

Bellway Homes (Wessex)

F.A.O. Paul Backhouse
Our Ref: 16362/SGRA
October 2017

Dear Paul,

RE: Padnell Grange, Padnell Road, Cowplain, Hampshire PO8 8ED

Bellway Homes commissioned Soils Limited to undertake a Soil Gas Risk Assessment at the site known as Padnell Grange, Padnell Road, Cowplain, Hampshire PO8 8ED.

Background

The Phase I Desk Study (Ref: 16362/DS, dated August 2017) identified a moderate risk of soil gas associated with an infilled clay pit onsite and a further four infilled clay pits to the north ranging from 24 to 165m from the site. Recommendations were made to undertake a soil gas risk assessment at the site, given its environs and the proposed residential development. As such, 6No. gas monitoring visits were undertaken over a period of three months to assess the risk posed to the site from the identified sources.

The Phase I Desk Study (Ref: 16362/DS, dated August 2017) and Phase II Ground Investigation Report (ref. 16362/GIR, dated August 2017) undertaken by Soils Limited, must be read in conjunction with this letter report.

This letter report documents the findings of the gas monitoring and makes recommendations for gas protection measures, where required.

Works Undertaken

On 5th July 2017 Four windowless sampler boreholes (WS1 – WS4) were drilled, using a Premier Compact 110 windowless sampler and dynamic probe rig, to depths ranging between 3.60m bgl (WS2) and 6.00m below ground level (bgl) (WS1) at locations selected by Soils Limited using a development plan provided by the client.

Four dual-phase monitoring well installations were installed within window sample borehole locations (WS1 and WS4) to allow for continued monitoring of both groundwater and soils gas. The monitoring well installations comprised 25mm ID HPDE pipework installed in boreholes. The response zone comprised a slotted pipe with non-calcareous gravel pack surround with a bentonite seal above. The headworks comprised a single gas tap fitted into an end cap and placed on the end of the pipework just below ground level within a metal stopcock cover set in concrete.

The ground conditions comprised Made Ground recorded to depths ranging between 0.25m and 1.30m bgl. The Made Ground typically comprised dark brown gravelly sandy SILT. Soils of the Lambeth Group which was encountered directly beneath the Made Ground in the east and the Lynch Hill Gravel in the west and was encountered from 2.10m and persisted to 6.00m bgl (DP1, DP3 and DP4) the final depth of the investigation. The Lambeth group comprised Greenish orange becoming olive green mottled orange fine to medium SAND with bands of soft clay. Soils described as Topsoil were encountered in five out of the ten trial holes from ground level to depths ranging between 0.10m and 0.40m bgl. The Topsoil comprised brown slightly gravelly sandy SILT with frequent rootlets

Soils described as Lambeth Group were encountered in all ten trial holes and were found in both cohesive and granular forms. The soils of the Lambeth group were encountered underlying the Made Ground/Topsoil and persisted to depth of 8.00m bgl, the full investigatory depth of DP1.

Soil Gas Monitoring Records

Monitoring was undertaken on six separate occasions over a period of three months. These included targeting periods of low and falling pressure where possible.

The results of the monitoring are provided within Table 1.

Table 1 – Soil Gas Results

Date (Barometric Trend)	TH	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flow (l/h)	Dp	H ₂ O (m bgl)	Base Of Hole (m)	VOC (ppm)
Tuesday 11/07/2017 (Steady)	ATM	0.0	0.1	21.3	0.0	0.0	0.0	1003	0.0	-	-	-	-
	WS1	0.0	3.1	19.3	0.0	0.0	0.0	1003	0.0	0.0	Dry	6.00	0.0
	WS2	0.0	2.5	19.6	0.0	0.0	0.0	1003	0.0	0.0	Dry	3.65	0.0
	WS3	0.0	3.0	18.6	0.0	0.0	0.0	1003	0.0	0.0	Dry	3.55	0.0
	WS4	0.0	2.2	20.4	0.0	0.0	0.0	1003	0.0	0.0	Dry	1.60	0.0
Friday 28/07/2017 (Steady)	ATM	0.0	0.0	21.2	0.0	0.0	0.0	1003	0.0	0.0	-	-	-
	WS1	-	-	-	-	-	-	-	-	-	-	-	-
	WS2	0.0	1.0	20.6	0.0	0.0	0.0	1002	0.0	0.0	Dry	3.65	-
	WS3	0.0	3.2	17.9	0.0	0.0	0.0	1003	0.0	0.0	3.55	3.55	-
	WS4	0.0	2.2	19.6	0.0	0.0	0.0	1003	0.0	0.0	1.95	1.95	-
Friday 08/08/17 (Falling)	ATM	0.0	0.0	21.0	0.0	0.0	0.0	1003	0.0	0.0	-	-	-
	WS1	-	-	-	-	-	-	-	-	-	-	-	-
	WS2	0.0	1.8	19.5	0.0	0.0	0.0	1002	0.0	0.0	Dry	3.65	0.0
	WS3	0.0	2.9	16.5	0.0	0.0	0.0	1002	0.0	0.0	3.55	3.55	0.0
	WS4	0.0	2.6	18.9	0.0	0.0	0.0	1003	0.0	0.0	1.95	1.95	0.0
Tuesday 19/08/2017 (Rising)	ATM	0.0	0.3	20.4	0.0	0.0	0.0	1010	0.0	0.0	-	-	-
	WS1	-	-	-	-	-	-	-	-	-	-	-	-
	WS2	0.0	2.7	18.7	0.0	0.0	0.0	1006	0.0	0.0	Dry	3.65	-
	WS3	0.0	2.5	17.5	0.0	0.0	0.0	1006	0.0	0.0	3.55	3.55	-
	WS4	0.0	2.3	18.4	0.0	0.0	0.0	1008	0.0	0.0	1.95	1.95	-
Thursday 14/09/2017 (Rising)	ATM	0.0	0.4	21.1	0.0	0.0	0.0	1007	0.0	0.0	-	-	-
	WS1	-	-	-	-	-	-	-	-	-	-	-	-
	WS2	0.0	2.6	17.9	0.0	0.0	0.0	1006	0.0	0.0	Dry	3.65	-
	WS3	0.0	2.5	17.6	0.0	0.0	0.0	1006	0.0	0.0	3.10	3.55	-
	WS4	0.0	2.1	18.5	0.0	0.0	0.0	1006	0.0	0.0	1.70	1.95	-
Thursday 12/10/2017 (Rising)	ATM	0.0	0.0	21.0	0.0	0.0	0.0	1003	0.0	-	-	-	-
	WS1	-	-	-	-	-	-	-	-	-	-	-	-
	WS2	0.0	0.2	21.3	0.0	0.0	0.0	1017	0.0	0.0	DRY	3.67	0.2
	WS3	0.0	0.2	21.0	0.0	0.0	0.0	1017	0.0	0.0	3.40	3.55	0.0
	WS4	0.0	2.8	19.2	0.0	0.0	0.0	1017	0.0	0.0	1.66	1.90	0.2

Maximum	0.0	3.2	21.3	0.0	0.0	0.0	1017	0.0	0.0	-	-	0.2
Minimum	0.0	0.0	16.5	0.0	0.0	0.0	1002	0.0	0.0	-	-	0

Note:

Zero reading (0.0) = below the equipment detection limit.

- = no data obtained

Only one round of monitoring was obtained from the installation in WS1, this was due to water levels covering the headworks. On three occasions during the monitoring period, WS1 was bailed dry. However, the ingress of water was at such a rate that no build-up of any potential soil gas was not possible. It is considered that sufficient data has been obtained from the remaining three boreholes.

The trend in barometric pressure over the week of the above dates is presented below, respectively.

Figure 1: Weekly Barometric Trend for Week Commencing 9th July 2017

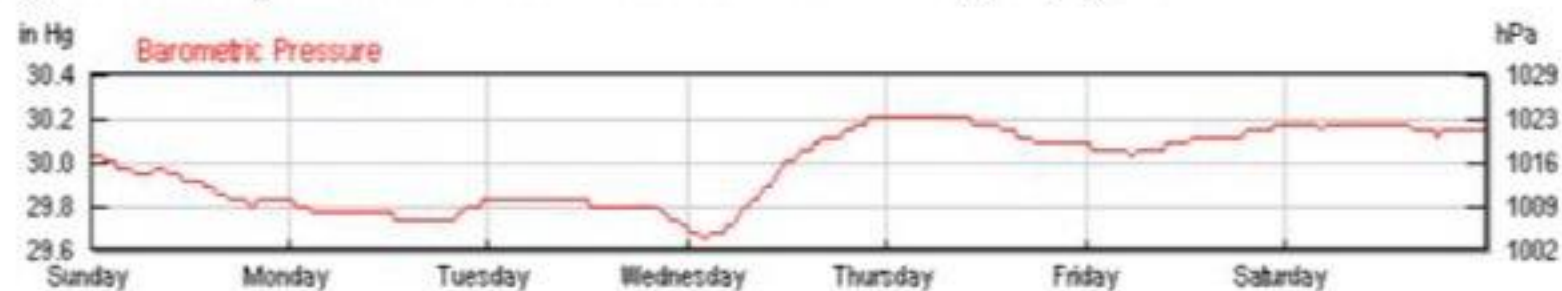


Figure 2: Weekly Barometric Trend for Week Commencing 23th July 2017

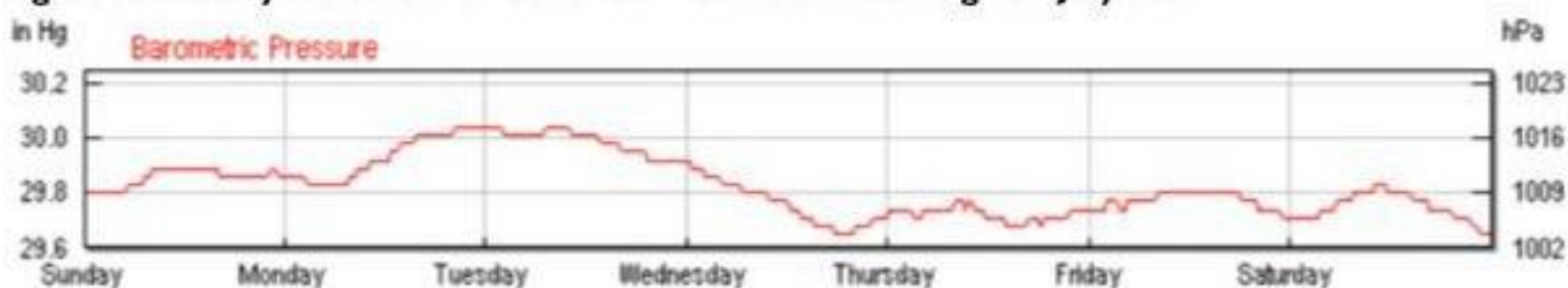


Figure 3: Weekly Barometric Trend for Week Commencing 6th August 2017



Figure 4: Weekly Barometric Trend for Week Commencing 13th August 2017



Figure 5: Weekly Barometric Trend for Week Commencing 10th September 2017**Figure 6: Weekly Barometric Trend for Week Commencing 8th October 2017**

The **highest concentration of carbon dioxide (CO₂)** was recorded at **3.2% by volume** in WS3 on the 28th July 2017.

The **lowest concentration of oxygen (O₂)** was recorded at **16.5% by volume** in WS3 on 8th August 2017.

No concentrations of methane total or LEL (CH₄), Carbon Monoxide (CO) and Hydrogen Sulphide (H₂S) were recorded above instrument detection limit.

No positive gas flow was recorded during the monitoring period.

Concentrations of Volatile Organic Compounds (VOCs) within the monitoring wells were measured using a Photo-Ionisation Detector (PID). Results showed a **maximum concentration of 0.2ppm**, which is not considered hazardous.

Data Quality

A review was made of the quality of the available data for the site, which can be viewed in Table 2. CIRIA 665 (2007) and BS 8485:2015 stress the need for risk assessments to be based on good quality data and give guidance as to best practice in this respect.

Table 2 – Review of Data Quality

Data Type	Current Situation	UK Practice
Geological and hydro-geological conditions	With regard to soil gas risk assessment the data from Desk Study and logged trial holes was good.	CIRA 665, Wilson and Card (2007) and BS 8485:2015 recommend that geology and hydrogeology be fully understood.
Monitoring period	The monitoring has been undertaken on a total of six occasions over a three-month period. Monitoring has been undertaken over a range of seasons and weather conditions including falling-rising and low and high atmospheric pressures.	CIRIA 665 recommends approximately 3-month monitoring over a range of weather conditions.
Gas data sets	Borehole flow velocity has been measured on each monitoring occasion.	Borehole flow velocity and borehole gas volume required to define characteristic gas saturation. Modified Wilson and Card, Table 8.5 of CIRIA 665 (2006)/Table 2 of BS 8485:2015.

Data quality was characterised as **good**, covering a range of atmospheric pressure trends. Geological and hydrogeological conditions have been investigated and fully understood.

Risk Assessment

Based on the documentation presented in the "BS 8485:2015, Code of practice for the characterisation and remediation from soil gas in affected developments" the hazardous gas flow rate (Q_{hg}) was calculated using Equation 1:

$$Q_{hg} = (C_{hg}/100) * q \quad \text{Equation 1}$$

Where:

C_{hg} is the measured hazardous gas concentration (in percentage volume-by-volume).

q is the flow rate in litres per hour of combined gases found by direct measurement.

The Q_{hg} for carbon dioxide was calculated using Equation 2a.

$$\begin{aligned} Q_{hg} \text{ (l/hr)} &= \text{gas concentration} * \text{borehole flow rate (l/hr)} \\ &= 3.2/100 * 0.1 = \mathbf{0.0032 \text{ l/h}} \end{aligned} \quad \text{Equation 2a}$$

The maximum carbon dioxide concentration was taken as the gas concentration. In light of no flow being encountered during the monitoring period a rate of 0.1 has been adopted, thus increasing the degree of conservatism adopted.

Based on a *Site Characteristic hazardous gas flow rate* (Q_{hg}) of 0.0032 l/hr and the maximum carbon dioxide concentration of 3.5% the site fell into a **Characteristic Gas Situation 1 (CS1)**, for which no special precautions are required as given in the "Guidance on methane and carbon dioxide, NHBC 2007" (refer to Tables 11.1 and 11.2).

Should you have any further questions please do not hesitate to contact the undersigned.

Yours Sincerely



John Hills BSc (Hons)

Graduate Geo-Environmental Engineer