
Weather Conditions:	Rising	Steady	Steady
Barometric Pressure Trend:	Cloudy	Cloudy	Cloudy
Surface Ground Conditions:	Dry		

VISIT THREE	Start	Finish
Time:	0900	1030
Barometric Pressure:	1025	1025
Background Oxygen:	20.9	20.9

Monitoring Point	Flow Rate (l/h)	Gas Concentration											Groundwater			Remarks
		Peak						Steady					Depth to Water	Depth to Base	Head of water	
BH N°		CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)	Flow Rate (l/h)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)				
WSI01	0	0	0	21	0	0/0	0	0	0	21	0	0/0	Dry	1.2	N/A	
WSI02	0	0	0	18	0	0/0	0	0	0	18	0	0/0	Dry	3.2	N/A	
WSI05	0	0	0.2	20	0	0/0	0	0	0.1	20	0	0/0	Dry	2.89	N/A	
WSI06	0	0	0.1	17.3	0	0/0	0	0	0.1	17.3	0	0/0	N/A	N/A	N/A	Install damaged bung not removable.
RBH101	0	0	0	20.2	0	0/0	0	0	0	20.2	0	0/0	5.57	18.85	13.28	
RBH102	0	0	0.3	16	0	0/0	0	0	0.3	16	0	0/0	6.7	11.32	4.62	

Comments:

 Civil, Structural & Environmental Engineers Commercial Wharf, 6 Commercial St, MCR, M15 4PZ	Job No:	4513	Site:	Plot 10b First Street
	Date:	14/12/2022	Client:	Vita
	Engineer:	RM	Equipment:	GFM435

	2 Days Prior	1 Day Prior	On day of Monitoring
Weather Conditions:	Cloudy	Cloudy	Cloudy
Barometric Pressure Trend:	Steady	Falling	Rising
Surface Ground Conditions:	Frozen		

VISIT FOUR	Start	Finish
Time:	1500	1545
Barometric Pressure:	1000	1001
Background Oxygen:	20.6	20.6

Monitoring Point	Flow Rate (l/h)	Gas Concentration											Groundwater			Remarks
		Peak						Steady					Depth to Water	Depth to Base	Head of water	
BH N°		CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)	Flow Rate (l/h)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)				
WSI01	0	0	0	11.1	0	0/0	0	0	0	11.1	0	0/0	Dry	1.2	N/A	
WSI02	0	0	0	20.5	0	0/0	0	0	0	20.5	0	0/0	WAB	3.2	N/A	
WSI05	Could Not Access / Monitor															Could not located assumed buried beneath stockpile
WSI06																Could not access (Bung missing)
RBH101	-16.4	0	0	20.2	0	0/0	0	0	0	20.2	0	0/0	5.57	18.96	13.39	
RBH102	Could Not Access															Could not access (Well full of frozen soil)

Comments:	WAB = Wet at bottom
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 Civil, Structural & Environmental Engineers Commercial Wharf, 6 Commercial St, MCR, M15 4PZ	Job No:	4513	Site:	Plot 10b First Street
	Date:	19/12/2022	Client:	Vita Group
	Engineer:	RM	Equipment:	GFM435

	2 Days Prior	1 Day Prior	On day of Monitoring
Weather Conditions:	Raining	Raining	Overcast
Barometric Pressure Trend:	Rising	Falling	Fluctuating
Surface Ground Conditions:	Wet		

VISIT FIVE	Start	Finish
Time:	1300	1400
Barometric Pressure:	995	996
Background Oxygen:	20.9	20.9

Monitoring Point	Flow Rate (l/h)	Gas Concentration											Groundwater			Remarks
		Peak						Steady					Depth to Water	Depth to Base	Head of water	
BH N°		CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)	Flow Rate (l/h)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)				
WSI01	0	0	0	18.5	0	0/0	0	0	0	18.5	0	0/0	Dry	3.22	N/A	
WSI02	0	0	0	20.4	0	0	0	0	0	20.4	0	0/0	1.15	1.2	0.05	
WSI05	Unable to Monitor												Dry	2.9	N/A	Bung missing
WSI06													Unable to Monitor			Bung tap missing & bung inaccessible
RBH101													5.52	18.85	13.33	Well flooded
RBH102													7.1	11.32	4.22	Bung missing

Comments:

 Civil, Structural & Environmental Engineers Commercial Wharf, 6 Commercial St, MCR, M15 4PZ	Job No:	4513	Site:	Plot 10b First Street
	Date:	05/01/2023	Client:	Vita Group
	Engineer:	RM	Equipment:	GFM435

	2 Days Prior	1 Day Prior	On day of Monitoring
Weather Conditions:	Overcast / Raining	Scattered Cloud	Scattered Cloud / Raining
Barometric Pressure Trend:	Falling	Increasing	Falling
Surface Ground Conditions:	Damp		

VISIT SIX	Start	Finish
Time:	1400	1500.00
Barometric Pressure:	1010	1010
Background Oxygen:	20.8	20.8

Monitoring Point	Flow Rate (l/h)	Gas Concentration											Groundwater			Remarks
		Peak						Steady					Depth to Water	Depth to Base	Head of water	
BH N°		CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)	Flow Rate (l/h)	CH ₄ %	CO ₂ %	O ₂ %	LEL %	H ₂ S/C O (ppm)				
WSI01	Well Damaged Due to Site Operations Tap Could Not Be Opened															
WSI02	0	0	0	20.2	0	0/0	0	0	0	20.2	0	0/0	Dry	1.2	N/A	
WSI05	Bung Missing Due to Site Operations											Dry	2.78			
WSI06	Bung Stuck In Well and Tap Damaged due to Site Operations															
RBH101	0	0	0	20	0	0/0	0	0	0	20	0	0/0	5.95	19	13.05	
RBH102	Buried Could not Located															

Comments:

TEST DATE AND CONDITIONS			
Date		08/07/2022	
Atmospheric Pressure		1015	mB
Ambient Temperature		21.4	°C
Envionics Serial No.		5089	

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311



GAS DATA
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Fax 02476307711

Customer	ROC Consulting
Certificate Number	123330
Order Number	331480

Serial Number	12229
Software Version	G436-00.0027/0009

Recalibration DUE Date
08/07/23

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB	250	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	59.7	60	40.0	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
	4.9	5	4.9	5	6.0	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N2	0.0	0	0.0	0	0.0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H2S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	995	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects									
Applied Gas (ppm)		Instrument Readings (ppm)							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX		
H2S	1500	1500		0		0			
CO	1000	50		995		0			
Hexane	2.0%	0		0		1.99			

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		1015	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200mb	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-30.4	Accept ± 3.0	-377	-383	Accept ± 50
-3	-3.0	Accept ± 1.0	-17	-17	Accept ± 6.0
0	0.0	Accept ± 0.0	0	0	Accept ± 0.5
3	3.0	Accept ± 0.5	15	14	Accept ± 3.0
30	30.0	Accept ± 3.0	295	294	Accept ± 50
60	60.0	Accept ± 6.0	880	876	Accept ± 130
90	89.8	Accept ± 9.0	1690	1703	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading $^{\circ}\text{C}$	
Applied Temperature $^{\circ}\text{C}$		
-10	-10.0	Accept ± 2.0
0	0.0	Accept ± 1.0
30	30.0	Accept ± 1.0
60	60.0	Accept ± 1.0
100	100.0	Accept ± 1.0

Technician:
<i>Jack Rutland</i>

Date Tested:
<i>08/07/2022</i>

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

Gas Data Ltd is certified to BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018.