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## Merchant Fields, Cleckheaton – Gas risk assessment

Further to issue of our Geoenvironmental Appraisal Report (No. 2828/1a, dated July 19), gas monitoring at the above site has now been completed and we are able to issue this supplementary letter report, together with copies of the monitoring results. This letter, which should be read in conjunction with Report No 2828/1a, reviews soil-gas conditions, assesses risks and details any mitigation measures required to render the site suitable for the proposed development.

### Background

The site is located approximately 1.2 km north of Cleckheaton town centre at NGR SE 190 264. The site comprises a single parcel of land of approximately 12.1 hectares (29.7 acres).

In relation to hazardous gas, the above-mentioned report found:

- a former landfill site 230m to the northwest (operated between 1979 and 1994), accepted industrial, non-hazardous and Inert wastes including industrial effluent treatment sludge
- shallow mineworkings are recorded in the area and are likely to underlie the site (less than 30m from surface)
- a backfilled quarry is located 100m east of the site, likely backfilled by 1957 (the nature of the backfill is unknown)

Based on the above, it was considered that the site might be at risk from hazardous gas and therefore monitoring wells were installed in 19 boreholes. Details of the individual installations are provided in Report No 2828/1A and the exploratory logs appended to this letter report.

The proposed residential development comprises 307 traditional two storey domestic dwellings, associated gardens, POS and adoptable roads and sewers, as shown on Drawing 2828/2 in Report No 2828/1a. The houses will likely be founded on traditional strip / trench fill footings.

### Scope of works

The generation potential of the gas source was initially considered to be Low and this has been confirmed by the monitoring results obtained. Consequently, in accordance with CIRIA Report C665, given the proposed residential end use, 9 visits have been completed over a 6 month period, between April and October 2019.



A standard procedure was followed in accordance with CIRIA guidance; this procedure involved measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring
- Methane, oxygen and carbon dioxide concentrations and flow rates using a Gas Data GFM430 infra-red gas analyser
- Standing water level using a dipmeter

## Gas monitoring results

The monitoring results are enclosed and summarised below:

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
PH01A	3.0m to 6.0m (sandstone and mudstone)	N.D.	0.1 – 1.5	N.D.
PH02A	2.0 m to 4.0m (sandstone and mudstone)	N.D.	0.1 – 3.6	N.D. – 3.2
PH03A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.5 – 2.5	N.D.
PH04A	2.0 m to 4.0m (Coal, sandstone and mudstone)	N.D.	1.1 – 5.4	N.D. – 1.5
PH05A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.0 – 0.5	N.D.
PH06A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.2 – 2.7	N.D.
PH08A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.1 – 1.7	N.D.
PH09A	2.0 m to 6.0m (sandstone and mudstone)	N.D.	0.7 – 3.5	N.D.
PH10A	2.0 m to 4.0m (sandstone and mudstone)	N.D.	0.5 – 2.3	N.D.
PH11A	2.0 m to 4.0m (sandstone and mudstone)	N.D.	0.4 – 4.0	N.D.
PH12A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.6 – 3.3	N.D.
PH13A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.6 – <b>6.6</b>	N.D.
PH14A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.4 – <b>6.9</b>	N.D.
PH15A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.1 – 0.7	N.D.
PH16A	3.0 m to 6.0m (Coal, sandstone and mudstone)	N.D.	0.6 – 3.2	N.D.
PH17A	3.0 m to 6.0m (Coal, sandstone and mudstone)	N.D.	0.5 – 2.4	N.D. – 1.4
PH18A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.1 – 2.0	N.D.
PH19A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.8 – 2.8	N.D. – 48.9

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
PH20A	3.0 m to 6.0m (sandstone and mudstone)	N.D.	0.7 – 6.7	N.D. – 0.8

Note: Atmospheric pressures varied between 986mb and 1014mb.

In accordance with the DETR approach, a value of 3.2 litres/hour has been used to calculate the gas screening value as the highest recorded steady flow.

A steady flow of 48.9 l/hr was reported during visit 9 in PH19A. However, monitoring ceased after 30 seconds; this did not allow enough time for a steady state to be established. It is considered highly likely that this was a peak flow rather than steady. Flow was not recorded in this, or any other monitoring location at this volume during any other visit. Given the uncertainty in this value it was not considered appropriate to use it to calculate the site wide GSV.

During 5 of the 9 monitoring visits, atmospheric pressure was falling, including one where the pressure was below 1000mb. Plots of atmospheric pressure versus time, with the monitoring visits indicated, are appended to this letter report.

### Current guidance

Generic Notes (01 Site Characterisation) outlining how monitoring results are interpreted are enclosed.

### Current gas regime

The proposed development comprises low rise residential housing. Consequently, the gas regime has been characterised in accordance with the Situation B (traffic light) methodology outlined in CIRIA Report C665.

Based on worst-case (peak) gas concentrations and steady flows, Gas Screening Values (GSV) for carbon dioxide is 0.32 (no methane was detected). This GSV equates to a Green gas regime (traffic light) for this site.

Steady concentrations of carbon dioxide have been recorded slightly in excess of the Amber 1 lower threshold (5%) in two boreholes (PH13A & 14A) on three occasions, and in PH20A on one occasion. However, concentrations were consistently below 7%v/v. These elevations are not considered to represent "Typical Maximum Concentrations" and no re-evaluation of the site characterisation is required based on these elevations.

Where Green, Lithos also consider the site in accordance with Situation A methodology (which does not assume a ventilated sub-floor) to check whether or not it lies within Characteristic Situation 1 (in which case no measures would be appropriate), or Characteristic Situation 2 (in which case a ventilated sub-floor void and membrane should be required). The carbon dioxide GSV of 0.23 classes as Characteristic Situation 2.

## Scope of protection measures

Based on the site characterisation (Traffic Light) discussed above, the proposed foundation solution, and with reference to the gas protection “scoring” system outlined in BS8485:2015+A1:2019, Lithos consider that the following protective measures should be incorporated in all new dwellings:

Traffic light classification and “score” req’d by BS8485#	Floor slab (BS8485 “score”)	Protective measures	
		Sub-floor ventilation (BS8485 “score”)	Membrane
			Type (BS8485 “score”)
<b>Green &amp; CS2</b> (Wilson & Card)  <b>2.5*</b>	<i>Select one from:</i>  i. Block & Beam – <b>(0)</b> . ii. Reinforced ground bearing slab – <b>(0.5)</b> . iii. Reinforced, cast in-situ suspended slab (with minimal and suitably sealed service penetrations & joints) – <b>(1.5)</b> . iv. Reinforced ground bearing raft (with limited service penetrations cast into slab). Note: the venting area through any downstand beam should be 3 times greater than that provided by the side ventilation (air bricks) – <b>(1.5)</b> .	<i>Select one from:</i>  Passive sub-floor ventilation; venting layer could be: i. A min. 150mm clear void <b>(2.5)</b> , or ii. A proprietary void former providing an equivalent clear void depth of 60mm; see Section B7 in BS8485 <b>(2.5)</b> , or iii. Min. 300mm thick blanket of min. 20mm single size gravel <b>(1.0)</b> .  Min. ventilation = 1,500 mm <sup>2</sup> /m run of external wall (via air bricks on each of 2 opposite sides), with 100mm pipes at 1.75m centres or honeycombing of any sub-floor sleeper walls.	Waterproof DPM (2000 gauge polyethylene). Lapped & sealed in accordance with BR 414. <b>(0)</b>

### Footnotes:

- # Scores are broadly based on those outlined in BS8485:2015+A1:2019 (for Characteristic Situations 2 & 3, and Building Type A).
- \* Modified from BS8485:2015+A1:2019 by Lithos. Monitoring data has also been reviewed using Wilson & Card methodology and found to be Characteristic Situation 2; consequently a lapped/sealed membrane & ventilation are recommended.
- Note NHBC guidance only requires membranes to be certified on Amber 2 sites. However, BS8485 is considered to ‘outrank’ NHBC guidance, and it would be prudent to comply with this Standard and CIRIA C735. Furthermore, (YALPAG) local authorities have issued guidance requiring a detailed verification method statement in advance of the construction phase. This should address how gas measures will be installed and what verification information will be provided to demonstrate that installation has been carried out in accordance with the appropriate guidance.
1. A combination of two or more of the three types of protection measures (slab, ventilation & membrane) should be used to achieve the BS8485 score.
  2. The membrane should always be lapped and sealed in accordance with BRE\Environment Agency Report BR 414 (2001) – “Protective Measures for housing on gas-contaminated land”. The membrane should be **continuous** across internal walls & the cavity, and there should be a **cavity tray** in external walls.
  3. In all cases there should be minimum penetration of floor slab by **services**; any penetrations should be suitably sealed.
  4. Integral **garages** with occupied rooms above, or direct access through a doorway from the garage to the house, should be provided with the same protective measures as the rest of the dwelling. Buildings with basement car parks (with ventilation in accordance with Building Regulations) may not require gas resistant membranes.

Whilst formal verification of gas measures on sites with Green/CS2 classification is not required, the ventilated sub floor void should be constructed appropriately and does form the primary means of protection from ground gas within the conceptual site model that underpins the Green classification. As such Lithos would recommend the first plot, and 1 in 20 plots thereafter, be inspected to confirm the void, vents and membrane meet with requirements outlined in the table above.

BRE\Environment Agency Report BR 414 (2001) – “*Protective Measures for housing on gas-contaminated land*” provides a practical guide to good practice for the detailing and construction of passive soil gas protection measures for new residential development. Of particular relevance are a list of ‘Watchpoints’, which offer practical information for installation and buildability.

We trust the above is sufficient for your present needs, but should you have any queries please contact the undersigned.

Yours sincerely

REDACTED

Liz Hart  
Associate Director  
**for and on behalf of**  
**LITHOS CONSULTING LIMITED**

**Enclosures:**

Drawing 2828/13 – Borehole Location Plan  
Gas Monitoring Results  
Plot of Atmospheric vs Time  
Borehole Logs

**Appendix A**  
**General Notes**

#### General

Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency). In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 01 – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark Information Group, the Environment Agency and the Local Authority and the British Geological Survey. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

#### Sources

Potential sources of hazardous gas include:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a "carrier" for hazardous gas
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

#### Generation

Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

#### Migration

Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

#### Gas monitoring procedure

Lithos adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration
- Gas emission rate
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism. Where samples of gas are required for laboratory analysis, Gresham Tubes or multi-layer Tedlar / ALTEF sampling bags are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

#### Current guidance

CIRIA Report 151 (1995)<sup>i</sup> identified that there was inadequate guidance on trigger concentrations for ground gases. CIRIA concluded that the most important aspect of a gas regime below or adjacent to a site was the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. CIRIA Report C665 (2007)<sup>ii</sup> advocates two methodologies for characterising sites:

**A** – All developments except low rise housing. The advocated methodology is that proposed by Wilson & Card, 1999<sup>iii</sup>

**B** – Low rise housing. An alternative (traffic light) methodology, derived by Boyle and Witherington, 2006<sup>iv</sup> for NHBC

Both methodologies refer to Gas Screening Values (GSV); previously referred to as limiting borehole gas volume flow.

### A – All developments except low rise housing

(Wilson & Card, 1999)<sup>v</sup> revised Table 28 of CIRIA 149<sup>iv</sup> in terms of borehole gas volume flow rate (now GSV) in order to achieve a more consistent design of protection measures. This was done to reflect the importance of recognising the gas surface emission rate. Wilson & Card then developed a method for classifying gassing sites (Table 1 below), which took into account the combined gas concentration and GSV.

Characteristic Situation	Gas Screening Value, CH <sub>4</sub> or CO <sub>2</sub> (l/hr)	Additional limiting factors	Typical source of generation
1	<0.07	Methane not to exceed 1% v/v and carbon dioxide not to exceed 5% v/v	Natural soils with low organic content
2	<0.7	Borehole air flow rate not to exceed 70 litre/hr otherwise increase to Characteristic Situation 3	Natural soil, high peat/organic content
3	<3.5		Old landfill, inert waste, mineworkings flooded.
4	<15	Quantitative Risk Assessment required to evaluate scope of protection measures.	Mineworkings – susceptible to flooding, completed landfill, inert waste
5	<70		Mineworkings unflooded, inactive
6	>70		Recent landfill site

**Notes:** Borehole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr). Gas Screening Value (litre/hour) = gas concentration (%) / 100 x borehole flow rate (l/hr). To facilitate design implementation, the limiting values for both methane and carbon dioxide are identical.

### B – Low rise housing.

NHBC have developed a characterisation system similar to that of Wilson & Card above, but specific to low-rise housing development (Boyle and Witherington) (Table 8.7). This approach compares measured gas emission rates with generic "Traffic Lights". The Traffic Lights include "Typical Maximum Concentrations" for initial screening, and risk-based Gas Screening Values (GSVs) for consideration of situations where the Typical Maximum Concentrations are exceeded. Calculations are carried out for both methane and carbon dioxide and the worst case adopted in order to establish the appropriate protection measures.

Table 8.7 NHBC Traffic light system for 150 mm void

Traffic Light Classification	Methane <sup>1</sup>		Carbon Dioxide <sup>1</sup>	
	Typical Maximum Concentration <sup>5</sup> (%v/v)	Gas Screening Value <sup>2,4,6</sup> (l/hr)	Typical Maximum Concentration <sup>5</sup> (%v/v)	Gas Screening Value <sup>2,3,4,6</sup> (l/hr)
Green	1	0.16	5	0.78
Amber 1	5	0.63	10	1.56
Amber 2	20	1.56	30	3.13
Red				

**Notes:**

- The worst gas-regime identified at the site, either methane or carbon dioxide, recorded from monitoring in the worst temporal conditions, will be the decider for which Traffic Light and GSV is allocated.
- Generic GSVs are based on guidance contained within "The Building Regulations: Approved Document C" (2004) and assume a sub-floor void of 150 mm thickness.
- A leak of gas from the sub-floor void into a small room (e.g. downstairs toilet with soil pipe potentially passing into sub-floor void) of dimensions 1.50m x 1.50m x 2.50m, with a total room volume of 5.63m<sup>3</sup> has been considered.
- The GSV, in litres per hour, is as defined in Wilson and Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.
- The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgment will be required, based on a thorough understanding of the gas regime identified at the site where monitoring in the worst temporal conditions has occurred.
- The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

<sup>i</sup> Harries CR, Witherington PJ and McEntee JM (1995). *Interpreting measurements of gas in the ground*. CIRIA Report 151

<sup>ii</sup> CIRIA (2007) – *Assessing risks posed by hazardous ground gases to buildings*.

<sup>iii</sup> Wilson SA and Card GB (February 1999). *Reliability and Risk in Gas Protection Design*. Ground Engineering.

<sup>iv</sup> Boyle & Witherington (2006) – *Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights"*. Report Ref. 10627-R01-(02), for NHBC

<sup>v</sup> Wilson SA and Card GB (February 1999). *Reliability and Risk in Gas Protection Design*. Ground Engineering.

**Appendix B**  
**Drawings**



NOTES

- MONITORING WELL LOCATION
- GRASS & OVERGROWN AREAS
- TREES/DENSE VEGETATION
- CLEARED TREES/DENSE VEGETATION
- CUT HEDGEROW/TREES
- TARMAC HARDSTAND
- SURFACE WATER FEATURE
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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HARRON HOMES

MERCHANT FIELDS, CLECKHEATON

MONITORING WELL LOCATIONS

DRAWN	CC/LEW	DATE	05 04 19	STATUS	FOR COMMENT <input type="checkbox"/>
CHECKED	MJT	DATE	05 04 19	FOR APPROVAL	DRAFT <input type="checkbox"/>
					FINAL <input checked="" type="checkbox"/>
SCALE	1:2000	SHEET	A3	DRAWING NO.	2828/13
				REVISION	

**Appendix C**  
**Gas monitoring results**

Job Title:				Job No:	
Merchants Field, Cleckheaton				2828	
Client:				Sheet:	
Harron Homes				1 of 1	
Date:	Arrival Time:	Depart Time:	Operator:		
15/04/2019	09:00	16:00	A Taylor		



Gas Monitoring Results:							
Ambient Concentration (% Volume):		CH <sub>4</sub> :	0.0	CO <sub>2</sub> :	0.0	O <sub>2</sub> :	20.0

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	3.58	ND	0.4	ND	0.4	20.0	15.0	ND	40.0	4.70	Well bailed to 4.28m at 13:17 -5l. Remonitored at 15:31.
PH02A	2.11	ND	0.7	ND	0.7	19.5	0.9	ND	3.0	3.69	Well bailed to 2.98m at 12:53 -4l. Difficult to lower. Remonitored at 15:39.
PH03A	2.89	ND	0.6	ND	0.6	20.0	ND	ND	ND	5.05	Well bailed to 4.49m at 12:39 -12l. Difficult to lower. Remonitored at 15:43.
PH04A	2.17	ND	1.2	ND	1.1	19.6	4.3	ND	10.0	3.60	Well bailed to 3.46m at 09:20 -4l. Remonitored at 15:02.
PH05A	2.39	ND	0.4	ND	0.3	19.9	ND	ND	ND	4.85	Well bailed to 3.32m at 09:48 -22l. Remonitored at 15:09.
PH06A	1.26	ND	2.9	ND	1.0	9.0	0.1	ND	10.0	4.84	Well bailed to 4.82m at 09:33 -7l. Remonitored at 15:16.
PH08A	1.73	ND	1.9	ND	0.5	19.6	ND	ND	ND	4.92	Well bailed to 3.87m at 10:02 -7l. Very heavily silted water. Remonitored at 15:22.
PH09A	3.68	ND	0.7	ND	0.7	19.1	ND	ND	ND	5.30	Well bailed to 5.10m at 11:51 -5l. Remonitored at 15:48.
PH10A	2.81	ND	2.0	ND	2.0	15.9	ND	ND	ND	3.75	Well bailed to 3.00m at 12:02 -3l.
PH11A	3.33	ND	0.8	ND	0.8	17.4	3.0	ND	26.0	3.74	Well bailed to 3.69m at 11:10 -1l.
PH12A	4.37	ND	1.6	ND	1.6	18.4	ND	ND	ND	5.32	Well bailed to 5.13m at 11:37 -3l. Very heavily silted water.
PH13A	4.76	ND	0.6	ND	0.6	18.9	ND	ND	ND	5.71	Well bailed to 4.98m at 12:15 -5l.
PH14A	4.44	ND	1.6	ND	1.6	15.2	1.0	ND	4.0	5.40	Well bailed to 5.30m at 12:26 -2l.
PH15A	1.81	ND	0.5	ND	0.4	19.8	ND	ND	ND	5.67	Well bailed to 4.23m at 13:07 -15l. Remonitored at 15:34.
PH16A	3.55	ND	0.8	ND	0.6	19.0	ND	ND	ND	5.78	Well bailed to 5.77m at 10:21 -6l.
PH17A	4.61	ND	1.6	ND	1.0	16.4	7.6	ND	20.0	5.55	Well bailed to 5.49m at 10:35 -4l.
PH18A	ND	ND	0.6	ND	0.6	19.2	ND	ND	ND	5.42	
PH19A	3.19	ND	0.8	ND	0.8	19.3	1.0	ND	2.0	5.65	
PH20A	4.27	ND	1.0	ND	0.7	19.2	ND	ND	ND	5.59	Well bailed to 5.49m at 11:23 -2l.

Notes

Equipment Used:	Next Calibration Date	Key
Gas Data GFM436 Infrared Gas Analyser	12/02/2020	ND None Detected
Geotechnical Instruments Dipmeter		NR Not Recorded
		1.0 Recorded value does not breach trigger levels
		5.0 Recorded value breaches trigger level 1
		10.0 Recorded value breaches trigger level 2

	Site Data:			Weather Station Data (Salisbury Road Weather Station)							CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>
	Temp (°C):	6 to 12.		Barometric Pressure Trend:			Falling						
Time:	09:00	12:30	16:00	00:04	05:04	08:59	12:29	15:29	20:04	Trigger level 1	1.0	5.0	16.0
Pressure (mb):	1010	1009	1005	1024	1022	1020	1018	1015	1015	Trigger level 2	5.0	10.0	10.0
	Weather Conditions:		Overcast.										
	Surface Ground Conditions:		Dry.										

Remarks:

Job Title:				Job No:	
Merchants Field, Cleckheaton				2828	
Client:				Sheet:	
Harron Homes				1 of 1	
Date:	Arrival Time:	Depart Time:	Operator:		
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Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	2.87	ND	0.3	ND	0.3	20.0	ND	ND	ND	4.70	Well bailed to 4.28m at 13:17 -5l. Remonitored at 15:31.
PH02A	2.06	ND	0.8	ND	0.8	19.8	1.2	ND	5.0	3.69	Well bailed to 2.98m at 12:53 -4l. Difficult to lower. Remonitored at 15:39.
PH03A	2.56	ND	0.3	ND	0.2	20.0	ND	ND	ND	5.05	Well bailed to 4.49m at 12:39 -12l. Difficult to lower. Remonitored at 15:43.
PH04A	2.15	ND	2.2	ND	2.2	18.8	ND	ND	ND	3.60	Well bailed to 3.46m at 09:20 -4l. Remonitored at 15:02.
PH05A	2.46	ND	0.1	ND	0.1	20.0	ND	ND	ND	4.85	Well bailed to 3.32m at 09:48 -22l. Remonitored at 15:09.
PH06A	0.99	ND	0.3	ND	0.2	19.9	ND	ND	ND	4.84	Well bailed to 4.82m at 09:33 -7l. Remonitored at 15:16.
PH08A	2.35	ND	0.4	ND	0.4	19.8	ND	ND	ND	4.92	Well bailed to 3.87m at 10:02 -7l. Very heavily silted water. Remonitored at 15:22.
PH09A	3.63	ND	1.0	ND	1.0	18.5	2.7	ND	5.0	5.30	Well bailed to 5.10m at 11:51 -5l. Remonitored at 15:48.
PH10A	2.81	ND	2.0	ND	2.0	15.9	ND	ND	ND	3.75	Well bailed to 3.00m at 12:02 -3l.
PH11A	3.33	ND	0.8	ND	0.8	177.4	3.0	ND	26.0	3.74	Well bailed to 3.69m at 11:10 -1l.
PH12A	4.37	ND	1.6	ND	1.6	18.4	ND	ND	ND	5.32	Well bailed to 5.13m at 11:37 -3l. Very heavily silted water.
PH13A	4.76	ND	0.6	ND	0.6	18.9	ND	ND	ND	5.71	Well bailed to 4.98m at 12:15 -5l.
PH14A	4.44	ND	1.6	ND	1.6	15.2	1.0	ND	4.0	5.40	Well bailed to 5.30m at 12:26 -2l.
PH15A	1.78	ND	0.1	ND	0.1	20.1	28.6	ND	18.0	5.67	Well bailed to 4.23m at 13:07 -15l. Remonitored at 15:34.
PH16A	3.55	ND	0.8	ND	0.6	19.0	ND	ND	ND	5.78	Well bailed to 5.77m at 10:21 -6l.
PH17A	4.61	ND	1.6	ND	1.0	16.4	7.6	ND	20.0	5.55	Well bailed to 5.49m at 10:35 -4l.
PH18A	ND	ND	0.6	ND	0.6	19.2	ND	ND	ND	5.42	
PH19A	3.19	ND	0.8	ND	0.8	19.3	1.0	ND	2.0	5.65	
PH20A	4.27	ND	1.0	ND	0.7	19.2	ND	ND	ND	5.59	Well bailed to 5.49m at 11:23 -2l.

Notes

Equipment Used:	Next Calibration Date	Key
Gas Data GFM436 Infrared Gas Analyser	12/02/2020	ND None Detected
Geotechnical Instruments Dipmeter		NR Not Recorded
		1.0 Recorded value does not breach trigger levels
		5.0 Recorded value breaches trigger level 1
		10.0 Recorded value breaches trigger level 2

	Site Data:			Weather Station Data (Salisbury Road Weather Station)							CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>
	Temp (°C):	6 to 12.		Barometric Pressure Trend:			Falling						
Time:	09:00	12:30	16:00	00:04	05:04	08:59	12:29	15:29	20:04	Trigger level 1	1.0	5.0	16.0
Pressure (mb):	1010	1009	1005	1024	1022	1020	1018	1015	1015	Trigger level 2	5.0	10.0	10.0
	Weather Conditions:		Overcast.										
	Surface Ground Conditions:		Dry.										

Remarks:

Visit 2

<b>Job Title:</b> Merchants Field, Cleckheaton				<b>Job No:</b> 2828
<b>Client:</b> Harron Homes				<b>Sheet:</b> 1 of 1
<b>Date:</b> 24/04/2019	<b>Arrival Time:</b> 13:00	<b>Depart Time:</b> 16:00	<b>Operator:</b> A Taylor	



<b>Gas Monitoring Results:</b>				
<b>Ambient Concentration (% Volume):</b>	<b>CH<sub>4</sub>:</b>	0.0	<b>CO<sub>2</sub>:</b>	0.0
			<b>O<sub>2</sub>:</b>	20.2

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	3.12	ND	3.9	ND	0.9	18.9	ND	ND	ND	4.71	
PH02A	2.36	ND	2.8	ND	2.8	12.7	ND	ND	ND	3.69	
PH03A	3.15	ND	0.6	ND	0.6	19.9	ND	ND	ND	5.07	
PH04A	2.26	ND	3.0	ND	2.5	16.3	ND	ND	ND	3.62	
PH05A	2.33	ND	0.7	ND	0.5	19.6	0.3	ND	5.0	4.73	
PH06A	1.25	ND	0.3	ND	0.2	19.9	ND	ND	ND	4.93	Well ripped out, but bung still in place. Open on arrival 13:19. Remonitored 15:50.
PH08A	1.84	ND	0.8	ND	0.7	19.9	ND	ND	ND	4.83	
PH09A	3.60	ND	1.8	ND	1.8	14.5	0.7	ND	10.0	5.24	
PH10A	3.04	ND	1.2	ND	1.2	17.5	ND	ND	ND	3.77	
PH11A	3.25	ND	1.3	ND	1.3	16.9	ND	ND	ND	3.76	
PH12A	4.78	ND	1.4	ND	1.4	18.1	ND	ND	ND	5.30	
PH13A	4.75	ND	2.9	ND	2.9	11.5	ND	ND	ND	5.51	
PH14A	4.50	ND	2.3	ND	2.3	13.7	ND	ND	ND	5.53	
PH15A	2.23	ND	0.8	ND	0.5	19.8	30.7	ND	10.0	5.60	
PH16A	3.52	ND	2.3	ND	1.4	17.3	30.0	ND	30.0	5.76	
PH17A	4.98	ND	2.3	ND	1.9	12.9	40.0	1.4	240.0	5.02	
PH18A	4.69	ND	0.7	ND	0.7	17.9	ND	ND	ND	5.43	
PH19A	3.09	ND	2.8	ND	2.8	14.8	0.4	ND	15.0	5.60	
PH20A	4.27	ND	3.0	ND	3.0	18.4	35.4	0.8	200.0	5.56	

**Notes**

<b>Equipment Used:</b> Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	<b>Next Calibration Date:</b> 12/02/2020	<b>Key:</b> ND None Detected NR Not Recorded 1.0 Recorded value does not breach trigger levels 5.0 Recorded value breaches trigger level 1 10.0 Recorded value breaches trigger level 2
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	Site Data:			Weather Station Data (Scholes Weather Station)						CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>	
	Temp (°C):	15 to 18.		Barometric Pressure Trend:			Falling						
<b>Time:</b>	13:00	14:30	16:00	00:04	05:04	13:04	14:29	15:59	20:04	Trigger level 1	1.0	5.0	16.0
<b>Pressure (mb):</b>	981	978	978	993.2	990	998.1	987.8	986.5	989	Trigger level 2	5.0	10.0	10.0
	<b>Weather Conditions:</b> Sunny (Haze).												
	<b>Surface Ground Conditions:</b> Dry.												

**Remarks:**

Visit 3

<b>Job Title:</b> Merchants Field, Cleckheaton				<b>Job No:</b> 2828	
<b>Client:</b> Harron Homes				<b>Sheet:</b> 1 of 1	
<b>Date:</b> 08/05/2019	<b>Arrival Time:</b> 09:30	<b>Depart Time:</b> 12:04	<b>Operator:</b> A Taylor		



<b>Gas Monitoring Results:</b>							
<b>Ambient Concentration (% Volume):</b>		<b>CH<sub>4</sub>:</b>	0.0	<b>CO<sub>2</sub>:</b>	0.0	<b>O<sub>2</sub>:</b>	19.9

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	3.38	ND	4.7	ND	0.8	17.8	ND	ND	ND	4.69	
PH02A	2.63	ND	3.6	ND	3.6	13.0	4.1	3.2	300.0	3.67	
PH03A	3.41	ND	1.0	ND	0.6	16.8	1.2	ND	5.0	5.10	
PH04A	2.37	ND	4.7	ND	4.7	11.2	1.5	1.5	180.0	3.65	
PH05A	2.42	ND	0.6	ND	0.5	19.5	0.2	ND	10.0	4.71	
PH06A	1.41	ND	0.7	ND	0.7	17.6	ND	ND	ND	4.87	
PH08A	1.94	ND	0.2	ND	0.2	19.8	ND	ND	ND	4.75	
PH09A	3.72	ND	2.4	ND	2.4	10.9	0.4	ND	10.0	5.22	
PH10A	3.32	ND	1.7	ND	1.7	17.6	ND	ND	ND	3.76	
PH11A	3.34	ND	2.1	ND	2.0	15.1	1.4	ND	6.0	3.75	
PH12A	5.06	ND	2.7	ND	2.7	15.0	ND	ND	ND	5.29	
PH13A	4.76	ND	2.5	ND	2.5	5.6	ND	ND	ND	5.50	
PH14A	4.55	ND	4.9	ND	4.9	6.4	ND	ND	ND	5.50	
PH15A	2.16	ND	0.3	ND	0.3	19.7	ND	ND	ND	5.58	
PH16A	3.62	ND	3.6	ND	2.5	15.0	4.5	ND	30.0	5.77	
PH17A	4.89	ND	2.2	ND	2.0	12.5	ND	ND	ND	5.69	
PH18A	4.80	ND	2.0	ND	2.0	16.4	ND	ND	ND	5.40	
PH19A	3.23	ND	2.0	ND	2.0	11.1	ND	ND	ND	5.55	
PH20A	4.27	ND	3.0	ND	3.0	18.3	ND	ND	ND	5.56	

**Notes**

<b>Equipment Used:</b> Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	<b>Next Calibration Date</b> 12/02/2020	<b>Key</b> ND None Detected NR Not Recorded 1.0 Recorded value does not breach trigger levels 5.0 Recorded value breaches trigger level 1 10.0 Recorded value breaches trigger level 2
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	Site Data:			Weather Station Data (Cleckheaton Weather Station)						CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>	
	Temp (°C):	7 to 8.		Barometric Pressure Trend:			Falling						
<b>Time:</b>	09:30	11:27	12:04	00:04	05:04	09:29	11:29	12:04	17:04	Trigger level 1	1.0	5.0	16.0
<b>Pressure (mb):</b>	983	982	981	1004	997	993	991	990	988	Trigger level 2	5.0	10.0	10.0
	<b>Weather Conditions:</b> Raining.												
	<b>Surface Ground Conditions:</b> Wet.												

**Remarks:**



Visit 4

Job Title: Merchants Field, Cleckheaton				Job No: 2828
Client: Harron Homes				Sheet: 1 of 1
Date: 24/05/2019	Arrival Time: 07:55	Depart Time: 12:30	Operator: J Brown	

Gas Monitoring Results:				
Ambient Concentration (% Volume):	CH <sub>4</sub> :	0.0	CO <sub>2</sub> :	0.0
	O <sub>2</sub> :	20.2		

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	3.57	ND	4.3	ND	1.5	18.1	ND	ND	ND	4.75	
PH02A	2.91	ND	0.1	ND	0.1	20.4	ND	ND	ND	3.77	
PH03A	3.79	ND	1.7	ND	1.7	14.2	0.7	ND	5.0	5.15	
PH04A	2.49	ND	1.5	ND	1.5	18.1	ND	ND	ND	3.67	
PH05A	2.65	ND	ND	ND	ND	20.3	ND	ND	ND	4.78	Well bailed to 3.21m at 09:36 - 20l removed. Recharge to 2.82m within 60 secs. Well not remonitored.
PH06A	1.74	ND	0.5	ND	0.2	19.1	ND	ND	ND	4.97	Well bailed to 4.80m at 09:23 - 10l removed. Remonitored at 12:20
PH08A	2.10	ND	0.8	ND	0.5	18.9	ND	ND	ND	4.85	Well bailed to 4.70m at 09:15 - 10l removed. Remonitored at 12:15
PH09A	3.74	ND	2.6	ND	2.6	10.9	ND	ND	ND	5.29	
PH10A	3.53	ND	2.3	ND	2.3	16.0	ND	ND	ND	3.78	
PH11A	3.46	ND	2.7	ND	2.7	13.1	ND	ND	ND	3.81	
PH12A	5.26	ND	3.3	ND	3.3	14.5	ND	ND	MD	5.28	
PH13A	4.88	ND	6.2	ND	6.2	1.4	ND	ND	ND	5.51	
PH14A	4.71	ND	6.2	ND	6.2	2.3	ND	ND	ND	5.65	
PH15A	2.52	ND	0.3	ND	0.3	20.3	ND	ND	ND	5.58	Well bailed to 4.16m at 10:11 - 15l removed. Remonitored at 12:07.
PH16A	3.72	ND	3.2	ND	3.2	15.3	ND	ND	ND	5.76	
PH17A	5.14	ND	2.4	ND	2.4	7.7	ND	ND	ND	5.64	
PH18A	5.17	ND	0.1	ND	0.1	20.5	3.0	ND	10.0	5.41	
PH19A	3.58	ND	1.9	ND	1.9	12.8	ND	ND	ND	5.63	
PH20A	4.42	ND	6.7	ND	6.7	15.6	ND	ND	ND	5.68	

Notes

Equipment Used: Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter		Next Calibration Date: 12/02/2020		Key	
				ND	None Detected
				NR	Not Recorded
				1.0	Recorded value does not breach trigger levels
				5.0	Recorded value breaches trigger level 1
				10.0	Recorded value breaches trigger level 2
Site Data: Temp (°C): 14.4		Weather Station Data (Salisbury Road Weather Station)			
		Barometric Pressure Trend:		Steady	
Time:	08:00 10:30 12:30	00:04	05:04	09:29	11:29 12:04 17:04
Pressure (mb):	1004 1003 1003	1013.2	1012.9	1014.2	1014.2 1014.2 1014.5
Weather Conditions: Sunny					
Surface Ground Conditions: Dry					

Remarks:

Visit 5

<b>Job Title:</b> Merchants Field, Cleckheaton				<b>Job No:</b> 2828	
<b>Client:</b> Harron Homes				<b>Sheet:</b> 1 of 1	
<b>Date:</b> 07/06/2019	<b>Arrival Time:</b> 14:30	<b>Depart Time:</b> 16:30	<b>Operator:</b> A Taylor		



<b>Gas Monitoring Results:</b>							
<b>Ambient Concentration (% Volume):</b>		<b>CH<sub>4</sub>:</b>	0.0	<b>CO<sub>2</sub>:</b>	0.0	<b>O<sub>2</sub>:</b>	20.3

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	3.56	ND	1.2	ND	1.2	19.7	ND	ND	ND	4.70	
PH02A	2.87	ND	3.1	ND	3.1	10.9	ND	ND	ND	3.66	
PH03A	3.32	ND	2.5	ND	2.5	8.8	ND	ND	ND	5.09	
PH04A	2.49	ND	2.4	ND	2.4	16.2	ND	ND	ND	3.65	
PH05A	2.62	ND	0.4	ND	0.4	19.6	ND	ND	ND	4.71	
PH06A	1.92	ND	0.5	ND	0.5	19.3	ND	ND	ND	4.86	
PH08A	2.11	ND	0.1	ND	0.1	20.1	ND	ND	ND	4.81	
PH09A	3.70	ND	3.5	ND	3.5	11.5	ND	ND	ND	5.22	
PH10A	3.66	ND	1.4	ND	1.4	18.7	ND	ND	ND	3.78	
PH11A	3.43	ND	3.4	ND	3.4	11.5	ND	ND	ND	3.76	
PH12A	ND	ND	1.5	ND	1.5	18.3	ND	ND	ND	5.27	
PH13A	4.85	ND	6.6	ND	6.6	1.1	ND	ND	ND	4.82	
PH14A	4.70	ND	6.6	ND	6.6	2.0	ND	ND	ND	5.51	
PH15A	2.43	ND	0.7	ND	0.7	19.5	ND	ND	ND	5.42	
PH16A	3.73	ND	1.7	ND	1.7	17.7	ND	ND	ND	5.76	
PH17A	5.09	ND	1.7	ND	1.7	13.7	ND	ND	ND	5.65	
PH18A	5.19	ND	0.5	ND	0.5	19.7	ND	ND	ND	5.40	
PH19A	3.57	ND	2.4	ND	2.4	10.6	ND	ND	ND	5.56	
PH20A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Couldnt find well amongst very tall grasses.

**Notes**

<b>Equipment Used:</b> Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	<b>Next Calibration Date</b> 12/02/2020	<b>Key</b> ND None Detected NR Not Recorded 1.0 Recorded value does not breach trigger levels 5.0 Recorded value breaches trigger level 1 10.0 Recorded value breaches trigger level 2
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<b>Site Data:</b>		<b>Weather Station Data (Scholes Weather Station)</b>											
<b>Temp (°C):</b>	13	<b>Barometric Pressure Trend:</b>			Falling								
<b>Time:</b>	14:30	16:15	16:30	00:04	06:04	14:29	16:14	16:29	18:59	Trigger level 1	1.0	5.0	16.0
<b>Pressure (mb):</b>	993	990	990	1006	1004	1000	999	999	996	Trigger level 2	5.0	10.0	10.0
<b>Weather Conditions:</b>		Raining.											
<b>Surface Ground Conditions:</b>		Wet.											

**Remarks:**



<b>Job Title:</b> Merchants Field, Cleckheaton				<b>Job No:</b> 2828
<b>Client:</b> Harron Homes				<b>Sheet:</b> 1 of 1
<b>Date:</b> 10/07/2019	<b>Arrival Time:</b> 15:00	<b>Depart Time:</b> 16:45	<b>Operator:</b> A Taylor	



<b>Gas Monitoring Results:</b>				
<b>Ambient Concentration (% Volume):</b>	<b>CH<sub>4</sub>:</b>	0.0	<b>CO<sub>2</sub>:</b>	0.0
			<b>O<sub>2</sub>:</b>	20.4

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	3.23	ND	1.5	ND	0.4	20.0	ND	ND	ND	4.72	
PH02A	2.68	ND	0.9	ND	0.9	19.9	ND	ND	ND	3.68	
PH03A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
PH04A	2.54	ND	2.6	ND	2.6	16.7	ND	ND	ND	3.65	
PH05A	2.84	ND	0.4	ND	0.4	20.0	ND	ND	ND	4.69	
PH06A	2.45	ND	0.9	ND	0.8	17.7	ND	ND	ND	4.95	
PH08A	2.26	ND	0.5	ND	0.4	20.1	ND	ND	ND	4.79	
PH09A	3.73	ND	2.9	ND	2.9	16.2	ND	ND	ND	5.20	
PH10A	ND	ND	1.7	ND	1.7	18.4	ND	ND	ND	3.69	
PH11A	3.50	ND	4.0	ND	4.0	9.7	ND	ND	ND	3.75	
PH12A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
PH13A	5.06	ND	6.2	ND	6.2	3.4	ND	ND	ND	5.54	
PH14A	4.75	ND	6.6	ND	6.6	1.6	ND	ND	ND	5.50	
PH15A	2.34	ND	0.5	ND	0.5	20.2	ND	ND	ND	5.51	
PH16A	3.77	ND	2.5	ND	1.5	15.9	ND	ND	ND	5.74	
PH17A	5.15	ND	1.6	ND	0.8	16.8	ND	ND	ND	5.61	
PH18A	ND	ND	0.3	ND	0.3	20.4	ND	ND	ND	5.34	
PH19A	4.42	ND	2.3	ND	2.3	13.2	ND	ND	ND	5.53	
PH20A	ND	ND	1.7	ND	1.7	18.4	ND	ND	ND	5.22	

**Notes**

<b>Equipment Used:</b> Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter		<b>Next Calibration Date</b> 12/02/2020			<b>Key</b>								
					ND	None Detected							
					NR	Not Recorded							
					1.0	Recorded value does not breach trigger levels							
					5.0	Recorded value breaches trigger level 1							
					10.0	Recorded value breaches trigger level 2							
	<b>Site Data:</b>		<b>Weather Station Data (Scholes Weather Station)</b>										
	<b>Temp (°C):</b> 18 to 20.		<b>Barometric Pressure Trend:</b> Steady.										
<b>Time:</b>	15:00	16:15	16:45	00:04	06:59	14:59	16:14	16:44	20:04	Trigger level 1	1.0	5.0	16.0
<b>Pressure (mb):</b>	1004	1002	1002	1012	1010	1009	1009	1008	1007	Trigger level 2	5.0	10.0	10.0
	<b>Weather Conditions:</b> Sunny.												
	<b>Surface Ground Conditions:</b> Dry.												

<b>Remarks:</b>													
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Visit 9

<b>Job Title:</b> Merchants Field, Cleckheaton				<b>Job No:</b> 2828	
<b>Client:</b> Harron Homes				<b>Sheet :</b> 1 of 1	
<b>Date:</b> 02/10/2019	<b>Arrival Time:</b> 11:00	<b>Depart Time:</b> 03:30	<b>Operator:</b> Rhianen Hughes		



**Gas Monitoring Results:**

<b>Ambient Concentration (% Volume):</b>	<b>CH<sub>4</sub>:</b>	<b>CO<sub>2</sub>:</b>	<b>O<sub>2</sub>:</b>
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Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	CH <sub>4</sub> % v/v	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	litre/hr	litre/hr	secs		
PH01A	1.60	ND	1.9	ND	0.4	19.6	ND	ND	ND	4.68	CO2 fell over 30 seconds, bailed 9 liters at 12:07 to 4.3m, recovered to 2.12m at 3:13
PH02A	1.84	ND	3.2	ND	2.0	12.1	2.1	ND	30.0	3.59	CO2 fell over 60 seconds
PH03A	1.20	ND	0.7	ND	0.5	19.4	ND	ND	ND	4.97	CO2 fell over 30 seconds, bailed 10 liters to 2,20m at 2:22 and this recovered to 1.25m at 3:16
PH04A	1.80	ND	5.4	ND	5.4	5.2	ND	ND	ND	3.50	
PH05A	2.40	ND	0.3	ND	0.2	19.9	12.0	ND	30.0	4.61	CO2 fell over 30 seconds, Bailed 10 liters at 1:06 to 2.8m and it recovered to 3.40 at 3:06
PH06A	NR	ND	0.6	ND	0.4	19.3	ND	ND	ND	NR	CO2 fell over 30 seconds, was not able to get bung off
PH08A	1.50	ND	4.2	ND	0.8	17.1	ND	ND	ND	4.66	CO2 fell over 30 seconds, bailed 10 liters at 12:44 to 2.5m, recovered to 1.1m at 3:01
PH09A	3.43	ND	1.5	ND	0.8	18.0	ND	ND	ND	4.00	CO2 fell over 30 seconds
PH10A	1.54	ND	1.2	ND	0.5	19.6	ND	ND	ND	3.51	CO2 fell over 30 seconds
PH11A	1.80	ND	0.5	ND	0.4	19.3	ND	ND	ND	3.58	CO2 fell over 30 seconds
PH12A	4.00	ND	3.2	ND	0.6	17.6	ND	ND	ND	5.15	CO2 fell over 30 seconds
PH13A	4.71	ND	3.2	ND	2.4	13.5	ND	ND	ND	5.28	CO2 fell over 30 seconds
PH14A	2.00	ND	0.4	ND	0.4	19.5	ND	ND	ND	4.41	bailed 10 liters at 2:44 to 2.82m recovered to 2.22m at 3:18
PH15A	1.92	ND	0.3	ND	0.3	19.4	-63.0	ND	60.0	5.40	bailed 10 liters at 11:54 to 3.81m, recovered to 1.45 at 2:53
PH16A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Unable to find too overgrown
PH17A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Unable to find too overgrown
PH18A	4.00	ND	0.3	ND	0.3	18.3	ND	ND	ND	5.20	
PH19A	3.81	ND	3.7	ND	5.7	0.6	50.8	48.9	30.0	5.41	
PH20A	3.86	ND	7.3	ND	5.4	11.3	ND	ND	ND	5.55	CO2 fell over 60 seconds

**Notes**

**Equipment Used:**

Gas Data GFM436 Infrared Gas Analyser  
Geotechnical Instruments Dipmeter

**Next Calibration Date**

12/02/2020

**Key**

ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

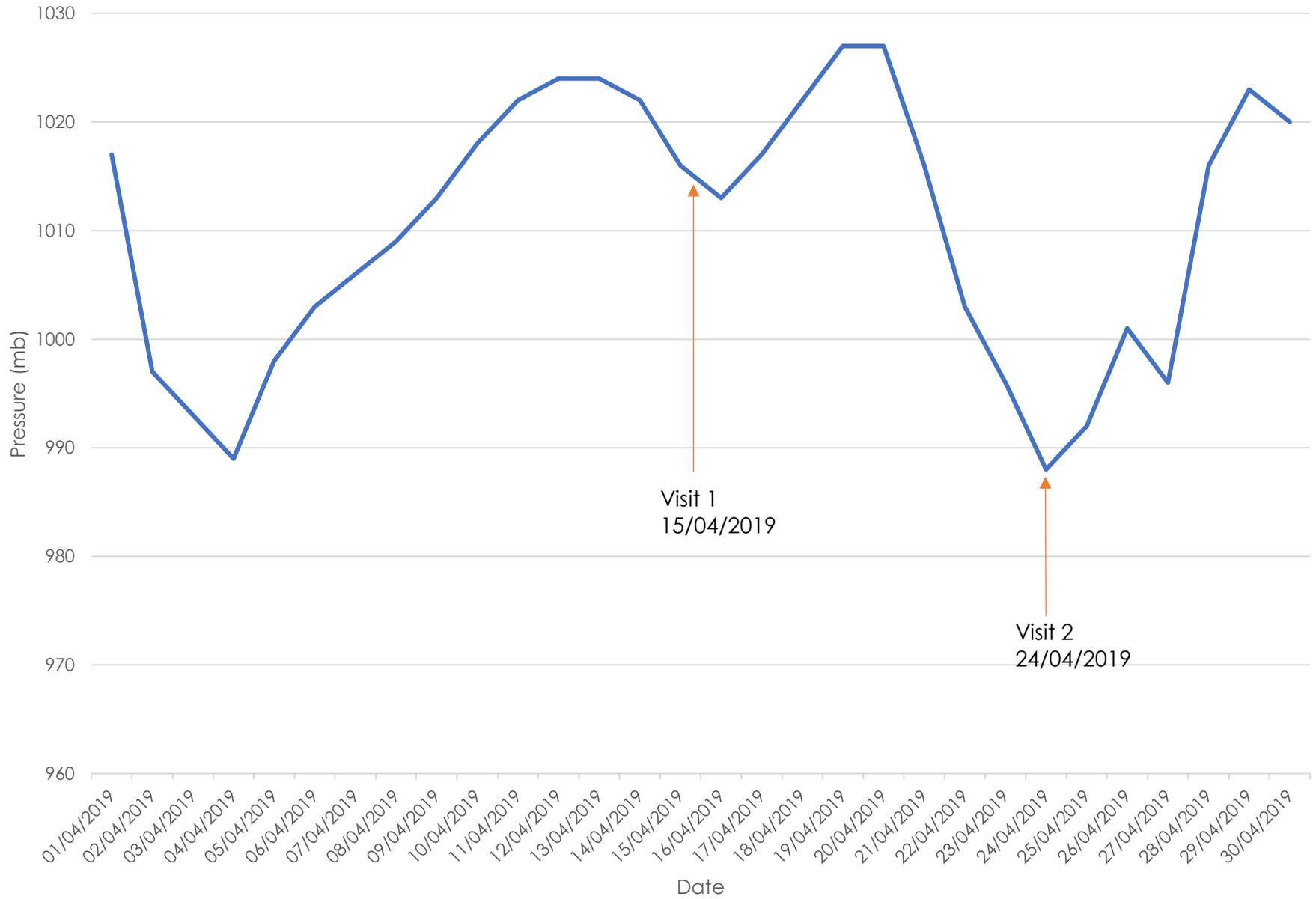
	Site Data:		Weather Station Data (**Station)										
	Temp (°C):	11 to 12	Barometric Pressure Trend:										
<b>Time:</b>	11:18	01:46	02:38	00:04	07:04	11:19	01:44	02:39	03:04	Trigger level 1	1.0	5.0	16.0
<b>Pressure (mb):</b>	1007	1008	1007	1004	1007	1010	1011	1012	1011	Trigger level 2	5.0	10.0	10.0
	<b>Weather Conditions:</b>		cool										
	<b>Surface Ground Conditions:</b>		dry										

**Remarks:**

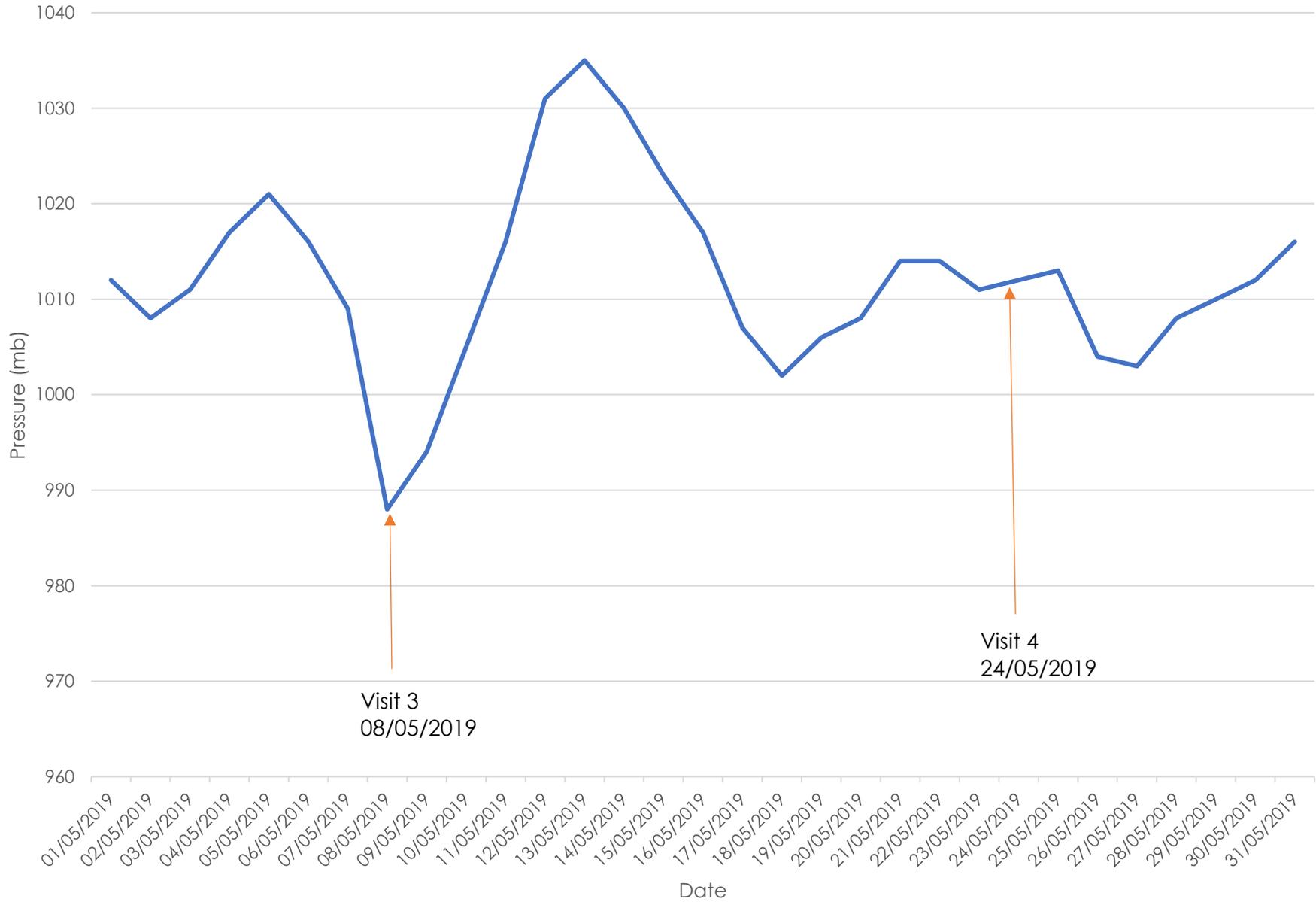
was very hard to find the boreholes

**Appendix D**  
**Atmospheric pressure graphs**

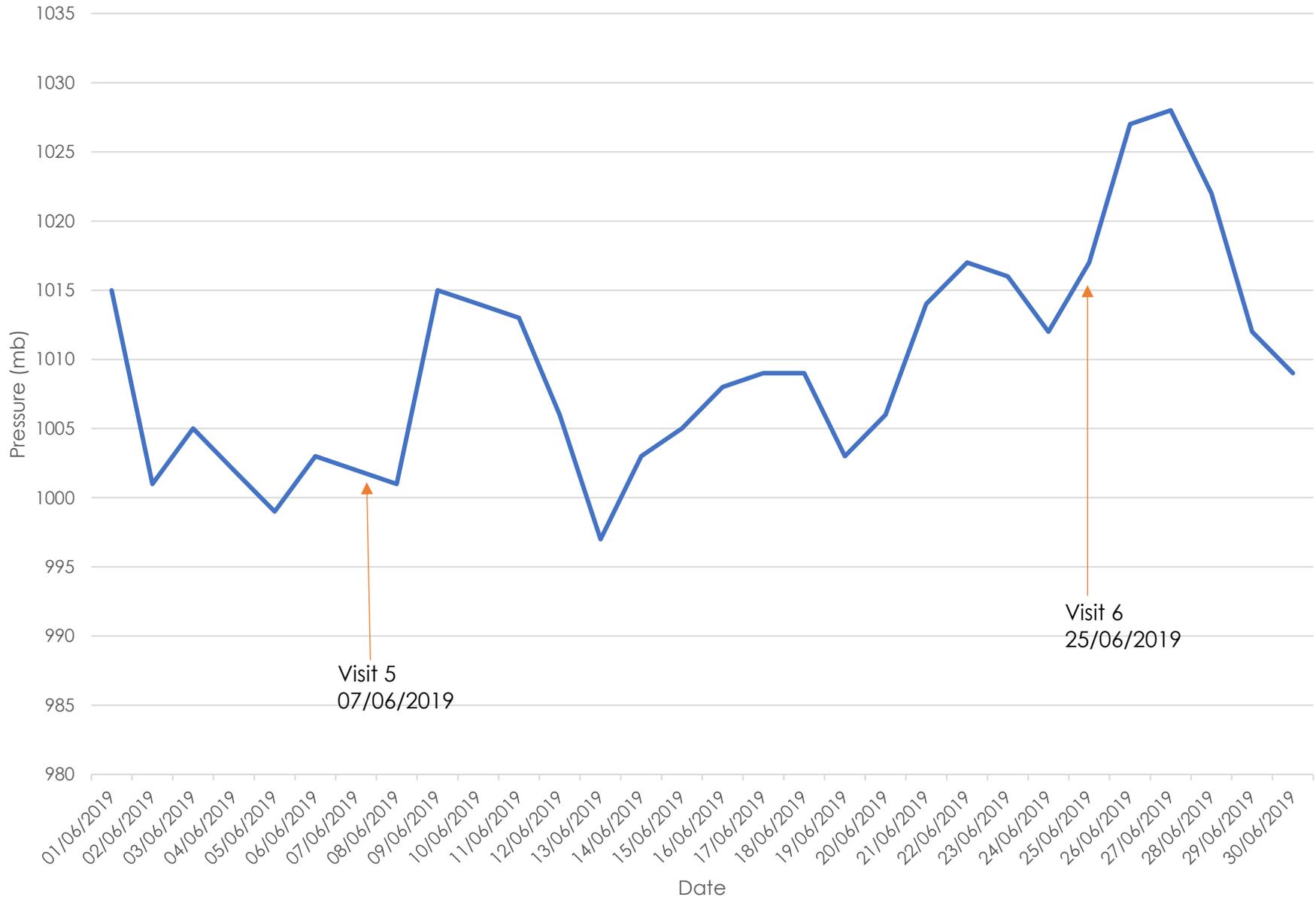
April 2019 Atmospheric Pressure Graph



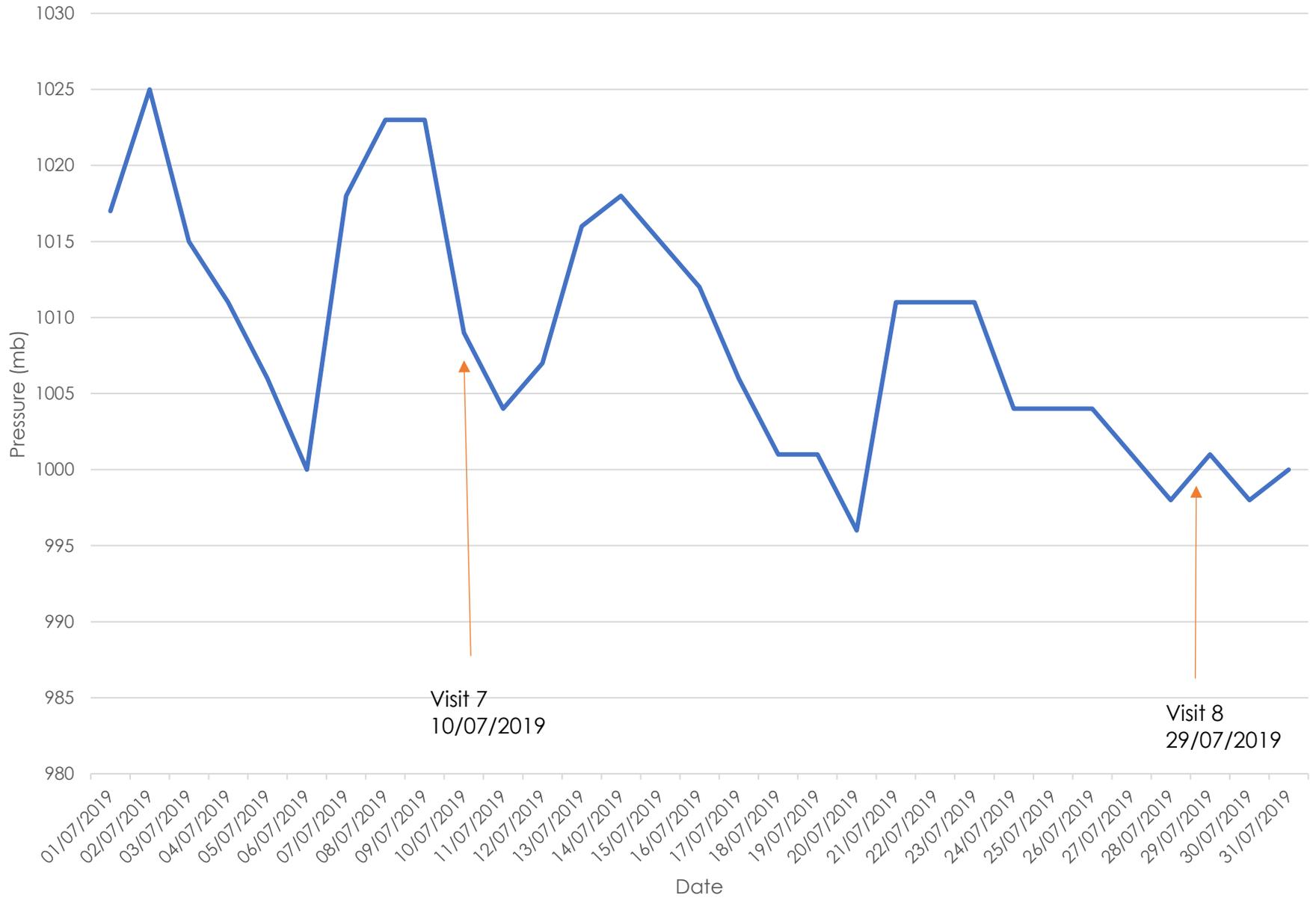
May 2019 Atmospheric Pressure Graph



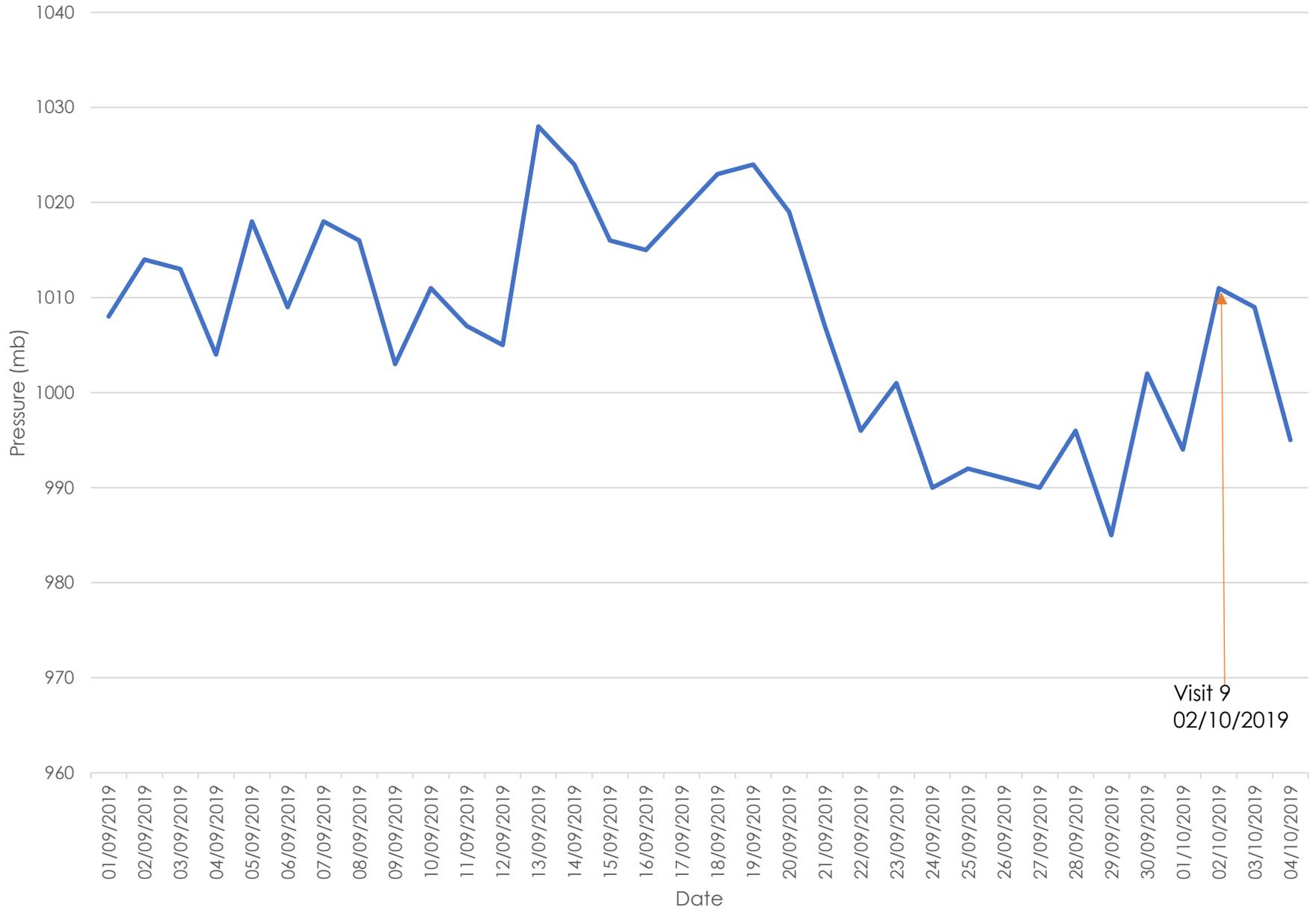
### June 2019 Atmospheric Pressure Graph



### July 2019 Atmospheric Pressure Graph



August/October 2019 Atmospheric Pressure Graph



**Appendix E**  
**Borehole logs**

# Borehole Log

Borehole No.

**PH01A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 419005.06 - 426633.53	Hole Type PH
Location: West Yorkshire		Level: 101.55	Scale 1:50
Client: Harron Homes		Dates: 01/04/2019 - 01/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
[Well ID]								Overburden.
					2.30	99.25	[Pattern]	Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)
					6.00	95.55		End of borehole at 6.00 m

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH02A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton

Project No.  
2828

Co-ords: 418966.56 - 426580.95

Hole Type  
PH

Location: West Yorkshire

Level: 101.40

Scale  
1:50

Client: Harron Homes

Dates: 01/04/2019 - 01/04/2019

Logged By  
CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
							Overburden.	
					2.00	99.40	Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	
					4.00	97.40	End of borehole at 4.00 m	

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH03A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418908.89 - 426540.44	Hole Type PH
Location: West Yorkshire		Level: 101.50	Scale 1:50
Client: Harron Homes		Dates: 01/04/2019 - 01/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
							Overburden.	
					3.00	98.50		
					6.00	95.50		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)
								End of borehole at 6.00 m

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

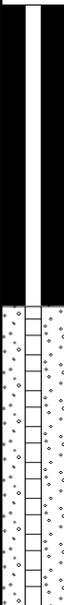
# Borehole Log

Borehole No.

**PH04A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 419110.35 - 426640.42	Hole Type PH
Location: West Yorkshire		Level: 95.90	Scale 1:50
Client: Harron Homes		Dates: 02/04/2019 - 02/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							Overburden.	1	
				2.00	93.90		Black COAL. (WHEATLEY LIME COAL)	2	
				2.50	93.40		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	3	
				4.00	91.90		End of borehole at 4.00 m	4	
								5	
								6	
								7	
								8	
								9	
								10	

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



# Borehole Log

Borehole No.

**PH05A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton

Project No.  
2828

Co-ords: 419240.69 - 426633.79

Hole Type  
PH

Location: West Yorkshire

Level: 87.35

Scale  
1:50

Client: Harron Homes

Dates: 02/04/2019 - 02/04/2019

Logged By  
CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
							Overburden.	
					3.00	84.35		
					6.00	81.35	Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	
							End of borehole at 6.00 m	

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH06A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 419162.05 - 426603.53	Hole Type PH
Location: West Yorkshire		Level: 90.40	Scale 1:50
Client: Harron Homes		Dates: 02/04/2019 - 02/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					2.50	87.90		Overburden.
					6.00	84.40		Light greyish brown interbedded SANDSTONE and MUDSTONE (COAL MEASURES)
End of borehole at 6.00 m								

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH08A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 419094.47 - 426548.84	Hole Type PH
Location: West Yorkshire		Level: 94.70	Scale 1:50
Client: Harron Homes		Dates: 02/04/2019 - 02/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
							Overburden	
					2.50	92.20		
					2.60	92.10		Black COAL. (WHEATLEY LIME COAL)
								Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)
					6.00	88.70		
								End of borehole at 6.00 m

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH09A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418870.11 - 426461.23	Hole Type PH
Location: West Yorkshire		Level: 99.50	Scale 1:50
Client: Harron Homes		Dates: 03/04/2019 - 03/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					2.50	97.00		Overburden.
					6.00	93.50		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)
								End of borehole at 6.00 m

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH10A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton

Project No.  
2828

Co-ords: 418932.35 - 426428.49

Hole Type  
PH

Location: West Yorkshire

Level: 98.45

Scale  
1:50

Client: Harron Homes

Dates: 03/04/2019 - 03/04/2019

Logged By  
CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.00	97.45		Overburden.	
					4.00	94.45		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1 2 3 4 5 6 7 8 9 10
End of borehole at 4.00 m									

Remarks  
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH11A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418902.60 - 426382.85	Hole Type PH
Location: West Yorkshire		Level: 96.30	Scale 1:50
Client: Harron Homes		Dates: 03/04/2019 - 03/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.50	94.80		Overburden.	1
					4.00	92.30		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	2
							----- End of borehole at 4.00 m	4	
								5	
								6	
								7	
								8	
								9	
								10	

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH12A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418855.00 - 426415.44	Hole Type PH
Location: West Yorkshire		Level: 96.50	Scale 1:50
Client: Harron Homes		Dates: 03/04/2019 - 03/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.00	95.50		Overburden.	
					6.00	90.50		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1 2 3 4 5 6 7 8 9 10
End of borehole at 6.00 m									

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH13A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418914.20 - 426482.47	Hole Type PH
Location: West Yorkshire		Level: 100.70	Scale 1:50
Client: Harron Homes		Dates: 03/04/2019 - 03/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Redacted]					1.00	99.70		Overburden.	
					6.00	94.70		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1 2 3 4 5 6 7 8 9 10
							End of borehole at 6.00 m		

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



# Borehole Log

Borehole No.

**PH14A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418967.23 - 426496.23	Hole Type PH
Location: West Yorkshire		Level: 100.30	Scale 1:50
Client: Harron Homes		Dates: 03/04/2019 - 03/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.20	99.10		Overburden.	1
					6.00	94.30		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	2 3 4 5 6
End of borehole at 6.00 m								6	
								7	
								8	
								9	
								10	

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



# Borehole Log

Borehole No.

**PH15A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton

Project No.  
2828

Co-ords: 419023.56 - 426573.15

Hole Type  
PH

Location: West Yorkshire

Level: 99.90

Scale  
1:50

Client: Harron Homes

Dates: 04/04/2019 - 04/04/2019

Logged By  
CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.00	98.90		Overburden.	
					6.00	93.90		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1 2 3 4 5 6 7 8 9 10
End of borehole at 6.00 m									

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



# Borehole Log

Borehole No.

**PH16A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418988.68 - 426188.22	Hole Type PH
Location: West Yorkshire		Level: 82.60	Scale 1:50
Client: Harron Homes		Dates: 04/04/2019 - 04/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							Overburden.		
					2.00	80.60		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1 2
					3.50	79.10		Black COAL. (MIDDLETON 11 YARD COAL)	3 4
					4.50	78.10		Light greyish brown MUDSTONE. (COAL MEASURES)	5
					6.00	76.60		End of borehole at 6.00 m	6 7 8 9 10

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



Project Name: Merchant Fields, Cleckheaton

 Project No.  
2828

Co-ords: 418967.36 - 426282.97

 Hole Type  
PH

Location: West Yorkshire

Level: 87.50

 Scale  
1:50

Client: Harron Homes

Dates: 04/04/2019 - 04/04/2019

 Logged By  
CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
Well	Water Strikes							Overburden.	
					1.00	86.50		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1
					5.50	82.00		Black COAL. (MIDDLETON 11 YARD COAL)	2
			6.00	81.50			End of borehole at 6.00 m	3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

# Borehole Log

Borehole No.

**PH18A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 418962.29 - 426378.91	Hole Type PH
Location: West Yorkshire		Level: 92.40	Scale 1:50
Client: Harron Homes		Dates: 04/04/2019 - 04/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.00	91.40		Overburden.	
					6.00	86.40		Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	1 2 3 4 5 6 7 8 9 10
End of borehole at 6.00 m									

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.





# Borehole Log

Borehole No.

**PH19A**

Sheet 1 of 1

Project Name: Merchant Fields, Cleckheaton	Project No. 2828	Co-ords: 419029.37 - 426344.86	Hole Type PH
Location: West Yorkshire		Level: 88.05	Scale 1:50
Client: Harron Homes		Dates: 04/04/2019 - 04/04/2019	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
[Well ID]					1.30	86.75		Overburden.	1
								Light greyish brown interbedded SANDSTONE and MUDSTONE. (COAL MEASURES)	2
									3
									4
									5
					6.00	82.05		End of borehole at 6.00 m	6
									7
									8
									9
									10

Remarks  
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



Project Name: Merchant Fields, Cleckheaton

 Project No.  
2828

Co-ords: 418854.56 - 426367.28

 Hole Type  
PH

Location: West Yorkshire

Level: 92.70

 Scale  
1:50

Client: Harron Homes

Dates: 04/04/2019 - 04/04/2019

 Logged By  
CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					1.20	91.50		Overburden.
					2.50	90.20		Light greyish brown SANDSTONE. (COAL MEASURES)
					3.00	89.70		Black COAL. (WHEATLEY LIME COAL)
					6.00	86.70		Light greyish brown interbedded SANDSTONE and MUDSTONE (COAL MEASURES)
							End of borehole at 6.00 m	

**Remarks**

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.