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Mr Richard Turner
TJ Thomson & Son Ltd
Stockton House
Grangefield Road
Stockton-on-Tees
TS18 4AE

Date: 20th December 2017

Our ref.: C7333/6894/CR/CR

Dear Richard,

Re.: C7333 – Millfield Works, Stockton-on-Tees

Further to our Geoenvironmental Appraisal Report for the above site (Sirius Report Ref. C7333, dated September 2017), the planned period of ground gas monitoring is now complete. This letter presents the results of that monitoring and an assessment of the risk posed by hazardous ground gases to the proposed development.

Whilst this letter discusses pertinent findings of the investigation, it must be read in conjunction with the aforementioned report, which presents in detail the site setting and the findings of previous phases of investigation.

Introduction

In undertaking this assessment, we have taken account of current best practice guidance in the assessment risk posed by hazardous permanent ground gases, including:

- BS8485:2015 "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings" (with February 2016 revision of Figure 5);
- BS8576:2013 "Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds (VOCs)";
- CIRIA "Assessing Risks Posed by Hazardous Ground Gases to Buildings", report C665, 2007;
- CIRIA "The VOCs Handbook. Investigating, Assessing and Managing Risks from Inhalation of VOCs at Land Affected by Contamination", report C682, 2009;
- CL:AIRE "A Pragmatic Approach to Ground Gas Risk Assessment", report ref. RB17, November 2012;
- NHBC "Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present", report version 04, March 2007.

It is understood that consideration is being given to development of the site primarily for a residential end use, however parts of the site may be retained for, or have continued use as, a commercial/light industrial end use. For the purposes of gas risk assessment, the proposed development is therefore

considered to be residential, characterised as comprising Type A buildings, as defined in Table 3 of BS 8485:2015.

Site Characterisation Relevant to Gas Risk Assessment

Site History

The site is located north of Grangefield Road and west of the Durham Coast railway line, approximately 0.6km west of Stockton town centre. The site is an irregular shaped relatively level area, which is currently occupied by the former Millfield Works, a scrap metal merchant and processing facility.

Summary of Relevant Site Investigation Works

The ground investigation comprised the excavation of 36 No trial pits to a maximum depth of 4.1m, the boring of 20 No. windowless sampler boreholes to a maximum depth of 4.45m depth, and the drilling of 5 No. cable percussive boreholes to a maximum 10m bgl depth.

Groundwater and ground gas monitoring wells were installed in 10 No. windowless sampler boreholes and 2 No. cable percussive boreholes.

Further information is contained within the Sirius report (Sirius Report Ref. C7333, dated September 2017).

Geology

Site investigation evidence and geological mapping indicate the following geological sequence to underlay the site:

- Concrete or asphalt hardstanding between 0.1 and 0.4m bgl;
- Predominantly granular made ground, locally cohesive in the north, ranging between 0.35 and 6.5m thick, although the exact depth was not proven in some locations. Gravel within the made ground comprised slag, brick, concrete, shale, occasional glass, clinker, metal, wood, sandstone and mudstone; and
- Natural soils comprised, stiff or very stiff, high and very high strength sandy gravelly clay.

Hydrogeology

The alluvium superficial deposits beneath the site are classified by the Environment Agency (EA) as a Secondary A Aquifer, with the glaciolacustrine deposits, Unproductive Strata.

The underlying solid geology is classified by the EA as a Principal Aquifer.

Mining

The site is not considered at risk from mining.

Waste Disposal

Three historical landfills are recorded on the site, which relate to the Millfield Works. Inert and industrial wastes are reported to have been deposited between 1980 and 1989. Six additional landfills are recorded within 1km of the site, all of which accepted inert construction/industrial wastes only.

Two licensed waste management facilities are recorded within 500m of the site, one being present on the site relating to mixed metal recycling at the Millfield Works. The second entry is located 63m north-east and relates to end of life vehicles.

Chemical Contamination that could Influence Ground Gas Composition

Chemical contamination of PAHs compounds including naphthalene has been identified in some parts of the site during the ground investigation, which may have the potential to influence ground gas composition.

Ground Gas Monitoring Data

An initial ground gas monitoring programme comprising 6 No. visits over a period of 3 No. months was specified. The wells selected for monitoring are described in the above-referenced Geoenvironmental Appraisal Report and shown on the Exploratory Hole Location Plan presented in Attachment A.

A summary of the monitoring data obtained is presented in Attachment B. The monitoring events covered atmospheric pressure conditions of 993-1020mbar, and included periods of falling pressure.

Tables 1 summarises the gas monitoring results obtained.

Table 1 - Summary of Ground Gas and Groundwater Monitoring Data

Well	Concentration ranges (%v/v)			Concentration ranges (ppmv)		Flow (litres/hour)		Depth to Groundwater (m bgl)
	Methane (Peak)	Carbon Dioxide (Steady)	Oxygen (Min.)	Carbon monoxide	Hydrogen sulphide	Peak	Steady	
CP01	ND	0.6-7.3	8.1-19.8	ND	ND	120	4.2-5.5	1.92-2.73
CP03	ND	ND-1.9	17.1-20.6	ND	ND	1.8	ND	1.94-4.70
WS01	ND-8.6	0.1-5.5	0.1-19.8	ND	ND	14.9-120.1	0.2-0.4	0.18-1.22
WS03	ND	3.4-4.3	14.8-16.0	ND	ND	ND	ND	DRY
WS05	ND	0.7-8.0	4.7-7.2	ND	ND	-0.9	ND	2.29-3.01
WS08C	ND	1.6-2.1	18.6-18.8	ND	ND	ND	ND	2.21-2.24
WS09	ND	ND-3.4	15.4-20.3	ND	ND	3.0-29.0	ND	GL-1.88
WS10	ND-0.4	0.2-0.4	ND-0.1	ND	ND	-6.7-0.5	ND	1.37-1.77
WS11	ND	8.2-9.7	4.0-5.6	ND	ND	-0.6	ND	DRY-3.07
WS13	ND	3.5-4.4	12.2-13.4	ND	ND	-0.40	ND	2.94-2.96
WS14	ND	0.2-1.1	17.9-20.5	ND	ND	-12.9	ND	1.18-1.37
WS15	ND	6.1-9.6	7.5-14.5	ND	ND	ND	ND	1.20-1.46

ND: Not Detected

Concentrations of methane were detected in WS01 up to 8.6 % v/v, and in WS10 to up 0.4 % v/v, with concentrations of carbon dioxide up to a maximum of 9.7 % v/v, with concentrations >5 % v/v recorded in five individual wells.

Significantly elevated peak flow rates observed in some wells may be attributed to a combination of the confinement of the ground gases within the solid section of pipework i.e. where groundwater levels are above the response zone of the well, or confinement within low permeability cohesive deposits, which can result in the gas becoming pressurised within the sealed space. Consequently, these exceptionally high initial flow rates could be considered unrepresentative of the true conditions, and have been discounted during this risk assessment. A site worst case peak rate of 29.0 l/hr is considered more representative. The maximum steady flow rate was recorded as 5.5 l/hr.

Revised Conceptual Site Model for Hazardous Ground Gases

Ground Gas Sources

Low to moderate sources of ground gas were identified in the conceptual site model, associated with deep made ground and organic soils beneath the site, and off-site landfills.

Transport Pathways

Direct migration of ground gas into properties through the underlying granular made ground and any natural granular soils.

Receptors

Proposed future buildings and their occupants.

Ground Gas Risk Assessment

The risk assessment considers both the detected concentrations of ground gases and borehole flow rates, in accordance with BS8485:2015. Q_{hg} (Quantity of hazardous gas) values for methane and carbon dioxide have been calculated in accordance with BS8485:2015 on the basis of measured gas flows and concentrations or a limit of detection (LoD) of 0.1L/hr and 0.1% v/v, respectively, whichever is the higher (Attachment B).

Very high peak flows have been discounted, the next highest peak value detected of 29 L/hr is considered more representative of the site conditions.

A 'worst case check' Q_{hg} value has also been calculated for both carbon dioxide and methane.

The derived Q_{hg} for methane, based on the maximum recorded concentration of 8.6 %v/v together with the maximum representative peak flow rate of 29 L/hr, discounting very high peak instantaneous flow concentrations, is 2.49 l/hr.

The 'worst case check' Q_{hg} value for carbon dioxide, in accordance with BS8485 Section 6.3.7.4, based on the maximum detected steady state concentration of carbon dioxide in any well on any occasion (9.7 % v/v) and the highest steady state flow rate in any well on any occasion, of 5.5 l/hr, is 0.534 l/hr.

On the basis of the worst case Q_{hg} values for both carbon dioxide and methane, the site could be considered to fall within Characteristic Situation (CS) 3 as defined in BS8485:2015.

Depleted oxygen concentrations (<18%v/v) have been detected on several occasions, with a minimum concentration of 0.1 %v/v recorded on one occasion in WS01. It is observed that the most significantly depleted oxygen concentrations generally correlate with higher recorded concentrations of carbon dioxide and methane.

Whilst such depleted oxygen concentrations within the ground are considered unlikely to present a significant risk to end users, depleted oxygen could potentially pose a substantial risk to construction/maintenance workers operating in confined spaces below ground level.

No significant concentrations of hydrogen sulphide or carbon monoxide were detected and the potential risk from such gases is considered negligible.

Conclusions and Recommendations

On the basis of the data obtained and the risk assessment, the site, at this stage, is concluded to fall within Characteristic Situation (CS) 3 as defined in BS8485:2015.

Based on Table 4 within BS 8485:2015, a gas protection score of 4.5 for the proposed development. This could be achieved by incorporation of a pre-cast suspended segmental subfloor (i.e. 'block and beam') and a passive sub-floor dispersal layer e.g. clear void, proprietary void former or 'no fines' gravel

layer, achieving a 'very good performance' as defined in Annex B of BS 8485, together with the incorporation of gas resistant membrane according to the criteria specified in Table 7 of BS 8485.

Should the land use or proposed building type(s) change from those assumed in the preparation of this letter, then re-evaluation of the conclusions and recommendations will be required.

The site is located within an area where no additional gas protection measures are required for protection of proposed new buildings from the ingress of radon gas.

In view of the localised elevated concentrations of methane, it is recommended that further laboratory analysis is undertaken on samples of gas from the wells which encountered methane. Should these results confirm the presence of hydrocarbon vapours, then there may be scope to revisit the ground gas regime, and potentially lower or zone the requirement for gas protective measures.

Should hydrocarbon vapours be confirmed, then there may be a localised requirement for hydrocarbon vapour resistant gas membranes.

Notwithstanding the above, gas monitoring of all excavations and/or underground spaces should be carried out prior to personnel entry, with continuous monitoring throughout the period of working. Gas monitoring by way of example should include as a minimum: methane, carbon dioxide, carbon monoxide, and oxygen. Gas monitor(s) shall emit both audible and visual warnings. Alarm levels should be set with due regard to the relevant Occupational Exposure Limits given in HSE EH40/2005, and for low oxygen concentrations. If any anomalous or significantly elevated/depleted gas concentrations are detected then all personnel should immediately evacuate the area and the advice of an appropriate specialist be obtained before work continues.

The conclusions and recommendations presented in this letter report are considered reasonable based on the findings of the work described. However, these cannot be guaranteed to gain regulatory or other approvals and, therefore, the report should be passed by the client to the appropriate regulatory authorities and/or other appropriate organisations for their comment and approval prior to undertaking any development works at the site.

Yours sincerely,



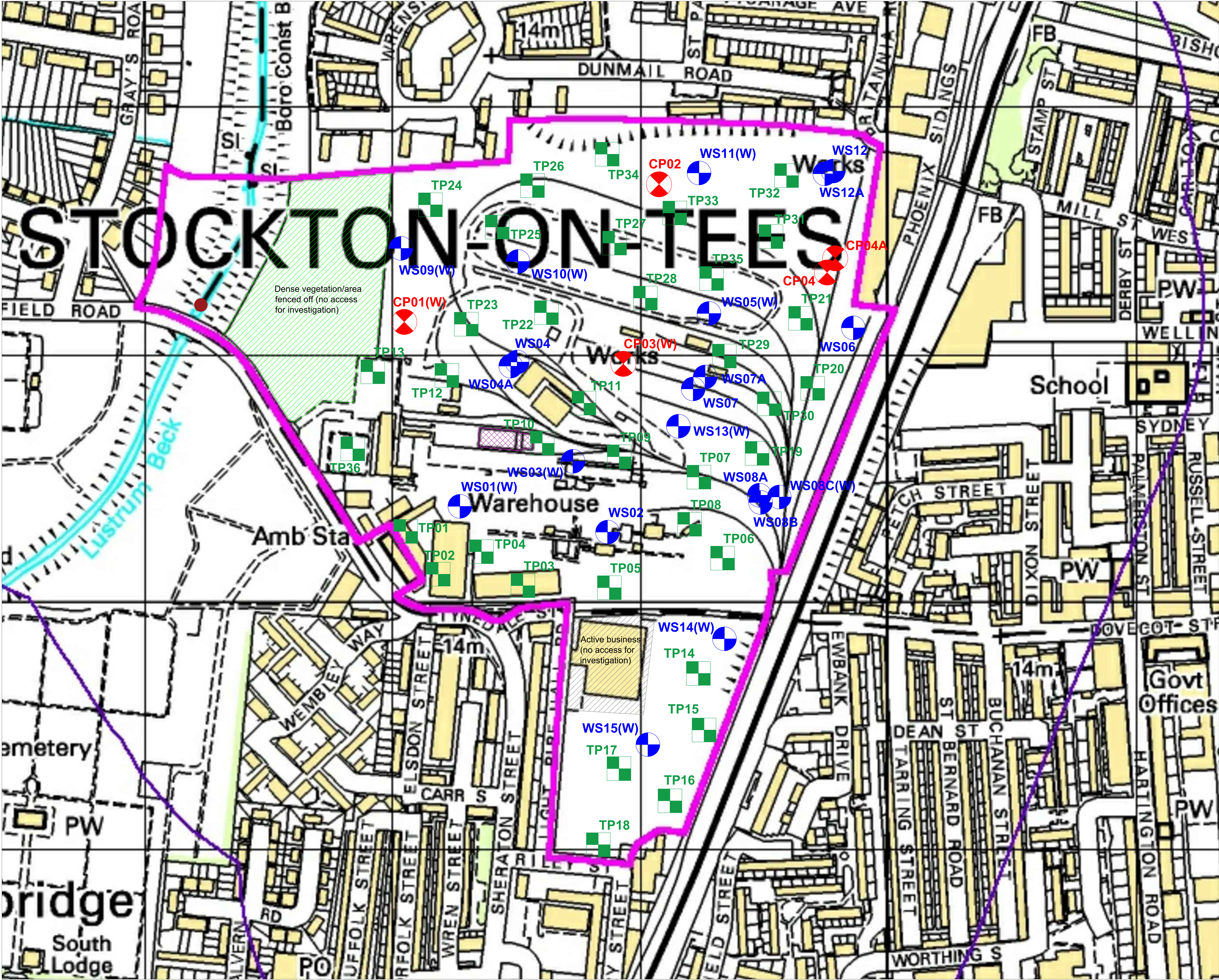
Chris Rudd

Associate

For and on behalf of
Sirius Geotechnical Ltd

Enc.: Attachment A. Drawings.

Attachment B. Ground Gas Monitoring Results.



- NOTES
- Site Boundary
 - Wooded Area (Outside Millfield Works Boundary)
 - Deep Substructure (Car Crusher)
 - Trial Pit
 - Window Sample Hole
 - Cable Percussive Borehole
 - (W) Monitoring Well
 - Surface Water Sampling Location

REVISION	
0	For Information
A	>>
B	>>
C	>>
D	>>

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CLIENT

TJ Thomson & Son Ltd

SITE

**Millfield Works,
Stockton-On-Tees**

DRAWING TITLE

**Exploratory Hole
Location Plan**

DRAWING NO. C7333/04		REVISION NO. 0	
DRAWN BY MG		APPROVED BY CR	
DATE September 2017	SCALE 1:1000		PAPER SIZE A0

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: TJ Thomson & Son Ltd
Site: Millfield Works, Stockton-On-Tees
Date: 23/08/2017

Job No: C7333
Visit No: 1 of 6 over 3 months
Operator: DB **Project Manager:** MG

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Worst-credible GSVs		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady										
CP01	ND	ND	ND	ND	7.3	7.3	ND	ND	ND	ND	8.1	8.1	NR	NR	120.0	5.5	39	240	0.12	0.4015	2.73	7.84	NR	NR	Glaciolacustrine clay	Water bailed to 2.93m bgl (6.5 litres).
CP03	ND	ND	ND	ND	0.8	0.8	ND	ND	ND	ND	19.6	19.6	NR	NR	ND	ND	ND	NA	NA	0.0008	4.28	7.87	NR	NR	Principally granular made ground	
WS01	1.0	1.0	23.1	23.1	0.1	0.1	ND	ND	ND	ND	9.7	9.7	NR	NR	14.9	ND	ND	1	0.149	0.0001	0.18	3.08	NR	NR	Glaciolacustrine clay	
WS03	ND	ND	ND	ND	4.0	4.0	ND	ND	ND	ND	14.8	14.8	NR	NR	ND	ND	ND	NA	NA	0.004	DRY	2.50	NR	NR	Granular made ground	
WS05	ND	ND	ND	ND	7.8	7.8	ND	ND	ND	ND	5.9	5.9	NR	NR	ND	ND	ND	NA	NA	0.0078	2.99	3.08	NR	NR	Granular made ground	
WS08C	ND	ND	ND	ND	2.1	2.1	ND	ND	ND	ND	18.6	18.6	NR	NR	ND	ND	ND	NA	NA	0.0021	2.22	3.06	NR	NR	Principally granular made ground	
WS09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.3	20.3	NR	NR	3.0	ND	ND	1	0.003	NA	0.00	3.13	NR	NR	Glaciolacustrine clay	Well submerged below ponded surface water. Water bailed to 3.07m bgl (6.5 litres).
WS10	ND	ND	1.2	1.2	0.3	0.3	ND	ND	ND	ND	0.1	0.1	NR	NR	-6.7	ND	ND	0	0.0067	0.0003	1.76	3.09	NR	NR	Granular made ground and glaciolacustrine clay	
WS11	ND	ND	ND	ND	9.1	9.1	ND	ND	ND	ND	4.6	4.6	NR	NR	ND	ND	ND	NA	NA	0.0091	3.07	3.08	NR	NR	Granular made ground	
WS13	ND	ND	ND	ND	3.5	3.5	ND	ND	ND	ND	13.4	13.4	NR	NR	ND	ND	ND	NA	NA	0.0035	2.94	3.00	NR	NR	Granular made ground	
WS14	ND	ND	ND	ND	0.2	0.2	ND	ND	ND	ND	20.5	20.5	NR	NR	ND	ND	ND	NA	NA	0.0002	1.20	3.06	NR	NR	Principally granular made ground	
WS15	ND	ND	ND	ND	9.6	9.6	ND	ND	ND	ND	12.1	12.1	NR	NR	ND	ND	ND	NA	NA	0.0096	1.28	3.07	NR	NR	Principally glaciofluvial clay	
Max	1.0	1.0	23.1	23.1	9.6	9.6	ND	ND	ND	ND	20.5	20.5	NR	NR	120.0	5.5	39.0	240	0.1490	0.4015	4.28	7.87	NR	NR		
Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	0.1	NR	NR	ND	ND	ND	NA	NA	NA	DRY	2.50	NR	NR		

ND - Not detected

NR - Not recorded

NA - Non applicable

Worst-possible GSVs

1.2 0.528

NB: Where no flow (ND) recorded, GSVs are calculated using equipment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of GSVs.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground: ☒ Dry ☐ Moist ☐ Wet ☐ Frozen
Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
Precipitation: ☒ None ☐ Slight ☐ Heavy
Time monitoring performed: ☐ Start ☐ End
Barometric pressure (mbar): ☐ 1012 ☐ Start ☐ 1014 ☐ End
Pressure trend (Daily): ☒ Falling ☐ Steady ☐ Rising
Source: www.wunderground.com
Air Temperature (Deg. C): ☐ 19 Before ☐ 22 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
Gas Range: CH₄ CO₂ O₂
Gas Flow range: +100/-50 l/hr
Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 01/08/2017
Date of next calibration: 01/09/2017
Ambient air check: CH₄ CO₂ O₂

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: TJ Thomson & Son Ltd
Site: Millfield Works, Stockton-On-Tees
Date: 13/09/2017

Job No: C7333
Visit No: 2 of 6 over 3 months
Operator: DB **Project Manager:** MG

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Worst-credible GSVs		WELL AND WATER DATA						Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone		
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady											
CP01	ND	ND	ND	ND	4.3	4.3	ND	ND	ND	ND	11.7	11.7	ND	NR	120.0	4.2	29	180	0.12	0.1806	2.47	7.84	NR	NR	Glaciolacustrine clay		
CP03	ND	ND	ND	ND	0.7	0.7	ND	ND	ND	ND	19.5	19.5	ND	NR	ND	ND	ND	NA	NA	0.0007	4.49	7.87	NR	NR	Principally granular made ground		
WS01	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Glaciolacustrine clay	Well submerged below ponded surface water.	
WS03	ND	ND	ND	ND	4.3	4.3	ND	ND	ND	ND	14.5	14.5	ND	NR	ND	ND	ND	NA	NA	0.0043	DRY	2.50	NR	NR	Granular made ground		
WS05	ND	ND	ND	ND	0.7	0.7	ND	ND	ND	ND	18.7	18.7	ND	NR	ND	ND	ND	NA	NA	0.0007	2.29	3.08	NR	NR	Granular made ground		
WS08C	ND	ND	ND	ND	2.0	2.0	ND	ND	ND	ND	18.6	18.6	ND	NR	ND	ND	ND	NA	NA	0.002	2.23	3.06	NR	NR	Principally granular made ground		
WS09	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Glaciolacustrine clay	Well submerged below ponded surface water.	
WS10	ND	ND	ND	ND	0.3	0.3	ND	ND	ND	ND	2.9	2.9	ND	NR	ND	ND	ND	NA	NA	0.0003	1.37	3.09	NR	NR	Granular made ground and glaciolacustrine clay		
WS11	ND	ND	ND	ND	9.7	9.7	ND	ND	ND	ND	4.1	4.1	ND	NR	ND	ND	ND	NA	NA	0.0097	3.07	3.08	NR	NR	Granular made ground		
WS13	ND	ND	ND	ND	4.5	4.4	ND	ND	ND	ND	11.4	11.4	ND	NR	ND	ND	ND	NA	NA	0.0044	2.94	3.00	NR	NR	Granular made ground		
WS14	ND	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	12.7	12.7	ND	NR	ND	ND	ND	NA	NA	0.0005	1.37	3.06	NR	NR	Principally granular made ground		
WS15	ND	ND	ND	ND	7.5	7.5	ND	ND	ND	ND	14.2	14.2	ND	NR	ND	ND	ND	NA	NA	0.0075	1.46	3.07	NR	NR	Principally glaciofluvial clay		
Max	ND	ND	ND	ND	9.7	9.7	ND	ND	ND	ND	19.5	19.5	ND	NR	120.0	4.2	29.0	180	0.1200	0.1806	4.49	7.87	NR	NR			
Min	ND	ND	ND	ND	0.3	0.3	ND	ND	ND	ND	2.9	2.9	ND	NR	ND	ND	ND	NA	NA	0.0003	DRY	2.50	NR	NR			

ND - Not detected

NR - Not recorded

NA - Non applicable

NB: Where no flow (ND) recorded, GSVs are calculated using equipment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of GSVs.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground: ☐ Dry ☐ Moist ☒ Wet ☐ Snow ☐ Frozen
 Wind: ☐ Calm ☐ Light ☒ Moderate ☐ Strong
 Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
 Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
 Time monitoring performed: ☐ Start ☐ End
 Barometric pressure (mbar): Start End
 Pressure trend (Daily): Falling ☐ Steady ☒ Rising
 Source: www.wunderground.com
 Air Temperature (Deg. C): Before After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
 Gas Range: CH₄ CO₂ O₂
 Gas Flow range: +100/-50 l/hr
 Differential Pressure: (+/-) 1000 Pa
 Date of last calibration: 11/09/2017
 Date of next calibration: 02/10/2017

Ambient air check: CH₄ CO₂ O₂

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: TJ Thomson & Son Ltd
Site: Millfield Works, Stockton-On-Tees
Date: 27/09/2017

Job No: C7333
Visit No: 3 of 6 over 3 months
Operator: DB **Project Manager:** MG

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Worst-credible GSVs		WELL AND WATER DATA					Comments	
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone		
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady											
CP01	ND	ND	ND	ND	1.4	1.4	ND	ND	ND	ND	19.0	19.0	ND	NR	ND	ND	ND	NA	NA	0.0014	1.93	7.84	NR	NR	Glaciolacustrine clay		
CP03	ND	ND	ND	ND	0.8	0.8	ND	ND	ND	ND	19.2	19.2	ND	NR	ND	ND	ND	NA	0.0008	4.39	7.87	NR	NR	Principally granular made ground			
WS01	8.6	8.6	>>>>	>>>>	5.5	5.5	ND	ND	ND	ND	0.1	0.1	11.2	NR	120.1	0.4	4	2	10.3286	0.022	1.21	3.08	NR	NR	Glaciolacustrine clay		
WS03	ND	ND	ND	ND	4.2	4.2	ND	ND	ND	ND	14.6	14.6	ND	NR	ND	ND	ND	NA	0.0042	DRY	2.50	NR	NR	Granular made ground			
WS05	ND	ND	ND	ND	7.8	7.8	ND	ND	ND	ND	4.4	4.4	0.4	NR	ND	ND	ND	NA	0.0078	3.01	3.08	NR	NR	Granular made ground			
WS08C	ND	ND	ND	ND	2.0	2.0	ND	ND	ND	ND	18.2	18.2	ND	NR	ND	ND	ND	NA	0.002	2.21	3.08	NR	NR	Principally granular made ground			
WS09	ND	ND	ND	ND	1.6	1.6	ND	ND	ND	ND	19.0	19.0	ND	NR	ND	ND	ND	NA	0.0016	1.88	3.13	NR	NR	Glaciolacustrine clay			
WS10	ND	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	0.2	0.2	2.2	NR	0.1	ND	ND	ND	0.0001	0.0005	1.73	3.03	NR	NR	Granular made ground and glaciolacustrine clay		
WS11	ND	ND	ND	ND	9.2	9.2	ND	ND	ND	ND	3.9	3.9	0.5	NR	ND	ND	ND	NA	0.0092	3.07	3.07	NR	NR	Granular made ground			
WS13	ND	ND	ND	ND	4.2	4.2	ND	ND	ND	ND	11.9	11.9	ND	NR	-0.4	ND	ND	ND	0.0004	0.0042	2.95	3M	NR	NR	Granular made ground		
WS14	ND	ND	ND	ND	0.7	0.7	ND	ND	ND	ND	17.7	17.7	0.3	NR	-12.9	ND	ND	ND	0.0129	0.0007	1.18	2.85	NR	NR	Principally granular made ground		
WS15	ND	ND	ND	ND	7.1	7.1	ND	ND	ND	ND	14.0	14.0	0.8	NR	ND	ND	ND	NA	0.0071	1.20	3.07	NR	NR	Principally glaciofluvial clay			
Max	8.6	8.6	ND	ND	9.2	9.2	ND	ND	ND	ND	19.2	19.2	11.2	NR	120.1	0.4	4.0	2	10.3286	0.0220	4.39	7.87	NR	NR			
Min	ND	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	0.1	0.1	ND	NR	ND	ND	ND	NA	NA	0.0005	DRY	2.50	NR	NR			
ND - Not detected NR - Not recorded																			Worst-possible GSVs								
																			10.3286		0.0368						

ND - Not detected

NR - Not recorded

NA - Non applicable

NB: Where no flow (ND) recorded, GSVs are calculated using equipment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of GSVs.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground: ☒ Dry ☐ Moist ☐ Wet ☐ Snow ☐ Frozen
 Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
 Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
 Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
 Time monitoring performed: ☐ Start ☐ End
 Barometric pressure (mbar): ☐ 1017 ☐ Start ☐ 1017 ☐ End
 Pressure trend (Daily): ☒ Falling ☐ Steady ☐ Rising
 Source: www.wunderground.com
 Air Temperature (Deg. C): ☐ 17 Before ☐ 17 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
 Gas Range: CH₄ CO₂ O₂
 Gas Flow range: +100/-50 l/hr
 Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 11/09/2017
Date of next calibration: 02/10/2017
Ambient air check: CH₄ CO₂ O₂

PID: MiniRAE 3000
 Calibrated range: 0.1 to 15,000 ppm
 Calibration gas: Isobutylene
 Response time: 2 seconds
 Accuracy: (+/-) 10%
Date of last calibration: 10/10/2016
Date of next calibration: 10/10/2017

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: TJ Thomson & Son Ltd
Site: Millfield Works, Stockton-On-Tees
Date: 11/10/2017

Job No: C7333
Visit No: 4 of 6 over 3 months
Operator: DB **Project Manager:** MG

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Worst-credible GSVs		WELL AND WATER DATA					Comments	
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone		
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady											
CP01	ND	ND	ND	ND	0.9	0.9	ND	ND	ND	ND	19.7	19.7	NR	NR	ND	ND	ND	NA	NA	0.0009	1.92	7.82	NR	NR	Glaciolacustrine clay		
CP03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.6	20.6	NR	NR	1.8	ND	ND	1	0.0018	NA	3.47	7.86	NR	NR	Principally granular made ground		
WS01	5.2	5.2	>>>>	>>>>	3.5	3.5	ND	ND	ND	ND	7.6	7.6	NR	NR	120.1	0.2	1	2	6.2452	0.007	1.09	3.06	NR	NR	Glaciolacustrine clay		
WS03	ND	ND	ND	ND	3.5	3.5	ND	ND	ND	ND	16.0	16.0	NR	NR	ND	ND	ND	NA	NA	0.0035	DRY	2.50	NR	NR	Granular made ground		
WS05	ND	ND	ND	ND	8.0	8.0	ND	ND	ND	ND	4.7	4.7	NR	NR	ND	ND	ND	NA	NA	0.008	3.01	3.08	NR	NR	Granular made ground		
WS08C	ND	ND	ND	ND	1.8	1.8	ND	ND	ND	ND	18.8	18.8	NR	NR	ND	ND	ND	NA	NA	0.0018	2.22	3.06	NR	NR	Principally granular made ground		
WS09	ND	ND	ND	ND	3.4	3.4	ND	ND	ND	ND	15.4	15.4	NR	NR	29.0	ND	ND	1	0.029	0.0034	1.59	3.13	NR	NR	Glaciolacustrine clay		
WS10	ND	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	0.1	0.1	NR	NR	ND	ND	ND	NA	NA	0.0004	1.73	3.07	NR	NR	Granular made ground and glaciolacustrine clay		
WS11	ND	ND	ND	ND	8.9	8.9	ND	ND	ND	ND	4.0	4.0	NR	NR	ND	ND	ND	NA	NA	0.0089	DRY	3.07	NR	NR	Granular made ground		
WS13	ND	ND	ND	ND	4.2	4.2	ND	ND	ND	ND	12.2	12.2	NR	NR	ND	ND	ND	NA	NA	0.0042	2.95	3.00	NR	NR	Granular made ground		
WS14	ND	ND	ND	ND	0.9	0.9	ND	ND	ND	ND	17.9	17.9	NR	NR	ND	ND	ND	NA	NA	0.0009	1.21	2.85	NR	NR	Principally granular made ground		
WS15	ND	ND	ND	ND	8.2	8.2	ND	ND	ND	ND	12.6	12.6	NR	NR	ND	ND	ND	NA	NA	0.0082	1.24	3.06	NR	NR	Principally glaciofluvial clay		
Max	5.2	5.2	ND	ND	8.9	8.9	ND	ND	ND	ND	20.6	20.6	NR	NR	120.1	0.2	1.0	2	6.2452	0.0089	3.47	7.86	NR	NR			
Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	0.1	NR	NR	ND	ND	ND	NA	NA		DRY	2.50	NR	NR			
ND - Not detected NR - Not recorded																			Worst-possible GSVs								
																			6.2452				0.0178				

ND - Not detected

NR - Not recorded

NA - Non applicable

NB: Where no flow (ND) recorded, GSVs are calculated using equipment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of GSVs.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground: ☐ Dry ☒ Moist ☐ Wet ☐ Snow ☐ Frozen
 Wind: ☐ Calm ☒ Light ☒ Moderate ☐ Strong
 Cloud cover: ☐ None ☐ Slight ☐ Cloudy ☒ Overcast
 Precipitation: ☐ None ☒ Slight ☐ Moderate ☐ Heavy
 Time monitoring performed: ☐ Start ☐ End
 Barometric pressure (mbar): ☐ 995 ☐ Start ☐ 995 ☐ End
 Pressure trend (Daily): ☒ Falling ☐ Steady ☐ Rising
 Source: www.wunderground.com
 Air Temperature (Deg. C): ☐ 14 Before ☐ 14 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
 Gas Range: CH₄ CO₂ O₂
 Gas Flow range: +100/-50 l/hr
 Differential Pressure: (+/-) 1000 Pa
 Date of last calibration: 02/10/2017
 Date of next calibration: 01/11/2017
 Ambient air check: CH₄ CO₂ O₂

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: TJ Thomson & Son Ltd
Site: Millfield Works, Stockton-On-Tees
Date: 02/11/2017

Job No: C7333
Visit No: 5 of 6 over 3 months
Operator: DB **Project Manager:** MG

	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Worst-credible GSVs		WELL AND WATER DATA					Comments
Monitoring Point	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady										
CP01	ND	ND	ND	ND	0.8	0.8	ND	ND	ND	ND	19.5	19.5	0.4	NR	ND	ND	ND	NA	NA	0.0008	1.93	7.82	NR	NR	Glaciolacustrine clay	Principally granular made ground
CP03	ND	ND	ND	ND	1.9	1.9	ND	ND	ND	ND	17.1	17.1	ND	NR	ND	ND	ND	NA	NA	0.0019	4.70	7.86	NR	NR		
WS01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	19.8	19.8	6.6	NR	101.1	ND	ND	1	0.1011	NA	0.88	3.07	NR	NR	Glaciolacustrine clay	Water bailed to 3m bgl (5.5ltr extracted).
WS01	2.2	2.2	51.9	51.9	1.6	1.6	ND	ND	ND	ND	16.7	16.7	3.0	NR	118.3	ND	ND	2	2.6026	0.0016	2.85	3.07	NR	NR	Glaciolacustrine clay	
WS03	ND	ND	ND	ND	3.6	3.6	ND	ND	ND	ND	15.5	15.5	0.5	NR	ND	ND	ND	NA	NA	0.0036	DRY	2.50	NR	NR	Granular made ground	
WS05	ND	ND	ND	ND	7.4	7.4	ND	ND	ND	ND	5.8	5.8	0.5	NR	ND	ND	ND	NA	NA	0.0074	3.01	3.08	NR	NR	Granular made ground	
WS08C	ND	ND	ND	ND	1.8	1.8	ND	ND	ND	ND	18.6	18.6	0.1	NR	ND	ND	ND	NA	NA	0.0018	2.24	3.06	NR	NR	Principally granular made ground	
WS09	ND	ND	ND	ND	2.6	2.6	ND	ND	ND	ND	16.8	16.8	ND	NR	16.3	ND	ND	1	0.0163	0.0026	1.20	3.13	NR	NR	Glaciolacustrine clay	
WS10	0.2	0.2	5.9	5.9	0.3	0.3	ND	ND	ND	ND	ND	ND	0.5	NR	0.5	ND	ND	0	0.001	0.0003	1.75	3.06	NR	NR	Granular made ground and glaciolacustrine clay	
WS11	ND	ND	ND	ND	8.8	8.8	ND	ND	ND	ND	4.6	4.6	ND	NR	ND	ND	ND	NA	NA	0.0088	3.07	3.08	NR	NR	Granular made ground	
WS13	ND	ND	ND	ND	4.3	4.3	ND	ND	ND	ND	12.4	12.4	0.1	NR	ND	ND	ND	NA	NA	0.0043	2.96	3.00	NR	NR	Granular made ground	
WS14	ND	ND	ND	ND	1.1	1.1	ND	ND	ND	ND	18.3	18.3	0.2	NR	ND	ND	ND	NA	NA	0.0011	1.26	2.85	NR	NR	Principally granular made ground	
WS15	ND	ND	ND	ND	6.7	6.7	ND	ND	ND	ND	12.8	12.8	0.2	NR	ND	ND	ND	NA	NA	0.0067	1.36	3.07	NR	NR	Principally glaciofluvial clay	
Max	2.2	2.2	51.9	51.9	8.8	8.8	ND	ND	ND	ND	19.8	19.8	6.6	NR	118.3	ND	ND	2	2.6026	0.0088	4.70	7.86	NR	NR		
Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	NA	NA	DRY	2.50	NR	NR		

ND - Not detected

NR - Not recorded

NA - Non applicable

NB: Where no flow (ND) recorded, GSVs are calculated using equipment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of GSVs.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground: ☒ Dry ☐ Moist ☐ Wet ☐ Snow ☐ Frozen
 Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
 Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
 Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
 Time monitoring performed: ☐ Start ☐ End
 Barometric pressure (mbar): Start End
 Pressure trend (Daily): ☒ Falling ☐ Steady ☐ Rising
 Source: www.wunderground.com
 Air Temperature (Deg. C): Before After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
 Gas Range: CH₄ CO₂ O₂
 Gas Flow range: +100/-50 l/hr
 Differential Pressure: (+/-) 1000 Pa
 Date of last calibration: 01/11/2017
 Date of next calibration: 04/12/2017
Ambient air check: CH₄ CO₂ O₂

PID: MiniRAE 3000
 Calibrated range: 0.1 to 15,000 ppm
 Calibration gas: Isobutylene
 Response time: 2 seconds
 Accuracy: (+/-) 10%
 Date of last calibration: 13/10/2017
 Date of next calibration: 13/04/2018

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: TJ Thomson & Son Ltd
Site: Millfield Works, Stockton-On-Tees
Date: 15/11/2017

Job No: C7333
Visit No: 6 of 6 over 3 months
Operator: DB **Project Manager:** MG

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Worst-credible GSVs		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady										
CP01	ND	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	19.8	19.8	0.2	NR	ND	ND	ND	NA	NA	0.0006	1.94	7.83	NR	NR	Glaciolacustrine clay	
CP03	ND	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	19.8	19.8	0.2	NR	ND	ND	ND	NA	NA	0.0006	1.94	7.83	NR	NR	Principally granular made ground	
WS01	ND	ND	ND	ND	4.6	4.6	ND	ND	ND	ND	5.8	5.8	3.7	NR	119.8	ND	ND	1	0.1198	0.0046	1.22	3.08	NR	NR	Glaciolacustrine clay	
WS03	ND	ND	ND	ND	3.4	3.4	ND	ND	ND	ND	15.7	15.7	0.1	NR	ND	ND	ND	NA	NA	0.0034	DRY	2.50	NR	NR	Granular made ground	
WS05	ND	ND	ND	ND	6.7	6.7	ND	ND	ND	ND	7.2	7.2	0.3	NR	-0.9	ND	ND	NA	0.0009	0.0067	3.01	3.08	NR	NR	Granular made ground	
WS08C	ND	ND	ND	ND	1.6	1.6	ND	ND	ND	ND	18.8	18.8	ND	NR	ND	ND	ND	NA	NA	0.0016	2.24	3.06	NR	NR	Principally granular made ground	
WS09	ND	ND	ND	ND	3.1	3.1	ND	ND	ND	ND	16.3	16.3	0.1	NR	20.2	ND	ND	1	0.0202	0.0031	1.01	3.13	NR	NR	Glaciolacustrine clay	
WS10	0.4	0.4	10.1	10.1	0.2	0.2	ND	ND	ND	ND	0.1	0.1	0.3	NR	ND	ND	ND	NA	0.0004	0.0002	1.77	3.07	NR	NR	Granular made ground and glaciolacustrine clay	
WS11	ND	ND	ND	ND	8.2	8.2	ND	ND	ND	ND	5.6	5.6	0.2	NR	-0.6	ND	ND	ND	0.0006	0.0082	3.07	3.08	NR	NR	Granular made ground	
WS13	ND	ND	ND	ND	3.8	3.8	ND	ND	ND	ND	12.9	12.9	0.1	NR	ND	ND	ND	NA	NA	0.0038	2.96	3M	NR	NR	Granular made ground	
WS14	ND	ND	ND	ND	0.9	0.9	ND	ND	ND	ND	18.5	18.5	0.1	NR	ND	ND	ND	NA	NA	0.0009	1.29	2.85	NR	NR	Principally granular made ground	
WS15	ND	ND	ND	ND	6.1	6.1	ND	ND	ND	ND	14.5	14.5	0.1	NR	ND	ND	ND	NA	NA	0.0061	1.34	3.08	NR	NR	Principally glaciofluvial clay	
Max	0.4	0.4	10.1	10.1	8.2	8.2	ND	ND	ND	ND	19.8	19.8	3.7	NR	119.8	ND	ND	1	0.1198	0.0082	3.07	7.83	NR	NR		
Min	ND	ND	ND	ND	0.2	0.2	ND	ND	ND	ND	0.1	0.1	ND	NR	ND	ND	ND	NA	NA	0.0002	DRY	2.50	NR	NR		
ND - Not detected NR - Not recorded																		Worst-possible GSVs								
																		0.4792	0.0082							

ND - Not detected

NR - Not recorded

NA - Non applicable

NB: Where no flow (ND) recorded, GSVs are calculated using equipment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of GSVs.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground: ☒ Dry ☐ Moist ☐ Wet ☐ Snow ☐ Frozen
 Wind: ☒ Calm ☐ Light ☐ Moderate ☐ Strong
 Cloud cover: ☒ None ☐ Slight ☐ Cloudy ☐ Overcast
 Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
 Time monitoring performed: ☐ Start ☐ End
 Barometric pressure (mbar): Start End
 Pressure trend (Daily): Falling ☐ Steady ☒ Rising
 Source:
 Air Temperature (Deg. C): Before After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
 Gas Range: CH₄ CO₂ O₂
 Gas Flow range: +100/-50 l/hr
 Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 01/11/2017
Date of next calibration: 04/12/2017
Ambient air check: CH₄ CO₂ O₂

PID: MiniRAE 3000
 Calibrated range: 0.1 to 15,000 ppm
 Calibration gas: Isobutylene
 Response time: 2 seconds
 Accuracy: (+/-) 10%
Date of last calibration: 13/10/2017
Date of next calibration: 13/04/2018