



GEO-ENVIRONMENTAL CONSULTING

BEK Geo-Environmental Consulting

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Our Ref: BEK-23127-240802-PH (Rev A)

2nd August 2024

PRINGLE HOMES

The Coach House Hollowforth Lane
Woodplumpton
Preston
PR4 0BD

Land at Crow Trees Farm, Chatburn - Ground Gas Risk Assessment

BEK Enviro (BEK) has been commissioned by Pringle Homes to carry out a ground gas risk assessment for the proposed commercial development of the land located at Crow Trees Farm, Chatburn.

The national grid reference for the site is 376789, 443933. The site can be accessed from Crow Tree Brow to the north-west.

The report has been prepared to support a planning application for the construction of 37 residential dwelling, alongside the refurbishment of the Grade II listed farmhouse and conversion/extension of the existing dairy building. An extract of the proposed development is shown below:



Figure 1: Proposed Development



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BEK has carried out intrusive site investigation during October 2023 to quantify the potential risks from contamination. The investigation included the installation of gas monitoring probes; the locations of which were determined by BEK following a review of the information presented in the BETTS Geo Consulting Engineers 'Desk Study report' (Report Ref: 22CHE293/DS, dated April 2022) and by the ground conditions encountered during the BEK site investigation.

This report should be read in conjunction with the Desk Study and the 'Site Investigation & Ground Assessment' report prepared by BEK (Report Ref: BEK-23127-1 (Rev A) dated 2023).

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Background Information

The site is accessed occupies and irregular shaped plot of land of approximately 1.7 hectares. The north of the site occupies a residential dwelling with garden and allotments, and a number of outbuildings associated with Crow Trees Farm. The remainder of the site comprises grassed fields.

The earliest available map shows the site to comprise an area of farm buildings in the north of the site with the rest of the site undeveloped. Circa 1910, a railway line is present along the southern site boundary. The site remains this way until present day, with the configuration of the farm buildings in the north changing slightly over time.

To characterise the shallow ground conditions and facilitate the assessment of potential risks associated with contamination and ground gas as well as provide geotechnical information to support foundation design, BEK carried out site investigation work which included the drilling of six window sample boreholes drilled to a maximum depth of 2.8 m bgl and the excavation of eleven machine excavated trial pits to a maximum depth of 2.1 m. The exploratory locations are presented on BEK Drawing No 23127-3, a copy of which is presented in Annex C.

Following a review of ground conditions, gas monitoring probes were installed in three of the boreholes (Boreholes WS1, WS3 & WS6).

Made ground was encountered at the surface of three exploratory locations to a maximum depth of 0.5 m. The made ground generally comprised sands and gravels with varying proportions of brick, and tarmacadam.

Natural strata was encountered below made ground within all exploratory locations and generally comprised Boulder Clay which became 'firm to very stiff' with depth. Suspected bedrock was encountered in 14 exploratory locations at depths ranging between 0.6 m and 2.3 m.

The exploratory records from the BEK site investigation are presented in Annex A.



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Assessment of Data

Guidance on the investigation and assessment of risk posed by hazardous ground gases is provided in CIRIA 665 and BS 8485:2015+A1:2019. These documents provide up-to-date advice and consolidates good practice on investigation, the collection of relevant data, and monitoring programs for a risk based approach to gas contaminated land.

These documents provide guidance on the assessing risks posed by hazardous ground gases to buildings. The guidance provides details on the scope of the gas monitoring program to be undertaken depending on the gassing potential of the source and the sensitivity of the end use.

Gas Monitoring

An engineer from BEK has monitored the boreholes on six occasions between 11th October 2023 and 4th January 2024 in order to assess the potential for the for the generation and migration of potentially hazardous gases arising from off-site sources.

Based on the ground conditions encountered and an initial review of the monitoring results, this monitoring program is considered to be sufficient to characterise the ground gas regime at the site.

The monitoring visits were carried out at atmospheric pressures ranging between 955 mb and 1009 mb. The visits undertaken during low/falling pressures are considered to represent a worst-case scenario for the generation and release of ground gas.

Each borehole was monitoring for the following parameters:

- Gas Flow Rates (l/hr)
- Gas Concentrations (methane, carbon dioxide, oxygen) (v/v)
- Water Level
- Barometric Pressure

A calibrated GFM436 Gas Data Analyser has been used to measure the above. The gas monitoring results are presented in Annex B.

Gas Risk Assessment

The gas risk assessment has been undertaken in accordance with BS8485:2015+A1:2019 and CIRIA 665. The method of assessment requires the calculation of the Gas Screening Value (GSV) for both carbon dioxide and methane.

The gas concentrations and borehole flow rates are used to calculate the GSV to provide a litres of gas per hour. This equals the maximum borehole flow rate (l/hr) x maximum gas concentration (v/v). The gas monitoring results and the calculated GSVs are summarised in the following table:



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Monitoring Location	Range of Concentrations (% v/v)			Max Flow Rate (l/hr) (steady state)	GSV (based on maximum values) (l/hr)	
	Carbon Dioxide	Methane	Oxygen		Carbon Dioxide	Methane
WS1	3.4 – 6.2	0 – 0	2.1 – 18.8	0	0.0062	0.0
WS3	0.5 – 3.6	0 – 0	14.1 – 19.9	0	0.0036	0.0
WS6	0.0 – 1.8	0 – 0	17.6 – 20.8	0	0.0018	0.0

Table 1: Summary of Assessment of the BEK Gas Monitoring Data

* Where gas flow or concentrations were recorded as zero, the limit of detection of the gas analyser was used (0.1 l/hr and 0.1 % v/v)

It can be seen from the above table that all boreholes have steady flow readings of zero, resulting in GSVs which are largely below the lowest threshold (0.07 l/hr).

However, consideration has also been given to the maximum concentrations recorded during the gas monitoring program. CIRIA 665 provides ‘typical maximum’ concentration of 5% for carbon dioxide and 1% for methane (Modified Wilson and Card classification) and if these typical maximum concentrations are exceeded then consideration should be given to installing measures which adhere to Characteristic Situation 2 (CS2).

It can be seen from the above table and the gas monitoring results (Annex B) that a carbon dioxide concentrations exceeded the typical maximum of 5% for carbon dioxide in Boreholes WS1 on multiple occasions.

Based on the above, it would be recommended that the site is characterised as CS2 (low risk).

Scope of Measures

In accordance with BS8485:2015+A1:2019, when determining the gas protection score, the Characteristic Situation and building type are taken into account. As discussed, the site has been characterised as CS2. BEK understands that the proposed development will comprise Type A buildings (Private housing). If the development changes from this then the risks will need to be re-assessed.

In accordance with Table 4 of BS8485:2015+A1:2019, it is considered that the gas protection score for this building type is:

CS2 Type A building = 3.5 points.

Determination of Protection Measures - New Builds

A combination of two or more of the following protection measures should be used to achieve the Gas Protection Score:



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- Structural barrier (floor slab)
- Ventilation measures
- Gas resistant membrane

Floor Slab

The floor will be precast suspended segmental subfloor (i.e. beam and block). Based on Table 5 of BS8485:2015+A1:2019, this will achieve a score of **0 points**.

Ventilation Measures

Based on Section B of Table 6 of BS8485:2015+A1:2019, ventilation protection measures should include a passive sub floor dispersal layer to achieve a score 1.5 to 2.5. 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

A gas protection score of **2.5** is achieved for very good performance and a score of **1.5** is achieved for good performance of the ventilation protection measures.

Gas Resistant Membrane

A low permeability methane and carbon dioxide resistant membrane which meets all of the requirements of Table 7 of BS8485:2015+A1:2019 will achieve a score of **2.0** points.

The manufacturer, membrane name and specification sheet should be forwarded to BEK and the EHO for assessment and approval prior to installation.

The membrane shall be extended across cavities and sealed around joints/service entries.

Gas Protection Score Summary

By implementing the above measures, the Gas Protection Score would be as follows:

Protection Measure	Score
Beam and block sub-floor	0
Ventilation Measures	1.5/2.5
Gas Resistant Membrane	2
Total	3.5/4.5



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Conclusions

Risks from ground gas are present at the site due to an off-site landfill located some 127 m north-east.

To mitigate the risks from ground gas, BEK recommends that all new builds should include gas mitigation measures in accordance with CS2. The recommended gas mitigation measures are summarised below:

Precast suspended segmental subfloor (i.e. beam and block) with passive subfloor dispersal layer such as clear void with a gas (carbon dioxide and methane) resistant membrane installed across the full footprint of the building. All joints and penetrations sealed. The installation of the gas measures will need to be independently validated.

The installation and validation of the gas mitigation measures should be carried out in accordance with a Gas Verification Plan.

I trust the above is satisfactory. Should you have any questions please contact the undersigned.

Yours sincerely

MICHAEL BUCKLEY

BSc (Hons) MSc MEnvSci CEnv

Rev	Date	Details of Amendments



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ANNEX A

Exploratory Records



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PROJECT NUMBER 23127	DATE 3rd October 2023
PROJECT NAME Crow Trees Brow, Chatburn	DRILLING METHOD Window Sample Borehole
CLIENT Pringle Homes	BOREHOLE NO WS1
	SHEET 1/6

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS Borehole dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Elevation (m)
0.2	0.1	D = 0.1 m					Grass onto brown silty clayey sand with frequent rootlets. (TOPSOIL)	0.2
0.4							Brown silty clayey sand	0.4
0.6							Stiff becoming very stiff brown sandy silty gravelly clay	0.6
0.8								0.8
1.0	1.0 - 1.45 1.0 - 1.5	SPT (C) N=11 B = 1.0 - 1.5 m	2,2/2,3,3,3					1.0
1.2								1.2
1.4								1.4
1.6	1.5	D = 1.5 m						1.6
1.8								1.8
2.0	2.0 - 2.45	SPT (C) N=15	2,3/3,4,4,4					2.0
2.2								2.2
2.4								2.4
2.6	2.6	D = 2.6 m					Very stiff brown sandy clay with limestone gravels	2.6
2.8							Termination Depth at: 2.8 m	2.8



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PROJECT NUMBER 23127	DATE 3rd October 2023
PROJECT NAME Crow Trees Brow, Chatburn	DRILLING METHOD Window Sample Borehole
CLIENT Pringle Homes	BOREHOLE NO WS2
	SHEET 2/6

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS Borehole dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Elevation (m)
0.2	0.15	D = 0.15 m					MADE GROUND: Tarmacadam onto black/brown gravelly sand, with rare broken brick fragments and occasional small cobble	0.2
0.4							Brown silty clayey sand	0.4
0.6							Stiff becoming very stiff brown sandy silty gravelly clay	0.6
1.0	1.0 - 1.45	SPT (C) N=10	2,2/2,2,3,3					1
1.2	1.2	D = 1.2 m						1.2
2.0	2.0 - 2.45	SPT (C) N=22	3,3/4,5,8,10					2
2.2							Black/grey limestone	2.2
2.4	2.5	D = 2.5 m						2.4
2.6							Termination Depth at: 2.5 m	2.6
2.8								2.8



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PROJECT NUMBER 23127	DATE 3rd October 2023
PROJECT NAME Crow Trees Brow, Chatburn	DRILLING METHOD Window Sample Borehole
CLIENT Pringle Homes	BOREHOLE NO WS3
	SHEET 3/6

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS Borehole dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Elevation (m)
0.2	0.15	D = 0.15 m					Grass onto brown silty clayey sand with frequent rootlets. (TOPSOIL)	0.2
0.4							Brown silty clayey sand	0.4
0.6							Stiff becoming very stiff brown sandy silty gravelly clay	0.6
0.8								0.8
1.0	1.0	D = 1.0 m						1.0
1.2	1.0 - 1.45	SPT (C) N=11	2,2/2,2,3,3					1.2
1.4								1.4
1.6	1.5 - 2.0	B = 1.5 - 2.0 m						1.6
1.8								1.8
2.0	2.0 - 2.45	SPT (C) N=24	3,3/4,4,6,10					2.0
2.2								2.2
2.4							Black/grey limestone	2.4
2.6	2.5	D = 2.5 m					Termination Depth at: 2.5 m	2.6
2.8								2.8



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PROJECT NUMBER 23127	DATE 3rd October 2023
PROJECT NAME Crow Trees Brow, Chatburn	DRILLING METHOD Window Sample Borehole
CLIENT Pringle Homes	BOREHOLE NO WS4
	SHEET 4/6

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS Borehole dry. Refusal at 1.50 m.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Elevation (m)
0.2	0.15	D = 0.15 m					Grass onto brown silty clayey sand with frequent rootlets. (TOPSOIL)	0.2
0.4	0.5	D = 0.5 m					Brown silty clayey sand	0.4
0.6	0.5 - 1.0	B = 0.5 - 1.0 m					Stiff brown sandy silty clay with occasional gravels	0.6
1.0	1.0 - 1.45	SPT (C) N=10	2,2/2,2,3,3				Black/grey limestone	1.0
1.2								1.2
1.4								1.4
1.6							Termination Depth at: 1.5 m	1.6
1.8								1.8
2.0								2.0
2.2								2.2
2.4								2.4
2.6								2.6
2.8								2.8



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PROJECT NUMBER 23127	DATE 3rd October 2023
PROJECT NAME Crow Trees Brow, Chatburn	DRILLING METHOD Window Sample Borehole
CLIENT Pringle Homes	BOREHOLE NO WS5
	SHEET 5/6

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS Borehole dry. Refusal at 1.60 m.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Elevation (m)
0.2	0.2	D = 0.2 m					Grass onto brown silty clayey sand with frequent rootlets. (TOPSOIL)	0.2
0.4							Brown silty clayey sand	0.4
0.6							Stiff brown sandy silty gravelly clay	0.6
0.8								0.8
1.0	1.0	D = 1.0 m						1.0
1.0 - 1.45		SPT (C) N=11	2,2/2,3,3,3					1.2
1.2								1.4
1.4								1.6
1.6							Black/grey limestone	1.6
1.6							Termination Depth at: 1.6 m	1.8
1.8								2.0
2.0								2.2
2.2								2.4
2.4								2.6
2.6								2.8
2.8								



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PROJECT NUMBER 23127	DATE 3rd October 2023
PROJECT NAME Crow Tree Brow, Chatburn	DRILLING METHOD Window Sample Borehole
CLIENT Pringle Homes Limited	BOREHOLE NO WS6
	SHEET 6/6

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS Borehole dry. Refusal at 1.5 m.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Elevation (m)
0.2	0.15	D = 0.15 m					Grass onto brown silty clayey sand with frequent rootlets. (TOPSOIL)	0.2
0.4							Brown silty clayey sand	0.4
0.6							Stiff brown sandy silty gravelly clay	0.6
0.8	0.8	D = 0.8 m						0.8
1.0	1.0 - 1.45	SPT (C) N=11	2,2/2,2,3,3					1.0
1.2								1.2
1.4							Black/grey limestone	1.4
1.6							Termination Depth at: 1.5 m	1.6
1.8								1.8
2.0								2.0
2.2								2.2
2.4								2.4
2.6								2.6
2.8								2.8



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PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP1 SHEET 1/11
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COMPLETION

COMMENTS Shear Vane at 0.8 m = 80 KPa, at 1.2 m = >120 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1						MADE GROUND: Grass onto cobble set	0.1
0.2	0.25	D = 0.25 m				Black/grey very gravelly sand with occasional broken brick	0.2
0.3						Brown clayey sand with rare clay pockets	0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7						Brown sandy gravelly clay, occasional small cobbles	0.7
0.8							0.8
0.9							0.9
1							1
1.1							1.1
1.2							1.2
1.3							1.3
1.4							1.4
1.5							1.5
1.6							1.6
1.7							1.7
1.8							1.8
1.9							1.9
2						Black/grey limestone	2
2.1						Termination Depth at: 2.1 m	2.1



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PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP2 SHEET 2/11
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COMPLETION

COMMENTS Shear Vane at 1.2 m = 92 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.15	D = 0.15 m				MADE GROUND: Grass onto black/grey very gravelly sand with occasional whole and broken brick and small cobbles	0.1
0.2						Brown silty clayey sand	0.2
0.3						Brown silty clayey sand	0.3
0.4						Brown silty clayey sand	0.4
0.5						Brown silty clayey sand	0.5
0.6						Brown sandy gravelly clay with occasional small cobbles	0.6
0.7						Brown sandy gravelly clay with occasional small cobbles	0.7
0.8						Brown sandy gravelly clay with occasional small cobbles	0.8
0.9						Brown sandy gravelly clay with occasional small cobbles	0.9
1						Brown sandy gravelly clay with occasional small cobbles	1
1.1						Brown sandy gravelly clay with occasional small cobbles	1.1
1.2						Brown sandy gravelly clay with occasional small cobbles	1.2
1.3						Brown sandy gravelly clay with occasional small cobbles	1.3
1.4						Brown sandy gravelly clay with occasional small cobbles	1.4
1.5						Brown sandy gravelly clay with occasional small cobbles	1.5
1.6						Brown sandy gravelly clay with occasional small cobbles	1.6
1.7						Black/grey limestone	1.7
1.8						Termination Depth at: 1.8 m	1.8
1.9							1.9
2							2
2.1							2.1



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PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP3 SHEET 3/11
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COMPLETION

COMMENTS Shear Vane at 1 m = 76 KPa, at 2 m = 62 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2						Brown silty clayey sand	0.2
0.3							0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7							0.7
0.8							0.8
0.9							0.9
1						Brown sandy gravelly clay with occasional small cobbles	1
1.1							1.1
1.2							1.2
1.3							1.3
1.4							1.4
1.5							1.5
1.6							1.6
1.7							1.7
1.8							1.8
1.9							1.9
2						2	
2.1						2.1	
2.4						Termination Depth at: 2.1 m	2.4



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PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP4 SHEET 4/11
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COMPLETION

COMMENTS Shear Vane at 0.8 m = 99 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2						Brown silty clayey sand	0.2
0.3							0.3
0.4							0.4
0.5							0.5
0.6						Brown sandy gravelly clay with occasional small cobbles	0.6
0.7							0.7
0.8							0.8
0.9						Organic peat	0.9
1						Shale	1
1.1							1.1
1.2						Termination Depth at: 1.2 m	1.2
1.3							1.3
1.4							1.4
1.5							1.5
1.6							1.6
1.7							1.7
1.8							1.8
1.9							1.9
2							2
2.1							2.1



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PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP5 SHEET 5/11
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COMPLETION

COMMENTS Shear Vane at 0.6 m = 91 KPa, at 1.6 m = 82 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2						Brown silty clayey sand	0.2
0.3						Brown sandy gravelly clay with occasional small cobbles	0.3
0.4						Brown very sandy gravelly cobbly clay	0.4
0.5						Brown very sandy gravelly cobbly clay	0.5
0.6						Brown very sandy gravelly cobbly clay	0.6
0.7						Brown very sandy gravelly cobbly clay	0.7
0.8						Brown very sandy gravelly cobbly clay	0.8
0.9						Brown very sandy gravelly cobbly clay	0.9
1						Brown very sandy gravelly cobbly clay	1
1.1						Brown very sandy gravelly cobbly clay	1.1
1.2						Brown very sandy gravelly cobbly clay	1.2
1.3						Brown very sandy gravelly cobbly clay	1.3
1.4						Brown very sandy gravelly cobbly clay	1.4
1.5						Brown very sandy gravelly cobbly clay	1.5
1.6						Brown very sandy gravelly cobbly clay	1.6
1.7						Brown very sandy gravelly cobbly clay	1.7
1.8						Brown very sandy gravelly cobbly clay	1.8
1.9						Brown very sandy gravelly cobbly clay	1.9
2						Termination Depth at: 2.0 m	2
2.1							2.1



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PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP6 SHEET 6/11
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COMPLETION

COMMENTS Shear Vane at 1.0 m = 87 KPa, at 1.6 m = 115 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2						Brown silty clayey sand	0.2
0.3						Brown sandy gravell clay with occasional small cobbles	0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7							0.7
0.8							0.8
0.9							0.9
1							1
1.1							1.1
1.2							1.2
1.3						1.3	
1.4						1.4	
1.5						1.5	
1.6	1.6	B = 1.6 m					1.6
1.7							1.7
1.8						Sandstone to the south and limestone to the north of the trial pit	1.8
1.9							1.9
2						Termination Depth at: 2.0 m	2
2.1							2.1



GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP7 SHEET 7/11
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COMPLETION

COMMENTS Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1						Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2	0.2	D = 0.2 m					0.2
0.3						Brown silty clayey sand	0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7						Black/grey limestone	0.7
0.8							0.8
0.9							0.9
1.0							1.0
1.1					Termination Depth at: 0.9 m		1.1
1.2							1.2
1.3							1.3
1.4							1.4
1.5							1.5
1.6							1.6
1.7							1.7
1.8							1.8
1.9							1.9
2.0							2.0
2.1							2.1



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP8 SHEET 8/11
---	--

COMPLETION

COMMENTS Shear Vane at 0.8 m = 77 KPa, at 1.4 m = 42 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.15	D = 0.15 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2						Brown silty clayey sand	0.2
0.3							0.3
0.4							0.4
0.5						Brown sandy gravelly clay with occasional small cobbles	0.5
0.6							0.6
0.7							0.7
0.8							0.8
0.9							0.9
1							1
1.1							1.1
1.2							1.2
1.3							1.3
1.4							1.4
1.5							1.5
1.6							1.6
1.7						Black/grey limestone	1.7
1.8						Termination Depth at: 1.8 m	1.8
1.9							1.9
2							2
2.1							2.1



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP9 SHEET 9/11
---	--

COMPLETION

COMMENTS Shear Vane at 1.5 m = 60 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2							0.2
0.3							0.3
0.4						Brown silty clayey sand	0.4
0.5							0.5
0.6							0.6
0.7							0.7
0.8							0.8
0.9							0.9
1							1
1.1							1.1
1.2						Brown sandy gravelly clay with occasional small cobbles	1.2
1.3							1.3
1.4							1.4
1.5	1.5	B = 1.5 m					1.5
1.6							1.6
1.7							1.7
1.8							1.8
1.9							1.9
2						Black/grey limestone	2
2.1						Termination Depth at: 2.1 m	2.1



GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP10 SHEET 10/11
---	--

COMPLETION

COMMENTS Shear Vane at 0.7 m = 100 KPa, at 1.3 m = 54 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2							0.2
0.3							0.3
0.4							0.4
0.5						Brown silty clayey sand	0.5
0.6							0.6
0.7						Brown sandy gravelly clay with occasional small cobbles	0.7
0.8							0.8
0.9							0.9
1.0	1.0	B = 1.0 m					1.0
1.1							1.1
1.2							1.2
1.3							1.3
1.4							1.4
1.5							1.5
1.6							1.6
1.7						Black/grey limestone	1.7
1.8						Termination Depth at: 1.8 m	1.8
1.9							1.9
2.0							2.0
2.1							2.1



GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 23127 PROJ. NAME Crow Trees Brow, Chatburn CLIENT Pringle Homes	DATE 2nd October 2023 EXCAVATION METHOD Trial Pit TRIAL PIT NO TP11 SHEET 11/11
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COMPLETION

COMMENTS Shear Vane at 0.5 m = 82 KPa, at 1.0 m = 60 KPa. Trial Pit Dry.

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Elevation (m)
0.1	0.1	D = 0.1 m				Grass onto black very silty clayey sand with occasional rootlets. (TOPSOIL)	0.1
0.2						Brown silty clayey sand	0.2
0.3						Brown silty clayey sand	0.3
0.4						Brown sandy gravelly clay with occasional small cobbles	0.4
0.5						Brown sandy gravelly clay with occasional small cobbles	0.5
0.6						Brown sandy gravelly clay with occasional small cobbles	0.6
0.7						Brown sandy gravelly clay with occasional small cobbles	0.7
0.8						Brown sandy gravelly clay with occasional small cobbles	0.8
0.9						Brown sandy gravelly clay with occasional small cobbles	0.9
1						Brown sandy gravelly clay with occasional small cobbles	1
1.1						Brown sandy gravelly clay with occasional small cobbles	1.1
1.2						Brown sandy gravelly clay with occasional small cobbles	1.2
1.3						Brown sandy gravelly clay with occasional small cobbles	1.3
1.4						Brown sandy gravelly clay with occasional small cobbles	1.4
1.5						Brown sandy gravelly clay with occasional small cobbles	1.5
1.6						Brown sandy gravelly clay with occasional small cobbles	1.6
1.7						Black/grey limestone	1.7
1.8						Termination Depth at: 1.8 m	1.8
1.9							1.9
2							2
2.1							2.1



GEO-ENVIRONMENTAL CONSULTING

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ANNEX B

Gas Monitoring Data

Ground Gas Monitoring Record

Borehole No	Gas Flow (L/hr)		Borehole Pressure (Pa)	Methane (%v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H ₂ S (ppm)		CO (ppm)		Hex (%v/v)		Depth to Water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady						
WS6	0.0	0.0		0	0			1.4	1.8	18.8	17.6	0.0	0.0	0.0	0.0			Dry	1.54	999	
WS1	0.0	0.0		0	0			3.4	3.6	14.4	14.0	0.0	0.0	0.0	0.0			Dry	2	999	
WS3	0.0	0.0																Dry	2.28		

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by:	MLM
Weather :	Wet, Rainy, Cloudy
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	Bung in WS3 was blocked as ground surrounding collapsed - See photos in file
	
	Contract: Crows Trees Farm
	Date: 11/10/23
	Job No. 23127
	Sheet No. 1

Ground Gas Monitoring Record

Borehole No	Gas Flow (L/hr)		Borehole Pressure (Pa)	Methane (%v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H ₂ S (ppm)		CO (ppm)		Hex (%v/v)		Depth to Water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS6	0.0	0.0		0	0			1.1	1.0	18.2	18.8	0.0	0.0	0.0	0.0			Dry	1.52	955	
WS1	0.0	0.0		0	0			5.6	6.2	5.1	3.8	0.0	0.0	0.0	0.0			1.73	2.03	956	ed to collect a reading) See pictures in file
WS3	0.0	0.0		0.00	0.00			3.6	3.5	14.1	14.3	0.0	0.0	0.0	0.0			Dry	2.34	956	

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring

Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	MLM Dry, Cloudy GFM436 Gas Analyser None None WS1 Borehole flooded (still managed to collect a reading) See photos in file		Contract: Crows Trees Farm <hr/> Date: 02/11/23 <hr/> Job No. 23127 <hr/> Sheet No. 2
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Ground Gas Monitoring Record

Borehole No	Gas Flow (L/hr)		Borehole Pressure (Pa)	Methane (%v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H ₂ S (ppm)		CO (ppm)		Hex (%v/v)		Depth to Water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS6	0.0	0.0		0	0			1.3	1.6	18.3	17.8	0.0	0.0	0.0	0.0			Dry	1.55	1009	
WS1	0.0	0.0		0	0			5.8	6.0	2.6	2.1	0.0	0.0	0.0	0.0			1.7	2.04	1007	
WS3	0.0	0.0		0.00	0.00			1.5	1.0	16.9	18.6	0.0	0.0	0.0	0.0			Dry	2.33	1007	

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by:	MLM
Weather :	Dry sunny slightly cloudy
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	
Contract:	Crows Trees Farm
Date:	17/11/23
Job No.	23127
Sheet No.	3



Ground Gas Monitoring Record

Borehole No	Gas Flow (L/hr)		Borehole Pressure (Pa)	Methane (%v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H ₂ S (ppm)		CO (ppm)		Hex (%v/v)		Depth to Water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS6	0.0	0.0		0	0			1.1	1.3	18.2	17.7	0.0	0.0	0.0	0.0			1.46	1.56	988	
WS1	0.0	0.0		0	0			3.8	3.9	7.7	6.7	0.0	0.0	0.0	0.0			1.68	2.02	988	
WS3	0.0	0.0		0.00	0.00			1.8	1.7	17.5	17.9	0.0	0.0	0.0	0.0			Dry	2.34	987	

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	MLM Dry, slight cloud, light rain GFM436 Gas Analyser None None
	
	Contract: Crows Trees Farm Date: 08/12/23 Job No. 23127 Sheet No. 4

Ground Gas Monitoring Record

Borehole No	Gas Flow (L/hr)		Borehole Pressure (Pa)	Methane (%v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H ₂ S (ppm)		CO (ppm)		Hex (%v/v)		Depth to Water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady						
WS6	0.0	0.0		0	0			0.8	1.2	19.7	18.2	0.0	0.0	0.0	0.0			1.46	1.61	1007	
WS1	0.0	0.0		0	0			3.8	4.6	7.4	4.9	0.0	0.0	0.0	0.0			1.73	2.05	1006	
WS3	0.0	0.0		0.00	0.00			0.7	0.5	19.2	19.9	0.0	0.0	0.0	0.0			Dry	2.34	1007	

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	MLM Cloudy, Dry GFM436 Gas Analyser None None
	
	Contract: Crows Trees Farm Date: 19.12.23 Job No. 23127 Sheet No. 5

Ground Gas Monitoring Record

Borehole No	Gas Flow (L/hr)		Borehole Pressure (Pa)	Methane (%v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H ₂ S (ppm)		CO (ppm)		Hex (%v/v)		Depth to Water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments	
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady							
WS6	0.0	0.0		0	0			1.2	0.9	20.0	21.1	0.0	0.0	0.0	0.0			1.47	1.57	988		
WS1	0.0	0.0		0	0			3.9	4.8	8.0	6.2	0.0	0.0	0.0	0.0			1.78	2.05	988		
WS3	0.0	0.0		0.00	0.00			0.1	0.0	19.7	20.8	0.0	0.0	0.0	0.0			Dry	2.35	987		

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by:	MLM
Weather :	Rainy cloudy
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	
	 GEO-ENVIRONMENTAL CONSULTING ENGINEERS
	Contract: Crows Trees Farm
	Date: 04.01.24
	Job No. 23127
	Sheet No. 6



GEO-ENVIRONMENTAL CONSULTING

BEK Geo-Environmental Consulting

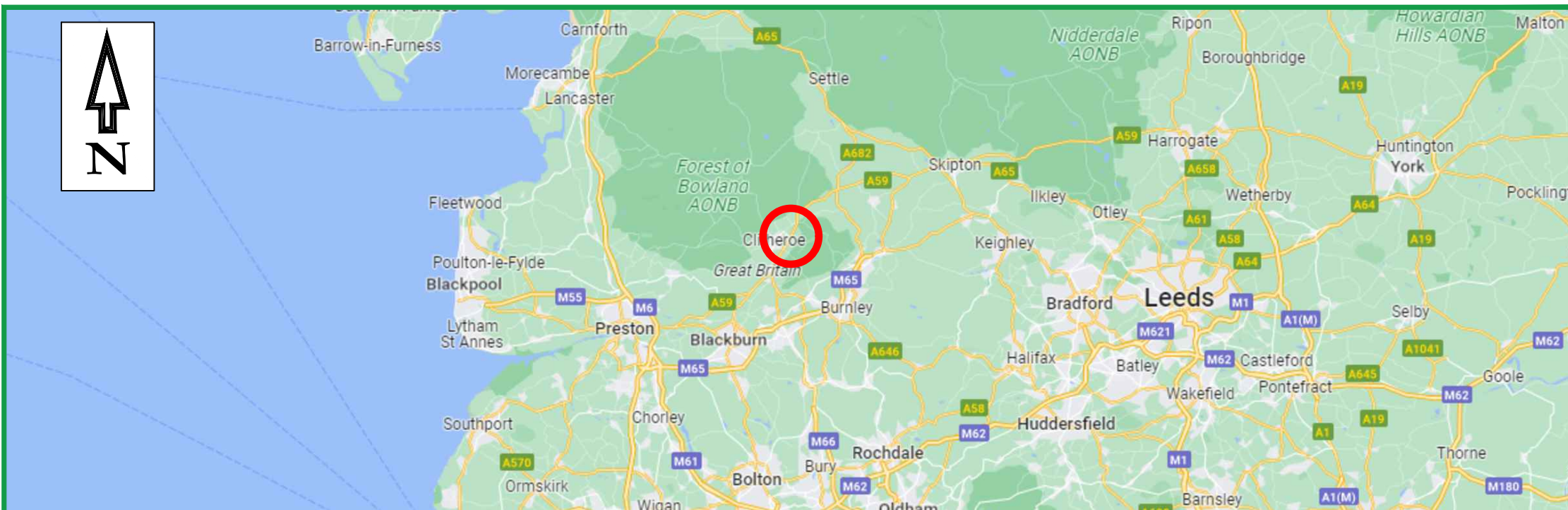
No.2 Landwick Court, Metcalf Drive, Altham Business Park,
Lancashire BB5 5TU

mbuckley@bekenviro.co.uk
bekenviro.co.uk


01254 377622

ANNEX C

Drawings



LEGEND

 SITE LOCATION

REV	DESCRIPTION	DATE	BY



GEO-ENVIRONMENTAL CONSULTING
 No 2 Landwick Court, Metcalf Drive, Altham Business Park, Lancashire
 Tel: 01254 377622 Mob: 07906753583
 Email: mbuckley@bekenviron.co.uk
 Web: www.bekenviron.co.uk

CLIENT.
 PRINGLE HOMES

JOB TITLE.
 LAND AT CROWS TREES FARM, CHATBURN


DRAWING TITLE.
 SITE LOCATION PLAN

SCALE © A3. N'TS	DRAWN BY. D.E.	APPROVED BY. M.B.	DATE. 16/10/23
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DRAWING No. 23127-1	REV. -
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LEGEND

 SITE FOOTPRINT

REV	DESCRIPTION	DATE	BY



GEO-ENVIRONMENTAL CONSULTING
No 2 Landwick Court, Metcalf Drive, Altham Business Park, Lancashire, BB5 5GY
Tel: 01254 377622 Mob: 07906753583
Email: mbuckley@bekenviro.co.uk
Web: www.bekenviro.co.uk

CLIENT.

PRINGLE HOMES

JOB TITLE.

LAND AT CROWS TREES
FARM CHATBURN

DRAWING TITLE.





SITE LAYOUT PLAN

SCALE © A3. N'TS	DRAWN BY. D.E.	APPROVED BY. M.B.	DATE. 16/10/23
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DRAWING No. 23127-2	REV. -
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LEGEND

-  WINDOW SAMPLE BOREHOLE
-  WINDOW SAMPLE BOREHOLE (GAS/GROUNDWATER PROBES)
-  TRIAL PIT
-  TRIAL PIT (INFILTRATION TEST)

REV	DESCRIPTION	DATE	BY
A	ADDITIONAL SI	23/11/23	DE



GEO-ENVIRONMENTAL CONSULTING
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CLIENT.
 PRINGLE HOMES

JOB TITLE.
 LAND AT CROWS TREES FARM, CHATBURN

DRAWING TITLE.
 SITE INVESTIGATION PLAN

SCALE © A3. N'TS	DRAWN BY. D.E.	APPROVED BY. M.B.	DATE. 16/10/23
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DRAWING No. 23127-3	REV. A
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